Spatial Planning and its contribution to climate friendly and sustainable transport solutions

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Contents

Abstract

This paper discusses and further elaborates on the issue of how spatial planning can contribute to the development of climate friendly and sustainable transport solutions. Focus here is placed, primarily, on climate change mitigation – reducing the emission of greenhouse gases – though the economic, social and environmental dimensions of sustainability are also highlighted. In order for spatial planning to properly address a sustainable approach to climate change mitigation, the other dimensions of sustainability, such as climate change adaptation, have also to be addressed. To achieve this, spatial planning, it is argued, has to create synergies between the six different toolkits presented in this paper. An understanding of the three factors of time, space and the nature of the stakeholders involved is also crucial in the search for climate friendly and sustainable transport solutions. The paper introduces a theoretical framework and then presents three cases in the regions of Stockholm, Helsinki and on the island Bornholm. The paper concludes with a discussion of the findings arising from the previous sections.

Preface

In 2009 Iceland has the Chairmanship of the Nordic Council of Ministers, and during this year sustainable transportation is one of the top priorities on the Nordic energy policy agenda.

This paper is part of the Icelandic Chairmanship Programme in the Nordic Council of Ministers. The paper is written by Christian Dymén and Anu Henriksson at Nordregio.

The Icelandic Chairmanship Project on Sustainable Transportation aims to tackle a number of issues in the transition to a more sustainable transport system in the Nordic region. In addition to this paper, a key element of the project is a report entitled "Foresight Analysis: Nordic Strategies for Renewable Transportation", which will depict a future Nordic transport system using 80% renewable energy. Emphasis is also placed on transport in sparsely populated areas in the West Nordic region.

For more information about the project, see the project website at www.nordicenergy.net/transport or consult www.norden2009.is for more information about the Icelandic Chairmanship in the Nordic Council of Ministers.

Helga Bardadottir
Icelandic Ministry of Industry
Chairman of the Nordic Committee of Senior Officials for Energy

Ole Damsgaard
Director of Nordregio

1 Introduction

The aim of this paper is to attempt to better understand how spatial planning can contribute to addressing the impacts of climate change through a reduction in the amount of greenhouse gases (GHG) produced, particularly in relation to transport solutions, in the Nordic countries. The paper places particular emphasis on the climate change aspects of urban development. Discussion is however widened to include a more general sustainability approach with an additional focus on "less urban areas" such as the example from Bornholm.

The paper represents a continuation of the work done in the report Dymén et al. (2009) which discusses the way in which urban development can seek to respond to sustainability questions and to climate change in particular. Dymén et al. (2009) is based on a series of workshops held during 2008 with Nordic experts in climate change, energy, transport, planning and lifestyles. The report identifies six toolkits as being crucial in the response to climate change – particularly as this relates to reductions in GHG-emissions - in urban development. These are (slightly modified) as follows:

1. Spatial planning – governance - of the toolkits outlined below.
2. Changes in attitudes and behaviour
3. Investments which facilitate acting in climate change friendly ways
4. Economic incentives
5. Changes in legislation
6. Physical planning and transport systems

The paper begins by introducing a theoretical framework, highlighting the complexities related to dealing with time, space and stakeholders when planning for reduced GHG emissions, in a wider sustainability approach related to transport systems. In the second part of the paper we introduce three case-study regions in the Nordic countries. These case studies help to illuminate three different ways of working with the challenges of climate change in spatial planning. The cases each have different backgrounds, methods and timescales. But what they all have in common is access to a broad network of actors..

1.1 Spatial planning and Governance

The main toolkit for climate change response in urban development is spatial planning. Spatial planning concerns the creation of strategies which seek to enhance the synergies between the abovementioned toolkits on the local, regional and national levels. It is also about finding ways to prioritise the reduction of greenhouse gas emissions in a wider sustainable development context. One important aspect here is how to create synergies between climate change mitigation and adaptation. Illustrating the challenges but also the opportunities in finding synergies between mitigation and adaptation reveals that spatial planning with its cross-disciplinary, cross-sectoral and multiscalar approaches can positively contribute to climate change response. Before focusing on the issue of climate change, particularly with regard to sustainable transport solutions, it is important to highlight why considering climate change mitigation in a wider context, relating also to adaptation, is important. Creating the compact city (as is argued in the following examples from Helsinki and Stockholm) is often used as an argument to help reduce GHG emissions, specifically, for instance, in relation to the need for greater public transport capacity and the creation and promotion of further opportunities to use transportation means such as walking and cycling. Whether or not it is a good strategy, the relation to the issue of climate change adaptation is crucial. A compact city demands great efforts be made when it comes to climate change emergencies such as flooding and heavy rain. A compact city also implies warmer surfaces which may however become increasingly unusable as global warming continues. Compact cities therefore need well planned green areas (c.f. Oke, 1978). This is simply to highlight the fact that climate change mitigation and other dimensions of sustainability such as climate change adaptation cannot be seen as separate issues. Even though this paper focuses in the main on mitigation, the adaptation issue is addressed, primarily in this first sub-chapter.

The challenge of finding synergies between mitigation and adaptation can be described as the "adaptation-mitigation dichotomy". There are at least three factors that strengthen the dichotomy: Differences in time; differences in space and differences in respect of the stakeholders involved (Biesbroek, 2009). These factors are also relevant when considering toolkits two to six in spatial planning and governance mentioned above. The basic issue here concerns the need to find ways to create synergies between different time and space aspects as well as dealing with different types of stakeholders, when planning for sustainable transport solutions. In the paragraphs below this dichotomy is outlined in brief, illustrating that, in order to incorporate a wider sustainability approach (including economic, social and environmental aspects) when dealing with the reduction of GHG emissions in respect of future

transport solutions, one has to think of the three factors: time, space and differences regarding stakeholders.

The first factor in the "adaptation-mitigation dichotomy" is the recognition that while adaptive measures are short term investments with short term solutions to the impact of climate change, mitigation strategies are long term investments seeking to impact climate results (Goklany, 2007). As such, decision-makers or politicians in urban planning making investment decisions related to climate change mitigation need to deploy long term thinking beyond a particular mandate period. A politician has to act now based on today's knowledge. The results of this action may not however become manifest for perhaps 20 years or more.

Regarding the second factor, adaptation measures derive from local decision making, whereas local mitigation measures derive from national and international policy agreements (Biesbroek, 2009). However, it is interesting that even though one would think that it would be easier to make decisions on the local level in respect of adaptation – given the more concrete local results – mitigating efforts have in the past and remain today much more highly prioritised even on the local level (c.f. Langlais et al. 2007).

The third factor in the "adaptation-mitigation dichotomy" concerns the stakeholders involved. Formulating policy strategies to reduce GHG emissions requires that major contributors from the industrial, transport and fossil fuel power generation sectors among others are involved from the outset. These stakeholders are to a large extent different from those involved in local adaptive strategies where agriculture, water management, nature conservation and development are among the main climate sensitive domains (c.f. Swart & Raes, 2007).

Despite the above-mentioned dichotomies between adaptation and mitigation, spatial planning is well suited to handling the task of utilising a broad approach where each of the various dimensions of sustainability can be incorporated. Biesbroek et al (2009) argue that spatial planning is often seen as a holistic approach, recognising the effects of spatial measures in a long term perspective. Spatial planning coordinates transportation systems, local economy, housing and environmental aspects. It is one of the many tasks of spatial planning to coordinate local preferences and stakeholder initiatives with sectoral policy from the local to the (inter)national level. Furthermore spatial planners are used to working in a cross-disciplinary fashion (Ibid.)

In conclusion, spatial planners are well suited to dealing with climate change issues demanding coordination from the local to the (inter)national level, demanding coordination between a vast array of stakeholders, as well as working within both a short and a long term perspective. In the following sub-chapters toolkits two to six – all necessary in spatial planning to reduce GHG emissions – will be presented. These toolkits focus mainly on climate change mitigation and therefore show the complexity regarding, on the one hand, decision making on the national and international level and concrete action on the local and regional level on the other. The results are necessarily however long term and therefore demand a significant dose of political will. As noted previously, policy makers are increasingly confronted with a civil society which wants to be involved in the process. Dealing with the above-mentioned toolkits in urban development also requires an approach which incorporates citizen participation. Larsen & Gunnarsson (2009) argue that deliberative planning processes create legitimacy, effectiveness and sustainable futures and that questions relating to who takes part in the process are important given that significant behavioural change is expected..

1.2 Changes in attitudes and behaviour

Kanninen (2008) argues that on the one hand our urban structures are becoming more specialised and differentiated, while on the other, we are continually striving for functional integration when it comes to housing, services and business. One of Kanninen's main conclusions is that tools that handle physical planning and urban structures have to be coupled with tools that can influence people's attitudes, lifestyles and behaviour.

Changing people's attitudes and behaviour can be done for instance through *information campaigns*. The following toolkits can also however be applied: *Investments that facilitate acting in climate friendly ways; economic incentives; changes in legislation and changes in the physical structure through strategic planning*. These are all presented in the following sub-chapters.

Information campaigns and other measures that do not restrict people's freedom of choice can be used in the short term. It can however take decades to make people change their behaviour patterns. In other words, information dissemination can be done quite quickly, while the results of changes in lifestyles and behaviour can take time to manifest themselves. Given that the results of diminishing GHG emissions in terms of a better environment/climate are unlikely to manifest themselves for many years - attitudes, lifestyles and behaviour have to be addressed by combining the other toolkits, ranging from action on the local and regional levels to decision-making on the national and international level.

To understand prevailing attitudes and behaviour among citizens it is relevant to highlight, among other things, the gender dimension. In respect of everyday life patterns and behaviour – thereby influencing GHG emissions – several studies show that women's and men's travel patterns and car usage are, for instance, often quite different (e.g. Sandow, 2008; Johnsson-Latham, 2007;

Transek 2006ab; Polk, 1998 and 2003; Krantz, 2000; Carlsson-Kanyama, 1999). Johnsson-Latham (2007) concurs that men in Sweden drive cars more than women and thereby contribute more to the production of CO2 emissions. Moreover, when it comes to attitudes there are several studies highlighting the fact that women are more concerned with environmental issues (e.g. Davidsson and Freudenburg, 1996; Stern et al 1995). Furthermore, from a transport perspective, Polk (2003) emphasises that women's and men's attitudes to car use are different. She argues that women not only use transportation modes that are more environmentaly friendly, but are also prone to express greater concern for the environmental impacts of car use while also showing a greater acceptance of the need to reduce car use.

It is not only gender however that has an impact on attitudes and behaviour. Understanding human movements and stability is also relevant and relates to the spaces of everyday life, namely locations where people live, work, learn, shop and socialise. Understanding these patterns of mobility/stability is crucial to understanding transportation systems for example (Hanson, 2005). It is also significant to underline the fact that people's mobility has increased in time and space due to faster and more accesible transportation systems. This clearly illustrates that behaviour can be influenced, for instance, by development in physical structures.

Remarkable is also Thulin *et al's* (2008) research showing that even though information technology such as mobile phones, computer and the internet have become important complementarities to the car, car usage is nevertheless increasing (Ibid.).

Before discussing how citizen's freedom of choice becomes more restricted through economic incentives, changes in legislation and physical planning it is interesting to highlight the work of Eriksson (2008). She argues that "since travel behaviour is performed in a physical and social context, changes in travel behaviour may be difficult to induce even with a strong individual motivation to reduce car use (Ibid. p 37)". It could be that the possibilities for using public transport are poor, and the expectations of family and friends encourage car usage (Ibid.). For example the potential to use public transport could be increased at the same time as the cost of using private cars is also increased (Fujii & Gärling, 2007). In the next chapter the example of congestion charges in the region of Stockhoplm shows how charges can be coupled with improvments in public transport, in order to create synergies.

Furthermore, Eriksson's (2008) thesis shows that it is important to let car users evaluate policy measures to understand the the car users reactions. If the car users fail to see how a pull measure (for example improved public transport) benefits them, the consequance may be continues use of car. Push measures on the other hand, such as different pricing strategies are likely to be noticesd if large enough. However, these measures can be hard to implement as they are often seen as unfair. Eriksson concludes that mixing push and pull measures may be most effective in achieving behavioural effects (Ibid.).

What Eriksson's research shows is that to understand the consequences of different policy measures one has to understand how citizen's will respond in terms of behavioural change. To achieve an understanding the policy maker also has to understand citizen's attitudes. When attitudes change behaviour can be changed also.

1.3 Investments and economic incentives: push and pull measures facilitating climate-friendly action

The toolkit *investments that facilitate acting in climate friendly ways* includes making it easier for citizens to act in a climate friendly way. This toolkit can be used in the short term on the municipal and regional level (*Dymén* et al, 2009). One has however to remember that implementing the toolkit does not guarantee changes in citizen's attitudes and behaviour. Changes in behaviour can take time, but the final result – less rapid and unmanageable climate change – may take decades. Political will is needed, however, given that the final result can take decades.

One such example of this toolkit could be shown to encompass small physical changes, such as implementing park-and-ride facilities. Investments could also include the adoption of new technologies. This is not however a short term tool. Developing and implementing new technology can take a considerable amount of time. One of the examples used in the next chapter highlights a project on Bornholm for the implementation of green technologies.

The case of Stockholm deals with new technology and the promotion of green cars. The City of Stockholm, Environment and Health Administration (2009) argues that markets for new technology can be described with the S-curve. The pattern in which the market is penetrated by a new technology such as green technologies can be described as an S-curve. When a new technology is introduced, most consumers are reluctant to use it. Slowly the volume of products on the market increases and new suppliers enter the market. Shortcomings such as high prices are diminishing and finally the market reaches an acceptance level, when mainstream consumers start to buy the new products. Finally, the new technology reaches a maximum level of penetration and the product is considered mature (Ibid.). Penetrating the market is thus highly dependant on citizen's attitudes and behaviour (c.f. sub chapter 1.3 in this paper). In sub-chapter 2.1, where the case of Stockholm is presented it is clear that the promotion of green vehicles via different methods - corresponding to the toolkits presented in chapter 1 of this paper – has tried to hasten

developments from the phase where consumers are very reluctant to use a new technology to the phase where the technology or the product has reached a mature level.

The toolkit *economic incentives* are somewhat more direct in effect with the purpose of rendering extra costs on those who do not act in a climate friendly manner. The principal that the polluter pays should be used in this toolkit. The toolkit can be used in the short term on the municipal, regional and state level. However, in some cases changes in legislation are needed, implying that the toolkit may not be used in this way (Dymén *et al*, 2009). One good example of this type of tool is the use of congestion charges/road tolls (*Stockholmsförsöket*) in the region of Stockholm. The trial period between 22nd August 2005 and 31st July 2006 was evaluated and showed interesting results (*Miljöavgiftskansliet Stockholms stad*, 2006a).

Interestingly the case illustrates that economic incentives – the road tolls – were supplemented with investments in public transport. This shows that the toolkit, in this case making people pay congestion charges, can be coupled with investments which facilitate climate-friendly consumer choices. What Miljöavgiftskansliet (2006b) shows is that improving public transport does not in itself make people change from private to public transportation. What can however be said is that the congestion charges combined with improved public transportation possibilities created good synergies. The charges saw a decrease in car use while improvements in public transportation encouraged people to change their means of transportation.

In conclusion the toolkits *investments and economic incentives* can be used in both the short and the long term perspective depending on whether changes in legislation are needed or not. The tools can also be used from the local/municipal level up to the regional and state level. The final results – reduced levels of GHG in the atmosphere - may not however be perceived until many decades later, implying the need for a substantial level of political will. This represents a clear difference with issues relating to climate change adaptation where the results are often achieved in the short term.

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1.4 Changes in legislation

Changes in legislation are undertaken with the purpose of prohibiting or restricting behaviour that goes against climate change policy or certain emission limits. How far an individual society can go when it comes to reducing emissions depends on the political will to implement restrictive (push) measures for reducing car use (congestion charges/ road tolls; park-and-ride facilities). Laws and regulations clearly limit citizens' and other actor's freedom of choice. Changes in legislation are undertaken in a long term perspective and aim at radically changing behaviour and attitudes. Changes are also made with a view to changing physical structures, transport solutions and energy use patterns. Changes in legislation however take time, while changes in behaviour are mandatory and therefore facilitate rapid accommodation to a new situation.

1.5 Physical planning and transport systems

By using *physical planning* as a tool, the city's future structure can be secured towards reduced GHG emissions and adaptation to inevitable climate change. The research community is not always in agreement as to whether physical structure and transport systems can effectively reduce emissions, without also considering citizen's attitudes and behaviour (see sub chapter 1.2). Physical planning is a toolkit used in the long term (Dymén et al, 2009).

The trend in the Nordic countries is that we live our daily lives in larger geographical areas at the same time as city centres are becoming more compact. How can this contribute to reducing GHG emissions? When discussing strategic physical planning one has to remember that citizen's lifestyles and attitudes are of major importance when it comes to emissions (c.f. Kanninen, 2008 & Gram-Hanssen, 2008).

Transport systems are an important component in physical planning. In the European Union 21% of GHG emission are due to transportation. When it comes to the Nordic countries emissions from the transport sector reach from 17.9 % in Finland to 30.7 % in Sweden (EEA Report No5:2008). As noted previously it is difficult to argue definitively the extent to which physical planning and transport systems can contribute to reductions in GHG emissions as compared to the influencing of attitudes, behaviour and lifestyles. Most probably, physical structures on the one hand and citizen's lifestyles and behaviour on the other influence one another over the long term in complex relationships. Schylberg (2008) therefore argues in her research that it is more fruitful in planning situations to learn how to support local processes, bringing forward models adapted to the specific situation, rather than spending time developing complex theoretical models (Ibid.).

The need to highlight the gender perspective, an important element of this sub-chapter, is particularly relevant in relation to attitudes, behaviour and lifestyles, showing that physical structures and transport systems affect different groups in society differently. Greed (2008) highlights in an interesting way how responding to climate change can affect women and men differently noting that "[…] rather than introducing negative car controlling policies first, it would be better to invest more in public transport and to use the planning control system to ensure that neighbourhoods are designed to provide local facilities, amenities and employment opportunities" (Ibid. p 251). This city of everyday life – the city of short distances, mixed land uses and multiple centres – would fully take into consideration gender aspects as well as

creating more sustainable cities (Ibid.). One of the most interesting points in her argument is that physical planning can facilitate climate change mitigation at the same time as gender aspects are considered. The challenge, in respect of the more compact city of everyday life, is to prepare for climate change emergencies, such as flooding and heat waves.

2 Cases

Legislation is changing the picture at the national level in the Nordic countries at the same time as action is being widely undertaken on the local and regional level. As stated in the previous chapter – as well as being shown in the examples reproduced below – climate change mitigation measures are mainly undertaken on a large – i.e. regional – scale. In the following cases we focus mainly on climate change mitigation. However, the examples show that work is already being done across sectors and disciplines, creating a good basis for dealing with other dimensions of sustainability simultaneously, such as climate change adaptation. The examples also show how the various toolkits presented above are used to achieve sustainable results.

To underscore why work benefits from being performed across sectors and disciplines and with a wide variety of stakeholders, the County of Stockholm highlights (e-mail questionnaire spring 2009) the difficulties faced in prioritising adaptation issues such as; incorporating more green spaces in urban areas to reduce the effects of heat waves due to climate change, when there are dozens of other more prioritised issues. One solution to the problems of prioritisation is to work across sectors and disciplines and with a wide variety of stakeholders to find synergies. The examples, reproduced below, from Stockholm and Helsinki are testimony to this. The example from Bornholm is not as broad in nature but nevertheless shows how technology can be used in climate change mitigation.

Our cases also represent work undertaken across different timescales. The work done by the city of Stockholm regarding sustainable transport issues has been ongoing for decades. It cannot thus be called 'a project' but is, as such, rather more of 'a process'. The Metka project in Helsinki was undertaken during 2007-08 with the results being made public in the near future. Although it was only a two year project, the ambition was that cooperation between the authorities should be increased and should continue into the future. The Edison project in Bornholm has just started. The innovative framework used provides an example for others to follow though the practical results are unlikely to emerge for several years. Preparation for the future has however already begun. Thus these projects cannot be meaningfully compared in any way but they do nevertheless describe the breadth of processes enhancing sustainable transport solutions currently being undertaken. These projects clearly show that work related to the reduction of GHG emissions is undertaken over a long period of time with a wide variety of stakeholders.

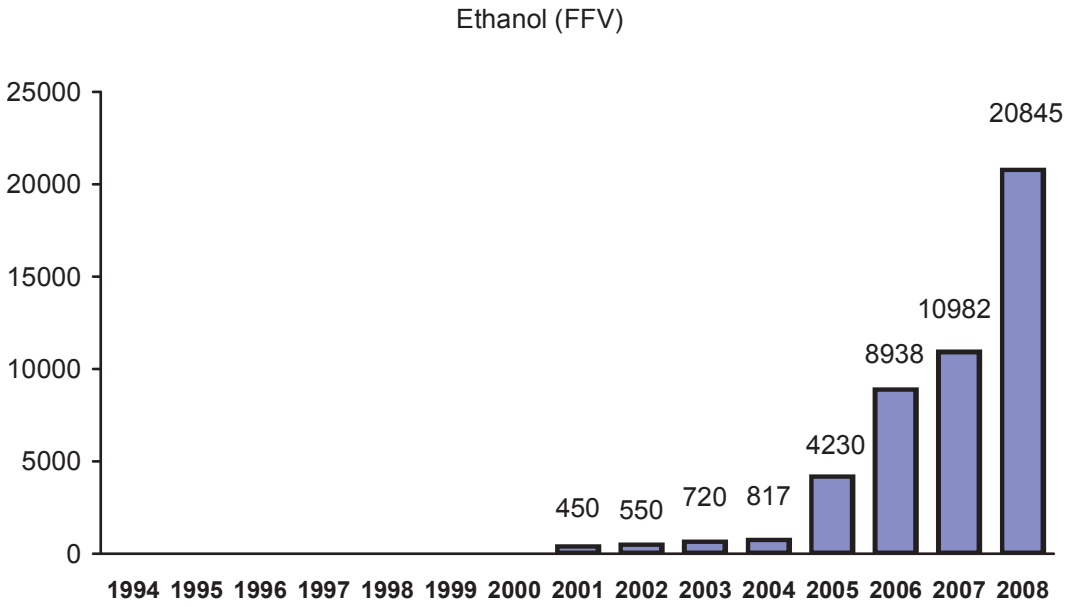
2.1 Stockholm congestion tolls and other sustainable transport 'push' and 'pull' measures

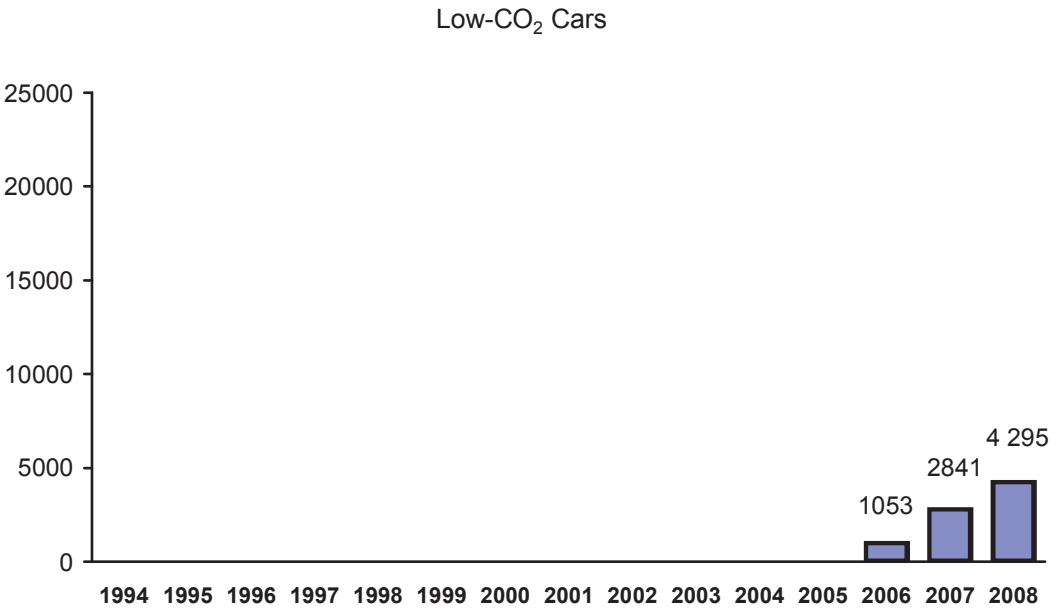
Stockholm provides an example of the need to adopt a multi-approach view to achieving sustainable transport goals in a Nordic metropolitan area probably because of long-term problems with congestion which are considered to be a threat to the economic growth capacity of the region and to the country as a whole. *The spatial planning and economic incentives* toolkits here are used to manage the complex situation and to change citizen behaviour. The two main measures introduced were congestion charges and promotion of the use of clean vehicles. The physical planning approaches include improving cycle lanes and public transport, new methods of transport, and the provision of environmental zones for lorries and busses.

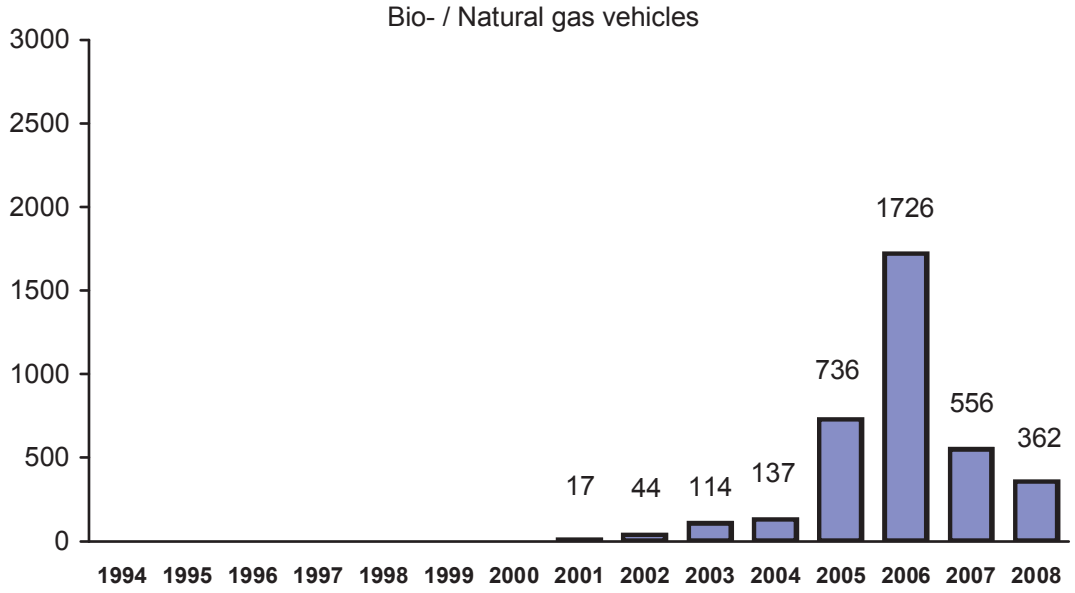
The first measure, enhancing the use of clean vehicles was introduced by the City of Stockholm in 2005. Clean vehicles are powered for instance by renewable fuels such as ethanol and biogas or other non-fossil fuels which have lower net emissions of carbon dioxide and cleaner exhaust gases. They are supposed to use at least 50% renewable fuels in order to gain the advantages allotted to them. The goal here is to influence the air quality, and to reduce GHG emissions and noise. Stockholm city is also participating in the European project BEST - Bioethanol for Sustainable Transport (*Miljöbilar i Stockholm*, 2009).

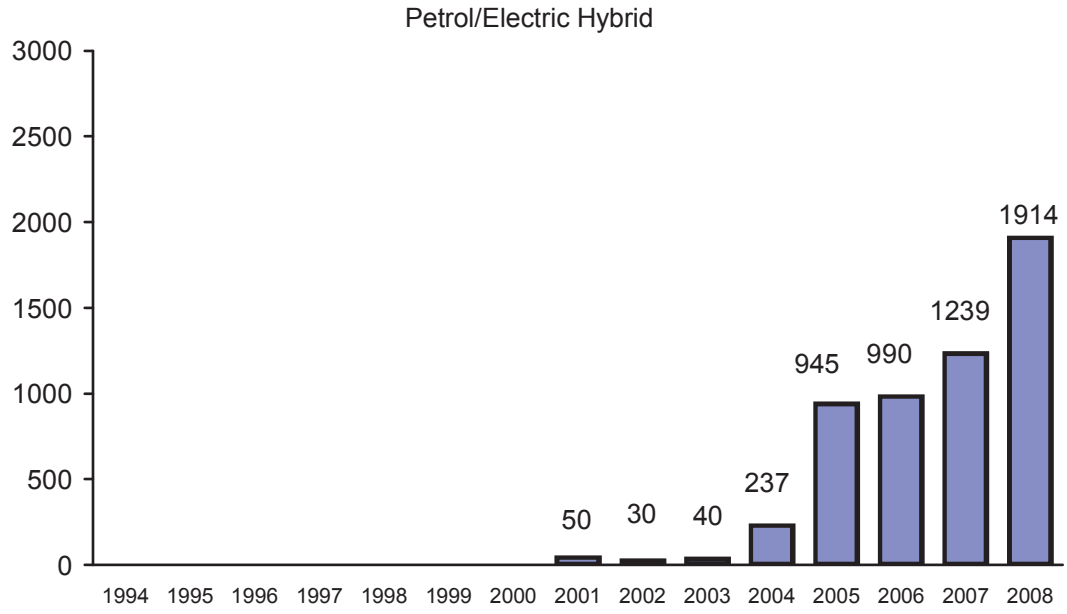
These clean vehicles are exempted from congestion charges and they have reduced parking fees. One can also get a national purchase subsidy of SEK 10 000. There is also a clean taxi promotion system and a project encouraging private car pools. This Stockholm city policy increases significantly the sale numbers of alternatively-fuelled vehicles. In 2008 sales grew at a record pace. One third of all cars sold in Stockholm were alternatively fuelled cars (in Sweden, one quarter) (Figures 1 and 2).

Figure 1: Stock of clean passenger cars (Stockholm County) Sources: SCB, Clean Vehicles in Stockholm, Svenska gasföreningen, BilSweden, 2008 (equals stock 2007 plus new registrations 2008)



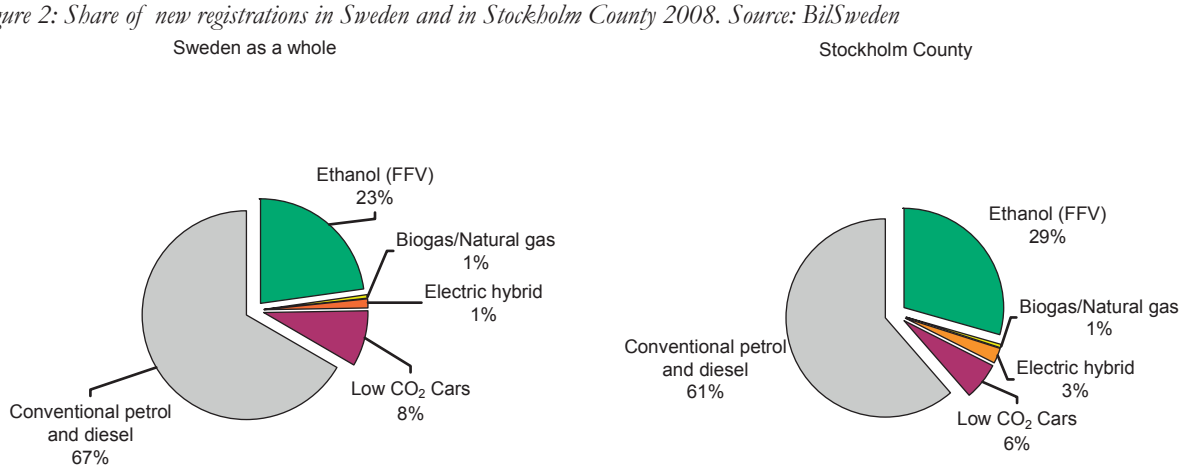






Source: City of Stockholm, Environment and Health Administration (2009

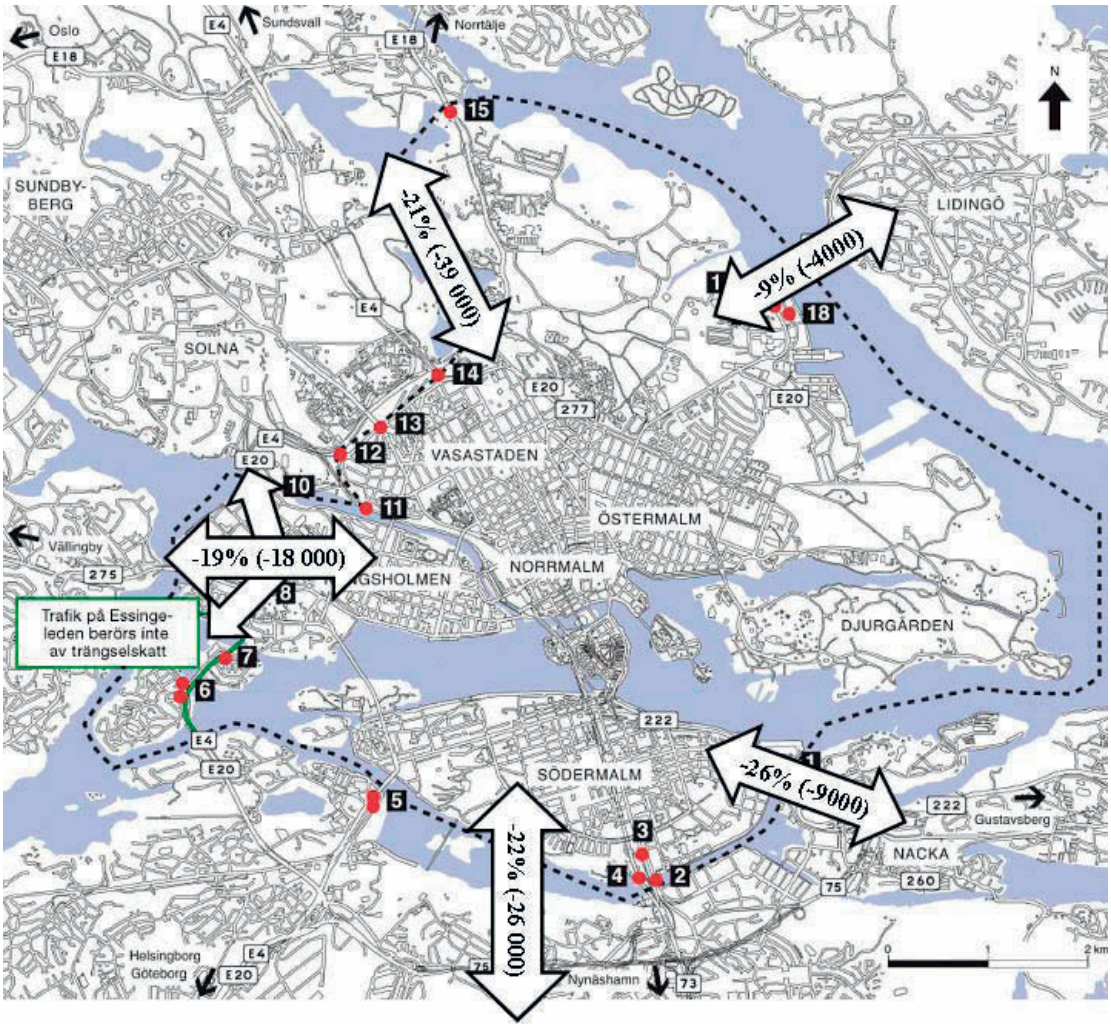
Figure 2: Share of new registrations in Sweden and in Stockholm County 2008. Source: BilSweden



Source: City of Stockholm , Environment and Health Administration (2009)

The second measure is, congestion charges - first tested during a one-year trial period 2005-2006 - together with increased public transport connections and an increased amount of parking lots (park-and-ride facilities) in Stockholm. The terms of the trial were set on in legislative format by the Government in Parliament in 2004 (Lag 2004:629 *om trängselskatt*). The congestion charges were collected at the city gates with the help of transponders located in cars. Transponders could be ordered from the Trial Office free of charge. Subsequently, the inhabitants of Stockholm and its neighbouring municipalities got the opportunity to vote to make the trial permanent or not. The results of the half-year test period however convinced the people of Stockholm and 51.3% voted to make the system permanent, beginning in 2007. The initiative had decreased the amount of cars in the city centre by 20-25% (approximately 100 000 cars) and emissions in the inner city by 14% (*Stockholmsförsöket*, 2009).

Figure 3: Percentage change in traffic flows across the toll stations during the charging period (6:30-18:30). The rate inside the brackets illustrates the change in the amount of cars



Source: Miljöavgiftskansliet Stockholms stad, 2006b

Another, maybe not beforehand calculated result is the increase of the sales of alternatively fuelled vehicles by about 23 % in the Stockholm County in 2008 (Miljöbilar i Stockholm, 2009). After concluding the results of the Trial however it can be clearly stated that simply enhancing the possibilities to use public transport does not help to reduce private car use but if it also becomes more expensive and/or if travelling times increase, more people will choose public transport. Another conclusion is that congestion charges give large, fast and cost-effective effects compared to other possibilities (Miljöavgiftskansliet Stockholms stad 2006b).

The congestion charge system was made permanent in 2008. The technical solution was developed and the registration system now works without the need for transponders. Cars are instead registered by photographing their licence plates. The licence number is identified from the photograph with OCR-technology (Optical Character Recognition) which identifies over 95% of licence plates automatically (*Transportstyrelsen,* 2009). The cars thus do not have to stop to pay while the Swedish Transport Agency registers the total payment incurred in a month. One journey costs 10-20 SEK with higher charges during rush hours.

Recently, Stockholm city has also begun to investigate the possibilities connected with electronic vehicles and chargeable hybrid cars. Current issues of note here include finding places to locate charging stations and outlining their aesthetic guidelines while also gauging the existing level of interest in electric cars across the city. Stockholm city has also decided to increase the amount of electric vehicles in its own car fleet.

2.2 Helsinki: The Metka-project "Sustainable Structure for the Metropolitan Area"

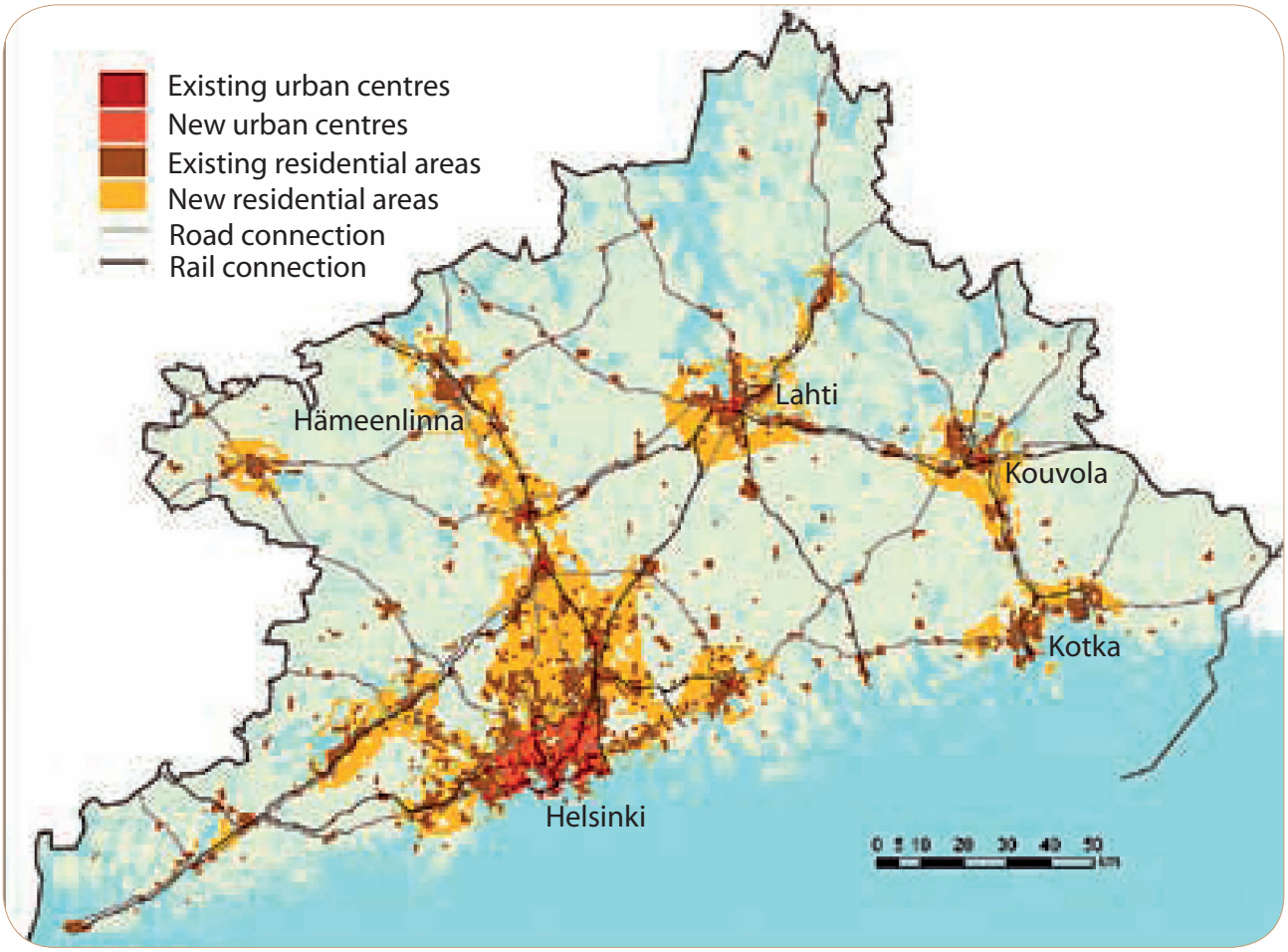
The Metka-project (Sustainable Structure for the Metropolitan Area) was carried out during the period 2007-2008 with the aim of creating workable methods for sustainable urban and traffic planning in the Helsinki Metropolitan area (the Uusimaa, Itä-Uusimaa, Kanta-Häme, Kymenlaakso and Päijät-Häme regions). In the background however there remained a certain level of concern about the impact of rapid metropolitan growth for both spatial planning and governance. (It can be said that metropolitan growth per se is not only a concern but also a political message to underline the significance of the region.) With the help of the project the actors in the Metropolitan area become more aware of the implications of current spatial developments. The planning authorities in particular gained a much broader insight that had hitherto been the case on the subject while the long-term knowledge base could be seen to have benefited from induced changes in professional practises.

The issue of 'metropolitan areas' is a relatively new one in the Finnish spatial planning context. The project was however able to bring together most of the important actors across administrative borders in the area, such as regional councils, route authorities and the environmental administration, to discuss and study possibilities in respect of finding better methods to control the early phase of strong metropolisation. The weakness of this approach is however that the need for a metropolitan policy is not seen as being as significant as that of a regional development policy. Despite this, the project was nevertheless able to put in place a broad cooperation network. The process can thus be seen as a useful model of cooperation for many regional actors and will hopefully lead to increased awareness among spatial planners in the metropolitan area.

The project concentrated on the physical urban structure, regulated by strategic planning and 'urban design'. In terms of alternative models, comparisons and influence estimations, the project defined development paths for the physical urban structure in the area. The current regional physical structure was extensively studied and visualised, using several databases, namely, the national information system for monitoring land use planning, the analysis methodology for land use and transport interaction, traffic models and the new assessment methods for ecological efficiency. The distribution of new structures were then estimated with a distance function. The results were illustrated by a map presentation and the effects of land use constraints on the new structures were visualised. (Sustainable Structure for the Metropolitan Area)

Four development paths were created by studying 24 indicators: sprawling "Old Way" (see Figure 4), rail-oriented "Rail Necklace", transport arteries-based "Strong Connections" and multi-centred "Balanced Centres". These paths were supported by two economic background scenarios for the year 2050. These alternative regional models were then analysed and compared.

Figure 4: Example of the development paths: "Old Way"



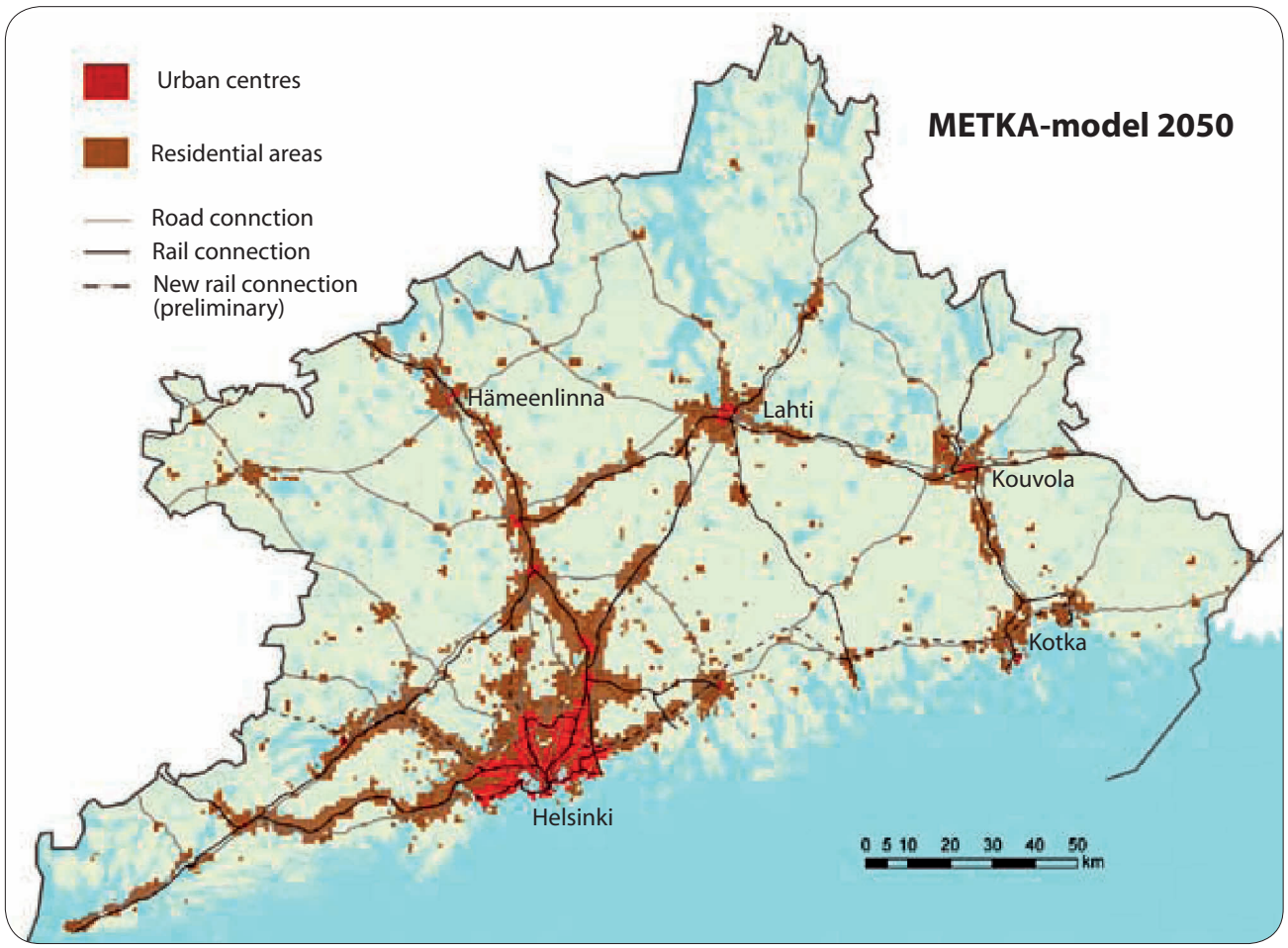
Source: Sustainable Structure for the Metropolitan Area

The result was defined as the METKA-model (see figure 5) which combines certain characteristics in the compared regional models. The model aims at the densification of current centres and the rail corridors between them. To achieve the model, regulatory measures and cooperation between the various actors is necessary.

The project did not include any practical decisions or measures to change planning policy but it undoubtedly increased awareness of the changes required. Current traffic policy decisions, for example, can thus be seen to create the basis for tomorrow's spatial structure

The results of the project have raised discussion about sustainable spatial planning and the concept of the metropolitan area itself. The process has increased mutual understanding among regions about spatial development principles and the importance of using similar methods to evaluate different factors in an area larger than a region. The idea of building a regional structure based on traffic is supported in the regions but it is going to take many years before it becomes planning practise. Four regions have continued to develop METKA project principles in order to have at their disposal a workable method to better deal with the interaction between land-use and transport.

Figure 5: METKA-model for sustainable Helsinki Metropolitan Area (expected population 2.7 million inhabitants, now approx. 1.3 millions)



Source: Sustainable Structure for the Metropolitan Area

2.3 EDISON (Electric Vehicles in a Distributed and Integrated Market Using Sustainable Energy and Open Network), Bornholm

A recent Nordic project designed to increase the possibility to use electric vehicles commenced on the Danish island of Bornholm in February 2009. The project represents an investment by several public and private actors with a view to facilitating sustainable transport forms by means of developing new technological transport solutions. The peripheral island with a population of 40 000 people produces a large amount of electricity via wind energy. That was the main reason for choosing the island as a test-bed for the project. Transportation in Denmark has not been as successful in saving energy and reducing GHG emissions as compared to private households, companies and power plants (Danish Energy Authority). The project is but one arm of the Danish Energy Authority's broader effort to study the possibilities of increasing the amount of electric cars in Denmark. The knowledge needed includes - technical, organisational (how to manage the distribution net), economic (how to manage the economic risks in the start) and environmental factors in respect of how electric cars are used, operated and maintained. The expected advantages are energy-efficiency savings and reduced GHG emissions, but also improvements in the urban environment with less noise and harmful emissions from cars. The effects of such a policy approach on spatial structures are potentially numerous.

The project aims to last three years concentrating on sustainable energy production (wind power energy) for electric vehicles and on testing intelligent technologies and infrastructure on the island of Bornholm for the large scale adoption of electric vehicles. The goal is firstly to enable researchers to investigate how energy systems function when the number of electric vehicles increases by means of simulation, and secondly, to develop power grids that can manage the change of energy from wind power to cars. The working assumption here is that cars can not only be loaded with wind power but also that they can safely 'return' power to the grid when wind power is low thus balancing the national power system. According to the Danish Energy Authority, it is computed that the windmills in Western Denmark for instance produce more energy than is needed for 70 days in each year. The challenge here then is to create new technological solutions for managing the uncertainty of wind energy and to address the need to load electric cars with sustainable energy forms.

The research consortium behind the project includes both Danish and international actors. *Danish Energy* is the project leader. In addition two other energy companies, *Dong Energy* and *Østkraft*, participate in the project. The Technical University of Denmark (DTU) is responsible for the large-scale real time simulations of electric vehicles' effect on the energy system. Two major international companies have also joined the project. IBM's role is to develop intelligent network technologies which synchronize the charging of the electric vehicles with the available amount of electricity based on wind energy, while Siemens is tasked with develop technology to draw electricity from the wind power plants to the charging stations. Another aim of the project is to utilise the battery capacity in an optimal way. Finally, a company specialising in hardware and software development, *Eurisco,* is responsible for communication and the physical charging system for the electric vehicles.

Electric cars have received a significant level of publicity in all Nordic countries and approval from national governments. The question of citizen attitudes however remains: the charging system has to work easily and straightforwardly to make people buy an electric car. It seems clear however that, initially at least, this will only be possible in big cities. Public financial incentives are probably also needed to change attitudes

3 Discussion

The three presented cases from Finland, Sweden and Denmark demonstrate how work related to the reduction of GHG emissions can be undertaken in transport solutions. The present paper's theoretical framework emphasises six different tools, all necessary to help spatial planning contribute to climate change mitigation in a wider sustainability context including climate change adaptation. Furthermore, the first toolkit *spatial planning and governance* highlights the need to find synergies between the three core concepts of time, space and stakeholders, in order to help spatial planning find ways to address all dimensions of sustainability in creating transport solutions. The three presented cases clearly illustrate that combinations of the six toolkits are used as well as an understanding of the concepts of time, space and stakeholders.

Relating back to the toolkit s*patial planning and governance* we want to highlight again the case of Stockholm. The stated goal that all vehicles should use at least 50% of their fuel from renewable energy sources shows that there is an ambition here to address the social, economic and environmental aspects of sustainability. This can only be done by involving different stakeholders and understanding the time and space dimension (see sub-chapter 1.1). Reducing noise and improving air quality has a direct social and economic dimension for certain groups of stakeholders, whereas reducing GHG emissions is more of an environmental issue in a long term perspective.

Furthermore, this paragraph puts forward the ways in which Stockholm has dealt with the introduction of green vehicles to the market (compare with sub-chapter 1.3). Several of the toolkits presented in the theoretical framework are used in this case, especially relating to: *Changes in attitudes and behaviour; Investments that facilitate acting in climate-friendly ways* and *Economic incentives*. The City of Stockholm, Environment and Health Administration (2009) highlights a wide range of measures undertaken to promote clean vehicles and renewable fuels in the Stockholm Region including: "market incentives, dissemination and awareness-raising (newsletters, seminars etc), joint procurement, investment support, extension of infrastructure, driver incentives and use of environmental criteria in the City's own vehicle and transport services procurement" (Ibid. p 26). These all correspond well with the toolkits presented in this paper's theoretical framework.

Finally, what the Stockholm case shows quite clearly is that in order to attain these kinds of results, long-term cooperation between the municipal authorities, strategic public and private partners and also national government authorities is needed.

With regard to the case of Helsinki and relating back to this paper's theoretical framework – one can see that the Metka project has mainly dealt with the toolkits related to *spatial planning and governance* as well as *physical planning*. When it comes to governance the time dimension is vitally important. Producing new approaches to sustainable urban and traffic planning is done with the long term results in mind as the results will only be realised in the years to come. However, given the fact that regional development is considered more important, the results of the Metka project in respect of the future physical urban and traffic structure could be seen as rather weak. The stakeholder dimension is also - as with Stockholm – considered strong in this case. A variety of stakeholders have to be incorporated to create sustainable urban and traffic solutions. Reducing GHG emissions is only one aspect among other economic, social and environmental sustainability dimensions, not the least of which is climate change adaptation. The question remains, how will a growing region and a more highly developed traffic system deal with a warmer climate, flooding and other weather-related emergencies?

The case on Bornholm – the EDISON project – is narrower in scope compared to the cases in Stockholm and Helsinki. The case deals mostly with the toolkits *Investments that facilitate acting in climate-friendly ways* and *Economic incentives*. However, even though the case is narrower in scope it still demonstrates the need to understand the concepts of time, space and stakeholders. As was highlighted in the case, many stakeholders with different types and levels of expertise are involved.

The expected results of the project include better energy-efficiency, reduced GHG emissions and improving the urban environment with less noise and harmful emissions from cars. These expected results demonstrate significant benefits when it comes to the social, economic and environmental dimensions of sustainability. The environmental benefits relate to reduced GHG emissions on a long term basis. Higher energy efficiency is primarily a short term result, highlighting the economic dimension of sustainability. The social dimension relates, for instance, to improved urban environments as well as to less noise and less harmful emission levels from cars. These results range from the short to the long term. When it comes to the concept of space the success of the project is dependant on everything from individual citizen choice and behaviour to infrastructure decisions taken on a regional to (inter) national level.

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APPENDIX 1

Other Nordic projects on the same theme

The physical urban structure, regulated by strategic planning and 'urban design':
- Swedish cities with traffic strategies: Eskilstuna, Eslöv, Gävle, Karlstad, Linköping, Lund
- Bustrip project (http://www.bustrip-project.net/)
    - o Developing transport planning processes, preparing new sustainable urban transport plans and revising existing
    - o Partly financed by the EU
    - o Finalised 2007
    - o Partner cities in the Nordic countries: Göteborg, Kouvola region, Sundsvall, Turku, Örebro
- Honkasuo development plan, Helsinki
    - o Residential area that is supposed to be the pilot area in Helsinki for preventing climate change

Planning, development and managing transport infrastructure, i.e. public transport:
- Finland: Tjänstebiljett – commuter travel vouchers
    - o Helsinki, Espoo, Tampere, Turku + ca 300 small or medium-sized companies = 22 000 users
    - o Similar projects also in other countries
- K2020 Future public transport in Gothenburg region
    - o Aims at increasing public transport use 20 % by 2020
    - o Cooperation with several organisations
    - o Main structure for public transport, nine quality goals
- Stockholm Public Transportation (SL)
    - o Works actively for environment
    - o Goal: SL traffic fossil-free latest 2025
    - o http://www.sl.se/Upload/om_sl/miljo/SL_miljoarbete.pdf

Rendering special activities and transport of public institutions more effective, for instance by means of 'mobility management':
- Mobility management efforts in Swedish cities: Borlänge, Eskilstuna, Göteborg, Helsingborg, Jönköping, Karlstad, Kristianstad, Linköping, Lund, Malmö, Ockelbo, Stockholm, Örebro, Östersund
- Sweden, Länsstyrelsen i Stockholms län: ResSmart.se
- Denmark, Copenhagen: company-oriented Mobility Center

Influencing traffic use by enhancing public transport, bicycling, or car pooling in a greater extent:
- Denmark: cooperation between the municipality of Koege and the private car sharing club. Performed from summer 2006 until summer 2007
- Helsinki: an internet program helping to make bicycle travel plans

Trying to influence manners of motorists by road pricing etc:
- Oslo
- Helsinki region congestion charges
    - o Studied by the Ministry of Transport and Communications
    - o The principles, possible formats and their consequences
    - o To be completed summer 2009

Development of new and energy saving means of transport and transport technologies dedicated to Nordic urban regions:
- Research projects:
    - o Chalmers Technical University, Gothenburg: Sustainable Transport Initiative (two areas: Transport efficiency and customer-adapted logistics, and Traffic safety) http://www.chalmers.se/en/sections/research/current-strategic/sustainable-transport
    - o VTI, Swedish National Road and Transport Research Institute: Sustainable transport (analysing planning processes and power structures in the transport sector, developing models for the energy use, exhaust emissions and environmental costs of transport) http://www.vti.se/
- Electric car charging network with Better Place Denmark network
- Bio-fuel/ethanol with St1 Energy Company, Finland
    - o http://www.st1.eu/ci/Etanolix_food_is.pdf

    - Innovative means such as wind power plant at a service station in Helsinki
- EU project BEST: Bio-ethanol for Sustainable Transport 2006-2010
    - The introduction and market penetration of bio-ethanol as a vehicle fuel, and the introduction and wider use of flexible fuel vehicles and ethanol cars on the market.
    - Nordic participants: Stockholm (lead partner) and Biofuel region (located in northern Sweden))
    - http://www.best-europe.org/