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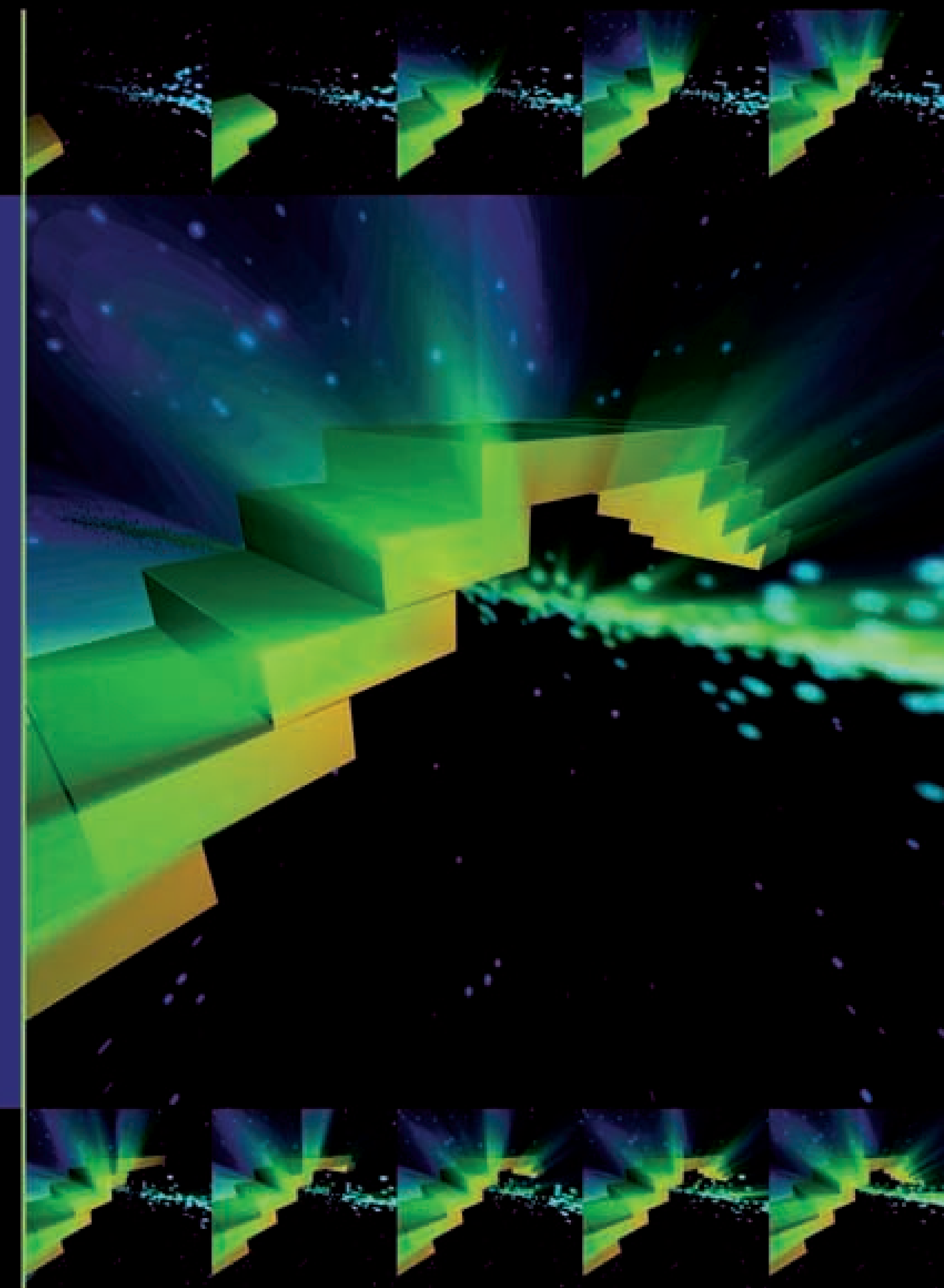
Energy Valley The Netherlands

Grounds for Change: Bridging Energy Planning and Spatial Design Strategies



Charrette report , May 24th- May 30th 2005

Energy Valley The Netherlands

Grounds for Change: Bridging Energy Planning and Spatial Design Strategies

Edited by Fons van Dam and Klaas Jan Noorman

Groningen, October 2005

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For the charrette report

The International Gas Union (IGU) has recognized its duty as the world organisation of the gas industry to commit itself to search for the relation between energy design and urban design in the future. This awareness was already present at the 22nd World Gas Conference in Tokyo in June 2003 where an international competition on innovative urban design between 9 teams was presented with the perspective of sustainable future over 100 years.
The IGU has now initiated the next phase of their ground-breaking Sustainable Urban Systems Design (SUSD) initiative with the project "Bridging to the Future".
It will engage four collaborative teams from Canada, China, India and the Netherlands to develop energy pathways for their urban areas around the globe. Each city's pathway will integrate urban and energy planning, accommodate variable energy scenarios, and use natural gas and other fossil fuels as a bridge to renewable energy and sustainable urban systems. The results will be presented at the next World Gas Conference in Amsterdam in June 2006.

The Dutch team, called Grounds for Change, has presented in May 2005 in Groningen its intermediate results, which form the basis for this booklet.

I hope this booklet may stimulate discussions for a further development to a more sustainable world, where people can live in a harmonious and environment-friendly way.

George H.B. Verberg, President of IGU

General Introduction

During the last week of May 2005 the Grounds for Change project team organized an Energy-Spatial Design charrette. The main goal of this international meeting was to bring into practise our challenging question: what are the consequences for spatial design strategies in the Northern part of the Netherlands when taking the energy system as a starting point for the spatial design process, and vice versa, in what ways can spatial design influence the options to make our energy system more sustainable?

These questions are at the heart of the Grounds for Change project which started a year earlier when a group of initiators came together to discuss the possibilities to contribute with a Dutch project to the IGU (International Gas Union) project Bridging to the Future.You will find more information on the Bridging to the Future project and the participating countries in the contribution of Sebastian Moffat, the international project leader.

From the very beginning of the Ground for Change project two things were clear:
We felt that the affiliation of governments, private firms, universities, and other experts, providing knowledge, experience and power to operate is a key factor to success. Furthermore, and this feeling was shared by all partners, the Northern part of the Netherlands is the ideal region to conduct this project, not only because Western Europe's largest natural gas reserves are located here but also because in this region urban networks are combined with highly appreciated landscapes. It is also in the Northern part of the Netherlands where powerful energy and energy related companies contribute to the acceleration of further economic development. Another consideration is that in this part of our country the possible effects of climate change might have significant impacts since a large part of the region is (far) below sea level.

Reading, thinking, and talking about our future energy system in relation to spatial planning and design is interesting, of course. But bringing these ideas into practice in design sessions would be exciting. We asked four cities in the region, Groningen, Leeuwarden, Assen and Emmen to bring in a concrete design question, presently on the agenda of these cities. Furthermore, we brought together a multidisciplinary team of senior experts in city planning, energy sciences, landscape architecture and building technology to make a first design at the regional level: Energy Valley region.

In this booklet we want to share the results of the charrette with a broader audience. In the first chapters you will find the contributions of the experts in the various disciplines who introduced us in their fields of knowledge. In the second half of the book the outcomes of the various design groups are presented. These first design results are the product of a very intensive four-days process in which junior designers and senior staff closely worked together.The results are meant as inspiring views on the various projects. Much can be said about the outcomes and, as a matter of fact, all results gave rise to many good discussions in the concluding session of the charrette. The results of the design groups all have in common that they are challenging and inspiring. By no means we have the ambition to present 'final results' to you. In stead, we consider these outcomes as a first, but important, stepping stone in the project. Many more steps are needed to reach the destination. However we are confident about one thing: without making this first step we would never reach the destination. It goes without saying that more detailed analyses are needed in the designs presented, notably on the energy aspects of the designs.We wanted the results to act as challenging idea's to shape our thoughts on the interrelationship between the development of sustainable energy systems and spatial planning strategies in the continuation of the project.
Most likely the outcomes presented in this booklet will not be realized in the future but perhaps elements of the results may return in future planning designs. We will proceed this project and its final outcome will be presented at the 23rd World Gas Conference in Amsterdam, in June 2006.

This charrette would not have been possible without the help of many organisations. We thank the municipalities of Groningen, Leeuwarden, Assen en Emmen for bringing in a project idea and experienced staff during the charrette. We also thank the provinces of Groningen, Fryslân and Drenthe for their support and contributions and the universities of Groningen and Wageningen for their expertise. DLG (Government Service for Land and Water Management) prepared great maps and brought in expertise on spatial planning and bioenergy. We received financial support from Gasunie, Gas Transport Services, NAM, Energy Delta Institute, the province of Drenthe, Regiovisie Groningen - Assen, and the municipalities of Groningen, Leeuwarden, Assen en Emmen.
Many thanks to the representatives of the other IGU teams: Sebastian Moffat and Innes Hood (Vancouver), Aromar Revi (Goa), and Zhang Xu and Tong Ming (Shanghai).
Last but certainly not least: many thanks for the great efforts of all students of the Wageningen University and their coordinator Sanda Lenzholzer and the students of the Groningen University. Without their enthusiasm, creativity, and stamina the publication of this booklet would not have been possible.
To all participants of the charrette: you brought us a lot of energy that will be used in the continuation of the Grounds for Change project!

On behalf of the project team:

Fons van Dam
Klaas Jan Noorman

This vision statement is a joined outcome of the discussions that took place during the Charrette. Sebastian Moffat brought the building blocks of the discussions together and was responsible for the first version of the vision statement

VISION STATEMENT

In 2035 the Energy Valley Region of North Netherlands is a place where a rich mixture of energy sources contributes to exceptional landscapes, prosperous businesses and a diversity of healthy lifestyles.

Wind and water, sun and land, plants and people, combine with the last reserves of natural gas. Like the many waterways that define the region, these energy sources emerge from deep in the earth, or high in the sky, and then weave through the environment, each directed to their best use, in a cascading stream of energy services. In the region a well balanced mix of energy sources is available, which helps to make Energy Valley a resilient region, where energy security and alternative approaches attract elite businesses and young professionals. Renewable resources now comprise more than 50% of the energy flows. The unique blend of sources and technologies is built upon the region's traditions as a centre of wind energy, agricultural activities, deep drilling, coastal farming and water management. The emergence of so many locally-appropriate, well-managed solutions has relied upon, and reinforced, the collective community spirit that was forged by the pioneers who created the region's islands, and later the dikes and polders.

A central part of the energy system is the management of energy demand through well-informed and motivated citizens, and though policies that encourage high-efficiency technology, conserving life-styles and effective land use planning. The region has the lowest energy use per person in the country, while still offering significant choice in building styles, transportation modes and neighbourhood character.

In addition to the reductions in energy demands, and the provision of appropriate energy supply, the system is carefully designed to contribute to many other features that make the region a world-class model of sustainability and resiliency. In particular, the energy system creates a tremendous variety of local jobs, and provides residents with a sense of pride and distinction. Energy facilities are multi-functional, providing recreational, educational and aesthetic amenities that compliment each of the towns, and sometimes serve the region as a whole. Energy investments are structured to enhance the diversity of lifestyles in the region, where quiet rural living coexists with network of dynamic towns.

Energy Valley is renowned for its ability to develop innovative energy systems through a collaborative process, bringing together leaders from government, private businesses and research institutions. The process emphasises on-going monitoring, learning, and adaptation. Local initiatives have been strongly supported by new policies at the national and European level, by innovations in institutional structures, and by special financing mechanisms for funding Energy Valley's transition to renewable energy. The region's businesses, and academic institutions, are routinely involved in sharing their knowledge and planning methods, providing coastal regions worldwide with a working example of how to use natural gas and local resources as a bridge to sustainability.

Bridging to the Future

Sebastian Moffat

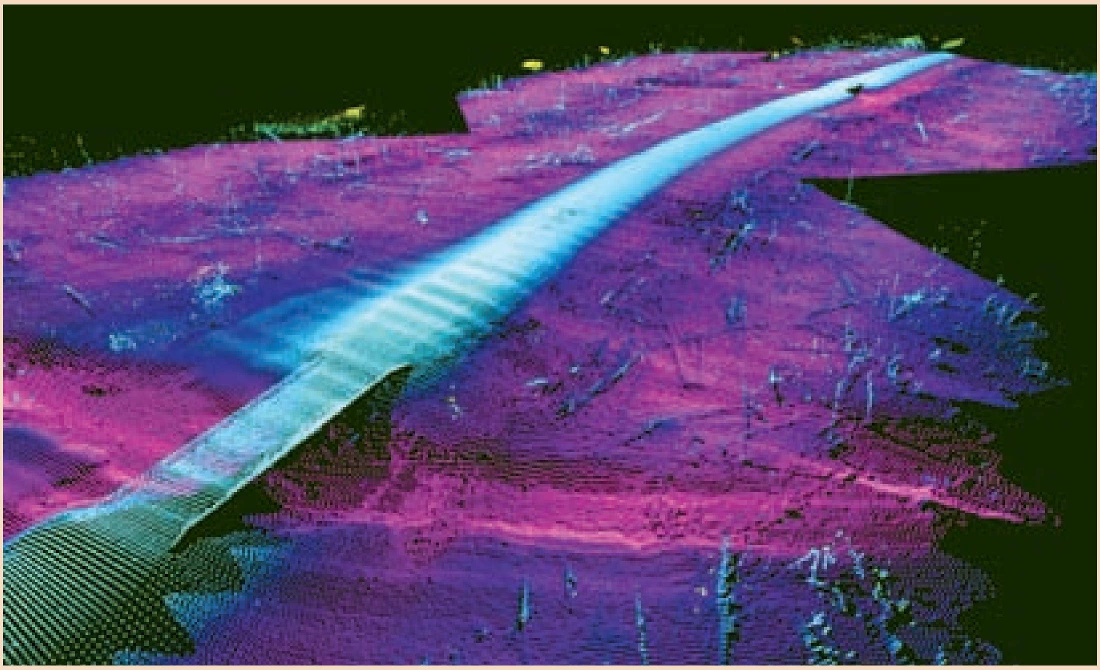
Grounds for Change is part of an international initiative referred to as *Bridging to the Future (BttF)*. Other locations participating in *BttF* include Canada, India and China. Collaboration with these teams provides Grounds for Change with new perspectives, alternative planning tools, and increased opportunities for both learning and leadership.

Representatives from the other *BttF* teams visited Groningen to participate in the Grounds for Change charette. Over the next year, representatives from Grounds for Change will be invited to participate in charettes in these other locations. Through such exchanges, the *BttF* teams are working together to determine how urban regions can manage the transition to sustainable energy and water systems. The long-term pathways and projects for four locations will be showcased as part of workshops and combined presentations at a number of international conferences, including the World Gas Conference in Amsterdam, June 2006.

Bridging to the Future is the second phase of the industry-led International Gas Union's (IGU) *Sustainable Urban System Design* competition, that took place between 2001-2003 and that focused on the creation of 100-year designs for nine existing metropolitan areas worldwide. The results of the competition include a fascinating collection of urban plans with many creative ideas about how to transform urban systems. Common themes that emerged from this competition provide valuable insights for cities everywhere. Adopting long-term horizons, and an integrated approach to infrastructure design, may help to stimulate a renaissance in energy planning and physical planning for cities. The results of the competition can be viewed at:
www.ibs.or.jp/m_pub/pub_03/book_19/book_19.html.

The Canada, India and China teams all participated in the IGU competition. Thereafter the chair of the International Gas Union was transferred to GasUnie in Netherlands, who decided to build upon the success of the competition and continue the industry-led project by launching a second Phase. In Phase II, the teams will collaborate rather than compete. The planning methods and tools, and all of the learning, are being shared with interested parties through a project web site: www.bridgingtothefuture.org, which includes articles, newsletters and software tools.

Similar to Grounds for Change, the other *BttF* teams have formed local collaborative organisations made up of municipal and senior governments, utilities and energy corporations, universities, institutes and private practitioners. In each location the teams will undertake some analysis and modelling to create a set of core indicators and visualizations. The shared methods will provide Netherlands with some benchmarks for truly comparing performance and targets with other international locations.



The *BttF* charette itself is one of the planning 'tools' that is being shared by the *BttF* teams. A manual on the web site provides a description of how to organise a charette for long-term, integrated systems planning, and examples of how to orient the participants and present the results. As Phase II continues, the *BttF* teams will enhance the tool and create further training materials and case studies.

One of the most unusual aspects of the *BttF* charettes is the 30-year time horizon, which is much longer than typical long-range plans for urban systems. Although looking so far forward increases complexity and uncertainty, it also provides potential benefits. The most significant benefits of the long-term approach are:

- A process that is based more on values than on protecting interests, and that is consequently more inclusive and positive;
- An ability to consider major changes to slow-moving elements of regions, such as land-use and infrastructure, and to find more elegant and efficient solutions at the 'whole system' level;
- Life cycle costing for long-lived investments such as transportation corridors;
- Clarification of major trends that are reshaping energy systems and ultimately creating major threats and opportunities for cities; (such trends include the decarbonisation of energy sources, increased flexibility and control, and dematerialization)
- The identification of major forces that are largely external to the regional plans, but that are likely to impact regional plans; (such forces include climate change, demographics, globalization and resource scarcities.)
- The opportunity to 'backcast' a pathway to sustainability, by first defining specific end-state conditions or goals, and then describing critical - but manageable - transition steps, starting today.

Grounds for Change: Bridging Energy Planning and Spatial Design Strategies

Klaas Jan Noorman, project leader Grounds for Change

Introduction

How will our future energy system look alike? How do we manage the continuing demand for energy and the fast increasing demand for space in the Northern part of the Netherlands? How can we maintain or even increase our quality of life in a sustainable way and how can we reverse the present trends in increasing environmental pressure to ensure the abilities of future generations to meet their own needs?

These, and many other questions shape our thoughts when thinking about possible futures of our society. Our world is changing (FIGURE 1). Of course this has been the case since the very beginning but the rate and magnitude of these changes rapidly increase. The North of the Netherlands is rapidly changing and it is generally recognized that in the process of exploring our future a balance is needed between economic, ecological and social-cultural goals.

The need for such a balanced development becomes even more clear when looking at our society as a complex system, consisting of a broad range of sub-systems, directly or indirectly influencing each other. The energy system, the agricultural system, the transport system, the water management system all interact. In our society, that becomes more and more complex, the danger of problem shifting in time, space and between subsystems should be acknowledged. Rather than using 'Business as Usual' strategies the search for answers for longer term problems should be based on the notion that an integrated approach focussing on system innovations is needed.

When looking at the (longer term) future there is no need to have a clear picture of the ultimate destination or the exact route that should be followed (as a matter of fact, this is almost an impossibility). A good first step is consensus about the direction. This ongoing process of searching and learning while 'being on the road' is known as 'transition management'. A transition is a structural societal change resulting from the interacting subsystems our society consists of. The search for innovative but also realistic transition pathways for North Netherlands is at the heart of the Grounds for Change project.

In the Grounds for Change project we focus on exploring energy pathways heading towards a sustainable energy system in North Netherlands in close relation with spatial developments in the region. The outcomes should not be regarded as a blueprint for tomorrow but should be seen as a means in the planning for further development of the region in a sustainable direction.

FIGURE 1 JUST ONE EARTH

The project Grounds for Change is part of the international project Bridging to the Future which is the second phase of the International Gas Union (IGU) initiative on Sustainable Urban Systems Design (SUSD) (FIGURE 2). More information on the international project is given in the contribution of Sebastian Moffat.

Why did we launch the Grounds for Change project?

The answer is in the sub-title of this contribution: bridging energy planning and spatial design strategies. The very basis of the project is about thinking or re-thinking our future. Grounds for Change is about incorporating longer term views in our present day decision making, taking into account different time horizons, and various spatial levels, from the global to the regional and local level, ultimately to the level of individual buildings. It is also about aiming for a well-balanced development taking into account economic, ecological and social-cultural thresholds. And it is about energy, being one of our most vital resources, and the way our thinking about future energy systems might affect future spatial design strategies and vice versa.
This is perhaps a difficult way to explain that sustainable development is in many ways a leading concept in our project. Talking about sustainable development always involves the danger getting involved in 'academic discussions' in which we forget to come up with concrete solutions that can be adopted in present day decision making. In Grounds for Change we aim at combining the development of new planning concepts, based on longer term time horizons, with concrete, present day solutions (FIGURE 3).

It was recognised that North Netherlands (the provinces of Groningen, Fryslân, and Drenthe) was an excellent area for building a project within the SUSD framework. The main arguments are:

- The presence of a powerful cluster of energy (related) companies in the region and the Energy Valley initiative, both initiating and accelerating further economic development in the region.
- The presence of the University of Groningen, notably the Centre for Energy and Environmental Studies and the Faculty of Spatial Sciences.
- The presence of the Energy Delta Institute, in which both academic and gas industry-based knowledge about energy and gas have been combined
- Local and regional governments, firms and private parties are already working together in ambitious programs aimed at increasing economic development.
- Western Europe's largest natural gas reserves are located in the region.

FIGURE 2 AN INTERNATIONAL LEARNING NETWORK

FIGURE 3 THE MAIN QUESTION

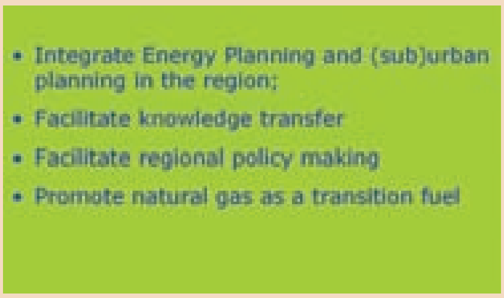


FIGURE 4 THE OBJECTIVES

Objectives of the Grounds for Change project
(FIGURE 4)

Integrate Energy Planning and (Sub)urban planning in the region
Exploring energy path ways towards a more sustainable energy system cannot be seen as an isolated exercise. Both developments in the demand for energy and energy supply are closely interlinked with build surroundings within the cities. Furthermore, rural planning is also seen as an important determinant of the way human activity is organised. As a result, both the organisation of urbanized areas (as a mal) and rural areas (as a contra mal) are considered to be interwoven with energy planning. This notion demands for new planning tools as a means for integrative and innovative planning.

Facilitate Knowledge Transfer
The multi disciplinary project team aims at developing new planning concepts that can be applied in new strategies for (sub) urban regions. The new insights obtained will be transferred both to other teams in the Bridging to the Future project as to energy planners and urban planners.

Facilitate regional policy making
Sustainable development strategies demand for new policy instruments that are within the scope of new idea's about partnerships between government and its target groups and innovative approaches known as network planning and governance. The Grounds for Change team aims to provide policy makers with an inspiring document to support new governmental planning ideas.

Promote natural gas as a transition fuel
Natural gas is regarded as an important transition fuel in the energy transition, providing options for new, biomass based gasses, and ultimately, heading towards a hydrogen economy based on renewables. The gas industry plays in leading role in this transition. The project Grounds for Change can make these efforts visible and can provide new ideas that can be implemented in new business strategies.

Two pillars: new energy pathways and new spatial planning concepts

It has become increasingly clear that the way we live our lifes is not sustainable: fossil fuel demand rates are worldwide rapidly increasing, the negative impact of humankind on climate change is generally accepted by most of the scientific world and politicians and the ecological footprint of human activity exceeds the amount of space available.
The transformation of our present energy system, mainly based on fossil fuel into a sustainable energy system is therefore one of the main challenges in the 21st century (FIGURE 5).

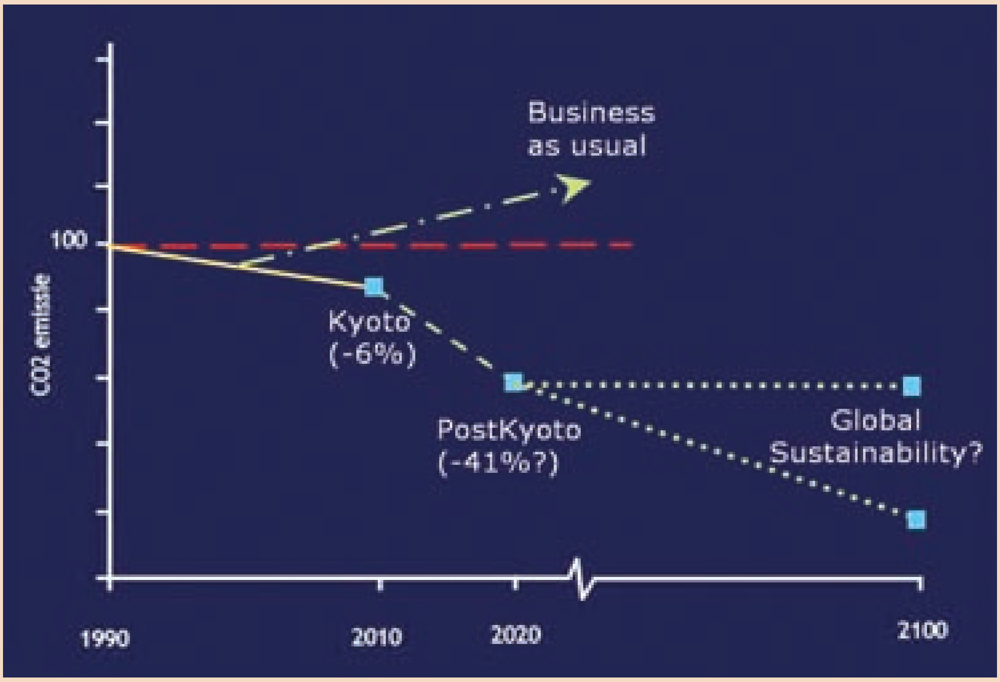


FIGURE 5 NEW ENERGY PATHWAYS

There are many options to build up a more sustainable energy system. When exploring future possibilities to make our energy system more sustainable it is sometimes helpful to look back in time. In the pre-industrial time energy was 'harvest' from the earth's surface: peat, biomass, animal and men power. Once fossil fuels were discovered we went (far) below the earth's surface to get our energy. Nowadays, rethinking our energy system, we are looking for options in which we (directly and indirectly) can gain solar energy. Most of these sources can also be 'harvest' from the earth's surface, just as in the old times (FIGURE 6).

To bring about a transition towards a sustainable energy system, changes a needed throughout the system. In general strategies embrace three routes:

1. Energy conservation
2. improving the energy efficiency of production and con sumption activities
3. large-scale changeover to renewable energy sources.

Although there is a substantial potential for renewable energy in The Netherlands, at present the share of renewable energy in the Dutch economy is only limited (1,5-2%). During the energy transition natural gas is regarded as an important transition fuel to be used in high-quality applications.

Next to the energy and climate agenda, another agenda becomes increasingly important in The (North) Netherlands: Spatial planning. The pressure on available space is increasing. There is a shortage of dwellings in the Northern part of the Netherlands and a significant part of the region is below sea level. New areas need to be pointed out and equipped as temporary water reservoirs in times of water surplus (FIGURE 7 AND 8).

Spatial planning and economic development are closely related. Balancing these two results in a more efficient use of available space, offers opportunities for better managing the trends in fast increasing mobility and helps improving the environmental quality of the cities. In North Netherlands these themes have high priorities. Next to the urban areas the rural areas are considered to be of significant importance in the region. In a densely populated country like The Netherlands, the Northern region is highly appreciated for its rural characteristics where many 'core qualities' like natural assets, recreation options and quietness are brought together.

Three spatial levels - region, city and buildings - are distinguished in Grounds for Change because different levels offer various options, both in exploring new energy pathways and searching for new spatial planning concepts (FIGURE 9).

Grounds for Change and Energy Valley

North Netherlands has the potential to play an important role in the energy transition process. Not only the largest natural gas reserves are situated in the North of the Netherlands, due to the presence of the gas industry and related industries also a broad range of knowledge is brought together in the region.

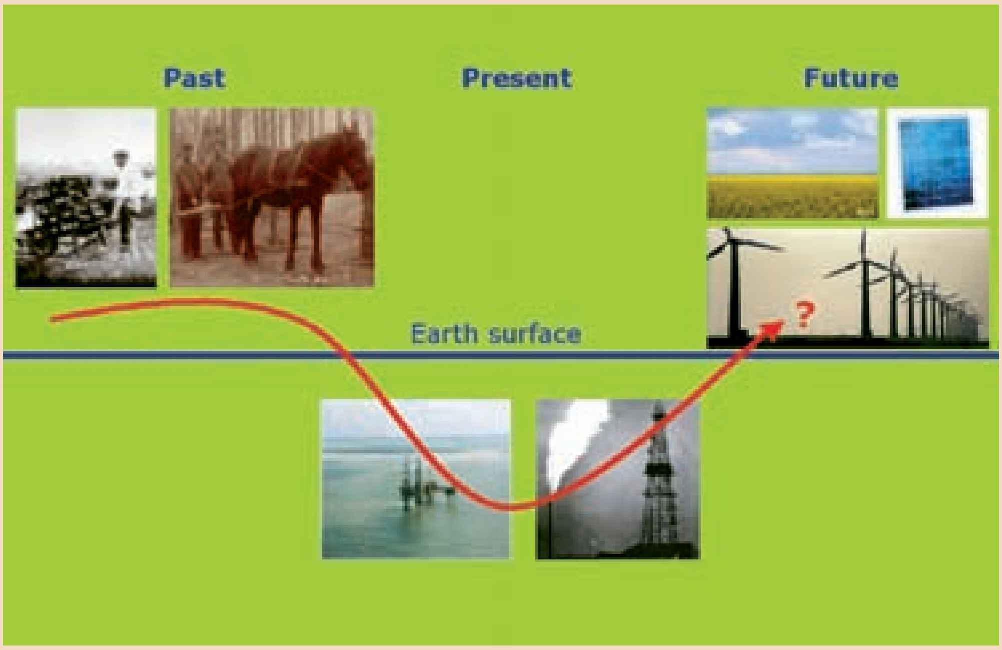


FIGURE 6 SOURCES OF ENERGY

FIGURE 7 TRADITIONAL DEMANDS FOR SPACE

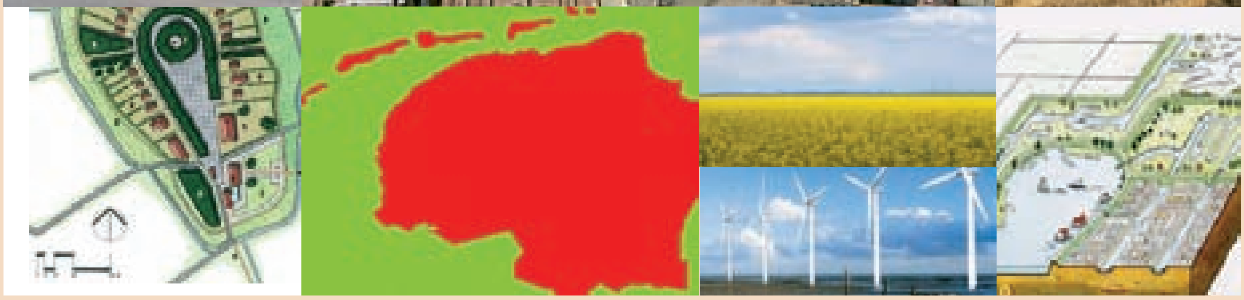


FIGURE 8 NEW DEMANDS FOR SPACE

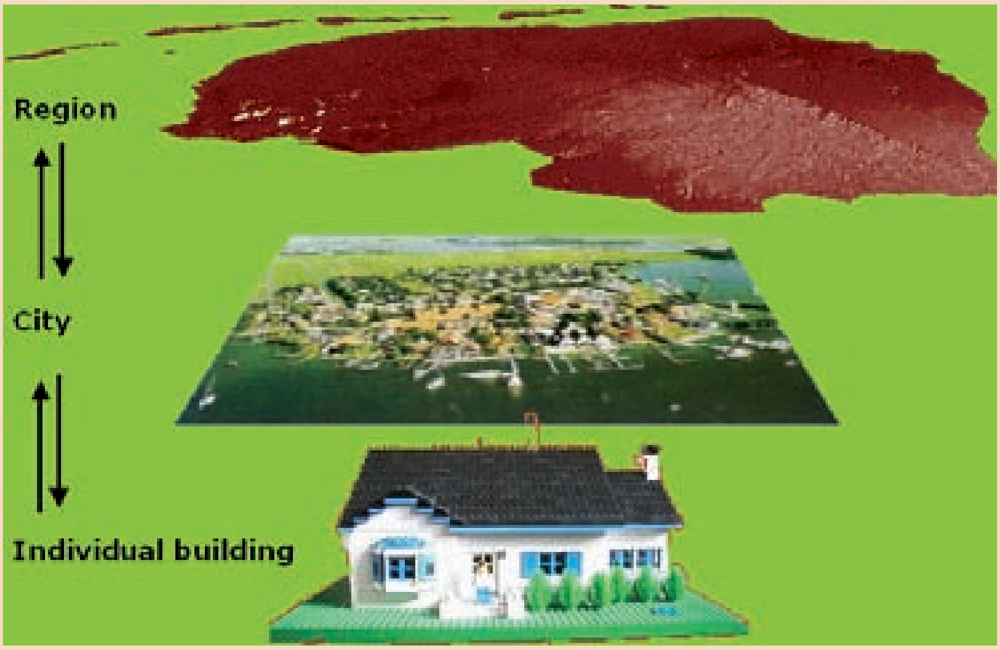


FIGURE 9 THREE SPATIAL LEVELS

In this perspective northern public and private partners[1] have decided to combine their powers in a new initiative: Energy Valley (FIGURE 10). Energy Valley aims at optimizing the economic potential of traditional and innovative energy developments in the northern region. Energy Valley is based on the cornerstones:

1. Sustainable energy;
2. Energy knowledge;
3. Energy business.

The combination of these cornerstones has to ensure a broad basis for energy activities at present as well as in the future. The Grounds for Change project is carried out under the auspices of Energy Valley. In 2004, five organisations took the initiative to start the Grounds for Change project (The NV. Netherlands Gasunie, Energy Valley, the University of Groningen, he Province of Groningen and KNN Milieu B.V.). We aim at getting involved many parties, representing governments, private companies, research institutes and NGO in the continuation of the project (FIGURE 11). We hope that this collaborative effort, together with the international learning network of Bridging to the Future results in a stimulating and powerful perspective on a bright, sustainable future for the region (FIGURE 12).

[1] The participants of Energy Valley are: the provinces of Drenthe, Fryslân and Groningen, the municipalities of Assen, Emmen, Groningen and Leeuwarden, NOM: Investment and Development Company North Netherlands, The Netherlands Gasunion, NAM: biggest producer of oil and natural gas in the Netherlands, and the University of Groningen.

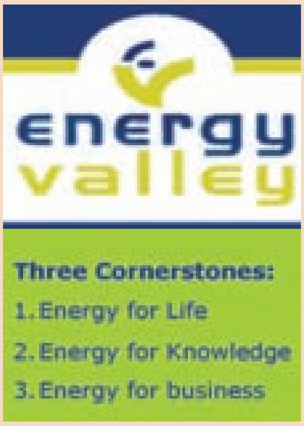


FIGURE 10 ENERGY VALLEY

FIGURE 11 ORGANISATIONS INVOLVED

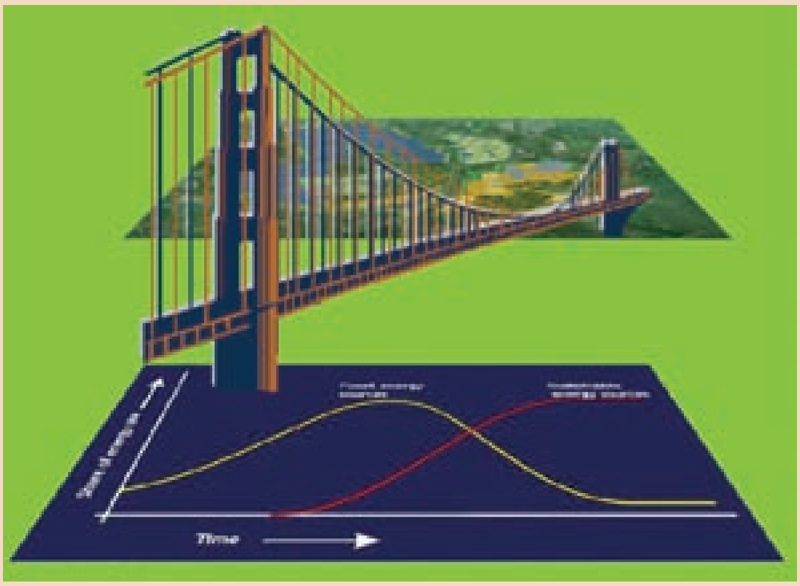


FIGURE 12 BRIDGING ENERGY PLANNING AND SPATIAL DESIGN STRATEGIES

Energy challenges and constraints relevant for sustainable regional development.

Prof. Dr. H. C. Moll, Center for Energy and
Environmental Studies IVEM, University of Groningen

1. Introduction on sustainable development.

Since the Brundtland report the challenge of Sustainable Development has been put high on the global agenda. Its major task is a just and adequate satisfaction of human needs inter the generations as well as intra each generation. Working on Sustainable Development implies working on a harmonious development of three spheres: the economic sphere, the social sphere and the ecological sphere.

Natural resources are used to enable the satisfaction of human needs. Technology plays an important role in the conversion of these resources into useful products and services. Energy is an important resource in the context of sustainable development, next to other natural resources like water, clean air, land and material resources. The present-day and future use of energy exerts very substantial influence on the development of these three spheres. The design of sustainable energy systems is an essential ingredient of global and national sustainable development strategies.
In the economic sphere the important role of energy is demonstrated by the economic benefits of the exploitation of energy sources and by its essential role as resource for production and service delivery in the economic sectors. From a social perspective it is observed that energy is directly and indirectly a source of health and wealth. Environmentally it is relevant that the extraction of energy produces several ecological effects and that the emissions due to energy use contribute to severe environmental problems.

2. Some important issues related to the use of energy.

The most important environmental effect of present-day energy use is the emission of gases contributing to the increased radiative forcing of the atmosphere (the greenhouse effect) that causes global warming. Carbon dioxide and methane are the relevant energy related emissions.
To almost stabilise the atmospheric concentrations the global use of energy from fossil carbon sources and the related emissions should be halved. Therefore it is necessary that the energy requirements of lifestyles are diminished, carbon-neutral energy sources are developed, and carbon dioxide is removed from tail gas. The behaviour of the average inhabitant of the Netherlands results in twice as much emissions as the global average emission of greenhouse gases. Therefore the direct and indirect energy use per capita - extracted from fossil sources - should be reduced to a quarter of the present level.
Contrary to the desired trend we observe in the Netherlands a rise of the energy use for electricity and transportation. The development of renewable energy sources occurs not very rapid. Presently biomass and wind energy get some support.
The Trias Energetica is a conceptual approach to enable sustainable design of new energy systems. A priori the fundamental energy needs should be inventoried. Then the first step in the Trias Energetica is the design and development of preventive solutions, i.e. solutions that minimise the resource use for the satisfaction of these needs. The second step is focussing on renewable resources: the required resources should be derived as much as possible from renewable sources. The last

step is the increase the efficiency of the use of non renewable resources as much as possible. Additionally one should also pay attention on the avoidance of problem shifting. The designed sustainable system should not compromise the potential of other systems (elsewhere or in the future) to also become sustainable. (FIGURE 1)

3. Energy system analysis and energy system development.

An energy system is defined as a social-economic system consisting of installations, institutions, arrangements and practices that is able to fulfil the demand for an energy service, like transportation and electricity.
Some common characteristics of energy systems are:

- Diversity of ways to produce, convert and distribute energy.
- Diversity of the demand of the final consumers of the energy service, including the appliances using the final energy
- Strategies to guarantee the sufficiency of the supply: the expected total demand should be met by the energy system.
- Strategies to guarantee the reliability of the supply: notwithstanding variation in the demand, the demand should be met at any time and at any place as much as possible.

Two different energy systems will be discussed in the remainder of the section.

The transport system

(FIGURE 2) The main elements of transport energy system are the oil refineries producing gasoline and diesel fuel, the filling stations delivering the motor fuel to the car users, the fuel tanks of the vehicles and the engines consuming the fuel for driving the vehicle.
The sufficiency of this system is guaranteed by the availability of crude oil, the total available refinery capacity, the aggregate delivery capacity of the filling stations, and the logistic system to supply the filling systems adequately. The reliability of this system depends mostly on the density of the filling stations (the interval between the stations along a road) and on the maximal content of the fuel tanks of vehicles. The sufficiency is fully determined by the supply side, but the reliability is also partly determined by demand side factors like filling behaviour by the drivers.
To change the transport system in a more sustainable direction, one should consider

- Changing the transport fuel may require changes at all steps in the system (refinery production, filling stations, storage and use in cars). A successful example was the introduction of lead-free gasoline. But clear failures until now are the introduction of electrically driven cars and CNG fuelled cars in the Netherlands, notwithstanding some environmental advantages of using these systems in transportation, because not all steps in the supply chain are developed to the same level, e.g. too few CNG filling stations.
- Changing the system in one step is feasible - as demonstrated in the case of the introduction of reformulated gasoline and the sale of energy-efficient cars - but depends on the investment and replacement rate in the oil refinery sector or the vehicle producing sector.
- Complex changes may be facilitated by a hybrid strategy: double storage (gasoline and LPG), a dual drive system (electric and combustion-engine-driven), or a conversion system may guarantee the sufficiency and the reliability of the system.

The electricity system

(FIGURE 3) The main elements of electricity system are the electricity producing and distributing companies, the electricity grid (divided in high, medium and low voltage grid), the goods (e.g. appliances and light bulbs) using the electricity, and the energy services delivered by these goods to the consumers (e.g. light, music, clean cloths and dishes).
The sufficiency of this system is guaranteed by the total available electricity capacity and the electricity transport capacity of grid. The reliability of this system depends on the regulatory strategy of the electricity producers and the availability of back-up capacity (on production and distribution level) in case of disturbances.
To change the transport system in a more sustainable direction, one should consider

- The presently available technologies differ with regard to efficiency, to flexibility, and to the ability to regulate the output, and to predictability. The mix of technologies used in a system determines the overall reliability of the system.
- A substantial diversity exists of electricity production methods: Regular sources are coal, oil, natural gas, nuclear; other (renewable) sources are waste, wind, solar PV; important technologies are gas turbine, steam turbine, combustion engines, combined heat and power systems.
- Some interesting change demand-side strategies are decentralised production and demand side management.

Thus, each energy system contains several elements, like sources of energy, investment goods (plants, grids, vehicles and appliances), human needs that should be fulfilled and behavioural patterns. System change may be realised by targeting each of these elements. However the dynamics of change may differ between these elements. Grids and buildings are constructed for half a century, appliances are in use for a decade, human behaviour may be changed quickly but maintaining desired behaviour asks also for some other efforts.

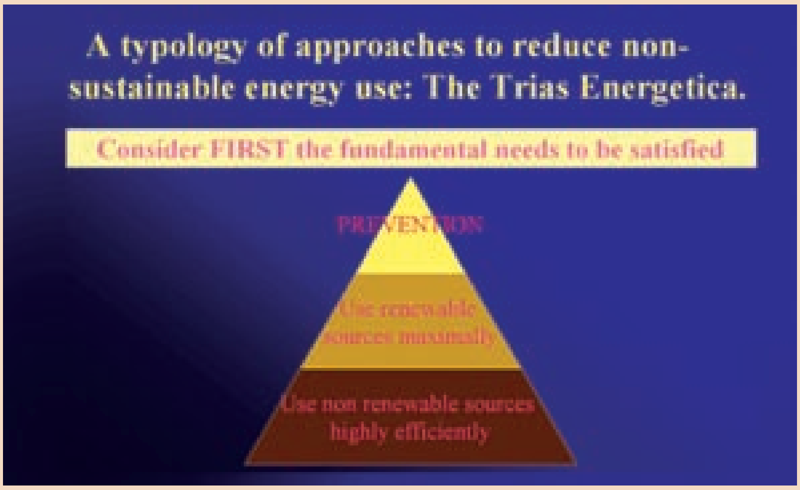


FIGURE 1 TRIAS ENERGETICA PRINCIPLES

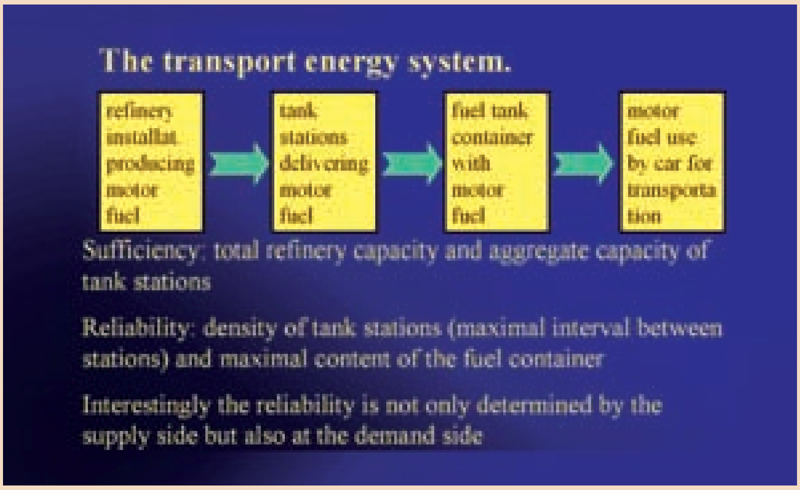


FIGURE 2 THE TRANSPORT ENERGY SYSTEM

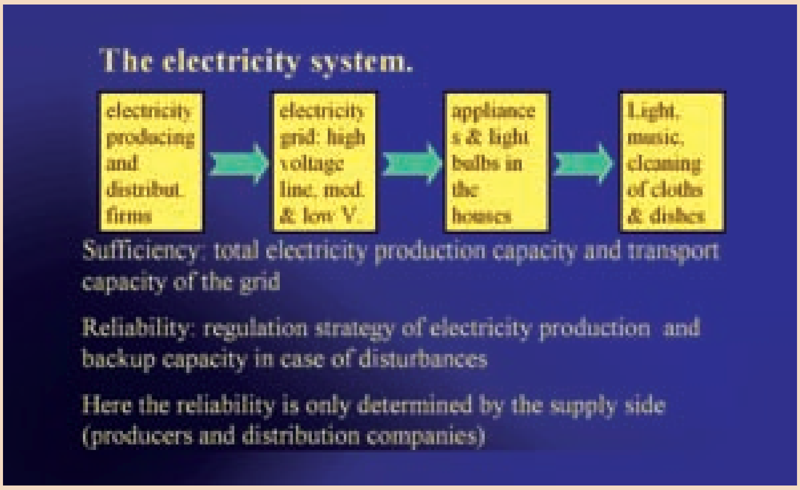


FIGURE 3 THE ELECTRICITY SYSTEM

4. Spatial relations and energy system development.

The spatial arrangements and planning exert influence on the development potential of the energy system. Here some issues are discussed. (FIGURE 4)
Some spatial issues are important for the design of sustainable housing systems. According to the Trias Energetica concept the following aspects are of interest: With regard to the human needs the density of houses and the average interior area/house should be considered. The prevention step implies attention for compact building and a high thermal insulation level. To increase the potential to use sustainable sources, the orientation of buildings to the south, the access of solar light, local seasonal storage of excess heat, access to surface ground water for heat pumps may be considered. In the step addressing efficiency local application of combined heat and power is an important spatial option, requiring adaptation of the electricity grid and or a heat distribution grid.
Also the increased use of renewable sources requires new spatial planning approaches. For the implementation of biomass production systems the spatial competition or synergy with other spatial functions should be studied like agriculture, forests, recreation facilities. To organise biomass conversion and use, the organisation of transport (import), the sites of conversion facilities and the regulation local applications are important issues. For the application of wind turbines the consideration of the effects on landscape and of local disturbances, are important points of attention in spatial planning. For the application of Solar power ideas should be developed about the integration of solar cells in the built environment

5. Conclusions.

Energy systems are characterised by actors and processes present at different levels of scale (local, regional, national). Changes in energy systems require a substantial span of time and long delays occur between implementation and realisation of the full effect. In these aspects energy planning has about the same constraints and limitations as spatial planning.
To integrate sustainably energy system development and spatial development, insight and knowledge is required in the structure and functioning of energy systems and the principles of sustainable energy planning.

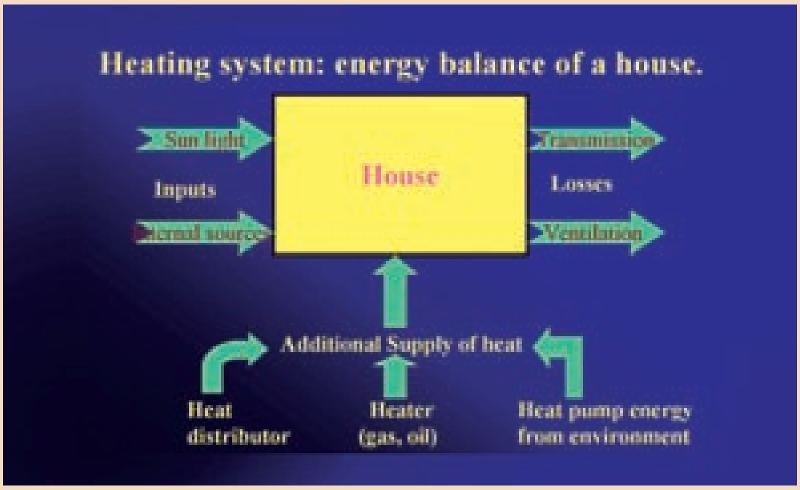


FIGURE 4 THE HEATING SYSTEM

Energy Use in the Northern part of the Netherlands

Klaas Jan Noorman, Henri C. Moll, René Benders, Ingrid Luijkx, Gerwin Wiersma

Introduction

When exploring energy pathways, knowledge and understanding about the present patterns of energy use, the primary factors influencing the demand for energy and insights in some important energy outlooks is very helpful. Therefore the Center for Energy and Environmental Studies IVEM and KNN Milieu B.V. worked together to present a first energy picture of the region. In this chapter estimates on the final energy use in the northern part of the Netherlands are presented. Subsequently, the main drivers of the increasing energy demand are briefly discussed. We summarise the findings of this chapter in a concluding section.

Description of the energy use in the Northern Netherlands region

In 2000 the final energy demand in The Netherlands was a little over 3000 PJ. As energy data are not available at the regional level economic data were used to estimate the demand for energy in the Northern part of the Netherlands. The energy demand of households was estimated based on numbers of inhabitants. In table 1 the energy use (PJ)[1] and production figures (€) per sector in the Netherlands and in Northern Netherlands are presented. (Table 1)

	Energy use (PJ)	Production (mln. €)		Energy use (PJ)
Sector	Netherlands	Netherlands	Northern Netherlands	Northern Netherlands
Mining	35	12.292	5.869	16.8
Energy business	577	18.249	2.092	66.2
Industry	878	210.900	17.892	70.5
Transport	463	72.929	5.283	33.5
Services and construction	506	422.592	32.919	39.4
Agriculture	169	21.863	2.811	21.7
Households	422			44.0
Total	3.050	758.825	66.866	292.1

Table 1 Energy use and production value per sector in the Netherlands and in the Northern Netherlands for the year 2000

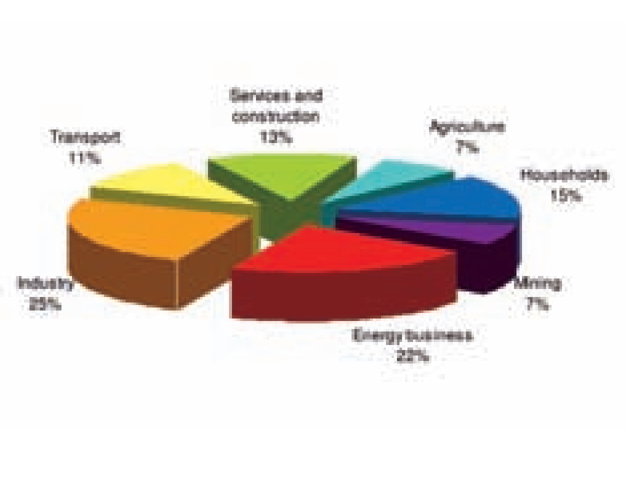


FIGURE 1 RELATIVE SHARES IN ENERGY USE PER SECTOR IN NORTHERN NETHERLANDS IN 2000

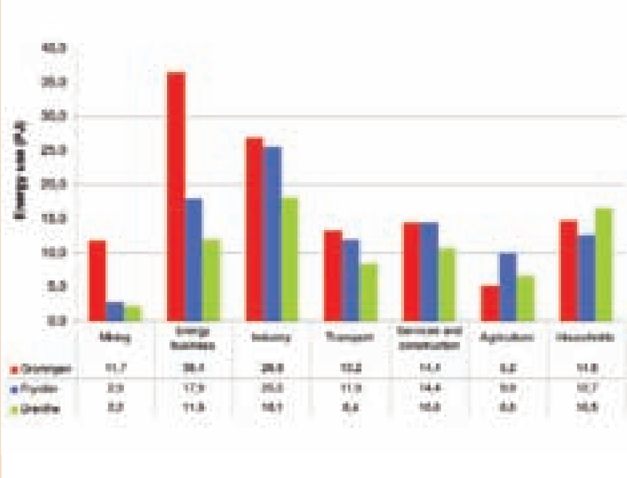


FIGURE 2 ENERGY USE PER SECTOR PER PROVINCE IN 2000

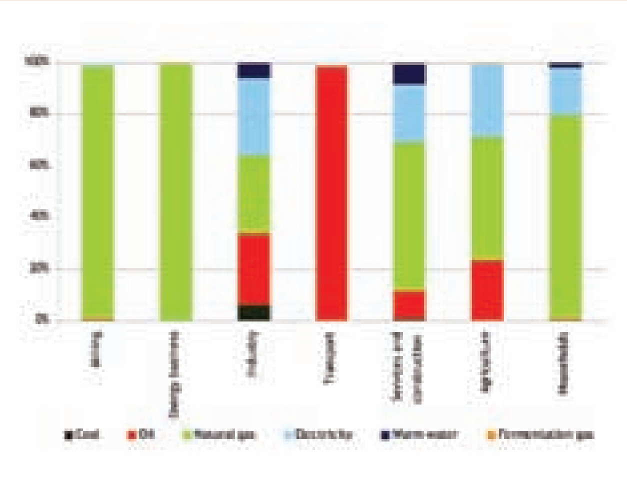


FIGURE 3 ESTIMATE OF ENERGY MIX OF FINAL ENERGY CONSUMPTION PER SECTOR IN NORTHERN NETHERLANDS

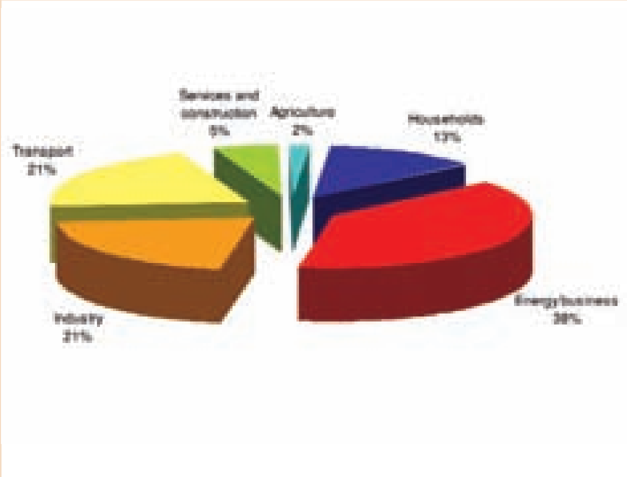


FIGURE 4 SHARE OF SECTORS IN TOTAL CARBON DIOXIDE EMISSIONS IN NORTHERN NETHERLANDS

The energy use in the Northern Netherlands was estimated to almost 300 PJ, about 10% of the total energy use in the Netherlands. About 10% of the Dutch population lives in this region which means that the energy per capita in this region is very much in line with the Dutch average.
When searching for options to make the energy system more sustainable it is interesting to know the relative share in energy use of the various economic sectors for the Northern Netherlands. This is shown in figure 1. (FIGURE 1)

The industry and energy business have an important share in total energy use. The high share of energy business in the total use of energy is due to losses in energy conversion (from gas to electricity).
When looking at the energy demand at the level of the three provinces (Groningen, Drenthe and Fryslân) it is interesting to notice that the highest share of the energy use in the region can be attributed to Groningen (42 %). This reflects the importance of the energy sector and heavy industry (chemical en metal industry) in Groningen. The energy use is Fryslân is about a third of the energy use in the region, whereas in Drenthe the energy use is about a quarter of the regional energy use.
Figure 2 gives more detailed the energy use per economic sector per province. (FIGURE 2)

Another interesting feature of an energy system is the use of the different energy carriers. Insights in the energy mix might give us indications of the possible energy pathways leading towards a more sustainable energy system in the region. Also it is noted that the mix of energy carriers is directly linked to the emission of CO2.
Some data on the energy mix are given in figure 3. Clearly natural gas is the leading energy carrier. Natural gas is used to produce electricity (the largest gas fired electricity production site of the Netherlands is situated in Groningen). Natural gas is also used for space heating (households). Only a very small fraction of the energy supply originated from sustainable energy sources (wind, sun, and biomass). From the figures it also becomes clear the transport fuels are oil based. In the industry a variety of energy carriers is used. (FIGURE 3)

In the present debate on climate change, the emission of the Greenhouse gas CO2 plays a leading role. Total CO2 emissions in the Northern Netherlands amount to almost 19 Mton. In figure 4 we show the contribution of the different economic sectors in the total CO2 emission. An important difference with the results showed in figure 1 concerns the share of the energy business in the total emission of carbon dioxide. This difference is due the fact that the CO2 emissions due to the high energy losses of electricity production are not attributed to all the sectors that use the produced electricity. (FIGURE 4)

Drivers for changes in the energy system

This section deals with the main influences on the energy demand and supply that may contribute to changes in the energy system. These drivers will be evaluated for the Northern part of the Netherlands in relation to the average situation in the Netherlands.
It is important in this analysis to distinguish the supply side and the demand side. The supply side is directly driven by issues like resource availability, technology and energy policy. The energy producers and distributors react on changes in the demand, but do not have much influence on that. Thus changes at the demand side steer also development of the energy system, but the drivers for these changes are found outside the energy system itself. The main drivers in the energy demand are:
- Demographic factors
- Economic factors
- Social factors
- Transportation patterns and consumption patterns

The main drivers in the energy supply are:
- Availability and prices of fossil energy sources
- Potential of renewable energy sources
- Energy policy
- Technology

Demography
About 10% of the population of the Netherlands lives in the Northern part of the Netherlands. Although the population growth rate is decreasing rapidly, the Dutch population is still growing. In the past 4 years, the absolute population growth has become four times smaller. Due to the ageing population, the part of the population over 65 years old increases. The percentage of elderly people is higher in the Northern part of the Netherlands (14.9%) than in the rest of the Netherlands (13.8%). This percentage is highest in the province of Drenthe. The average household size in the Northern part of the Netherlands of 2.3 persons per household is equal to the Dutch average. The size of the households in the provinces Fryslân and Drenthe are above the Dutch average, and in the province of Groningen it is below average because of the large number of students (single person households) in the city of Groningen. A remarkable difference found in the Northern part of Netherlands is the percentage of persons with a non-western background. This percentage is strikingly lower in the Northern part of the Netherlands (4.2%) than the Dutch average (10.2%). Also the Northern part of the Netherlands differs with regard to the number inhabitants per hectare. The Northern part of the Netherlands is considerably less densely populated (2.0 inhabitants per hectare) than the Dutch average (4.7 inhabitants per hectare).

Especially the increasing number of elderly people may result in changes in consumption and transportation patterns. Most demographic differences between the Northern Netherlands and the other parts of the Netherlands will not change substantially.

Economic factors

The agricultural land use in the Northern part of the Netherlands is 10% higher than the Dutch average (79% compared to 69%). The province of Groningen relatively has the largest share of agricultural area. The agricultural land in the Northern part of the Netherlands is mainly used for grass (58%) and crops (38%).
The gross domestic product (GDP) of the Netherlands has increased over the past decades. For the Northern Netherlands GDP/capita is slightly below the Dutch average. The GDP per capita in the provinces Fryslân and Drenthe is a little below the Dutch average whereas the GDP in the province of Groningen is slightly above the Dutch average.
The production level in the Northern part of the Netherlands amounted almost 10% of the Dutch total production in the year 2000. In general terms the regional economy in the Northern part of the Netherlands prospered over the past decade. However, the average income and employment are still below of the Dutch average.
The production structure in the North is less diversified when comparing it with the rest of the Netherlands. A large part of the economical production in the mining sector can be attributed to the Northern region. Other main sectors are agriculture and the energy production sector.
Notwithstanding economic policy goals, the differences in level and structure between the Northern region and the rest of the Netherlands are expected to remain the same. The general development pattern of the national economy will also determine the developments in the Northern Netherlands.

Social factors

During the last two decades the labour participation in the Netherlands has increased strongly, from 52% to 64%. This increase can mainly be attributed to the fact that more women and elderly people remained working. Besides that, the educational level of the working population also increased. In the Northern part of the Netherlands, the labour participation is below the Dutch average (61%). This might be attributed to the previously mentioned high share of elderly people in the Northern region.
The unemployment rate in the Netherlands has been decreasing for years until it started increasing since 2002. This trend can be seen in all parts of the country. The unemployment rate in the Northern part of the Netherlands is strikingly higher than the Dutch average (7.7% compared to 6.4 % in 2004)

Transport and consumption patterns

Everywhere in the Netherlands the roads are becoming increasingly crowded, especially during the rush hour. The increasing level of commuter traffic contributes to the increasing rush hour crowdedness on weekdays. The amount of commuter car movements during the morning rush hour increasedwith 25% from 1990 to 2003. Besides that the car movements for other purposes also increased, with about 10%. Especially the evening rush hour became more crowded. The amount of commuter car movements increased from 1990 with 40 percent. The car movements for other purposes increased with almost 20 percent.
The possession of motor vehicles and of passenger cars (expressed in per capita numbers) is almost equal in the Northern Netherlands compared to the national average. The distance travelled per capita is about 5% higher in the Northern Netherlands, probably explained by the lower population density.
In the period 1981 to 2001 the average purchasing power of households increased with almost 30 percent. On the other hand, poverty is increasing in the Netherlands. The group of people with a low income is growing and an increasing number of households have difficulties with their financial situation. This is especially true for single parent households.
Expenditures on services like housing and transport are increasing. Living expenses are a large burden on the budget of the low income category. Over the past years households have spend more money on services. Especially expenses on transport and communication are increasing. In 1995 these services covered 4.7% of the expenses. In 2003 this percentage has become 6.9%. Living expenses comprise 15% of the total expenses. The share of the expenses spend on consumer durable goods has recently decreased to 21%. The share spent on food, beverages and tobacco is about 14%.
Transportation and consumption patterns seem to follow closely the economic trends, sometimes even with the same high growth rates as the whole economy. Changing this pattern may be possible, but would require the development of more environmentally friendly alternatives and better information systems for consumers.

Availability and prices of fossil energy sources

The future availability of fossil energy sources is a permanent issue for debate. The general idea is that constraints related to the effects of fossil energy use (greenhouse effect) are more limiting than the constraints related to scarcity on the long run. On the short term a mismatch between the supply and demand of energy will lead to strong price fluctuations due to inelasticity on the supply and demand side of the energy system. Compared to some decades ago the economic vulnerability of the Western countries to price hikes is limited, but for developing economies such price hikes may produce devastating effects.

Potential of renewable energy sources

Presently the contribution of sustainable energy sources in the energy supply of the Netherlands is low. Wind, waste and biomass are the largest contributors. The total use of sustainable energy in 2000 in the Netherlands was 1.2% of the total energy supply. The policy target of 3% for 2000 was not met. The Energy research Centre of the Netherlands (ECN) predicted the contribution of sustainable energy in the Dutch society for 2020. ECN expected the contribution to be 209 PJ in 2020. The expected share in the Dutch energy supply herewith becomes 5.4%. The government target of 10% is therefore not met in this scenario. For the longer term the KNN report "Duurzame energievoorziening in Noord-Nederland, een schets" expected the contribution of renewables to be 585 PJ for the Netherlands and for the Northern Netherlands 133 PJ. Interestingly they found a high share for Northern Netherlands. In the KNN study the most important energy sources are PV solar cells, bio energy and heat pumps. Notwithstanding the potential of renewable energy sources, the feasibility and acceptability is limited mainly due to high investments and the fluctuations in the production (solar and wind), and by the land requirements and the small financial revenues (biomass). Political and social change is needed to mitigate some of these barriers.

Energy policy

In 1992 the climate convention was signed at an international level in Rio de Janeiro. The Kyoto protocol was formulated in 1997. Both the climate convention and the Kyoto protocol have been ratified by the Netherlands, implying binding commitments for the Netherlands. The Kyoto commitment implies that the Netherlands should reduce its CO2 emission level with 6% compared to the 1990 emission level. In order to implement this commitment, the national government has formulated the "Uitvoeringsnota Klimaatbeleid". This contains several measures for all public sectors, including the different governments. For the implementation of the climate policy, several ministries (in particular Ministry of Economic Affairs, Ministry of Housing, Spatial Planning and the Environment and Ministry of Transport, Public Works and Water Management) have formulated regulations and action programmes stimulating (further) energy conservation and sustainable energy. Two policy instruments are relevant for the regional level.
One implementation instrument is the "BANS/Climate agreement", formulated and signed by the national government, IPO (Inter-Provincial Council) and VNG (Dutch Municipality Association) on 18 February 2002. For instance the province of Groningen also signed this agreement. Provincial objectives and implementation plans are being developed, based on the provincial "menu", as an implementation tool for the "Climate agreement". A financial contribution can be expected from the Ministry of Housing, Spatial Planning and the Environment to implement these plans.
The second implementation instrument is the administrative covenant "national development wind energy" (BLOW). This covenant has been signed between the national government and the provinces and municipalities. The goal of this covenant is to realize 1500 MW of (onshore) wind energy and to distribute this power optimally over the 12 provinces.
So energy policy may be an important driver for change, but in many cases energy policy may be compromised by other policies seeking to realise other kinds of objectives, like economic development, expanding the number of houses, fighting road congestion and so on.

Technology

The energy supply and the energy demand can be influenced trough the adaptation of new, cleaner technology. Technology will have an important role in making the energy use in (the Northern part of) the Netherlands more sustainable. Firstly it is important to decrease the energy demand, and maintaining the quality of the service functions. This can be done in two ways:

- Decreasing the energy demand by dematerialisation or changing functions
- Increasing efficiency of the energy use of which cascade use of resources is an important example.

An important bottleneck in decreasing the energy use by dematerialisation and increasing of efficiency is the rebound effect. This effect nullifies the energy conservation by increasing volumes. Besides efficiency and dematerialisation, new technologies can be an important factor in reducing energy use.

Technological development may be a strong driver to decrease the energy use required to fulfil the needs of the consumers. But in many cases technological development results also in the growth of consumption next to raising efficiency in production and consumption.

Conclusion

The Northern Netherlands differs in some aspects from the rest of the Netherlands. Important differences are seen with regard to the population density and the land use pattern. The Northern Netherlands shows a relatively low population density and a relatively high share of agricultural land. Other less outspoken differences are found with regard to the percentages of elderly people and non-western people and with regard to the production, economic structure, labour participation and employment. Notwithstanding these differences the energy system in the Northern Netherlands can be compared with the rest of the Netherlands. So with regard to the development of the energy system (supply and demand side) the challenge to transform the energy system towards sustainability and efficiency is on the agenda everywhere in the Netherlands.

Energy policy aiming at technological innovation and the use of renewable energy sources will be the most important driver to work on global and regional sustainable development. In the Northern Netherlands "Energy Valley", EDReC, Costa Due, and the research of the Gasunie form a potential base for such a regional sustainable development policy. Next to policy and technology, also demographic trends and consumer behaviour are important drivers for change.

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[1] PJ (Peta Joule) equals to 10^{15} Joule. 1 PJ is the energy content of about 30 million cubic meter natural gas. This corresponds to the yearly natural gas use of about eighteen thousand households.

The Energetic Strategy of Ecosystem Development and Urban/Regional Spatial Restructuring and Regeneration

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THIS PAPER IN ABBREVIATED FORM WAS ORIGINALLY PREPARED FOR PRESENTATION AT THE INTERNATIONAL SYMPOSIUM AND DESIGN CHARRETTE 'GROUND FOR CHANGES' IN JUNE 2005, IN GRONINGEN PROVINCE, NETHERLANDS

In the process of building cities, and accommodating cities' growth', particularly after the industrial revolution, we have consumed disproportionate amounts of energy and material resources. More than our human share, and more than the capacity the land, a place, an ecosystem could support. Many of these resources are non-renewable, and human societies have destroyed the 'integrity' of man 'with' the environment and erased the identity 'of' (people with) place. Having lost cultural identity and ecological integrity, many cities today try to brand their place through marketing gimmicks rather than letting their identity emerge from place and people in symbiotic and co-evolutionary processes.

Given the evolutionary imperative for realizing, on one hand, economy in the use of limited, non-renewable resources (in this case energy, space, and landscape) and, on the other, for protection of place identity and sustainability in the process of building and managing our cities and regions, we now have to find new ways of structuring our cities and of regenerating our urban and rural places.

The theses of this paper are:

1. that spatial structuring has direct implications to urban energetics, and
2. that an ecological approach, more specifically, an ecosystem strategy for development and stability provides a use full model for the urban and regional spatial structuring and regeneration for energy economy and environmental sustainability,
3. that integration of principles of the ecosystem development with purpose of city building and design, can lead to a useful set of principles for sustainable urban and regional re-structuring and regeneration, and
4. that these principles, creatively applied, would also enhance the health and wellbeing of the community as well as the identity and spirituality of the city, lost in contemporary cities and built environment.

We build our cities to work more efficiently, to gain more freedom, and to live more meaningfully. Productivity, health and well-being as well as continuing prosperity and cultural advancement are what we are trying to achieve through our community and built environment. Through cultural evolution over a long period of time humans learned to build communities and build environment to enhance adaptive advantages. Such built environments manifest not only that we humans are territorial animals, adapting through spatial occupation and structuring, but also that we strive through such adaptation for dynamic and on-going negotiation between our needs and aspirations, and concrete and changing cultural and ecological 'conditions'. Here, nature, as well as culture, is both life support system, and process. Cities and regions are at once the product and producer of civilization. Yet, today, we find ourselves very often in cities which are no longer civil or sustainable due to industrialization and urban sprawl. Focused on production and growth, urban and regional planning neglected energy housekeeping and ecological stability.

Vision and Re-vision of Good Cities

What are the purposes of cities to begin with, and what are good cities? Until we have clear and persuasive visions for them, it would be difficult to discuss, 'how' we could go about designing and building such cities. This is all the more so because of the complexity of issues, dynamicity of situations and context, inherent uncertainty of our knowledge and fundamental inter-determinacy of things and events themselves.

As for this writer, the view that (good) cities are for 'maximum contact, and minimum travel', has proved to be a succinct and useful definition. Today, however, experience of so many urban environments leads to the reverse situation, 'maximum travel, and minimum contact.' For Kevin Lynch, the attributes of good cities include: Choice, Freedom, Gathering, Diversity, Vitality, Health, and Delightfulness. To this one can add such environmentalist qualities as: access to nature, amenity, climate, clean air and water, and public space.

These definitions, however, make no reference to such factors as energy, resource, environmental degradation and 'sustainability', and identity of land and landscape as support system. This indifference to environment, energy and landscape, in the existing urban theories is, on one hand, the reflection of anthropocentric culture, and on the other, the reason for our contemporary problems of urban and environmental degradation and loss of sustainability.

Why Ecology and Ecosystem Approach?

A science of studying organism(s) in its interrelationship to the biotic and abiotic environment, ecology is one of the most relevant natural sciences to sustainable design and development. Not just because it is a science that deals with environment, energy, and resource, but also because of its holistic (integrative) and dynamic (regenerative) approach reflected in a 'system' thinking and 'process ordering' focus. Ecology uses 'ecosystem' as a unit of study. Ecosystem is inclusive of community and environment, which establishes cycle of matter (nutrients) and flow of energy. Ecology, related to the Greek word Oikos, explains how energy housekeeping is done in landscape. Biologic and life-based, an ecological approach to spatial structuring is by nature integrative and regenerative.

Even for those who believe that human society is fundamentally different from plant and animal communities and nature, one can point out that nature, because of its long process of evolution, has produced the most efficient, and integrated energy flow and material cycle system, and that the eco-system is a self-organizing, intelligent system. Nature not only knows, but it also creates and loves. And nature and ecology are not only the best model but unavoidable context. 'Photosynthesis' is still one of the most primary models of creativity, integrating the organic and inorganic by means of energy, with water mediating, producing carbohydrate, a base material of life. It is a process of 'order building'; as such it is a model for designing and building as much as producing. It is then no accident that even industrial production facilities are often called plant, such as petrochemical plant or automobile plant.

In order to re-vision cities and urban theories, we must look at two interrelated problems of cities built for and through industrialization and modernization: the alienation of humanity (dehumanization), and the destruction of environment (de-environmentalization). Revisions of urbanism during the last three decades focused on the 'humanization' aspect, as did scholars such as Kevin Lynch[1], Christopher Alexander[2], or Amos Rappoport[3], whereas the environmentalization aspect of urban and regional theories can find its intellectual basis through such persons as Ian L. McHarg[4], John T. Lyle[5], Erich Jantsch[6], and others.

In spite of the apparent multiplicity and complexity facing urban and regional theories, there is, I believe, a deep simplicity when urban and regional systems are considered in energetic terms. The ecologist, Howard T. Odum, noted more than three decades ago: "When systems are considered in energy terms, some of the bewildering complexity of our world disappears; situations of many types and sizes turn out to be special cases of relatively few basic types"[7].

To consider the urban/regional system or its spatial structuring in connection with energy economy and ecological stability, is to base our approach on three fundamental natural scientific facts:

1. The first Law of Thermodynamics (Law of Conservation)
2. The Second Law of Thermodynamics (Law of Equilibrium), and Ilya Prigogine's theory of "Order through Fluctuation" as related to self-organizing systems
3. Post-Modern, New Sciences such as Chaos Science, and Fractal Geometry.

More specifically, I find theories of ecosystem development (particularly that of Eugene P. Odum) and its urban application by Newman[8] pertinent. I include at the end a brief summary in Tables 1 and 2.

Ecological Strategy for Conservation of Energy/Information

Ecological strategies for energy conservation are, of course, nature's strategies for economy and efficiency for growth and stability. I call these strategies inclusively as 'Inclusive Unity', referring to integration of living system with environment in addition to an internal integrity of ecological community itself. Under this principle I had articulated in the past the following eight strategies of nature and ecosystem that have particular theoretical relevance and practical usefulness to spatial ordering and landscape structuring:

1. Hierarchical integration (nested hierarchy, complexity at every level, fractals)
2. Differentiation of form, niche, and territory
3. Localization
4. Self-regulation
5. Growth and reproduction by means of cell as building block (DNA, Genome as blue print)
6. Three-way interdependency of form, function, and structure
7. Bio-rhythm (periodicity), cycle of growth and decline
8. Minimum volume or minimum surface/volume ratios (relevant to the principle of close-packing, and compact city concept).

These are all strategies for energy economy and system stability, and for complexity, and community. All have direct implication for re-visioning the 'architecture' of cities and regions, as well as of buildings and landscapes[9].

Nature's Strategy for Creation and Creative Adaptation

Nature not only conserves but creates and creatively adapts to changes. Besides, after major environmental disturbances, it also regenerates. Many fields of contemporary sciences offer us insights into such ordering and reordering of 'process', whereas morphological sciences (bio-morphology, geomorphology, etc) of the 19th Century offered insights in order and ordering of 'form', and became the basis for architectural 'forming' principles including functionalism until the mid 20th Century.

These contemporary insights of process ordering reveal to us how nature - in the face of ceaseless change and immense diversity and through frequent perturbation and disturbance - changes, develops, adapts, and even re-organizes itself, ensuring both system (re)development and inorganic, organic and cognitive evolution (from inorganic to organic, to intelligence, conscious culture, and even to cosmic love and spirituality). Supporting these revelations are contemporary theories of system development and self-organization of open systems (organic and inorganic, ontogeny and phylogeny, human psychological, cognitive development and cultural evolution). All of these add to our present understanding of creative, adaptive, and evolutionary processes of nature and cultural adaptation.

Again, as we relate to the creative adaptability of urban and regional organization, I find Odum's discussion 'a shift of emphasis' in ecosystem development strategy as the system moves from early and mature phases (shift of emphasis changes from simplicity and growth to diversity and stability), a relevant and useful model. Newman had already discussed this parallel between ecosystems' strategies to spatial structuring, and I believe that this ecosystem development strategy has direct relevance to urban spatial structuring. This model can be a useful starting point as we look into 'process ordering' of how cities could 'mature' from their young 'growth' oriented phase to a mature 'stability' oriented one, and how the city restructures itself to make the transition from industrial/machine/fossil age to sustainable age.

Ecosystem Strategy of (Urban) Development and Spatial Organization

A forest community, for example, grows and develops through phases called 'successions' from its pioneer phase, to early succession, to mature phase, and to stable climax state. This process is predictable, irreversible and biogenetic. Usually, a forest community may take 150 to 250 years to reach its final phase. At the earlier phases of this development, the physical environment is usually the dominant factor of influence, whereas when the system reaches maturity, the biological environment, or biological community, becomes the dominant factor as the biological environment works as buffer against the physical environment. In the process, the ecosystem also places emphasis on 'growth' of a few pioneer species in early succession phases, and then shifts its emphasis on 'stability' (resource distribution) among many species. As a result the mature ecosystem reveals distinctively different patterns of energy flows and spatial structuring/colonization, putting more emphasis on maintenance of system health (or what we call 'energy housekeeping') than on net growth of biomass. It is this point, and this biogenetic intelligence, that I find relevant to sustainable urban modeling. We can apply this intelligent self-organization to find ordering for the city, making the transition from its growth/quantity oriented early phase (that is, industrial city) to its health/quality-oriented mature phase of high environmental quality and integrity, and thus, sustainability.

The specific characteristics of spatial organization in the ecosystem in its direction to maximize resource utilization are: vertical layering/stratification, and horizontal zonation of territory which overlaps, periodicities and niche (time-share concept of space) differentiations. Whereas vertical layering has a direct parallel with urban center/core, overlapping horizontal zonation has an opposite implication against reductionistic land-use planning practices. This concept of periodicities however has never been integrated in 'space'/'form'-oriented urban theory of Modernity, and the niche concept (organism's time and space) is superior to the time/space duality that affected Modernist theories of architecture and urbanism. Organism in community occupies not just space but space in time and time in space. Nature refutes the false dualism of time and space (which we know from Einstein's astrophysics as well as Heisenberg's subatomic physics). Niche is like today's 'time-share' use of many expensive contemporary offices and recreational condominiums. Ecology provides thus an insight to make a conceptual transition from 'space' planning to 'territorial' and 'niche' planning.

Re-Visioning Post-Industrial Cities

In the light of such principles of ecosystem's intelligent development and creative biological evolution, I suggest fundamental re-visioning of cities, urbanism and spatial planning. We can go beyond 'form/object' thinking to 'process/system' thinking, a thinking based on life and environment rather than on classical physics. I find a 'typological approach' of some urbanists since the 1970's is hopelessly historical and object-oriented. Likewise, a 'compact city' approach is favoring energy economy over human freedom. Even 'landscape urbanism' is not presenting explicit spatial structuring strategies integrating energy and resource concepts. Instead, I like to present three new broad visions: (1) Landscape as Body, Cities as Mind, (2) Ecological Concept as Urban Concept; and (3) Regenerative and Integrative Cities.

The first vision is inspired by East Asian Fengshui as well as ecology. The traditional Chinese approach to medicine conceptualizes the body in terms of five systems and six parts. It accepts the repeated cycle/recycle of birth-growth-death (rather than a linear view of 'progress' and 'history'), and flow of Ki within the body and between body and environment. It suggests an acupuncture approach to design and development ('Strategic design'), and homeopathy (comparable to "aesthetics of emergence"), rather than a surgical transformation of the city. To think of the city as mind, land as body, leads to a vision of the city as brain cell network, with complex and spontaneous synaptic connections, a vision of traffic and roads as blood cells traveling through arteries, with the heart working as intelligent regulator.

The second vision is to take the science of ecology, empirically as well as theoretically, (as both 'concept' and 'context'), and city as ecosystem with a capacity of 'production' as well as 'habitat construction and sustenance', with its growth limited by the carrying capacity of the land.

The third vision points to the fact that today urban and regional designers will rarely have opportunities to design 'new' cities. Instead more effort and attention needs to be directed to regenerating, restructuring old, weak, even abandoned cities into vital and productive ones, or recycling cities by finding new roles, uses and users. In other words, more attention must be given to maintenance, repair, and reuse, rather than to expansion and new construction. The architect of such vision is not just builder, but repair person and 'healer'. In such a vision the industrial/modern city of uncontrolled and unregulated growth became a cancer on earth, leading at once to sick city syndrome as well as sick earth. In such a vision, global warming is like the earth experiencing a fever, vehicles on a congested motorway are just like blood cells in clogged veins of a high-cholesterol body. We have already reached a point where we can no longer continue to develop making green fields into brown fields without replenishing the site's uniqueness and ecological functions. In the end, the green field, and the land, is our life support system, which itself is living, not a tabula rasa.

If these three re-visions are too bold and abstract to the reader, I like to advance more concrete measures as 'master principles' for restructuring urban/regional space, and for bringing energy and sustainability as a core concept into urban/ regional design theories. By 'master principle' I am implicitly rejecting the grand idea of a rigid and linear 'master plan'. By adopting this 'master principle' approach, I recognize the foresight of Christopher Alexander in his book, The *Oregon Experiment*, and focus not on ordering of form, but ordering of process.

Master Principles for the Integration of Energy and Sustainability in Urban Spatial Planning

To make the transition from ecological science to ecological art of city building, I like to make a bold conjecture and imaginative jump. As I must present these principles without detailed discussion here, one can use them as guidelines, as starting point, and even as hypotheses and assumptions for a predesign conception process.

Following eleven interrelated principles are what I can offer now:

1. Closing the energy cycle
2. Multi-function, mixed-use, time-share approach to urban spatial design
3. Compact form and densification whenever/as much as possible
4. Dwelling with nature and co-evolution
5. Dematerialization
6. Networking
7. Slimming
8. Landscape as living machine
9. City as place for environmental education and repair
10. Celebration of chaos aesthetics and self-similarity
11. Selective and differentiated use of energy and resource, Exergy

For the sake of briefness I provide here some concrete illustrations without discussing each of the principles.

1 Closing the energy cycle:
- eliminating energy waste at source (natural lighting, ventilation, climate control)
- making energy waste a source (wasted heat of industrial plants)
- reuse brown fields, derelict sites, and abandoned structures
- continuity and integrity of design-construction-management
- 'attention to housekeeping' (energy house-keeping; water house-keeping; cleaning up waste, disorder and pollution)
- activating Ki cycle and human energy

2 Multifunction, Mixed-Use, Time-share in spatial structuring and function:
- minimum travel
- minimum vacancy in time and space
- minimum waste/lost opportunities of energy assimilation, material/nutrients distribution
- mass transportation as priority
- telecommunication rather than tele-transportation
- limited car/road construction

3 Compact Form, Densification:
- compression leads to miniaturization, miniaturization to spiritualization and dematerialization
- 'minimum travel with maximum contact' (with people and nature) as principle of city
- 'hollow core', 'courtyard', 'central area as park' (as opposed to central area as business area), 'green heart'
- minimum surface, maximum common wall
- Buckminster Fuller's dome, layered roofs and walls, atrium, sky gardens
- Maximum/massive green, functioning walls/roofs

4 Dwelling with Nature:
- open-up system, space: day-lighting drainage, street with landscape view and access
- 'permeable', 'breathing' walls/roofs/pavements (building/city wall like human skin/cellular membrane)
- 'room with view', 'city with a view'
- attention to indoor/outdoor interface, layered enclosure: interface/edge as place, filter; arcade, balcony, veranda, stoop, bay window
- wall as skin of body or cellular membrane

- 'house with garden', 'city with landscape' as an integrated entity, Oikos
- designing for experience and sense of 'living in the world', sense of a place in the universe
- design with nature; work with nature; sustain with nature
- public access and belvedere to/of river front, ocean front, forest edge (awareness of connection to nature and community)

5 De-materialization
- 'environmental crisis as problem of 'material' culture
- material is energy spent
- attention to such non-material quality as: 'poetics', 'spirituality', 'aesthetic', 'quality', 'thermal delight' (beyond visual aesthetics)
- realize energy economy by meaningful/spiritual design and experience
- use energy as information, information as energy: information-intensive landscape, knowledge-intensive design
- landscape that moves and enlightens people
- not owning the land, but borrowing space, materials (not owning but stewarding), people as 'guests in landscape'
- promoting aesthetics of moment, transience, and impermanence
- Buckminster Fuller's search for covering maximum space enclosure with minimum material
- light, light-footed construction
- movable, recyclable, collapsible structure, 'Nomadic' architecture

6 Networking:
- down sizing
- network city
- incremental growth, change
- brain cells
- intensification of connection to node or of nodes with infrastructure
- acupuncture approach to development
- shared regional/global nodes

7 Slim and Small 'Optimum' City/Block:
- Sandwich City, Vegetarian City, Low Cholesterol City
- 'Health', 'Fitness', Lightness' as aesthetic values
- 'small is beautiful'
- town in country', 'country in town', 'city in landscape', 'landscape in city' (Yin-Yang equilibrium)
- avoiding 'Fat/Sick City Syndrome' (courtyard house, urban 'hof')
- cellular structure (vs. mega structure), fractal geometry
- city as 'net energy producer', city as 'net knowledge producer'
- - "Gracht" as blessing for achieving slimness

8 Landscape/Region as Living Machine:
- landscape (city) as water/ventilation/waste treatment machine and energy assimilation 'plant'
- soil as water storage, filtering agent
- enduring 'ecological performance' over immediate, slick 'sex appeal' image (or 'image merchandising') in design
- accepting and expressing complexity, resilience of natural form and processes rather than 'simplifying' and 'rigidifying'
- 'beyond Euclid', e.g. 'sensitive chaos', 'nested hierarchy', 'complexity at each scale', 'fluid process', 'bio rhythm', 'periodicity', "tijd", 'chaos aesthetics'
- 'beyond pastoral and picturesque image' and Romantic 'sublime'

9 City as Place for Environmental Education and Repair:
- form of city informing the public about environment's functions
- a city that makes people learn to live fully, and love and experience others and nature.

10 Chaos Aesthetics and Self-similarity
- beyond Euclidian geometry: formal differentiation with functional integration (in space/time)
- non-Euclidian fractal geometry (nature and living systems hate straight lines; only inorganic systems have straight lines)
- regional differentiation ('droogmakerij' in wetland; water retention in upland)
- bio-climatic adaptation (hot, cold, humid, dry, temperate climates require different street layout, spatial structure, and densification)
- use of local technology, materials, labor
- use of 'human energy' through stakeholder and community participation allowing 'self-expression'
- 'genotype' and 'phenotype' differentiation
- building orientation to sun/wind/view/place/street
- street orientation
- differentiation of fast/slow change space
- active/passive space in city/building (full heating, half heating, self heating) space
- differentiation with time, phase, age (seasonal/ diurnal/life cycle adjustability)
- accepting, celebrating 'agedness', 'aging' and change, by providing continuity and unity

11 Selective, Differentiated Use of Energy and Resource: Exergy
- Low intensity energy by solar radiation, high intensity energy by fossil fuels
- Combination of energy use with heating production
- Use of latent human/user/community energy
- Multi-function of water:
  - water town, water city as aesthetic transportation type
  - microclimate modifier, thermal storage
  - wetland for wildlife, waste treatment
  - natural stream as drainage and flood control mechanism
  - Use of latent human/user/community energy

	Young Ecosystem	Mature Ecosystem
Energy and Material Resources		
a) Gross productivity b) Net productivity c) Efficiency	Rapidly increasing Rapidly increasing Low - wastage of energy and materials - process inefficiencies	Stable and less Zero High - waste organic matter as important energy source - recycling of materials - conservation in the use of materials - processes more efficient
d) Trophic structure	Producers mainly	Balance of producers, consumers, decomposers, and integrative species
Space		
e) Spatial efficiency	Low Dispersed form Low structural diversity: - small structures only - lateral patterns only - - small variety in shape	High Compact form High structural diversity: - structures both large and small - lateral and vertical patterns (stratification) - large variety in shape
Information		
f) Community diversity g) Community organization	Low - few functional niches - generalists Low - little interconnection	High - many functional niches - specialists High - much interconnection
Overall		
h) Environmental control	Low - resource availability external to biotic system - climate un-buffered - system instability	High - resources availability controlled within the biotic system - climate buffered - system stability

Source. Peter W.G. Newman: An ecological model for city structure and development

TABLE 1: CHARACTERISTICS OF YOUNG AND MATURE ECOSYSTEMS

Young City	Mature City
a + b) High productivity	Productivity mainly balanced by homeostatic maintenance
c) Inefficient in use of energy and resources - wastage of energy and materials - process inefficiencies	- Efficiency in use of energy and resources - waste organic matter as energy source - recycling of materials - conservation in use of materials - process more efficient
d) Emphasis on producers, less on manufacturers, little on services	Balance of producers, manufacturers, and services
e) Inefficient use of space Dispersed Low structural diversity - Only small structures - lateral patterns only - small variety in form	Efficient use of space Compact High structural diversity - structures both small and large - lateral and vertical patterns - large variety in form
f) Low functional diversity	High functional diversity
g) Low community organization	High community organization
h) Weak protection from environment perturbations: - resources poorly managed - vulnerable to changes in the physical environment - system instability	Strong protection from environmental perturbations: - resources lightly managed - more able to buffer and cope with changes - system stability

Source. Peter W.G. Newman: An ecological model for city structure and development

TABLE 2: CHARACTERISTICS OF YOUNG AND MATURE CITIES

Conclusion:

I have provided a broad-stroke claim about how ecology as a holistic and evolutionary science can be a useful model for re-visioning contemporary urbanism. I also provided a set of concrete strategies of bringing 'energy/process' concerns into 'spatial/form' thinking of the city and regions.

Sustainability and energy economy are apparently two pressing concerns for our society and global security. (Landscape) architects can contribute by re-visioning of how we could re-structure our built environment without the need for fossil energy subsidy. We could do this by using landscape as energy machine, as well as a source for cultural identity and human spirit.

Whereas many scientists, engineers and industrialists pursue 'technology' based solutions, one must also realize that spatial structure and structuring (i.e. design) are at once product and producer of an energy system, and that we must fundamentally examine the basis of Modernist urbanism, and the destructive impact of industrialization, caused by indifference to energy and resource, and to identity and life of landscape itself.

Believing in deep simplicity, and thinking simply, of the city and region as energy system, of the city not as producer but consumer of energy and resource, and thinking of people as inseparable from place, in other words, people-place as an integrated system, I had presented three visions of cities and eleven master principles. Creatively utilized, these principles hopefully will lead to a different and more effective way of restructuring the cities and regions.

1 Image of the City, What time is this Place?
2 The Timeless Way of Building, The Oregon Experiment, Nature of Order
3 Human Aspect of Urban Form
4 Design with Nature
5 Strategies for Regenerative Design
6 Design for Evolution
7 H.T. Odum: Environment, Power and Society
8 Newman, "An ecological model for city structure and development"
9 Koh; 2004, 197

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Exploring the role for natural gas in the transition to sustainable urban systems

Sebastian Moffatt, Mike Hollinshead

Cities are the most complex and long-lived artifacts created by humanity, and any attempt to summarize or generalize is difficult. Nevertheless, it is possible to examine urban systems as they have evolved in different eras and cultures, and to seek patterns that transcend time. In this article we will begin by examining how the changing nature of energy and fuels over the last 200 years has influenced the form and function of cities, their technology, economies, buildings, transportation, social structures, and quality of life. We will also examine how the energy systems themselves are likely to evolve in the future.

This look back and forward in time provides an important context for examining how cities are likely to respond to new energy sources and technologies, and the implications for urban infrastructure. We will explore how cities can take advantage of new energy sources and how they might accommodate likely changes in urban form. In particular, we look at the question of how natural gas might serve as a transition fuel for cities seeking to manage the transition to sustainability.

Cities and energy systems are dynamic and interdependent

Cities can't exist without energy and it seems that the more you have and the cheaper it is, the greater a city's size, complexity and material wealth. Cities need energy to build infrastructures, heat and light buildings, power machines, process raw materials, manufacture goods and transport people, materials and goods. Thus the potential for prosperity of a city is directly proportional to the amount of energy it can commandeer for these purposes. The more a city has, the more it can accomplish.

Energy is a kind of currency that is exchanged as part of every event occurring in the physical world. Thus a city can be conceived as a flow of energy in, and work and wastes out. This is a very useful concept when it comes to discussing the sustainability of cities, because environmental sustainability is fundamentally about keeping the energy flow within the bounds of what the natural world can provide, and the waste flow within what the environment can absorb in the very long term.

When we look at the history of cities and civilizations, it is evident that we have used a variety of energy forms, and that, in fact, these form a progression in time beginning with human food as the primary energy source, then moving through wood and hay, coal and oil. We now seem to be in the process of moving along next to natural gas (methane) as a primary fuel, and then either to nuclear or renewables or some exotic mixture. (FIGURE 1)

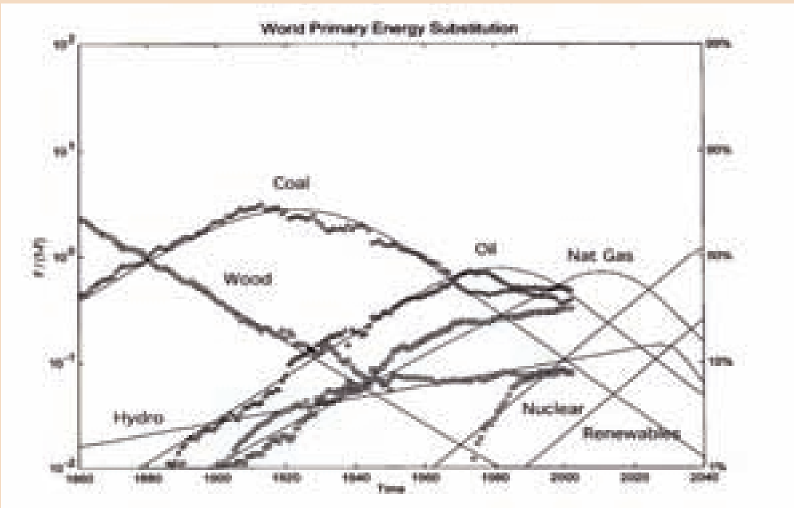

FIGURE 1 PRIMARY WORLD ENERGY CONSUMPTION PAST AND FUTURE

It is impossible to discuss energy without bringing in technology. Energy and technology are complements. Historically, each primary energy source has been uniquely associated with a particular set of technologies. Together they have amplified the efforts of humans so that they can do more than is possible with human hands and energy alone. This complementarity is the basis for civilizations (or city-centred societies). In particular, it was the pairing of coal with the steam engine, and later oil with the internal combustion engine, which has made the prosperity of modern times possible. It is the apparent unsustainability of continued use of these energy / technology systems that may require cities to progress to systems based primarily upon renewable forms of energy such as the sun, wind and biofuels.

The technologies required to make a transition to renewables are mostly in their infancy and in some cases too expensive to be economic at present. However through long-term integrated planning, it may be possible to create urban 'pathways' that can help to better manage the transition.

Natural Gas is poised to play a very important role

One promissing strategy is to use methane (natural gas) as a bridge to a future of renewable and sustainable systems. Such a strategy is consistent with several well-established facts.

The fuel cell, which runs on methane or on hydrogen made from methane, is a rapidly maturing technology which will soon be ready for 'prime time' and has the technical characteristics necessary to substitute for the internal combustion engines used in transportation, back-up power generation, and small scale space heating and electricity generation.

Both industry and government have in the past, and are now, investing enormous sums in fuel cell development. Financial resources are sufficient to develop the technology into a commercial proposition - a goal that is now embraced by many firms and governments.

Supplies of methane look to be adequate to meet the demand over the key transition period of 25 to 30 years (Nakicenovic, IGU), although the availability may vary by region and from year to year.

The progression from wood/hay to coal to oil involves an increasing ratio of hydrogen to carbon. This has been an extremely robust and consistent trend. The obvious next fuel in this progression is methane (and the obvious one following that is hydrogen) (FIGURE 2)

Two trends help to define future urban systems

The progression from high to low carbon content is a trend that helps to put the energy transition into context, and is especially relevant to the question of future urban systems.

Methane is a primary energy source, so we need to better understand how primary energy for cities has changed over time, and the consequences. Two simple historical sequences, with their logical extensions, shown below, capture most of the information.

SEQUENCE I: TOWARDS DECARBONISATION
hay -> coal -> oil -> natural gas (methane) -> hydrogen?

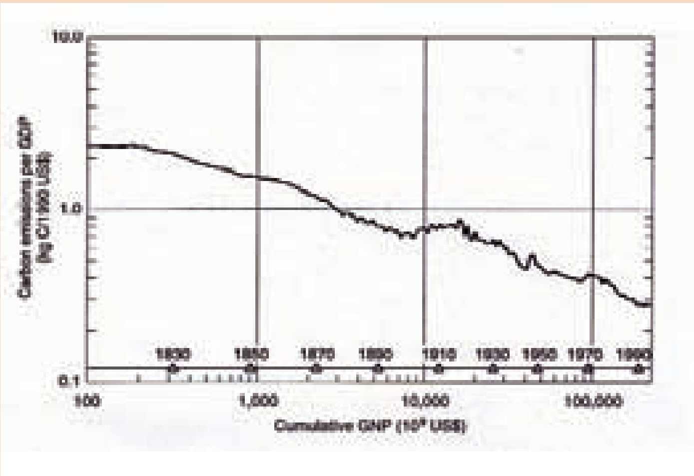

FIGURE 2 DECLINING CARBON INTENSITY OF ECONOMIC OUTPUT (KG C/$

Each successive fuel contains less carbon relative to hydrogen in its chemical composition. Methane has only one carbon atom, so the logical next step is pure hydrogen.

SEQUENCE 2: TOWARDS FLEXIBILITY AND CONTROLLABILITY
solid -> liquid -> gas -> particles (electrons, photons, nuclei)?

The quality of the fuel goes from coarse to increasingly fine, with a corresponding increase in both flexibility and controllability.

These two sequences have played out over the past 200 years and the patterns provide a strong indication of the future for primary energy substitution. Interestingly both sequences appear to undergo a 'discontinuity' or fundamental change in the near future, and this may indicate that we are now entering a very new era. Moving from carbon-based fuels to non-carbon (i.e. hydrogen) is the first discontinuity. Hay, coal, oil and natural gas (methane) are primary energies that occur naturally - they are lying around in Nature for us to harvest or mine. Pure hydrogen does not occur in Nature. It is always bound up with at least one other element. To get to pure hydrogen people have to separate it from other molecules - and of course this separating process uses energy. This means that, unlike wood, hay, coal, oil and methane, hydrogen is not a primary energy. Rather it is an energy depository or energy carrier.

Ultimately we will see a wide variety of energy sources, combined with a hydrogen economy

We have described both a change to non-carbon fuel or energy carrier, and requirement for generating fuel (hydrogen) from base materials. Both of these facts make a difference for cities. They force us to reframe how we think about our energy systems. For example, grass does not grow everywhere and coal, oil and gas are not found everywhere either. They are found in specific, limited locations. Historically, this has influenced urban systems in two ways:

1. Owners of energy-rich locations have manipulated the supply of primary energy to their advantage - in fact, during the industrial age, new cities have often emerged in close proximity to sources of primary energy; and
2. Energy commodities have typically moved great distances - often thousands of kilometres - from supplier to consumer, creating an economic drain on cities and a vulnerable supply chain.

The future may be quite different. Raw materials for making hydrogen include sunlight, human and industrial waste, water, plant cellulose and sugars. These exist everywhere cities are located. Thus in a hydrogen-based system, fuel supply becomes local. It is difficult to monopolize. (There will be no 'HPEC'). There is no need to fight wars over access, with a corresponding relaxation in the no geopolitics of energy. And monstrous world-straddling transportation systems to deliver energy become much less critical.

During the transition period, if methane is used as a bridging fuel including as a source of hydrogen, the advantage goes to locations with natural gas reserves, and of course the world distribution systems for methane become more important. However this may change, depending upon innovations in technology for collecting seabed methane (methane hydrates), which are found off every continent. If methane hydrates become accessible, then methane itself provides an interesting bridge from a geographically constrained energy supply to one that is universally available. The second sequence described above, moving from chunky matter to tiny particles, implies much greater flexibility in the form and mix of land use in urban areas. Solids, liquids and gases are assemblages of atoms. Particles are constituents of atoms. They are therefore in a different category. There is a quantum leap in controllability. Compare two energy / technology systems:

1. adding coal and air to a steam locomotive, or throttling the gasoline and air intake of an internal combustion engine; versus
2. directing the flow of electrons around a microchip, or photons along a fibre optic cable.

The trend to improved controllability supports a parallel trend of diminishing size, because the more control you have over the release of energy from the fuel, the more efficient the process becomes and the smaller energy machines need to be for a given power output. The steam traction engine weighs a tonne, the internal combustion engine a hundred kilos, the fuel cell only 10 kilos. This is a drop in two orders of magnitude, for the same output. Thus the scale of infrastructure for a given amount of energy output has continually fallen, and the trend is likely to continue for a long time.

The implication is that energy systems will become much more efficient, distributed, and diverse. Accordingly, land use systems become much less 'planned' and static, and the connections between the elements within cities become multi-directional, multi-functional, and intelligent. The interaction between land uses and energy systems become more designed, and more dynamic, at every physical scale.

Urbanisation depends upon decarbonisation and controllability of energy systems

Decarbonisation of the fuel supply has been driven in part by urbanisation. The denser a city becomes the more expensive it is to store and move things. Economic pressures reward innovations that minimise the expenses related to storage and transportation. Imagine storing and moving hay into and around London today (and stabling the horses for several hundred thousand people in a few square miles). Imagine delivering and storing enough coal to last a winter, or even fuel oil. Basically, as the density of energy use goes up so must the deliverable energy density and convenience of the fuel.

Thus the controllability and flexibility of energy have profound effects on what goes on in cities. There is a huge difference in the physical size of energy uses that are coarse and relatively inflexible and those that are fine and flexible.

Compare a steel foundry with a computer chip foundry. An integrated steel mill covers several square kilometers, but a chip foundry covers only a hectare. The ecological footprint of the steel mill is enormous. Japanese steel mills draw millions of tonnes of iron ore from Australia and North Africa and millions more tonnes of coal from Canada, South Africa and Australia and more millions of tonnes of dolomite from the Philippines. A chip foundry draws a few thousand kilograms of silicon from local quarries. The steel foundry requires huge supporting infrastructure of railways, marshalling yards, canals and docks to transport raw materials and energy in and product out; the infrastructure requirements of a chip foundry are much more modest - a transit system, and a parking lot with loading bay, near an arterial road. Moreover, the value added of the chip foundry is many times greater than that from the steel mill. The steel mill is a major source of pollution; the chip foundry is a minor one. To capture all this in a thumbnail image: compare Pittsburgh to Vancouver, or the Ruhr Valley to Bangalore.

Shifting technological systems indicate a third trend, and another discontinuity

At the same time another major discontinuity is occurring which intersects and synergizes with our two sequences. The third discontinuity is occurring as we shift the technological base of societies from pyrotechnology to electro-chemistry and microbiology.

SEQUENCE 3: TOWARDS LOWER TEMPERATURE & PRESSURE, WITH HIGHER EFFICIENCY

Blast furnace -> combustion engines -> hybrid electrical engines -> electro-chemistry -> micro-biology?

Each successive technology is smaller in scale, and requires less total energy to perform equivalent tasks. The shift away from high temperature and pressure ultimately leads to cool processes in tiny packages, and the system efficiencies improve by orders of magnitude.

Pyrotechnology involves the burning of fuels to create heat in order to melt and mould materials and to provide the electricity to shape them with machines. Think of blast furnaces and coal fired steam turbines and stamping machines and lathes. Electro-chemistry involves the reordering of atoms though chemical reactions facilitated by catalysts and electrical currents. Think of fuel cells in which hydrogen and oxygen are brought together with a catalyst such that an electron is stripped from the hydrogen to create an electric current. Microbiology uses microbes and enzymes to alter materials at the molecular level. Think of gene splicing.

The old and the new technologies are different in two important ways: scale and energy use. The old pyrotechnologies are huge in scale. Think of a blast furnace holding several hundred tons of coal, iron ore and dolomite, or an oil refinery's cracking tower. The new technologies are minuscule. Think of a gene sequencer (a bit bigger than a desk top computer) or a fuel cell (max 4x4 inches). Pyrotechnologies gulp energy. A blast furnace might consume hundreds of tonnes of coal in a day, representing. The new technologies sip it. A gene sequencer uses watts per hour. The refill cartridge on a direct methanol fuel cell for your cell phone or laptop is the size of a butane cigarette lighter. (FIGURE 3)

Tiny and efficient energy technology will change land use and infrastructure

This third discontinuity implies an implosion for how urban systems use space, and an even greater reduction in their ecological footprints. Large centralised facilities for generation, treatment and storage facilities, and large transmission and transportation corridors will follow the path of computers, which shrank from room-sized mainframes in universities and defence establishments, to laptop computers on everyone's desk. Instead of a coal-fired steam generator housed in a building the height of a ten storey building covering two to four city blocks plus many acres for the coal mine and coal storage and transportation systems, you have a fuel cell the size of a breadbox in each home (fueled by piped gas) or a wind turbine four feet in diameter or solar tiles on the roof.

In order to grasp the magnitude of the change in planning practice try to imagine the job of planning Chicago or Pittsburgh in 1900 then planning for Los Angeles in 1970. They are hugely different, mostly because of the energy available to consumers and their technological systems (street cars to autos, ships to planes, trains to trucks and pipes). The planning challenges and practices of the methane city will be as different again.

For one thing, it raises the degree of flexibility and control of energy and manufacturing processes to thenth degree. As the Nobel Prize winning physicist Richard Feynman remarked, the room on the downside is infinite - down to single molecules.

It is because of the room on the downside that the density of transistors on a computer chip has been doubling every eighteen months for five decades and is now doubling every twelve months - and will continue to do so for decades more. This is the famous Moore's Law. There is a 'Moore's law' for fuel cells as well, for the same reason. The efficiency of fuel cells is based on the amount of reactive surface that can be created in the cell. This depends on the ability to finely divide the material into a porous matrix in a controlled way. Right now the matrix consists of clumps of materials consisting of millions of molecules. We will not reach the limit of division until the matrix is divided into single molecules. The power density of proton-exchange membrane fuel cells is doubling every seven years; for solid oxide fuel cells it is doubling every five years. That pace of improvement will continue for decades as nanotechnology enables us to divide the materials ever more finely. We will end up with fuel cell stacks adequate for a home the size of a sugar cube instead of the size of a breadbox.

A smaller and much more distributed energy infrastructure would make it easier to rely on biomass instead of hydrocarbons. Essentially it could facilitate a loop back to the beginning of the hay to methane sequence to live off hay and wood again, but in a different way i.e. in the forms of ethanol, methanol, biodiesel and hydrogen. Which choice do we make, when? And what is the role of methane in planning our road map?

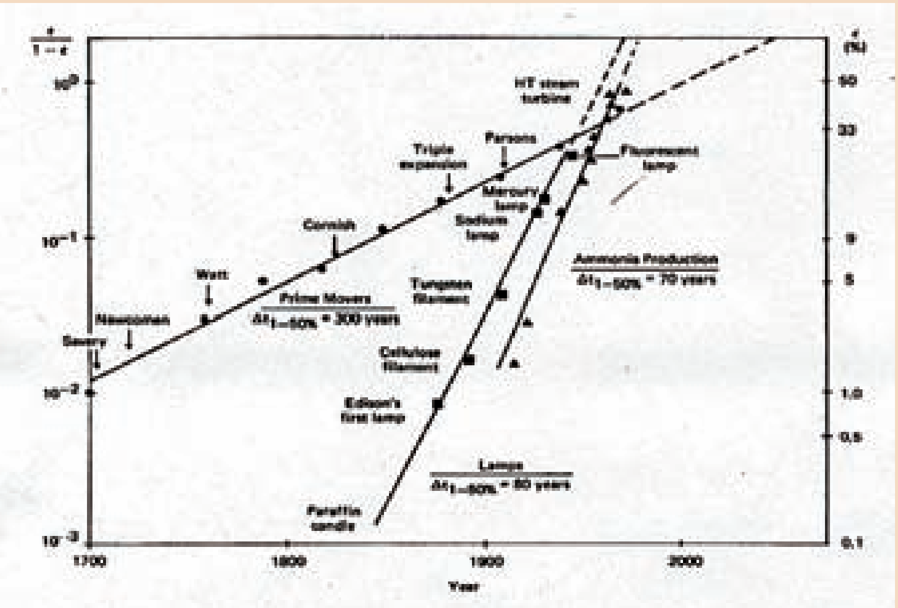

FIGURE 3 INCREASING EFFICIENCY OF ENERGY TECHNOLOGIES THROUGH TIME

In many ways methane appears to be an ideal bridge

First let us recognize that the world as a whole is already using methane as a bridge to some kind of future. Methane is set to take over from oil as the dominant primary energy by the early 2020s. In most cities in Europe and North America methane is already the dominant energy source. However the dominant role for methane does not necessarily imply a managed and smooth transition to more sustainable systems. In fact it could be the reverse. If natural gas is simply used to prolong traditional technologies, the delays could translate into sudden discontinuities with associated loss in investments as equipment becomes prematurely obsolete. Cities can loose their competitive advantage and their social stability, if the transition is abrupt and creates unemployment and unaffordable services.

So exactly how can methane serve as a transition fuel? As we mentioned at the beginning of this paper, methane is a fuel that may be fundamentally suited to this purpose. To begin with, it is supportive of the electro-chemical technologies. You can use it directly in molten carbonate and solid oxide fuel cells. It can be readily reformed into pure hydrogen to fuel proton exchange membrane fuel cells, or into methanol and used in direct methanol fuel cells. Thus methane becomes a bridge to the post pyrotechnical world: where electro-chemical machines (fuel cells) use half the energy of internal combustion engines per unit of output; and where more of the energy sources are local. Both these directions will shrink the footprints of cities.

Methane can also be a bridge to particles. The electro-chemical technologies produce electrons. Moreover, they accomplish this without the risks of nuclear weapons proliferation and radioactive waste associated with splitting nuclei. Methane does not support the photon aspect of the gas to particle discontinuity directly - there are no processes by which photons can be used to make methane or by which methane assists directly in the transition to photon-based technologies.

However, By supporting the selection of hydrogen-fueled fuel cells, methane can be a bridge to a hydrogen economy ultimately fueled by solar-hydrogen technologies.

Methane can also be readily made from biomass - everything from human and industrial wastes to crops and trees can be digested by microbes with methane as the by-product. Molten carbonate fuel cells are already being fueled in this way. It can also therefore be a bridge back to the beginning of the grass to natural gas sequence. Back to the future.

Methane provides an opportunity for urban planners to immediately explore methods and tools for distributed energy and smart grids. Combined heating, cooling and power systems using methane are now available at all scales, from single houses to entire neighbourhoods. It is challenging to establish the 'right' scale for such applications, as the technologies and institutional arrangments change, and for different combinations of climate, land use and energy resources. Is it best to use methane to power micro-cogenerators at the scale of single buildings, sharing excess power on the electricity grid and using the free heat on-site? Or is it best to plan for district systems, that allow for localalise networks of heating and cooling pipes, and that can be easily converted to new fuels and managed like micro-utilities? Such questions are manifold, and cannot be well addressed without integrating energy and spatial planning. Perhaps the greatest opportunity methane offers cities is the chance to more about planning complex 'ecological' systems, and creating more flexible institutional arrangments.

So, when all is said and done, methane appears to offer an attractive bridge to a sustainable future as it can help us surmount many of the obstacles (or discontinuities), without locking us into any one route or destination. It supports those directions that appear to fit with our ultimate destination of sustainability, without closing off any options.

Long range strategic sustainability concerns for the Groningen-Friesland-Drenthe region (2005-2035)

Aromar Revi

TARU Leading Edge,New Delhi

Introduction

The Netherlands presents a sustained example of long-range economic growth that has rarely been emulated by other nation-states over the last 500 years. Following a period of colonial expansion, high agricultural productivity growth, pioneering use of new energy sources, the development of a range of new liberal institutions and a wide range of financial and economic innovations, the Netherlands peaked as an economic power in the early 18th century. Nevertheless, unlike many other imperial powers, notably Britain and Spain, the Netherlands has been able to maintain its relative share of global economic output, quality of life and an open economy over the long durée. (Fernandez-Armesto, 1996, Maddison, 2001).

Key drivers of this long-range development strategy of the Netherlands have been its intensive management of the natural environmental, harnessing much of its available ecosystem services starting with wind and water and then graduating into non-renewables like peat and coal before finally transiting into the global oil and gas economy. Yet, it is precisely these drivers that are at risk in a period of disruptive change expected in the next thirty years.

A Unique Regional Metabolism: increasingly at Risk

The Groningen-Friesland-Drenthe (Energy Valley) region in the northern Netherlands has been central to this last fossil fuel based transition with the exploitation of the large Groningen natural gas reserves in the late 1960s. This has enabled the development of a gas-driven metabolism for much of the Netherlands that is relatively cheap, clean and with lower carbon intensity that other European economies. A future strategic concern of the Netherlands and specifically the Energy Valley region is the sustainability of its current energy metabolism and economy, once these gas reserves begin to deplete over the next two decades.

Long-ranging human intervention in terrestrial, aquatic and coastal landscapes has made the Netherlands one of the most highly managed human environments in the world. A central element is the uniquely Dutch system of polders, pumped drainage, land reclamation, dikes and canals which has enabled an expansion of the national footprint to well beyond its original natural endowments. This has been enabled by the labour and the surplus value of many generations, apart from continuing investments of energy and financial resources to maintain these systems. (de Vries, 2002).

Strengthening and expanding this system in the face of expected increases in North Sea storm frequency and intensity and climate change induced sea level rise is technically feasible. It is however expected to challenge the regional economy, institutions and community lifestyles. While the Dutch have successfully dealt with these challenges in the past, it is yet whether the process of European economic and political integration will enable the further development of the intensely local adaptation strategies that have been successful in the past.

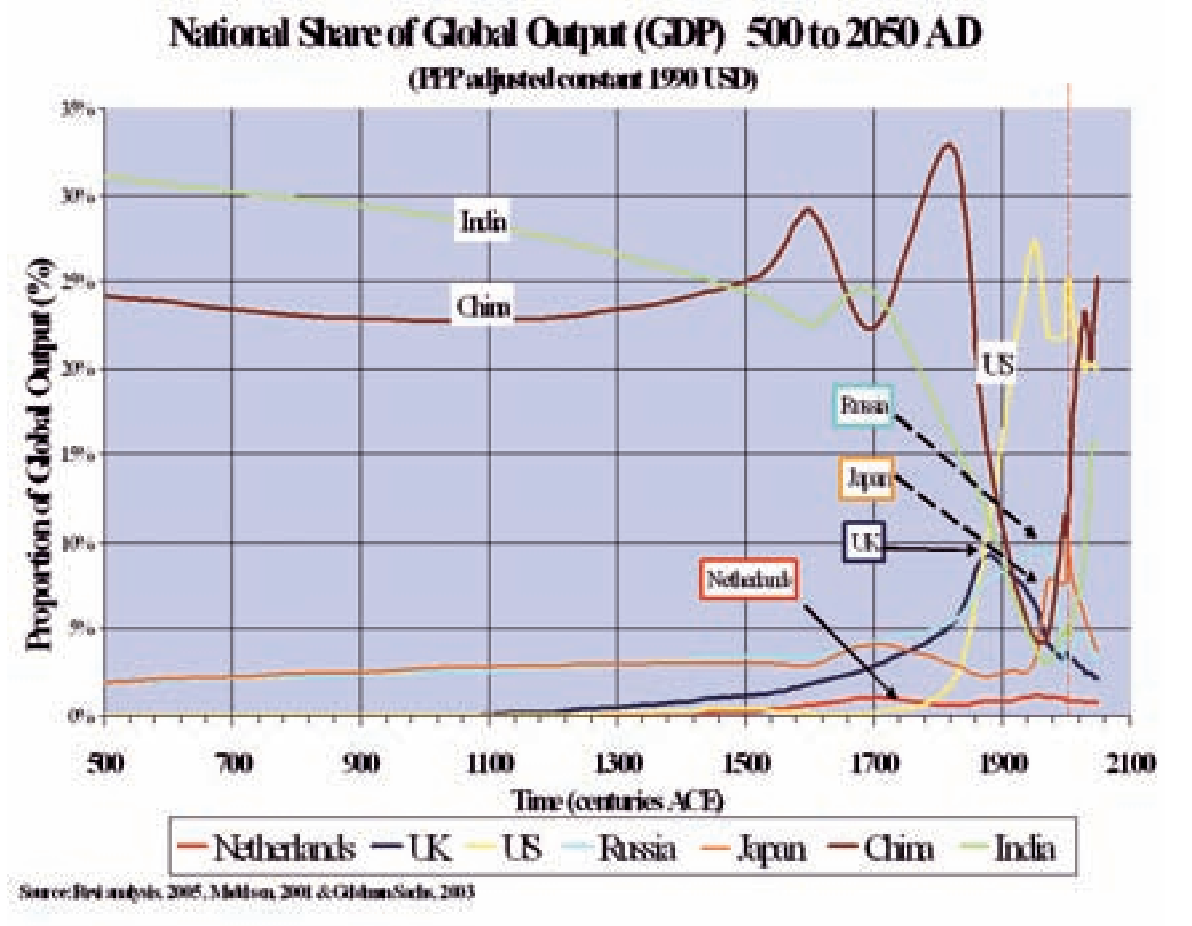
National Share of Global Output (GDP) 500 to 2050 AD
(PPP adjusted constant 1990 USD)
Proportion of Global Output (%)
India
China
US
Russia
Japan
UK
Netherlands
500
700
900
1100
1300
1500
1700
1900
2100
Time (centuries ACE)
Netherlands
UK
US
Russia
Japan
China
India

FIGURE 1

Emerging Challenges to Institutional Adaptation

The Netherlands had by the early-18th century developed an adaptive mercantile economy that was able to respond flexibly to regional and global changes in economic and political power during the early phase of western global expansion. It showed considerable flexibility in making multiple transitions over the last 200 years for example from a strong commodity trade and early industrial technology dependence to an advanced service-sector oriented economy. This has been underpinned by a long series of financial and institutional innovations, precursors to many of the central institutions of the global market economy: the joint stock company, stock and commodity exchanges and various forms of public debt.

The Dutch strategic emphasis on economic development and growth led by trade and control of specific financial and commodity markets; stable returns from invested capital; intensive management of available land and waterscapes to maximize productivity; externalization of part of its ecological footprint to trading regions in the global South; leadership in niche technical innovation seems to be well placed to maintain its competitiveness as a 21st century economy. It would therefore seem that the Netherlands would coast through the this century with the same aplomb it did over the last, especially with the European Union re-emerging as a potential Great Power in the next few decades.

Vulnerability, Risk & Strategic Options for Adaptation

Yet it seems that this long-term Dutch development strategy is at moderate to high risk in the future. This is marked in the less developed areas of the northern Netherlands, with its lower levels of concentration of economic and financial activity, knowledge-based industry, economic infrastructure and population concentrations and ongoing employment and resource management challenges.

The Dutch share in global trade, markets and the economy has remained relatively stable which given its population trajectory has meant a long-range high relative standard of living. This however, cannot be assured in a world that will almost certainly experience a tectonic shift of demographic, economic and possibly military power to Asia in the next few decades. (Frank, 1998).Coupled with this is the high exposure of the material assets of the Netherlands to risk of climate change. (RIVM, 2004)

Hence, a note of caution may be useful. Dutch borders have been breached twice in the last two hundred years: during the Napoleonic wars and more recently in the mid-20th century during a period of short but brutal Nazi hegemony that still lives in the popular memory. Such dramatic actions are not expected in a new Europe, but more subtle changes due to migration, a high-degree of openness of the economy and the capture of domestic institutions by various forms of ideology may already be taking place. A key question is the role of the Energy Valley region in a future networked global order where world regions become increasingly more important. (Castells, 2003).

Given these strategic vulnerabilities and their associated risks, a key question is whether the regional economy of the northern Netherlands can adapt to the needs of a changing economic metabolism, structure and technological base over the next couple of decades? Can the region shift away from an economy that has been propped up by the security of one of the largest OECD gas reserves to a much more diverse and renewables energy oriented mix? Can this be enabled simultaneously with declining energy intensity, combined with a dematerialisation and decarbonisation? (Weizsäcker et. al. , 1997)

There are, therefore, three broad-brush strategic regional options that emerge. One, to strengthen the 'fortress walls' to exclude these emerging risks as the Netherlands has done very successfully in the past, while keeping a moderate degree of openness of its economic system. Two, slowly breaking down the 'cell wall' to create a porous border that integrates the Netherlands into a supra-national European entity that has a greater probability of being sustainable in the long-run at the cost of sacrificing some of the unique Dutch identity. Three, to bumble along a potentially fictitious middle path responding adaptively to short-term political and economic changes. These are trajectories that will need to be examined via detailed scenario analysis for the Energy Valley region. These nevertheless, need to be situated within the tectonic shifts that are expected in the world-system over the next thirty years (Wallerstein, 1997)

A Transition of Economic Power & Political Hegemony away from Western Europe

A simple (but sometimes misleading) indicator of the economic power of nation states is their long-run share of global output, i.e. the proportion of their GDPS to the sum of national GDPs. This long run trend of share of global output over the 500 AD to 2050 AD period of key nation states in constant Geary Khamis 1990 US $ is presented in Figure (1). This is drawn from two major sources. For the 500 AD to 1998 AD period (Maddison, 2001) and the 2000 AD to 2050 AD period (Wilson & Purushotaman, 2003) with appropriate adjustments to resolve the two-time series to a common base. This presents the envelope within which Dutch and the northern Netherlands future development trajectories may be constrained. (FIGURE 1)

World economic output has experienced exponential growth over the last half millennium, as per capita economic output seeks to stay ahead of exponential population growth (Meadows et. al., 2005). This however masks significant shifts in regional and national economic power during a process of colonization and industrialization. India and China made up over 50 percent of global output over much of this period from the 6th to the late 16th century. Their relative share in global output dropped dramatically over the 18th and 19th century during a period of massive western colonial expansion, recovering only in the middle of the 20th century. The rise of the Spanish empire, expansion of Dutch fortunes and then the rise and fall of British Empire ran concurrently with this decline in Asia as the primary locus of the world-system and its economy. (Maddison, 2001; Niall, 2004).

With the mid-to-late 20th century ascendance of the United States and Japan as global economic powers, the notional centre of gravity of the world-system shifted westward from its former locus in western Europe. In spite of these changes, unlike other former European imperial powers, the Netherlands has managed to maintain a relatively small but stable share of roughly 4 percent of global output for more than 300 years. (Maddison, 2001).

A number of projections indicate that the rapid economic growth of East Asia and the moderate growth of South Asia will lead to a further westward shift in the locus of global economic power by 2050. A shift of global hegemony from the Atlantic Ocean to the Pacific-Indian Ocean basins is expected during this period of disruptive change. (Frank, 1998).

The implications for the Netherlands are significant. If these trends continue then it will find itself moving from near the center of the world-system (which was typically close to London c.1905) towards the periphery of the world system as an relatively rapid shift takes place possibly towards Beijing (c. 2035).

In this period of change, the Groningen-Friesland-Drenthe region can at best expect to continue as a Tier-2 or Tier-3 world region. Further changes in the global economic system, with East Asia challenging the dominance of the United States, potential disruptions in the global economy and trade system due to volatility in energy and commodity supply, a less than stable world financial system coupled with the costs of mitigating climate change could create significant strategic risks for the northern Netherlands. It is therefore eminently clear that a business-as-usual approach to long-term development of the region will not work.

A Possible Way Forward

Long-range sustainability planning provides us with a number of methods to address these ongoing challenges and explore whether a medium-run sustainability transition is at all possible (Moffat et.al., 2003). Once a broad envelope for possible transition pathways can be established, a range of different scenarios could be examined to help develop multiple options with key stakeholders. Link energy to regional planning is central to this as fossil fuels have been a key driver of the development and growth of Energy Valley.

The implementation of widespread energy efficiency measures across key economic sectors; changes in lifestyles and consumption patterns and the faster gas-enabled transition to renewable energy will be a key element of a Sustainability Transition for the northern Netherlands. This would also help mitigate some of the key risks facing the region.

In able to do this, a six-step process of engagement has been suggested by the *Bridging to the Future* process:

1. Definition of multiple scenarios and an adaptive management paradigm
2. Assessment of regional ecosystems, economic and social metabolism
3. A strategic assessment of key natural, physical, human and financial capital stocks and flows and transformation trajectories
4. Development of a series of strategic options based on the above
5. A systematic assessment of risks and possible mitigation measures
6. Development of a broad brush financing plan following an appraisal of economic, financial and institutional viability of these identified options

It is hoped that a structured process based on this method would enable a more grounded and holistic set of strategic direction, interventions and pilot projects to emerge for the Energy Valley region.

Conclusion

The Groningen-Friesland-Drenthe region, will by the mid-21st century shift from being close to the heartland of the 20th century world-system to one of its peripheries. This could imply considerable dislocations in the economy, lifestyle and culture of the region. Part of this will be driven by tectonic geopolitical changes, but a significant set of drivers may have greater levels of endogenous control e.g. a transition from a gas-rich and fossil fuel dependant regional metabolism to one in which renewables, efficiency, dematerialization and decarbonisation will be central. Business as usual approaches could be expected to precipitate serious regional dislocations in the face of multiple economic and environmental risks. Hence, building an adaptive and innovative transition management framework is in order.

There are few regions in the world (other than small island states) where the immediate linkage between carbon and GHG emissions and the local environment are starker than in the northern Netherlands. Addressing this will require a candid examination of many implicit assumptions including that of the current Dutch land and waterscape management systems, including the centrality of polders and flood defence systems.

For a transition to a more sustainable future for Energy Valley, these interventions will need to be undertaken simultaneously with a period of transformation of legacy 20th century industries, a structural shift of the regional economy increasingly towards services, sustainable agriculture, green production and consumption: the building of clean transportation and knowledge infrastructure and the revitalization of a number of historic urban centres. Linkages with the rest of the Netherlands and other neighbouring regions in Europe will also need to be strengthened simultaneous with a net reduction in material and energy fluxes.

It is unclear whether such a Sustainability Transition is financially, institutionally and socially feasible - but the technical and environmental management options to enable this already exist as demonstrated in the Groningen Charette. The Grounds for Change project will hopefully provide by 2006 a clear analytical basis to examine these and related questions.

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The Northern Netherlands: Scanning the Future

Participants of the session:

Jeroen Akse, Ettienke Bakker, Bertus de Jong Jusuck Koh, Sebastian Moffat,, Ton Schoot Uiterkamp, Paul Ramsak, Rob Roggema, Baerber Schwaiger

Reported by Ton Schoot Uiterkamp, Fons van Dam, Klaas Jan Noorman and Rob Roggema

Introduction:

During the charrette a team of senior experts was asked to think about images of possible futures for the Northern region. Furthermore the team was asked to come with an overview of approaches that can be adopted in the Grounds for Change project to elaborate on these first images. In this chapter we briefly report on the most important outcomes of this session.

The kick off was given by Ton Schoot Uiterkamp who presented an overview of the main characteristics of the region. The results of this session were presented by Paul Ramsak in an inspiring and lively discussion at the end of the day in which all participants took part. In this chapter we first present the introduction on the Northern region. Subsequently we present the main results by discussing the methods and strategies that can be applied in the continuation of the Grounds for Change project.

The Northern Netherlands; a brief desciption of the present

The Northern Netherlands is a characteristic part of the Netherlands. It is relatively sparsely populated, offers a rich variety of landscapes whereas one of the largest natural gas fields in North Western Europe is located in the region. For climatological, geological, socio-economic and political reasons the region is undergoing major transformations now and in the next decades. (FIGURE 1)

The Netherlands

The Netherlands is a country full of contrasts. It is densely populated yet the population is disproportionally concentrated in the western provinces of North-Holland, South-Holland, Utrecht, collectively known as Randstad ("Border city") Holland. In the Randstad 7.5 million people live corresponding to 46% of the 16.2 million people in the Netherlands. The land area of the Randstad (8,292 km^2) is about 25% of the land area of the Netherlands (33,784 km^2).

FIGURE 1

The Northern Netherlands

The Northern Netherlands consisting of the provinces Drenthe, Frysân and Groningen has about the same land area (8,507 km^2) as the Randstad but has only 1.7 million inhabitants corresponding to 10.5% of the Dutch population. This results in very different population densities: 200 people per km^2 in Northern Netherlands and 912 people per km^2 in the Randstad. The consequences of these differences are clear. By Dutch standards the Northern region is a relatively empty region. There are only three cities (Emmen, Groningen and Leeuwarden) with a population over 100.000. The rest of the population lives in small villages or dispersed in rural areas. Like elsewhere in the Netherlands during the last decade, the population of the rural and transition regions in Northern Netherlands has grown faster than that of the urban regions. Since most employment and educational facilities are located in the cities the commuter traffic has steadily increased during the same period. Because of the low population density the public transportation system is unable to meet the demand and therefore most commuters in this area travel by car.

Provinces

The provinces Drenthe, Fryslân and Groningen differ geographically. Sea- bordered Fryslân and Groningen are largely below sea level, while Drenthe is landlocked and largely above sea level. Fryslân is relatively rich in lakes and other surface waters as Drenthe has almost none. In contrast Drenthe is rich in forests. Groningen and eastern Drenthe have large agricultural industries like sugar refineries and potato-starch-factories. Fryslân has dairy farming.
Water-rich Fryslân focuses on water-bound tourism and Drenthe offers facilities for hiking and biking. (FIGURE 2, 3 AND 4)

Natural gas

Groningen has extensive chemical industries in the harbour town Delfzijl. The chemical complex is based on three geological factors: natural gas, sodium and magnesium salts and deep see access. The exploration of the natural gas fields in Groningen began in the early 1960's. Since then the gas exploration has given rise to substantial tax revenues for the national government. It also resulted in employment in the aluminium-, silicon carbide-, magnesium chloride and petrochemical industries around Delfzijl. Moreover it has resulted in the construction of the architecturally striking buildings of the Groningen Museum and the Headquarters of Gasunie, the organisation responsible for distributing and marketing the natural gas from the the Northern Netherlands fields both in theNetherlands and abroad.

FIGURE 2 LANDSCAPE FRIESLAND

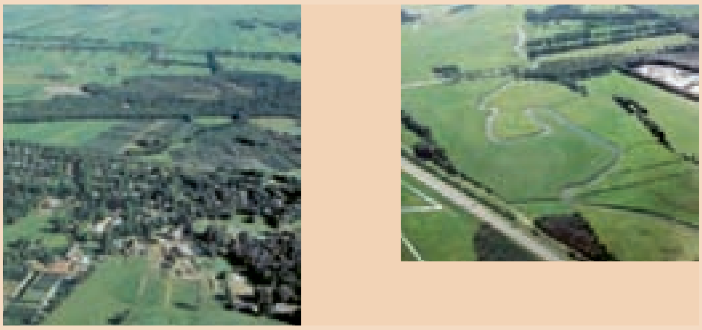

FIGURE 3 LANDSCAPE GRONINGEN

FIGURE 4 LANDSCAPE DRENTHE

Grounds for Change

The natural gas production in the province of Groningen during forty years resulted in major geological consequences. In some parts of the province the surface level has dropped around half a meter and will continue to drop even further when gas production continues during the next few decades. Simultaneously the sea level will continue to rise due to climate change. Together these conditions literally constitute "grounds for change" since large areas in the region are below sea level. (FIGURE 5 AND 6)

In the lowest areas of the province two new lakes named "Blauwe Stad" ("Blue City") and Meerstad ("Lake City") are being formed. By creating lakes additional water storage is introduced. Beside that they will be the basis for new housing projects and recreational amenities.
Meerstad is located near the city of Groningen, the capital of the province. The project aims to identify those elements in Northern Netherlands that amight stimulate a transition towards a more sustainable energy future for both consumers and producers. Other focal points in Grounds for Change are parts of Leeuwarden, the capital of Friesland, Assen, the capital of Drenthe, and Emmen, the largest city in Drenthe.
The project has to take into account the political consequences of globalization and diminishing EU agricultural subsidies for crops like potatoes and sugar beets. However, because of its extensive agricultural facilities and because of its location near the sea, the Northern region offers also good opportunities for renewable energy production from biomass and wind turbines

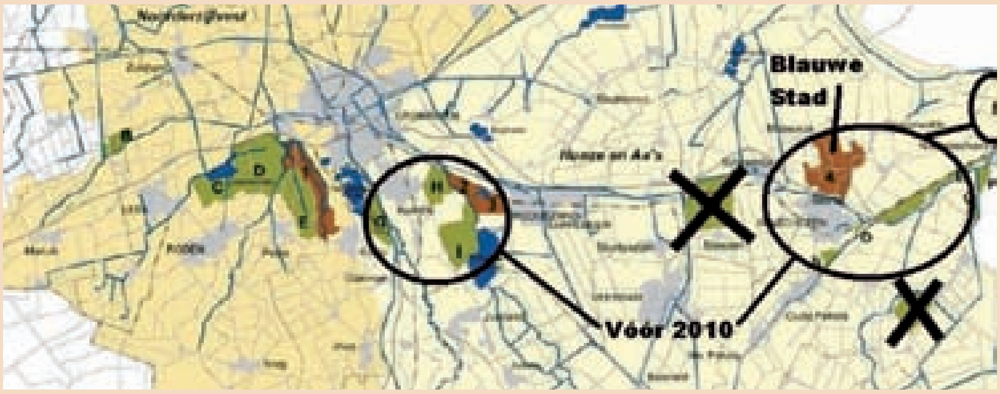

FIGURE 5 WATER STORAGE REGIONS

FIGURE 6 DE BLAUWE STAD

Scanning Futures: Searching for methods and strategies

When exploring possible pathways for future development scenarios can be used to investigate and compare various routes. The term 'scenarios' is derived from dramatic arts and movie arts. As we all know, in drama and movies, scenarios are used to describe the successive scenes resulting in a (often) happy ending. When exploring the future, scenarios might play a comparable role: they can be regarded as experimental tools in which various possible future developments can be thought over and compared. It should be stressed here that scenarios do not predict anything! Scenarios are being used to deal with uncertainties that are inevitably connected with our images of the future (our scenario plots) and are therefore very helpful in stimulating and structuring our thoughts about longer term futures. In the session some basic approaches in scenario building were discussed: casting and backcasting.

In a forecasting approach present trends are being extrapolated. Therefore, forcasting demands for a detailed analysis of present day relations between many factors that all play their role in shaping our future. The results are very much depending on the assumptions about future trends.

A backcasting approach starts with defining a desired situation at a determined point in the longer term future. Subsequently, scenario's are developed, connecting the present situation with the desired future point and wich steps can be taken to realise the desiored future. This approach generates insights into the challenges that lie ahead to realise the longer term goal.

Next to these two approaches also backtracking was presented as a valuable approach.

Backtracking is focussing at a point in history when one could speak it was a sustainable situation. This situation is transplanted to the present as a base for future developments and planning. This approach learns us the basis values of the region, which are almost forgotten nowadays, due to technological and economical focuses. To base future developments on these values and to add current and future needs to it, create spatial visions of the future. (FIGURE 7)

Important aspects to incorporate in Scanning strategies:

A number of strategies/approaches were presented that could be used in the continuation of the design processes. The most important are presented here.

1. Develop a multi-energy strategy

It was agreed upon that an energy supply system dependent on just one or two fossil energy sources becomes very vulnerable, not only because we might run out of the indigenous energy sources at a certain moment which would make us increasingly dependent on imports but also because most likely large investments are needed to adjust the monoculture based energy infrastructure to the new generation of energy sources. Therefore, strategies aiming for a sustainable energy system should include a broad pallet of energy sources, ultimately only including different forms of renewable energy sources. (FIGURE 8)

2. Include LowEx principles

Sustainable design should take into account exergy principles. The exergy principle is directly related to thermodynamic laws. Although it is far beyond the scope of this chapter to go into thermodynamic laws a few words on the application of

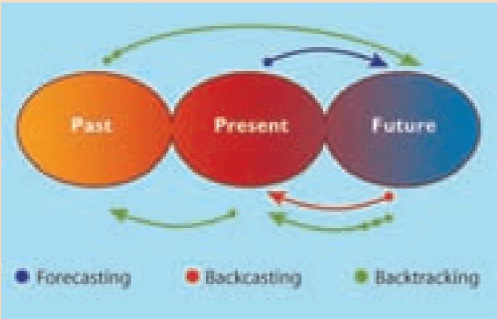

FIGURE 7 TO APPROACHES

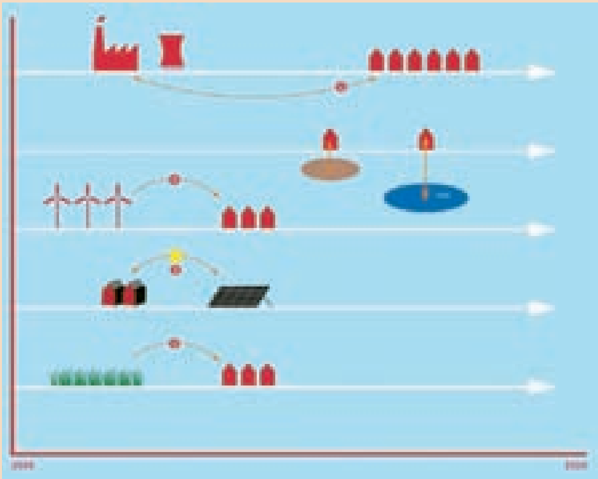

FIGURE 8 A MULTI-ENERGY STRATEGY

exergy are mentioned here, simply because the exergy concept is at the very base of 'smart'energy system design. Exergy analysis is an important concept when re-thinking the way energy sources are used in societal systems such as households, buildings, cities and regions. Exergy analysis takes into consideration energy quality, next to its quantity. Taking into account the quality of a certain amount of energy, offers much room for efficiency improvements. At present high-quality energy, e.g. heat of high temperatures (1200 degrees C.) is often used for low-quality purposes, such as space heating of houses, for which only a temperature of about 20 degrees C. is needed. Another example is the use of electricity (valued as a high-quality energy source, produced from primary energy sources at an efficiency of about 50%) for producing hot water. Taking into account the quality of energy sources result in the development of energy cascades, involving the design of long cascades of energy use, from high quality energy (high temperature) to low temperature heat. This requires an adjusted spatial planning strategy. (FIGURE 9 AND 10).

FIGURE 9 ACTUAL EXERGY CASCADE

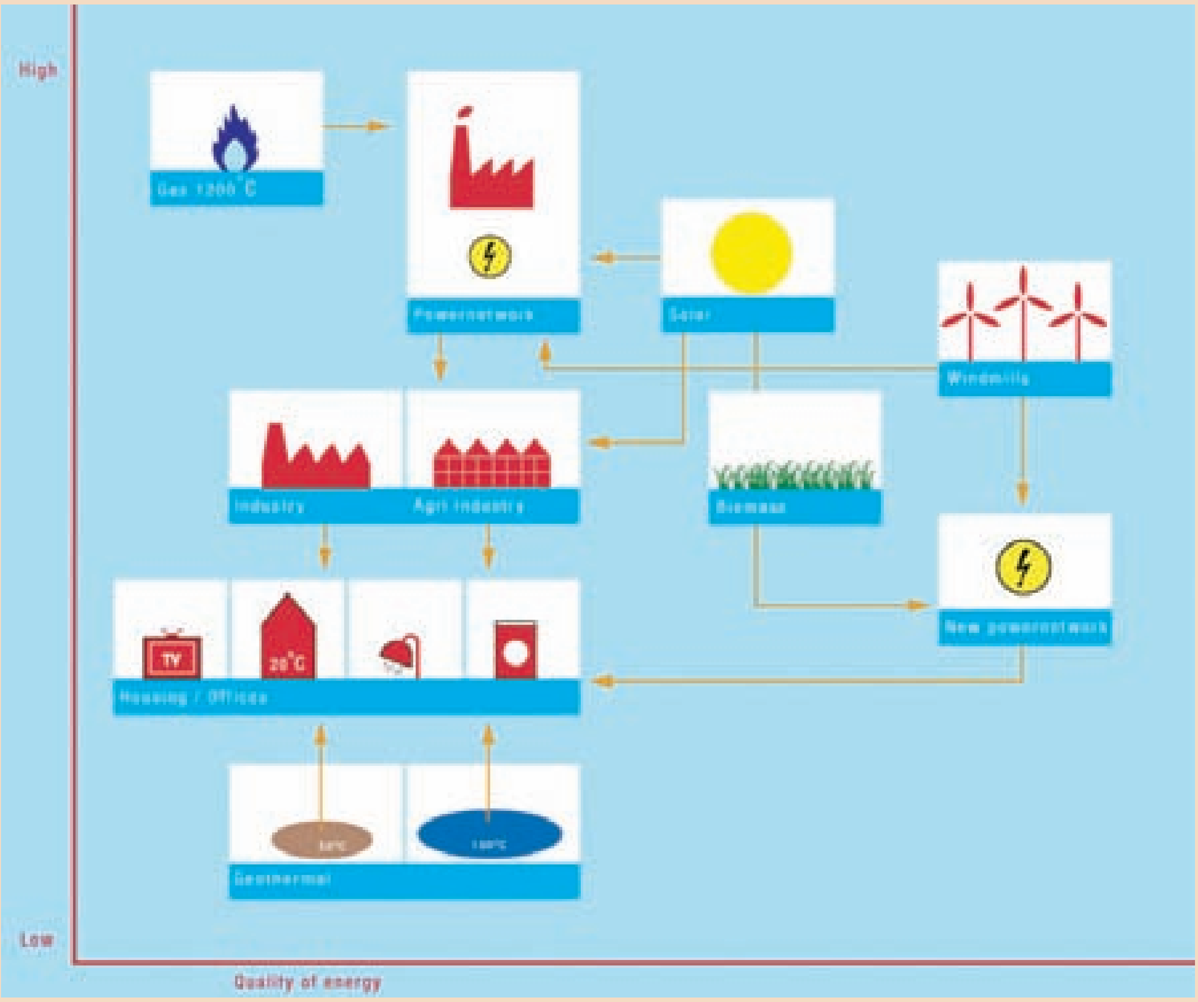

FIGURE 10 INCLUDING LOWEX PRINCIPLE

3 3-dimentional vision

Although our present energy sources come from a depth of several kilometres, when planning our future energy system the main focus is two-dimensional: the earth surface and about 100 metres in the air (the height of a modern windmill). It is increasingly recognized that the (deep) underground offers promising options for our future energy system. The ground has the capacity to store thermal energy over long periods for seasonal purposes. In addition, the techniques required are not very complicated and do not require fancy technologies. One example of underground thermal energy storage is storage in aquifers (large natural groundwater basins). Furthermore, the deep underground can also be used for the storage of CO_2. It was for these reasons a 3-D vision is very relevant to include in new planning paradigms.

4 Footloose/ worldwide process-product

The approach used in the design process in the Grounds for Change project should be available and possibly reproduced in other processes and regions in the Netherlands and abroad. An approach footloose from the specific local situation. (FIGURE 11)

5 Human energy

Energy is not only heat or electricity. Everyone knows what can happen if one's mental energy level increases: a joyful day with a lot of fun! This mental energy can be increased by working on an ambitious project or taking part in an appealing event. And it also can grow by lying back in a peaceful environment and give new thoughts a chance to appear. Uploading this mental energy can be facilitated extremely well in the Northern region, in Energy Valley. People fill up their minds and deliver energy by working in rewarding idealistic projects. (FIGURE 12)

FIGURE 11 A FOOTLOOSE APPROACH

FIGURE 12 HUMAN ENERGY

Energy-design for Energy Valley challenges

climate change governed in the Northern Netherlands

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By accident a seawall breaks through. King William IV hurries to Energy Valley to look at the damage, inspects all flooded goods and mourns over the lost lives. Even with all his experience this time the water could not be managed. The Netherlands too long believed that technical solutions, such as heightening the dikes over and over again, should protect the country against a rising sea level or more frequent and heavier storms. However, when it finally goes wrong, it is going terribly wrong. People have forgotten to adapt to inevitable developments. They forgot to make use of the changes in climate to make a big step: instead of denying the problem, use it as inspiration.

Keep in mind that we describe here a long term view, with some rather astonishing aspects, which differ completely from the landscape we know nowadays in the Northern Netherlands. In 2035 things will probably not have been changed so drastically.

1. A logical necessity

Region at high risk

The next decades a couple of developments will influence the Northern part of the Netherlands. The surface will sag slightly and the surrounding sea will rise. The supply of gas will decrease. Due to the economic balance shifting towards countries as India and China less financial reserves will remain for periphere regions as the Northern Netherlands. Therefore, protection against floods and severe storms is becoming less easy. Fossil fuel and clean drinking water will become scarce. This makes it absolutely necessary to develop plans responding to these developments. Nowadays people, policymakers, designers and politicians are not taking upcoming problems very seriously. Money and a technical solution should tackle the problem. However, within 30 years there will be a natural necessity to cope with this kind of matter and we will have to act fundamentally in another way towards our environment.

Our time frame is under pressure so quick action is required. This is not necessarily a threat. It also can become a trigger and stimulus for new approaches and new solutions. The region needs to face the upcoming developments with confidence. This however requires a new way of looking at things: a new paradigm.

Existing policy

One can see discussions have been started on how to cope with the threat of water flooding in different parts of the Netherlands. This discussion was started by the 'Ooievaar' plan, which introduced greater flooding areas next to the major rivers. Some large areas, for example the Blauwe Kamer near Rhenen, have changed from a traditional river landscape, protected by dikes, into a periodically flooded area in which nature and water storage are the main functions. Projects like Grensmaas in Limburg, reintroduction of water in polders in Zeeland and the development of the policy of Space for the River gave birth to a new insight that we might need to give space to the dynamics of water instead of trying to control it and to limit it to existing paths. In this respect the ideas for Energy Valley fit into this young tradition.

Shift

In the old 'technological' paradigm, assignments regularly are defined as a long list of requirements, programmatic demands and rules which a design should comply with. With a little friction and tension, normally the design will succeed in this, but it hardly seems to contribute to the major problems society faces.

In the new paradigm the assignment is put differently: use natural processes to design sustainable development of the region. This more or less requires a new design language and toolbox. The new design language should enhance the designer's creativity, imagination, fantasy and identity. The solutions resulting from this can newly shape a region and give it a unique identity, because it can be perfectly based on the regions own qualities. This new approach is used to design a regional vision for Energy Valley.

2. A long term vision on the region

The new paradigm is based on simultaneous use of the principles of 'backtracking' and 'backcasting', which have different meanings.

'Backtracking' offers the possibility to look back in time to a situation known as still 'sustainable'. At this time production and consumption of resources such as energy, water, food, and building materials was still largely in equilibrium with the natural ecological system restoring human extraction and pollution. The landscape had been shaped by natural processes and a rich nature existed. Technology was not yet as dominant as we know it today. The sustainable situation decreased from that moment in time. Backtracking guides us back in time, showing the landscape in a more natural state, clarifying the basic ingredients that shaped it and making it possible to translate this information to the future. The purpose is not to create a

world in an 'original and historical' state, but use the natural and typical driving forces of the specific situation and location. These insights offer chances to design a specific and fitting image for the region.
For the Northern Netherlands, the moment in time that the region was not yet completely protected against influences from the sea, could be declared a sustainable situation. A wide zone behind the current sea dikes was an open playground for the sea. People were living on higher grounds, on the terps, artificial hills, and were used to living with the water periodically flooding their properties. A broad natural zone existed in which salt and sweet water influenced one another developing a ecologically rich gradient. Man lived in balance with his environment. (FIGURE 1)

If we combine this historical image with a map of the present and the high risk profile of the region, incentives for a sustainable regional design will come up. (FIGURE 2A)

Based on present and expected future needs and restrictions by the natural limits of resources and pollution, 'backcasting' implies defining a future situation to be expected as 'sustainable', and translating this back towards now: what do we need to start, develop and design now, in order to achieve the desired future. In this future situation there is a closed loop of produced and consumed resources such as energy, water, food, and building materials, and a balance will have been achieved between the human economic system and the natural ecological system.
For Northern Netherlands a possible image of this future may be that natural processes, whether or not influenced by man over time, once again are taken as a constraint for spatial developments. This means that the prospected climate change and its diverse effects are taken for granted: for instance, people will simply have to live with a 1 meter sea level rise. As a consequence of this, significant parts of the Wadden Islands and the ecologically valuable Wadden Sea have disappeared and become the WasWadden Sea. Due to the shallow waters and sandbanks in this coastal zone, it has become an appropriate area for surfing. (FIGURE 2B)

However, the combination of a substantial sea level rise and restrained forceful draining of polders suddenly offers new changes and challenges: new, ecologically more valuable, wetlands or even a new 'Wadden sea' is appearing behind the former sea dikes, enabling a range of ecological, social, and economical use.
Technology is supporting sustainable processes rather than being an autonomous development on its own. Therefore, the century long battle against the sea has been converted to cooperating with the sea and other natural processes. Man has learned to live with restrictions to resource consumption, and use of fossil fuel and other depleting resources therefore is very limited; the global economy is powered by a mix of sustainable energy resources, based on local characteristics and opportunities.

FIGURE 1 NORTH NETHERLANDS 1810

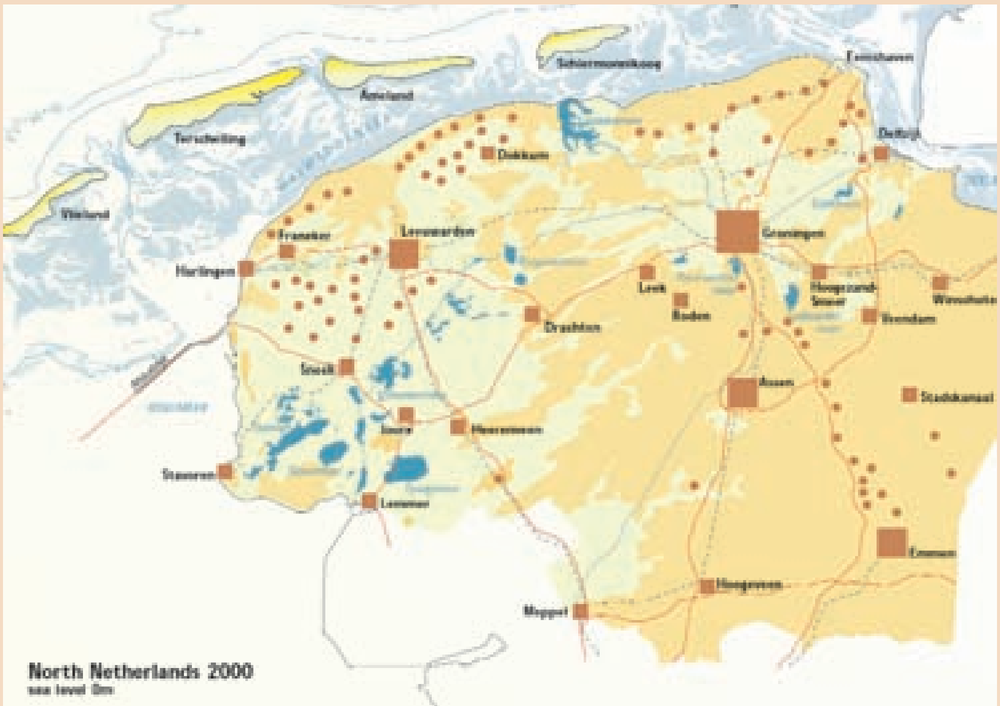

FIGURE 2A CURRENT SITUATION OF THE REGION

FIGURE 2B IMAGINARY SITUATION OF THE REGION IN 2100

FIGURE 3 SALT WATER SYSTEM READJUSTED

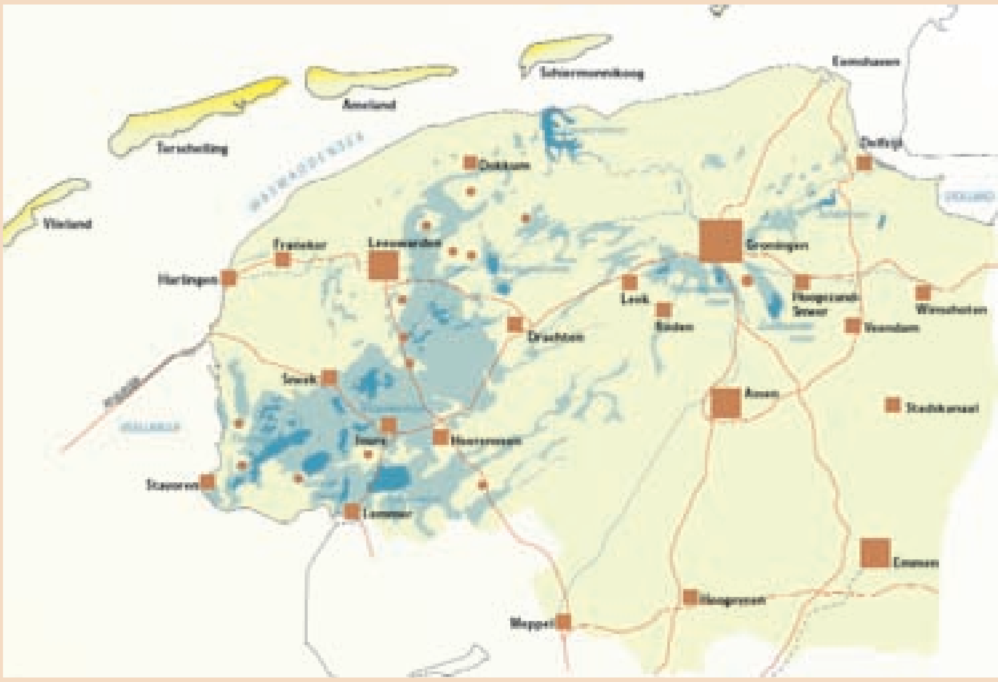

FIGURE 4 SWEET WATER SYSTEM READJUSTED

Readjusting the salt water system

Adapting to natural processes means that seawater shall again gain influence in the hinterland. A complete inundation is not imaginable nor wise, but a well-controlled and well-directed inlet of seawater, whenever necessary, contributes to the development of the region. When a severe storm or heavy rainfall occurs, the seawater can enter the historic Northern rivers, such as the Reitdiep, Fivel en Aa. As a consequence, maintenance and heightening of the dikes may be postponed. A considerable amount of money can be invested in other goals. Behind the dikes the landscape floods periodically, in the beginning rarely, later more often.

The sea-influence should be directed in a safe and secure way, especially to areas with specific qualities, such as economically and agriculturally valuable cities and villages. People living on the higher grounds are safe but the lower areas in the region need protection by a second ring of connected older sea dikes behind the existing seawalls. Other solutions within a 30 year time period are, for instance: starting to have people in the lowest areas moved to higher places in the region, to develop floating villages or buildings on poles, or to construct new living areas on newly deposited sand ridges.

A salt marsh landscape, which until has now only existed in the Wadden Sea, can be foreseen in this new flooded area. An enlargement of the unique nature of the Wadden Sea will be necessary by that time, because the largest part of the Wadden Sea itself, including the habitat of thousands of seals, will have disappeared. Anticipating these future developments, a 'New Seal Land' can be created in the lower parts of the Northern Netherlands. It might also include some new possibilities and challenges for the agriculture. The question whether there is any perspective for agriculture in the northern parts of the Netherlands is getting pregnant. Introduction of certain salty areas might give agriculture a new potential, for instance when salt water based crops can be introduced or shellfish production areas can be created. Touristic impulses can be expected from people with ample time, money and interest for nature are visiting the new wetlands

Readjustment of the saltwater system requires a step-by-step approach. Starting with an experiment, possibly the Lauwersmeer area, will offer insight and knowledge for a successful wide application of the approach. (FIGURE 3)

Readjusting the fresh water system

Currently, a large area of the region needs to be drained continuously. This costs a lot of energy and money. And in the future, due to sea level rising and surface sagging, it will cost even more. The fresh water system needs to be readjusted by simply stopping the drain pumps. A large and inter-connected lake area will be the result. It will be supplied by the IJssel Lake, implying that an indepletable spring of fresh water will remain available in the future. Not only can it be used for leisure, e.g. sailing, it will also function as a resource for drinking water. Apart from that, large areas of lakes and water are a good pull factor for living and economic areas. Thanks to the re-introduction of water a lot of towns and villages will be positioned at the new waterfront. Groningen and Leeuwarden will become capitals bordering large areas of water, and Sneek, right in the middle of the 'Lake District' and surrounded by water, will become the water-capital of the Netherlands. A rigorous halt to draining will lead to disaster, therefore a step-by-step approach is required. In order to gain experience, to protect the sensitive areas and to determine the benefits and drawbacks of the new approach, in the beginning only small parts of landscape should be given back to the water. Thereby stopping the process will be possible at every instant and it can be continued when successful. Critical research is needed to find out in which areas the introduction of water is technically and socially acceptable. Such processes will be adaptive. (FIGURE 4)

3. Energy drivers

Based on the principles discussed above, a couple of energy drivers, derived from the 'Scanning the Futures' session, were used for inspiration during the process of regional design. In the regional design principles of various energy strategies were taken into account:

1. Multi-energy strategy
2. Low exergy
3. 3D vision
4. Footloose approach
5. Human energy

For a more detailed description of these strategies we refer to the Scanning the Futures chapter.

4. Regional energy system

The energy system for the Northern Netherlands is based on a division of the region in sub-areas, depending on the respective characteristics and opportunities: (FGURE 5)

1. *Industrial Development Area*

In the zone between Eems harbour and Delfzijl large industrial developments should be projected, as a result of the production of high-grade energy in and around the Eems power plant. This power plant is not using only agricultural biomass (mainly from Biomass County), but also the waste from the Urban Corridor and other bordering areas. It supplies energy to the industry in the development area, other economical and agricultural functions using waste heat from the industry, and eventually living areas in the entire connected Northern region.

2. *Biomass County*

The Eastern part of the provinces of Groningen and Drenthe changes into a biomass production landscape. Large scale, agro-industrially produced biomass is efficiently transported to the biomass-plant relatively nearby in the Industrial Development Area (Eems harbour-Delfzijl).

3. *The Urban Corridor*

Connected through high-quality public transport (light rail) upon the highway A28, all towns between Zwolle and Groningen will be part of the Urban Corridor, a dense urban network connecting the region to the rest of the country, a dynamic corridor delivering everything modern people demand. This dense linear area is especially adequate for connection to an efficient energy infrastructure system. This corridor uses electricity produced by the Eems power plant in the Industrial Development Area, and waste heat from higher-grade functions in the energy cascade. For additional heating, this area is also connected to a series of geothermal drillings.

FIGURE 5 REGIONAL ENERGY LANDSCAPES

4. *Dog Ridge Estate*
At the Dog Ridge (Hondsrug), between Groningen and Emmen, a couple of luxury estates can be developed. They will make use of heat-pumps exploiting the out flux of ground water from the Drenthe plateau to the lower eastern peat lands of Groningen.

5. *The Green Community*
At the end of the Dog Ridge lies Emmen, which transforms into a Green Community, boasting an ecological lifestyle. The energy supply is organised through mainly biomass and geothermal heat.

6. *Windy Dikes & Reefs*
The Wadden Islands and the existing seawalls are especially feasible for wind energy. Wind is abundant and strong. Existing techniques like windmills deliver the needed electricity for the 'Connected Hinterland'. New techniques like the Kite-mill (W.Ockels) will also be placed in this zone.

7. *The Connected Hinterland*
The Northern parts of Groningen and Frisia are supplied with electricity through wind-energy. Heat demand of larger towns such as Sneek, Leeuwarden, Dokkum and Leek, and also existing knoll villages will be supplied by geothermal energy. Therefore, drillings in the underground towards the warm layers at approximately 900 m are necessary. If possible, existing drillings for natural gas extraction can be used, defining new areas for living around these drillings. Potential and temporary shortages will be obviated by a back-up connection with the Industrial Development Area.

8. *Waterworld*
The southern and eastern part of Frisia will, as time passes by, retain more and more water. An osmosis-plant is introduced in the area yielding the opportunities of fresh and salt water mixing. The re-introduction of tides will open up the possibility of a tidal plant near Lauwersoog, at the present sea locks, the location of the largest historical sea inlet. These amenities will produce electricity and deliver it to the grid. Many living areas in Waterworld will consist of separated communities with low densities on or near the water. In order to supply energy for these areas, solar panel, big and small wind turbines, and heat pumps will be applied.

9. *Autarkadia*
The higher plateau of Drenthe and the eastern part of Frisia on both sides of the Urban Corridor have an geophysical position unfavourable for an efficient connection to the other energy networks. Therefore, a self-supporting strategy will provide the best opportunities for this area. The idea is that people living here do not primarily use amenities at a distance, but provide themselves with water, food, energy, and materials, requiring an autarkic lifestyle. Rainwater will be used or infiltrate in the soil, where it replenishes the ground water. The most important small-scale energy technologies will be based on solar energy, local biomass production, heat-pumps and geothermal energy, depending of the specific situation. This will result in a sparsely lighted area and, for the Netherlands, extremely clear skies. Additional supplies are taken away from (super)markets close by. The autarkic inhabitant will use his SATIC (Sustainable All Terrain Individual Car) to go there, driving on hardly maintained dirt roads.

5. Time strategy

The new image for the region as described in the regional vision is a future image. For some people it will be appealing, for others it may be a nightmare. Further study and design is necessary. Explicit bonuses of this new vision and a well-presented illustration of the ideas and their possible image in the future can help to convince people and to create enthusiasm. However, this will not yet lead to a break-through of existing constitutions. Only a gradual pathway is expected to be successful. A step-by-step approach makes it possible to fall back on proven techniques and systems.

The following steps can be distinguished:

1. *Design guidelines & conditions*
   To make the proposals accepted, existing values and qualities need to be absolutely secured. Inhabitants should not be forced to move elsewhere, existing buildings should keep their value and stay in use and well-functioning agricultural areas should maintain their agricultural purpose.

2. *Catalyst structures*
   The first realisation of projects should start as quick as possible, not as a new dogma, but as a series of experiments, which can be studied, assessed and adjusted,. Herewith the showcases will be developed. They will clarify how urban planning with exergy as a driving force will look like and function. Eventually, mistakes can be corrected, improved and realised on a larger scale. The series of experiments are concentrated in certain areas: the catalyst structures, based on the old development lines in the landscape. (FIGURE 6)

3. *Energy and Building Expo 2014*
   In order to create a clear and attainable goal for the future, coinciding with the 400th anniversary of Groningen University and the 50th anniversary of the Gas Union, in Energy Valley in 2014 an Energy & Building Expo will be organised. Designers, energy-technicians, developers and builders from all over the world get the chance to show their best practices. They will be realised and shown in 2014.

4. *The continuation*
   If the way of thinking and the design approach are successful, the process will continue and larger and smaller parts of the regional vision on 2035 will be realised. Thinking in Energy and Space will by then be in the genes of inhabitants and politicians. A breakthrough is not a goal anymore but a fact.

Conclusion

The first results show that designing based on a new paradigm may lead to big changes. It resulted in a first and rough re-design of the Northern Netherlands, in which the relation between Energy and Space is explored, a tender relationship with opportunities to be yielded. Further extension of the relationship can meet the expectations through design at different levels of scale. A time of hard work lies ahead of us.

In 10 years time, king William IV will open the first hole in the protective seawall, and with one motion he will stop the first drain pump working. Slowly the salt and fresh water will flow into Energy Valley. No wild currents but a secure and controlled action. The Northern Netherlands will be safe and understands that it is possible to control the threats of the water by cooperating with it. This proves that in Energy Valley people can cope with climate change and supply their own needs. Management of energy and water can be done excellently on a regional scale.

The Regional Design team consisted of: Kees Stegenga, Eric Luiten, Henk Moll, Ina Molenaar, Sebastian Moffat, Andy van den Dobbelsteen, and Rob Roggema.

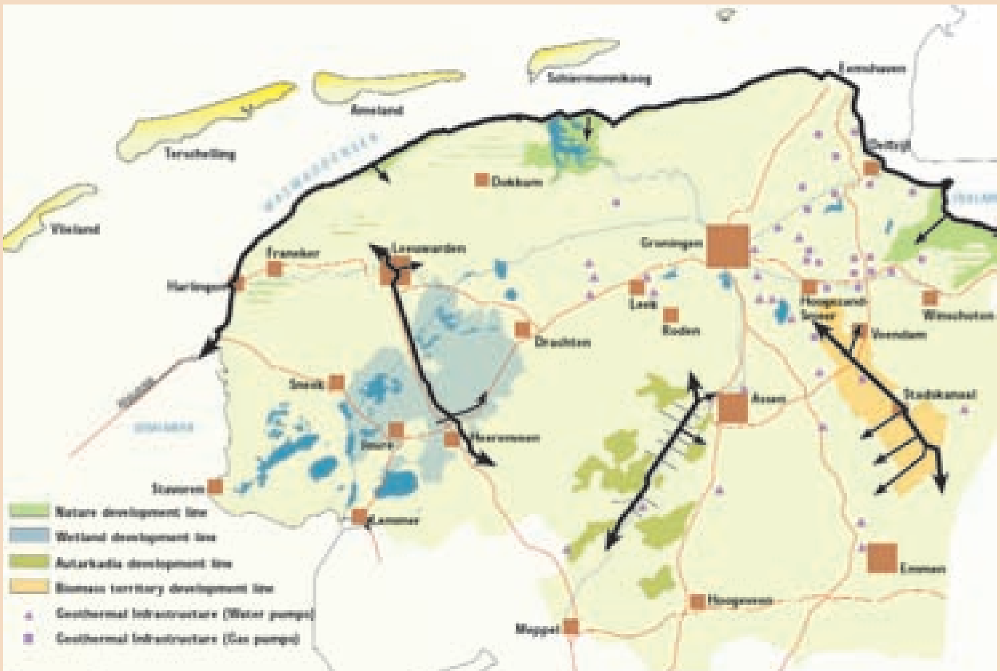

FIGURE 6 CATALYST STRUCTURES

Design Meerstad: Visible Energy

Byong Wook Min, Asier Larretxea

Introduction

Existing Plan and Condition

(FIGURE 1) Before we started the charrette a Masterplan of Meerstad project was already available. The Meerstad project includes the development of a large lake. Around the lake housing areas with different densities will be developed as well as recreational areas. Furthermore, the plans include nature development and agricultural activity.

Constraints and Opportunities (issues)

Constraints	Potentials
• The main structure of the area is already fixed. In case, it is necessary to work not in the hardware, but in the software. • The circulation system is fixed.	• Previous study on energy (waste heat from the gas extraction, earth warm, water warm collector, CHP, etc.). • Diversity makes the area rich in possibilities. • Almost 15 years of development, program.

Conclusions of the analysis

- As mentioned, the structure of the study area is quite fixed. Therefore the "effort" of this study should focus on the interconnections between the various 'elements' of Meerstad (housing, recreation, nature, mobility etc.).

- The variety of the different areas creates new opportunities, not only for living quality, but also for new energy systems.

- Because the development of the area follows different stages, the implementation of the technologies could also follow different stages, learning from the previous practices.

Concept and Extra Program Development

Concepts

Relationship with Groningen

(FIGURE 2) The symbiosis between the city of Groningen and Meerstad can create a system full of opportunities to reduce the energy consumption and to introduce renewable energy sources.
• Groningen giving history and tradition, Meerstad giving aliveness and new experiences
• Groningen giving knowledge and experience, Meerstad giving a playground for experimenting
• Groningen giving city feeling, Meerstad giving open and recreational space

Energy Responsive Life Style

The combination between the idea of living environment as a crucial part of human well being, and the use of the locally produced energy creates a strong physical relationship with the physical surroundings and becomes the base for a "Energy responsive life style". (FIGURE 3)

FIGURE 1 EXISITING PLAN

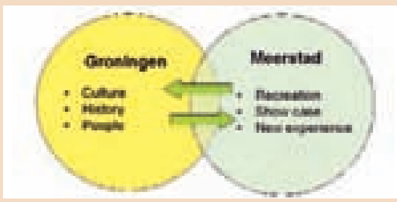

FIGURE 2

FIGURE 3 AN ENERGY RESPONSIVE LIFE STYLE

Energy Theme Park City

The spatial (Master)plan already exists. This sets high demands for the design. We made the choice to develop a route, inspired by the energy theme. The main route and its crucial points offer 'spatial experience' . (FIGURE 4)
The route is marked by different renewable energy sources that can be applied in Meerstad. These are water, fire, wind, ground, plant, solar, and human's spirit*. We adopted these elements as the central theme of this plan. Therefore, Meerstad can be seen as a theme park on renewable energy sources, offering its inhabitants a collective experience. This experiential route is composed of 7 spots on the main circulation road. (FIGURE 5)

New Spatial Program (FIGURE 6)

no	program	content
1	Living in the forest:	Green houses for biomass and
	Forest housing	heat production
		Houses attached to forest
2	Living on the water:	Self rotating houses for sun orientation
	Rotating houses	Place for aqua culture
3	Children park	Small amusement place for children
		Active experience of energy
4	Exploring through the Islands	Linking the loop of the circulation of Wind
		Energy production and public
		experience
5	Living with fire:	Using waste heat from the gas plant
	Dense living area	Using geothermal after exhaustion
		of the gas
6	Generating Ferris wheel	Landmark
		Generating and amusement

Design Examples

1. Living in the Forest

This is supposed to be the first area when visitors take the route we have set. This area is marked with low density housing within a natural forest. We thought that this housing should take advantage of being in the forest by making use of renewable energy produced by the forest. (FIGURE 7)

The biomass produced can be applied in various ways but it became clear that the amount of wood produced in the forest would only limited contribute to the energy demand of the inhabitants. An option to tackle this problem is to create a rather extreme environment that can help trees to grow very fast by building greenhouses in the forest. In the Greenhouses the growing conditions for the trees can be optimized. We also expected the group of the glasshouses to create an identifiable image for this region. (FIGURE 8]

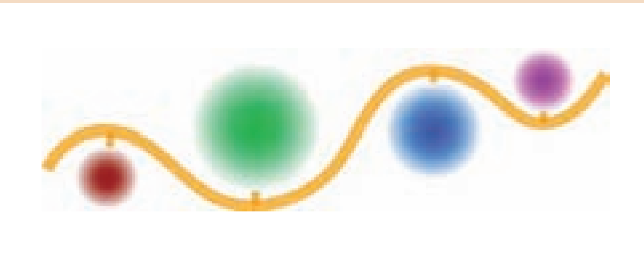

FIGURE 4 A MAIN ROUTE MARKED BY CRUCIAL POINTS

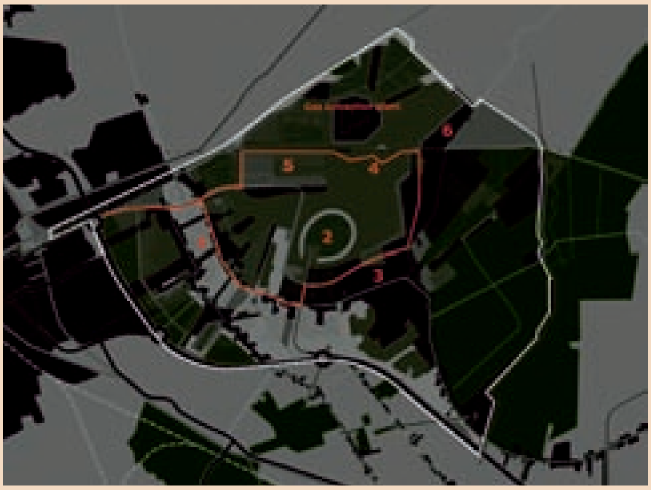

FIGURE 5 THE THEME ROUTE

FIGURE 6 THE BASE PROGRAM

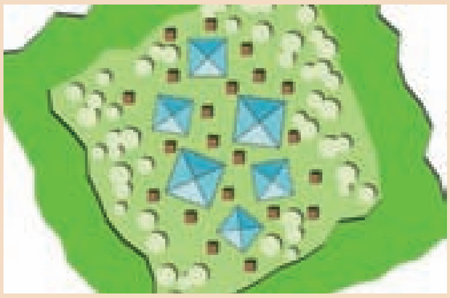

FIGURE 7 LIVING IN THE FOREST

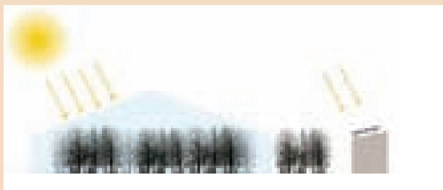

FIGURE 8 GROWING TREES IN THE GREENHOUSE

2. Living on the water: rotating houses

(FIGURE 9) This place demonstrates the energy potential of sunlight and water. There is an island in the existing plan in the middle of the site. We decided to locate an experimental housing pattern using passive and active solar energy. Taking advantage of being near the water, we found that we could introduce floating houses so that the houses would be able to rotate on the water surface making optimal use of the sun. We are also thinking of having an aqua culture program. (FIGURE 10)

3. Children Park

Meerstad has already plenty of recreational places. We want to include a playing ground centered around the energy theme. We think of an image of human's spirit: liveliness created by children. We maximize the interaction between people and energy or nature using earth work with tools and facilities so that children can experience the sense of energy.
For example, children can play in cascade which generates a "small" amount of electricity using water power or we can also think of a playing facility considering wind power as well. (FIGURE 11)

4. Exploring though the Islands of Wind

(FIGURE 12) In the lake we build a bridge, connecting islands with windmills. These windmills will generate electricity and act also as symbolic images of renewable energy. (FIGURE 13)

FIGURE 9 ROTATING HOUSE

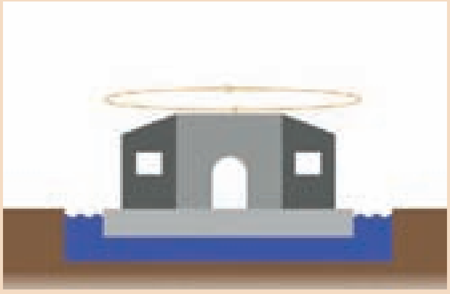

FIGURE 10

FIGURE 11

FIGURE 12 WINDMILLS

FIGURE 13 WINDMILL ISLANDS

5. Living with Fire

This is supposed to be the area with the highest dwelling density. The area is located near the gas extraction plant. For heating purposes we can take advantage of using the waste heat from the plant. Since the efficiency of using the low temperature heat declines drastically when the distance from the plant increases we located the high density housing area with a range of 2 km of the site. The distance to the city was a leading principle in our design. We developed a special street with various energy efficient buildings having an experimental image. (FIGURE 14)

6. Generating Ferris Wheel

In the very beginning of this project, we thought there should be a very impressive, somehow exaggerating, representative image in Meerstad to show the leading energy design principles to the visitors: we called this the "Wow effect". We started thinking of a huge object which also would have meaning and a function from an energy perspective. We finally decided to develop a Ferris wheel of 99.5m height. By combining a huge wind mill and a Ferris wheel, this image should function as an electricity generator as well as an amusement facility. We expect this will play a main role in creating "Wow effect". (FIGURE 15)

Conclusions

- Aiming at maximizing the energy potential of the area we focused on several solutions at different scales, taking into account the interconnections between these solutions.
- Various renewable energy sources are used in different and creative ways. We also tried to bridge the use of natural gas and renewable sources.
- The theme park creates the perfect situation for demonstrating catalyst projects and to become a place for understanding the significant role of energy in our society.

In Meerstad we created a variety of energy living places in which, not only the inhabitants, but also the visitors can learn and feel how energy has become (and will stay) an important part of our society.

[*] See the chapter on Scanning the Futures

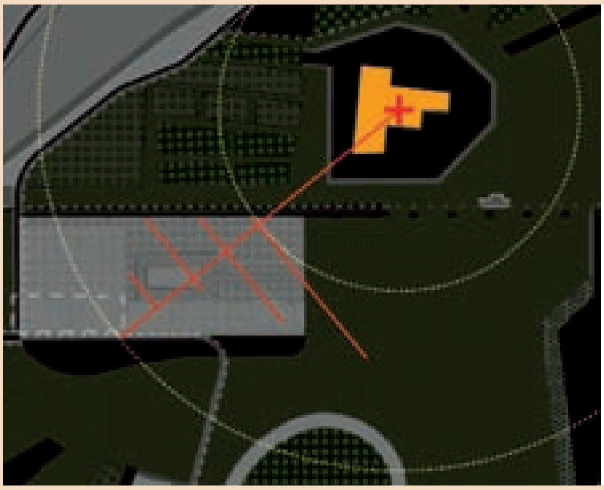

FIGURE 14 SHORT DISTANCES TO THE GAS EXTRACTION PLANT

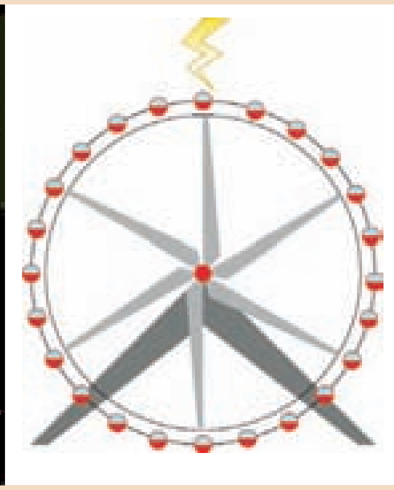

FIGURE 15 THE FERRIS WHEEL

Energy Plantage, Leeuwarden: Look and Feel

Shady Attia, Daniel Huffschmid

Team members: Ling Zheng, Shady Attia, Daniel Huffschmid, Bertus de Jong, René Benders, Richard Jungman

Introduction

With over 85.000 inhabitants Leeuwarden is the urban centre of the province of Fryslân.
The new residential area "De Plantage" is part of the development of "de Zuidlanden", situated south of Leeuwarden. This large urban project (in total 6500 houses will be build) seeks to attract young families from the rural surrounding by offering a high quality suburban living area. The main objective of "De Plantage" design, as one of the Pilots projects in the charrette of Grounds for Change, is to virtually develop a spatial image of "De Plantage" being an example of sustainable urban design, meeting the ambitions and needs of the city and the region of tomorrow. (FIGURE 1)

De Plantage: an energy neutral design

In the 'Plantage' about 2500 houses will be built. In our calculations for energy neutral 'Plantage' we assumed that here will be built 2490 houses: 500 detached, 500 duplex houses, 1250 terraced (5 in a row) houses and 240 apartments (3 levels).
Most of the calculations were made by means of a computer model MERLiN[1.]
We divided the energy demand into energy needed for space heating, hot water and electricity. The energy neutral supply for these three demands is worked out below.
Space heating: According the trias energetica (reduction, renewable energy, efficient fossil) we started with reducing the energy demand for space heating by designing the construction of this district as optimal as possible. All houses were south orientated so making optimal use of passive solar energy and also giving the best opportunity for active solar energy. Second the insulation was brought on a high level. To further reduce the energy used for space heating all houses were equipped with a high efficient ventilation heat exchanger. For heat supply a low temperature heat network will be build. The heat is derived from an asphalt heat collector system with seasonal storage in the underground (aquifer). The houses will be equipped with low temperature heat exchangers (floor heating)

FIGURE 1 DE ZUIDLANDEN

Hot water: For the hot water supply 4 square meters of solar boiler in combination with a small heating system (heat pump) to bring the temperature to the necessary temperature if needed was installed.
Electricity: To reduce the electricity demand hot fill connections were installed. So the hot water needed for the washing machine and the dishwasher could be supplied by the solar boiler. At the level of individual houses 4 square meters of solar PV panels are installed on every house. These panels generate about 380 kWh which is a little more than 13% of the total electricity demand[2]. The rest of the electricity needed is produced in the district area by means of wind mills and by the production of processing the biomass in a biogas reactor in combination with a gas motor for the electricity production or by directly burning the biomass to produce electricity in a conventional small scale power station.
The overall results are presented in table 1.

Table 1: Overall results of the energy supply-demand in the 'Plantage' district

	Demand	Production
Electricity (GWh)	8.6[3]	9.4
Space Heating (TJ)	29	75
Hot water (TJ)	25	32

(FIGURE 2 AND FIGURE 3)

Meeting the energy demand

As a result of the discussions and the estimates on the energy demand of the Plantage it was concluded that 10 windmills ranging in height from 35 to 70 meter should be included in the plan. In the design we took into account noise contours of 350 meters, taking in consideration that the noise level of one windmill exceeds 100 dB. In the line positioning we used a repetition model of 5 times the height of the windmills. From the total available are of 224 ha. about 50% should be planted with willows, rape seeds, poplars and other plants to produce material for electricity generation. Furthermore, in addition to the locally produced organic waste, biomass could be collected at a region scale and processes in a biogas reactor for producing electricity. (FIGURE 4)

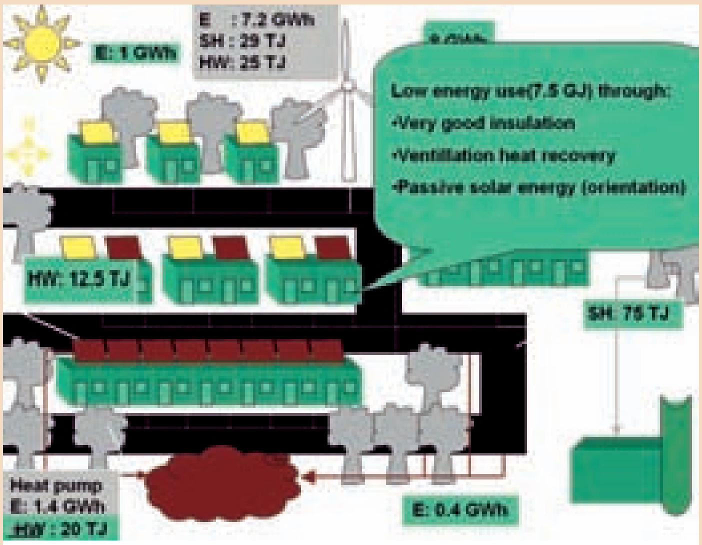

FIGURE 2 THE ENERGY DESIGN


FIGURE 3 BASE COMPONENTS OF THE DESIGN


FIGURE 4


FIGURE 5 A

Concept of a spatial image

Achieving low energy demand patterns were at the base of the design. Not only a lot of attention was given to insulation measures, bringing down the average heat demand per household to a level of about 250 m^3 . Also an asphalt heat collector was introduced. Rows of trees are protecting the residential district from the prevailing winds. (FIGURE 5 A AND B)

Also attention was given to the noise levels caused by the railway and windmills. By planning the 10 windmills along the edge of the plan parallel to the railway a 'noise wave' will be created. Both the noise levels of the train and the windmills ill be visualized in a biomass production field. A tree belt will shape these production fields.

This new spatial layout is reflecting the old parcelling of the clay soil polder which was structured by dikes. The Windmills function as focal design elements. Each windmill will crown a land parcel. The infrastructure of the new urban area will be oriented to the west-east direction. The area with too high noise level from windmills will be used as biomass field. Under the slogan "Look and Feel" the new energetic design approach is at the base of the new urban district. The new schemes should make the people aware of the energy in their neighborhood. (FIGURE 6)

The energy based scheme will create a special identity for "The Energy Plantage". The Energy Plantage is a new place that respects the existing culture and introduces a new futuristic vision on sustainable design strategies from an energy perspective. (FIGURE 7 AND FIGURE 8)

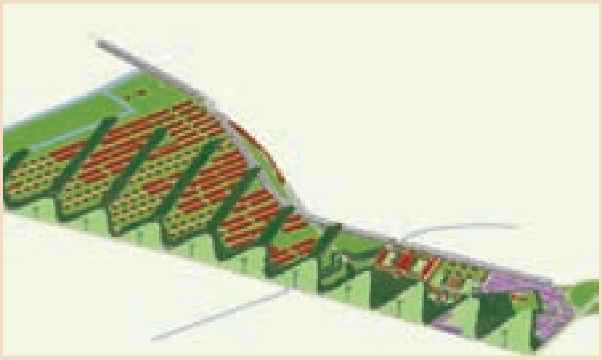

FIGURE 5B

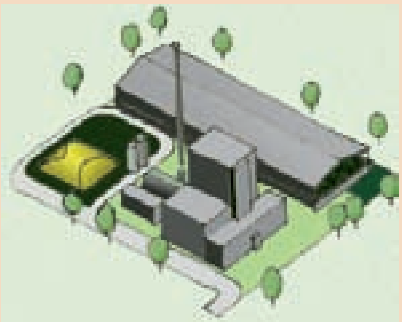

FIGURE 6 FOCAL DESIGN ELEMENTS IN THE DESIGN

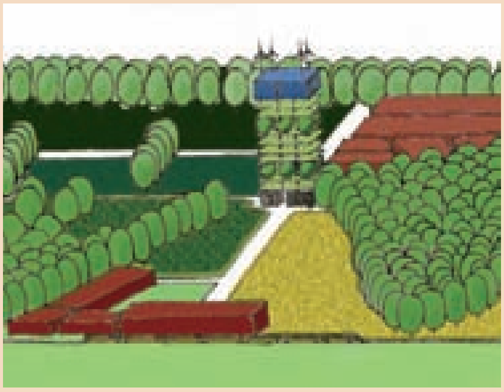

FIGURE 7 PERSPECTIVE FROM THE TRAIN

FIGURE 8 A BIOMASS FIELD

A Design alternative: Energy3

Concept
"Energy cubed" refers to taking into account three "dimensions" when searching for option to design a sustainable energy system: the (deep) underground (i.e. underground thermal energy storage), the earth surface (i.e. biomass production) and the sky (i.e. collecting solar energy).

Local Identity
According to our main idea of the low energy district, this spirit is visible and can be felt everywhere.

Urban Context
The strict pattern dictated by the existing polder landscape in the north of the area flows out in more organic shapes in the south. Here we see the transition to the "lommerrijk" (Forest area with changes in sun and shade). The so called "kanaal-zone" (Canal Zone) in the north will be integrated to the area in the South though interfering biomass fields. Sporting fields are relocated outside the area. (FIGURE 9A AND 9B)

Spatial layout
Starting point for the spatial layout is the existing polder landscape with its linear dikes in the north. The housing scheme is oriented along those lines as continuity of the cultural heritage. By doing this, it ensures integration with the surroundings. Furthermore, the former road that crosses the area will be transformed into a foot and cycle path.
A second recreational axis continues from the river in the south of the area. Along this river, there are open spaces offering resting places along the new recreational route.
Spatial Image (FIGURE 10)

[1] MERLiN stands for Modelling Energy Resources Limitation in Neighbourhoods (Benders, R.M.J., P. de Jong, H.C. Moll, A. Meijer, R. Eenkhoorn, K.J. Noorman (2004). *Perspectief op een optimale en duurzame energie-infrastructuur op een decentraal niveau*).

[2] Assumption: average electricity demand = 3250 kWh, reduction by hot fill appliances = 340 kWh.

[3] 7.2 GWh 'normal' electricity demand + 1.4 GWh for the heat pumps to produce hot water

FIGURE 9A POLDER PATTERN

FIGURE 9B ATMOSPHERE IMAGE

Grounds for Change

FIGURE 10 ENERGY³

Design Assen

Design group: Liesbeth Nix, Age van der Mei, Moritz Bellers, Nguyen truon Phuc

Assen 2035: City of *Sustainable Transportation and Innovative Working Environments*

The goal of the case study Assen was *to develop the southern part of Assen in such a way, that it can be used to demonstrate how sustainable energy can be integrated in new spatial developments*. The southern part of Assen is the home of the TT-area, where the famous annual TT-motor races take place that attract thousands of people every year. It is a big event, considering the fact that Assen currently has a population of less than 70.000. But Assen has more typical characteristics than just the TT-races: it is a quiet, green and bicycle-friendly city, with hardly any high buildings and a high quality of life. The population is expected to increase to 80.000 in the next thirty years and the infrastructure will change as the N33, the connection from Assen to Veendam, becomes a highway. As the city will continue to develop in the coming years, it makes sense that the municipality of Assen also wants to develop the Southern region.

When we started to look at ways to develop the Southern part of Assen, we soon discovered that it was impossible to see the development of this part of Assen independently from the entire city of Assen. A design for the Southern part could only be sustainable, if it took into account the development of Assen as a whole as well, especially because Assen has major plans and is rapidly developing. So we decided to develop the Southern part in relation with a sustainable development for Assen in general. (FIGURE 1 AND FIGURE 2)

Assen is changing and expanding, and it has roughly spoken two ways to develop. The first way is by expanding to the outside: new living areas will then be built on the other side of the highway whereby the area of Assen will increase. This is a logical way of growing, considering the development of the last century. There is enough space outside Assen and there is no reason not to expand the city. It is interesting to realise though that this (historical) way of developing is a result of the *fossil fuel driven economy*: the entire system of highways and the rapidly expanding to the outside of the city started in the

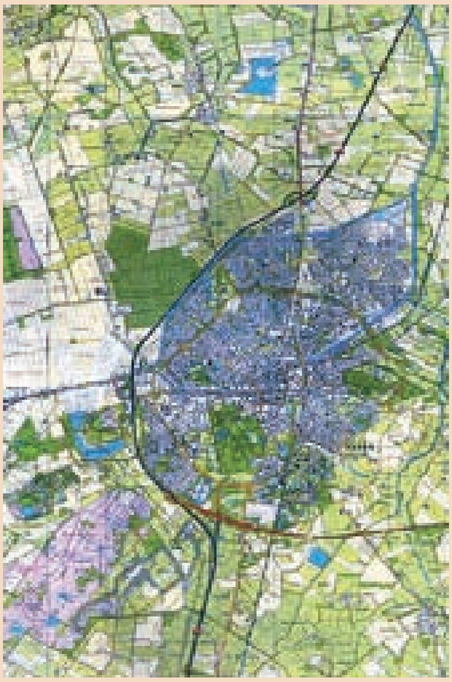

FIGURE 1 ASSEN CITY

FIGURE 2 SOUTH OF ASSEN

FIGURE 3 ASSEN PRESENT SITUATION

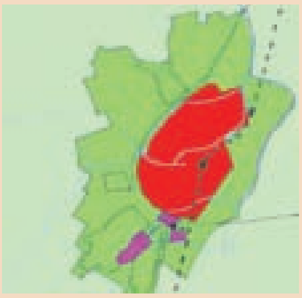

FIGURE 4 ASSEN 2035, 'GREEN FINGER' CITY

FIGURE 5 ASSEN 2035, 'GREENBELT' CITY

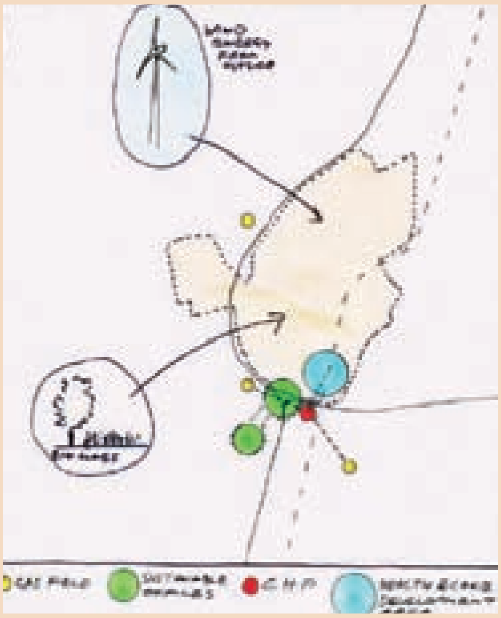

FIGURE 6 GENERAL ENERGY OPTIONS

FIGURE 7A TRANSPORTATION

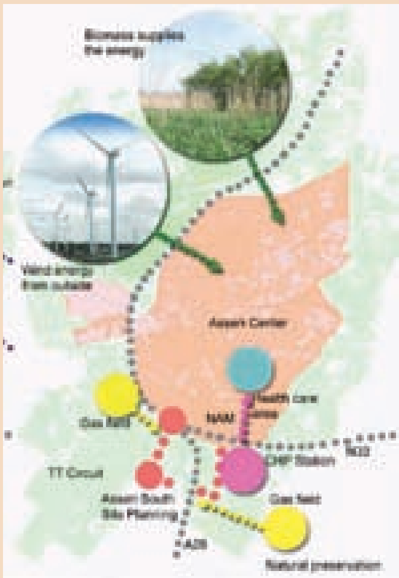

FIGURE 7B ENERGY

beginning of the 20th century and is based on the availability of cheap petrol. As we eventually will run out of (cheap) fossil fuels, this is probably not the most sustainable way for Assen to develop in the long run. If Assen continues to develop only to the outside, the compactness of the city may be lost and the city will become less bicycle-friendly. In addition, the strong relationship with the countryside may weaken because the land is slowly taken over. If the growth continues, Assen has the risk of 'falling apart' into smaller pieces with less cohesion. (FIGURE 3, FIGURE 4 AND FIGURE 5)

To maintain the strong characteristics of Assen (compactness, green, bicycle-friendly, strong relationship with the countryside) , it can also chose to develop by 'expanding to the inside': new living areas can be built *inside* the current borders of Assen. The compactness of the city will then increase, the city can remain bicycle-friendly and keep its strong relationship with the countryside. The area around Assen can remain partly green, and compact expanding of the city can easily be combined with strong development of public transport.. Especially in the long run, when the dominance of fossil fuels and the corresponding ways of transportation will diminish, this might prove to be a far more sustainable way to develop.

Assuming Assen will indeed focus on its strong characteristics and on both compact and 'inward' development, we could start designing the Southern area in a sustainable way as well. The most important qualities of Assen and especially the southern area were hereby taken as a starting point:

- The unique quality of life: Assen as a green and bicycle-friendly city, with a strong relationship with the countryside;
- The development of a multimodal transport area; the junction A28/N33/Assen south will be transformed in combination with upgrading of the N33 as a 4-track highway and a new railway station;
- The clear identity of Assen as TT track area;
- The presence of the headquarters of NAM (Dutch oil company) and the health area with hospital;
- The presence of some gas wells that cannot be economically exploited at the moment.
  (FIGURE 6 AND FIGURE 7A AND B)

Two main aspects were then taken as the key points of the sustainable development of Assen: *energy* and *transportation/mobility*. Sustainable energy is necessary for sustainable development, and Assen has some opportunities with the gas wells. At the moment it is not economically feasible to exploit these wells, but when energy prices rise even further and the gas only needs to be transported over a short distance, this can change. The gas can then be used in a small scale electricity plant (Combined Heat Power station, CHP) in the Southern part of Assen as a *transition fuel*: the plant can *start* on the gas from the wells and slowly switch to *biomass*. The NAM can use its expertise with gas and expand their skills. The heat of the plant can be used for the heating of houses, the hospital and NAM buildings. So for the design of the Southern part of Assen, a small scale natural gas/biomass power plant is the key element of the energy system. A sustainable energy system can be expanded by making use of wind and solar energy and by making buildings as efficient as possible in their energy use.

The second key aspect, *transportation*, is also a major part of sustainable development. Assen in general has great possibilities to become a symbol for sustainable and futuristic transportation and mobility: it is a green, compact and bicycle-friendly city, which can be used to promote sustainable transportation that is *not* focused on fossil fuels. In addition, Assen is already famous for the TT-races, which are all about mobility. Of course, the TT-races are far from sustainable at the moment, but the area can be developed as THE place for modern, fancy *and* sustainable ways of transportation, making use of the reputation it already has. For example, the area can be used for various races and events that focus on different types of mobility and sustainable transport. It is also possible to use the area for a permanent exhibition of various kinds of vehicles and modes of transportation, and combine this with the already present Traffic Park in the Southern part. That way, the area can develop as a place where people can have fun, can become enthusiastic about future modes of transportation and can learn about the history of transportation and the need for sustainability. The new station will create possibility's for the TT-circuit and area to develop into a location for big national events. To make the concept of sustainability even clearer, the development of the area should also focus on making sustainability *visible* for the people. A restaurant on the TT-area for example (which will inevitably be build if the area is indeed going to be used on a more permanent and more regular basis) can use solar energy and green houses for energy and food supply. That way, people can really *experience* the concept of sustainability: the energy, the food and the transportation.

To make this all economically even more attractive, the Southern area can be developed as a sustainable working environment, with recreation, energy related research and flexible working environments. Therefore new offices and conference places, that are energy-efficient and suitable for flexible working, can be built east of the TT-area. They can use the electricity from the small-scale energy plant and be connected to the new developed TT-area.

So the key words for the development of the Southern part of Assen are sustainable energy, sustainable transportation and flexible working environments. By focusing on a combination of recreation, education, events, knowledge centres and flexible working places, the economy can be stimulated. To make sure that the Southern part of Assen remains connected to the centre, an ecological structure and infrastructure were developed. As transportation already was a key point, we decided to design a major 'transportation hub' for Assen. The general idea hereby was that the centre of Assen as well as the Southern part of Assen can be easily reached by making use of various sustainable, innovative ways of transportation. The hub can be the centre of an attractive mobility system and be the symbol of the new identity of Assen as a city of sustainable transportation. The transportation hub should therefore also be really visible as such, and therefore some high landmarks were designed. This resulted in a futuristic design of a transportation hub where people can switch from mode of transportation. (FIGURE 8 AND FIGURE 9)

This mobility network was then expanded with an ecological network: two plantation structures were designed as green corridors that connect the Southern part with the centre of Assen. The canal network can be enlarged and added to the transportation network. Altogether, this results in a highly mobile, green and sustainable system. The various figures illustrate the designs for the networks, the transportation hub and the sustainable energy system. (FIGURE 10)

Summarised the design for Assen focused on *using renewable energy and innovative transport solutions*, making Assen a centre for knowledge intensive facilities, recreation and flexible working environments. A *strong interconnection between urban, rural and natural areas* provides a *special and high quality of life* for the people, making full use of the already exisiting strength of Assen. Assen 2035: A green and compact city, focused on multifunctional working and living spaces where people are highly mobile and can enjoy living in. (FIGURE 11)

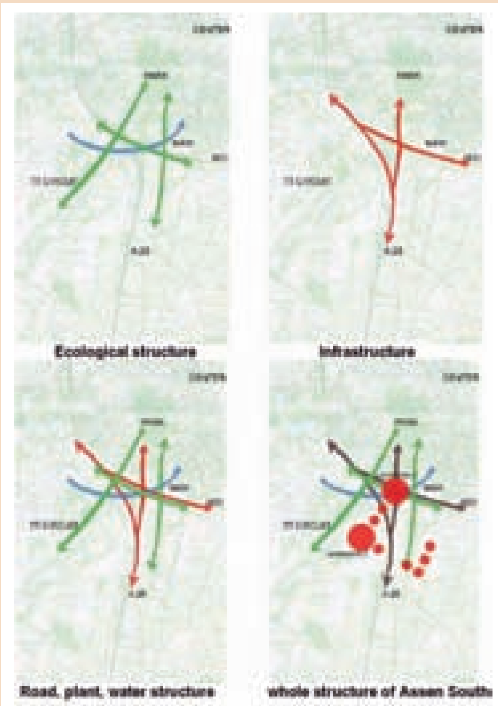

FIGURE 8 COMBINING ECOLOGICAL STRUCTURES, INFRASTRUCTURE AND WATER IN THE MAIN DESIGN STRUCTURE

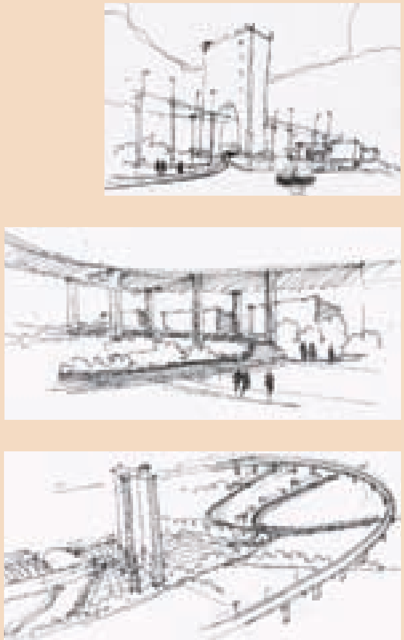

FIGURE 10 SOME IMAGES OF POSSIBLE FUTURES

FIGURE 9 IMPRESSION OF THE SOUTHERN REGION AND THE WATERWAY

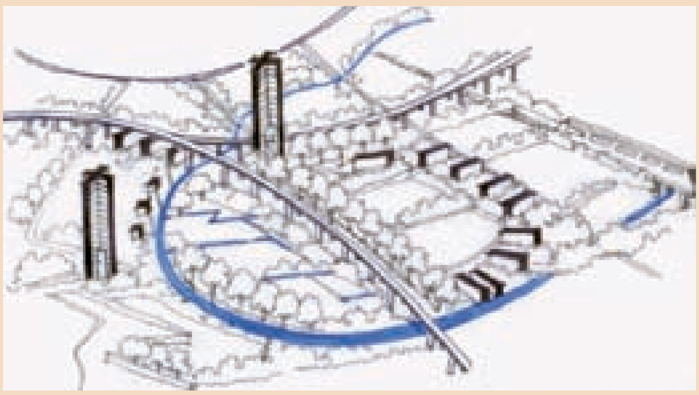

FIGURE 11 AN OVERVIEW OF ASSEN

Design Emmen

Evi Georgiou, Alexander Stark

Introduction- the challenge

The city of Emmen has high ambitions when it comes to concrete implementation of local energy and climate policy. As a significant proportion of the municipality's total area is rural, the design question of Emmen focussed on the rural area. As part of its energy policy Emmen investigates various options to increase the share of bio energy in the energy supply system. Therefore, focus on the rural area as an important potential producer of biomass that can be converted in various renewable energy carriers, is extemely relevant. Other considerations that underlie the interest in the rural area are the expected changes in the agricultural activities during this decade and its atractiveness for recreation purposes.

The cities aim to contribute to a sustainable energy system in such a way that this would also contribute to the attractiveness of the landscape while keeping open new possible options for agricultural activity in the region were at the heart of this design.

The municipality of Emmen asked us to create a new, interesting landscape by considering alternative solutions for the potential use of the rural area. The municipality also requested 50% reduction in the CO2 emission by the year 2035, through the introduction of energy crops in the area.

The vision for the city

The autarkic city: The main idea is to create a new identity for Emmen, the main capital of the South Eastern part of Drenthe, by turning its decentralized position into its main privilege. Our vision is to turn it into an autarkic city both in terms of energy as well as food production. (FIGURE 1 AND FIGURE 2)

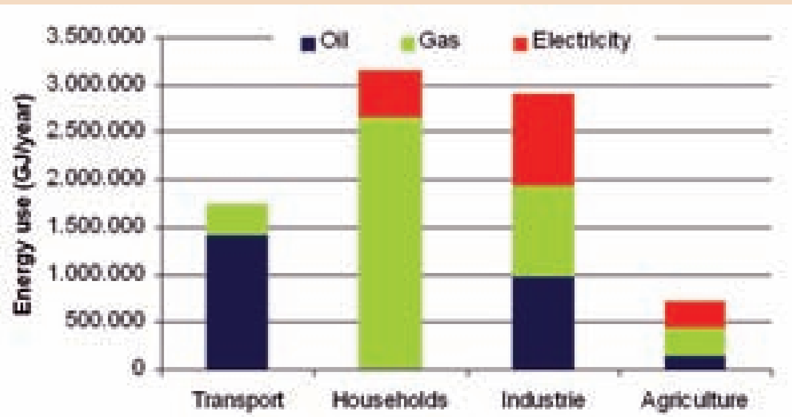

FIGURE 1 THE ESTIMATED PRESENT ENERGY USE OF EMMEN

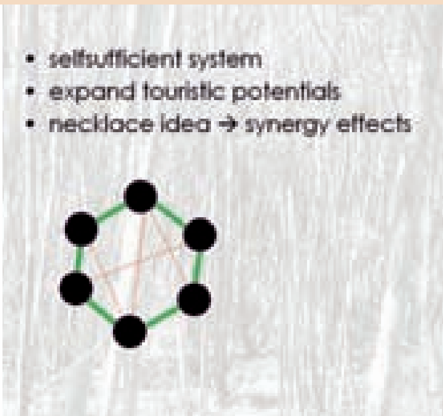

FIGURE 2 A NEW IDENTITY FOR EMMEN

The agricultural land will be used both for the production of food and energy crops. Food is either produced in the fields or in the greenhouses, whereas the energy crops create a dynamic environment which changes in seasons. (FIGURE 3, 4 AND 5)

The touristic city: The magnificent animal park of Emmen, right at the heart of the city, attracts almost two million visitors every year. The municipality is planning on expanding the park, a thought which became a source of inspiration for our vision. Based on the city's autarkic status, Emmen's touristic activity could be expanded from a single day trip to a few days trip in summer. A new type of alternative tourism is rising in the city, where the elements of the landscape embrace the visitors to make them feel part of the natural environment.

At the same time tourism creates job opportunities for the city, where the current unemployment rate reaches 15%. Tourism, in combination with new seasonal happenings, offer a new aroma to the city.

The design concept

The idea is to expand the touristic activity by introducing two closed loops which refer to different seasons. The loops are based on the already existing points of touristic attraction but their character is dynamic, as new parts can be added to them. The structure of the two loops is similar to that of a necklace, with the points of attraction represented by the "perles" which are bonded together by the "lace", the energy crops between them. (FIGURE 6)

The 1st loop (small one) refers to the day trip bike excursions all year through. The 2nd one includes the small loop as well as another part which refers to the seasonal tourism. There, visitors can take a stop for a weekend or longer to enjoy the summer happenings and gain contact with nature. The trip happens with low or no energy demand vehicles which are CO_2 neutral, such as bicycles or special buses, based on bio-fuels.

FIGURE 3 DIFFERENCES IN LAND USE

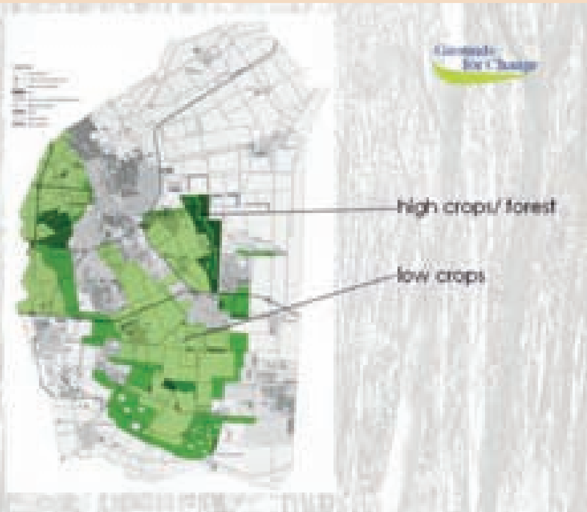

FIGURE 5 DIFFERENCES IN LAND USE

FIGURE 4 DIFFERENCES IN LAND USE

FIGURE 6 THE MASTERPLAN

The route

The hunebedden: In the forest, near the city, one can enjoy the megalithic monuments of the Neolithic era.

Emmen's expansion to the west: The new houses can be integrated in between the energy crops and forests, a showcase of living in a changing environment.

The lake: swimming and water sports can combine the educational purposes of the tour with recreation during summer.

The Zoo: The greatest attraction of the city is its magnificent park, which the municipality is planning on expanding in the future. New parts are going to be added to the south, spread in-between the energy crops.

The energy crops: They form the connecting link in between the "perles" of the "necklace".

The wind park: Half way of the loop, the wind park will serve as a landmark for the visitors to orientate themselves in the landscape.

The peat reserve: A unique natural area which attracts a lot of bird species.

The greenhouses: Here the visitors can learn how food production is made. The greenhouses store the surplus of heat during summer in the aquifers to use it during winter. In that way they are self sufficient in terms of heat production.

The peat museum: The visitors can learn about the peat soils and their use in time.

The biomass powerplant: In the industrial area of Emmen there is an already existing biofuel factory and a wood incinerator which are going to be reused for bioenergy production.

The energy crops- the festival area- the autarkic living

The energy crops form a connecting link between the different points of touristic attraction. They form either corridors, reassuring the visitors that they are on the right track, or rooms which host events and invite people to interact with them. The crops have a dynamic character as their height and texture changes in time, creating sometimes open landscapes and other closed views. (FIGURE 7)

During the summer season part of the energy crops will be used for recreational purposes such as festivals (the already existing peat art festival, a new music festival etc.) and games. The crops, which will be very high in summer season, will form "the walls" between the different rooms of the festival. The transition from one room to the other will have a playful, labyrinth character, with the visitors experiencing the absolute interaction with the landscape.

Next to the "festival area" a modern camping idea is rising in Emmen: Wooden or peat "autarkic" (in terms of energy) seasonal houses in-between the energy crops form a new idea for alternative tourism, based on restoring the relationship between people and nature.

In the end of the summer events, the visitors will be invited to participate in the harvest. Competitions, games and similar happenings will motivate the guests, as well as the locals, to contribute to the harvesting process by enjoying themselves and improving their physical condition.

FIGURE 7 THE PEAT ART FESTIVAL

Energy flows- the situation in 2035

In our energy perspective a 40% reduction of the energy demand should be arrived in 2035. Among other things, that could be achieved by reducing domestic energy demand through retrofitting the existing housing stock and building high quality houses that offer the households a broad range of opportunities to significantly reduce their energy demand, both for heating purposes as their demand for electricity. New technologies available for households will help consumers to adopt 'low energy demand lifestyles'. Furthermore, we assumed that about half of the total energy demand should be met by renewable energy sources. (FIGURE 8)
Biomass will produce heat for the households as well as electricity for the households and the industries. On the other hand, organic residues of the fields, the animal park, the greenhouses, the autarkic houses (in summer), the city and the industrial area will be transferred to the powerplant so as to be turned to bioenergy. (FIGURE 9)

Solar energy will provide the greenhouses with heat during summer, the surplus of which will be stored in the aquifers for winter. That way the greenhouses will be self sufficient in terms of heat demand.

At last but not least, **wind energy** which will be generated by 18 windmills will provide the industries, the greenhouses and the Zoo with electricity. (FIGURE 10 AND 11)

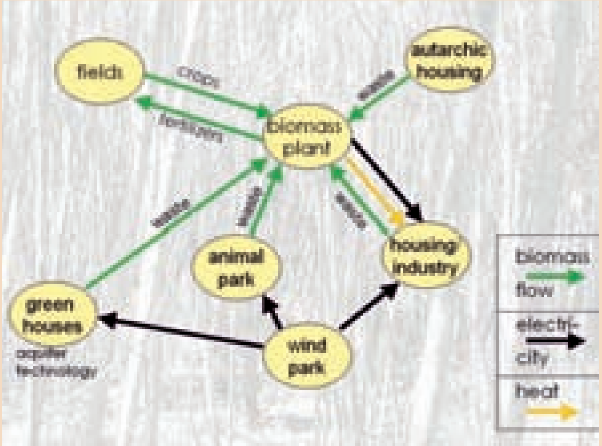

FIGURE 8 THE ENERGY FLOW DIAGRAM

FIGURE 9 DIFFERENT TYPES OF BIOMASS

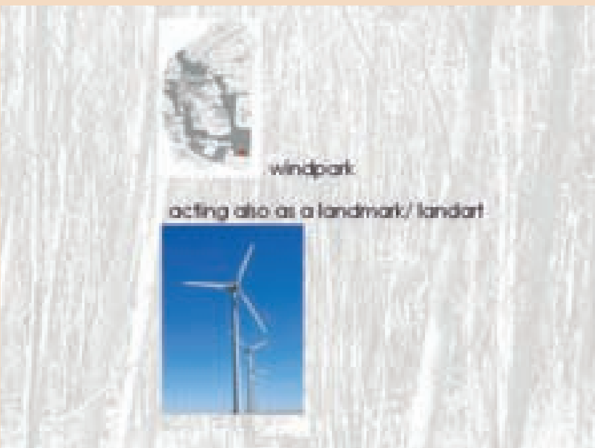

FIGURE 10 WINDMILLS ACT AS LANDMARKS

FIGURE 11 THE PRESENT LANDSCAPE AND THE FUTURE, MULTIFUNCTIONAL LANDSCAPE

Concluding remarks

This report is a 'stepping stone' on the route towards to the 23th World Gas Conference. Many organisations and people made a significant contribution to this charrette. The results are promising: we started the design process and got a first impression on the mutual relationships between future energy systems that are in line with longer term sustainability goals and new spatial demand strategies. Both at the regional level and at local levels we were able to present the first designs. Common features indicate a modular approach of space and energy, where cities offer maximum contact and minimum travel and a flexible and ecological response to the wide variety of needs.
These first designs offer us insights in how to continue the Grounds for Change project. We will proceed from here and will present a least two challenging designs, one at the Energy Valley region level and one at the city level and further on to the level of individual buildings.

Participants Grounds for Change Charrette May 2005

(some part time)

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Mr. W. Boetze	Government Service for Land and Water Management
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Mr. A.P. van Dam	Gas Transport Services
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Mr. P. Doorman	City of Assen
Mr. W. Elbersen	Wageningen University
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Mr. P. Gautier	City of Assen
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Mr. K. de Jong	Province of Drenthe
Mr. R. Jungman	Bureau Van Werven
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Name	Organization
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Mr. A. v.d. Mei	University of Groningen
Mrs. B. Meiberger	Hanzevast
Mr. T. Ming	Tongij University Shanghai
Mr. S. Moffat	Consensus
Mrs. I. Molenaar	Province of Groningen
Mr. H.C. Moll	University of Groningen/IVEM
Mr. P. Nguyen Truong	Wageningen University/ Landscape Centre
Mrs. L. Nix	Technical University Eindhoven
Mr. K.J. Noorman	KNN Milieu BV
Mr. H. Overdiep	Gasunie
Mr. R. van Paasen	Region Assen-Groningen
Mr. K. Pals	Hanzevast
Mr. E. Panman	International Gas Union
Mr. G. Paraskevi	Wageningen University/ Landscape Centre
Mr. P. Ramsak	SenterNovem
Mr. A. Revi	TARU Leading Edge
Mr. R. Roggema	Province of Groningen
Mr. A.J.M. Schoot Uiterkamp	University of Groningen/IVEM
Mrs. B. Schwaiger	European Institute for Energy Research Karlsruhe
Mr. H.P Slot	City of Assen
Mr. A. Stark	Technical University München
Mr. K. Stegenga	Stegenga, werkplaats voor stedenbouw
Mr. W. Timmermans	Wageningen University/ Landscape Centre
Mrs. W. Udding	Province of Groningen
Mr. S. Ulri	Province of Drenthe
Mr. G. Verberg	International Gas Union
Mr. U. Vermeulen	Gasunie
Mr. J. Volkers	Energy Valley
Mr. D. de Vries	Province of Groningen
Mr. J. Waal	Government Service for Land and Water Management
Mr. G. Wiersma	KNN Milieu BV
Mr. J. Wijma	Region Assen-Groningen
Mr. B. Wook Min	Wageningen University/ Landscape Centre
Mr. Z. Xu	Tongij University Shanghai
Mrs. L. Zheng	University of Groningen/IVEM