

Sustainable Socio-technical Transition

A Scenario for ICT as a Situation of Opportunity in Södermalm 2030



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Abstract

This study examines how Information- and Communication Technologies (ICT) can contribute to a Socio-technical Transition towards a low energy, low carbon society in the city district Södermalm in Stockholm, Sweden. This Situation of Opportunity is inspired by backcasting and is illustrated as a scenario, which is presented as four images of a future Södermalm. A key feature in the scenario is the integration of actors (who), objects (what) and measures (how). Data for the scenario is compiled through literature reviews and two focus groups and is analysed, assessed and discussed through literature reviews and six expert interviews. A key feature is a Home Energy Management system, which is able to control the energy usage of the home and inform residents about energy performance. As a key actor, City of Stockholm is likely to take a lead in the Socio-technical Transition in collaboration with various other actors such as niche oriented companies. Inspired by the scientific approach of Critical Realism, the underlying mechanisms and structures in the scenario from perspectives of behaviour changes and Transition Management are analysed. Special attention in the process should be directed to the strategic phase, where transitions arenas are created, and the tactic phase where the agents negotiate and implement the objects. The analyses and assessments further reveal that the increased prevalence of ICT along with changes of the social structures such as norms, attitudes, beliefs and incentive structure can result in a behaviour change of the citizens in Södermalm. However, rebound effects and the role of the public authorities are discussed, and it can be concluded that the public authority plays an all-important role in the Socio-technical Transition and that rebound effects has to be systematic coped with. A high degree of environmentally sustainability can hardly be attained within the prevailing neo-classical regime. Finally, it is concluded that this Situation of Opportunity can contribute to the destabilisation of the socio-technical regime and can pave the ground for further organisational and social changes in order to enhance sustainable Socio-technical Transition.

Preface

This study was written during the autumn 2010 and spring 2011 as an extended master's thesis of the M.Sc. programme in Sustainable Planning at Department of Planning, the Faculty of Engineering and Science, Aalborg University (AAU).

Besides being a master's thesis, this report is preliminary contribution to an ongoing cross-disciplinary research project 'Situations of Opportunity in the Growth and Change of three Stockholm City Districts', SitCit for short, which is being conducted at the Department of Environmental Strategies Research at the Royal Institute of Technology (KTH) in Stockholm, Sweden. The aim is to study how the energy use of three city districts with contrasting properties can be reduced to a sustainable level concretised as a low energy, low carbon society. This study represents one of those cases.

The explored Situations of Opportunity and city districts in SitCit are:

- Urban renewal and housing refurbishment in Rinkeby-Kista;
- Introduction of car sharing and improvements of public transportation in Bromma; and
- Introduction of information- and communication technology (ICT) for automation and persuasion in relation to energy usage in Södermalm.

Several speakers at the Stockholm Futures Conference (2010) called for approaches in Futures Studies, consisting of both qualitative and quantitative methods. This study contributes to the qualitative part of the third Situation of Opportunity, and it aims at developing a scenario for Södermalm through elements of backcasting that illustrates a Socio-Technical Transition with ICT as the motor and guided by the vision of a low energy, low carbon society. The quantitative energy modelling of this Situation of Opportunity will be carried out by researchers at KTH. Potentially, the scenario, and the study in general, can contribute to the ongoing debate on how a sustainable development can be pursued.

This study contains 12 chapters which are divided into five main parts as a scenario building process. *The Introductory Part* elaborates on the problem with the current development of energy use in society, the creation of knowledge and the applied methods. *The Theoretical Part* elaborates on the main theories applied in this project; the governance process of Socio-technical Transition and behaviour change. *The Scenario Development Part* outlines factors for Socio-technical Transition in terms of prerequisites and assumptions as well as the scenario illustrated as a Situation of Opportunity as a part of Socio-technical Transition. *The Assessing Part* analyses and assesses the scenario with regard to the governance process of Socio-technical Transition and behaviour change, and the critical elements for the transformation process to accomplish are focal points for discussions subsequent to the scenario. This part further assesses the scientific value and quality of the study as well as reflects upon overarching methodological issues. *The Concluding Part* finalises the report and summarises the findings in a conclusion which is followed by an outlook where other perspectives for achieving the Socio-technical Transition than ICT are elaborated.

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Enjoy the reading,

Kristian Løbner

Marie Sølgaard Bang

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1. Introduction

Looking back at the past 20 years, the Andersons state that ICT has helped them to change their habits towards a more sustainable living. In addition, they state that increased energy prices and the economic gains from heat pumps, solar cells, more energy efficient household appliances and HEM were a major driving force together with the public authorities' willingness to implement policy packages. The money saved is used for, among other things, more exotic holidays and a better everyday life. And of course, to be on the wave with the newest technologies such as smart phones also played a major role.

The paragraph above is an excerpt from a scenario, which illustrates how a desirable future evolved, and in which ICT acts as a motor for Socio-technical Transition towards sustainable changes in energy usage in the realms of housing and transportation. The aim with this study is to explore how such a Socio-technical Transition towards sustainable energy usage can happen with regard to especially the organisational and social structures of sustainable changes. A transition process towards such a future is now urgent and one of the greatest present challenges of humanity as there is a need for radical changes in the way energy is produced and used. Especially the urban areas are of great importance to the transformation process as more than half of the global population live in there and urbanisation is rapid (UN-Habitat, 2009). This study seeks to contribute to the understanding of what needs to be changed, by whom the development can be changed, and how this can be done.

1.1. Unsustainable Energy Usage

A glance at the current development of energy usage reveals a tendency throughout the past half century where humanity has misused the natural resources without any concern for future generations (IPCC, 2007). This behaviour has caused a high reliance, especially among the Western societies, on energy from non-renewable sources (IEA, 2010). This has resulted in high emissions of particles and greenhouse gases causing climate changes with the effect of having parts of the Earth flooded and others dried out, resulting in migration of people to other parts of the world (IPCC, 2007). Especially CO₂ emissions are regarded as drivers for climate changes, and according to the Intergovernmental Panel on Climate Change it is a necessity to reduce these by 50-85 % to mitigate long-term and irreversible climate changes (IPCC, 2007). The long term vision in this project stems from the desire of a society in 2060 where each individual on average does not use more than 2000 Watt and does not emit more than 1 tonne of CO₂ per year – a sustainable level without immediate devastating consequences (Jochem, 2004). In other words, the current trends in Western societies' energy consumption are following a highly unsustainable trajectory, and societies around the globe must break the trend and instead strive for the low energy, low carbon society. Among the suggested solutions are new types of energy systems, more energy efficient appliances, energy reducing refurbishment of the existing building stock, increased usage of public transport, and information- and communications technologies (ICT) (Jochem, 2004).

Already in 1987, with the release of the report 'Our common future', the World Commission on Environment and Development (WCED) emphasised the urgent need for

changes and political action in order to achieve what they called sustainable development. This was defined as a 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains two key concepts:

- the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and
- the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs' (WCED, 1987, p. 43).

Here, sustainable development is regarded as the equilibrium of ecological, social and economic matters, but others (such as Lafferty & Langhelle (1999) and Høyer (2000)) have since argued that sustainable development must concentrate on the three extra prima characteristics:

- safeguarding long-term ecological sustainability;
- satisfying basic needs; and
- promoting inter- and intra-generational equity (Høyer, 2000).

To be part of a sustainable development strategy, secondary targets must be related to at least one of these three all-important targets. However, as the term of sustainability originates from ecological science and since the ecosystem forms the basics of living conditions of human beings, the environmental dimension of sustainability is in this study regarded to be of first priority because achievement of the first two dimensions will not be possible in the long run if the requirements of environmental sustainability are not met. Social and economic sustainability should also be important targets, although the ecological perspective dominates this study.

Economic sustainability is a feasible development which strives for satisfaction of needs across boundaries and generations.

Social sustainability is a development which moves towards improved social equity and social progress across boundaries and generations.

Environmental sustainability is a development towards an intact natural capital for both present and future generations.

If the current increase of energy consumption continues, it is likely to entail enhanced negative impacts on the environment and depletion of fossil fuels. The contrast between the actual, present consumption and the desirable future consumption of energy calls for a change in the ways in which the city is developed, used and managed – especially if the development is to be sustainable.

Urban sustainable development, as this study deals with, does not only contain the environmental aspect of sustainability, but can be argued to refer to increasing life quality for both present and future generations. Issues such as health, culture, security, environment and economy are important factors for the urban sustainability and will

be the underlying understanding of how urban sustainability is perceived in this study. A definition of the desired sustainable development could be:

Sustainable development is a development towards safeguarding long-term ecological sustainability while striving for increasing life quality for both present and future generations of citizens across national and international scales.

1.2. Approaches for Socio-technical Transition towards Sustainability

It has been argued that technology alone cannot reduce the increasing energy consumption, and that social structures and agency are important aspects to include in studies of consumption and of the future (e.g. Røpke, 2009; Wangel, 2011). Socio-technical Transitions aim at merging the social and technical aspects in the transformation at several levels of the prevailing system (Geels & Schot, 2007), which the previous section found to be unsustainable. Meadowcroft (2005) argues that transitions play key roles for creating sustainable development as they can facilitate radical changes and improvements in how society performs and is managed. The transitions of current unsustainable socio-technical regimes should strive for a fundamental and irreversible reframing of the current paradigms (Kemp et al., 2007). According to Sondejker et al. (2006) and Loorbach (2010), transition of socio-technical systems can be argued to build upon and merge:

- Complexity Theory, which focuses on the dynamics of complex and adaptive systems;
- Governance Theory, which focuses on the process where actors articulate their interests and exercise power to make and implement policies; and
- Social Theory, which focuses on interactions between structures, actors and practices.

Transitions of socio-technical systems are rather slowly changeable, often more than 50 years, and agency is always taken actively part (Geels & Schot, 2007). The time span and ideas of Socio-technical Transitions seems suitable for applying the concept to pursuit the vision of a low energy, low carbon society. Throughout this study a Socio-technical Transition is defined as:

A **Socio-technical Transition** is understood as fundamental change in the structures, cultures and practices of how individuals and society engage with technology.

1.2.1. Strategies for Socio-technical Transition

Managing, facilitating and governing a Socio-technical Transition requires implementation towards fundamental changes in the underlying structures of society and socio-cognitive elements. Vested interests and power structures can hamper the implementation, and a complete and well-tested strategy for a Socio-technical Transition towards increased sustainability in the realms of housing and transportation does not exist. Adopted from the literature on sustainable mobility (Holden, 2001), three main strategies can be followed in order to attain the target of the low energy, low carbon society:

- The efficiency strategy;
- The substitution strategy; and
- The reduction strategy.

It is likely that combating climate changes requires integration of all three strategies, especially as IPCC (2007) suggests that both adaptation to and mitigation of climate changes are necessary. The efficiency strategy aims at developing more energy efficient technologies in order to enable the continuation of current ways of living. More efficient technologies for power production, increased efficiency of vehicles and automation technologies which even out the peak hours in energy usages are all examples on the efficiency strategy. This strategy is linked to the implementation of new technologies but refers merely to the issue of minimising energy usage and unwanted pollution (Holden & Høyer, 2005). Substitution is linked to changing the means of e.g. how energy is produced and citizens' transports. Examples on substitution strategies are renewable energy sources in substitution for fossil fuels and public transport in substitution for cars.

It can be argued that the optimisation and substitution strategies focus on a continuous increase of current living standards and consumption and a continuation of the prevailing paradigm. Hence, a Socio-technical Transition will not occur by only focussing on the first two strategies. In order to cope with fundamental changes in the underlying structures of society towards increased sustainability, the focus must also be directed towards the reduction strategy. There is a need for decreased consumption in several matters in order to reach the target of a sustainable society; e.g. consumption of goods, space and travels. As Holden & Høyer (2005, p. 402) conclude, it seems that only a combination of the three strategies will meet long-term objectives of sustainability.

Sweden, as an example of a Western society, has the past 40 years substituted a major part of the fossil fuels with especially nuclear power and renewable sources such as bio fuels (Statens energimyndighet, 2009a, pp. 14-15). In the housing sector, the fossil fuels have been substituted in favour of electricity and district heating, and the energy usage tends towards a reduction, arguably due to heat pumps (Statens energimyndighet, 2009b, p. 11). The transport sector is still increasingly dominated by fossil fuels with a tendency towards diesel instead of petrol (Statens energimyndighet, 2009a). Cars have become an incorporated part of everyday life in the modern society and in Sweden, for example, more than half of the daily trips take place by car (SIKA, 2009, p. 42). There are, however, several reasons for choosing the car, which do not have any connection to the type of fuel. Measures such as land use patterns (Newman & Kenworthy, 1989), re-

sources, time, flexibility, need, distance, and comfort are influential factors for especially choosing the car in favour of public transportation (Transportrådet, 1997). Furthermore, this travel behaviour tends to be promoted by the car's symbolic value and its ability to function as a personal space between everyday related obligations (Jensen, 2001). These factors are to a wide extent related to human behaviour and lifestyles (Berge, 1996).

There is a potential for changing the energy usage in the transportation and housing sectors through substitution, optimisation and reduction of sources. Guided by the idea that people are capable of changing and steering development through Socio-technical Transition, this project will focus on how the apparent unsustainable trajectory can be changed in order to reduce the negative impacts by focusing on how exactly humanity can change their behaviours related to personal activities. In order to cope with the major challenges of orchestrating the Socio-technical Transition, several means are applicable; among others increased urban densification, mixed-use development in interplay with public transportation and pedestrian friendly environments, reduced consumption, refurbishment, increased public transport, and ICT can be mentioned.

ICT – Potentials and possible Rebound Effects

In the Western World, ICT arose together with the network- and information society which has superseded the industrial era, which previously replaced the era when agriculture was the dominant activity (Banister & Stead, 2004). The perception that society is organised as networks in which people to a great extent communicate and share information has, according to several authors, resulted in an increasing time-space compression and acceleration of society, where more interactions, information and human relations take place, and with increasing pace (Harvey, 1989; Thrift, 1996; Urry, 2000; Castells et al., 2007). Some even propose a sociology of time and technology (Wajcman, 2008; Sassen, 2002; Wellman, 2001). Time and information technologies are becoming increasingly important for society and social relations, and Lash (2002) states that the contemporary world is governed by a principle of information exchange, rather than of a principle of society, where the social bonds and relations are stretched across space but compressed within time.

The emergence of ICT as a driver for the 'information age' has led to a dispersal of activities around the globe but at the same time, it has obviated the notion of space and time because much work can be handled from the home (Hjorthol & Nossun, 2007). Therefore, ICT has had a great impact on the current society and is also expected to play an important role for peoples' everyday life in the future, but there are both benefits and problems linked to this development.

ICT is one of policy instruments, which has been identified for its potential to take part in a transition towards a sustainable development through facilitating all of the three aforementioned strategies. ICT includes all stationary and portable electronic equipments used to inform users and aid communication such as (mobile) phones, computers, PDAs and videos. Erdmann & Hilty (2010) illustrate how various types of ICT can contribute to a sustainable development, and from their work it becomes evident that rather than contributing to sustainable development directly, ICT works as the binding

material between decision-making, energy usage and behaviour changes (see table 1.1). Zapico et al. (2009, 2010) further argue that ICT can enable a behaviour change and thereby a reduction of energy usage by providing the user with feedback about environmental impacts of behaviour and products. Here, ICT is understood as climate persuasive technologies.

Regarding the housing sector, automated homes or Smart Homes are a notion for the installation of ICT in homes, where electronic devices are integrated in an ‘invisible’ system which can control and monitor the indoor environment and activities such as heating at lightning and further provide feedback about the energy usage to the consumer (Ricquebourg et al., 2006; Sandström et al., 2003). This automation is part of the efficiency strategy but pitfalls for reduced energy usage and resource consumption become evident when the increased amount of technological applications must be installed and when people use the saved energy elsewhere.

CT application domain	Generic description	Examples of established ICT applications	Examples of newer ICT applications
Power generation and distribution management (efficiency)	ICT-supported measures to improve the coordination of electricity supply and demand	ICT-based load detection	Electricity consumption feedback (smart metering) and demand-side management (smart appliances)
Building Management (efficiency)	All ‘soft measures’ supported by ICT to reduce the energy consumption of buildings	Intelligent HVAC management	Energy consumption feedback (smart metering)
Intelligent transport systems (efficiency)	ICT applications assisting drivers and managing transport infrastructure (all modes)	In-vehicle navigation systems	Real-time road traffic routing
Virtual goods (substitution)	ICT applications supporting a product-to-service shift and the digitisation of physical products	ICT-enabled services (e.g. web-based car sharing)	E-paper, e-books
Telecommuting (reduction)	ICT-supported work away from the firm’s premises, which replaces commuting travel	Personal computer and Internet access at home	Virtual workspace at home

Table 1.1: Generic description of ICT, their domain of application and relevant examples. Examples from Erdmann & Hilty (2010).

Regarding transportation, ICT can, among other things, provide the passenger/driver with real-time route planning information before and while transporting (however, with the risk of longer trips and higher energy usage/CO₂ emission as a result) (Banister & Stead, 2004).

Regarding the work related journeys, ICT can reduce the number of trips through videoconferencing and teleworking. A rebound effect of this development is that with increased virtual transport follows increased physical transport due to the human desire for face-to-face contact (Urry, 2004). ICT is studied in this project with regard to how it can optimise, substitute and reduce energy usage by the principles of automation, information and persuasion and is defined as:

Information- and communications technology (ICT) refers to the application and linkage of electronic equipment to automate as well as inform and communicate with and among people.

Occasionally, the reduction strategy of ICT is referred to as dematerialisation.

1.2.2. Futures Studies and Backcasting Scenario

Futures Studies is a discipline applied, among others, in planning as a tool to illustrate possible implications of taking the challenge of sustainable development seriously, since it through prospective thinking can 'contribute to the well-being both of presently living people and of the as-yet-voiceless people of future generations' (Bell, 2003, p. 73). Furthermore, Futures Studies can assist planning to adapt to the uncontrollable future and to create the controllable future (Höjer & Mattson, 2000). This is based in a desire of knowing what the future will bring so adjustments can be made in time and in a belief that planning can change the development. According to Bell (2003), the main purpose of Futures Studies is to examine, evaluate and propose alternative futures which are possible, probable or preferable as a means to transform the society into something better for the human beings. This may require radical, comprehensive and innovative changes of the current society, which is the case for pursuing a sustainable development. In other words, Futures Studies can create a basis for decision-making, from which choices regarding future development are taken. However, this implies that the existing societal structures are being questioned as the most appropriate for future development (Bell, 2003).

Backcasting is a normative, transformative scenario type which is pointed out as a promising approach when complex problems such as sustainable development are at stake and when current trends need to be broken in order to meet a target of a desirable future (Höjer & Mattson, 2000; Dreborg, 1996). Methodologically, this is done by firstly setting the target of and illustrating images of the desirable future, and secondly, analysing the pathways leading to this future. The time perspective in backcasting studies is usually 25-50 years but can be up to 100 years (Robinson, 1990).

In this project, the existing trends in energy usage are considered unsustainable since a continuation of the trends is likely to have fatal and irreversible implications for the future generations. If present trends in energy usage in the transportation and housing sector are extrapolated, it would show a gloomy future of non-sustainability and climatic disasters. Therefore, the purpose of this project is to create a scenario inspired by backcasting, illustrating a desirable future which is sustainable as the current trends in energy consumption shall be envisioned to be broken. Thus, the scenario becomes an illustration of a Socio-technical Transition, and a scenario is in this study defined as:

A backcasting **scenario** aims at illustrating an alternative to the prevailing unsustainable trends by developing target-fulfilling images of a desirable future and the pathways leading to those.

1.2.3. Situations of Opportunity

The aforementioned target of a low energy, low carbon society has been adopted in the research project 'Situations of Opportunity in the Growth and Change of three Stockholm City Districts', SitCit for short, at the Royal Institute of Technology (KTH) in Stockholm, Sweden. Through utilising elements of scenario building and the backcasting methodology, the purpose is to explore when and how Situations of Opportunity can lead to a sustainable society. A Situation of Opportunity is defined as:

'A description and evaluation of a period of transformation in the city's future development when a limited number of actors can plan and implement a consistent set of measures that profoundly and lastingly contribute to urban sustainable development – changing the city's built environment and infrastructure systems, its institutional set-up and city life, but retaining its ability to sustain the good life of its citizens' (Svane et al., 2009, p. 5).

As elaborated in Appendix II, a hallmark of the explorative concept of Situations of Opportunity in analysing planning processes, real or fictitious, is the integration of object (what), measure (how), agency (who) and time (when) through addressing the questions of:

- *What* can change?
- *How* could change take place?
- *Who* could change?
- *When* is change feasible and possible?

The aspects of whom and what are often referred to as Agents of Change and Objects of Change, respectively. This integration has been proved to be successfully identified through the iterative questioning of what can change and by whom (Bang et al., 2010; Lewakowski et al., 2010; Wang, forthcoming). The Agents of Change refer to the actors, who have the ability and capacity to influence and modify the Objects of Change in any phase of the planning process – preferably towards a sustainable future. Included in this definition are the citizens who are affected by the changes but as well could take active part in the transition. Within the realms of housing, transportation and ICT, pub-

lic planning authorities and public transport providers are important Agents of Change as well as the actors who develop and provide telecommunications. Furthermore, the citizens are playing an active role as end users. However, the Agents of Change could as well be actors who are opposing transition. Objects of Change refer to objects within three societal structures, which need to be changed during a Situation of Opportunity in order to achieve urban sustainable development. Inspired by Weingaertner (2005), who originally defined the concept, the structures in this study encompass (see Appendix II for further elaborations):

- *Urban structures* refer to the interplay between the built environment's functions and location, the green and blue elements, and infrastructure.
- *Organisational structures* refer to the ways that organisations through decision-making and implementation constrain, control, support and enable the behaviour of individuals, groups and institutions.
- *Social structures* refer to the larger scale forces within societies that affect the everyday practices of individuals. As such, social structures are systems of social relations and their products.

Shaped by Agents of Change, these three structures should be considered as arenas that enable and constrain the citizens' everyday practices. In that sense, the citizens become users of the three structures but are also able through their interactions and behaviour to shape the structures. Hence, society and its actors are regarded as being mutually structuring each other.

In this study, a Socio-technical Transition towards a low energy, low carbon society is being studied as a Situation of Opportunity and illustrated through a backcasting scenario. For simplification and contextualisation, a city district functions as an illustrative case of a Western society which requires radical social and technical transitions to occur.

1.3. Södermalm as an Illustrative Case of Socio-technical Transition

Sweden is an example of a developed, urbanised country, which during the past 40 years has witnessed an increase in energy usage by 34 % - mainly due to the transport sector (Statens energimyndighet, 2009a, pp. 12-13). In 2008, each Swede used 43 MWh (Statens energimyndighet, 2009a), and the vision of a low energy, low carbon society implies that each Swede is required to reduce the average energy usage and CO₂ emission by 58 % (compared to year 2008) and 81 % (compared to year 2006), respectively (Statens energimyndighet, 2009a). The distribution of energy per capita in City of Stockholm is displayed in figure 1.1. It is evident from the chart that 2/3 of the energy usage of an average citizen in Stockholm is related to Personal activities and Housing. The largest contributors are heating (24.0 % of the total energy use) and leisure trips (18.5 % of the total energy use). Work related trips only hold a little share of the total energy usage, but this is likely because the inhabitants in City of Stockholm have in average shorter trips and lower share of car travel than the suburbanites (and than the average Swedish population). As energy used for housing and personal trans-

- Personal activities: includes leisure activities and transport related to this, pleasure commodities, electricity and communicative appliances.
- Housing: includes expenses for the dwelling itself, interior, maintenance and the energy used for heating.
- Food: includes the food and energy used for preparing and storing food, also at restaurants and cafés.
- Social- and Health Care: includes institutions for education, caring and nursing.
- Personal contribution to society: includes the energy consumed for work related journeys, the 'outcome' of a job – the salary – is used to pay the abovementioned categories.

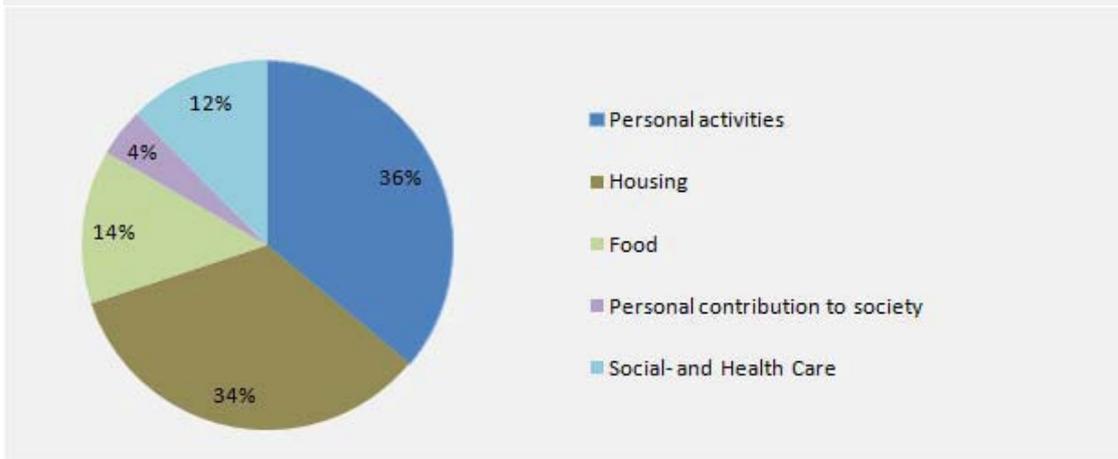


Figure 1.1: Energy usage per capita within City of Stockholm (based on figures from the year 2000 in Gullberg et al., 2007, pp. 337-352). Personal transportation is distributed in Personal activities (transportation related to leisure activities) and Personal contribution to society (transportation related to work).

portation, including both leisure- and work related trips, takes up a large share of the total energy usage in Sweden, these two domains are chosen as the primary areas of research in this study.

Stockholm has a long tradition for environmental programmes, and the willingness of change towards sustainability is regarded to be higher than in many other Western cities. Since the mid 1970s, City of Stockholm has produced five environmental programmes of which the most recent was published in 2008. When the City Director and the Vice Mayor presented the programme for 2008-2011, they stated that:

‘to succeed, environmental work must go on all the time. Prevention is always better than cure, and it is unproductive to keep the environmental issues in the background...our environmental programme can only be achieved if both the city administration and the citizens contribute’ (City of Stockholm Executive Office, 2008, p. 2).

Södermalm is a city district in the southern part of the inner city of the Swedish capital, Stockholm (see figure 1.2). Very shortly, Södermalm, or Söder in everyday speech, is on a tourist website described as ‘trendy, charming and unique’ (Stockholm Visitors Board, n.d.) and inhabited by ‘the creative class’ (Florida, 2002). Compared to most of the other 13 city districts of City of Stockholm, Södermalm is quite unique due to its ur-

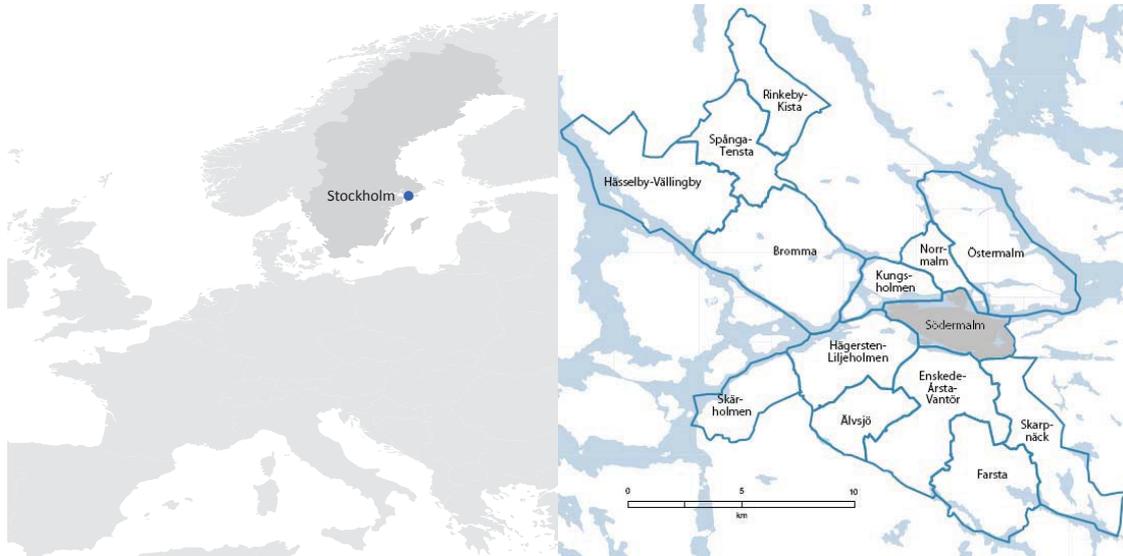


Figure 1.2: The location of Sweden and Stockholm in Europe (own map), and the 14 city districts in Stockholm (based on USK, 2009, p. 25). Södermalm is the city district, which has the highest population (USK, 2009, p. 26).

ban structure, environmental patterns and demographics. The dense urban structure of Södermalm leaves only few possibilities for in-fill development, and the population is relatively environmentally concerned. These two factors have the potential of acting as incitements for implementing ICT as means for pursuing a low energy, low carbon society, and Södermalm is for these reasons chosen as the illustrative case of how a Socio-technical Transition can emerge and be managed.

1.4. Problem Statement

This introduction has illustrated that the current energy usage in Sweden and the rest of the world is unsustainable with depletion of non-renewable sources and climate changes as consequences. This calls for radical changes in order to accommodate the good life of also future citizens and to pursue a sustainable development, and it is argued that the idea of Socio-technical Transition could act as a 'trend-breaker'. Extrapolation is likely to worsen the situation due to the self-fulfilling risks of predictive scenarios, whereas backcasting has been put forward as promising methodological approach when long-term changes, powerfully contributing to sustainable development, are at stake (see chapter 2). To reduce energy usage and CO₂ emissions by a factor 4 or 5 within the next 50 years in the realms of housing and transportation, ICT is one among many means. It has the advantage of indirectly altering peoples' everyday practices towards more sustainable ones without the need for extensive physical changes, for example in the urban fabric. However, having innovative ways of applying ICT as a guiding principle in Socio-technical Transition towards accomplishing a vision of sustainability concretised as a target of a low energy, low carbon society two generations hence does not automatically entail that this will be achieved. Thus, the Socio-technical Transition is divided into a sub-target of 2030, and the time span from 2010 to 2030¹

can be regarded as a Situation of Opportunity. This study will explore, analyse and assess how the full Socio-technical Transition is underway in 2030 (see figure 1.3).

Problem Statement

How could the innovative application of ICT contribute to more energy efficient transport habits and facilitate more sustainable ways of managing and using buildings in a city district such as Södermalm, Stockholm?

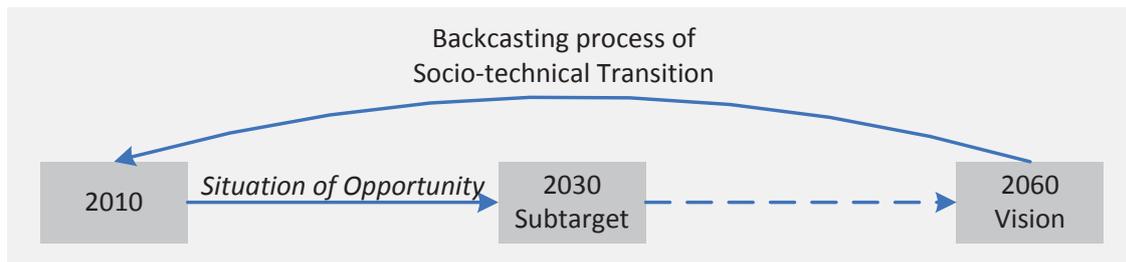


Figure 1.3: The backcasting process of the Socio-technical Transition with the sub-target of 2030.

Objectives

The problem statement functions as a guide for the content of the scenario, whereas the following objectives reflect the purpose of the study:

- The aim with this study is to explore how a Socio-technical Transition towards a low energy, low carbon society can emerge and be realised within the time span of 20 years.
- The aim with this study is to explore how scenario building and backcasting can illustrate a Socio-technical Transition in a context of planning in Western societies.

Delimitations

To narrow down the scope of focus area, this study is mainly concerned with the organisational and social structures of sustainable changes as the primary focus is on the process of Socio-technical Transition from a planning perspective and neither from pure political science nor psychology. Thus, the urban structure is not a major theme in this study, but it is acknowledged that changes of this structure may be necessary in order to accomplish Socio-technical Transition. Since ICT can be implemented in new as well as existing buildings and transport systems, it is not expected that the urban structure will be changed extensively as a result of applying ICT, but rather as a parallel development. Other developments towards reduction of the energy usage, like improved isolation in the building stock and densification, will also happen in parallel to the development of ICT. The scope of the study is not on the specific technical configurations of ICT, but rather on how ICT as a tool for efficiency, substitution and reduction of energy can be introduced.

¹ The time span of the explored Situation of Opportunity is shorter than the usual time span of backcasting studies (Robinson, 1990). A time span of 20 years is regarded as sufficient in order to initiate and realise Socio-technical Transition towards a low energy, low carbon society two generations hence. The start and end year could as well be other years, but using whole decades seem easier to comprehend.

2. Scientific Approach

‘Science [...] is a social activity whose aim is the production of the knowledge of the kinds and ways of acting of independently existing and active things’ (Archer et al., 1998, p. 18).

Knowledge generated for constructing, assessing and discussing a scenario of a Socio-technical Transition is to a high degree based on individual values and normative approaches to science. The scenario can be regarded as the nexus of the study, as it will be developed, analysed, assessed, discussed and reflected on. Hence, the purpose of this chapter and to enhance transparency is to outline and justify how knowledge about a scenario of a Socio-technical Transition is produced in this study. The overarching approach to science in this study is Critical Realism (see Appendix I) and the overall methodological approach is related to Futures Studies and especially scenario building and backcasting. Firstly, the Futures Studies approaches of scenarios and backcasting will be elaborated before elucidating the research design and the structure of the report. The following chapter 3 presents the more concrete and applied methods for collecting data, integrating ideas and checking for consistency. These two methodological chapters as well as the introduction form the basis of the first part of the study.

2.1. Futures Studies Approaches for Socio-technical Transition

Wondering about the future is no new phenomenon and for centuries, even millenniums, people have tried to anticipate the future – although not always with great precision. Within the past 40 years, the field of Futures Studies has gained increasingly steady ground in studies of sustainable development, and several authors such as Bishop et al. (2007), Börjeson et al. (2006), Patomäki (2006) and van Notten et al. (2003) have tried to clarify the typology of the complex and confused field of Futures Studies.

2.1.1. Scenarios

Börjeson et al. (2006) have introduced a typology for the discipline of Futures Studies, in which the main feature is the development of a scenario, illustrating the future situation and the events, leading to those. Regarding the use of scenarios as means for envisioning the future, Bishop et al. (2007, p. 5) state:

‘The scenario is the archetypical product of futures studies because it embodies the central principles of the discipline. It is vitally important that we think deeply and creatively about the future, or else we run the risk of being surprised and unprepared. At the same time, the future is uncertain so we must prepare for multiple plausible futures, not just the one we expect to happen.’

Elsewhere, scenarios are put forward as not only an efficient tool for researchers but also as an efficient and powerful method for communicating knowledge and expression of statements through painting a picture of a plausible future:

‘Scenarios have the potential of being a less rigorous and more open method of exploring the future. Perhaps they are the only method to identify

‘corridors’ of relevant and feasible futures within a universe of possible ones...Used in public planning discussions, scenarios have the potential to translate expert opinion into a format comprehensible also to non-experts and so to stimulate the debate between the expert community and the public’ (Wegener, 1998 cited in Höjer & Mattson, 2000, p. 629).

Construction of scenarios has been designated as an essential component of transformation planning towards a sustainable development (Swart et al., 2004), and although several similar definitions on scenario development have been coined, the characteristics of scenario can be summarised in the following four points:

- ‘scenarios are *hypothetical*, describing possible future pathways;
- scenarios describe *dynamic processes*, representing sequences of events over a period of time;
- scenarios consist of *states, driving forces, events, consequences and actions* which are causally related;
- scenarios start from an *initial* state (usually the present), depicting a *final state* at a fixed time horizon’ (Rotmans et al., 2000, p. 811; emphasis in original).

Three Types of Scenarios

In the typology by Börjeson et al. (2006), a distinction is made between predictive, explorative and normative scenarios. Each of these categories corresponds to the terms of the probable, possible and preferable futures, respectively, outlined in Bell (2003), and the three modes of thinking about the future according to Dreborg (2004); the predictive, the eventualities, and the visionary modes of thinking.

Predictive scenarios attempt to respond to what the most likely or probable future is often based on 1) trend extrapolations (projections) of historical quantified data or 2) assumptions regarding if certain events occur (Bell, 2003). These two types are by Börjeson et al. (2006) labelled as forecasts and what-if scenarios, respectively. Predictive scenarios can be useful to planners, who have to deal with foreseeable challenges, such as climate changes, and have to take advantage of foreseeable opportunities (Shoemaker, 1993). Predictive scenarios are criticised for being self-fulfilling, creating path dependencies and being based on a principle of causalities, which hamper transforming and breaking undesirable historical and present trends (Börjeson et al., 2006; Dreborg, 1996). And due to this, Höjer & Mattson (2000, p. 628) state that predictive scenarios are only useful as ‘alarm-clocks’ of an undesirable development. The time perspective in predictive scenarios is often short-term (Börjeson et al., 2006).

Explorative scenarios aim at emancipating from ‘conventional, orthodox, or traditional thinking’ (Bell, 2003, p. 75) and attempt to examine what can happen in the future from different perspectives (Börjeson et al., 2006). Often, explorative scenarios are created in a fan or ‘set’ of scenarios as a means to widen the possibility of alternative developments and actions and to illustrate their range of possible consequences (Bell, 2003; Börjeson et al., 2006). Based on comparable preconditions, the parameters, which determine the outcome of the scenario, can be adjusted like levers on a machine or numbers in a spread sheet. The scenarios need to be as objective as possible

in order to map a possibility space and inform decision-makers of the present (Sondeijker et al., 2006). They allow structural and profound changes within a rather long time horizon, and they often take a starting point in the future. For example, the scenario could be presented as scales in diagrams (Banister, 2010; Schauer & Demdorfer, 2010) or as different textual images of the future (Gullberg et al., 2007). A tendency within this approach is that an average mean is likely to be chosen (Guttu, 1993). Explorative scenarios can help explore developments that need to be taken into consideration, when society changes rapidly, or when the mechanisms leading to a threatening future are not fully known (Börjeson et al. 2006). For example, explorative scenarios were used in the IPCC study of greenhouse gas emissions to predict a range of possible outcomes (IPCC, 2007).

Normative scenarios are characterised by specifying a specific target, symbolising a desirable future, and a description of how this can be accomplished (Börjeson et al., 2006). By including norms and by beginning with describing a future state, these types of scenarios are normative and explorative at the same time (Dreborg, 1996; Berkhout & Hertin, 2002). The normative scenario types are by Börjeson et al. (2006) further divided into preserving and transformative scenarios, depending on whether the target can be reached within the prevalent societal structure and development, or whether major changes are needed. An example of the latter is backcasting which is an approach, focussing on ways to break the current problematic trends, e.g. in energy consumption in order to reach a desirable and long-term target involving complex issues such as sustainable development (Höjer, 2000; Dreborg, 1996; Höjer & Mattson, 2000).

It can be questioned if all three categories of scenarios in one way or another ‘predict’ the future. The discussion of prediction is brought forward by Bell (2003, p. 98), who argues that the term is being used interchangeably and states that prediction should be defined ‘simply as a statement or assertion about how the future might turn out to be’ under certain assumptive conditions. It is in this study acknowledged that the assumptive conditions should be laid forward in order to increase the transparency of the scenario and the study as a whole, and the assumptions and prerequisites are therefore presented in chapter 6.

The three different categories of generations of scenarios origin from different fields and with different values (see table 2.1). The different categories of scenarios are all part of planning for the future but each have their limitations. As argued, sustainability matters are best dealt with within the tradition of normative scenarios. As the table displays, there has been an evolvment in the tradition of using scenarios for envisioning the future, which is tending as a shift from forecasting to backcasting or from being mainly objective to being more subjective. This is based in the belief that the future is not only predictable but also controllable and shapeable (Shipley, 2000). For example, in the field of British transport planning the past fifty years, there has been a shift in approach from being rationalistic to being more ideological, and what popularly has been labelled a shift in approach from predict-and-provide to predict-and-prevent (Banister, 2002; Owens, 1995). This entailed that projections of the amount of traffic should be

2. Scientific Approach

	Predictive Scenarios (1 st generation)	Explorative Scenarios (2 nd generation)	Normative Scenarios (3 rd generation)
Origin	USA in the 1940s for military studies on inter-continental non-surface warfare – initiated by Project RAND (Cornish, 1977).	EU (Netherlands) in the 1970s during increased rate of societal changes such as the oil crisis – initiated by Shell (van der Heijden, 1996).	EU (UK) and Canada in the 1970s as a respond to the assumptions that energy demand mainly was a function of current policy decisions (Qvist & Vergragt, 2006).
Aim	To explore probable futures (Bell, 2003) based on technological and economical forecasting (Shoemaker, 1993).	To explore different possible futures (Berkhout & Hertin, 2002).	To create desirable future visions and planning how to reach them (Dreborg, 1996).
Applicability	Predictions of probable future needs by extrapolating current trends in e.g. population, infrastructure or energy demands.	Strategic explorations of possible futures of e.g. agriculture or water supply which are based on new techniques or policies.	Desirable planning for e.g. sustainable transportation systems or how to make companies sustainable.

Table 2.1: Origin, aim and applicability for predictive, explorative and normative scenarios.

prevented by, among other instruments, integration of land use and transport planning in contrast to constructing more roads, which eventually would lead to more traffic. The predict-and-provide approach is an example of forecasting, resulting in path dependency cf. predictive scenarios.

The choice of adopting scenario development as the overarching method is highly acknowledged by several authors on e.g. futures studies of sustainability (Rotmans et al., 2000), development of sustainable transportation systems (Banister et al., 2000) and ICT as driver for sustainability (Mansell & Wehn, 1998).

In the approach to scenario development in this study, it is acknowledged that the Socio-technical Transition towards a low energy, low carbon society with ICT as the motor calls for radical changes. Extrapolations based on current developments create path dependency, inhibit free thinking and constrain the current system, which is sought avoided in this study. Explorations of possible futures based on different prerequisites and assumptions can open the debate of which trajectory should be followed, but the idea of matching targets and pathways as in backcasting is regarded as more suitable for the aim of the study in order to create a desirable and sustainable future, which is radically different from the present state. In order to explore how sustainable Socio-technical Transition could happen, a new, open-minded and creative process should be initiated for envisaging the desirable future. As a method for creating a normative, transformative scenario, the backcasting technique is applied in this study.

2.1.2. Backcasting Scenario

Backcasting is an alternative planning technique and was developed in the 1970s, when Lovins (1976) applied the technique on supply and demand of electricity. Lovins, however, called the method ‘backwards-looking analysis’, and later Robinson (1982) proposed to call the method ‘energy backcasting’. Whether backcasting is a technique, a method or an approach can be discussed, but in this study it should be seen as an approach as the application of backcasting implies a reflective and iterative process as well as methods for generation data for the scenario. The choice of backcasting rather than forecasting implies epistemological and ontological considerations of how the future is perceived.

The Methodology of Backcasting

The methodology of backcasting is three-fold. Firstly, normative images of the future are created; secondly, an analysis on the pathways leading to this future is conducted; and thirdly, concrete activities as milestones leading to the desirable future are defined and planned (Robinson, 1982; Robinson, 1990; Dreborg, 1996). Each pathway can be regarded as a storyline, which ‘offers an alternative narrative for how the future may unfold’ (Patomäki, 2006, p. 18). Figure 2.1 displays a visualisation of the backcasting method.

Backcasting is typically applied ‘on long-term complex issues, involving many aspects of society as well as technological innovations and change’ (Dreborg, 1996, p. 814), and backcasting examples on sustainability matters have been applied for:

- sustainable transportation systems (Banister et al., 2000);
- making companies sustainable (Holmberg et al., 1998);
- exploring futures for regions like the Baltic Sea (Dreborg et al., 1999).

In this project, however, backcasting is used in connection to the scenario in order to analyse how the desirable future can be achieved through the creation of four narratives which at the same time illustrate a desired image of the future.

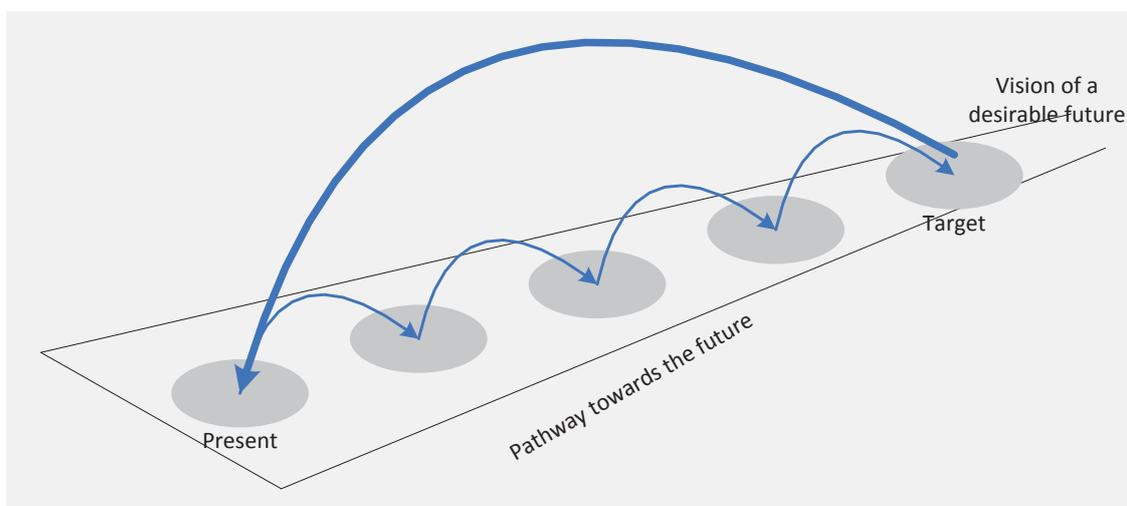


Figure 2.1: The backcasting process.

When studying a complex socio-technical system several intertwining areas must be analysed and as argued in chapter 1, the organisational and social structures are objects of closer assessments and discussions. Closely related to the analytical framework of Situations of Opportunity is the recognition of the duality of structures and actors, or Objects of Change and Agents of Change, and this study is applying the question of how change can happen. Through the creative, analytical and argumentative processes of abduction and retroduction (see Appendix I), the triggering mechanisms and underlying structures are identified and explored.

The scenario in this study illustrates one among multiple possible futures. This stems from the tradition of Critical Realism in which the future is regarded as real but since it has yet to be determined, there are multiple directions of development and opportunities for the future to unfold (Patomäki, 2006). Further, it is based in the belief that there exists a reality independent of our knowledge about it, and that this reality is not immediately empirically accessible (Danermark et al., 2002).

2.1.3. Criticism of Backcasting Scenarios

Narratives and scenarios in general may have the risk of painting a too rosy or science-fiction-alike image of the future (Carlsson-Kanyama et al., 2003; Connelly & Clandini, 1990). On the other hand, the transformative scenario should present a way for transforming the socio-technical system, and the balance between science fiction and business-as-usual may be hard to find. The backcasting scenario should be critically reviewed, as it consists of normative values and there might be a risk of being too utopian. On the other hand, it should be transformative and not be business as usual, and this is another hard balance to find. As the scenario in this project is presented as narratives, it is important to emphasise that the narratives cannot stand alone. The reader should be fully aware of the underlying mechanisms, prerequisites, values and choices behind the illustrated transition to enhance the transparency of the research. However, this also requires the authors of scenario development to be reflective, critical and conscious about choices when developing scenarios. However, the scenario should not be seen as the correct answer to the equation of how a sustainable development can be pursued through transition of a socio-technical paradigm but rather as an exploration of how such a development can emerge with the intention to guide and encourage changes in a more sustainable direction. Especially, the purpose is to illustrate the relations between structures (Objects of Change), the actors (Agents of Change) and the process of how change can happen.

2.2. Research Design

The research design of this prospective study of how ICT can act as a motor for transition includes a strategy for collecting, analysing and assessing data in order to ensure that the problem statement is being answered in the most proper manner. This project does neither aim at only understanding nor only explaining the problems of the current unsustainable energy usage, but instead to explore how a sustainable society can be achieved through planning of a Socio-technical Transition. Such an approach lets the research be rather action and change-oriented with a focus on the processes of social

change. However, the study should not be seen as action research in the traditional understanding as the authors are not involved directly in the change processes. On the other hand, it is acknowledged that affection of the participating stakeholders in the study is unavoidable, and it is likely that they will continue to reflect on the project and its themes within their daily work as e.g. city planners or researchers. The aim with this study, however, is to elucidate an image of the future state of a low carbon, low energy Södermalm and analyse, assess, discuss it with regard to critical aspects for sustainable Socio-technical Transition with ICT as motor for transition.

2.2.1. Illustration of the Research Design

In order to specify how knowledge is created, the research design for this study is displayed in figure 2.2, and this paragraph will elaborate on the illustrated aspects. The double-headed arrows illustrate the iterative process of the project where the scenario and the assessments have been revised several times due to new findings in order to increase the quality of the study.

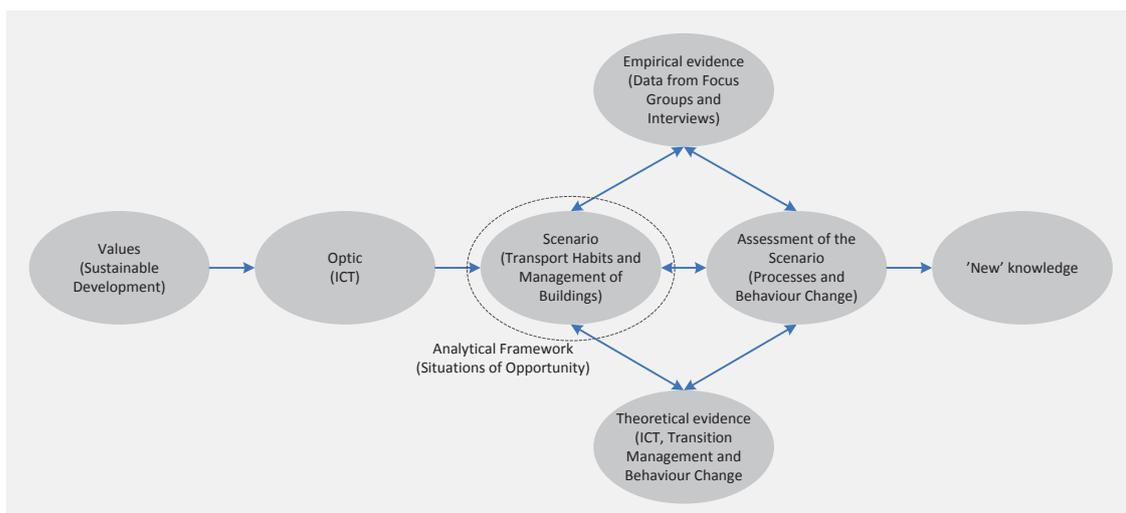


Figure 2.2: Research Design.

Values

Sustainable development, and especially environmental sustainability, is the underlying value guiding and steering the study. The socio-technical system of ICT, sustainable development and the various stakeholders are seen as a complex open system and qualitative methods are regarded as important for understanding how the future is developed. These values and understandings are to some extent built upon the social sciences and especially the Critical Realist approach, which regards society as a complex, multi-intertwined socio-technical reality. According to Patomäki (2006, p. 5), 'it is now widely accepted that values affect or are involved in social scientific research'.

Optic

It is assumed that ICT plays a prominent and leading role in the change towards a low energy, low carbon society, and ICT therefore comprises the optic. It is through the

optic of ICT as the motor for transition that the image of a more sustainable future is developed. ICT is chosen among a broad range of potential solutions which can help initiate societal change towards a sustainable development but due to limited time frame and resources, only one aspect, ICT, is dealt with. With the golden mean of Critical Realism in mind, such complex socio-technical issues can be seen as embedded in society on many levels. Many ICTs are already invented and the development of them is rapidly progressing. They are not science fiction, and a future where ICT plays an important role in society seems very plausible. Therefore, the main question, which is explored in the scenario, is not which technologies should be applied but rather how to initiate applications of them in order to pursue Socio-technical Transition towards sustainability.

Scenario

It follows from the problem statement that peoples' every day activities need to be changed in order to reach an acceptable level of sustainability, and the focal point in this study is to create a scenario where ICT plays an important role for this change. If the image of the future is to be reached, it implies that people in urban areas need to change their ways of thinking and acting. The Socio-technical Transition can be seen as the object of study in this project, and it is assessed from the perspectives of the governance and behaviour changes. It is acknowledged that a transition must be initiated and realised by Agents of Change. Such an approach stems from the social sciences' focus on individuals and groups, the focus on power relations and the Critical Realist approach of interplay between structures and agents (Patomäki, 2006). As seen in figure 2.2, the concept of Situations of Opportunity is applied as an analytic framework in order to illuminate what can change and by whom with the addition of a more transition-oriented approach of how the change can be initiated. This entails that the scenario illustrates a part of a Socio-technical Transition, which is being studied as a Situation of Opportunity. Arguably, Situations of Opportunity and its Agents of Change are similar terms for 'nodal points' and 'motive agencies' within Critical Realism, respectively (Bhaskar, 1986 in Patomäki, 2006). Both theoretical and empirical knowledge will be studied in order to determine the structures and the agents. The scenario is presented as narratives through storytelling, a presentation technique used for maintaining the diversity and complexity.

Theoretical and Empirical Evidence

Evidence regarding ICT and its potentials and down sides is collected through already existing, theoretical knowledge and through empirical data. The methods for collecting evidence and their merits and shortcomings are described and justified in the more concrete chapter 3. Triangulation of methods enhances the validity of the study.

Analysis and Assessment of the Scenario

The scenario is being analysed in terms of the organisational- and social structures and reflected on with regard to the consistency. These structures are being derived from the analytical framework of Situations of Opportunity. During the analysis and assessment, the Situation of Opportunity and the barriers for Socio-technical Transition are being determined. This stage forms the basis of the 'new' knowledge which can be derived from the assessments, discussions, reflections and conclusions.

New Knowledge

The scenario is supplemented by an analysis and assessment of how the Socio-technical Transition is being initiated and carried out. This entails that the approach in the latter part of the project is retroductive because the mechanisms leading to behaviour change in Situations of Opportunity during a future urban development process is identified and analysed. In addition, the scenario is being critically reflected on in order to assess its consistency. New knowledge is created in terms of how and when Situations of Opportunities emerge, how they can be harnessed, and how the barriers for Socio-technical Transition can be coped with.

2.2.2. Creation of Backcasting Scenario and Structure of the Report

This study takes a point of departure in a curiosity about the future by trying to think counterfactually of the ongoing unsustainable societal development because planning based on extrapolations of current developments do not initiate Socio-technical Transition. The ‘counterfactual reasoning about the possible effects of an altered context’ is acknowledged by Critical Realists in order to realise concrete utopias as illustrated through scenarios (Patomäki, 2006, p. 12). Avoiding path dependency is sought through the wondering Seed for Transition to develop a scenario as used within the concept of Situations of Opportunity (Appendix II):

What if ICT was innovatively used in buildings and transport systems to automatically control energy use as well as to inform and persuade users to use less energy?

This counterfactual assumption about the future represents the desirable image of the future in the backcasting scenario and is thereby strongly connected to the low energy, low carbon target. The purpose of Futures Studies is, as the critical realist Patomäki (2006) argues, not to predict the future, but to try to analyse trends and possibilities, and to build scenarios. It is acknowledged that knowledge can be fallible, especially when trying to comprehend the future (see Appendix I for further elaborations on the epistemology and ontology of the study), but scenarios have the ability of exploring the future in order to cope with barriers for Socio-technical Transition. Scenarios, however, can be developed in many ways, for various purposes and under different circumstances as seen above about the typology.

In this study, a procedure of developing a counterfactual scenario with five steps is completed inspired by Schwartz (1991), van Notten et al. (2003), Wiek et al. (2006), van der Heijden (1996), Wilson (2000) and Godet (2001) while keeping the concept of Situations of Opportunities in mind. The scenario represents a case study of how ICT can contribute to sustainable changes in energy usage in an urban district in a Western society – Södermalm in Stockholm. By applying the case study research, it is acknowledged that concrete and context-dependent knowledge can contribute to more general and underlying knowledge rather than finding a so-called ‘Grand Theory’ (Yin, 1981, 2003). Hence, the assessing, discussing and reflecting chapters of the report aim at improving current knowledge; cf. Critical Realism. The steps in the procedure for developing the backcasting scenario correspond to the division of the report into different parts.

The Introductory Part

This part (chapters 1, 2 and 3) elaborates on the problem with the current development of energy use in society, the creation of knowledge and the applied methods. Appendix I and II supplement this introductory part by elaborating on the applied philosophy of science and Situations of Opportunity.

Step 1: Identifying aim, goal and function of the scenario

The first step in constructing a backcasting scenario towards sustainability is to identify the problems with the current development and to make a strategy for how these can be overcome in terms of specifying the aim and goal of transformation. A vision should be created, and the purpose of the scenario should be explicitly presented.

The aim is to study how Socio-technical Transition can be illustrated as a Situation of Opportunity as a scenario. The overarching goal is a Socio-technical Transition's contribution to a low energy, low carbon society. The function of the scenario in this study is to generate alternative inputs to how a more sustainable future in Södermalm can be developed, and to give inputs to assessments and discussions of how the barriers towards Socio-technical Transition can be coped with.

The Theoretical Part (chapters 4 and 5)

Step 2: Creation of knowledge foundation

This step elaborates on the main theories applied in this project; the governance process of Socio-technical Transition and behaviour change. The underlying analytical, explorative approach, Situations of Opportunity, is found in Appendix II. These theories are applied in the scenario and are further assessed and discussed in the assessing part with the aim of achieving a deeper understanding about the structures, mechanisms and power relations that affect agency during transition (Patomäki, 2006).

The Scenario Development Part (chapters 6 and 7)

Step 3: Analysing the prerequisites and assumptions for the future development

In order to identify the Objects and Agents of Change that should transform and lead the future development, the reasons, trends and actors' wants and needs behind the present unsustainable development must be understood (Patomäki, 2006). In other words, in order to change the future we must understand the past and the present. The underlying factors, tendencies and mechanisms of economic, technological, environmental, organisational and social character are being analysed in this study as the 'boundary conditions' for scenarios as a means for increasing the plausibility of the envisioned development (Patomäki, 2006, pp. 10, 23).

Step 4: Presenting the scenario for the desirable future state

As stated above, the backcasting scenario is in this study created with a point of departure in a Seed for Transition; an assumptive question which is guiding the transformation. There are several methods which can be used for presenting the scenario such as computerised models, visualisations or texts but it can be argued that due to the qualitative and explorative approach, a creative and open-minded presentation should be made. In this study, narratives are chosen to illustrate the desirable future and pathways.

The Assessing Part (chapters 8, 9 and 10)

Step 5: Identification and assessment of the Objects and Agents of Change

Based on the vision of and aim with the scenario, the analysis of factors for the future development and the scenario itself the elements which need to be changed can be assessed and discussed. In the scenario literature, these elements are mentioned as parameters, key issues or important factors and by utilising the concept of Situations of Opportunities, they can in this study be mentioned as Objects and Agents of Change and supplemented by the more process oriented 'How to Change' and 'When to Change'.

The key parameters are further assessed with regard to the governance process of Socio-technical Transition and behaviour change, and the critical elements for the transformation process to accomplish are focal points for discussions subsequent to the scenario.

Step 6: Evaluating scientific value

The final step in the construction of a backcasting scenario is an evaluation of the scientific value. Preferably, qualitative and external evaluation of the scenario should be made and six interviews with experts on the subject were conducted. As this final part of constructing the scenario can give suggestions for improvements, some parts of the scenario have needed to be revised.

The Concluding Part (chapters 11 and 12)

This part finalises the report and summarises the findings in a conclusion which is followed by an outlook where other perspectives for achieving the Socio-technical Transition than ICT are elaborated.

2.2.3. Research Questions

This paragraph elaborates on the problem statement by presenting seven subsidiary questions which are compiled in a table and combined with required data, applied methods and main sources. Recalled from chapter 1, the problem statement is:

How could the innovative application of ICT contribute to more energy efficient transport habits and facilitate more sustainable ways of managing and using buildings in a city district such as Södermalm, Stockholm?

In order to address the objectives presented in chapter 1 to a satisfactory level, a number of different subsidiary research questions aim to guide the production of knowledge. Drawing on the approach to scenario building, the chapters following the methodological chapters of 2 and 3 are to be regarded as steps in a scenario development process. The first step is to create a foundation of knowledge in order to develop a scenario illustrating a Socio-technical Transition. Assuming that the current organisational setting and the citizens' everyday practices (but not necessarily the urban fabric) must change in order to achieve a desirable future with ICT as the motor for transition, the focus in chapter 4 is how Socio-technical Transition can be initiated, facilitated and realised by (co-operating) Agents of Change through governance by identifying underlying mechanisms and key factors:

Research question I: *What characterises a governance process of Socio-technical Transition in terms of initiation and realisation?*

Where the previous research question focuses on Agents of Change as decision-makers directly involved in the governance process of Socio-technical Transition, chapter 5 emphasises the citizens as being affected by changes in the organisational and social structures. Embedded in the concept of Socio-technical Transition is the assumption that people must change their everyday practices. With a focus on the social structures, it is examined how citizens can be guided by other Agents of Change and their actions towards a more sustainable path by identifying underlying mechanisms and key factors for behaviour change:

Research question II: *What determines behaviour, and how can it be changed?*

Before presenting the scenario, it is imperative to outline the factors for Socio-technical Transition in terms of prerequisites and assumptions as they reflect choices regarding content in the scenario. The factors draw on current trends within the structures embedded in the concept of Situations of Opportunity and are contextualised to Södermalm in parallel to Agents of Change. Hence, the third subsidiary research question is addressed in chapter 6, and it sounds:

Research Question III: *What characterises Södermalm as the case in the scenario and which societal factors influence the envisioned Socio-technical Transition?*

In chapter 7, the fictitious Socio-technical Transition for Södermalm is presented as a scenario with a focus on the integration of Agents of Change, Objects of Change and how the transition can happen. The construction of the scenario is guided by the fourth subsidiary research question:

Research Question IV: *To meet the target of a low energy, low carbon society through Socio-technical Transition, how are Agents of Change guided by different measures to alter the Objects of Change while sustaining the citizens' good life?*

The scenario is in chapter 8 analysed from the perspectives of governance and behaviour change and subsequently assessed with reference to the concept of Situations of Opportunity through addressing the following subsidiary research question:

Research Question V: *To which extent is the scenario reasonable and consistent in presenting changes of the organisational structure needed to make the proposed measures happen, citizens' behaviour and its determinants as Objects of Change, and interventions?*

As a further step in assessing the scenario in particular and Socio-technical Transition in general, chapter 9 discusses some more overarching issues such as rebound effects, and whether the Situation of Opportunity illustrated as a Socio-technical Transition can contribute to a low energy, low carbon society. Hence, it is a discussion of the degree of sustainability in the scenario. The discussions are guided by the sixth research question:

Research Question VI: *To which extent does the Situation of Opportunity in the scenario contribute to a low energy, low carbon society?*

As a final step in developing a scenario, the scientific value of the study is assessed in chapter 10. This is based in retrospective reflections regarding usefulness of the research design and the applied methods, and because production of knowledge can be fallible. Furthermore, the chapter reflects upon the usefulness of scenarios in a context of planning. The chapter thereby refers back to this chapter and chapter 3. Hence, the seventh research question is:

Research Question VII: *To which extent is the study of scientific value, and how can scenario building and backcasting illustrate a Socio-technical Transition in a context of planning?*

ICT has been the focal means in this study, but it is acknowledged that several other means are at least as important and hold at least as high potential for reaching the low energy, low carbon society. The final research question addresses an outlook of the study in chapter 12 and sounds:

Research Question VIII: *How can other Seeds for Transition than ICT or supplementing ICT contribute to achieving a low energy, low carbon society?*

The research questions are compiled in table 2.2, which also includes the chapter in which the given research question is answered, and what the required data is in order to answer the subsidiary question. Finally, the table illustrates the methods applied to gather this data, and what the key sources of information are.

2.3. Summary

This methodological chapter has presented how knowledge is created through scenario development inspired by Futures Studies and Critical Realism. Furthermore, it has introduced the research design and the structure of the report. The scenario development process is very much related to the concepts of abduction and retroduction within the philosophy of science of Critical Realism, because the underlying mechanisms and structures of Socio-technical Transition are being identified and analysed. As production of knowledge can be fallible, reflections on the conducted methods for creating knowledge in this study are presented in chapter 10.

The values behind this project stem from a purpose to strive for sustainability, and the optic in this study is ICT. The primary methodological approach is scenario development, and the scenario is presented as narratives through storytelling. Theoretical and empirical data is used in a qualitative triangulation in order to create and assess the scenario, and focus group research, literature reviews and interviews are main methods, which will be further elaborated on in chapter 3. New theory on the Socio-technical Transition is developed through the discussions on critical perspectives in chapters 8 and 9.

2. Scientific Approach

Research question	Chapter	Required key information	Methods	Key sources
I. What characterises a governance process of Socio-technical Transition in terms of initiation and realisation?	4	Information about governance, power, roles and planning; that is how a transformation process can be organised.	Literature review	Geels Kooiman Lindblom Loorbach
II. What determines behaviour, and how can it be changed?	5	Information about social structures in terms of determinants of behaviour and policy instruments.	Literature review	Fogg Lindén Vedung Cialdini Fishbein & Ajzen
III. What characterises Södertälje as the case in the scenario and which societal factors influence the envisioned Socio-technical Transition?	6	Information about Södertälje and Stockholm as well as actors related to housing and transportation, including facts and figures. Information about societal tendencies which are prerequisites and assumptions for the scenario.	Literature review Actor categorisation Analysis of statistics	Public agencies City of Stockholm
IV. To meet the target of a low energy, low carbon society through Socio-technical Transition, how are Agents of Change guided by different measures to alter the Objects of Change while sustaining the citizens' good life?	7	Information about ICT applications, planning, Transition Management, behaviour change and Södertälje.	Focus group research Literature review Narrative writing	Kramers Student reports REEB Experiences Chapters 4 and 5 Own ideas
V. To which extent is the scenario reasonable and consistent in presenting changes of the organisational structure needed to make the proposed measures happen, citizens' behaviour and its determinants as Objects of Change, and interventions?	8	Information about organisational structures, measures, ICT applications and behaviour change with a point of departure in the scenario.	Literature review Interviews	Experts Own reflections Chapters 4 and 5 Appendix II

Research question	Chapter	Required key information	Methods	Key sources
VI. To which extent does the Situation of Opportunity in the scenario contribute to a low energy, low carbon society?	9	Information about sustainability, rebound effects and Futures Studies.	Literature review Focus group research Interviews	Røpke Høyer Wangel Own reflections Experts Appendix II Chapter 2
VII. To which extent is the study of scientific value, and how can scenario building and backcasting illustrate a Socio-technical Transition in a context of planning?	10	Criteria for scientific value.	Interviews Own reflections Literature review	Miles & Huberman Lincoln & Guba Experts Own reflections
VIII. How can other Seeds for Transition than ICT or supplementing ICT contribute to achieving a low energy, low carbon society?	12	Information about other perspectives and instruments and their applicability.	Literature review	Experts Own reflections Flyvbjerg Wallgreen

Table 2.2: A systematic overview on the procedure in the study. The table as a research strategy is inspired by Yin (2003).

3. Applied Methods

Having justified how the different parts in the project are integrated and how knowledge is produced, the purpose of this chapter is to justify the selection and application of methods for developing and assessing the scenario as well as their merits and shortcomings. Börjeson et al. (2006) suggest that scenario development, or the production of knowledge in more general terms, requires completion of the following three steps, each step with its affiliated methods: generation of ideas, integration of ideas, and checking for consistency. This threefold division forms the base for this chapter.

3.1. Methods for Collecting Data – Generation of Ideas

In this study, desk as well as field research (Armstrong, 2006) are applied as the overall approaches for collecting data to produce knowledge. Desk research has proven to be an inexpensive method for collecting information and by complementation of field research, a comprehensive picture of the studied field is obtained. The two main methods in desk and field research are literature review and focus group research, respectively.

3.1.1. Literature Review

To obtain a thorough understanding about ICT's applicability for changing the energy usage in transport and housing as well as to generate ideas for the scenario, a number of relevant sources were identified through mainly Google Scholar searches before their content was reviewed. The search was not set up to encompass only scientific literature (such as journals and books) but also publications from governmental and non-governmental organisations to widen the field of knowledge and perspectives. The information encompasses both qualitative and quantitative information such as statistics. However, the reviewers have responded to the literature with a critical eye in order to sustain a high scientific quality.

In general, the purpose of doing literature reviews is to generate an understanding about the topic in question based on relevant concepts and theories, to detect possible controversies and inconsistencies among authors, and to reveal unanswered problems (Bryman, 2008). The method of literature review is applied with different purposes and in different parts of the project, which are further described below.

The Introductory Part

The first part of the report can be seen as the preliminary stage of creating a knowledge foundation for developing the scenario together with the theoretical part. Literature is reviewed in order to gather basic information about the current problems due to energy usage and about the development within ICT and sustainability.

Swedish and international statistics and reports from organisations and agencies such as IPPC and Statens Energimyndighet have been studied in order to analyse the development in energy and CO₂ consumption and the development of ICT. Documents and other written information from governmental and private organisations such as City of Stockholm, the Swedish Transport Agency and Ericsson have been analysed in order to gather information about the context-dependent present state, ongoing development

and visions, and strategies for the future. Finally, a large number of theoretical papers from international journals have been studied in order to develop a sufficient general and theoretical knowledge base before analysing the findings in the focus group research (see the list of references).

The Theoretical Part

In this part, literature review is applied to gather theoretical knowledge about important themes, issues and elements to be included in the scenario. Literature such as peer-reviewed journal articles and books has been reviewed with regard to what the perspectives of transition management and behaviour change encompass and how it can be achieved. The literature reviewed is mainly written by contemporary psychologists, sociologists, political scientists and planning theorists such as B.J. Fogg, Anna-Lisa Lindén, Evert Vedung, Frank Geels and René Kemp. Using the newest research in the field is another way of increasing the scientific quality of the study as the historical and social context of these has not changed much within the past few years.

The Scenario Development Part

Having gained a base of general knowledge, the next step was to collect the actual specific data for the scenario. Together with focus group research (see below), literature reviews were used to assemble a broad range of ideas from written sources with knowledge on the specific context:

1. Basic information about the scenario settings; i.e. information about Södermalm and Stockholm in general and about factors for a Socio-technical Transition;
2. A literature review on ICT for reducing energy usage in buildings; and
3. A literature review on student reports from the 2009 master's course 'Planning the Sustainable City' at KTH.

Ad 1) See the paragraph above about the application of literature reviews in the introductory part.

Ad 1) The literature review on applied ICT in buildings was conducted by Ph.D. student, Anna Kramers, from the Centre for Sustainable Communications, KTH. With Kramers' more than 10 years of experience in a large international company, which develops different kinds of ICT and its related infrastructure, the prerequisites for conducting such a literature review are assessed to be fulfilled. The review itself contains descriptions of a broad range of technical devices, installations and ideas as well as analyses of their merits and shortcomings in terms of:

- The actor perspective,
- The possible energy reductions,
- The personal integrity, and
- Synergies and conflicts between different kinds of objectives.

Kramers' report builds on conclusions drawn on the two year European Strategic Research Roadmap to ICT enabled Energy-Efficiency in Building and Construction (REEB), and can therefore be concluded to hold a high degree of validity and reliability (see further reflections regarding the scientific quality of the study in chapter 10).

Ad 1) The review of the student reports, on the other hand, seize more freely interpretations of what, by whom and how ICT can be motor for the transition towards decreased energy usage in the building and transportation realms. The review was mainly completed by two of the master students who followed the course (Lewakowski et al., 2010). The aim of the review as well as the student reports was to outline as many plausible ideas for the implementation of ICT as possible. As the students come from a broad range of theoretical backgrounds, the plausibility aspect might be underdeveloped in some cases. Although some of the ideas seem somewhat science-fiction-like, many new basic ideas were put forward, which complement the theoretical perspectives, as they are given new and free angles on how a Socio-technical Transition can happen.

3.1.2. Focus Group Research

To enable the creation of a scenario for Södermalm in year 2030, the research method of focus group research is chosen to collect empirical, qualitative data. It allows a group of deliberately selected people in interaction to discuss, share and compare their understandings and perceptions about a given topic (Bryman, 2008; Morgan, 1998) or to generate ideas and identify opportunities in relation to a given topic (Morgan, 1998). This implies that the data is generated through group discussions rather than interviews (Morgan, 1998) despite that many of the considerations regarding conducting interviews are similar to the ones for conducting focus group research (Bryman, 2008). However, focus group research has the advantage of producing a great amount of in-depth and context-dependent inputs in a short period of time compared to individual interviews (Bryman, 2008; Morgan, 1998). Furthermore, the interaction allows participants to be inspired by and expand on ideas from other participants. Morgan (1998) stresses that the motivation for conducting focus groups research should be a desire to listen to and learn from people.

In this project, focus group research is applied with a little twist. Here, the purpose of collecting empirical data is to generate ideas for the scenario content rather than providing an understanding of how the participants comprehend and construe the topic – in this study ICT. In this sense, a range of important inputs to the scenario is developed from data gathered from listening to and learning from people. Another opportunity was to gather a group of experts to discuss and reach consensus regarding a future state in which ICT has been implemented, which is the typical approach in Delphi studies (Dalkey, 1969). However, the intention with focus group research in this study is to have as wide an approach as possible to use ICT as a means to change the energy usage.

Börjeson et al. (2006) argue that workshops, in which a variety of creative techniques can be applied, are appropriate when the intention is to generate ideas for a qualitative scenario, which is the case in this study. In the 1950s, the American advertising manager, Alex Osborn, developed the creative problem solving and -finding technique known as 'brainstorming' (Rickards, 1999). This approach for generating new ideas from an ability to emancipate groups from restricted thinking has won worldwide recognition. In its most classic meaning, a group get together facilitated by a moderator, which is similar for focus group research (Bryman, 2008; Morgan, 1998), and through freewheeling thinking generate a list of ideas, which subsequently is clustered in

themes, evaluated and processed (Osborn, 1963). From a Futures Studies perspective, this technique seems suitable for envisioning alternative and desirable images of the future and pathways leading to these. Therefore, in this project workshop sessions are held with focus groups aiming at generating ideas for the scenario content by means of brainstorming.

In the remainder of this section, considerations regarding preparation and conduction of the workshop are presented with continuous reference to the textbooks about focus group research and the brainstorming technique.

Preparation of Workshop

This stage includes considerations regarding the selection of participants, and how they are invited. The preparation also includes articulation of questions to be addressed in the actual workshop. Bryman (2008, pp. 481-482) stresses that one focus group is insufficient but realises that the number depends on time and resources available to the researchers conducting focus group research. Preferably, the number should reflect theoretical saturation, meaning that the moment when ideas are repeated reflects the sufficient number of different focus groups. Regarding the size of focus groups, Bryman (2008, p. 479) recommends smaller groups (around 6 participants) when the issue at stake is complex, and when participants are more likely to demonstrate a willingness to talk. On the other hand, larger groups are preferred when the aim of the sessions is to reveal numerous and brief ideas. There is a general agreement about the preference of having homogenous groups selected from stratifying criteria to ensure comparability between different focus groups (Bryman, 2008). Furthermore, it is recommended that the participants are not too familiar with each other to reduce the influence of inherent power relations and 'taken-for-granted assumptions' (Bryman, 2008, p. 482).

In this study, two workshops with focus groups, each consisting of five participants, were carried out on 3rd and 17th November 2010 in Stockholm. Each session took place at KTH, and this location seemed neutral to all participants. The participants were selected from the criteria of having a connection to the SitCit research project and/or of having expertise or occupation in the fields of urban planning, Futures Studies, Socio-technical Transitions, and/or ICT. The group of participants was sought to be unknown to each other and to be a mixture of experts and stakeholders. No citizens in terms of end users were invited to participate as knowledge about the interaction between humans and ICT already exists. In addition, no politicians were invited because they were perceived to have too little knowledge in the specific fields. The participatory technique of involving both stakeholders and experts is quite new, but acknowledged, in focus group research and in the Futures Studies by Robinson (2003) and most of the speakers at the Stockholm Futures Conference in 2010. Furthermore, the use of expert can be regarded as a means for overcoming subjective bias of the authors (Patomäki, 2006). More generally, the method of using interaction among scholars and practitioners to produce (better) knowledge and achieve legitimation is referred to as Interactive Social Science (Caswill & Shove, 2000). The deliberative selection of respondents is applicable from interviews, where the interviewees are deliberately selected due to the idea that they have the best to offer to the research. However, some participants

may be biased by being employed in companies which are financing parts of the SitCit research project. There is a risk that these participants are cultivating specific ICT solutions beneficial for their companies while rejecting other non-beneficial ideas. What the participants choose or not choose to say during the brainstorm activities is beyond control of the moderators, but the below mentioned conventions aim to encourage that the participants do not get stuck on a certain lane of thinking. Retrospectively, the above discussion on bias did not seem to be a problem during any of the two focus group sessions. Research leader on the SitCit project, professor in urban sustainable development Örjan Svane, kindly aided at identifying and contacting the participants as they also are working and living in Stockholm. More than fifteen possible participants were contacted by email in Swedish with an attached invitation in English. The email/invitation contained information about the research project, the purpose of the workshop, and how they would be able to contribute with their respective knowledge. Those participants who responded to the email are listed with names and occupation in table 3.1 and 3.2 for each session. It is evident from the table that the participants in both focus groups are a mix of practitioners and researchers as well as occupied in various fields. In Bryman's (2008) viewpoint, the size of five participants in each session can be characterised as small groups. The intension to get a wide range of ideas calls for larger groups, but a complex issue as sustainable urban transformation calls for small groups. Since three reminders on email only had a minimal effect on the number of responds, the size, therefore, is an adequate mix in between the two ends of small and large groups. Furthermore, the idea of having two minor groups instead of one large is to make the participants feel comfortable and to let other ideas flourish in the case that the group gets stuck in one track of thinking.

Name	Occupation and background
Joakim Barkman	Trained in transport and communication and works as a project manager at the Swedish Transport Administration (Trafikverket) with traffic management and traffic information services – especially the Swedish journey planner Trafiken.nu.
Anna Kramers	Ph.D.-student at the KTH Centre for Sustainable Communication, studying ICT's potential to create sustainable cities, has worked several years for Ericsson with the more technical aspects of ICT.
Nicholas Richter	M.Sc.-student in Spatial Planning at KTH where he has worked with the concept of Situations of Opportunity, daily user and fond of several ICT applications.
Craig Donovan	Employed at Ericsson Research, is working at the Royal Seaport project and with the Smart Grid.
Josefin Wangel	Ph.D.-student at KTH, works on the Bromma case in the SitCit research project, is knowledgeable in theories on governance of change, meta-governance and transitions.

Table 3.1: Overview of the participants in focus group 1 and their background.

Name	Occupation and background
Jorge Luis Zapico	Ph.D.-student at the KTH Centre for Sustainable Communication, trained in computer science and sustainable technology, researching on the linkage between technology and sustainability.
Elias Arnestrand	Researcher in sustainable transport at the Viktoria Institute (research in applied information technology within the transport sector) and traffic planner at Samtrafiken (a national Swedish organisation that coordinates journeys with different travel modes).
Rebekah Cupitt	Ph.D.-student at the KTH Centre for Sustainable Communication, studying the process of change and the human interaction with computers, trained as an anthropologist.
Donnie Lygonis	Employed as a Technology Transfer Manager at KTH Business Liaison with how the KTH ideas can be transferred into practice.
Daniel Koch	Ph.D., architect, researcher and teacher in Urban Planning and Design programme and in architecture theory at KTH School of Architecture and runs his own business, Patchwork Architecture Laboratory.

Table 3.2: Overview of the participants in focus group 2 and their background.

Conduction of Workshop: Generation of Ideas

The workshop is the session where the empirical, qualitative data is collected, and completion of this stage includes considerations regarding time, the type of activities, the nature of questions, and the level of moderator involvement.

The textbox displays the agenda for the workshops, including the variety of activities. The sessions lasted for approximately three hours, and either started or ended with an hour lunch paid by Sit-Cit to show gratitude for participation. The workshops started by a presentation of the moderators and this study, the purpose of the workshop, how the data was intended to be used subsequently, and the participants were introduced to each other. Furthermore, consent to record the session was requested, and it was guaranteed that the participants would not be quoted in the further analysis of ideas. Finally and recommended by Bryman (2008) and Osborn (1963), the conventions for the workshop were outlined, and they are based on guidelines developed by Osborn (1963, p. 156):

Agenda for workshops

- Welcome and introduction to the session
- Structured brainstorming: what-who integration
- Break
- Unstructured brainstorming: how
- Future ICT experience
- Ending

- ‘Criticism is ruled out.
- “Free-wheeling” is welcomed.
- Quantity is wanted.
- Combination and improvement are sought.’

Furthermore, and in order to improve the quality of the recordings, it was requested that only one participant should speak at a time. Moreover, the participants were encouraged to go to the future and stay there.

The first activity was a group based structured brainstorm in which the participants in turn should mention either an Object of Change or an Agent of Change as two of the main features of the concept of Situations of Opportunity (see Appendix II). The structured brainstorm had the purpose of generating ideas to the integration of what can change in the urban development process and by whom in order to achieve sustainable development. For a ‘traditional’ focus group discussion, a list of questions is produced beforehand, as with an interview guide for unstructured interviews. This is done in order to ensure that the discussion remains focused on the issue at stake, and if the discussion fades (Bryman, 2008). However, additional questions should be asked as/ if they arise during the discussion (or conversation in interviews) (Bryman, 2008). The questions should be phrased as open-ended questions to encourage multiple answers and discussion. However, as the brainstorm was structured, open-ended questions were not formulated. Instead, a list of three Objects of Change and three Agents of Change was prepared to allow the structured brainstorm to develop in potentially different directions. The list is displayed in table 3.3. The Objects of Change were selected from the idea, that they fit the content of the problem statement. Travels to work and heating were chosen because they were found in chapter 1 to be the most energy consuming activities per person in Stockholm related to the themes within the problem statement. Habits were chosen because it is assumed that people must change these in order to achieve Socio-technical Transition. The Agents of Change were selected because they are assumed to be the three leading actors in Socio-technical Transition, either as ‘receivers’ or ‘senders’ of change (see chapter 6). It turned out that the structured brainstorm in session 1 was very general, and the ideas could be applied in any city district and even any country. This, however, emphasises the potential for transferability from one case to another, but to contextualise the ideas more to Södermalm and Stockholm, the list was more specific for the second session (see table 3.3). Furthermore, the moderators experimented with the idea of starting each structured brainstorm with a what-if-question that took a point of departure in either a specific

	Objects of Change	Agents of Change
Session 1	<ul style="list-style-type: none"> - Travels to work - Heating - Habits 	<ul style="list-style-type: none"> - Citizens - Private companies - Public authorities
Session 2	<ul style="list-style-type: none"> - What if ICT was used to plan <i>work journeys</i>? - What if ICT was used to control the <i>heating</i>? - What if ICT was applied to change peoples’ <i>everyday life</i>? 	<ul style="list-style-type: none"> - What if the <i>citizens</i> in Södermalm initiated the change? - What if <i>private companies and public authorities</i> such as Fortum and SL collaborated to initiate the change? - What if <i>public authorities</i> such as Stockholms Stad initiated the change?

Table 3.3: Words and phrases used to ‘kick-start’ new rounds of structured brainstorming.

Object or Agent of Change. This was inspired by the overarching what-if-question for this study as presented in chapter 2.

The structured brainstorm was carried out as six rounds of 5 minutes followed by a short break to clear minds before the next round started. Each round was initiated by the moderator with one of the six 'kick-start' words in table 3.3, and the involvement of the moderator can therefore be characterised as modest. Usually in a structured brainstorm, the 'chain' continues until all participants have passed. The aim of having a time limit was to encourage impulsive and unusual thinking (quantity of ideas) and to ensure that different themes were covered in the brainstorm. The structured brainstorms were recorded and transcribed, and the results can be found in Appendix A1 and A2. In a conventional brainstorm, the generated ideas would now be clustered and evaluated by the participants, but as the purpose is to generate ideas, they undergo a subsequent processing by the authors instead (see section 3.3). However, during a break, the participants were asked to individually place three Xs on the most promising Objects of Changes and three Xs on the leading Agents of Change.

Since one of the limitations with focus groups research is that the researcher can have less control over the proceedings and thus the outcome (Bryman, 2008), the structured brainstorm prevented this risk to flourish. However, Bryman (2008, p. 480) stresses that 'the approach should not be intrusive and structured' and with Morgan's (1998) definition of focus groups as being group discussions, the next activity in the workshop was an unstructured brainstorm/discussion of 30 minutes.

In the unstructured brainstorm, the participants were to a greater extent allowed to think freely on, modify and question each others' ideas. The unstructured brainstorm started by each participant briefly telling, where and why they placed the six Xs. Without any request from the moderators, the participants started to discuss each others' choices in both sessions. The discussion focused on the 'how' aspect of transition, and the discussion was guided by questions asked by the moderators such as the following:

- How can the policy instruments be implemented?
- How can the transformation be initiated?
- How can the stakeholders collaborate?

Again, the involvement of the moderator was modest to encourage a vivid and free discussion. The unstructured brainstorms were recorded and transcribed (see Appendix A1 and A2). A risk in a group discussion or unstructured brainstorming is related to the group dynamics (Bryman, 2008). For example, participants may be more or less reluctant to speak in front of others or one or more are more dominating than others. However, it must be assumed that the participants with their positions as practitioners and researchers are used to speak in front of an unfamiliar audience. To encourage a fair and equal discussion, it was in the introduction to the workshop outlined that all viewpoints and ideas would count equally. Furthermore, during the discussion the moderators gave the word to less dominant participants if it turned out to be necessary.

The final activity was an individual writing. By now, the participants would hopefully have been introduced to many ideas, promoting urban sustainable development. Thus, the purpose of this activity was to write down an image of a future in which people to a greater extent use ICT in their everyday life concerning transportation and housing management. In other words, in 15 minutes the participants were requested to write a short narrative about a future ICT experience, which is also the way the data from the workshops were intended to be processed subsequently (see section 3.3). The participants' narratives can be found in Appendix A1 and A2 as they can have contributed with ideas for the scenario.

The workshops had a mixture of creative (structured brainstorm and writing the narrative) and more analytical exercises (unstructured brainstorm) which required the participants to 'jump' back and forth between the future and the present. To guide the participants, the moderators gave small comments such as 'envision you are in 2030' or they talked in the past tense. Inspired by the method of Mental Time Travel (Markley, 2008), the moderators tried to a greater extent to bring the participants into a visionary mood in session 2. This was done by asking them to close their eyes, envision that they left all their prejudiced ideas at the central station in Stockholm and took a vehicle to Södermalm. The ideas emerging at session 2 are slightly more creative than in session 1, but whether this is due to the participants' personalities and inherent creative mindset or the mental time travel is unknown and difficult to guess about.

During the workshops, the authors swapped between being the moderator and the 'secretary' which aimed at ensuring a good flow. Having two focus groups with time in between also allowed the study's authors as moderators to modify the agenda and activities.

3.1.3. Summation

As this study examines how a Socio-technical Transition can happen and as illustrated as a scenario, it requires data to be collected. This happens through the methods of literature review and focus group research. The former focuses on collecting written, existing knowledge, whereas the latter is applied to generate and collect oral knowledge. The combination of using desk as well as field research is to achieve a wider perspective on ICT and its applicability as it was also justified through figure 2.2.

3.2. Methods for Processing Data – Integration of Ideas

The purpose of processing data is to integrate the ideas from the focus groups and the knowledge obtained from literature reviews into a consistent, cohesive whole – the scenario. However, such a scenario does not emerge spontaneously and the following section describes the stepwise creative process of creating the scenario that the authors went through. Reading of the scenario does not entail knowing about the rather creative process behind its construction, but the process may illuminate the selection of different themes and choices behind the narratives and thus what the scenario contains. Following that, the concept of narrating is introduced because the scenario is presented as four narratives. This is mainly drawing upon the American linguist Bar-

bara Eckstein, who in recent years has been researching in the role of storytelling in a context of urban planning, Futures Studies and sustainability.

3.2.1. Creation of Scenario

The process of creating the scenario included several steps and is illustrated in figure 3.1; each step is elaborated on below.

Step 1: Compilation of Data Basis

As justified in the previous section, a combination of desk as well as field research was chosen in order to collect as broad a range of ideas for the scenario as possible. Thus, the first step of the scenario creation was compilation of data basis. During the authors' actual writing of the narratives, search for more specific knowledge about, for instance, Södermalm or a specific ICT also took place when it was found necessary. Hence, the retrieving line from step 6 to step 1 in figure 3.1.

Step 2: Analysis of Data

Having compiled the data basis in step 1, the analysis of data by each author aimed at identifying ideas and clustering them into themes as a sort of 'meaning categorisation' (Kvale, 1996, p. 196ff) with the intention to reduce and re-order the comprehensive amount of data. The selection of main categories was predetermined by the authors in collaboration, but the identification and clustering of ideas was done by the authors separately in order to minimise biased subjectivity (Kvale, 1996, p. 208). The main themes were based on the overall division of ICT's qualities into automation/control and/or persuasion/information, but also from the conviction that implementation would require more than just the existence of ICT in itself. Under a final category, it was allowed to list own ideas. The main themes were:

- Automation/control,
- Persuasion/information,
- Driving forces,
- Power,
- Initiators/initiating events,
- Barriers/obstacles,
- Instruments,
- Misc. ideas (those that did not fit into any of the above categories), and
- Authors' own ideas.

Step 3: Creation of One Idea Bank

The two sets of ideas created in step 2 were in step 3 compared towards one set of ideas. Taking one category at a time, the ideas were written down on post-its and clustered on the black board in the group room. It turned out that the two 'idea banks' complemented one another fairly well. Many ideas were identical but each author had unconsciously focused differently on each theme which meant that the idea bank became much broader. With the typology of the concept of Situations of Opportunity, the joint idea bank can be said to be the Field of Options but contains mainly ideas in terms of Objects of Change (see Appendix II). The idea bank can be found in Appendix A3.

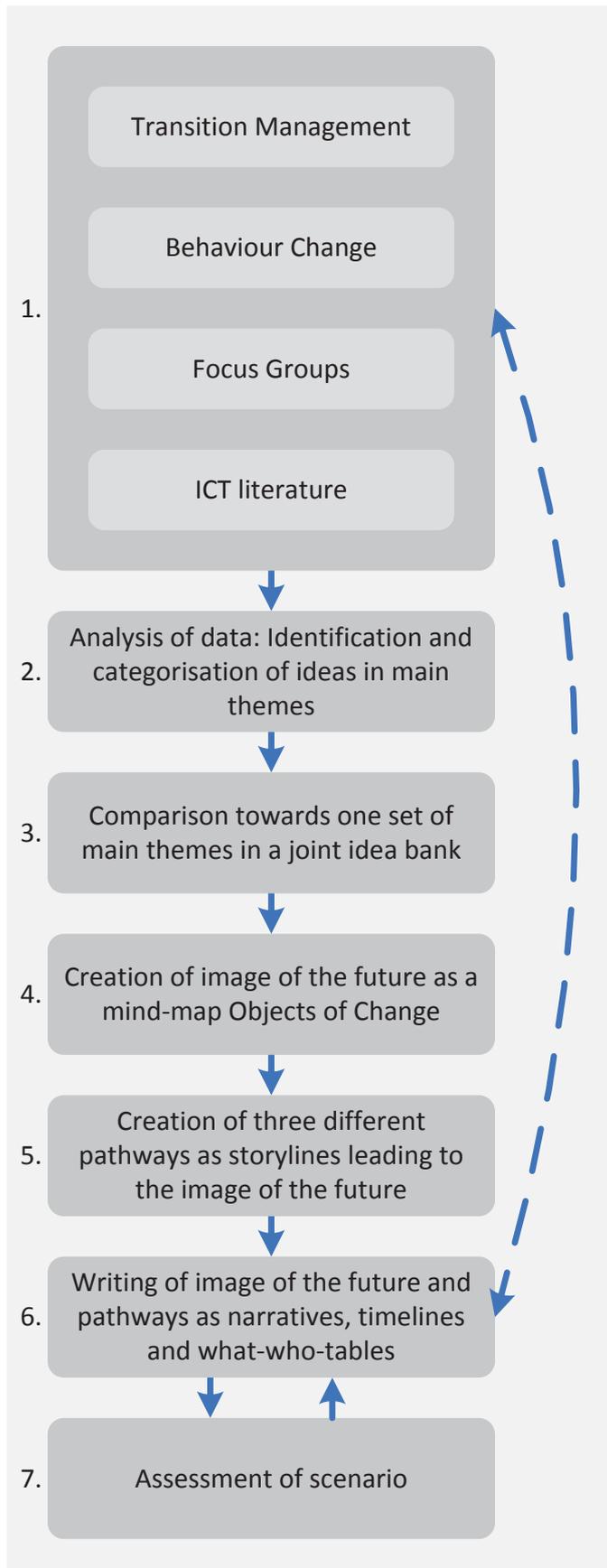


Figure 3.1: The process of creating the scenario.

Step 4: Creation of Image of the Future

In backcasting, the image(s) of the future are created before the pathways in order to ensure that the pathways are directed towards the desirable future. Thus, having created an idea bank, the aim of step 4 was to get an overview of how the ideas and actors could be connected to each other in an image of the future – a future which is ideally more sustainable than today. The tool for obtaining this overview was ‘an extended version’ of mind-mapping. Usually in mind-mapping, the subject of study is written in a circle from which lines with affiliated themes are drawn from which again lines with more specific topics are drawn. This ‘spider-web’ can principally continue with a greater complexity as a result and perhaps a lost overview. In this scenario creation process, the web of ideas started with the smart phone in the middle as this device was found to be an important feature of the future. Several lines were then drawn to other ideas as they were added to the piece of paper. A simplified illustration of the idea mind-map is displayed in figure 3.2

and a photo is attached in Appendix A4. A similar mind-map was intended to be created for actors in order to link and enhance the linkage between the actors and structures. However, the actor mind-map soon became too complex and chaotic as most actors were connected either directly or indirectly, and it was therefore decided to scrap the idea of a separate actor mind-map and instead make them more visible in the creation of pathways.

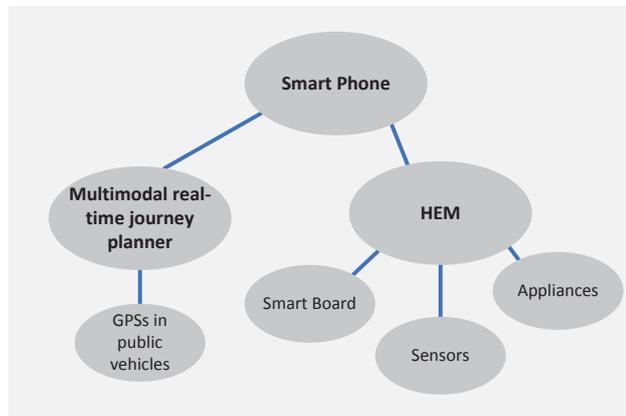


Figure 3.2: Simplified illustration of idea mind-map.

Step 5: Creation of Pathways

Having a perception of how the future should look, three different pathways were created with the aim of illustrating three different initiators/initiating events. It was soon found that the pathways more complemented each other and the image of the future than being three different, possible pathways, reflecting a Socio-technical Transition. Therefore, the scenario comprises four narratives which reflect four different perspectives on the Socio-technical Transition, and it thus contains elements of the end state (year 2030) as well as the process. As the image of the future, the three ‘pathways’ were created as notes on a large piece of paper in five year intervals. The Objects of Change, Agents of Change and measures that need to be implemented in each five year period were then written down under each year. A simplified illustration is displayed in figure 3.3, and photos are attached in Appendix A4.

Step 6: Writing of Scenario

The next step was to translate the mind-map and pathways notes into something readable. To illustrate the Socio-technical Transition from different angles and more vividly, different writing styles, layouts, and narrators/characters were chosen in the four narratives (see below about presenting the scenario as narratives). Already now it should



Figure 3.3: Simplified illustration of a pathway where each year reflects kinds of milestones in the transition.

be noted that the scenario as a whole should not be perceived as a complete strategy towards the future but more as an illustration of how Socio-technical Transition can emerge and be realised. Other authors as well as different data would without doubt result in another kind of scenario.

Step 7: Assessment of Scenario

As a final step, the scenario is being assessed in order to identify rationales and mechanisms that influence a Socio-technical Transition. The assessment of the scenario is based on data collected through interviews with experts (see section 3.3), who revealed different aspects of the scenarios which could be altered to enhance the consistency and realism. Thus, the scenario underwent a final revision with minor changes; hence, the retrieving arrow in figure 3.1. The consistency of the scenario is assessed in chapter 10.

The stepwise process of creating the scenario has been rather creative with the use of different tools in order to get from data to narratives. Each step has narrowed down the great amount of data, and there is a risk that 'good' ideas have become deselected because they at one time did not seem to fit into the story of a desirable Södermalm. Another risk is that the chosen ideas are not the most energy efficient or reducing solutions due to the authors' lacking skills in energy technology. On the other hand, the identification of possible implementation obstacles even before the writing of the scenario may result in a more realistic scenario instead of being a pure heart-warming story. The theoretical chapters, the scenario and the subsequent assessment aim to generate insight into the deeper connections in reality as well as to enable the identification and analysis of the underlying mechanisms, relations and structures which influence Socio-technical Transition. As such, the scenario and the assessment reflect abduction and retroduction (see Appendix I).

3.2.2. Presenting the Data: Narratives and Storytelling

In this project, the scenario is presented in the form of narratives/stories because:

'Carefully told and carefully heard, stories do have the potential to act as a bridge between engrained habits and new futures, but their ability to act as transformative agents depends upon disciplinary scrutiny of their forms and uses...A focus on storytelling emphasizes the elusiveness of truth and the complexity of desire. For those who want to plan for a sustainable urban future, these qualities must be acknowledged and explored' (Eckstein, 2003, pp. 13-14).

Furthermore, scenarios presented as stories can provide more vivid ideas of the future, which are tangible for the reader to envisage and comprehend (Lewakowski et al., 2010; Bang et al., 2010). Narrating stems from the interpretative schools of philosophy of science, and it has, for example, been used in urban planning research by Simonsen (2005) to understand how people perceive the city because they construct narratives when they talk about the city they live in.

The stories must be ‘provocative, memorable, eliciting a rich imaginary’ (van der Heijden, 1996, p. 213). They can be defined as ‘verbal expressions that narrate the unfolding of events over some passage of time and in some particular location. Stories use language to frame what has happened to a set of characters in a particular time and space’ (Eckstein, 2003, p. 14). Connelly & Clandini (1990), however, distinguish between stories and narratives by stating that stories are the phenomenon when people tell about their lives and experiences, whereas narratives are a method used by researchers to present the stories told by people. Using this categorisation, the scenario created in this project is a narrative. The following section presents the characteristics of a narrative.

Characteristics of Narratives

A narrative consists of an author, a reader and the actual story. The *author* is invisible in the story but s/he incorporates values and assumptions and must be acknowledged as a person to enhance transparency and credibility (Eckstein, 2003). The narratives are written and told by the authors of the study and are based on the generated ideas from literature reviews and focus group research. Careful listening to the focus group participants is required (Forester, 1989) and so are skills of interpretation. When the participants’ orally produced ideas are converted by the authors into written narratives, the authors’ values of sustainability and ICT are incorporated in the narratives and scenarios (Connelly & Clandini, 1990), which is also encouraged by van der Heijden (1996, p. 213).

The *reader* is the person, who the story is aimed at (the receiver). The reader should be invited to participate in the ‘real’ transition (Connelly & Clandini, 1990) and encompasses end users as well as directly involved actors in the implementation. A deliberate use of person (singular or plural) is a tool for implicitly defining the reader and his/her tasks and different ways for presenting the objectives of the story (Eckstein, 2003). For example, the use of ‘we’ can emphasise that the Socio-technical Transition should be carried out collectively and urge a feeling of ‘standing-togetherness’, or ‘I’ can see and hear for the reader and in that sense personalise the narrative.

From the previous definition of a story, it is evident that narratives combine the features of space and time by bringing order to events in a certain location (Eckstein, 2003). Space and time are by Connelly & Clandini (1990) referred to as the scene and plot, respectively. The scene in the narrative is characterised by place/physical environment, cultural and social context, and characters. The latter feature is also recognised by Eckstein (2003), who states that it should be possible to both identify the actors and the events leading to transition, which is in line with the Situations of Opportu-

nity's emphasis on addressing the questions of what, who, how and when (Appendix II). In that sense, narratives can unfold the perception of transition from the character's point of view, and the character could thus very conveniently be a resident in Södermalm, who through ICT has changed habits in the everyday life. By that, the transition may become more evident. The plot refers to the temporal dimension of a narrative, which always has a beginning, mid and end (Connelly & Clandini, 1990). Eckstein (2003, p. 24) states that the order of events in the narrative can resemble a linear cause and effect. Without using the notion of causality, Connelly & Clandini (1990, p. 9) say that the narrative is distinguished from a chronicle by also presenting the meaning and influence of the events. The authors behind the concept of Situations of Opportunity are reluctant to perceive the events, occurring in a transition as being purely based on causalities (see a further discussion in Appendix II). The events are connected, and despite that the events are presented in a chronological order, they may occur simultaneously (Connelly & Clandini, 1990). However, the narratives are simplistic stories of how the development *can* plausibly happen and not predictions of how they *will* happen, and the linear causalities between sequences in the narrative might well be more complex in reality. The scenario is presented as four narratives in order to view the coherence between the events from different perspectives and in order to broaden the perspective of how such a development can take place.

According to Hajer (2005), discourse analysis is a method for identifying and interpreting different discourses, occurring in discussions around a given subject, for example sustainable urban development, where actors use metaphors and storylines to express statements and perceptions. Opposite of identifying the prevalent discourse, doing narrative can be argued to create a discourse(s) as the values and assumptions determine how the future and development process are presented, constructed and interpreted. The scenario, therefore, can become an illustration of a new discourse of a sustainable paradigm. The metaphors may be what cause the scenarios to be perceived more 'realistic' and vivid. In addition, the more detailed the descriptions of the process, setting and characters, the more realistic and vivid is the narrative (Eckstein, 2003).

Criticism of using narratives to illustrate a transformation process is to a wide extent the same as for a scenario (see chapter 2).

Application of Narratives

Transferred to this project, the above entails that the scenario as a narrative illustrates a Situation of Opportunity as a Socio-technical Transition. In this process, a number of events emerge that change the prevalent structures (Objects of Change) due to a number of measures implemented by Agents of Change (characters) in Södermalm (place) and Stockholm (context) in the period until around year 2030 (time), where the residents (characters) are envisioned to change their energy usage due to ICT. Each narrative has its own narrator, and the scenario becomes a narrative of how these persons perceived and took part in the different events in the Socio-technical Transition. In addition, they are written in the past tense to encourage, provoke and illustrate that change is possible. The application of narratives is summated in table 3.4.

Feature	Scenario in this study
Form of scenario	Narratives with elements of backcasting
Narrators (authors)	A Södermalm family of five, a city planner, an Ericsson employee, and a YIMBY member – all represented by the project’s authors
Time/plot	2010-2030
Scene/space	Place/physical environment: Södermalm
	Characters: Agents of Change
	Context: Stockholm and Sweden
Readers	Whoever who find an interest in change
Content	Introduction of ICT as means to change energy usage

Table 3.4: Overview of how the idea of narrating is applied in this project.

3.2.3. Summation

After the data for writing the scenario is compiled through literature reviews and focus group research, the data is integrated into the scenario presented as four narratives, reflecting the transition from different perspectives. Creation of the scenario happens as a step-wise creative process in which the data is processed.

3.3. Methods for Evaluating the Scenario and Consistency

The final step of illustrating a Socio-technical Transition as a scenario is a twofold assessment of the scenario. The first one aims at analysing and assessing the scenario by identifying the underlying structures influencing such a transition. The second one aims at evaluating the consistency of the scenario as a means for assessing the reasonableness of it and the overall scientific quality of the study.

3.3.1. Assessment of Scenario

As justified in Appendix I, a hallmark of Critical Realism is the focus on analysing the underlying mechanisms and structures rather than the actual phenomenon of study – in this study a sustainable Socio-technical Transition towards changes in energy usage and CO₂ emissions. Therefore, a thorough analysis as a kind of summative evaluation of the scenario using the analytic framework of Situations of Opportunity is conducted with emphasis on the organisational and social structures. As a foundation of knowledge for creating the scenario, the theoretical perspectives of those two structures are found in the thoughts behind Transition Management (chapter 4) and behaviour change (chapter 5). Here, the theoretical perspectives identified through literature reviews are supplemented by expert knowledge compiled through interviews. Chapter 8 and 9 aim at identifying elements of governance and behaviour change in the scenario and discuss some of the more general issues of the scenario. The point of the assessment can be argued to be an elucidation of focal issues which need to be taken into consideration if the Socio-technical Transition of making ICT a motor for transiting Södermalm into a sustainable city district should happen but also more generally.

The method of semi-structured interviews has been applied to supplement the theoretical knowledge base as a way of cross-testing the findings. The combination of conducting desk as well as field research aims to obtain a more comprehensive assessment. The methodological triangulation increases the degree of validity of the study.

Semi-structured Interviews with Experts

To collect empirical data for the assessment, the methods of focus group research and semi-structured interviews were compared. Table 3.5 is an overview of pros and cons of using those methods to collect data for assessment of the scenario.

It was chosen to conduct a number of semi-structured interviews, utilising an interview guide to ensure that specific themes were illuminated, but also allowing new perspectives to emerge during the interview. Depending on the progression of the interview, different questions were asked, and the structure was adapted around the interview as it occurred. Hence, the notion of semi-structured interviews (Bryman, 2008). The interview guide (see Appendix C1) was created before the interviews took place and was based on the pre-understanding gained from the desk research as well as the scenario, hence it was a prerequisite to gain valuable outputs that the interviewees read the scenario beforehand. The interview guide contained guiding open-ended questions under the themes of:

- Formalities,
- Narrative as a method,
- The content of the scenario,
- The transition, and
- Misc. Comments.

Focus Groups	Semi-structured Interviews
+ Discussion/ping pong between participants/ (dis-)agreements + Time: approx. 1 hour of completion + Generation of ideas	+ Easier to get interviewees and for interviewees to attend – more flexible + The expert gets speaking time + More in-depth assessments
- Lack of discussion/understanding due to different expertises - Risk of turning into a meeting with only interaction between the interviewer and interviewees separately - Difficult to find a time where everybody can attend - Some may know each other - Lack of disagreements - Lack of participants' preparation	- Lack of participants' preparation - More time-consuming for authors regarding the actual interviewing time and preparation time - Lack of discussion – only separate assessments from different angles

Table 3.5: Overview of pros and cons of utilising focus group research and semi-structured interviews for collection of data for the assessment of the scenario.

3. Applied Methods

A mixture of both practitioners and theorists knowledgeable in the fields of planning, transitions, Futures Studies, energy and ICT was contacted in order to get as many and as broad perspectives on the assessment as possible. The interviewees are also referred to as experts although they are not used with the intention to merely detect new information and perspectives but also for verification/contradiction of the theoretical knowledge. Positive responses were received from five people in total of which a representative from the local energy company Fortum was included. However, as the representative failed to attend the scheduled interview, two additional interviews were scheduled to be carried out via telephone after returning from the interview tour to Copenhagen, Lund and Stockholm in late April 2011. Furthermore, as the four interviewees had contributed with various perspectives, additional interviews could either contribute with missing perspectives on the scenario which were in the interview guide or the interviewees could begin to repeat each other. The state of repetition reflects a level of theoretical saturation, which is assessed to have been obtained with six interviews. Full details of interviewees are summarised in table 3.6. All six interviewees had received the scenario beforehand and only Mattias Höjer had not had time to read it. This interview came to deal with more general perspectives on scenarios and Futures Studies, which were valuable for the assessment of the study's scientific quality in chapter 10.

For ease of analysis, the six interviews were recorded and subsequently transcribed (see Appendix C2-C7). Additionally, a list of questions for interpretation of interviews (see Appendix C8) was produced as a way to create an overview of the interviews' con-

Interviewee	Field of knowledge	Details
Inge Røpke	Ecological economist and associate professor at the Dept. of Management Engineering, Innovation and Sustainability at the Technical University of Denmark (DTU)	Monday 28 th March 2011 – DTU
Anna-Lisa Lindén	Professor in sociology at Dept. of Sociology at Lund University (LU), Sweden	Tuesday 29 th March 2011 – LU
Maria Lennartsson	Environmental manager in the environmental management team at the City Development Office at City of Stockholm	Thursday 31 st March 2011 – City Development Office
Mattias Höjer	Associate professor at Dept. of Environmental Strategies Research and director at Centre for Sustainable Communications (CESC) – both at the Royal Institute of Technology, Stockholm	Friday 1 st April 2011 – CESC
Anders Bjerre	Economist and senior researcher at Copenhagen Institute for Futures Studies, Denmark	Monday 11 th April 2011 – Telephone interview
Karl Georg Høyer	Professor at the research programme in Technology, Design and Environment at Oslo University College	Tuesday 12 th April 2011 – Telephone interview

Table 3.6: Overview of interviewees.

tent as well as potential dis-/agreements among the interviewees. The questions are grouped under the headings of:

- Assessment of Consistency,
- Assessment of Scenario, and
- Assessment of Process (i.e. the Socio-technical Transition).

The purpose of conducting interviews was not only to identify perspectives in the scenario that could verify (or contradict) the theoretical perspectives in the assessment of the scenario, but indeed also as a means for evaluating the consistency.

3.3.2. Evaluation of the Scenario's Consistency

In this study, the scenario's consistency is a measure for the coherence between the narratives as well as the integration of Objects of Change and Agents of Change as a hallmark in the concept of Situations of Opportunity (Appendix II). Thus, the evaluation of consistency is related to the validity of the study. The evaluation of consistency is an assessment based on the interviews. The what-who integration is assessed with a point of departure in a table which besides integrating what and who also relates to the phase of transition as well as the effect of changing Objects of Change (see Appendix IV). The assessment of the consistency is found in chapter 10.

3.3.3. Summation

As a final step in the production of knowledge, the collected and processed data is evaluated based on data collected through literature reviews and six semi-structured interviews with experts. Again, triangulation of methods was chosen to obtain more comprehensive perspectives and to enhance the validity of the study. Furthermore, the scenario is being checked for consistency, increasing the validity of the study.

3.4. Summary

This chapter has outlined, how various methods are applied in order to collect, integrate and assess data with the overall intention of producing knowledge. Table 3.7 is an overview of the utilised methods and for which purpose they are applied.

The division of stages by which knowledge is produced is a way to ensure coherence between the problem statement and the findings, i.e. the reliability of the study. The

Purpose	Methods
Collection of data	Literature review
	Focus Group Research
Integration of data	Step-wise creative process
	Narratives
Assessment	Literature review
	Semi-structured Interviews

Table 3.7: Overview of data sources applied at the different stages methods.

mixture of methods, on the other hand, aims at ensuring validity through verification of theoretical and empirical data. Further reflections regarding the outcome of the applied methods and their contribution to produce knowledge for enabling a conclusion to the problem statement are provided in chapter 10.

4. Transition Management

‘Transition management could be viewed as ‘evolutionary governance’ as it is concerned with the functioning of the variation-, selection- and reproducing process at the societal level: creating variety informed by visions of and experiments for sustainability, shaping new pathways and reflexively adapting existing institutional frameworks and regimes’ (Kemp & Loorbach, 2006, p. 103).

The purpose of this theoretical chapter is to identify the elements which constitute the transformation process in terms of initiation and realisation. Furthermore, it presents how sustainable Socio-technical Transition can be initiated and intentionally planned in order to avoid path dependency. These critical aspects are utilised in the scenario and provide input to the assessing part.

This first chapter of the theoretical part treats the organisational structures in terms of how the innovative application of ICT can be introduced, how Socio-technical Transition can be governed, and how the pitfalls can be avoided in order to exploit the Situations of Opportunity in the process. It is recognised that the actor- and the social perspectives of Socio-technical Transitions are crucial to understand as the transition process is human made (Loorbach, 2010; Wangel, 2011). Hence, the following chapter 5 elaborates on theories of the social structures and how they can be changed in order to instigate behaviour change.

Organisational structures in Socio-technical Transition are related to how the process is planned and governed as well as to specific elements in the process such as planning, power, interest and the role of the various actors. Firstly, Socio-technical Transition is elucidated in section 4.1 which forms the basis for the remainder of the chapter and this section can be argued to contain the ‘what?’ question. Secondly, the ‘why’ question is asserted in section 4.2 which consists of theoretical considerations regarding the planning and governing of Socio-technical Transition. Section 4.3 aims at answering the ‘how’ question by conceptualising the process of Transition Management. Finally, a summary is given in section 4.4 before continuing the theoretical part by focusing on the social structures and behaviour change.

4.1. Socio-technical Transition

In order to understand the underlying structures and mechanisms behind how the organisations manage transition processes, the Multi Level Perspective of Socio-Technical Transition is presented as a theoretical perspective. This section as well as the following section will be followed up in section 4.3 which analyses how the Transition Management could happen preferably.

4.1.1. Characteristics of Socio-technical Transition

In the context of ICT and energy usage in Södermalm, technologies play a major role for the transition but it is recognised that ‘only in association with human agency, social structures and organisations, does technology fulfil functions’ (Geels, 2002, p. 1257). As the socio-technical system consists of a seamless web of physical artefacts, educational

systems, organisations, natural resources, scientific outcomes, legislative artefacts and user practices (Hughes, 1983; Hughes, 1990; Rip & Kemp, 1998), these elements must all be part of the transition.

The socio-technical system is becoming increasingly complex as society faces huge challenges by developing sustainable energy systems, and governing such a development is thus becoming increasingly complex. 'Systems thinking' is a way of analysing the persistent problems embedded in the socio-technical system as it addresses complex patterns of the interactions between the aforementioned different elements in complex and adaptive societal and organisational systems (Loorbach, 2010). In order to deal with complex and long-term development towards sustainability, Loorbach (2010, p. 166) argues that:

- All societal actors exert influence and thus direct social change, while being aware of the opportunities as well as the restrictions and limitations of directing;
- Society is shaped through agency and interaction in networks, conceptually referred to as 'governance';
- Top-down planning and market dynamics account for part of societal change; network dynamics and reflexive behaviour account for other parts; and
- Steering of societal change is a reflexive process of searching, learning, and experimenting.

As it is acknowledged that a relationship exists between the transition of the socio-technical system, the patterns and dynamics that constitute the system and the actors who influence as well as enact in the system, the term 'Transition Management' is applied in this thesis as a conceptual framework for analysing, assessing and discussing the scenario in the assessing part of the report.

4.1.2. Sustainable Transition of a Socio-technical System

The origin of the concept of Socio-technical Transitions stems from the view that 'transitions are important in relation to sustainable development as they can open the door to radical improvements in societal performance' (Meadowcroft, 2005 in Sondeijker, 2006, p. 18). Furthermore, the long-term persistent problems are regarded to be 'deeply rooted in our structures and institutions and for which no tailor-made solution is available' (Dirven et al., 2002 in Sondeijker et al., 2006, p. 15). Although Socio-technical Transitions cannot be completely controlled, they can be influenced by intentional intervention, which is a focal issue of this study. Analysing how a transition towards sustainability in a socio-technical system realises is no easy task as the complexity of the process is vast. A theoretical framework for conducting such analysis is the Multi Level Perspective (MLP), which is developed in the Netherlands where especially René Kemp, Arie Rip and Frank W. Geels have been main contributors. The understanding of transitions within the MLP framework is the alignment of developments at three analytical and heuristic levels, namely the landscape, the regime and the niche levels.

The technological niches act as 'incubation rooms' for radical new technologies (Schot, 1998) and are unstable, rapidly changing, and multi-dimensional socio-technical configurations which are not yet fully developed for the mainstream market. The techno-

logical niches, as Geels (2002, p. 1260) argues, are important for the transition of the socio-technical systems as they provide:

- locations for learning processes, e.g. learning by doing, learning by using and learning by interacting;
- space to build the social networks which support innovations, e.g. supply chains, user-producer relationships; and
- the seeds for change in terms of new and innovative ways of behaving in the socio-technical system.

The micro-level of technological niches need to be protected from the 'normal' market selections at the regime level because they of their low technological performance and often are unwieldy and expensive. As technologies emerge as 'hopeful monstrosities' (Mokyr, 1990) they can break through to the regime level.

The socio-technical regime sets the socio-cognitive rules and norms which are embedded in the complex world of research, development and engineering. The regime level is the location of 'practices, production process technologies, product characteristics, skills and procedures, ways of handling relevant artefacts and persons, ways of defining problems; all of them embedded in institutions and infrastructures' (Rip & Kemp, 1998, p. 340). Changes at the socio-technical regime refer to changes in socio-cognitive patterns and depending on the type of socio-technical system, regime changes might take years or decades. For example, development of the automobile regime, for instance, took around 50 years and the development of the socio-technical regime of the Internet took around 20 years. As Geels & Schot (2007, p. 400) argue, socio-technical regimes stabilise prevailing structures through:

- cognitive and persisting routines which lead engineers and developers to follow a certain path;
- regulations and standards which preserve the regime;
- adaptation of lifestyles to certain technical systems; and
- sunk investments in machines, infrastructures and competencies.

The meso level, the socio-technical regime, relates to the predominant practices, habits, rules and beliefs, which form and guide the public policies, the interests for the companies and the individual actions. A rather stabile regime is likely to optimise current processes within the regime rather than transform them into new ones. It is especially the Situations of Opportunity which occur in the socio-technical regime that are of importance in this study as they constitute focal points in the transition process of a socio-technical regime. As such the socio-technical regime of ICT, energy usage and behaviour is difficult to change as it demands changes in several socio-technical regimes simultaneously. Possible rebound effects will be further discussed in chapters 9.

The socio-technical landscape refers to external structures or factors outside the direct influence of technological niches and socio-technical regimes. Changes at this level happen at a rather slow pace (decades) and can be cultural changes, demographic trends and macro-economic- and the macro-political environments (Geels, 2002, pp. 1260-1262).

When ongoing processes in the regime and landscape levels create a 'window of opportunity' radical innovators at the niche level seize the potential of breaking through to the mainstream markets. Such windows of opportunities can be created in times of uncertainty, by pressure in the socio-technical regime or by shifts at the landscape level, which can unseat the socio-technical regime and force it to change (Geels, 2002). Where 'window of opportunity' refers to a short timeframe during which otherwise unattainable opportunity exists, the concept of Situations of Opportunity differs by applying the urban structure and the socio-cultural, the institutional and the environmental aspects and by searching for coherent connections between Objects of Change and Agents of Change. It can be argued that transition happens through interactions between processes at the three mentioned levels and the process can be described as following:

- niche-innovations build up internal momentum, through learning processes, price/performance improvements, and support from powerful groups;
- changes at the landscape level create pressure on the regime; and
- destabilisation of the regime creates windows of opportunity for niche innovations (Geels & Schot, 2007).

The configuration of these processes enables the breakthrough of new innovations in mainstream markets where they compete alongside with technologies in the existing regime (ibid., p. 400). However, the Multi Level Perspective has been exposed to criticism due to the relative neglect of actors (Smith et al., 2004) and too much emphasis on the technological niches as driver for changes in the socio-technical regime (Berkhout et al., 2004). Geels & Schot (2007) have responded to the critique by arguing that the Multi Level Perspective does contain an implicit actor perspective, which can be backed by stating that the actors are context-dependent. They also state that technological niches rather than landscape structures can be affected and then change the existing socio-technical regime. However, it can still be argued that the process of change towards ICT as driver for Socio-technical Transition demands more than nurturing the niche innovations and must include also social change. Furthermore, the critics might have a point in claiming that a clearer and more explicit analysis of the actors within the transition process is needed in order to conduct a more thorough assessment of how the transition process can be managed.

4.2. Managing Sustainable Socio-technical Transition

As actors and organisations are regarded to hold important keys for the success of a transition process towards a more sustainable regime of ICT, behaviour and energy usage this section deals with the managerial aspect of the Socio-technical Transition.

4.2.1. Government, Governance and Meta-governance

Governance is a concept, which similar to sustainability, has been derived, explored and embraced since the late 1980s and mid 1990s. Governance as a contrast to conventional thinking of political systems became increasingly important and recognised as it encompasses a broad set of integrated and linked mechanisms, which determine the steering of societal processes (Kemp et al., 2005; Kooiman, 1993). Where *govern-*

ment refers to ‘all those activities of social, political and administrative institutions and actors that can be seen as purposeful efforts to guide, steer, control or manage (sectors or facets of) societies’ (Kooiman, 1993, p. 2), *governance* ‘accommodates the fact that state actors rely upon non-state actors in the formulation and implementation of public policy’ (Smith et al., 2005, p. 1498). More concretely, the ‘governance structures are ... formal and informal institutional devices through which political and economic actors organize and manage their interdependencies. The purpose of such structures is to organise negotiation processes, set standards, perform allocation functions, monitor compliance and resolve disputes’ (Eden & Hampson, 1997, p. 362). However, creating informal institutions (e.g. common ambitions, habits, decisions and policy instruments) calls for continuation of formal systems to legitimise and establish the decisions. Hence, neither government, governance nor private actors can stand alone when it comes to changing a socio-technical system. The issues of the actors’ powers, roles and interests are also key features in the governance concept and will be further elaborated on later in this section. In the remainder of this chapter, governance refers to how Socio-technical Transition can be managed, and it thus embraces both the approaches of government and governance.

A great challenge for enabling change of the energy usage while implementing ICT in housing and transportation in Södermalm, is to find ways of establishing transition-oriented governance regimes., who, It can be argued that organisations are deliberate compilations of actors who need to have a reasonable coherence of visions, specific rules which sets common standards for collaborations, commitment and trust by the participants. As Socio-technical Transition is based on changes at the niche-, regime- and landscape levels, the changes must integrate governance at several different levels. As previously argued, the Multi Level Perspective to systems innovations proposes a theoretical framework for analysing how such Socio-technical Transitions occur. Governance for such a process must ensure that the technological innovations on the niche level are accompanied by parallel changes in formal and informal institutions on the regime level. Hence, it can be argued that governance for the complex task of developing sustainability should:

- make use of increased actor involvement engaged in sustainability matters;
- be focused on the long-term development;
- make use of visions of sustainability and scenarios;
- be concerned with learning, innovation and adaptation;
- be open and creative; and
- be aware of moving targets.

Governance of Socio-technical Transition can be viewed as a form of soft or indicative planning. By opting for taking small steps on the development path, transition management can be viewed as an exercise in incremental planning (Kemp & Loorbach, 2003 p. 17). There is a danger of conservatism in forms of veto powers, special interests and resourceful stakeholders and the small changes on short term basis might not develop into the desired and urgently needed direction, seen from a sustainability perspective. However, further elaboration on Transition Management as incremental planning and as adaptive, reflexive, interactive and multi-level governance is further elaborated in Appendix III.

Meta-governance is an important aspect for Socio-technical Transition and according to Sørensen & Torfing (2005, p. 202), meta-governance is ‘... the endeavour to regulate self-regulating policy networks by shaping the conditions under which they operate. It involves the attempts of politicians, administrators or other governance networks to construct, structure and influence the game-like interaction within particular policy networks’.

The meta-governors, who can be regarded as coordinators for empowering the Agents of Change, are in this study seen as essential for the transition process to succeed, albeit their roles can be questioned. A more thorough critique of both the role of planning and the issues of democracy and legitimacy is further elaborated in the assessing part.

4.2.2. Elements of Governance

As it is recognised that Socio-technical Transition must happen as interplays at multiple levels and that it is carried out by multiple actors, especially partnerships as organisational and intersectoral collaboration arrangements must be studied. The elements of interests and roles are here being elucidated and power is regarded as embedded in the elements of the governance process and will be assessed throughout this paragraph.

Partnerships as intersectoral collaborations

Since the mid 1990s and after the term of sustainable development had been explored, ‘partnership’ has become a similar term for intersectoral collaborations. It can be argued that partnerships are linked to sustainable development and Transition Management as the complex nature of the Socio-technical Transition towards sustainable development demands active involvement of Agents of Change at all societal spheres. In this study, partnerships occurring in Socio-technical Transition are understood as ‘collaborative arrangements in which actors from two or more spheres of society (state, market and civil society) are involved in a non-hierarchical process, and through which these actors strive for a sustainability goal’ (van Huijstee et al., 2007, p. 77). The partners have mutual interests and by supporting each other on a long-term basis, their common goal can better be achieved. By focusing on the actor perspective of partnerships, they are analysed as strategic instruments for the goal achievement of the transition management process. The concepts of ‘governance’ (Kooiman, 1993), ‘cooperative management regimes’ (Meadowcroft, 1998) and ‘public private partnerships’ (LaFrance & Lehman, 2005) all refer to arenas in which collaboration can be established. It is needed to form coalitions with prime actors or organisations in the technological niches or socio-technical regimes who are ‘technically, financially and politically so powerful that they can strongly influence the development and diffusion process’ (Jacobsson & Bergek, 2003, p. 5). Again it should be underlined that the perspective of power should be a key component for the analysis of such partnerships towards sustainability as power can work either for or against changes and either towards or away from sustainability in the socio-technical regime.

Not only should the involved Agents of Change be aware of the advantages and challenges by establishing and engaging in a partnership but they should assess their aims and purposes with such collaboration. Engaging in collaborations can mean clashes of

interests and facilitating the process is important for the results. Especially leadership is widely regarded as a critical component for collaboration and for facilitating the collaboration process in order to make the actors engage with each other in a collaborative spirit (Ansell & Gash, 2008). Collaborative leadership, or meta-governance, demands time, resources and communication skills which should be important aspects. For a more thorough description and analysis of when and how to start or continue the partnership, see the 'decision path' developed by Rondinelly & London (2003, p. 68) and for a more concrete constitution of collaborative governance, see Ansell & Gash (2008, p. 550). A critical view on partnerships, collaboration and the communicative turn with regard to the scenario is further assessed and discussed in the assessing part of the report.

Power

Ultimately, it can be argued that Socio-technical Transition refers to shifts in power, and organisations and actors have interests in working either for or against transition or for a transition in a different, and perhaps diametrically opposite, direction. Essentially, power refers to an influence relation, which happens when one actor causes behaviour change of another actor (Lukes, 1974). Several authors (Haugaard, 2003; French & Raven, 2001 among others) have tried to compile the dimensions of power. It is acknowledged that power can be divided into several dimensions and types varying from power as coercion (Dahl, 1957; Bahcrach & Baratz, 1962) over power as knowledge (Foucault, 1980; Clegg, 1989) to power as reproduction of meanings (Barnes, 1988; Giddens, 1984). In the following, these theories of power are applied to the context of sustainable Socio-technical Transition.

However, in order to manage Socio-technical Transition, power is an inevitable issue. A focal point of the transformation process is the emergence and harnessing of Situations of Opportunity (as also presented as a prerequisite in chapter 6). Meta-governors and leaders who deal with the actual transition must be analysed closer with regard to leadership and power as they create and utilise the 'policy windows'. Power can be exerted at all levels of the socio-technical system and by all dimensions, although it can be argued that the invisible and unconscious dimensions of power are the most important. Creation of shifts in powers must take place in order to detach the reproducing of the current unsustainable socio-technical regime. By exercising power on the niche-level companies, for example, they can be encouraged to develop sustainable ICT based appliances or the accessibility to the products can be increased. Power at the landscape level can occur as e.g. increased knowledge of the reasons for climate changes and the governmental decision making or regulations on energy prices.

It can be argued that in order to facilitate a Socio-technical Transition with the long-term target of radical decreases in energy usage and CO₂ emissions, most dimensions of power must be utilised. Coercion, as removing of parking places, extension of the congesting charge zone or modifying roads into biking paths might be unpopular if the prevailing paradigm still favours the car. Theoretical elaborations on changing beliefs, values, norms and cultures in order to enhance behaviour change are presented in chapter 5. In governance processes there can be a level of expert power where

decision makers act in accordance to experts' recommendations, hence, there might be a good point of including experts of sustainable communications in the group of meta-governors for a sustainable planning process for implementing ICT. Finally, there might be some kind of referent power employed when prestige groups, acknowledged companies or trustworthy authorities are changing behaviour. Power can be exercised differently and the desirability of the pursued interests can vary, depending on the perspective of sustainability and the Socio-technical Transition.

Interests and roles

The interests and roles of the actors who are, with the words of John Forester (1989), 'Planning in the Face of Power' are important to analyse in the light of the pitfalls of the planning approaches for Transition Management presented in Appendix III. According to Bengs (2005), the most powerful or resourceful institutions will have their interests followed while the powerless would not have a say and are reduced to 'extras'. As it is acknowledged that some actors will hamper Socio-technical Transition while struggling for maintaining the current regime, or developing it towards an even more unsustainable regime, the aspects of interests and roles must be understood in order to plan for success of the transition. To form, act and engage in partnerships is important for the success of the governance process of Transition Management towards sustainability. However, there must be a purpose and an interest for the stakeholders to interact in such constellations. Three main categories of actors can be claimed to exist; citizens, private companies and public agencies and these will be analysed in terms of their interests for and roles in Socio-technical Transition.

Interest, in this sense, relates to benefits or advantages for an individual or an organisation which participates or otherwise is involved in a certain activity. The benefits or advantages can vary, so can the degree of participation. By beginning at the individual level of interest, it can be argued that the aim for the individual is to increase, or at least not decrease, life quality. There is, however, no simple answer on how to increase life quality and several theories have collided in trying to reach a definition of human interests and life quality. The Economic Man, which always strives for the most economical beneficial action, was introduced by Mill (1836), the hierarchy of needs by Maslow (1943) with physiological needs in the bottom and the need of self-actualisation in the top and finally, Diener (2000) among others, have proposed a national index for happiness. Globally, there is a tendency to use the Gross Domestic Product (GDP) as an indicator of the current economic state but it can be argued that increasing the income of all in a society does not increase the happiness off all in the same society as the because 'the material norms on which judgments of well-being are based increases in the same proportion as the actual income of the society' (Easterlin, 1995, p. 44). Another measure for life quality is the Human Development Index developed in the 1990s which measures life expectancy, literacy, education and standards of living. The Buddhist inspired country of Bhutan introduced the Gross Domestic Happiness index as a replacement of the economically laden GDP index in order to examine the impacts of a given activity (Ura & Galay, 2004). Recent years' growth in environmentalism can be regarded as a tendency of increased responsibility, common concerns and showing off the personal surplus energy, which for example the growing market for organic food

and biking are indicators on. On the other hand humans are very convenient and habit creating creatures who tend to strive for most happiness.

The roles of the citizens are quite ambivalent as they can be argued to be both residents of the city, voters for the governmental bodies, employees at their companies, consumers of goods and experts in everyday life. They are users, consumers and demanders of products and services provided from the private companies and public authorities.

A group of people working together in order to reach a common target can have similar interests as individuals and their role can be argued to be providers of services and products. A private organisation working on the regular market basis has an overall aim of creating profit to its shareholders and by lobbying and exercising power on decision makers their interests are sought followed. Besides direct profit, corporate social responsibility (CSR) is gaining increasing momentum as the customers are becoming increasingly aware of the impacts caused by the companies. CSR management can be argued as a marketing attempt in order to make even more money and act as indirect profit. Information plays a vital role for the private companies and ICT plays an important role for facilitating the widespread of information.

Organisations, however, can also be public and with a primary duty to plan and implement 'public interests', a term which is further discussed through arguments from e.g. Klosterman (1985), Bengs (2005) and Sager (2005) in the assessing part. Increased life quality for the citizens is argued to be one of the goals for the public authorities but as earlier mentioned, this can be hard to define. Another issue for the public authorities is the question of the extent of interventions versus leaving planning to the market forces which also will be further elaborated in chapter 9. The public authorities as Agents of Change have the interest of accomplishing the transition process towards a more energy efficient system where ICTs play major roles. As a supposed overall interest for the citizens, the City is pursuing sustainable targets on behalf of the whole region and the citizens. On the other hand they have the duty of providing infrastructure, security and health in order to protect the citizens and provide them with assets needed for increasing life quality.

4.3. Conceptualising the Process through Transition Management

This final section of the assessment of the organisational structures follows upon the two previous sections, the Multi Level Perspective and the management of Socio-technical Transitions, and concretises how the process could be structured in order to follow the trajectory towards a low energy, low carbon society.

4.3.1. The Transition Management Approach

The concept of Transition Management 'tries to unravel the complex interaction patterns between individuals, organisations, networks, and regimes within a societal context, and how over time, these can lead to nonlinear change in seemingly stable

regimes' (Loorbach, 2010, p. 167). Recalled from the concept of Situations of Opportunity and the approach of Critical Realism, the complex integration of changing structures and agents is used to create a scenario that explores and illustrates the change of the socio-technical regime of high energy usage and CO₂ emissions from the transportation- and housing sectors into a more sustainable one. Transitions of socio-technical systems call for several considerations and inspired by Loorbach (2007, 2010) and Rotmans and Loorbach (2008), the following nine aspects must be considered:

- The content of the system and the process to change it are inseparable, thus, **insight of how the system works** is an essential precondition for effective management.
- **Long-term thinking** should be used for shaping policy in the context of persistent societal problems. Especially two approaches are useful: a) creating short-term goals based on long-term targets and b) reflecting on future developments through the use of scenarios.
- **Objectives should be flexible** and adjustable at the system level. There should be inherent possibilities for adjusting the objectives, since sustainability management on a long-term base consists of moving targets.
- **The timing of the intervention is crucial**; hence, it is not sufficient to explore the Situations of Opportunity but also to take action effectively.
- Managing a complex and adaptive system calls for the **use of destabilising as well as stabilising means** e.g. means that complicate the present consumption patterns in the current system and means that encourage the transition to new and more sustainable behaviours.
- Agents with some distance to the regime can effectively create a new regime in a protected environment to permit investment of sufficient time, energy, and resources. **Collaborations in a test bed** can be a possible way of initiating such innovation.
- Structures, agents and behaviours adapt and anticipate in such a manner that they **should be directed from the 'inside'** and are more reluctant to change if they are steered from the 'outside'.
- A necessary precondition for change is **knowledge about different actor perspectives** as it is acknowledged that there are Agents of Change towards sustainability and Agents of Change against sustainability.
- **Participation of and interaction between Agents of Change** towards reframing problems and solutions is a necessary basis for developing support for policies.

4.3.2. The Transition Management Cycle

In order to operationalise the rather abstract and complex governance issues, the more concrete Transition Management framework is being applied with inspiration from Loorbach (2007, 2010) and Kemp & Loorbach (2006). Such a framework for Transition Management includes four successive governance levels with relevance for Socio-technical Transitions; strategic, tactical, operational, and reflexive. Figure 4.1 illustrates the process of Transition Management.

The Strategic Level

At this initiating level of Transition Management strategic activities, such as development of a vision, long-term goal formulations and discussions on normative values are being carried out. It is also at this level that the desirable socio-technical system is discussed in terms of norms, values, identity, ethics, sustainability and functionality. The actors involved at this stage could be decision makers and planners who favour sustainability, people who are capable of creating new institutions and transition agendas and also people who are knowledgeable about the future

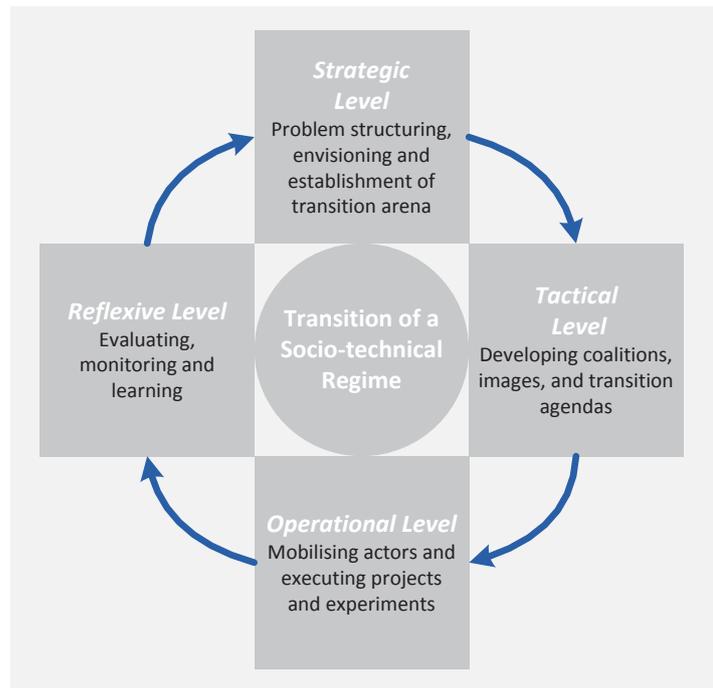


Figure 4.1: The Transition Management Cycle (inspired by Loorbach, 2010, p. 173).

and the potentials of ICT. Power becomes an important issue as it takes power to create new decision arenas and a key issue is to place the Socio-technical Transition at the political agenda. One central aim of Transition Management is to integrate and embed these long-term activities into fundamentally and necessary elements of policy making towards a sustainable development. (Loorbach, 2010, pp. 168-169)

The Tactical Level

At the tactical level, the steering activities related to the socio-technical system are identified, which could be establishment of patterns and structures such as legislation, institutions, organisations and other networks, infrastructure and routines. These activities are primarily focused on achieving the goals set at the strategic level and deals with the everyday operations (Loorbach, 2010, p. 169). The new coalitions, collaborations and regulations form the basis of further development towards the desired future and it can be argued that within each transition arena, new cycles of Transition Management take place. The transition arenas created by form the strategic level are operationalised at the tactical levels through creation of collaborations, agreements and plans.

The Operational Level

At the operational level, the activities have short-term horizons and can be identified as innovative practices, which are carried out through projects/programs, in businesses/industries and in politics/civil society. The operations are based upon decisions, plans and projects envisioned at the strategic level and made possible at the tactical level through concrete agreements and detailed plans. Innovation is very important in terms of Transition Management and together with societal, political and technical application the new socio-technical system can be increasingly embedded as behavioural

practices and interactions with new structures, cultures and daily routines (Loorbach, 2010, p. 170). These can be regarded as the final effect of the plans and policies determined at the strategic level, made possible at the tactical level and implemented at the operational level.

The Reflexive Level

The reflexive activities are related to monitoring, conducting assessments and evaluation of ongoing policies, and ongoing societal change. The media platforms, such as the Internet, play important roles at the reflexive level as a communicating mediator between the affected actors, and science plays a role in terms of advancing and refining the innovation. Feedback from end users to manufacturers, suppliers and programmers is important in order to improve the technical solutions in terms of usability and performance. It can be argued that reflexivity needs to be an embedded part of the governance process for Transition Management itself and not act as an ex-post evaluation tool (Loorbach, 2010, pp. 170-171). The long time-horizon for Socio-technical Transition oblige the participants at all levels to be reflective, to learn by doing and to adjust the planning along the path of development. With regard to the reflexive task of meta-governance, see Appendix III, the planning process towards Socio-technical Transition should be adjustable and as chapter 9 will discuss further, it must take into account the various rebound effects.

All Transition Management processes are unique in terms of context, actors, structures, problems and solutions. The cycle presented in figure 4.1 holds both a flexibility to encompass most Transition Management processes and on the other hand it can be used in a more prescriptive and concrete way in functional practice. The cycle should be seen as an illustration of how transition of a socio-technical regime can happen and is not a complete model of the complex process. The understanding of the dynamics within the complex and adaptive systems gives knowledge on the opportunities, limitations, and conditions under which it is possible to direct such systems (van der Brugge, 2009).

4.4. Summary

Socio-technical Transition can occur when niche-developments destabilise the prevailing regime and when landscape changes affect the mentality of citizens as well as the national and municipal decision makers. To transform the existing socio-technical system it must be acknowledged that all societal actors exert influence and thus direct social change, while being aware of the opportunities as well as the restrictions. Furthermore, the aspects of governance, where Agents of Change collaborate in networks, and government, where top-down planning determine the path, must both be part of the transformation process. Finally, as long-term societal changes require steering and management of organisational and social structures, the process should be reflexive, learning and experimenting and adjust accordingly.

The organisational settings such as partnerships, interests, roles and power should create opportunities where timing, trust and mutual dependency should be considered carefully. The meta-governors play a crucial role for Socio-technical Transition and it

should be opted for involving the most powerful Agents of Change as the main ‘spiders in the seamless web’.

Overall, Transition Management can be seen as providing an analytical perspective on dealing intelligently with the complex long-term governance of changing a socio technical system. Transition Management is ‘normative in its ambition, prescriptive [in its] nature, long-term [by] focus, and analytical [by] basis (Loorbach, 2010, p. 178). By taking small steps based on research, ongoing learning and experiments, the reflexive approach to governance can help facilitate long-term Socio-technical Transition.

5. Factors for Behaviour Change

'As everyday behaviors are repeated, they exert significant, cumulative impact on medical, social, and economic outcomes experienced by both individual consumers and society as a whole' (Verplanken & Wood, 2006, p. 90).

Since Socio-technical Transitions refer to changes in structures and practices of how people engage with technology, it becomes imperative to understand the social structures and how they, as larger scale forces within society, affect peoples' everyday practices. Implicit in this assertion is that social structures and technology together affect people. Hence, the purpose of this chapter is to identify and examine underlying structures and mechanisms behind human action, as one of the focal points of Critical Realism, and subsequently examine how behaviour can be changed. The question of 'why' is examined before 'how', based on the perception that it is useful to attempt to understand why people behave as they do before it can be considered how they can be influenced. The focus in the chapter is primarily on how social structures can induce behaviour changes of actors, and how Agents of Change can indirectly induce behaviour change of end users through influencing the social structures. Although acknowledged that technologies and spatial planning can influence human behaviour, these aspects do not get any attention because it has been argued elsewhere that ICT enables behaviour change (Zapico et al., 2010; Mattern et al., 2010). Further, because it is beyond the scope of this study to focus on changes in the urban fabric of Södermalm.

5.1. Factors for Behaviour

Behaviour, routines, habits and practices are different concepts used in social theory to describe and explain peoples' actions. *Behaviour* is a performed action of an individual and composed by the four elements of action, target, context, and time (Fishbein & Ajzen, 2010). For example, to turn the thermostat up (action) to heat (target) the living room (context) each afternoon (time). A particular behaviour can be performed once or several times. When behaviour becomes a routine, meaning a continuous, unconscious performance of actions in stable contexts, they are referred to as *habits* or habitual behaviour (Verplanken & Wood, 2006). Much everyday behaviour constitutes habits or routines (Fishbein & Ajzen, 2010).

Habitual behavior is carried out without any separate motivation for each individual action because the individual needs are satisfied (Vermeir & Verbeke, 2006). Besides context where the actions are performed, time pressure is regarded as influencing behaviours to turn into habits. Another factor that influences habits is expectations which are related to convenience and comfort. As people repeat their actions, they expect to perform it again which creates a lack of openness against other ways of performing. The most obvious differences between behaviour and habits are that habits happen in stable contexts and with greater automaticity – 'the environment's automatic activation of well-practiced responses is a key to the persistence of habits despite people's best intentions' (Verplanken & Wood, 2006, p. 93). Practice is a concept for categorising behaviour that has become habit, and Røpke (2009) argues that practices should get more attention in studies of consumption.

Due to the idea of repeating an action, it is assumed that predictors and determinants of habits to a large extent are the same as those of behaviour.

The American psychologists Fishbein & Ajzen (2010) assert that attitude, norms and perceived control are three main determinants of intention, which is perceived as a predictor of behaviour. The determinants are guided by a person's belief or information about the behaviour, and these beliefs are influenced by a number of background factors. This relationship is rather hierarchical and deterministic, but it is likely that the determinants as well as background factors also affect each other horizontally. For example, a person's attitude is likely to be influenced by the norms embedded in cultures.

5.1.1. Determinants

Attitude is a person's perception about and evaluation of a particular phenomenon (Fishbein & Ajzen, 2010, p. 76) and it thus reflects a person's tendency to behave in a certain way (Holden, 2007, p. 118). Attitudes alone are a poor determinant for intentions and behaviour, because there is often an inconsistency between what people think and what they do (see examples in Holden, 2007).

Norms refer 'to what is acceptable or permissible behaviour in a group or society' (Fishbein & Ajzen, 2010, p. 129). Norms can be conceptualised as strict rules, general guidelines or social pressure, guiding human behaviour (ibid.). As such, norms can be influenced by peers or public authorities.

Perceived control refers to 'the extent to which people believe that they are capable of performing a given behaviour, that they have control over its performance' (Fishbein & Ajzen, 2010, p. 154). Perceived control is individually determined. *Actual control* (internal and external factors in terms of skills and abilities as well as luck, context and other people, respectively) can directly enable as well as constrain behaviour to be performed; hence, intentions alone are not always the best predictor of behaviour. Indirectly, actual control affects behaviour by influencing the individuals' perception whether they believe that they can perform the action, i.e. the perceived control. Actual control resembles Røpke's (2009) practice determinant of competence.

Fogg (2009) asserts that behaviour change is the result of the timewise convergence of *triggering* the behaviour when a person is both *motivated* and has the *ability* to change – people are in other words persuaded to perform a particular behaviour. In Fogg's model, ability is related to what Fishbein & Ajzen call perceived and actual control, which he argues can be increased through simplicity of the activity, and motivation seems to be a merge of norms and attitudes. Hence, the focus on triggers is added compared to Fishbein & Ajzen's model. In addition, determinants do not only vary among persons, but also between contexts (Fogg, 2009). The weight of the three determinants is individually determined (Fishbein & Ajzen, 2010), and it implies that people should be influenced differently in order for Socio-technical Transition to succeed.

Beliefs guide a person's decision about whether or not to perform the action and are by Lindén (2001) regarded as a driver for human action. The behaviour must make sense

for the individual, and this is by Røpke (2009) referred to as meaning. Fishbein & Ajzen (2010) distinguish between three types of beliefs which each correspond to a determinant – behavioural, normative and control beliefs. To be able to construct a perception and to enable evaluation, a person must be knowledgeable not only about the given phenomenon's existence, but also about its consequences (Lindén et al., 2006), and therefore, behavioural beliefs determine attitudes. Normative beliefs reflect an individually perceived social pressure by the society of whether to engage in the behaviour. Social rejection or social acceptance is according to Fogg (2009) motivators (or determinants) of human behaviour along with pleasure, pain, hope and fear. The two latter motivators can be argued to relate to behavioural beliefs as they are based on a result of anticipating something better or worse to happen and thus a perception about the outcome of the particular behaviour. The final type of beliefs is control beliefs, which refer to personal and context-dependent factors that guide the perception of whether the behaviour can be performed.

5.1.2. Background Factors

Beliefs are potentially influenced by various background factors (Fishbein & Ajzen, 2010), which reflect an individual's personal prerequisites and cultural lifeworld (Lindén, 2001). The three categories are:

Individual factors are related to personality, needs and mood. Furthermore, the physical effort, whether the action requires (too much) thinking, and whether the behaviour has become a routine (Fogg, 2009). This is supported by Lindén (2001), who states that it is important that individuals do not see the behaviour change as too demanding and as resulting in too many modifications of their everyday life.

Social factors include socio-economic variables such as culture and education. The interviewees claim that younger people tend to be fonder of new technologies than the elderly and also more adaptable to new habits. Hence, a barrier for Socio-technical Transition may be that not all socio-economic groups pick up new technologies and behaviour with the same pace as also indicated above by Fogg.

Information reflects an individual's exposure to information by for example the media and education. This background factor shares name with one of the interventions presented below, where also examples of information is the scenario is provided.

Behaviour is then more than just the actual observable action – it is related to reasons for behaving in a certain way. Thereby, the previous example can be extended to be: to turn the thermostat up (action) to heat (target) the living room (context) each afternoon (time) because it is chilly (reason).

The coherence of attitudes, values, norms, preferences, and culture as well as embedded social patterns and habits is what Bourdieu (1994) refers to as habitus. This is the foundation for human practice. Each person has its own habitus, although it is often shared among many. Habitus is rooted in human experience, socialisation and practices stemming often from childhood, which makes it difficult to influence, and

habitus is on the other hand influenced by the surrounding structures in society. And when Bourdieu talks about how field and capital influence on habitus, these are in this study assumed to be similar terms for control/ability and for context, respectively, as crucial determinants of behaviour (Verplanken & Wood, 2006). Habitus and habits should despite their wording similarities not mistakenly be equalised.

5.1.3. Barriers for Behaviour Change

Verplanken & Wood (2006) state that when people do not to change behaviour, in spite of invitations through normative pressure, it is often due to biological factors or psychological needs such as hedonism, which also reflects the importance of focusing on the background factors if behaviour change is wanted by Agents of Change. Fogg's reflections regarding the simplicity of a behaviour is based in a conviction that people in general are lazy and arguably also because they are reluctant to change behaviour that has become habitual, i.e. a practice. This is where it is important to keep the *triggers* in mind. Although a person demonstrates a high level of ability and motivation, the right or opportune moment is just as crucial for individual behaviour change as it is with long-term societal changes resulting from Situations of Opportunity. This was by the Greeks named as Kairos (Fogg, 2009). If a person is above the Behaviour Activation Threshold, a trigger will result in performance of the behaviour. Fogg (2009) identifies three different types of triggers. When a person demonstrates a high ability but low motivation, *facilitator* intends to make the target behaviour easier to perform. When a person demonstrates high ability, *spark* aims to increase the degree of motivation by focusing on the motivators. *Signal* serves only as a reminder because the person already demonstrates both high ability and motivation.

These barriers could as well be included in the model as underlying determinants or mechanisms that influence whether or not behaviour can be achieved and sustained. However, as the list of mechanisms could proceed in the infinity, the ones included in the figure are perceived as the primary ones.

5.1.4. Summation

This section has elucidated that human behaviour is influenced by attitudes, norms, perceived and actual control, and beliefs. These are referred to as determinants of behaviour and are in their turn influenced by a number of background factors. When the context is stable, it enables behaviour to be repeated and thereby turn behaviour into habits or practices – see figure 5.1. The determinants and background factors should be understood as the social structures affecting human actions. From this section it can be derived that in order for Agents of Change to accomplish a Socio-technical Transition, it is crucial to try to influence peoples' background factors as well as to produce new stable contexts.

The model displayed in figure 5.1 seems deterministic and indicates that behaviour change is cause-effect related. The model is, obviously, a theoretical and simplified construct and the point is to illustrate that not only the influence on one determinant results in change of behaviour or habit but that it requires the turning of more buttons (and in the correct way). This is supported by the empirically observed efficiency of

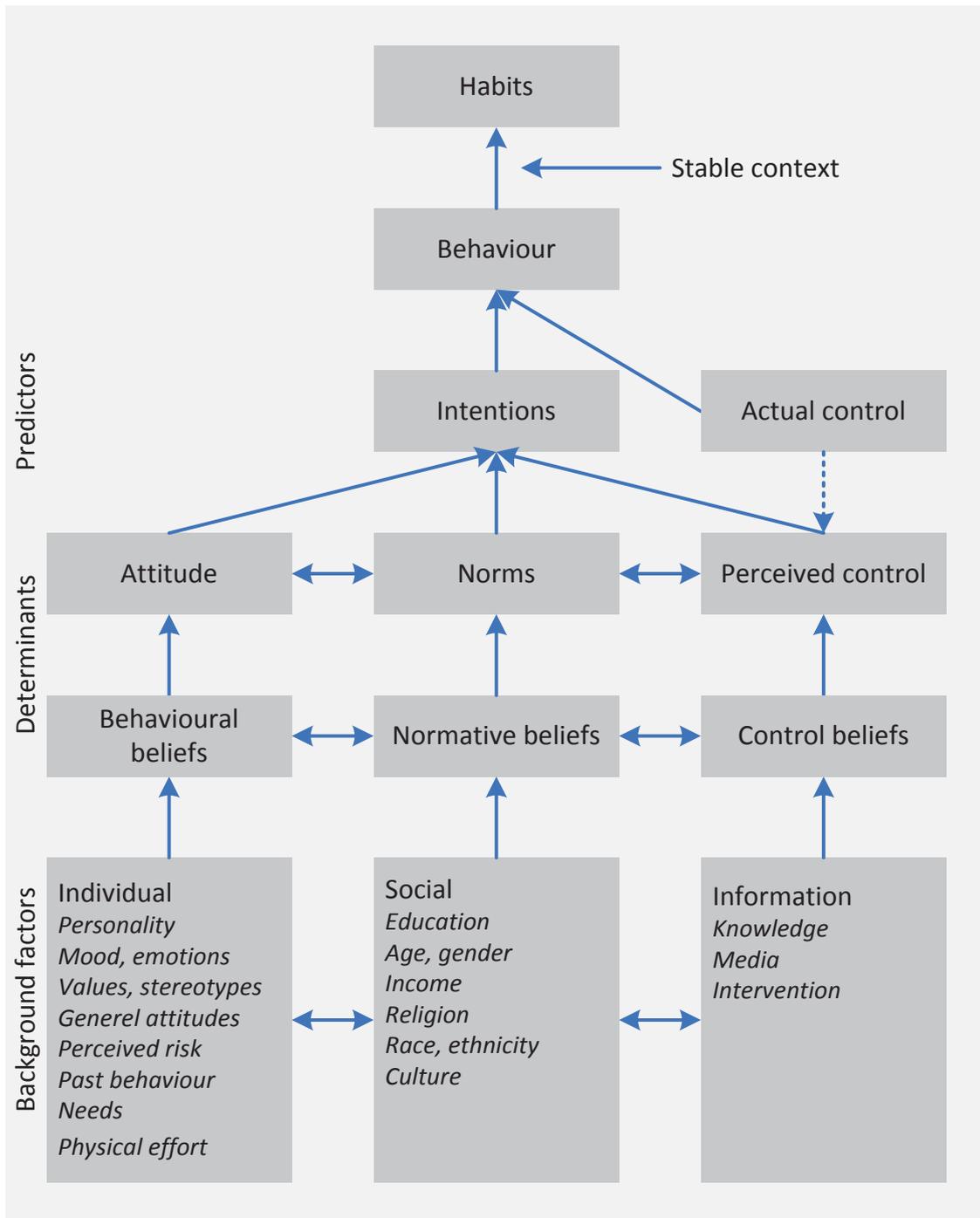


Figure 5.1: Schematic presentation of behaviour model (adapted from Fishbein & Ajzen, 2010, p. 22). Behaviour turns into a habit when it is repeated in a stable context. Habits are to a large extent influenced by the same factors as behaviour.

combining interventions (see e.g. Verplanken & Wood, 2006; Lindén et al., 2006; Vedung, 1998). The following section presents interventions that are aiming at motivating people, making them more capable of performing an action, and producing new stable contexts.

5.2. Interventions for Change of Behaviour and Habits

From the previous section it was found that there is a distinction between behaviour and habits, but that they to a large extent are influenced by the same factors. To increase the potential for change, it is necessary for Agents of Change to match interventions to the citizens' behaviour and habits, respectively (Fogg & Hreha, 2010; Verplanken & Wood, 2006). To design the most efficient package of interventions, the following steps must be completed by Agents of Change:

1. Determination of whether the targeted behaviour is habitual; and
2. Selection of interventions (Verplanken & Wood, 2006).

As a guide to match behaviours with appropriate solutions, the Behaviour Wizard has been created as an attempt for a systematic categorisation of behaviour, which previously has lacked in the field of psychology (Fogg & Hreha, 2010). By being aware of the type of behaviour change an individual is seeking or a persuader is inducing, it increases the potential for resulting in behaviour change (ibid.). The Behaviour Wizard with environmentally sound examples is displayed in table 5.1 as a matrix which encompasses 15 different types of behaviour shared among the two dimensions of flavours and duration. For example, Blue Span Behaviour means doing a familiar behaviour for a period of time such as biking to work for two months. Each type of behaviour is individually determined.

Based on the Behaviour Wizard, the two steps can be completed.

1. Evidently, for Socio-technical Transition to become a reality, a mixture of different types of behaviour change is necessary. Installation of solar cells on buildings is only necessary once (Dot) whereas starting to use public transport or videoconferencing more frequently reflects an increased performance of behaviour (Path). In other words, behaviour as well as habit change is necessary for Socio-technical Transition to succeed.

Flavours Duration	Green Do new, unfamiliar behaviour	Blue Do familiar behaviour	Purple Increase behaviour intensity or duration	Grey Decrease behaviour intensity or duration	Black Stop existing behaviour
Dot One time	Install solar panels on house	Tell a sister about eco-friendly soap	Plant more trees and native plants	Buy fewer cases of bottled water today	Turn off space heater for tonight
Span Period of time	Try carpooling to work for three weeks	Bike to work for two months	Recycle more of household waste for one month	Take shorter showers this week	Don't water lawn during summer
Path From now on	Start growing own vegetables	Turn off lights when leaving room	Buy more local products	Eat less meat from now on	Never litter again

Table 5.1: The Behaviour Wizard including examples suggested by Fogg (2011).

2. Interventions for behaviour and habit change differ (Verplanken & Wood, 2006). Since they reflect a state of habits and thus a permanent nature, new Path Behaviours are more difficult to induce and maintain and thus require more consideration and continuous triggering (Fogg & Hreha, 2010). For these reasons, Path Behaviours have a higher Behaviour Activation Threshold than Dot Behaviours, and it may be fruitful to trigger a Span Behaviour to achieve Path Behaviour (ibid.). In other words, behaviour change is important in order to change habits. At times, achieving one type of behaviour is interconnected to and dependent on another type; for example, bicycling to work from now on (Path) may be the result of stop taking the car for the same purpose (Dot).

A common term for interventions is policy instruments, which are a package of techniques that public authorities employ to induce behaviour change of citizens (Vedung, 1998). Hence, policy instruments are triggers of behaviour/habits. Drawing on a tripartite taxonomy of power by Etzioni, where power is understood as means of compliance and control, Vedung (1998) elaborates on a categorisation of policy instruments into regulations, economic means and information of which each is suited to match behaviour and habits differently (Verplanken & Wood, 2006). Common for all three categories is that each policy instrument consists of action content and authoritative force (Vedung, 1998). The former encompasses information about the effect, whereas the latter encompasses the degree of constraint or power exerted by the public authority. The application of policy instruments establishes a horizontal relation between the governmental authority as senders of interventions and the citizens, who are expected to change behaviour and referred to as receivers. However, economic means and information can also be employed by other Agents of Change than public authorities.

5.2.1. Regulations and Legislation

Regulations are the most constraining type of policy instruments as the receivers are required to obey what the regulation prescribes (Vedung, 1998). Thus, regulations have an immediate effect on human behaviour and habits and can be regarded as the environmental constraints that can prevent individuals from carrying out their intentions. They encompass prescriptions and proscriptions; the latter often in the form of (un-)conditional prohibitions:

- *Unconditional prohibitions*: The behaviour is absolutely binding for the receiver and violation is punished with sanctions such as fines or imprisonment. The point is to prevent a particular behaviour to be performed such as driving in the wrong side of the road or parking outside appointed spots.
- *Prohibitions with exemptions*: The behaviour is only allowed with exemptions. Driving on pedestrian streets of inner cities is prohibited unless the purpose is to deliver goods. Hence, lorries are exempted from this regulation in a certain time span.
- *Prohibitions with permissions*: If the receiver meets the requirements to acquire a permission to perform the behaviour such, the behaviour is allowed to be performed. The point is to control behaviour by granting permits and licenses, for example.
- *Prohibitions with obligations to notify*: The behaviour is forbidden, but once the

proper authority is notified, the behaviour becomes legitimate. For example, an addition to a house under 50 m² is allowed to be built once the municipality has been notified (The Building Code, 2010).

Regulations are synonymous to what Lindén et al. (2006) have labelled administrative instruments, which are argued to have an immediate effect once resolved by the authorities. The role of the authority is to introduce as well as monitor that the citizens act in accordance with the regulations, and regulations provide authorities with the greatest power compared to the two other policy instruments (Lindén et al., 2006; Vedung, 1998). Vedung (1998) refers to regulations as sticks due to their negative nature and tendency to be punishing.

Through regulations authorities can create a social pressure on the citizens, e.g. reflecting that it is more appropriate to use public transport and bikes/walking as means of transport. And for those who already have a positive attitude, regulations can make an action, such as biking, easier by proscribing cars in certain areas. This implies that regulations influence the individual's beliefs and function as all Fogg's triggers.

5.2.2. Economic Means

Economics means do neither prohibit nor prescribe behaviour the way regulations do (Vedung, 1998). Instead, economic policy instruments are a combination of being constraining and enabling as they can make the behaviour either cheaper or more expensive in terms of various resources to perform; that is, an arrangement according to a positive-negative and in-cash-in-kind dichotomy, respectively. In-cash instruments refer to the governmental transfer of money, whereas in-kind instruments refer to transfers of free goods such as free meals or medicine.

Incentives aim to promote and encourage a particular behaviour by a resource transfer from senders to receivers. Incentives include subsidies, loans, tax exemptions, and cash transfers (in-cash), but also public and private provision of goods and services such as hospitals and education (in-kind). Incentives are often perceived as being positive. *Disincentives*, on the other hand, are negative of nature as they restrain, punish and discourage behaviour. In-cash disincentives include charges, taxes and customs duties, but no in-kind means. Lindén et al. (2006) stress that economic policy instruments are most effective on behaviour changes if they are continuously repeated and thus become reminders. As the incentives and disincentives as applied to encourage and discourage environmentally good or bad behaviour, respectively, they function as social pressure on people and the targeted behavioural change reflects what the senders regard as the norm.

Vedung (1998, p. 30) refers to economic means as carrots, but it is arguably only incentives which can be termed as carrots due to their positive and encouraging nature. Disincentives should such as regulations and legislation rather be labelled sticks as they aim to punish bad behaviour. A risk, however, is that the economic means work in the opposite way to what was the originally intention. For example, organic food is more expensive than food produced with pesticide use (but it would not have been if the

pesticide-food producers had to pay the true costs of their way of producing). Thus, it becomes important to construct the incentive structure so that it really rewards the desirable behaviour while punishing the undesirable.

While regulations treat every citizen equally, a drawback of economic means is that they enable those who can afford it to continue the behaviour that is intended to be changed. For example, affluent people may not be affected by increases in energy prices, parking charges or congestion charges. This is a reason for the planners in Swedish practice to be aware of whom they intend to reach by public intervention and to match target groups and measures in order to achieve the wanted outcome of change and to ensure equity.

Economic means influence the control determinant of behaviour through changing the perception of whether an individual is capable of performing the action. If the economic incentive is combined with information, people become persuaded, and the attitude thereby changes.

5.2.3. Information

The third type of policy instruments, information, 'covers attempts to influencing people through the transfer of knowledge, the communication of reasoned argument, and persuasion' (Vedung, 1998, p. 33). Information is regarded as better tactics for inducing change in behaviour than of habits (Fogg & Hreha, 2010; Verplanken & Wood, 2006).

Information can be divided into mediated and interpersonal transmission, respectively (Vedung, 1998). The *mediated* category includes information dissemination through mass media channels such as TV, radio, newspapers, posters and brochures. Taking into account the year of Vedung's publication, the internet with social media platforms and news media should be added to the list. The *interpersonal* category encompasses demonstrations, exhibitions, advices, workshops and classroom education, which characterise face-to-face information exchange. As with the other two types of policy instruments, information has an affirmative side and a negative side, meaning that it can restrain/dissuade as well as promote/persuade actors to act. Unlike the other types of policy instruments, information can be a policy instrument per se as well as a necessary precondition for economic means and regulations to function and for such measures to gain political support. Vedung (1998) labels information as sermons due to its nature of moral suasion and exhortations. The receiver's acceptance of information is voluntary and thereby information has a slow effect on behaviour change as compared to the other types (Lindén et al., 2006). In relation to the behaviour model, information aims at changing peoples' belief and eventually attitudes, norms and control.

Making consequences of undesirable behaviour visible as information through ICT is argued to induce behaviour change (Zapico et al., 2010; Mattern et al., 2010; Lindén et al., 2006). For example, providing the user with feedback about the energy performance of different activities and comparing this with the way others behave, smart electricity metering, smart phones, applications, and social media become channels for persuading residents to change behaviour via the principles of self-monitoring, comparison and social facilitation (Zapico et al., 2010).

Information is quite interesting in relation to the themes of Socio-technical Transition and sustainable development as it can be disseminated according to the dominant discourse as a social structure of society. Discourse reflects how a group of people give meaning to a social or physical phenomenon in regular ways by articulating it through a set of concepts (Hajer, 2005). Although discourse has undergone democratisation, meaning that 'inequalities and asymmetries in the discursive and linguistic rights, obligations and prestige of groups of people' has been diluted (Fairclough, 1992, p. 201), discourse is acknowledged for being able to influence norms and attitudes by outlining the 'right' behaviour through discourse techniques such as teaching, counselling, and advertising (Fairclough, 1992). This indicates that it is not a question of how much information a person possesses. Rather it refers to the type of information in order to make the desirable discourse the dominant one and thereby influencing how citizens think, talk and write about environmentally friendly behaviour. Complexity, lack of availability or contradictory information creates an uncertainty about how to choose or act (Vermeir & Verbeke, 2006). For example, counterargument and scepticism have been widely used tactics by especially US conservative think-tanks since the influential UN World Summit in 1992 to question the significance of environmental issues such as climate change (Jacques et al., 2008). This has in the context of US resulted in a weakened commitment to environmental protection, and the counter movements of climate scepticism are referred to as organisations of denial (Jacques et al., 2008). Although one of the drivers for change in today's society is peoples' ability to be reflexive (Vermeir & Verbeke, 2006), it may still require too much of abstract thinking to understand the bias or even discursive manipulation by elite-driven counter movements and their non-immediate impacts on one's behaviour, which can result in un-wanted behaviour (see below on the prisoner's dilemma conditions). Furthermore, as most everyday behaviour constitutes habits, and thus less of careful thought, people may 'forget' to be reflexive about their behaviour.

Having information equated with persuasion, principles used in especially marketing are examined closer as a means to elucidate how the residents of Södermalm indirectly can be persuaded to change behaviour.

Persuasion Principles

Like Fogg, the American psychologist Robert D. Cialdini considers the key to behaviour change to be persuasion – an approach for 'directing our actions with quiet power' (Cialdini, 2007, p. 57). Hence, persuasion theory has parallels to power theory and to the sermons among Vedung's policy instruments. In his book *Influence: The Psychology of Persuasion*, originally published in 1984, Cialdini offers a guide to induce behaviour change based on six persuasion principles, which can be regarded as triggers. Common for 'the weapons of influence' is their ability to make a shortcut in thought or as an automatic, mindless compliance, meaning that the change of behaviour happens with no or little conscious deliberation.

(1) *Reciprocation*: Inherent in the nature of human beings is a desire to repay favours and actions as a feeling of obligation. If this is created, the persuaded individual will most likely perform an action; that is, change behaviour. Creation of a sense of obligation or

indebtedness can happen by doing an uninvited or unfair favour, which cannot be repaid equally, or by providing concessions; for example by providing a gift or price reduction. The principle of reciprocity is widely used in political logrolling/negotiations.

(2) *Commitment and Consistency*: People want to appear as being consistent with their actions, beliefs and values. When they have made a commitment, people will stick to it in order to appear consistent. A commitment can be sustained by writing it, stating it publicly, going through extra effort, and providing a reason. Cialdini exemplifies this principle by referring to an experiment where two samples of households were approached differently with regard to energy conservation. The households who had their names publicly stated achieved remarkable energy savings. More remarkable is it that those households kept, even at an increased level, conserving energy afterwards. Furthermore, the experiment indicated that in spite of peoples' good intention, information about energy conservation is not enough to induce change of behaviour, whereas a public, written statement was more powerful. The commitment is likely to have resulted in a self-enhancing effect and change of attitude, where the households began to perceive themselves as conservation-minded and felt proud and good about their efforts.

(3) *Social Proof*: Individuals tend to behave like other individuals in a given situation – people want to 'go with the flow' and follow the norms of a society (see above). This happens mainly in situations of uncertainty and touch of similarities with other individuals. A drawback of this principle is the risk of a situation to result in 'pluralistic ignorance'; a phenomenon where the behaviour of many individuals results in a negative outcome. An example concerns how people continue to drive cars despite awareness about accidents and pollution, but since everybody else continues, the individual may find it difficult to be convinced to stop driving cars. There are other reasons for driving a car, such as time, status and convenience; yet in general terms people may think: 'Why should I change behaviour when no one else does'. Such circumstances are often explained in the light of game theory and the well-known prisoner's dilemma (Klosterman, 1985). An action which from a societal viewpoint seems irrational for obtaining optimal outcome for the public good may be rational for the individual in a quest for pursuing self interest. This justifies public intervention (Klosterman, 1985) and it indicates why interventions should be matched to target groups according to Lindén et al. (2006).

(4) *Liking*: Individuals tend to perform the same behaviour as other people or respond to requests by people they like or know. Means to increase liking include physical attractiveness, similarity (e.g. same background or interests), compliments, contact and cooperation, and conditioning and association. Examples include linking celebrities to a product or by creating a shared sense of being on the same side. This principle is related to the normative beliefs determining behaviour.

(5) *Authority*: Inherent in human beings is a sense of duty to authority whatever function the person or institution must have. Obedience to a person can be triggered through titles (e.g. physician or professor), clothes (e.g. uniforms or business suits) and trappings (e.g. jewellery or cars). To sustain compliance, the authority must establish

trust in their actions, for example by mentioning a drawback in complement to more significant advantages. Considering the obedience to authorities, it is important that those provide valid information promoting sustainability and try to refute information provided by counter-movements (see above about discourse).

(6) *Scarcity*: When items and information are rare, limited or exclusive, people tend to have a greater interest in possessing them and rate them as valuable. Likewise, when actions are banned, people are inclined to perform them. This is based in a human belief that when opportunities become less available, people see scarcity as a loss of liberty. According to Cialdini, optimum conditions for the principle to operate are in times of newly experienced scarcity, limited duration, and in competing for scarce resources. This principle equates the market mechanism of supply and demand. It is questionable whether the principle in some cases can result in a backfire. For example, if car driving is being (almost) banned as a result of passed legislation, limited to some days a week (like during the oil crisis in the 1970s in Denmark and Norway) or limited due to increased oil prices, it may become an even more attractive mode of transport than it is already. On the other hand, although fossil fuels are becoming more scarce, (Western) societies strive for independency hereof. This indicates that the scarcity principle should be exploited carefully. In commercialisation of new products that can save money (through saving energy), Cialdini (2007, p. 238) recommends that campaigns should focus on the amount of money spent if not buying the item rather than the money saved.

Besides the six principles, Cialdini also highlights the principle of providing a reason for the request. This could be combined with the other policy instruments. For example, sell your car because the parking charges increase or start to bike *because* it is good for your health. Not included in the list of principle is the principle of material self-interest (see above about the prisoner's dilemma conditions); yet it is acknowledged by Cialdini (2007, p. xiii). Here it is assumed that a driver for human behaviour is when a minimum of money (and probably also other resources such as time, abilities and efforts) leads to maximised personal benefits.

Cialdini's principles are based on his research in marketing and salesmanship where companies are likely to be interested in spreading a product rather than in how people use it (if they do). However, the principles have been applied to other fields; for example to computer science and sustainability (Zapico et al., 2009) and in studies of computers as persuasive technologies referred to as captology (Fogg, 2003).

5.2.4. Summation

This section has reviewed the potentials of mainly the three policy instruments of regulations, economic means and information as social structures for changing the behaviour of citizens to be more sustainable. The instruments can be seen as tools for increasing the ability and motivation of an individual, i.e. changing the determinants of behaviour, and thereby as triggers of behaviour change. Furthermore, by changing the current incentive structure (as an Object of Change) into a new stable context, the Agents of Change intentionally induce a change of behaviour which potentially can

turn into habits. It is important that the Agents of Change acknowledge that different categories of people must be influenced differently in order to attain a positive outcome of intervening in peoples' everyday life. The strategy to managing Socio-technical Transition (see chapter 4) determines the degree of application of policy instruments (Vedung, 1998).

5.3. Summary

Derived from the idea that behaviour change as a part of Socio-technical Transition is required to achieve a low energy, low carbon society, this chapter started by identifying the underlying determinants and background factors for behaviour and habits as Objects of Change from which it presented interventions in terms of policy instruments for triggering a change of behaviour. Regulations and legislation, economic means and information should be seen as instruments for getting ICT widespread and as complementary to the behaviour change that technologies exert on people. It can be learned that informal social structures such as norms, culture, values, attitude, personal abilities and background and beliefs as well as formal institutions such as the policy instruments are Objects of Change that influence how people behave. In order to attain Socio-technical Transition, it requires that Agents of Change organise on the regime-level as a counter-movement to the prevailing structures. Further, that they create an incentive structure as a new stable context which rewards environmentally friendly behaviour and enables new habits to flourish and that this structure influence different societal groups.

6. Factors for Socio-technical Transition

‘Since the future is not a disconnected end-state, but rather rooted in both the past and the present [...], images of the future will inevitably bear traces of yesterday’s as well as today’s zeitgeist’ (Gunnarsson-Östling & Höjer, 2011, p. 6).

Backcasting as a normative, transforming type of scenario aims at illustrating how the prevailing structures can be changed in order to accomplish a target of a desirable future and thus how current unsustainable tendencies can be broken in order to avoid path dependency. According to the above assertion, scenarios, fictitious or real, should be regarded as only a snapshot of a future societal development. Hence, it is of importance to identify and analyse the factors that can enable or constrain a Socio-technical Transition as they can be crucial for whether the target can be accomplished and the identification can per se be seen as a result of backcasting (Höjer, 2000, p. 14). In addition, Höjer argues that the balance between illustrating a futuristic science-fiction-like image and a development which follows business-as-usual can be achieved through outlining the enabling and constraining factors in order to maintain the plausibility of the scenario. The purpose of this chapter is to identify and analyse factors for Socio-technical Transition as the conditions which the scenario’s Agents of Change act within.

In this chapter, the identification of factors is based on analyses of tendencies and is finally arranged according to whether the factors can be regarded as assumptions or prerequisites. This distinction should not mistakenly be equalised with external and internal factors (Börjeson et al., 2006), which refer to whether a factor/development is controllable by the Agents of Change. The development of some of the factors happens on a more general and societal level and as a parallel to the Socio-technical Transition with ICT as a motor. Nevertheless, the factors’ influence is sought contextualised to the local level of Södermalm, which is the case of this study. The assumptions and prerequisites are elaborated below and grouped in overall categories, which relate to the three structures within the concept of Situations of Opportunity:

Assumption refers to a development which is supposed to happen although not required for the Socio-technical Transition.

Prerequisite refers to a development which is required for the Socio-technical Transition to happen.

1. Socio-economic factors (related to social structures)
2. Factors for technological development
3. Urban factors (related to urban structure)
4. Organisational factors (related to organisational structure)

6.1. Socio-economic Factors

Socio-economic factors are in this study referred to as the social and economical relations and patterns which are enabling or constraining for everyday practices and thus influence the ‘success’ of Socio-technical Transition. These factors are influenced by behind lying mechanisms or determinants such as economic development, consumption, demographic factors, and environmental concerns, which are elucidated below.

6.1.1. A Shift from Neo-classical Economy towards Ecological Economy

An important driver for the development of Western societies has traditionally been economic development. Economic growth refers to the average rising of living standards of the population and has become 'the secular religion of advancing industrial societies' (Friedmann, 2005, pp. 3-4). Several Western governments, also in Sweden, have traditionally strived for socio-liberal values and have acknowledged the forces of the free market as main driving forces and prerequisites for societal development. The mainstream neo-classical economists argue that negative consequences are results of market failures and seek to adjust market forces to cope with environmental impacts. The impacts on the environment from unsustainable energy usage are by the neo-economical approach to economy regarded as a market failure which should be dealt with by public interference.

Oppositely, ecological economists regard the economy as an open subsystem of the global ecosystem and consider long-term and unlimited economic growth as contradictory to environmental sustainability (Daly & Cobb, 1989; Røpke, 2004), and evidently such a view on growth strongly disagrees with the conventional approach to economy. As long as the economy grows without decreases in the resource consumption, sustainable development can hardly be achieved (Næss, 2006a, p. 222). With regard to the strategies for sustainability presented in chapter 1, the ecological means for regulating economy and environmental impacts is directed towards the reducing strategy. Decreases of (energy) usage and heavy limitations of the powers of the free market are all inconsistent with the current developments but are regarded as needed in order to attain the Socio-technical Transition.

However, the neo-classical view on economic growth is not desirable in this study as this would hamper the Socio-technical Transition by struggling for maintaining the current paradigm. As an external factor to the scenario, **the neo-classical paradigm is assumed to become less dominant, and within the time span of the Socio-technical Transition, the development must tend towards more ecological paradigms of economics in order to reduce the energy usage.** Public intervention in terms of regulations and investments is needed in order to cope with the massive market failures (Klosterman, 1985) causing climate changes and ecological disasters. Such regulations should not only reinforce the market forces and cause reduced energy usage but should destabilise the current socio-technical regime and pave the ground for ICT as a means for changing the energy usage towards a more sustainable path. In Sweden, as well as in most Western societies, the development has been towards the growth, increased standards of living, and increased consumption and the following paragraphs will elucidate how these tendencies affect the Socio-technical Transition.

6.1.2. Enhanced Standards of Living

In 2010, Sweden was ranked as number 9 in UN's Human Development Index of very highly developed countries (UNDP, 2010, p. 143). The index is a measure of how developed a nation is in terms of its citizens' possibility for achieving a long and healthy life (measured in life expectancy), access to knowledge (measured in years of schooling),

and a decent standard of living (measured in gross national income). Since the first report was published in 1990, Sweden has always ranked high in the index with increasing values. It can be expected that Sweden also in the coming 20 years, equal to the time span of the scenario, can enhance or at least maintain decent standards of living. In fact, **it is a prerequisite that the residents have an income which allows purchasing of ICT**. However, the issues of increasing living standards are strongly connected to the issue of consumption, at least as long as the prevailing neo-liberal paradigm exists. The assessing part will discuss possible rebound effects of increased consumption when people experience economic growth in their private economies; for example that the extra money is spent on consumer goods such as travels, entertainment and status symbols rather than on energy reducing appliances.

6.1.3. Consumption

By following business-as-usual, consumption is by Scandinavian economic advisors assumed to increase. For example, the private consumption per capita in Denmark is expected to be doubled within 40 years (Jespersen, 2010). If this prediction or expectation proves correct, it implies that the residents in Södermalm, as well as the rest of Sweden, can be expected to consume more energy than today as larger dwellings are bought, more consumption goods are produced and more waste is deposited and etc. Although ICT can contribute to energy savings, ICT also uses energy – 4.3 % of overall electricity consumption of EU-27 in 2005 (Mattern et al., 2010). This is likely to be in conflict with the vision of a low energy, low carbon society and it calls for a strategy of reducing the energy consumption. An ecological drawback of the technological development in combination with a continuation of enhanced standards of living is that development is likely to entail that people more frequently buy new and more products as the prices drop, the service life is (deliberately by the manufacturers) shortened, and new products enter the market with increasing pace due to increased demand. The augmented number of (energy efficient) products can result in an unintended increased energy usage, which is referred to as rebound effects (Plepys, 2002; Zapico et al., 2010). **In order to reach the low energy, low carbon society in 2060, it is a prerequisite that the level of consumption is decreased.**

6.1.4. Demographic Factors

Demographic factors are external factors, but they are assumed to develop in parallel to the Socio-technical Transition. Globally, urbanisation is rapid and in 2030, it is expected that 60 % of the world population will live in urban areas compared to around 50 % today and it is by UN expected that the total global population will increase by around 16 % until 2030 (UN, 2004). This tendency is also witnessed in Sweden where the population is expected to increase by 10 % until 2030 (SCB, 2010). The city district of Södermalm was in 2008 inhabited by 118,000 residents, and this number is expected to grow by 7 % to 126,000 inhabitants in 2018 (USK, 2009) due to urbanisation and a higher birth rate than death rate. Despite that a population projection is not a simple calculation, adding a tendency line in Excel demonstrates a total population growth in the time span of the scenario on approximately 30,000 persons or approximately 23 % (see figure 6.1).

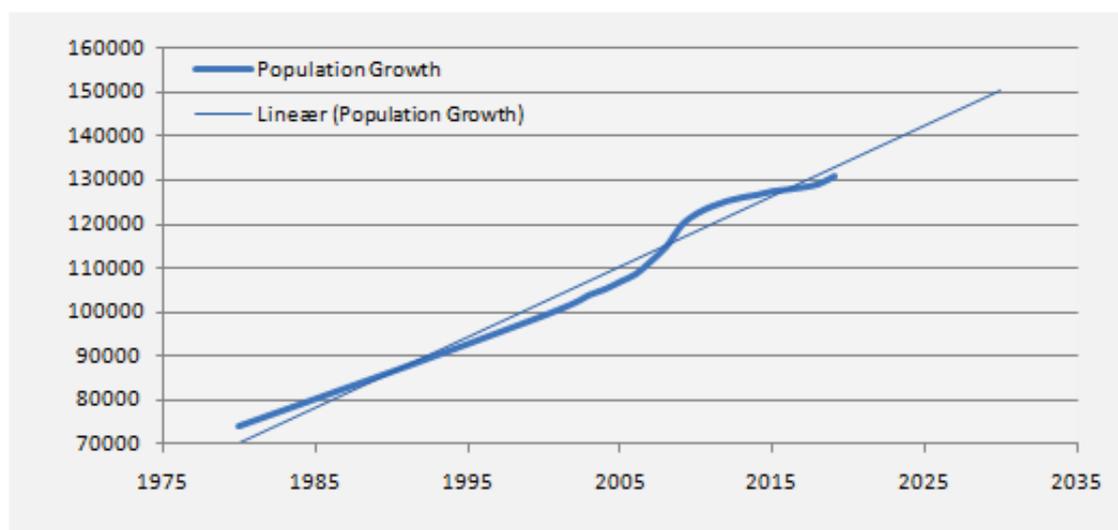


Figure 6.1: Population Growth and Prediction in Södermalm (USK, 2010, p. 79; USK, 2009a, p. 127; USK, 2004, p. 126). Tendency line added by the authors in Excel.

When it comes to the more specific demographic development in Södermalm, the average age has decreased from 46 years in 1980 to 40 years in 2008 – a development which corresponds to the general picture of Stockholm (USK, 2009a, p. 26). A younger population can be a driving force for Socio-technical Transition, as younger people often are leading innovators in the use and spread of ICT. In Södermalm, the mean income is generally higher than the city average for all age groups (USK, 2009a, pp. 139, 44, 79), and through gentrification the district now features mainly the middle and upper classes rather than the working class and more upgraded housing towards more elegance and expensiveness (Franzén, 2005). Although the population in Södermalm is rather affluent, **economic incentives are assumed to make behaviour more sustainable.**

6.1.5. Increasing Environmental Concern

Since the energy crises in the 1970s, the Brundtland report from 1987, the Kyoto Protocol from 1997, the COP16 agreement in 2011, and media's increased focus on the climate changes, the environmental concern among Western societies has increased through policies for reducing emissions of greenhouse gases. The planners and politicians of Stockholm, a city which is well-known for its environmentalism, are especially aware of the link between energy usage, emissions of greenhouse gases and climate changes and has declared a goal in the 'Action Programme on Climate Change' of being a fossil fuel free city by 2050 (Stockholms stad, 2009a).

On the Stockholm Environmental Barometer, the Södermalm residents demonstrate a generally higher personal concern and interest for environmental issues as compared to the rest of the city (Stockholms stad, 2009b). This is reflected through the travel behaviour, which, compared to the other city districts within City of Stockholm, is a bit more environmentally friendly as public transportation and walking/cycling is used more frequently than the car (see figure 6.2). In addition, the residents of Södermalm display a lower automobile ownership rate (17.2 cars per 100 inhabitants) than the inner city (19.2 cars per 100 inhabitants) as well as the whole city (22.7 cars per 100

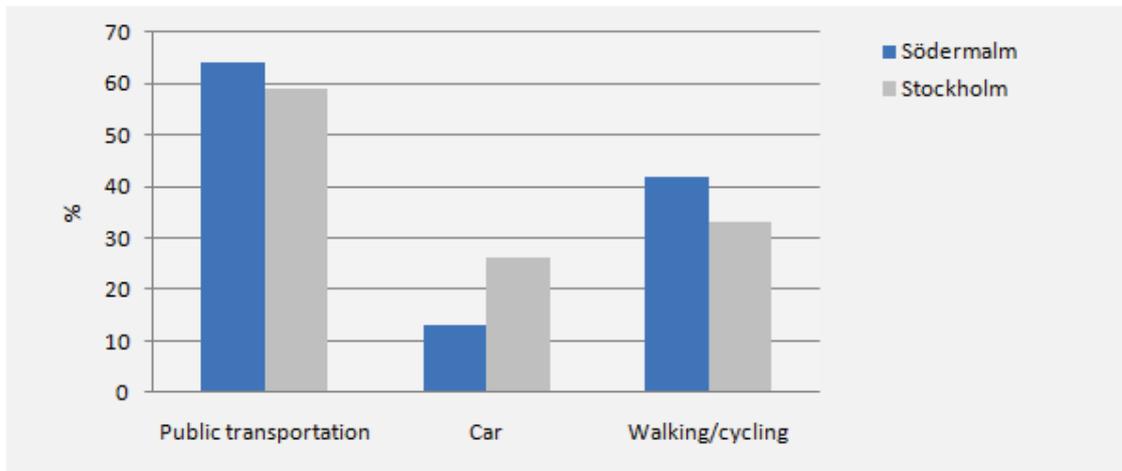


Figure 6.2: The actual modes of transport in Södermalm compared to the rest of Stockholm. Figures from year 2007 (Stockholms stad, 2009b).

inhabitants) (Stø, n.d., p. 66). However, the dense urban structure, the service of public transportation and the proximity to the inner city may also explain the preferred modes of transport on Södermalm by encouraging certain travel behaviour.

Although the Södermalm citizens, and the Stockholmers in general, demonstrate a high level of environmental concern, it has also been proven that there can be a mismatch between attitude and behaviour, meaning an inconsistency between what people believe and think and how they act (see examples in Holden, 2007). Nevertheless, a positive attitude towards environmentalism may be important to possess in order to take actively part in Socio-technical Transition. One way to do this is through policy instruments by which one actor ('sender') intends to motivate or force another actor ('receiver') to change behaviour (Lindén et al., 2006). Important in this connection is that people should likely be influenced differently due to socio-economic factors. In the scenario, **it is assumed that the Södermalm residents continue to be rather environmentally concerned in the future.**

Several authors assert that ICT is able to change behaviour (see, among others, Mattern et al., 2010 and Zapico et al., 2009, 2010) through automation and visualisation of energy performance. It is therefore reasonable to assume that the Södermalm citizens will change behaviour as part of the Socio-technical Transition, but it is a prerequisite that ICT can become available to and adapted by the users (see below and Holden (2007)).

6.1.6. Summation

The socio-economic assumptions and prerequisites are important for Socio-technical Transition as they are determining for organisational and social changes. Firstly, it is *assumed* that the neo-liberal paradigm becomes less dominant within the time span of the Socio-technical Transition; on the other hand, it is a *prerequisite* for the low energy, low carbon society that the development tends towards more ecological paradigms of economics. Secondly, it is *assumed* that the environmental concerns increase in the future, and it is regarded as a *prerequisite* that the level of consumption is decreased.

Thirdly, a *prerequisite* for enabling the Socio-technical Transition with ICT as motor is an income allowing the residents to purchase ICT, and finally it is *assumed* that economic incentives can make citizens act more sustainable and that people are willing to change behaviour.

6.2. Factors for Technological Development

It is evident that humankind has faced a technological development throughout human history – otherwise we would still walk barefooted, live in shanties and hunt for a living. The reasons for technological development are many, and it can be argued that some of the most obvious are:

- Enhancement of survival,
- Increasing living standards,
- Curiosity,
- Achievement of greater power.

The present and expected future prevalence of ICT is the result of technological development. Technology refers to a socio-technical system which can ‘enable humans to extend their capabilities and to accomplish tasks which they could not perform otherwise’ and it encompasses hardware, software, social as well as organisational know-how and techniques (Grübler, 1992, pp. 2-3). Technological development is a continuous cyclical process in which technologies are discovered, improved and adopted through the stages of invention, innovation and diffusion (Weaver et al., 2000). Not only do more people have access to ICT, the improvement of electronics has also increased while prices have decreased (Plepys, 2002), which is also assumed to happen in the future. Technological development has also changed the design of ICT: computers have gone from being very expensive desk tops to lap tops for the masses, and mobile phones have gone from being large suitcase born devices which could only make a phone call to pocket size smart phones with Internet, GPS and High Definition video camera.

The invention of a new technology entails invention of affiliated technologies. For instance, the discovery of electricity entailed the invention of new types of illumination (Weaver et al., 2000). From this follows that one solution or technology cannot stand alone, hence technologies cluster. Furthermore, technological evolution indicates that while new technologies are born, other technologies are turning into museum artefacts. And together with new inventions, new so far unknown needs and wants emerge which again can create the foundation for new (clusters of) technologies to be invented (ibid.), some even with the intention of creating a more sustainable society such as the ICTs mentioned in the scenario. Behind technological development lies organisational and social structures and Holden (2007, p. 73) points out that use of a new technology require that it:

- is being invented;
- is made available to the users; and
- is being adopted by the users.

As many ICTs exist, although yet not widespread, the question is how a situation for a change in technological paradigm can occur with focus on Holden's second and third requirement and this is what the scenario and the project more generally is seeking to explore.

As an internal factor, **a prerequisite for Socio-technical Transition is that new ICTs continuously are being invented, made available and gradually improved by developers/manufacturers and continuously made affordable and adopted by the residents of Södermalm.**

Although mobile phones are expected to play a prominent and persuading role in the peoples' everyday life in the future (Fogg & Eckles, 2007), they will most likely look different from today and contain scores of yet unknown applications and functions – they will simply be smarter. This is far from unrealistic as the number of sold smart phones in Denmark in the summer 2010 surpassed the number of sold mobile phones with the American company Apple as the leading brand despite their prices on smart phones and other consumer electronics (Rasmussen, 2010). A new technology can be adapted by users through force or attractiveness (Holden, 2007, p. 73) and Apple's consumer electronics such as the iPhone and iPad are examples of attractive technologies due to, among other things, the unique design, which for some people have become 'a must have' regardless of the price. Such technologies appeal to people, and are thus examples of integrating social and technical structures.

ICT can be used for all three strategies of efficiency, substitution and reduction (Mattern et al., 2010; Kim et al., 2009). One major technology cluster which is expected to be implemented in the future as a means to deliberate the energy system from fossil fuels is the Smart Grid (see below). Smart Grid and related ICTs are even expected to induce a paradigm shift in the energy sector towards a change in behavioural patterns (Mattern et al., 2010). The same could perhaps be said about the smart phones whose applications in terms of games and programmes in principle could change users' behaviour. A related technology to the Smart Grid is the concept of Smart Homes (Ricquebourg et al., 2006; Sandström et al., 2003), which was introduced in chapter 1.

6.2.1. Smart Grid

The increased awareness on the outlook for depletion of non-renewable sources and increasing climate change has created a possibility for grid owners and energy suppliers to create an energy system which is based on electricity from decentralised energy generation through renewable sources such as wind-, hydro- and solar power in interplay with electric heat pumps as well as electric- and hybrid plug-in cars – a so-called Smart Grid. Such a system can be said to entail a paradigm shift in the energy sector (Mattern et al., 2010). Smart Grid is by the 'European Technology Platform for the Electricity Networks of the Future' (2006) defined as 'electricity networks that can intelligently integrate the behaviour and actions of all users connected to it – generators, consumers and those that do both – in order to efficiently deliver sustainable, economic and secure electricity supplies'. In times of overproduction, the energy is conserved locally or distributed back to the grid and used elsewhere and if the overproduction is

general nationwide, the energy is stored. In times of local underproduction, electricity is supplied by the storages and from other sources such as large wind turbines. As wind and solar are fluctuating energy sources, there will still be a need for combined heat and power plants (CHP), preferably run by cleaner energy sources like biogas, or nuclear power stations in the case of Sweden. However, smart appliances and demand management in the household that automatically turn on and off the home appliances can be installed to respond to fluctuations and expensive peak hours and thereby save the owner money. Thereby, the dwelling becomes a Smart Home and the households become 'prosumers' as they will become producers and consumers of energy simultaneously. It is beyond the scope of this project to go further into technical detail about how the Smart Grid works.

In an assessment of the barriers and potentials of implementing the Smart Grid in Denmark, ICT is put forward as the means to make the different elements in the Smart Grid communicate (Dansk Energi & Energinet.dk, 2010). ICT for the Smart Grid is needed under the following categories:

- Systems for cross-disciplinary coordination and exchange of data between the electricity system operators;
- Equipment for real-time measuring of the condition of the distribution network (the electricity grid) to avoid overload;
- Equipment for flexible management and billing of energy usage (including a smart electricity meter) among house owners who invest in heat pumps, photovoltaic cells or an electric car; and
- Equipment to ensure system stability.

To summarise, **the Smart Grid is a prerequisite for the Socio-technical Transition to occur in Södertälje**. However, since the Smart Grid makes up an external factor as it is to be implemented nationwide, or at least on a greater scale than Södertälje, the scenario will not focus on the actual implementation. **It is assumed that the Smart Grid will be implemented during the next 10-15 years** according to the Danish expectations (Dansk Energi & Energinet.dk, 2010) – a horizon which is assumed to be similar in a Swedish context. On the other hand, Södertälje can be used as a test bed for installing and subsequently improving the concept of Smart Homes.

Smart Grid as a Prerequisite for Commercialisation of Electric Cars
The quest for finding and implementing alternatives to fossil fuels has lasted for more than 30 years, and in recent years in the light of the discourse on sustainable development (Holden, 2007). In order to find the appropriate technologies for sustainable transport, the right energy chain must be found; that is, 'the optimal combination of vehicle concept, fuel and energy source [...] that satisfies long-term ecological sustainability requirements' (ibid., p. 79). Based on life cycle assessments (LCA) of fuels (often referred to as well-to-wheel analyses) and ecological footprints of 14 different energy chains, Holden found electric cars² with batteries based on hydro-power³ as the most sustainable energy chain. However, Holden (ibid., p. 90) stresses that the performance of batteries must be improved in order to increase the performance of the vehicle compared to conventional vehicles. This is expected to happen within a few years as

technologies develop further. Electric cars are interesting in the light of the Smart Grid's development because they allow for integration of wind as a fluctuating energy source to be stored as energy in the car batteries. Through demand management of the Smart Grid, the batteries can be automatically charged when there is an overproduction of wind (and hydro) power. As part of the technological development, **a prerequisite for Socio-technical Transition is the commercialisation of electric cars**, following the expectations of more electric and hybrid vehicles for both private and public transportation are fulfilled from 2012 in Sweden (Elforsk, 2010). This is also assumed in the study 'Bilder av Framtidsstaden' (Gullberg et al., 2007).

6.2.2. Dematerialisation

Zapico et al. (2010) assert that ICT can have environmentally positive impacts through optimisation, behaviour change, and dematerialisation; i.e. all three strategies of Holden (2001). Dematerialisation aims at replacing physical objects and services with virtual ones. Hence, dematerialisation is sometimes referred to as virtualisation. Embedded in dematerialisation is not only a shift in technologies but also a shift in behaviour. **A development towards increased dematerialisation is a prerequisite for Socio-technical Transition**, at least to some degree, and some examples are:

- A shift from physical travelling to virtual presence through tele- and video conferencing;
- A shift from paper mail and books to electronic mail and books;
- 'E-Everything' such as e-commerce, e-networking (social media) and e-banking;
- Cloud computing⁴.

However, rebound effects are attached to dematerialisation. For example, the replacement of physical mobility in favour of virtual mobility has been questioned by, among others, Hjorthol (2002), Plepys (2002), Urry (2002) and Lassen et al. (2006). This is grounded in the idea that travelling is not isolated from other activities. Furthermore because decentralisation, as an effect of ICT (Banister & Stead, 2004), expectations of networking, tourism and personal identity building all require longer journeys to other parts of the region, nation and/or world. Furthermore, an associated problem is the lack of visual, physical and social contact with others, places and moments as an inherent need in all human beings and this affects that people still need to 'corporeally' travel (Urry, 2002). Furthermore, although ICT can save energy and space in office buildings, additional energy is needed in home offices instead (Plepys, 2002). In other

² There are different types of electric vehicles (Dansk Elbil Komité, 2009): A *Hybrid Electric Vehicle (HEV)* is a petrol driven vehicle with an additional electric engine of batteries, which, however, cannot be charged from sockets. A *Plug-in HEV* has, compared to the HEV, larger batteries and a battery charger, which implies that it can be plugged into the grid, and it has a longer range. The *Battery Electric Vehicle (BEV)* uses only batteries and has a range as a regular vehicle with an internal combustion engine – charging happens through the grid.

³ In 2008, hydro-power accounted for 11 % of the total Swedish energy supply (Statens energimyndighet, 2009a, p. 10).

⁴ A model that benefits from economies of scale by consolidation of computing resources in central data centres which are accessible from the internet. Examples encompass storage, servers, software and services (Kramers, 2010).

words, ICT can only modify the travel patterns and not fully substitute/replace travels, and it indicates that a total dematerialisation is not possible.

It is assumed that people to a greater extent use teleworking from home or work hubs and videoconferencing as a means to reduce the need for physical travelling although this may have some side effects which are discussed further in the assessing part.

6.2.3. Summation

Technological development is a foundation for Socio-technical Transition and several of the assumptions and prerequisites presented in this section are directly connected to ICT as the core technical innovation enabling the transition to occur. A first *prerequisite* is that new and future ICTs are invented and improved and that the improvement of electronics increases while prices decrease. Secondly, it is a *prerequisite* for the scenario that the Smart Grid is developed and implemented during 10-15 years. Finally, it is *assumed* that the development towards increased dematerialisation from hardware to software continues with high pace.

6.3. Urban Factors

Planning and urban development focuses on where, when, how and by whom the city shall develop in the future. Seen from a perspective of energy usage, this seems appropriate because studies have shown a correlation between land use patterns and fuel consumption globally, (Newman & Kenworthy, 1989), in Nordic cities (Næss, Sandberg & Røe, 1996), and in Swedish cities (Næss, 1993). Besides reduced fuel consumption, it can be argued that a denser city is more effective as it uses less energy for space heating, that public transport becomes increasingly feasible and that the accessibility to organised social facilities like hospitals and universities increases. Although denser cities are aligned with reduced energy usage, they may also be attached with rebound effects, which will be further analysed in chapter 9.

Three different tendencies of urban development have influenced Sweden well as other Western societies in the past century as, and it is likely that these in combination will dominate in the future development of Stockholm as well (Bergman, 2007):

- Low-rise settlements: the decentralised city of low-rise buildings;
- Urban cores: Centralisation of the city centre with satellite cities; and
- Suburban centres: Polycentric structure of mega centres and urban nodes.

A key driving force for the urban development is population growth, which within the area of City of Stockholm is expected to increase (see figure 6.1). To accommodate the need for more dwellings and workplaces, the comprehensive plan for City of Stockholm designates a number of key development areas for densification of the city as a whole (Stockholms stad, 2010). Most of them are located outside the inner city (i.e. outside the city districts of Norrmalm, Östermalm, Kungsholmen, and Södermalm – see figure 1.2).

The urban factors presented in the following relate to the urban structure within the concept of Situations of Opportunity. Although this study delimited from changing the

urban fabric of Södermalm, the urban factors give an idea about Södermalm as a case area. Most of the factors can be regarded as internal factors but not required as an Object of Change in a Socio-technical Transition.

6.3.1. The Built Environment and Distribution of Functions

Södermalm has a total surface area of 800 hectares and is mainly a residential city district as the built environment is characterised by multi-dwelling buildings of 3 to 6 stories in height (97,5 % of the total dwelling amount) (USK, 2010, p. 40). The apartments are in 2009 a mixture of housing cooperatives (55 %), public housing (14 %) and rented housing (31 %) (ibid.).

A home is for many people equal to a social right with which people seek identification, intimacy and realisation, and many people tend to possess a desire of more square meters (Gullberg, 2007). The amount of floor space for one- or two dwelling buildings in Sweden has tended towards an increase since the late 1980s, while the opposite has been the case for multi-dwelling buildings (Statistics Sweden, 2007, pp. 77-79). However, when looking at the Stockholm area, the number of room units has doubled the past 50 years (ibid., p. 165), while it has been steady within City of Stockholm and Södermalm (USK, n.d.a.). An explanation of the differing tendencies may be that while the building stock in Södermalm and the rest of the inner city has changed slowly since World War 2, then massive development of suburbs with many single family houses happened in parallel with the expansion of the underground system (Lundin & Gullberg, 2007). The number of rooms in a dwelling does not necessarily reflect the actual size of it. However, as the number of room units in new dwellings is generally higher than the average of the building stock in City of Stockholm (USK, n.d.a.), it indicates that new dwellings are constructed larger than earlier as found with the increased amount of floor space of one- or two dwelling buildings.

To meet the needs for accommodation of new residents in Södermalm until 2019, City of Stockholm has predicted a growth in the housing stock of well over 6,000 dwellings to be built primarily at Södra Hammarbyhamnen (USK, 2010, pp. 79, 86), which in everyday speech is known as Hammarby Sjöstad. This number of dwellings does, however, not meet the expected growth of population in Södermalm if the general decrease in the average number of household members is considered (USK, n.d.b.). Hence, Södermalm is likely to face a conflict between the population increase and production of new dwellings. Housing requires energy for heating, ventilation, air conditioning (HVAC), lighting, and hot water, and increases in the amount of living space imply that more energy is used for controlling the indoor temperature, and there is an opportunity that ICT can play a leading role in how the services should be serviced, marketed and managed. Today, 80 % of the energy used in a dwelling is because of the dwelling space (Gullberg, 2007, p. 166) and around 40 % of the national energy usage is used for space heating (Statens Energimyndighet, 2010). This creates an incitement for reducing the floor space for new dwellings although the opposite has been predicted by the Swedish energy sector's R&D company, Elforsk (Gullberg, 2007, p. 176). Although ICT can be applied as a means for optimising and automating energy usage of HVAC in dwellings, it might only contribute somewhat to factual reductions in energy usage. In order to reach

the 2060 target of a low energy, low carbon society, it is assumed that other developments (such as densification and isolation) towards energy reductions than ICT occur in parallel to the Socio-technical Transition although not illustrated in the scenario.

Besides being mainly a residential area, Södermalm is also known for its fashion, design shops and cafés. It also has a high number of workplaces which influence the commuting patterns. The number of commuters going to Södermalm exceeds the number commuting from Södermalm by approximately 10,000 people (USK, 2009a, p. 52).

Population growth does not necessarily entail a greater prevalence of ICT in Södermalm. However, population growth in the city district and urban densification are factors that call for expanding the public transport system, which contribute to reducing the energy usage.

6.3.2. Transport System and Transportation

In Sweden, the amount of passenger transport has doubled in the past 50 years towards a clear dominance of road traffic of which cars accounted for 90 % in 2008 (SIKA, 2009, pp. 41-42). That 44 % of all journeys are made by car as the only mode of transport (ibid., p. 43) implies that the Swedes are very fond of the car as a means of transportation although fossil fuelled car driving is regarded as a highly unsustainable means of transportation.

In order to reduce traffic in the inner city, the comprehensive plan enables construction of new roads such as the express highway Stockholm Bypass. The planned highway is to be constructed in 2012-2020 and has been criticised by the Swedish Environmental Protection Agency (EPA) for being against regulations in the Environmental Code and work against the national climate policy (Naturvårdsverket, 2009). This is supported by a study conducted at KTH, which, among other things, concludes that Stockholm Bypass will lead to:

- increasing emissions of greenhouse gases;
- increasing traffic volumes; and
- an urban structure of Stockholm which is ineffective from a perspective of energy usage and climate (Finnveden & Åkerman, 2009).

Regarding public transportation, the comprehensive plan for City of Stockholm outlines a transport system, which the coming years should be extensively expanded through construction of new roads and extension of existing public transport lines. Thus, the focus is on expansion rather than on substitution of means of transport. Noise and air pollution are reduced by leading traffic away from the inner city rather than by implementing policies such as the congestion charging, although it has proven to have a positive impact on noise, air quality, emissions and traffic volumes of fossil fuel driven vehicles (SLB, 2010a). Due to Stockholm's location on 14 islands, Södermalm being one of them, much through traffic is crossing the bridges in inner city districts which results in congestion. As a result, a congestion tax zone was introduced in August 2007 as a means to reduce the increased congestion through an economic incentive for leaving the car at home and thereby improving the environmental condition (Transportsty-

relsen, 2010). Södermalm is a part of the zone. As a result of comprehensive planning, Stockholm's current local transport system, which dates back to the 1950s (Andersson, 1998, p. 23), now consists of:

- An underground system (tunnelbanan in Swedish) with seven lines, connecting the suburbs to the inner city;
- A number of commuter train lines, connecting the surrounding cities to the inner city;
- Several bus lines;
- Three light rail lines; and
- Trams in the city centre (see figure 6.3).

In Södermalm, the street network and squares were defined in the 17th century and a large share of today's building stock dates back to around year 1900 (Andersson, 1998). The street pattern can be characterised as orthogonal with Hornsgatan and Söderleden (tunnel) as the two main roads (see figure 6.4); the former being one of the most polluted streets in Stockholm and Europe with levels significantly above the recommended (Gidhagen et al., 2004). A study of two measures (prohibition of heavy traffic and environmental zones) showed that it is possible to reduce the levels to Swedish and European Standards (SLB, 2010b); that is, more or less, equal to turn Hornsgatan into a pedestrian street. The publicly owned company Stockholm Parkering is responsible for more than 74,000 parking spaces throughout Stockholm where more than 5,000 are located in streets and parking garages in Södermalm (Stockholm Parkering, n.d.).

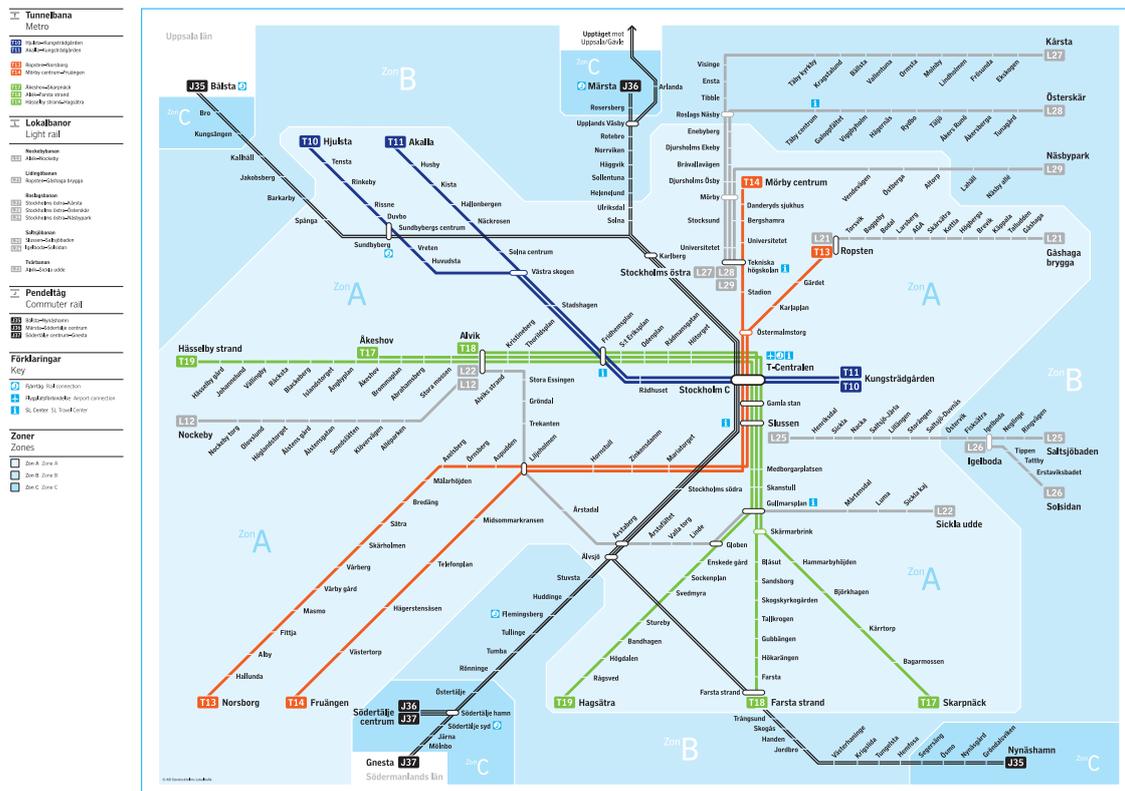


Figure 6.3: The underground system in Stockholm (SL, 2009).

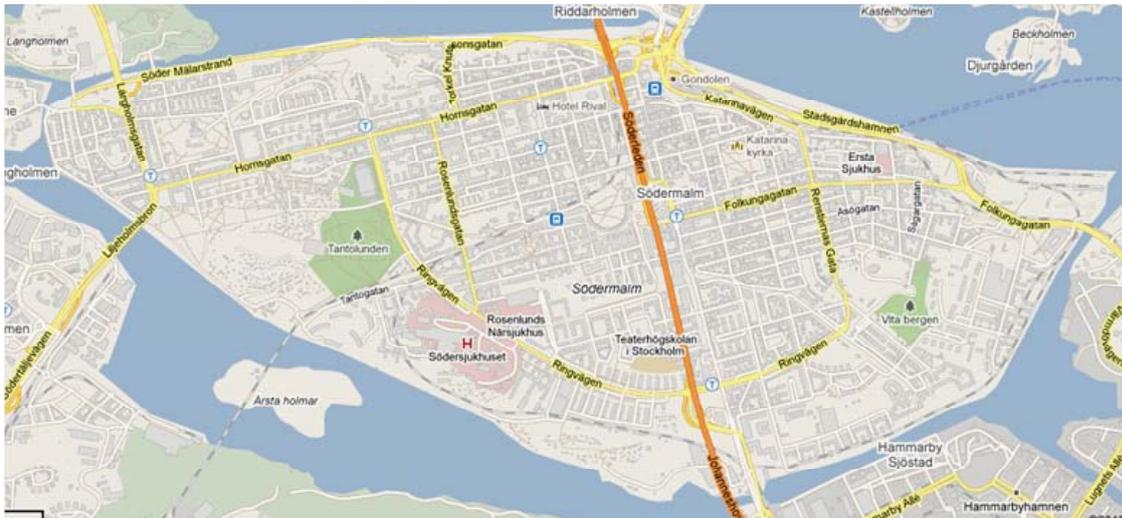


Figure 6.4: Södermalm's urban structure (Google Maps, 2010).

The transport system in Södermalm is in 2011 well-established with the red and green underground line (six stations), commuter trains (two stations) and several bus lines. In the 2010 comprehensive plan (Stockholms stad, 2010), several transport initiatives are mentioned as improvements and upgrades of the public transport system.

In the scenario, **it is assumed that people, both in Södermalm and on a more general level, will still have a need for high physical and virtual mobility 20 years hence.** However, the future of personal transport is a question of how and how much. Based on City of Stockholm's plans for an expanded public transport system, it is in this study assumed that different means will replace, at least some portion, of the car based personal transport with public transport. **It is assumed that the citizens of Södermalm in the scenario are persuaded to use walking and cycling as well as public transport for transportation more extensively than today.** In order to promote a greater prevalence of walking and cycling, construction of bicycle tracks and -parking facilities at public transport nodes are typical applied solutions. However, the public discourse, i.e. in media, of biking and walking is important for these sustainable transport modes to succeed. In Copenhagen, biking has become a signal of a green and healthy lifestyle and the bicycle now has started to be articulated as an accessory (Maagaard, 2011). This could also happen in Stockholm, which historically is environmentally concerned.

6.3.3. Infrastructure in Södermalm

Regarding infrastructure for water, energy and telecommunications, Södermalm is well serviced. Stockholm Vatten is responsible for the water supply. Heating and hot tap water, primarily through district heating as well as electricity, is supplied by Fortum and Vattenfall AB. Telecommunications such as TV, broadband and telephony are individually selected and provided by private enterprises such as TeliaSonera. In the scenario, it is presupposed that Sweden continues to have high speed internet (Whitney, 2010; Akamai Technologies, 2010), and that the number of internet and mobile phone subscriptions continue to increase (Trafikanalys, 2009), this indicates that ICT's prevalence and speed will increase also in the future. **Internet is a prerequisite for Socio-technical Transition as embedded**

in most every day practices and high speed internet is everywhere present in Stockholm in 2030 and is regarded as a basic infrastructure like electricity and water supply.

6.3.4. Summation

It is *assumed* that there will be no radical changes in today's well-defined physical structure of Södermalm. This indicates a potential for bringing forth alternatives such as how the buildings are managed through ICT which from a sustainable and energy use perspective makes sense (Svane, 2004 in Svane, 2006). It is *assumed* that people will still have a need for high physical and virtual mobility 20 years hence, that Internet is everywhere present in Stockholm in 2030, and that teleworking from home or work hubs and videoconferencing is used to a greater extent. Regarding physical transport the expectations of more electric and hybrid vehicles for both private and public transportation are fulfilled from 2012 in Sweden. Finally, it is *assumed* that other means are developed parallel to ICT such as building isolation and urban densification and will play important roles for reducing energy usage in buildings as well as for transportation.

6.4. Organisational Factors

The final assumptions and prerequisites to be presented for the Socio-technical Transition concern the organisational structure – in particular in terms of involved actors.

6.4.1. Management of Socio-technical Transition

Planning as public intervention is regarded as being a fruitful tool to enhance equity and consideration for the environment (Klosterman, 1985), when long-term radical changes of the prevailing structures are needed (as assumed in backcasting). 'The communicative turn' in planning and the shift from government to governance (Hajer & Wagenaar, 2003) can be regarded as an approach that to a wider extent tries to realise the liberal-democratic potential of planning. This is done by engaging a wide range of actors in the planning process for collectively finding a way to act and where the traditional hierarchical institutions tend to be replaced by decentralised and informal arrangements, decision making and implementation. It was a turn away from the more rational-technocratic approach to planning in which the planning practitioners were seen as the experts. Ansell & Gash (2008) even argues for collaborative governance. The benefits from involving actors in planning processes are many (see e.g. Healey, 1998 and Innes, 2004), and it is likely that a combination of different planning approaches is required when sustainable development is at stake (Næss, 1994).

For the scenario, this entails that **governance is a prerequisite for Socio-technical Transition to be accomplished**, i.e. that the transition happens not only through decision making in the City Council and the different administrations but also through collaboration and dialogue with many other Agents of Change with interest in ICT, sustainability and energy. **It is also assumed that the planners have prominent roles in initiating and facilitating the Socio-technical Transition** in Södermalm, where 'planners' can be both personified as a human being and non-personified as an e.g. public authority. The role has been referred to as being the meta-governors of planning processes (Sehested, 2009). These assumptions for enabling a Socio-technical Transition are in line with the

assumption given in the concept of Situations of Opportunity, which is that the full utilisation of the potential of a Situation of Opportunity requires that actors join efforts through collaboration (see Appendix II). Furthermore, a very crucial prerequisite for the Socio-technical Transition to happen is that Agents of Change are capable of identifying and taking advantage of Situations of Opportunity.

Many actors are related to sustainable development, energy usage and ICT and their contrasting interests are likely to be reflected in the level and type of public intervention. Citizens can find the increased number of ICTs in their everyday life intruding and intimidating, elderly people can find it difficult to use ICT because they have not been used to it to the same extent as the young, and citizens with a different ethnic origin can find it difficult to use ICT due to the language. Furthermore, some actors can be expected to oppose the transition by having their own agenda reflected through interests and power exertion. For example, oil companies are not expected to be advocates of increased use of teleworking or electric cars. Both proponents and opponents can be expected to lobby their interests in such a Socio-technical Transition as envisioned to occur in Södermalm, and this is discussed further in the assessing part. Thus, **it is presupposed that through governance and negotiations, Agents of Change can reach agreement about the measures to be taken in order to achieve a low energy, low carbon society.** Not all potential actors might have an interest to take part in a Socio-technical Transition, but the following section provides an overview of the most obvious actors related to ICT, energy and sustainable development who in one way or another are supposed to be involved in such a process and thus who may appear in the scenario.

6.4.2. Categorisation of Actors

The overview is guided by a categorisation to enhance the understanding of different roles. This preliminary stakeholder analysis can be characterised as being descriptive (Reed et al., 2009) as the purpose is to describe the relationship between the structures of ICT/Södermalm and actors and their (conflicting) interests rather than the mutual relationship among actors. A stakeholder can be defined as any individual, group or organisation, 'who has the power to influence their outcome' (Reed et al., 2009, p. 1933); hence, stakeholders are parallel to Agents of Change. A more neutral term may be 'actors' given that an individual or a group may not be aware that they have a stake in a given phenomenon, have the power to influence, or know that they are being affected by different decisions and actions. However, actors' interests and influences can change over time (Reed et al., 2009).

The actor analysis is categorised into whether the actor is:

- affecting,
- affecting and affected, or
- affected.

Categorisation could also be after time-wise appearance throughout the transition or after geographical scale, meaning whether the actors mainly influence on a national, regional or local level. As the focus in this thesis is on planning at a local level, the actor categorisation focuses on actors related to this context. All actors have been identified through the conducted focus groups, literature reviews, and through the above review of Södermalm.

Affecting actors

In urban development, the planning authority is one of the major affecting actors as it adopts new plans and regulations. The municipality is in Sweden responsible for long-term spatial planning and development of the outdoor environment and is obliged cf. the Planning and Building Act to produce a comprehensive and detail regulatory plans. A number of laws and regulations give power to these plans as well as restrict what can be planned, for example by the Environmental Code, which thus affect the transformation of Södermalm. Also other actors such as private companies, groups and individuals can affect a transformation process towards increased urban sustainability. The most obvious affecting actors and their role in sustainable urban development with ICT as a driver are described below.

Stockholms stad – City of Stockholm is the municipality of Stockholm and is administratively defined by the geographical borders seen on figure 1.2. Besides local administrations in all city districts and a central decision-making body in the City Council, City of Stockholm consists of a range of special administrations and municipally run companies. Once the political decisions are taken for practical implementation, the employees of the administrations and businesses take over and finally the physical structures are visible for the general public. Relevant administrations in relation to traffic, planning, sustainable development, and housing are the City Planning Administration, the Development Administration, the Environment and Health Administration, and the Traffic and Waste Management Administration (City of Stockholm, 2010a). Companies owned by City of Stockholm includes the housing associations of Svenska Bostäder, Stockholmshem and Familjebostäder, and IT construction and operation (Stokab) (City of Stockholm, 2010b). Besides being the planning authority, City of Stockholm seems to be quite powerful with shares in many companies and it is not always dependent on private companies for implementing plans; for example, water is supplied by the municipally driven company Stockholm Vatten, and City of Stockholm holds shares together with Fortum in a local heating company. Based on the roles of the different administration and companies, City of Stockholm will inevitably play a prominent role in the future development of ICT on Södermalm.

Other public authorities, on a more national level, affect the plans for Södermalm and Stockholm as well as form the basis for a future collaboration with the city for implementation of decisions through various instruments. Some of the most obvious affecting public authorities are the Swedish Transport Administration, the Swedish National Board of Housing, Building and Planning, and the Swedish Energy Agency.

Non-Governmental Organisations (NGOs) are often pursuing wider social or political targets without having any governmental status. Examples of such civil society organisations are Svenska Cykelförbundet (Swedish Bicycle Association), Svensk solenergi (Solar Energy Association of Sweden) or Svenska Elfordonsföreningen (Swedish Electric & Hybrid Vehicle Association). These three examples are all assumed to be proponents of a cleaner environment and sustainable development, but the opposite can also occur. Bil Sweden (The Swedish Automobile Association) work for better conditions for car drivers, which can be either sustainable through e.g. more energy friendly styles of

driving or unsustainable through e.g. more roads. Oil companies, although they are not NGOs but private companies, can have the power to influence the decision-makers and advocate for an energy supply based on non-renewable sources.

Transport services organisations are the providers of public transport. In substituting cars with public transport, which reduce the energy usage, Storstockholms Lokaltrafik (SL) has a dominant role as the transport services organisation in the county of Stockholm. SL is owned by Stockholm County Council, which decides upon new lines, extensions on or rerouting of existing lines, prices and the type of ticketing; arguably, however, in close collaboration with the regional and local planning authorities in order to implement their plans. ICT plays a role in public transport through, for example, intelligent transport systems and real time visualisation of schedules and e-ticketing.

ICT-related companies are important actors as they link technology with users in order to make their businesses economically sustainable. Such businesses could be providers of mobile phones, broadband, urban technology equipment and IT-infrastructure. Without their ability to invent and implement new technologies, the implementation of ICT in Södermalm as a means to change the energy usage would not be possible.

Affecting and Affected

While the aforementioned actors mainly are affecting others, this group of actors are both affected by and affecting others.

The energy sector addresses production and supply of energy to the society. Three companies own the majority of the Swedish electricity grid: E.ON Sverige AB, Vattenfall AB, and Fortum Power and Heat AB. In Stockholm, energy for heating and hot tap water is supplied by Fortum Värme and Vattenfall AB Värme primarily through district heating. This means that energy companies for a large part both produce and supply energy and own the infrastructure (municipal monopoly by law in Sweden). In 2008, City of Stockholm began the collaboration with the energy company, Fortum, about the development of infrastructure for enabling a shift towards electric cars (Fortum, 2008).

Housing cooperatives, public housing companies and tenant associations are the owners of the dwellings, which are occupied by citizens. Common for the three types of associations is that they have the full power of the residents. Tenants thus have a much smaller field of influence than the residents in cooperatives.

Research institutions encompass universities as well as private and public research institutes and are important actors for innovating, researching and teaching towards a more sustainable future such as new technologies or new knowledge about behaviour. A growing trend is the increased collaboration between private companies and universities through funding of research projects that the companies can benefit from, resulting in new modes of knowledge production (Gulbrandsen & Smeby, 2005). This is also something that City of Stockholm prioritises in the vision (Stockholms stad, 2007). This indicates that research institutions have a position where they can affect others but are also affected.

Affected actors

The most obvious group of actors who can be categorised as affected are the *citizens*, who in terms of users and customers play a significant role in Socio-technical Transition as they are the ones who change practices. Public authorities and private companies may also be required to change their routines and way of thinking, but if the users – the citizens – do not pick up the new technologies, the energy usage will not decrease and the target of urban sustainable development will not be met. Citizens do, however, not always take the role of passive end users. As a democratic right, the citizens influence the political system by voting for the politicians in the City Council, and they thereby influence the prevailing organisational structure. Through elections, the citizens delegate power to the politicians who become decision-makers of the level of environmentalism in urban development. Another well-known phenomenon in planning is the NIMBY-effect (Not In My BackYard), which represents a situation in which people are proponents of development but not when it is planned to happen in their own neighbourhood. The NIMBY-people can then start at rebellion through, for example, letters to the editor or petitions. Depending on their success, they can have the power to influence politicians to change or drop the plans. A new and growing trend in Sweden and Norway is YIMBY (Yes In My Backyard), which is a politically independent citizens' initiative that advocates for a cleaner, compact, and mixed city without cars; they are proponents of development, especially in their neighbourhood (YIMBY, n.d.). The network operates mainly through the media and on their own website. YIMBY can perhaps be characterised as a citizens groups or a NGO rather than a distinct planning phenomenon.

From the exposition of affecting actors, it was found that a strict categorisation of actors into either 'affecting', 'affecting and affected', or 'affected' has its difficulties. The actors operate in one big network and influence each other on different levels of society and the best category may thus be 'affecting and affected'. The list of actors is not exhaustive and some of them may not appear in the scenario at all or in obvious and dominant roles.

6.4.3. Summation

The overall tendencies within planning point towards increased involvement of and collaboration among actors through governance. However, full consensus is not expected to be achieved in Socio-technical Transition. Planners are regarded to employ the role as moderators or facilitators (meta-governors) in the process of planning the Socio-technical Transition and it is presupposed that public intervention through governance and a wide array of policy instruments is employed in order to achieve the vision of a low energy, low carbon society.

6.5. Summary

The aim with this chapter was to provide an overview of the factors for the surrounding settings of scenario in terms of socio-economic factors, factors for technological development, urban factors and organisational factors – see table 6.1. The surrounding factors have been deployed to the local context of Södermalm which forms the basis of the illustrative case of this study.

6. Factors for Socio-technical Transition

Factors	Assumptions	Prerequisites
Socio-economic	<ul style="list-style-type: none"> - The neo-liberal paradigm becomes less dominant within the time span of the Socio-technical Transition. - Economic incentives are assumed to make behaviour more sustainable. - The Södermalm residents continue to be rather environmentally concerned in the future. 	<ul style="list-style-type: none"> - The development must tend towards more ecological paradigms of economics. - The residents of Södermalm will have an income which allows purchasing of ICT. - The level of consumption must be decreased.
Technological Development	<ul style="list-style-type: none"> - It is assumed that the Smart Grid will be implemented during the next 10-15 years. - People use teleworking from home or work hubs and videoconferencing to a greater extent as a means to reduce the need for physical travelling. - The improvement of ICTs increases while the prices decrease. 	<ul style="list-style-type: none"> - New ICTs are continuously being invented, made available and gradually improved by developers/manufacturers and continuously made affordable and adopted by the residents of Södermalm. - A general development towards increased dematerialisation. - Development of the Smart Grid. - Commercialisation of electric cars.
Urban	<ul style="list-style-type: none"> - People will still have a need for high physical and virtual mobility. - The citizens of Södermalm can be persuaded to use walking and cycling as well as public transport for transportation more extensively than today. 	<ul style="list-style-type: none"> - Internet becomes an important factor and is embedded in most every day practices and high speed internet is everywhere present in Stockholm in 2030 and is regarded as a basic infrastructure like electricity and water supply. - High speed internet becomes embedded in most every day practices and is everywhere present in Stockholm in 2030.
Organisational	<ul style="list-style-type: none"> - The planner has a prominent role in initiating and facilitating the Socio-technical Transition. 	<ul style="list-style-type: none"> - Governance is applied for Socio-technical Transition to be accomplished. - Agents of Change are capable of identifying and taking advantage of Situations of Opportunity. - Through governance and negotiations, Agents of Change can reach agreement about the measures to be taken in order to achieve a low energy, low carbon society.

Table 6.1: Assumptions and prerequisites for the Socio-technical Transition in the scenario.

7. The Scenario

The first six chapters of this study have elaborated on how the current energy usage is related to societal problems, the call for radical Socio-technical Transition and behaviour change and what the assumptions and prerequisites are for this to occur. This chapter presents the scenario of a Socio-technical Transition, which through four narratives illustrates a Situation of Opportunity in the context of planning. Hence, the scenario illustrates how Agents of Change through the use of different measures change objects within existing structures in order to pursue a low energy, low carbon society. The scenario should be regarded as comprising both an image of the future and a possible pathway. The chapter bridges between the assumptions and prerequisites, the content of the scenario, and the following analyses, assessments and discussions.

7.1. Introduction to the Scenario

This section is meant as ‘a reader’s guide’ to the scenario by providing summaries of the narratives as well as describing the core technical innovation outlined in the scenario.

7.1.1. Summaries of the Four Narratives in the Scenario

The scenario is presented as a supplement to a fictitious newspaper issued in 2030, which contain articles looking back on how a part the Socio-technical Transition was initiated and carried out. The articles presents four narratives, which each reflect the Socio-technical Transition in Södermalm from different perspectives in order to illustrate the variety of ‘what’, ‘who’, ‘how’, ‘why’ and illustrate different events throughout the process. Besides the four narratives, the scenario comprises the table in Appendix IV.

The newspaper supplement starts with an introduction, which outlines why the Socio-technical Transition was initiated, and these initiating events can be regarded as the drivers or crucial tipping points for the transition. Throughout the scenario, the reader is introduced to additional drivers and the list includes, for example:

- A willingness in City of Stockholm to regain the title of being an European Green Capital;
- The occurrence of climate changes in Stockholm and Sweden;
- Soaring energy prices due to fossil fuel shortage and turmoil in the Middle East etc.;
- New national strategy for the energy supply;
- Development of the Smart Grid;
- Establishment of Strategic Office and a steering group; and
- Citizens’ protest march against increased congestion and the related noise and air pollution.

Some of the events/drivers are caused by one another as a kind of cause-effect-relationship, but they cannot all be fitted into a linear process. The newspaper proceeds to the four narratives after having outlined how the Socio-technical Transition was initiated.

Narrative 1 – ICT and the Andersons

The Anderson family consists of five persons for whom ICT has become embedded in their everyday life from transportation over work and teaching to leisure- and household activities. Through heat pumps and solar cells, implemented through investments by Fortum and the housing cooperative, as well as a home energy management (HEM) system (see below), which they are awarded in an energy contest, the family reduces their energy usage while contributing to a more efficient energy system. The family substitutes their car in favour of bikes and public transport due to the policy instruments implemented by public authorities. The family is indeed driven by saving money although they are also environmentally concerned, and the saved money is spent on consumption of other goods such as holidays.

The Anderson family represents an ordinary family in Södermalm and the narrative is an indirect way of illustrating the scenario since it reflects Socio-technical Transition on the societal level. However, it may not be that all families or social groups are as adaptable to new technologies and everyday practices as the Andersons (see chapter 8 for further discussions).

Narrative 2 – ICT for sustainable Södermalm

City planner, Magnus Enquist, is the project leader of the steering group which has the task of realising the 'ICT for Sustainable Södermalm' project that is being placed on the Environmental Programme and the long-term budget as an environmentally profiled flagship of City of Stockholm. The project starts in 2010 while the City Planning Administration creates a vision of a low energy, low carbon society for maintaining Stockholm as a Green Capital of Europe. Together with the steering group, Magnus negotiates policy packages aiming at promoting ICT and sustainable urban living. The policy packages are mainly implemented by public authorities. Political persistence, determinism, and a belief that the project will finally be a success are all drivers for the success of the project.

Narrative 3 – Establishment of a Public Private Partnership to Implement ICT in Södermalm

In this narrative, the reader meets Ericsson employee and environmental engineer Gustav Svanström. The focus from this perspective is on how Ericsson, Fortum and City of Stockholm establish a public private partnership (PPP) with the joint vision of turning Södermalm into a test bed for ICT solutions. Thus, Ericsson also gets to hold a chair in the steering group. Through close collaboration with Fortum, who already is in close contact with the housing cooperatives and tenant associations as the building owners in Södermalm, HEM is introduced as a means for automating the homes as well as to persuade the users to change behaviours. The PPP also collaborates with SL, the Swedish Traffic Administration and City of Stockholm to sophisticate an online multi modal journey planner with a special application that can calculate the energy performance and CO₂ of journeys.

Narrative 4 – Excerpts from YIMBY blog

The young YIMBY blogger, Malin Johansson, is convinced that noise- and air pollution on her street of living, Hornsgatan, is getting out of control, and she plans a small public

protest which turns into a large demonstration march. Malin becomes a representative of the Södermalm residents in the influential steering group supervised by City of Stockholm. Through the blog, the reader is introduced to her increasing concern with the people who are discomforted with rapid technological change like the elderly, the disabled and other vulnerable groups. Other concerns like decreasing life expectancy of electronic devices, electronic waste management and hacking of HEM and smart phones are also concerns of hers.

The newspaper ends with a summary of the Socio-technical Transition by a journalist from an 'outsider's perspective'.

7.1.2. Home Energy Management

The energy management system envisioned in the scenario is an integrated smart electricity meter and automation system. Although it is beyond the scope of this project to elaborate on how such a system technically functions an overview of its applicability may be of convenience to better understand its role in a resident's everyday life⁵.

The smart electricity meter is a technical system which enables an altered energy usage, yet dependent on users to use it actively. Dansk Energi & Energinet.dk (2010) stress that the smart electricity meter does not *per se* create a more flexible usage, although it plays a crucial role in the paradigm shift towards a two-way energy supply system. Smart electricity metering still has some teething troubles to overcome regarding, for example, costs, usage and accuracy (Mattern et al., 2010).

However, it is in the scenario assumed that smart electricity metering requires relatively low installation and maintenance costs, is user friendly and is able to measure energy usage accurately. In the scenario, the system is called HEM as the abbreviation for Home Energy Management and with a reference to the Swedish word for 'home'. Besides being a smart meter, HEM can automatically control indoor climate such as heating and lighting as well as turn on and off appliances. The central interface is a smart board with different menus and applications which are accessible with a code through the family's smart phones and computers (see figure 7.1). HEM is also a smart electricity meter, displaying the real-time and historical energy performance in terms on both generated and used energy in total or per appliance as well as pricing but also compared to the average of the building, street or neighbourhood or to a similar household. Through sensors in every room, which measure and detect light, temperature, pressure, noise, humidity, air quality, presence, activity etc., weather forecast and user behaviour, it can control heating and lighting (Kramers, 2010). Other applications in HEM include a weather channel, a journey planner and an information sharing system. From the beginning, HEM was using cloud computing. HEM can turn dwellings into 'smart homes' where HEM displays the home's heart-beat.

⁵A thorough description of a smart electricity meter called eMeter is provided in Mattern et al. (2010).

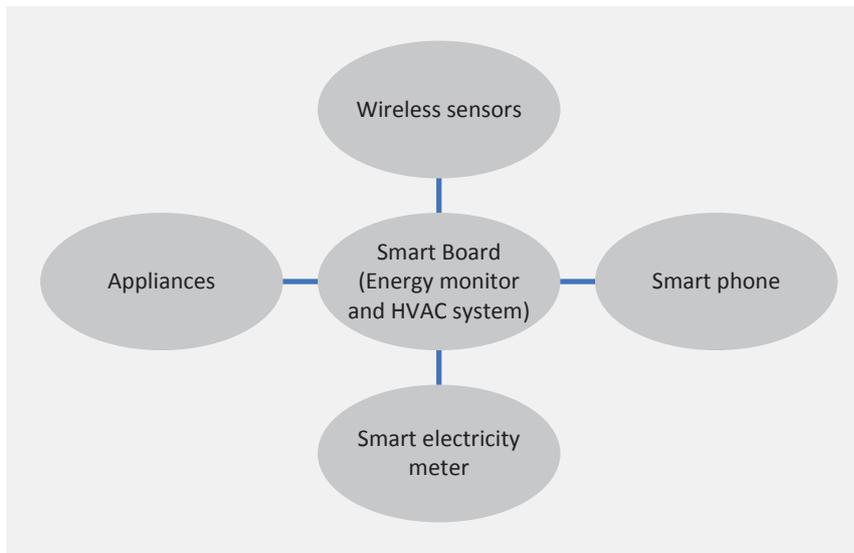


Figure 7.1: HEM. HVAC = Heating, Ventilation, Air-conditioning, Cooling

The system is a way of optimising the energy usage through automation and control, whereas the display of real-time energy usage and pricing is a factor for behaviour change (Zapico et al., 2010). HEM requires that actors can develop the system and that energy companies are willing to provide data about performance and pricing feedback to the costumers.

According to Mattern et al. (2010), the potential for energy savings from smart electricity metering varies from 1 % to 12 % in trial periods. Figures for the total potential of a combination of more energy efficient devices and appliances, home automation and smart electricity metering etc. are difficult to find, perhaps because the technology is still at an immature state and thorough evaluations are yet to be compiled.

HEM represents a cluster of technologies which have the potential to reduce the energy usage through visualisation of energy performance to the users as well as making it more efficient through automation. Dematerialisation is a common term for strategies that intends to reduce the energy usage through substitution of hardware with software.

7.2. The Scenario of Socio-technical Transition in Södermalm

CITIZEN

Supplement to Stockholm Herald | January 12th 2030

Stockholm Announced as the 20th European Green Capital Mainly due to Energy Reductions Based on ICT in Södermalm.

In 2010 Stockholm had the honour of being awarded as the first European Green Capital due to a progressive public administration which had put sustainable development high on the planning agenda through clear and effective measures. However, such a title commits! This year, Stockholm is again appointed as the European Green Capital due to, among other things, the experiments with changing the energy usage in Södermalm through application of information- and communication technology (ICT) in the realms of transportation and the existing building stock. A Socio-technical Transition of Södermalm has occurred and the city district is today a well-functioning test bed, which serves as inspiration for other cities and city districts across Scandinavia and Europe. This issue of CITIZEN outlines the story of the Socio-technical Transition from different perspectives.

Back to 2010

A lot of things happened in Sweden as well as in the rest of Scandinavia during the first decade of the new century: climate changes effects such as winter storms and summer heat waves as well as drastically increasing energy prices as a result of high energy consumption, less water in the rivers and the lakes, turmoil in the Middle East, nuclear accidents in Japan, and fossil fuel shortages. This made the Swedish Government adopt the Energy Strategy 2010-2040, which emphasised the Smart Grid to ensure a safe and sustainable energy supply in Sweden. City of Stockholm saw the opportunities and created a Strategic Office in 2011 under the City Planning Administration, which was challenged to produce a vision of a low energy, low carbon society to maintain and develop Stockholm as a Green Capital. More concrete strategies were produced such as 'ICT for Sustainable Södermalm', and in this issue, we report how this strategy influenced families' habits and formed new organisations.

Projects leading to 'European Green Capital'

The past 20 years City of Stockholm has initiated a number of projects; for example the new city district of Norra Djurgårdsstaden, refurbishment of housing in Rinkeby-Kista, car sharing in Bromma, and Södermalm as a test bed for ICT. All projects are aiming at not only reducing the energy usage but also to improve the life quality of the citizens and to create a fossil fuel free Stockholm by 2050.

Inside this issue

In this issue, we focus on Södermalm and we meet the Anderson Family – an ordinary Swedish family in Södermalm, who has witnessed the transition at close range; Magnus Enquist – city planner and project leader for 'ICT for Sustainable Södermalm'; Gustav Svanström, engineer at Ericsson, who took part in the development HEM, which most residents in Södermalm today use; and Malin Johansson – YIMBY representative in the steering group for 'ICT for Sustainable Södermalm'.

ICT and the Andersons

Many families have experienced that ICT has become embedded in their everyday life. The Anderson family is one of those, and the family consists of mother Eva (project leader at an advertising agency, 43), father Greger (café owner and cook, 45), Camilla (18), Johan (14), and Emma (11). They live in a five room housing cooperative flat in Södermalm and have experienced the transition at first-hand. It is families like the Andersons who are carrying Stockholm towards a leading position within sustainable development.

Andersons' ICT Home

The Anderson residence is filled with ICT such as TVs, laptops, smart phones and tablets but also the new smart HEM system which plays a key role in the Smart Grid. As Södermalm had become designated as an environmentally profiled area by City of Stockholm in 2015, Fortum – as one of the key players in the development of the Smart Grid – decided to employ Södermalm as a test-bed. Fortum contacted the tenant associations and housing cooperatives with flats in Södermalm one by one in order to install solar cells and heat pumps at first hand. Later, they connected them to systems like HEM and had electric as well as plug-in hybrid vehicles widespread. Having received state subsidies for the Smart Grid implementation, Fortum decided to pay half of the investments in heat pumps and solar cells for every housing association, which paid the other half. Each flat was equipped with a heat pump, whereas the solar cells were installed on the buildings' facades and roofs. What the residents maybe not knew at the time was that through heat pumps and electric cars, they would contribute to a more efficient energy system, substitute fossil fuels with renewable energy sources, and reduce the dependency on imported fossil fuels. This entails that the building owners can generate electricity for their own use, and in times of overproduction, the Smart Grid makes sure that the extra energy is not wasted but used in, for instance, other households. The Andersons and many other in

Södermalm have become 'prosumers' as they are both producers and consumers of energy.

From 2015, the Anderson home was equipped with a heat pump, and a few years later, they also had a HEM system which automatically controlled the household appliances and the indoor climate by being connected to the heat pump and solar cells. The Andersons got HEM because: *'You know, we tend to see ourselves as rather environmentally concerned, having a competitive spirit, and trying to keep up with new technologies without being extraordinarily technically skilled. And since the energy prices had gone to enormous heights, it was obvious for us to sign up for Fortum's 'Södermalm Energy Contest' already when it was launched in 2017'*, says Eva. Being one of the ten best energy reducing families of 2017, the Andersons were rewarded with the Ericsson developed HEM. Everything was included in the package – from hardware to software and from service to sensors in the existing household appliances. The Andersons have found the local branch office of the Swedish Centre for Energy Savings and their website very helpful during the transition as a place to seek knowledge, advices and solutions for reducing their energy usage.

At first hand, many of their friends thought of this new ICT adventure as being a bit crazy and exaggerated but when they became aware of the heavily reduced bill on

energy through HEM's automation, solar cells and heat pumps, at least four couples in their circle of friends in Södermalm bought HEM.

As the Andersons got accustomed to live with HEM, Fortum asked the family to display their home as a kind of open house where other families, by appointment, could test HEM themselves. The Andersons were flattered by the offer of an economic gain from Fortum and agreed to be ambassadors for Fortum and HEM. Many other residents came by, and Andersons assisted at convincing them to buy HEM.

Travelling with ICT

In 2010 the young Anderson couple of Eva and Greger lived in Flemingsberg because they could not afford residing closer to the inner city of Stockholm. Despite the fact that a trip with the commuter train to the Stockholm Central Station only lasted approx. 20 minutes, the couple had a car mainly because it was a status symbol of the Swedish welfare society. Today, as we know, the old fashioned fossil fuelled car does no longer dominate the street scene – increased fuel prices, commercialisation of electric vehicles, and public policy packages implemented by City of Stockholm, SL and the Swedish Traffic Administration have resulted in large-scale substitution of vehicles. Magnus Enquist, city planner in Stockholm, says: *'We knew that we had to do something out of the ordinary to change how people travel if we wanted to meet the requirements to become the Green Capital again. We introduced different instruments in terms of both 'sticks' and 'carrots' to discourage and support environmentally bad or good behaviour, respectively, of Södermalm households.'* Apparently this worked for quite many.

Also as a result of new job opportunities and the location of schools made the Andersons sell their car and move to Södermalm. As most other residents in Södermalm, the Andersons today rely on their bikes and the well-connected public transport service. Since 2010, SL has expanded it with automated electric trams and light rails. Furthermore, many local residents, together with many other Stockholmers, enjoy the smart SöderShopper (small electric buses which drive around the Södermalm shopping areas, ed.) which the new Södermalm Trade Association introduced to take customers from the home to the shops and/or showrooms.

When asking them about biking everywhere, the Andersons all start to laugh. *'Of course we don't bike or use the public transport service for all our journeys. For example, if we have to pick up a large commodity in Kungens Kurva, or go on skiing holidays in Northern Sweden, we just book an electric car in SCC [Södermalm Car sharing Company, ed.]. We book the car on a website, and GPSs in the cars send information to the website about the location of nearest parked car. It's really convenient and easy, especially because my smart phone is used to pay the lease,'* says Greger Anderson. ICT is also here an important feature of running SCC.

Based on experiences on car sharing in the city district of Bromma and due to the development of the Smart Grid, SL, Fortum and the nationwide car sharing company Bilpoolen AB decided to form SCC in 2020 with Bilpoolen as operators. An additional twist is that a personal smart SL transport card for all household members is included in the user fee. Fortum saw an incitement to join SCC and required the fleet of vehicles to be electric driven. Very quickly SCC became a great success due to

the increased tolls adopted by the Swedish Transport Agency, and the new parking structure in Södermalm adopted by the Traffic Administration. The fleet of vehicles in SCC is exempted from the tolls and parking charge, and there are dedicated parking places as in Hammarby Sjöstad.

When SL, the Swedish Traffic Administration and the municipal Traffic Administration launched the new, sophisticated online multi-modal journey planner in 2015, especially Eva was pleased: *'My employer has encouraged us to work from home or use videoconferencing, but as a project leader, I'm often on the move, and the new journey planner is really helping me to find the fastest, least polluting and most convenient route to my customers. And they're often quite impressed when they see me coming on my bike – it's really good publicity for the company.'*

An extra feature of the journey planner is the carbon footprint app, which measures the CO₂ impact from the journey. The saved travel data and information about the carbon footprint can be uploaded on the personal Social Network profile which enables comparison with others', self-monitoring and even competing on how much energy they can save. Recently, a rumour about personal carbon taxes started in one of the Facebook groups' notice boards. For visualisation and learning for children, a special extension to the smart travel app has been developed. A polar bear is displayed on a more or less melting iceberg and depending on the CO₂ emissions from their actions, the water level is changing. Especially for Johan and Emma Anderson this app has been a persuasive tool to inform about good behaviour and making play become learning. The developers of HEM, Ericsson, added a similar avatar to HEM, displaying

the rather abstract energy usage in other terms than kilowatt hours.

ICT and Teaching

All three Anderson kids are very confident with using ICT, mainly because all pupils since 2012 have had an iPad paid by the schools. They use it to find answers online and there is problem based learning via virtual games. Homework is also done from the computer, and today the pupils do not hand in assignments in paper anymore as their parents did. Much of the teaching and learning simply happens online now.

Since 2015, all pupils in Södermalm have had annual project days where good energy behaviour is taught in different ways depending on the age group. The idea came from one of the principals because he knew that allowing certain behaviour to be embedded during childhood often follows the person the rest of his/her life. About the energy project days Emma Anderson says: *'I really enjoy the energy project days because then we play different online energy games and we get to see how the waste is being transformed into heating'*. District heating is in focus this year due to national and Stockholm decision makers', energy companies' and IT-companies' growing interest for copying the success with the Smart Grid to the district heating system.

ICT and Work

As a result of the knowledge society, most of the work does not need to be performed at a certain place, and many employers now offer a home office to save building space and time for commuting. As already mentioned, Eva teleworks a couple of times a week, but as most other people, she likes the face-to-face contact with her colleagues. Greger is experienc-

ing the same at his café 'Greger's Greener' at Medborgarplatsen in Södermalm, which gradually has turned into a work hub. Here people can telework because Greger offers the free services of high-speed wireless internet and a room for video conferencing. This service is easily covered by the additional number of lattes and sandwiches. For Greger, ICT has also entailed automatic ordering of supplies and electronic invoicing.

ICT and Leisure

It is evident that the family uses ICT for almost everything; it has simply become embedded in their everyday life. When the children are not at school or doing sports they spend much of their time watching TV in their separate rooms or chatting with their friends on social media platforms – something we knew as Facebook and Twitter back in the 2010s. One drawback of ICT, however, is that the kids occasionally spent too much time in front of the computer instead of having face-to-face contact with friends. They also play games of which some are based on reducing the energy usage. For example, competitions have been embedded in the new SimCity 7 LIVE, where the gamers compete in building and designing a society with the specific goal of being the most sustainable city.

The Andersons also like to watch shows such as TV4's 'The Modern Sustainable Family' where Swedish families struggle with reducing their energy usage; for example through other ways of doing household activities. Via the interactive TV, viewers get tips for reducing energy, sustainable receipts for the dinner and special offers on ICT devices for their HEM. About the increased commercialism of environmentalism, Eva says: *'Sometimes I think of the power of the media and how*

good they are at persuading us consumers through offers to buy organic, Nordic ingredients that are adjusted to the seasons or new more energy efficient devices and appliances – it's really impressive and it works!'

Andersons' Evaluation of ICT

Looking back at the past 20 years, the Andersons state that ICT has helped them to change their habits towards a more sustainable living. In addition, they state that increased energy prices and the economic gains from heat pumps, solar cells, more energy efficient household appliances and HEM were a major driving force together with the public authorities' willingness to implement policy packages. The money saved is used for, among other things, more exotic holidays and a better everyday life. And of course, to be on the wave with the newest technologies such as smart phones also played a major role.

ICT for Sustainable Södermalm

City Planner Magnus Enquist, 56, has been a key figure in the planning process for transforming Södermalm into a well-functioning test bed for energy reductions in buildings and transportation through the innovative application of ICT. In this interview, he elaborates on how the 'ICT for Sustainable Södermalm' project became a reality.

How did the Strategic Office take on the challenge of producing and pursuing the vision of a low energy, low carbon society through ICT?

It was, of course, an exciting but serious challenge, and drawing on experiences from Hammarby Sjöstad and Norra Djurgårdsstaden, we knew in the Strategic Office that such a challenge would require collaboration and partnerships with other actors. Around 2010 the Stockholm City Development Administration announced that the city was beginning to reach its limits for urban development of the inner city, and we then knew that something besides 'traditional' urban development should be needed to address the vision. Stockholm had for many years been a pioneer within the development of ICT within Kista Science City and when researchers early in the new century indicated new ways of applying ICT to reduce the energy usage it was, therefore, natural for us to focus the development of Södermalm on this branch.

Drawing on research and trend analyses, the Strategic Office in 2012 decided to focus on building management and transportation and appointed a steering group as a means to implement the vision through what we later named 'ICT for Sustainable Södermalm' and I became the project leader of this steering group. My main purpose was, frankly, to make 'ICT for Sustainable Södermalm' a success. Actually, the project became environmentally profiled when it was placed in the Environmental Programme and the city's long-term budget until 2030 by a vast majority in the City Council in 2015 – the po-

litical acceptance and acknowledgement of its importance was really a milestone for the project.

Who were in the steering group, and what were their tasks?

The steering group consisted of representatives from SL, the Södermalm Trade Association, SÖDER Housing Cooperative, the tenant association Svenska Bostäder, Fortum, the Royal Institute of Technology (KTH), Ericsson and two politicians from the Green and Moderate parties, respectively. From 2014, the steering group was expanded with a representative from YIM-BY, who was also a Södermalm resident.

I believe that a primary priority to success is to have consistency between visions, strategies and action plans. Furthermore, the transition process should increase (or at least not negatively affect) the quality of everyday life. The steering group's work and decisions must also be publicly visible. Therefore, we asked the Swedish Centre for Energy Savings to open a local office in Södermalm and a website where residents and companies could get advice, read about plans etc. – a bit like the exhibition for the entire city in the Culture House.

Through a series of meetings and creative workshops, the steering group asked three key questions:

1. What do we want?
2. Where are we now?
3. How do we get there?

The first question forced us to think and re-think a desirable future where ICT

plays a central role for reducing energy usage from the end user. The second question aimed at the current infrastructure, behavioural elements, the ongoing development within the ICT world and the present plans and policies for the city. The final question aimed at addressing the most difficult issue for planners and politicians – how to reach this desirable future. All this was articulated in the strategy ‘ICT for Sustainable Södermalm’. Persistency and a truly positive dialogue striving to overcome initial tensions and conflicts have been hallmarks of mine and I tend to see myself as a facilitator rather than a project manager.

The strategy contained a number of different initiatives, which were implemented from 2016. What were the most spectacular changes, who implemented them and through which measures?

Where should I start...such a strategy can't be achieved overnight, and we wanted to use different instruments, which were articulated gradually as policy packages in order to reach all residents. One idea with involving a broad range of actors in the steering group was to enable implementation when each steering group member went back to their workplace, so to speak, for implementing the initiatives. One solution I'd like to highlight is Ericsson's Home Energy Management systems (HEM), which automatically control the homes' energy usage and which together with the Smart Grid has allowed residents to become 'prosumers'. However, to get HEM widespread in the Södermalm households, Ericsson entered into a Public Private Partnership with City of Stockholm and utilised different instruments to motivate the residents; for example, the 'Södermalm Energy Contest'. Another example is the increased use of Intelligent Transport Systems. The Stockholm Traffic

Transport Package 1: 2016-2019

- Journey planner
- SL Card is embedded in the smart phone as a chip / E-ticketing
- Permission to bring bicycles in underground trains
- Construction of more cycle paths
- ITS
- Increased frequencies of trains and buses

Transport Package 2: 2020-2023

- New parking structure with 2000 fewer spaces in Södermalm
- 100 % increase of parking charges
- 27 minor streets became car-free
- Easily accessible park'n'ride facilities
- Free loan of electric bikes in six months to people who live between 10 and 30 km from their workplace
- Bike rental system based on ICT operated by an urban facility and advertising company
- Establishment of a car sharing enterprise
- If car no. 2 is sold a bargain on the SL Card is granted
- Re-scheduling of the congestion tax (tolls)
- Interactive smart boards at underground stations and bus stops
- Expansion of the underground system

Housing Package: 2017-2025

- Södermalm Energy Contest
- Rebates on HEM
- HEM as lease or service

and Waste Management Administration programmed the traffic lights so that bikers have 'green waves', the Swedish Traffic Administration mounted electronic billboards at roads, informing drivers about congestions, road work, accidents, parking spaces etc., and SL uses intelligent

transport systems (ITS) to display the time-schedules at stations and stops. SL also mounted interactive, online smart boards with access to the sophisticated multi-modal journey planner developed by Ericsson. Other factors aiming at motivating the Södermalm residents was, for example, the City Planning Administration's plan for decreasing the number of parking spaces while increasing the number of bicycle paths. This was assisted by the Swedish Transport Agency's increase of the Stockholm congestion tax. These incentives were combined and changed the travel habits of the Södermalm residents quite effectively. A mix of ICT based instruments and more traditional planning instruments, you could say.

The new and increased congestion tax zone was implemented for a 12 month test period, which made the transition more digestible for both citizens, the businesses etc., and after this test period we conducted a referendum, where the citizens could declare their meaning about the changes. As you may recall, the vast majority of the citizens voted in favour of keeping the taxes.

The transition process towards a low energy, low carbon society seems very smooth. Was that always the case?

Well, with the project at hand, the number of actors is enormous and a 100 % consensus was simply neither possible nor desirable in the steering group. On the other hand, it was important for me, the rest of the steering group and the legislators that the process was not finalised in terms of 'the most powerful stakeholder wins'. Of course, there were massive protests from the car commuters, some shop owners and from people afraid of change in general. But look at the situation now – people cannot even imagine



Figure 1: Bicyclists can now bring their bicycles in the underground trains.

a life without these changes! Political determination, persistence and a belief that the project would become a success have really proven to be extremely important parameters.

In the beginning, we had numerous meetings with the citizens in Södermalm where we tried to identify the focal issues for the residents in relation to energy reductions and ICT. From a societal, solidarity and social perspective, they seemed very interested in the transition process but when it came to an individual level, the tune was suddenly changed to a more narrow-minded perspective. It is all about value to the end user and we were very vigilant on creating value in terms of e.g. comfort, economy, branding and knowledge. It was also a benefit to have such a broad steering group of members who represented different interests. However, the number of conflicting interests was occasionally also a problem and it took sometimes several meetings of negotiations to reach agreement.

Another example of reluctance in changing the current development was the private sector, and I clearly remember the shop owners and other private industries who were obviously concerned if such heavy car reductions could and would

take place. They were the actual opponents to implement the policy package and the whole union of shop owners in Stockholm backed them up. It was, to be honest, an organisational mess to have such an important sector totally against our plans. After pushing them persistently and agreeing on economical benefits in terms of free sponsoring in certain public places in Södermalm, creation of the now quite strong Södermalm Trade Association and implementation of the high-frequency SöderShopper, they finally accepted the policy package. Again, creating value for the private sector, the individual users and the urban environment in general was a difficult but necessary task.

I also think that the fact that we managed to collaborate with stakeholders from a national Governmental level to encourage people in Södermalm and the fact that we managed to negotiate fair trade-offs and added value to most people made it a positive process. The political 'muddling through' is also a part of the job of a city planner – especially one who is a project leader on such a large project.



Also, we could see that the increased implementation of ICT resulted in enhanced volumes of ICT waste, and this made City of Stockholm to adopt an 'ICT Waste Management Strategy' in 2012.

In retrospect, where does that leave the project and where do you think we are heading with ICT?

In 2017, the first HEM systems were installed in private homes in Södermalm as a result of Fortum's contest and they are now running smoothly due to several upgrades by Ericsson. Based on evaluations, we can see that many have reduced their energy usage substantially thanks to HEM and the other initiatives. However, this development could not have happened without the Smart Grid being implemented and running and even electric vehicles are now plugged into our new smarter world in Södermalm. The citizens really enjoy the transition, and I have heard several of the most sceptic ones saying that this is one of the best things Södermalm has seen in a long time. I think that City of Stockholm will try to expand the ICT project to other areas of the city, and I think it will be a rapid development. The dark side of the coin is that some people are experiencing that the Big Brother society has come alive as GPS, smart phones, smart homes and Smart Grids are really controlling their life. A key issue in the forthcoming years will be to empower the people and be aware of information, knowledge and sustainability as our generation's oil rush.

Establishment of a Public Private Partnership to Implement ICT in Södermalm

The Swedish telecommunications company, Ericsson, is one of the main Agents of Change behind the transition towards a low carbon, low energy society. As a result of the involvement in the steering group, Ericsson entered into a Public Private Partnership (PPP) with Fortum and City of Stockholm in 2015 about the system called Home Energy Management (HEM). Here, environmental engineer Gustav Svanström, 47, reports about this collaboration.

The Main Drivers for Developing HEM

Why did Ericsson develop HEM?

‘When the National Government in 2010 adopted the strategy for the energy system for the coming 30 years, one of the concrete actions was to tailor the electric grid into a two-way system based on electricity from renewable sources. This required implementation of the Smart Grid and numerous related technologies as well as collaboration between multiple actors such as the grid owners, the energy transmission companies and the renewable energy supply companies. To benefit from the more flexible and sustainable two-way energy supply, building owners had to invest in heat pumps and solar cells but also in a system that could automatically control the appliances, lighting and the indoor climate in terms of heating and ventilation as well as display the real-time energy usage and pricing. In the early 2010s many citizens were not aware of the great potentials of the Smart Grid but today, many have purchased electric and plug-in hybrid vehicles which can be charged at very reasonable prices due to the Smart Grid’, says Gustav Svanström.

Ericsson Enters the Steering Group

When the strategy for ‘ICT for Sustainable Södermalm’ was adopted by the City Council in 2015, Fortum and City of Stockholm called for a partner to develop the aforementioned system through public procurement. Ericsson had been working

at the initial phases on developing such a system for quite a while, yet without the chance for economic gains on an immature market. Ericsson seized the opportunity, made an offer and won.

After having negotiated the positive gains, having agreed on mutual terms and the financial settings, Fortum, City of Stockholm and Ericsson established a PPP in 2016 that lasted for 10 years. Through a PPP, all actors could gain from optimising resources and broader and innovative ideas while reducing the financial risks of developing. Svanström reports: ‘We had an interest in the project because it was an opportunity to benefit economically from investing in developing the home energy management system and its related services and devices. The PPP could simply ensure a market to be created with us having the right of being first on the market. City of Stockholm and Fortum, on the other hand, went after a secure, cheap, reliable and widespread solution to become first movers in public buildings in Södermalm, which was a way for us to improve HEM’.

PPP – a Joint Organisation

To enhance transparency and give the HEM project identity, a joint organisation between Fortum, City of Stockholm and Ericsson was established. To ensure independency from other politically motivated decisions taken in the steering group and the City Council, the partners produced a joint vision and an action plan. The action plan included:

- A general description of the vision and the project as well as the more specific initiatives;
- A description of the implementation process, including time frame, budget and milestones;
- Assessment of HEM's potential for energy reductions;
- Assessment of the reductions in environmental impacts;
- Assessment of risks and how to reduce them;
- A plan for public participation;
- A plan for marketing; and finally
- A description of the responsibilities of Fortum, City of Stockholm and Ericsson, respectively and jointly.

Distribution of HEM

How did you manage to get HEM widespread in Södermalm homes?

'When we entered into the PPP, HEM was actually ready to be tested and a prototype was introduced on the market in 2017 for the consumers; i.e. for the households where the energy is used. To kick-start the sale and in order to brand this new technology, Fortum, which already had invested in heat pumps and solar cells in Södermalm buildings, launched 'The Södermalm Energy Contest' for a five year period. Voluntarily, residents in Södermalm could sign up on a website and compete in reducing energy and CO₂ emissions through changing behaviour in their everyday life. Their energy usage became publicly visible, and the ten households with the greatest energy reductions for each year were awarded with a system for free', says Gustav. The contest did, however, not result in mass sales as Gustav and his colleagues had hoped for.

The members of the PPP knew from public authorities such as the Council for the Safe Traffic and marketing campaigns in gen-

eral that information campaigns could be effective instruments for gradually changing peoples' habits. STHLM ADS was contacted due to their previous success with campaigns for energy reductions. The information campaigns ran during the same period as the contest, and they focused on how much time and money consumers would use and spend if not investing in HEM. It was argued that the use of HEM would eventually lead to improved life quality for the users as it would give time to the family and friends away from boring chores due to the HEM automation.

The number of HEM in Södermalm homes was in 2022 still too low for being a feasible product in Ericsson's portfolio. However, this all changed when City of Stockholm, Fortum and Ericsson decided to be more progressive. The PPP agreed on an economic incentive where owners who had signed up for the 'Södermalm Energy Contest' could buy HEM at a more affordable price. Furthermore, a deal was established where HEM either could be leased for a certain amount of money per month. After five years, HEM would essentially be paid, and the leaser could keep HEM. Or, HEM was owned by Ericsson and leased by the households, and the economic gains would be shared between them. Again, the incentives were marketed as money saving to motivate the residents.

Ericsson's Collaboration with Other Actors

Ericsson was also directly involved in one of the other initiatives which the steering group orchestrated – they wanted to sophisticate the online journey planner known in 2010 as 'trafiken.nu' into a multimodal real-time travel information system. Ericsson assisted STHLM IT that became responsible for develop-

ment and design of the site, while SL, the Swedish Traffic Administration and City of Stockholm's Traffic Administration were responsible for its operation. The service was expanded to include also cycling (15 km/h) (also rented bicycles) and walking (4 km/h) which were compared to the time consumption of the chosen route with a car, bus and train. The user just enters where s/he wants to go, and then the travel app suggests and displays the route and mode with the lowest energy usage, time consumption and CO₂ emissions, taking delays, congestion and roadwork into account. For example, it can inform if there is a major breakdown in the underground and that it would be faster to ride the bike. Later on, the journey planner could also suggest park'n'ride facilities at public transport nodes. By the launch of the journey planner in 2015, everything was wireless with high speed internet access and GPS location services were widespread. Thus, the journey planner soon became popular because it was developed as a free application for smart phones and HEM, and because SL and City of Stockholm in collaboration had expanded the number of 'What's on in Stockholm'-billboards throughout the city at stops and stations with the new transport application. 'It's really amazing how much people use the smart phones nowadays – especially in the underground when commuting. It's really convenient', says Svanström. While developing and designing, Ericsson collaborated closely with researchers from Stockholm University regarding the motivation to changes in travel behaviour.

Ericsson's Evaluation

Through the steering group and internally at Ericsson, continuous evaluation of the progress of the transition has been completed. The conclusion by Gustav and Ericsson of 'ICT for Sustainable Södermalm' is clear. Not only did Ericsson get a change to develop new technologies and services, they also got the chance to be responsible for the management of HEMs. For example, they provide home service if something does not work as intended and they provide data connection back and forth between the energy companies and households. Another conclusion concerns social networking: 'My years at Ericsson and in the steering group have taught me how important it is to have a professional as well as a personal network because they often are the doorway to other partnerships'.

Next Step for Ericsson

Gustav reports that one of the problems with the transition is that from the increased number of devices, a lot of energy is used despite their energy efficiency. When suggesting a new collaboration with Fortum to develop a Smart District Heating Grid so that households can become 'heat prosumers' through solar panels, Gustav gets a smile on his lips. Maybe this is indicating the next cash cow of Ericsson?

Excerpts from a YIMBY Blog

As a member of the YIMBY (Yes In My Back Yard) network advocating for sustainable urban development, we follow Malin Johansson's experiences about the Socio-technical Transition of Södermalm. As a YIMBY representative and later as a member of the steering group realising 'ICT for Sustainable Södermalm', she has been the voice of the residents in Södermalm – especially the ones who were never asked whether they wanted to be part of turning Södermalm into a test bed for ICT solutions.

December 11, 2010

Welcome to this new YIMBY blog. I'm Malin, 28 years old, I've lived in Södermalm for my entire life, and I can't think of any other place to live. Unfortunately, Stockholm has become an unpleasant place. Just take this afternoon – it was impossible to get a seat in the overcrowded underground trains back to Södermalm, where I was attending in a meeting in YIMBY at 'Greger's Greener' in central Södermalm – a place where I actually go to work sometimes. Walking along Hornsgatan to the YIMBY meeting, I discovered that many house walls were all dirty of particles and the noise from the street was really intense. I couldn't help record and photograph the lungs of Södermalm. So much for Stockholm being the European Green Capital of 2010 – I can't believe that I'm proudly living and breathing in this...and to make things worse, Peter Linnström (a YIMBY member and expert in environmental related health diseases) showed me some dramatic figures of increasing counts of deaths related to the urban air and noise pollution – he said that Hornsgatan is one of Europe's most polluted urban streets! Someone has to do something.

February 26, 2012

'We should simply just block Hornsgatan during a peak hour – that is visible and will put things on the agenda', Henrik Bötin writes in another blog of ours. Is that maybe a bit too drastic? Will the decision makers even listen? Oh well, I've created this web poll – here you can vote whether you are willing to participate in a march

on Hornsgatan as a message to the City Council that the situation is running out of control. Please spread the word.

March 10, 2012

Oh dear. 2,324 people have voted 'yes, I'll march on Hornsgatan during the afternoon rush hour to clarify our message of concern to the decision makers'. In only 10 days. And, I've got comments from car commuters that they're also willing to support us as they're angry over a complete traffic jam during the morning and afternoon peak hours. Environmentalists, parents who care about the health of their children and ordinary concerned Södermalm residents have stated their commitment to join. Wow, this is a bit wild. I guess we have to take some kind of action now. Please reply here if you want to join the organisational team of 'Hornsgatan Environmental Line Protest' (HELP).

August 21, 2012

Today was our big day – a march from Hornsgatan to the City Hall in the Friday afternoon rush hour! More than 5,000 Södermalm residents attended the demonstration against the increasing levels of noise and pollution in our neighbourhood. On behalf of the organisational team behind HELP, I'm so glad to see all your creative banners and being part of the uplifted feeling of being collectively doing something important. Several people from the 'crowd' appreciated the initiative and told me we're fighting an important case – I really think these issues matter a lot for the citizens. Please upload

your pictures directly on the website for the demonstration, www.help-march.se. The best thing today was SVT1's interview with the five of us from the organisational board and the head of the City Planning Administration, where we demanded to be included in planning for a better urban environment in Södermalm. They can't avoid planning for the environmentally concerned people any longer. Thank you friends, I appreciate the great help and I think we managed to make a clear statement to the decision makers. Also thanks to the smart phone developers – this is simply the best organisational tool in the world :-). Guess we are all very excited about what the next move will be.

September 28, 2014

I've just read the letter (yes, a real paper letter!) from City of Stockholm's Strategic Office. Due to the YIMBY activities such as the march, I'm invited to be part of a steering group for 'ICT for Sustainable Södermalm' – isn't that great!? And who can turn this down!? Apparently, the purpose of the steering group is to decide upon and realise strategies for a sustainable Södermalm through the application of ICT. I'm looking forward to tell more about the outcome of these meetings. I will make it a key issue that my voice speaks for YIMBY and all of us here in Södermalm – please post here if you have some great ideas.

January 16, 2017

The work in the steering group has given me something to really put an effort in. It might be crazy but I feel I really can do something good here. To be part of the steering group together with people with direct influence on the city planning policies is indeed very cool. And the most important thing – I'm actually being heard and considered as a valuable member of the group. So far, the steering group has

discussed issues related to energy reductions. The first transport package is already being implemented. The Smart Grid is running now and the developers seem to have overcome the most critical teething problems such as incompatibility with HEM and other devices in the smart home and serious hacking attempts where private information has been stolen. A transition has begun!

November 10, 2019

21.59 SEK. That was the price for one litre of biodiesel this morning. Colleagues of mine told me that the price on other energy sources, such as coal and gas, also are rapidly increasing. Fortunately, a second policy package was adopted today by the City Council and implementation starts next year – hopefully this will create a more sustainable Södermalm. For two years, we have in the steering group been working on the policy package, sometimes with huge disagreements. The good thing is that the other members finally acknowledge the growing concern for environmental issues as a driver for changing habits. The ICT industry is indeed becoming a massive player but so far I only see positive outcomes of it – take, for example, how easy it is to buy a single or monthly e-ticket for public transport, plan your journey, or control your home from your smart phone. By the way, look out for the increasing numbers of biking commuters – they now have green waves in the streets and are allowed to bring their bikes in the underground trains thanks to City of Stockholm and SL.

June 2, 2020

On my way to a meeting in the steering group, the environmental RSS feed app on my smart phone told me that the electric vehicle revolution is on its way and I've actually noticed that many of you have ei-

ther bought one or sold the old dirty energy swallowing 4-wheeler. Actually, you should start to think about replacing your car with a membership in the new Södermalm Car sharing Company (SCC), which today saw the light as a partnership between Fortum, Bilpoolen AB and SL. Ericsson also took part in the negotiations and provides new apps and smart GPSs for installation in the cars of the fleet. The deal runs for at least five years with good possibilities for extension. Have you signed up for Fortum's 'Södermalm Energy Contest' where you compete with others on how much energy you can save? If you are good, you can win Ericsson's Home Energy Management system (HEM)! It can automatically control appliances and the indoor climate – the journey planner is integrated and it can be connected to your smart phone. Wait to see it in practice, you will be utterly amazed!

December 19, 2022

Today, Fortum announced the skilled and enthusiastic winners of their 'Södermalm Energy Contest'. The competition worked not quite as intended despite all the effort of continuous consulting and advising by the local branch office of the Swedish Centre for Energy Savings in Södermalm. If you install HEM, your electric car is being recharged at the lowest possible price compared to environmental impacts due to the Smart Grid. And it works!

October 2, 2023

Maybe you haven't noticed, but we're in the middle of a Socio-technical Transition! This is my ninth year in the steering group. To keep up with how you think and to get ideas, I'm trying to schedule public meetings as often as possible. I always get so amazed by your passion to build on the existing solutions – just take the prototype of solar cell driven charging garage

for electric vehicles developed by local residents. Today, I went to the Södermalm Show Room to look for a new winter coat. I bought one through my smart phone and it was delivered two hours later at my block's common and secure drop-off point by an electric van. Nice! I really think that the private companies are getting into the sustainable revolution but I guess it is only because they can see economic advantages of doing so.

August 25, 2024

Greens are keen, browns are down! I was just joyfully remembering some slogans from HELP in 2012. But it might not be that simple. How about the 'browns' who are scared by technology and reluctant to change their habits via ICT? You know, like our parents, grandparents or just those who are disabled in some way or another – I'd better raise the issue for the steering group. For most people ICT has become embedded in our everyday lives and changed our habits but we should not look with evil eyes at those who don't undergo the same process of change. Take care of each other and remember to help those who are discomforted with rapid technological change.

January 18, 2025

Good morning from the red underground line – I've been in the steering group for 'ICT for Sustainable Södermalm' for eleven years now and things are running quite well – HEM is getting widespread, more people are biking, car traffic has reduced much, new ambitious Environmental Quality Objectives have been formulated etc. But, I'm tired and filled up with meetings – it's always the muddling through principles, financially feasible solutions and political goals. There are so many fresh brains out there – please squeeze yourselves into the municipal decision

making bodies and be ready to acknowledge that planning is policy. I'm over and out, but will still be blogging!

September 2, 2027

I've noticed that ICT is not visible but you know it's there – everywhere, practically. The number of electronic devices is increasing and the life expectancy for these devices is so short that they just get replaced by new and better ones. Apropos, I went to the recycling station today in one of the electric cars from SCC, and I was amazed by the mountain of electronic waste! I'm so happy that City of Stockholm adopted the 'ICT Waste Management Strategy' in 2012, but I'm afraid this isn't enough. I guess that the large amount of resources and energy used to generate our energy savings and increased life quality is producing a lot of waste, environmental hazardous problems in the third world and they are using the energy that we are saving here... Where is the recycling revolution?

May 19, 2030

Hornsgatan, the formerly clogged, congested and smog producing nightmare, which was the original reason for my commitment to creating a more sustainable Södermalm, is nice and quiet and several small urban parks have popped up along the road. It has been narrowed in favour of wide paths for biking and walking, initiated by City of Stockholm and by some of you, my dear fellow Stockholmers. I've heard from my former colleagues in the City Planning Administration that similar things are happening in Bromma, Rinkeby-Kista and Annedal. It works. We succeeded. But it doesn't stop here. The future does not come as you want it all by itself. Get out there. Be active. Take responsibility for your own and co-citizens' futures. Yours sincerely, Malin.

Overview of the Socio-technical Transition of Södermalm

This special issue of CITIZEN has portrayed the work and influence of different actors in turning Södermalm into an ICT test bed. Together with other projects orchestrated by similar steering groups, this has led Stockholm to become the 20th European Green Capital in 2030. This indicates that extensive change is possible within 20 years, but also that change is dependent on patience and persistence by the Agents of Change who make use of different policy instruments. Evident is, however, that many actors have been involved in the process and that the transition has become a reality.

From a more general perspective of the Socio-technical Transition in Södermalm it seems that people have changed behaviour as a result of the three policy packages, but also because a number of external factors made the transition possible; for example, the Smart Grid development and EU common standards for the compatibility of ICT devices. Furthermore, a general trend in the society due to the financial crisis in the late 2000s became evident when people slowed down their consumption and were more reluctant to spend money on different commodities, including energy. Including articulation of environmentalism by politicians, media channels and NGOs, it seemed to be the effect of increasing energy prices and a mixture of different instruments which encouraged a more environmentally friendly behaviour in Södermalm.

7.3. Integration of What, Who, How, and When in the Scenario

A more indirect aim with this study is to illustrate the integration of Objects of Change and Agents of Change as derived from the concept of Situations of Opportunity (Appendix II). Recalled from chapter 1, objects can change within the urban, organisational and social structures, which are all identifiable in the scenario. Table 7.1 displays a part of a more comprehensive table in Appendix IV, which gives an overview of the relations between the scenario's Objects and Agents of Change. Besides what and who, the table also comprises the questions of when, how and why (whenever possible) as well as the assessed effect in terms of negative or positive outcome of the change. This is done to illustrate that all changes are carried out and affecting actors, but also that every choice has some effects and are driven by more underlying intentions and arguably also interests and values. Figure 7.2 displays the key events during the Socio-technical transition in the scenario.

IMPLEMENTATION					
What (Objects of Change)		Who (Agents of Change)	How	Why	Effects/problems
Urban Structure	Change of homes and cafés into home offices and work hubs, respectively	Workplaces Cafés	Teleworking Videoconferencing	To reduce the need for physical travelling (dematerialisation)	People commute over longer distances
	Change of the transport system through lay on of automated trams, extension of lines, fewer parking spaces and more cycle paths	SL City of Stockholm	Regulations	To enable a substitution of transport means, which can result in reduced energy usage and reduced noise- and air pollution	-
	Change of the energy supply through the Smart Grid, installation of HEM, heat pumps, solar cells and a change of telecommunications systems by having wireless internet everywhere	Fortum Ericsson Building owners Communication providers	Investments Subsidies	To make the energy supply more efficient and potentially to reduce the energy usage	People do not use HEM as the intended way

Table 7.1: Overview of what-who-how-when integration.

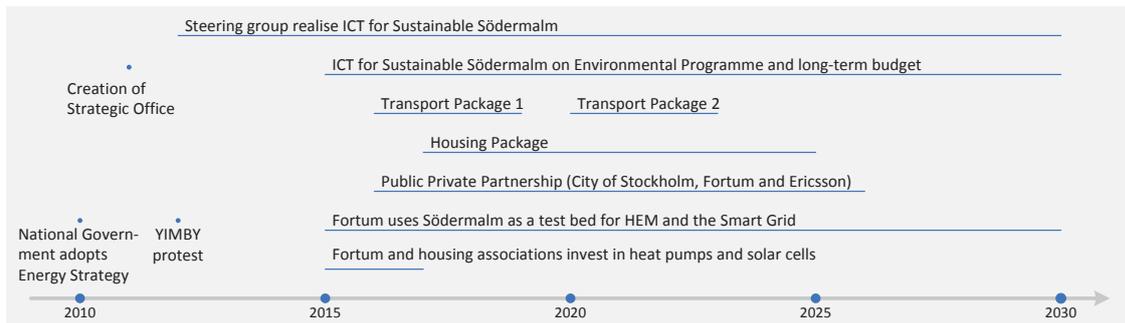


Figure 7.2: Overview of the process of the Situation of Opportunity as a Socio-technical Transition.

7.4. Summary

This chapter has presented how the innovative application of ICT contributes to more energy efficient transport habits and sustainable ways of managing buildings. This has been illustrated as a part of Socio-technical Transition in a scenario of four narratives studied as a Situation of Opportunity. It appears from the scenario, the what-who table and the process diagram that features elements such as HEM, a multi modal journey planner, environmentally sound applications and teleworking along with a new incentive structure and formation of new organisations are Objects of Change. The key Agents of Change in the scenario are a steering group of various representatives, Fortum, City of Stockholm and Ericsson in a Public Private Partnership and the citizens as the end users of the changes.

8. Analysis and Assessment of Scenario

'Qualitative data analysis is the process of bringing order, structure and meaning to the mass of collected data. It is a messy, ambiguous, time-consuming, creative, and fascinating process. It does not proceed in a linear fashion; it is not neat. Qualitative data analysis is a search for general statements about relationships among categories of data.' (Marshall & Rossman, 1999, p. 111)

As the introductory quotation for this chapter reveals, the purpose with the qualitative assessment is to derive general statements about relationships among categories of data – categories here refer to the theoretical aspects of Transition Management and behaviour change, and data refers to the content of the scenario and the content of the interviews. Identifications and analyses of the relationships and interventions between Agents of Change and Objects of Change are made as well as assessed in terms of how Socio-technical Transition happens in the scenario, and how the scenario could be improved. This chapter should be regarded as not only an analysis of the scenario, but also an assessment of the applicability of the two theoretical perspectives and therefore also an assessment of the applicability of the concept of Situations of Opportunity for analysing urban transition in a context of planning. Statements from the interviewees are integrated into the chapter to supplement the analysis and assessment, and they are referred to by their last name and no years as in other references.

8.1. Analysis and Assessment of Transition Management

This section determines the elements of governance processes in the transformation of the socio-technical system presented in the scenario and assesses how they work in the scenario as well as how they could be coped with in order to improve and optimise the transition process. Firstly, the Multi Level Perspective will be analysed and assessed, and secondly, the cycle of Transition Management is applied on the scenario.

8.1.1. Transition of the Socio-technical Regime

The stability of socio-technical regimes, the theoretical part concluded, is constituted from the developments in the niche- and landscape levels. Destabilising socio-technical regimes might create changes in how the system interacts with societal and technological changes which finally can lead to a transition.

The Niche Level

In the scenario, it is found that several technological niches (e.g. HEM and the journey planner) are breaking through to the mainstream market on the regime level from their niche incubations. The technological developments are carried out by private companies such as Ericsson, which are pursuing an opportunity for developing a new market. However, in order to increase the chance of success, Ericsson is in the scenario forming a partnership with the public authority, City of Stockholm, and the energy company, Fortum. However, City of Stockholm should be aware of not creating a monopoly-like condition for Ericsson and HEM but should encourage the development and implementation of the HEM or similar systems. Such collaborations do not emerge spontaneously, and the scenario has presented how Fortum and City of Stockholm form a

public procurement which Ericsson wins. Negotiations, where the roles, the powers and how the interests should be divided are discussed, eventually form the Public Private Partnership in the scenario. Lennartsson recognises the vast amount of meetings in order to create a common discourse and agreement and finds this task challenging although very important for the success of the partnership and development. Both Bjerre and Höjer acknowledge the importance of collaborations with technological niche companies and stress the importance of 'getting off the edge' which the universities and public authorities can help facilitate. The Public Private Partnership in the scenario could have emerged from various collaborations, e.g. between a niche company and the Royal University of Technology in Stockholm or between a major housing cooperative and a niche company. Disregarding the specific constellation, it is assessed that the facilitating role of the public authorities as well as collaborations are important for major technological developments to break through to the regime level.

Together with related ICTs for HEM, developed by other companies, this niche can increasingly affect the socio-technical regime as HEM is becoming more widespread. As presented in the scenario, it is of importance to create a value for the user and to combine this with principles for persuasion utilised by the partners in the partnership in commercialisation of the product. It is assessed that the intention of the Public Private Partnership is to develop the system for national markets, and Södermalm can arguably be a reasonable test bed due to its urban structures and demographics presented in chapter 6. As the intention with HEM is to become widespread at the national level and together with the Smart Grid, national legislations for standardisation should be developed. It can be argued that the geographical delimitation of Södermalm is way too small for national legislation of the niche level (as also discussed in section 8.2). The majority of the interviewed experts assessed primarily increasing energy prices and secondarily increasing environmentalism as the two main drivers for energy reductions and the role of ICT as optimising energy usage, connecting devices and substituting travels. Hence, pressure could be placed on these elements in order to enhance the application of ICTs for reducing energy usage.

The Regime Level

The scenario presents changes of several of the connected regimes such as the automobile regime, automation of the homes' energy usage, the way of communicating, the education system and the dematerialisation of technological artefacts. These changes on the socio-cognitive level are not very easily implemented without radical and maintaining transformations of the institutions and infrastructure. Examples of such changes in the scenario could be more explicit although increased dematerialisation of paper and IT hardware and transformation from roads to biking paths are presented. Other and more radical changes, Røpke argues, could be employment of a Personal Carbon Account which should be used as payment equal to the monetary system or apply taxes on consumption. Others, which only at an indirect level are incorporated into the scenario, are incentives for companies, e.g. for marketing-, time saving- and economical reasons, to encourage employees to teleworking and reducing business trips, as Höjer states. Arguably, the scenario seems to be too vague in explaining how ICT can facilitate these elements.

A general acceptance of massive surveillance and automation of energy usage is also needed but if it is made economical reasonable and more convenient, this will create an increased effectiveness of energy usage which now to a large extent is steered by the energy companies rather than by the consumers. This is seen in the scenario where Fortum registers the energy usage and where the carsharing company relies on built-in GPS's in the vehicles. As Lennartsson argues, the new buildings should preferably be fabricated with ICT for reducing energy usage, leaving the dwellers no choice but accepting the new socio-cognitive paradigm. As mentioned in chapter 6, it was assumed that new dwellings would be constructed to accommodate the growth in population but in parallel to the Socio-technical Transition illustrated in the scenario. In order to automate the home's energy usage the technology should be brought there by the building owners/developers. A key feature for ICT to function is the everywhere presence of internet, which is found in the scenario as well as assessed in the expert interviews. Many of the norms and values change around this infrastructure – as a matter of fact an increasing amount of practices are related to the internet. Teleworking, massive online communication and the control of HEM via smart phone are all features, which are forcing the regime to create new institutions, regulations and standards for IT. Especially standardisation among all the new appliances is seen as a major component in order to facilitate a well-functioning ICT infrastructure according to both the focus groups and the expert interviews. As cloud computing is developing and as the citizens are being increasingly dependent on the ubiquitous prevalence of internet, such a dematerialisation is of large importance to energy reductions because of the decreased need for mass-ownership of computers, servers, disks etc. and energy effectiveness of mass-storage systems. Further discussions on the changes at the regime level are found in chapter 9.

The Landscape Level

Along with internal and context dependent changes, the scenario contains external changes at the landscape level such as increase energy prices, continuation of technological development, increased occurrence of effects of climate changes, and the establishment of the Smart Grid. These changes destabilise the regime and create opportunities for niche innovations. When energy prices are increasing, it leaves space for developing new, renewable and cheaper energy sources (Holden, 2007). When the price of these technologies is decreasing while performance is improving, as a result of continuous technological development, the new technologies will begin to replace the old ones at the existing regime. The effect of energy prices may be underestimated in the scenario as they could have a more direct impact on implementing ICT for increasing the effectiveness of energy usage in the transport- and housing sectors. Global energy politics, turmoil in the oil producing countries and too optimistic estimations on the current reserves are all elements which are difficult to deal with on a local level such as Södermalm and therefore it can be argued that the landscape level of the Multi Level Perspective for analysing a Socio-technical Transition is downplayed in the scenario in this study. On the other hand, the landscape elements in the scenario presents clear examples of how the macro level can influence transition at micro level. It can be argued that this level is downplayed because they constitute external factors which are beyond control of local Agents of Change. However, the reason for still illustrating them is that some of the changes taking place in the scenario may seem a bit implausible.

8.1.2. Managing Socio-technical Transition

Derived from the theoretical considerations regarding Transition Management for sustainable development in chapter 4 and the scenario, the following will elaborate on analyses and assessments of the four levels of the Transition Management Cycle:

- The strategic level,
- The tactical level,
- The operational level, and
- The reflexive level.

From the theoretical part, it was concluded that the process should be open and creative while including expertise, private participants and public agencies in collaborative manners. It is important to create a situation of timing, trust and mutual dependency while actively empowering the less powerful participants. Both the government, which can result in unpopular decisions on a short-term basis, and governance, where broad collaborations are empowered, are needed in order to create a transition towards a more sustainable Södermalm and also generally in Socio-technical Transitions.

The Strategic Level

Recalled from chapter 4, this level consists of the creation of visions and long-term goal formulations for the desirable Socio-technical Transition. From the scenario for Södermalm, it is derived that such visions and long-term goals are the agreement between the decision makers to strive for the low energy, low carbon society, to become a Green Capital of Europe, placing the plans and programs at the city's long-term budget, and make the project Environmentally Profiled. Such visions could for example be decided and formulated by the City Council, and at this strategic level, it can be argued that decisions are formed through parliamentary decision-making. According to the approach of Transition Management, these goals should be flexible and in order to create them, systems thinking and insight of how the system work should be applied. In planning practice in Stockholm, systems' thinking is widely used according to Lennartsson. It is also at this level that the desirable socio-technical system is discussed in terms of norms, values, identity, ethics, sustainability and functionality. However, this could be more evident in the scenario which could elaborate on the creation of a discourse in favour of Socio-technical Transition – discussions which could take place, for instance, at universities, in NGOs, the media coverage, or in political negotiations. In the scenario, the strategic level overlaps with the tactical level at the moment where the empowerment of the steering group is settled. Establishment of a meta-governing group is regarded to be a focal point for the transition process to succeed as they have political anticipation as well as close connections to the Agents of Change at the operational level. It is assessed that the constellation of the steering group is broad and include important Agents of Change. However, it could be elaborated more explicitly how they collaborate with more specific project groups at the tactical and operational level. Furthermore, it is of importance that the members of the steering group possess the necessary power to take important decisions. As Lennartsson argues, the steering group should consist of heads of the involved public and private organisations which empower powerful individuals as meta-governors to create transition arenas at the tactical level. Finally, as Høyer states, the rebound effects must be considered care-

fully, and the process should be well considered. The strategic level sets visions and targets, and it must be acknowledged that some actors will strive for maintaining and further stabilise the current system, like the Södermalm Trade Association, and some may even promote new, highly unsustainable technologies, products and practices, if they consider such initiatives to be profitable for themselves. Hence, persistence, communication skills and political will is of high importance at this level.

The Tactical Level

As concluded in chapter 4, this level consists of establishment of patterns and structures such as legislation, institutions, organisations and other networks, infrastructure and routines. The tactical level consists of the transition arenas and can be regarded as the link between the strategic and visionary level and the operational and concrete level. Besides the steering group, coalitions like the car sharing company (SCC) and the Public Private Partnership (PPP) are being established at the tactical level of the scenario in order to create arenas for the transition to happen. The new coalitions, collaborations and incentive structure form the basis of further development towards the desired future and it can be argued that within each transition arena, new cycles of Transition Management take place. Within the PPP, for example, one strategic vision could be to install HEM in 80 % of the dwellings in Södermalm. At the tactical level, project leaders from Ericsson, City of Stockholm and manufacturers of ICT collaborate in order to make HEM work and to make it feasible. At the operational level the PPP mobilises mass production of HEM as well as actors who install HEM in collaboration with the building owners. Finally, at the operational level, the tactically established PPP monitors and improves the HEM system. This example could have been expanded in the scenario where something similar happens indirectly without being described explicitly. However, other examples on the governance processes in the scenario are:

- Negotiations between Ericsson, Fortum and City of Stockholm on what HEM should contain, who should implement and maintain it and how the process should be planned;
- Planned trade-offs and establishment of the SöderShopper in order to reach acceptance from the Södermalm Trade Association on the issue of reduced parking places; and
- The establishment and organisation of Fortum's 'Södermalm Energy Contest'.

According to the governance of transformation processes, the meta-governors as well as other Agents of Change should be determined to follow the trajectory set out in the visions and strategies for a sustainable Södermalm. To embed the policies into concrete actions and operationalisation demands wise and determined public authorities which acknowledge that power is everywhere present in the collaborations, partnerships and decision makings. As such, both *government* and *governance* must work correspondingly to pursuit the target of a low energy, low carbon society.

The Operational Level

At this level of the transition process the activities have short-term horizons and can be identified as innovative practices, which are carried out through projects/programs, in businesses/industries and in politics/civil society. Examples of the operational level in

the scenario could be more visible and detectable, and it can be argued that the operational level is somehow hidden. Since the purpose with this study is to illustrate how the innovative applications of ICT can be implemented, the operational phase has been slightly downplayed. If another layer of detail was added to the scenario, the more technical and concrete examples of carrying out of the projects could have been explained more in detail, e.g. concrete removing of parking places, detailed technical explanation of how the congestion charging zone was expanded, and how and where solar panels were installed. In many cases, it is assumed that the meta-governors mobilise actors who physically carry out the decisions. As also Bjerre argued, the meta-governors at this stage should mobilise and create mutual value for the Agents of Change in order to develop engaged and fruitful collaborations. In the scenario, Fortum and City of Stockholm present a public procurement for the HEM, which Ericsson wins. However, it is not regarded as important for the transition process how, in more specific terms, HEM produced, how the technical installations are made and how the support functions. Another example could be the establishment of the work-hub on top of Greger's café, where the important issue is that it is attractive, well-visited and save office workers for physical travels – not how it is designed, constructed and furnished. The operational level can be argued to work from either top-down decisions (e.g. removing of parking places, subsidies for solar cells or tablets for pupils) or from the bottom-up perspective (e.g. citizens work together for establishment of better biking paths or citizens become engaged in planning for implementing solar panels on rooftops).

The Reflexive Level

Monitoring, conducting assessments and evaluation of ongoing policies, and ongoing societal change are all activities at the reflexive level. Reflections at both the operational, tactic and strategic levels should make the involved actors take a step back from the process and review it critically, and the plans and politics should be adjusted as new knowledge is produced and as landscape level impacts influence the political agenda. Magnus, the city planner in the scenario, reflects on the Situation of Opportunity which has happened during the past 20 years, and it becomes evident that the public authorities play important roles as both meta-governors and as final decision makers. It can be argued that the reflexive level of the Transition Management Cycle not only should entail final reflexions on the process but should be incorporated and included throughout the process, according to the meta-governance approach of reflexive governance. Non-reflexive processes within Socio-technical Transition can deter the sustainability of the outcome. Especially Høyer calls for a constant and critical evaluation of possible rebound effects and as knowledge develops it should be incorporated in the Transition Management. Finally, the lack of reflexivity of decision makers can result in selective solutions which maintain and further stabilise the socio-technical regime.

8.1.3. Summation

Destabilising socio-technical regimes from both the niche- and the landscape levels might create changes in how the organisations interacts with societal and technological changes which finally can lead to a transition. Based on analyses of the scenario this section has found that the public authorities play major roles for both enabling niche based companies to break through to the regime level and for complying with the land-

scape changes in order to destabilise the current socio-technical regime. Furthermore, it can be concluded that the importance of the meta-governors in the scenario should not be underestimated as they can facilitate transition arenas. However, as power can act as a driver for Socio-technical Transition, it has been analysed that this also can have the opposite effect, and the power relations should preferably be under constant observance in order to facilitate desirable changes towards sustainability. From this section, it can also be derived that the Transition Management is applicable for analysing the governance in the scenario, and the theory is therefore useful for understanding and analysing organisational structures of a Situation of Opportunity. Especially the interactions between the strategic level and the tactical level should be considered closely as the transition arenas are created at this intersection, this is where the Agents of Change are empowered and here new minor cycles of transition can transpire. From the assessments of the scenario in this section, it can be concluded that the operational level could be more explicit although it is assessed of higher importance to focus on the former two levels; the strategic and the tactical. Adjustments for the Transition Management Cycle could be made at the reflexive level as reflexions should be made throughout the process and not only as monitoring and learning. Transforming reflexive governance can be argued to refer to learning-by-doing and reflections on power relations, visions, transition arenas and executive planning should be done along the Socio-technical Transition.

8.2. Analysis and Assessment of Behaviour Change

In chapter 5, a behaviour model was presented in order to illustrate the factors that influence behaviour. As behaviour is individually determined and the scenario is fictitious, it is not possible to assess directly how and why the scenario characters think and act as they do. Instead of trying to identify determinants and background factors as pure guesswork, the following analysis of the scenario is centred on how the policy instruments are applied by Agents of Change and for what purpose as a means to clarify how they are attempting to change behaviour of the citizens in order to enhance Socio-technical Transition.

All three types of the policy instruments described in chapter 5 are applied in the scenario as attempts to induce behaviour change – see table 8.1 and below.

8.2.1. Regulations and Legislation

Regulations and legislation are the least used types of policy instruments in the scenario. Being part of the policy package created by the steering group and adopted by the City Council, the policy packages are assumed to entail that more citizens bike or walk. Eventually, this would reduce the number of cars and thereby contribute to reducing the energy usage through substitution. Permission to bring bicycles in underground trains should be given by SL or the County Council as the owner of SL, whereas the regulation about car free streets is adopted by the City Council and most likely through change of the existing detail regulatory plans or new ones. The examples in the scenario are regulations which eventually can become the norms of a society and thereby reflect a shift in paradigms.

8. Analysis and Assessment of Scenario

REGULATIONS AND LEGISLATION	
Prescriptions	Unconditional prohibition
Permission to bring bicycles in the underground trains is more a prescription than a prohibition with permissions because commuters do not need to meet any other requirements than bringing a bicycle. The point is to encourage environmentally friendly behaviour. This regulation is related to the substitution strategy.	Car free streets (no specification of the degree and type of sanction. To have an effect on behaviour change, buses should arguably be exempted by which the regulation gets status as a prohibition with exemption). This regulation is related to the reduction strategy.
ECONOMIC MEANS	
Incentives	Disincentives
Subsidies: Installation of solar cells and heat pumps SL transport card included in the SCC member fee SCC vehicles exempted from congestion charging and increased parking charges Free iPads in schools Investments in energy project days Reduction of SL fee if the second car is sold Free sponsoring for shops on public spaces Contenders can buy HEM at reduced prices Lease of HEM as a kind of instalment payment	Increased fossil fuel prices (however, not a deliberate chosen instrument in the scenario (but could be), but happens as a result of international circumstances) Congestion charge Parking charge increase
INFORMATION	
Mediated	Interpersonal
HEM: Traffic situation, weather, news, (dis) aggregated energy usage etc. Journey planner incl. bike rental and SCC Carbon footprint application on HEM, smart phone, social media channels – special children’s feature Information about teleworking Social media and games TV shows ITS, e.g. interactive smart boards in public transport Södermalm Energy Contest Campaigns about HEM and energy reductions, saved money and time, and improved quality of life	Exhibition about plans on Södermalm Teaching, e.g. energy project days Swedish Centre for Energy Savings Friends’ internal competition about energy reductions YIMBY march Continuous public meetings Steering group’s evaluations

Table 8.1: Overview of policy instruments applied in the scenario.

Although regulations are not widely applied in the scenario, Sweden, in reality, is often mentioned as 'the country of rules'. Using regulations to promote sustainability does not necessarily require the number of regulations in society to be increased but rather that Agents of Change are willing to change the incentive structure and thereby change the social structures influencing human behaviour. The reason for the modest use of regulations and legislation in the scenario seems quite obvious. Legislation is an external factor to planning in a local context and thereby beyond the scope of influence by the Agents of Change at a local level. City of Stockholm as planning authority does not have the authority to pass laws, only the National Government has. Passing a law which is only valid for the citizens of Södermalm is simply neither possible nor desirable within the democratic ideal.

Compared to regulations and legislation, economic means and information are to a greater extent applied in the scenario as evident from table 8.1.

8.2.2. Economic Means

Economic means are applied in the scenario based on the assumption that people are more likely to be motivated by saving money than by saving energy alone. Incentives are applied as attempts to increase the ability of changing behaviour through making it less affordable to acquire HEM and other technologies as well as a means to encourage a membership of Södermalm Car sharing Company. For example, people with a low income can find it easier to lease HEM because the costs are divided in minor portions. Lindén states that in order to enable a greater number of users of public transport, it is efficient if the tickets are lowered. This has not been applied in the scenario but could be necessary in order to enable a substitution of means of transport. Further not included are subsidies for the instalment of HEM. As also discussed in the first section of this chapter, Fortum approaches the building owners in Södermalm to install solar cells and heat pumps through shared investments. A similar model could be applied to get HEM widespread. Being part of the Public Private Partnership and having shares in large housing associations, City of Stockholm could be either first movers of installing HEM in public housing in Södermalm, and subsidies could be given to other building owners.

Disincentives applied in the scenario include increase parking- and congestion charges. The former is in the hands of City of Stockholm, whereas the latter is only possible if the Swedish Transport Agency agrees to. It is questionable whether it is fair for the citizens of Södermalm that only their city district is more regulated than the other city districts within the existing congestion zone. However, the congestion charge attempts to influence the commuters passing Södermalm, and it will most likely not have the greatest effect on the travel behaviour of the Södermalm residents as they already demonstrate a low automobile ownership. This should be improved in order to lower the energy usage by a factor 4 or 5 as assumed in the low energy, low carbon society.

Among the interviewees, there is a general agreement regarding the effectiveness of economic means. Lindén emphasises that it is important to create a positive atmosphere around public intervention and that incentives are to be preferred in favour of disincentives because of the rewards. 'However, economic incentives appear less ef-

fective when they provide rewards for specific outcomes of more complex behaviors' (Verplanken & Wood, 2006, p. 97). As exemplified in chapter 5, more affluent people may not react to economic means, but also more 'ordinary' people may not be affected by economic means. Lindén states that if they are in a position where they cannot (or do not want to) stop doing behaviours or habits they just spend their money differently whereby the consumption just gets changed and not reduced.

It is also likely that the funding that enables incentives must come from disincentives so that a balance between revenues and expenditures is sustained. However, if the incentive structure works as intended, there will be fewer and fewer people acting in such ways as for generating revenues, whereas there will be more and more people acting in such ways that they are entitled to receive incentives. Therefore, the tax level of disincentives will have to be gradually raised and the level of incentives gradually lowered if the sum of incentives and disincentives should be fiscally neutral.

As an economic means, most of the interviewees also regard the energy prices as effective for inducing behaviour change, but it can be discussed whether they can be regarded as a policy instrument per se or they are kept high due to, among other things, taxes, which is a policy instrument. Throughout history, the energy prices have been influenced by different events such as nuclear accidents or wars, but they are also kept artificially high through 'green taxes' as a way to internalise externalities in the prices. If people really tend to react to economic means including energy prices, it would be natural to argue that Socio-technical Transition can benefit from authorities' deliberate increase of energy prices and from implementing economic means. Results could be that people begin to reduce their energy usage and/or that this creates an incitement for substituting energy sources. Evidently is, however, that the energy prices are an external factor and thereby beyond the control by local Agents of Change.

8.2.3. Information

Information is in the scenario applied with at least two different purposes. Firstly, information about energy performances and consequences is given through the different ICTs such as HEM, which has been argued to enable behaviour change. However, Lindén stresses that energy performance disseminated in terms of kilowatt hours and carbon dioxide emissions are too abstract for ordinary citizens to comprehend because they cannot see the consequences from such figures. In Lindén's opinion, it is better to get close to people by employing a familiar language, to use illustrations and images and let people feel the behaviour on their own bodies. Furthermore, Lindén states that in particular families tend to be very reflexive and concerned due to their children and therefore she regards this phase of life as an opportunity for addressing families with information about environmental issues such as energy usage. Secondly, information is applied to educate citizens about energy conservation and here information reflects an environmentally pro discourse. Examples of information as education from the scenario include schools in Södermalm teaching energy conservation, the Swedish Centre for Energy Savings opens a local office in Södermalm to counsel the residents, and finally, advertising is widely utilised to get HEM widespread in homes. Common for the techniques is that they represent the discourse of the steering group, and maybe

even the National Government, which is that of using energy more efficiently and conserve energy. Environmentally promoting discourses are likely to require skilful use of discourse tactics and techniques by broad coalitions of environmentalists in order to counteract the proponents of the prevailing structures so that discourse does not come to act as a barrier for transition towards sustainable development and consumption. This is by Høyer referred to as discursive rebound effects, which can be counteracted by being proactive and far-sighted. Also the interviewees Røpke, Lindén and Höjer recognise discourse as an influential to create environmental awareness. Another example from the scenario is that public transport during the timespan is starting to be articulated as public transport service to give it a more positive tone among the citizens. The local transport services organisation, SL, arguably holds an important role in changing the citizens' perception about what public transport should be regarded as. Being also one of the categories of background factors in figure 5.1, the increased dissemination of information is assessed to change the control beliefs, which influence on the perceived control.

Vedung (1998) equates information with persuasion, and although not included in table 8.1, the persuasion principles are also identifiable in the scenario as utilised by the Agents of Change. As mentioned in chapter 5, the *principle of reciprocity* is often utilised in political logrolling/negotiations, and this could likely be the case among the Agents of Change involved in the steering group in the scenario in order to reach agreement about the policy packages which are intended to induce behaviour change of the citizens. Guided by the vision of a low energy, low carbon society, the project 'ICT for Sustainable Södermalm' is initiated by the new organisation of the Strategic Office, and it is likely that the steering group does not have unlimited financial resources although the project is being environmentally profiled by being placed at the long-term budget for Stockholm. Hence, to find a balance between revenues from disincentives and expenditures to incentives, the Agents of Change in the steering group are forced to find the right balance and one which does neither favour nor 'punish' one or few Agents of Change in the steering group. Another more indirect use of the principle of reciprocity is the free sample of HEM, which the winners of the Södermalm Energy Contest are rewarded. Although the citizens sign up voluntarily, they may feel obliged to use HEM or buy additional applications once they get it. The competitive spirit of the Andersons is an example of an individual factor because it reflects the personality of the family members. Once HEM is acquired the automatic control of the home does not imply too much thinking by the residents, and it reduces on the same time the physical effort of saving energy (in the home at least). The reciprocity example from the scenario is also related to the *principle of scarcity* because the limited number of HEM is only accessible through signing up for the contest in the beginning. As more people acquire HEM and get accustomed to using it, HEM cannot any longer be considered as a scarce item. Drawing on Cialdini's (2007, p. 238) recommendation of marketing a product not as being money saving, the information campaigns in the scenario for getting HEM widespread focused on how much money people would spend if not buying HEM and not how much they would save from using it for automation of their dwelling.

The example from chapter 5 about energy conservation using the *principle of commitment and consistency* can also be found in the scenario. As a result of signing up for the Södermalm Energy Contest, the Anderson family (and other participants) commits publicly that they want to change their energy usage, and they can therefore be expected to be consistent with their new behaviour also after the contest ends. As Fortum 'persuades' the Södermalm residents to change behaviour regarding energy usage by signing to the contest publicly, the principle is harnessed by an Agent of Change towards the end user Agent of Change during the transition through influencing the behaviour determinants of attitude and perceived control. Hence, the Anderson family has a very strong positive attitude towards environmental issues as they sign up for the Södermalm Energy Contest with the intention to reduce their energy usage, and already demonstrate perceived control as they believe that they are capable of saving energy. An additional example in the scenario is the connection between the carbon footprint application on the smart phone and the social media platforms, whereby not only the individuals can track their energy performance but also that of their individual friends, which is a tool allowing individuals' behaviour to be consistent with their commitments. It is also related to the *principle of social proof*, because following others' performance can encourage individuals to start doing the same. Here, the principles are harnessed by end user towards other end users as a form of social pressure, and the principles are therefore applied to influence the norms determining intentions towards performing behaviour of an individual. The opposite can also be found in the scenario. Through the protest march against rising air- and noise pollution and congestion, the citizens are persuading the politicians to take action. The citizens are putting a social pressure on the Agents of Change, and the organisational structures changes as a result because Malin subsequently is invited to join the steering group and because policy packages are being implemented to influence the behaviour of the car drivers.

The *principle of liking* can be found used in the scenario by the Anderson family as they persuade their friends to begin their own 'ICT adventure' and are likely to do because they like their friends (the Anderson family). Furthermore, the principle is in the scenario utilised by Fortum to allow the Andersons to become role models of HEM users and sustainable living for other peers which by Bjerre and Lindén is argued to be a driver for others to pick up new technologies. Another example concerns the YIMBY representative and Södermalm resident, Malin, who becomes the 'friend' of other Södermalm residents by confronting the decision makers through the protest. However, Malin can be regarded as a 'lobbyist' of the steering group by talking about the plans at public meetings and in her blog. This may be a deliberate choice made by the steering group and a reason for involving her in the governance process. Depending on whether Malin is aware of her role, this is close to be manipulation or exploitation of a citizen and also of the citizens who listen to Malin. This principle was indirectly mentioned during the interviews, where Lindén and Bjerre both talked about the potential for behaviour change through having ambassadors or opinion leaders as advocates of socio-technical change. These could be regular citizens who through interaction with others indicate the norms within ICT and energy usage, but they could also be prominent public actors such as the mayor or celebrities as mentioned in chapter 5.

The final principle found applied in the scenario is the *principle of authority* exemplified through the Centre for Energy Savings, which functions as experts who counsel the residents on energy saving initiatives, and because they are experts, they are regarded as more credible (Cialdini, 2007, p. 218). Indirectly, the principle of authority is also observable through the employment of the policy instruments of regulations and legislation as well as economic means. Because they are applied by City of Stockholm as policy packages, the citizens obey the authority by changing the behaviour as a result of being influenced by the new incentive structure.

Based on the application of persuasion principles in the scenario as tools in Socio-technical Transition, it can be concluded that they are not only applicable in marketing or computer science but also in planning. Furthermore, it is found that if harnessed by Agents of Change, the persuasion principles are efficient tools for influencing behaviour by turning on the different factors, determining behaviour.

Compared to the other types of policy instruments, information seems to be the only instrument directly related to ICT in the scenario. For example, intelligent transport systems (ITS) are used to inform passengers about time-schedules and drivers about road work etc. In addition, ICT is applied to inform the residents about the consequences of a journey in the journey planner as well as the carbon footprint application on the smart phone. This verifies the statement in chapter 1 that ICT in general terms can be used for information/persuasion and automation although it can be discussed how energy reducing this means really is.

8.2.4. Combination of Policy Instruments

As stated in chapter 5, literature and most of the interviewees have argued for the efficiency of combining the policy instruments. This can also be found in the scenario in which policy packages of numerous policy instruments are meant to support each other. For example, it is found that increase of parking charges and congestion charge together with car free streets, fewer parking places, ITS and construction of bike paths are complementary tools of influence. Evidently, this combination is attempting to not only induce a shift of behaviour (Dot cf. Fogg) but also that the new behaviour turns into habits (Path cf. Fogg).

The scenario also indicates that one policy instrument is not always sufficient to induce a change of behaviour. For example, information alone does not seem as a very efficient instrument for making people buy HEM. Instalment of HEM is only necessary once (Dot Behaviour), although different kinds of service checks and upgrade are likely to be necessary for HEM to continue to work. Bjerre predicts that the costs of hardware in such a system are running towards zero, whereas the operating system combined with purchase of smart appliances will continue to be relatively costly. It can, however, be argued that people acquire HEM with the intension of using it (Path Behaviour/habit), and in that sense, HEM is a combination of a change of behaviour and habits. Although HEM is marketed correctly (e.g. through the use of persuasion principles), it may still be too expensive for all population groups to acquire. In addition to this, more affluent societal groups are typically better educated, meaning that they

have other background factors for obtaining a change of behaviour. Besides having a greater economic scope, these groups may be better informed about the potential of HEM and find a meaning of acquiring it. On the other hand, lower income groups may find a better incentive to save money from buying HEM than higher income groups. Information alone may not be sufficient to have HEM widespread to all societal groups and economic means and regulations could be added or in combination.

It is widely acknowledged among the interviewees and in the literature that the policy instruments have the greatest effect on behaviour change if they are combined and as Lennartsson puts it: 'It has to go both ways, but I think it has to be the carrot and the stick always otherwise you won't get the donkey moving'. Bjerre is more explicit by stating that most effective may be the combination of the good story, good values and an incitement for saving money as the rationales for 'saving' the environment – a combination of policy instruments.

When Agents of Change create a new incentive structure, which in itself is a change of behaviour, they also produce a new stable context, which in chapter 5 was argued to be efficient for the persistence of habits. This indicates that applying a single or a combination of policy instrument is efficient for inducing a change of behaviour where combining the policy instruments are efficient for maintaining of the new behaviour towards turning into habits.

Fogg's assertion that people are lazy is shared by professor in sociology Anna-Lisa Lindén, who has done research in environmental behaviour for years, and practitioner at City of Stockholm Maria Lennartsson, who through work with waste management has experienced the same. Other barriers for change include a general reluctance to change, because people are afraid of new ways of behaving, but once they have seen something in practice, they are more willing to adopt the behaviour, states Lindén. This is because their attitude has changed, they experience a normative pressure, and they find that they have the ability. However, the novelty of something tends to wear off as people become accustomed to using or doing something, according to Røpke, and this reflects a decrease of motivation. Especially reminders were identified by Lindén and Lennartsson during the interviews as crucial for enabling behaviour to be persistent because people tend to fall back into their old habits if they are not reminded.

8.2.5. Summation

This section has found that all three categories of policy instruments have been applied in the scenario although to a varying degree. Common for the policy instruments are that most of them are applied by Agents of Change in order to induce behaviour change by the citizens as complementing the energy reductions which HEM are assumed to achieve through automation of the dwellings. Further, the policy instruments are used for marketing purposes in order to get HEM widespread and adopted by the citizens. This implies that the changes of the energy usage assumed to occur in the scenario does not happen as a result of only technological development, but also social change which indicates that a Socio-technical Transition can possibly happen. The analysis of the scenario also indicates that policy instruments can be regarded as for-

mal social structures as well as tools for changing the informal social structures such as norms, interactions and attitudes. The final conclusion relates to the behaviour model in chapter 5. Being aware of the determinants and background factors that constitute behaviour and eventually also habits, this knowledge is useful for understanding the differing influence of the policy instruments. With this knowledge in mind, it can facilitate a successful Socio-technical Transition in reality. The model combined with knowledge about behaviour is important for Agents of Change to know as this indicates what buttons to turn, by whom, how and when during transition. This entails that the application of the theoretical perspective of behaviour change has been useful for analysing the scenario. Therefore, it can be concluded that theories of behaviour change is suitable for analysing the social structures within the concept of Situations of Opportunity.

8.3. Is the Socio-technical Transition a Situation of Opportunity?

In this study, the Socio-technical Transition of Södermalm has been studied as a Situation of Opportunity, and the content of the scenario has been identified through applying the questions of:

- *What* can change?
- *Who* could change?
- *How* could change take place?
- *When* is change feasible and possible?

Each question is addressed below as a means for assessing whether this four-fold approach is applicable to the study of Socio-technical Transitions and scenarios.

‘A description and evaluation of a period of transformation in the city’s future development when a limited number of actors can plan and implement a consistent set of measures that profoundly and lastingly contribute to urban sustainable development – changing the city’s built environment and infrastructure systems, its institutional set-up and city life, but retaining its ability to sustain the good life of its citizens’ (Svane et al., 2009, p. 5).

8.3.1. What

Objects changing the current *urban structure* of Södermalm in the scenario are transformations of homes and cafés into home offices and work hubs, respectively; a change of the transport system through implementation of automated trams, extension of lines, fewer parking spaces and more biking paths; a change of the energy supply system through the implementation of the Smart Grid, installation of HEM, heat pumps, solar cells and a change of telecommunications systems by having access to wireless internet everywhere. None of the examples changes the large-scale physical structure of the city district. Regarding the *organisational structure*, a new incentive structure is being applied by City of Stockholm and other Agents of Change in order to implement especially HEM but also to induce a more environmentally friendly behaviour of the citizens. Also the organisational setting is being changed with the appointment of the steering group, establishment of a Strategic Office and Public Private Partnership, negotiations between involved actors, and public meetings. The *social structures* in terms of behaviours and policy instruments are in the scenario Objects of Change influ-

enced by the changed organisational setting and minor changes in the urban structure. Furthermore, it can be derived that the introduction, acceptance and usage of certain results of technological development (i.e. the energy-saving ICT technologies) are Objects of Change in this study as a result of new coalitions among Agents of Change which has changed the organisational structure.

As the analyses in the first two sections in this chapter showed, it is possible to pinpoint aspects from Transition Management and behaviour change in the scenario. From this it can be derived that the scenario is reasonable in presenting Objects of Change.

8.3.2. Who

The main Agents of Change in the envisioned Socio-technical Transition are the public authorities (e.g. City of Stockholm), building owners, and private development companies of ICT (e.g. Ericsson). The citizens also have a prominent, although diversified, role in the scenario. The citizens are passive end users, whose altered everyday activities stemming from change of social structures result in a changed energy usage. As an Object of Change, the energy usage is changed because the citizens accept the new role of 'prosumers' which becomes possible through the Smart Grid and HEM. They are not only end users, consumers or voting cattle but hold a more potential role as Agents of Change. For example, through the protest march which results in a more direct involvement of citizens in the steering group. It can be argued that the citizens are the genuine Agents of Change as without behaviour changes, the Socio-technical Transition would not happen.

As the table in Appendix IV also displays, the scenario has been consistent in presenting an Agent of Change in connection to an Object of Change.

How Are the Agents of Change Empowered?

Underlying social mechanisms form the basis of how 'value' is perceived by the Agents of Change. It can be argued that their actions have intentions and purposes, which must be understood by the meta-governors in order to empower them in the most appropriate way. Different actors have different embedded values, and from the scenario, it can be derived that Ericsson envision economic gain by involving in the Public Private Partnership while Malin perceives a value of responsibility as well as health concerns. On the other hand, the Andersons see a value of increased life quality as HEM saves time from boring daily chores. It can be concluded that value and rationale are perceived differently from actor to actor and the neo-classical rationale of the Economic Man does not prevail as extensively as it sometimes are laid forward by the decision makers. Organisational changes should be made in order to change the underlying values towards values of sustainability and common responsibility. By taking the present organisational structures for creating value into consideration, they could be exploited and changed towards a new societal discourse. However, this can hardly only be done in Södermalm which is no isolated island, but the media, the public debate, the education system and the visions set out by decision makers should preferably strive for putting sustainability high on the agenda. In the scenario, such new organisational settings towards a discourse of sustainability are seen in computer games, in sustainability

projects in the school, programs on the TV etc. Other, and more radical organisational changes for empowering the Agents of Change, could be changes for coupling the monetary system with the ecological system (see chapter 9 for examples). With regard to the discussions of democracy and public intervention, it can be argued to which extent the public authorities and the meta-governors should intervene. Although it can be hard to distinguish the organisation structures from the social structures, it is concluded that the meta-governors should be aware of the different underlying values and rationales of the Agents of Change.

Empowering the Agents of Change can happen by the meta-governors inviting the Agents of Change into a transition arena. Examples from the scenario on this strategy are the creation of a public procurement, the placement of the plan for 'ICT for Sustainable Södermalm' on the budget and inviting the Andersons to become ambassadors for HEM. Collaborations must be formed, transition arenas created and the role of the meta-governors as facilitators and moderators of the process is important. Negotiations, trade-offs and agreements should be made, however, with the overall target in mind. The other way of empowering the Agents of Change is when the actors have ideals they want to pursue and contact the meta-governors for help with the facilitation and implementation processes. From the scenario this can be seen in the protest march, where citizens of Södermalm try to affect the public authorities to act against increasing pollution. Obviously, when it comes to this point, planning has clearly gone wrong. However, the important issue here is that the public managers know who to approach, and it can be derived that clarity of who the meta-governors are is important.

8.3.3. How

The 'consistent set of measures' (cf. the definition of Situations of Opportunity) reflects the question of how change is carried out. As stated above, the introduction, acceptance and usage of technological development can be regarded as Objects of Change, whereas the technologies more are to be regarded as measures that contribute to achieving the vision of a low energy, low carbon society. Also more 'traditional' measures such as policy instruments are introduced by Agents of Change for affecting Objects of Change within the social structure and for getting ICT widespread. However, this is only happening in the envisioned Socio-technical Transition because new organisations are formed.

How do Public Authorities Intervene and Affect Change?

It can be concluded that the public authorities play important roles for the intentionally transformation process towards a sustainable socio-technical regime. They interact, intervene and affect change at several levels by guiding and steering the development in the desired direction. As it was concluded from the second section of this analysing and assessing chapter, laws are being decided on the national level and the local authorities do not possess the power, and it would be problematic from a democratic perspective, to create laws on e.g. higher energy prices, mandatory HEM for all or a completely car free area only in Södermalm.

Instead, incentives and disincentives are utilised in the scenario in order to encourage people to choose certain behaviour, and this desirable behaviour reflects the intentions of the decision makers. It has been argued that both 'sticks' and 'carrots' are needed in order to encourage people and as earlier stated, the public authorities should analyse the underlying norms and values of the affected group in order to achieve the greatest effect of change. It can be concluded that planning in this way can learn from the fields of marketing and motivation.

The most obvious intervening and affecting tool for the public authorities is the executing of plans and programs. The second narrative of the scenario consists of reflexions of such a process and insights of how plans are being executed. Such plans and programs, however, cannot be executed without interaction from Agents of Change and without implementation of Objects of Change. The earlier stated two ways of engaging with Agents of Change can here be supplemented by a third, which is rooted in fixed plans, complete drawings and predetermined calculations on how a specific Object of Change transform as a result of specific project planning – e.g. how roads should be transformed to biking paths, how new subway stations should be constructed and how internet cables should be upgraded to high speed wireless internet. This form of entrepreneurial role of the public authorities is well known and further underlines the power of having meta-governors to manage transition. Among other critical aspects of Socio-technical Transition the role of the public authorities should be further discussed in terms of democracy and legitimacy.

As an extension to the what-who integration in the concept of Situations of Opportunity, this study has attempted to integrate the question of how more explicitly, which one of the columns in Appendix IV also displays. In most cases, either technological development or the three types of policy instruments constitute the measures taken by the Agents of Change in order to affect the Objects of Change. However, the City Council's adoption of 'ICT for Sustainable Södermalm' on Environmental Programme and long-term budget can be regarded as an Object of Change that influences the organisational structure, and the measure is stated to be negotiations. On the other hand, a change of behaviour by the citizens can be the result of the City Council's adoption of the project, whereby the project becomes a measure and not an Object of Change. It can be derived that the integration of what, who and how is possible and that the scenario is relatively consistent in doing this, but that it for the reader may seem difficult to detect the difference between Objects of Change and measures if not stated explicitly. On the other hand, if stated too explicitly, the narratives may lose some of the benefits of storytelling, and the scenario comes to resemble more a traditional strategy or plan for a city district. The issues of applying the elements from the concept of Situations of Opportunity in scenarios and in a context of planning are further discussed in chapter 10. Whether more radical measures towards a shift of the prevailing socio-technical regime should have been introduced in the scenario in order to ensure a greater chance for pursuing the low energy, low carbon society is discussed in chapter 9. Additional measures that could contribute to the low energy, low carbon society, which are not merely technology related are elaborated in the outlook in chapter 12.

8.3.4. When

The moment for initiating and realising a Socio-technical Transition or a Situation of Opportunity is when inertia against change is low (Svane et al., 2009). In the scenario, possibilities to initiate changes emerge as the result of a number of external factors on the landscape level such as the development of the Smart Grid, but also because the public as well as private actors can see the mutual benefits of initiating change. The Agents of Change simply have the will and the power to seize the chance, and a number of strategic decisions make it possible to turn Södermalm into a test bed for ICT as a means of initiating Socio-technical Transition. Following the Transition Management Cycle, the Socio-technical Transition as a Situation of Opportunity illustrated in the scenario can be divided into different phases as indicated in this chapter's first section and in the table in Appendix IV. However, the different phases of transition could be more explicit in the scenario, for example by having one narrative per phase. Arguably, this would give a better picture of the different events in the scenario, and the figure of the transition in chapter 7 would be redundant, although it is useful for obtaining an illustrative overview. The risk is, however, that the events would be presented in a chronological order, which can give the impression that the events are causally related, which may not be the case as several sub processes are happening simultaneously. For example, the distribution of HEM is happening while SL is expanding the transport system.

Also derived from the section about the Transition Management Cycle is that the Situation of Opportunity illustrated in the scenario not only illustrates the formative moment, where the decision regarding transition is taken, but also the preliminary events and decisions that influenced the final and crucial decision as well as the outcome of it. Hence, the temporary dimension of the Situation of Opportunity in the scenario corresponds to the one contained in the concept (see Appendix II).

8.3.5. Summation

Because the changes of the social and organisational structures in the scenario assist technological development by niche companies and behaviour change of citizens, both the 'social' and 'technical' parts of Socio-technical Transition have been achieved. Furthermore, since it has been possible to detect the various aspects of the questions with regard to the scenario, for example in the table in Appendix IV, the Situation of Opportunity can be characterised as a Socio-technical Transition. From this it can be derived that the concept of Situations of Opportunity seems to be applicable for analysing Socio-technical Transitions and scenarios as prospective studies, whereas it previously has been applied in retrospective studies of urban planning processes (Weingaertner, 2005).

8.4. Summary

Based on analyses of the organisational and social structures in the scenario, it is concluded that Transition Management and behaviour change are suitable as theoretical perspectives for identifying and examining these structures in terms of underlying determinants and mechanisms of change. Thereby, the two perspectives seem applicable in the concept of Situations of Opportunity as expansion of hitherto developments of the analytical framework for analysing urban planning processes.

Furthermore, it can be derived that the scenario is reasonable and consistent in presenting changes of the organisational structure needed to make the proposed measures happen, citizens' behaviour and its determinants as Objects of Change, and interventions along with Agents of Change. Simplified this entails that the Situation of Opportunity is realised as a result of changes in the organisational and social structures.

The approach of addressing the questions of what, who, how and when seems suitable for analysing also future planning processes because it forces the researcher to distinguish more carefully between the aspects. However, this distinction is difficult to obtain as the questions are so integrated.

9. Discussions

Having developed, analysed and assessed a scenario for Södermalm with the innovative application of ICT as a motor for transition, it is appropriate to reflect upon to which extent the Situation of Opportunity in the scenario contributes to a low energy, low carbon society. First, discussions on the sustainability of the scenario are provided which are followed by discussions on environmental and societal rebound effects. Finally, the role of planning and ICT as a driver for change will be discussed.

9.1. Sustainability

In the scenario, the innovative applications of ICT and other policy instruments have been applied to change the energy usage in Södermalm in order to break the path towards a low energy, low carbon society. In retrospect, however, it can be discussed how sustainable the scenario is. It can be argued that the innovative applications of ICT can be applied for information and persuasion purposes as well as enhance efficiency and automation while levelling out the energy usage in the realms of housing and transport. In the cases of teleworking and increased use of public transport, ICT can substitute unsustainable elements such as gasoline-driven cars and loads of IT hardware as a process of dematerialisation. However, when it comes to the only strategy which seriously deals with sustainability, reduction as Høyer argues, it can be argued that ICT comes to short, as it focuses primarily on optimising, and that other policy instruments like the building code towards increasing isolation and economic means for reducing consumption are more sustainable as they are directed at reducing energy usage. Although the organisational structure in the scenario is changed through contemporary constellations of a steering group and a Public Private Partnership, the need for more continuous and steady changes can be discussed. The contemporary organisational changes can preferably develop and result in more steady constellations, and more deep structural changes could also have been imposed in the scenario in order to enhance sustainability. However, the changes in the organisational settings must have direct or indirect aims at reducing the energy usage and not only to aim at optimising and substituting energy. Some organisational settings are changed into stable structures in the scenario, like a new incentive structure, the Smart Grid, and the home energy management system. Reduction of consumption is often considered as a condition for reaching sustainability (Sanne, 2002), and Næss (2006a) argues that as long as a strong neo-liberal regime constrains the development towards decreased consumption, a sustainable society can hardly be developed.

The constant demand of increased consumption caused by desires of economic growth can hamper the sustainability of the scenario, Røpke argues. Changing the societal-setting of institutions and regulations require politicians, who are willing to change the development and break the current tendencies. In a representative democracy like most Western societies, the politicians are elected by the citizens, who then become Agents of Change. If the politicians decide upon unpopular decisions on short-term basis, like inconvenient carbon taxes or reduced parking spaces, the unpopularity might not result in re-election. Van Marrewijk (2003) argues that there is an ethical and urgent need for governments, businesses and citizens to view and decide upon the longer term of sustainability than the short-term of monetary gains. From the state's

perspective, it can be discussed it should strive for creating sustainability as an urgent need for citizens in society. From the businesses' perspective, Wempe & Kaptein (2002) argue that a corporate sustainability should be build upon the three pillars of profit, people and the planet. From the citizens' perspective, the responsibility can be argued to be to elect decision makers who strive for sustainability and pursue behaviours and products which enhance sustainability.

9.1.1. Summation

ICT can optimise energy usage, to some degree substitute travels, and facilitate communications between different Objects of Change and Agents of Change. However, the constant demand of increased consumption caused by desires of economic growth can hamper the sustainability of the scenario.

9.2. Rebound effects⁶

A planning process regardless of further reflections on the landing points, visions and rebound effects does not make any sense in the light of sustainability (Robért et al., 2002). A thought through discussing and reflecting process of possible drawbacks for the transformation process is necessary in order to contemplate the sustainability of the outcome of Socio-technical Transition. Two categories of rebound effects can be identified; environmental rebound effects and societal rebound effects, and these will be discussed with regard to the three strategies for sustainability: optimisation, substitution and reduction.

9.2.1. Environmental Rebound Effects

According to the interviewees Røpke, Höjer and Høyer, a drawback of ICT is a tendency towards increasing energy usage as the number and distribution of ICT increases. As this study is focused on how the energy usage can be changed with innovative applications of ICT as a main driver, it is doubtful that the target of a low energy, low carbon society can be reached without a break in this tendency. Such a break can likely occur by making the technologies more energy efficient while applying ICT for energy reductions in e.g. housing and transportation. As the life cycle of ICT still requires research, development, production, transportation and recycling, there are a number of various consumed resources related to ICT. As the number increases, the energy usage for the production will arguably also increase. In the light of environmental rebound effects, it can be argued that if technological development fails to reduce resource consumptions more, the most environmentally sound strategy is to reduce the amount of ICTs. However, with the strong technological development, increased demands from consumers and decreased life expectancy for ICT in mind, the likeliness of following such a strategy seems rather pessimistic.

⁶ Definitions on rebound effects are built upon papers published in Energy Journal and Energy Policy. Energy Policy published a special issue (vol. 28, no. 6-7, 2000) on rebound effects which provide a useful overview.

Recalled from the previous discussions of the sustainability of the scenario, another environmental concern is the rebound effect of induced energy usage as ICT makes it more convenient and effective to e.g. commute by car due to Intelligent Transport Systems (ITS) or to leave the increasing amount of ICT applications for telecommunication with the power on. Here, it is questionable whether the strategies of optimisation and substitution are causing induced energy usage rather than decreasing it, and again it is regarded that ICT cannot cope with the reducing strategy alone. In order to cope with the rebound effects related to induced energy usage, other means than ICT must be applied to the planning process of changing the socio-technical regime (see examples in chapter 12). If different interventions as applied in the scenario are not complementing ICT in a transition of the socio-technical system, it can be discussed whether the energy usage will most likely increase rather than decrease.

It can be discussed whether the decreased life expectancy of ICT-related products is favourable in an ecological perspective as the mountain of electronic waste is increasing with soaring rates (UNEP, 2009). Another issue, which relates to the societal rebound effects (see below), is the individual desire of being recognised. With ICT as artefacts for recognition combined with the high pace of technological development, smart phones, tablets and advanced photography equipment are replacing functioning and simpler technologies. Substitution of high energy consuming televisions with more energy effective flat panels optimises the energy usage, some would argue. However, development has shown that it has become a status symbol to possess a larger TV, and then to have a large TV in every room of the apartment. Although energy optimisation of ICT has been developed, environmental rebound effects occur when the focus on volume is lacking, states Høyer.

Recycling strategies, however, should be implemented in order to alleviate the increasing problem by reusing elements and parts from worn out ICTs. Recycling, especially in terms of Cradle to Cradle (Braungart et al., 2007), is favoured as it reuses recyclable parts in new products and technological development combined with environmental concern has resulted in greener products, where some can be totally recycled. Although recycling is favoured in the light of ecological concerns, the manufacturing processes still use energy. With the increasing amount of recycling due to even rapidly technological development, the energy usage for recycling could most likely increase. It can be discussed, from an ecological perspective, that although energy production becomes more environmental sustainable, wind mills and solar panels still demand space. The development towards increasing exploiting of ecosystems in the favour of human made energy for human made products for human made needs is simply not sustainable and once again, this leads back to policies for reducing consumption and eventually growth.

Although 'the link between sustainable resource use and growth is, perhaps, the key economic question' (Golding & Winters, 1995, p. 2), there is a wide dispute whether economic growth is consistent with sustainable development. Thought-provokingly for the mainstream economists, especially the ecological economist, Herman E. Daly (1990), discusses the term 'sustainable growth' and state that the physical dimension

of economy is an open subsystem of the earth ecosystem, which is finite, non-growing and materially closed. When the economic subsystem grows, it incorporates an increasing proportion of the resources of the ecosystem and it has to reach the limit of 100 % sometimes. Therefore, as Daly argues, growth is not sustainable. Ekins (2000, p. 60) argues that if 'the reduction of the material intensity of economic value can be continuously reduced, then the possibility exists of indefinite growth of value'. With regard to the discussion of growth and sustainable development, the terms 'growth', 'value' and 'development' should be further discussed and reinvented as they are closely linked to economic measures. However, such discussions are important for the sustainability of the scenario but would demand further research within the fields of sustainability research, political research and economic research.

9.2.2. Societal Rebound Effects

The rebound effects at the more general and societal level are referred to as products of discursive rebound effects and behavioural rebound effects.

A drawback in changing the current socio-technical regime is that people might be unwilling to change behaviour. As found in chapter 5, several factors such as convenience, socio-economic factors, level of information, norms and context lie behind the decision of maintaining or changing the current behaviour of an individual. All the parameters have to be affected, and at the best they are affected synergic and simultaneously. A serious discursive setback can emerge when e.g. the HEM system does not function accordingly to the expectations, or if the underground system is clogged. Such events can hamper Socio-technical Transition due to negative experiences, which can result in negative publicity and a negative attitude towards otherwise sustainable sound systems.

If the transition process is felt coercively forced upon the citizens, they might feel the change as left by 'no choice' and experience inhibition of the free will. A societal rebound effect of reluctance to Socio-technical Transition can possibly be coped with by generating value for the citizens and other Agents of Change. Constructing a feeling of self-chosen change might prove important in order to cope with negative stands towards change. Furthermore, by involving the citizens actively can ease discursive and societal rebound effects, and upheavals against change can be dealt with in a strategy of 'preventing rather than cure'.

As indicated in chapter 5, and as argued by Røpke (2009, p. 2496), the lack of reflexivity in practices may constitute a barrier to the inclusion of environmental considerations. A societal rebound of lost reflexivity might reflect a general discourse of sustainability in society, and in order to avoid a drawback for the Socio-technical Transition sustainability must be on the agenda for politics and media. Articulation of sustainability matters is perceived as important to avoid a draw back in terms of negative discourse.

The division between environmental and societal rebound effects is not always clear as rebound effects refer to the functioning of market economies where increases in efficiency are frequently overcompensated by effects in growth and resource con-

sumption (Binswanger, 2001). For example, money saved on the energy bill is used on consumer goods such holidays to exotic and distant places (as exemplified with the Anderson family in the scenario) and more effective handling of the car traffic makes it easier and more convenient to go by car. Such rebounds should be coped with in order to create a sustainable transition (Robért et al., 2002), and it can be discussed if new values, norms and ethics should be developed accordingly with the creation of new institutions which enhance sustainable behaviour.

9.2.3. Summation

It can be discussed that in order to mitigate increasing energy usage, a specific focus should be on the reduction strategy as proposed by Høyer. ICT should be regarded as an important part of the solution but cannot cope with reductions without public interference. Finally, in order to avoid discursive and behavioural rebound effects, there must be created values for the citizens and other Agents of Change, and the public discourse should be directed at positive promotion of ICT as a motor for Socio-technical Transition. This, however, demands that the technologies work and generate positive feedback, hence, the needs of the citizens must be understood in depth.

9.3. The Role of Public Planning

A primary and essential question for planning is whether or not it should intervene with the ongoing development. Public intervention is when public authorities initiate top-down or bottom-up regulation in order to achieve targets, which could not have been accomplished by reliance only on market forces (Klosterman, 1985). Public planning should preferably strive for achieving 'public interest', but this notion has been widely disputed within planning theory. Especially two approaches to planning and their consequences for Socio-technical Transition will be further discussed, namely New Public Management (NPM) and communicative planning.

New Public Management

New Public Management (Lane, 2000) emphasises economic norms and values and favours cost-effective analyses of means for public management. This approach to public management is related to the steering of a private organisations and contracts, effectiveness and cost-benefit analyses are favoured means. A broad range of critics have argued against the NPM approach with regard to sustainability (see Hezri & Dovers, 2006) because plans are being hastily decided on, procedures are streamlined and objectives and benchmarks are strived for in the most effective ways in order to reduce delays and enhance economic feasibility. The NPM can be criticised for limiting the role of planning to augmented neo-liberal ideologies of free market forces while facilitating ongoing developments and it reduces citizens to economic rational consumers. As important negotiations take place with the most powerful actors around the table, the New Public Management approach leaves no prominent roles for neither planners nor citizens who, with Bengs' (2005) words, could be reduced to 'pure extras'. With regard to Socio-technical Transition and Futures Studies, this approach to planning inhibits regime changes and free thinking as the most cost-effective approaches and strategies are being implemented in the most efficient manner from the current perspectives

where much relevant information on environmental downsides is not included. It can be discussed whether the right information is included in the cost-effectiveness and cost-benefit analyses, and how sustainability is assessed in these calculations. Hence, the New Public Management approach to planning should be avoided if sustainable Socio-technical Transition should be realised. Decision makers and meta-governors should be aware of actors who promote New Public Management as it can be discussed whether it hamper rather than entail sustainable planning. In other words, opponents of Socio-technical Transition might turn to arguments held within a NPM paradigm and one primary role of the meta-governors is to handle and deal with such arguments.

The notion of 'public interest' is rather controversial as it implies that the public as a unity has a common interest, which by NPM is regarded as economical. Healey (1997, pp. 124-125) writes of an 'aggregated interest', 'shared interest' and 'common concern' which implies that citizens strive for the good life, and organisations for what optimises their purposes. This should leave citizens, organisations and decision makers as stakeholders who can form partnerships in development projects and is regarded as a more fruitful way to view 'public interests'. As one major aim of this study is to pursue sustainability, it can be discussed whether this conflicts with NPM and neo-liberalism. Prevalence of the existing regime, favouring economical feasible means and the perception of citizens as consumers further enhance the unsustainable trajectory of increased consumerism and energy usage while neglecting to focus on the reduction strategies.

Communicative Planning

Communicative planning is rooted within the Habermasian theories of critical theory and communication actions and those concerned of the planning and the outcome should participate on free and equal terms while communicating, cooperating and searching for the best achievable future. Sager (2005, p. 3) points at four reasons why communicative planning has gained foothold during the last 30 years:

- Societies and cities are becoming increasingly multi-cultural, which demand broad and deep preparation of projects and plans;
- Citizens are more educated than ever before and demand to be involved in public matters;
- Civil society is more organised and is strong enough to challenge bureaucratic and political decisions; and
- There has been a lack of objectives for assessing environmental and social consequences while favouring assessments of economical and technical objectives.

While focussing on the process and on the better argument rather than on coercive power plays, communicative planning endeavours at orchestrating openness, equality and reaching understanding. It can be argued that communicative planning contributes to deliberate democracy (Sager, 2005). However, it should also be discussed whether consensus building in planning is the most proper way to initiate sustainable Socio-technical Transition. It can be argued that communicative planning might opt for levelling the power of the participating actors. A major discussion of communicative planning is whether the role of the meta-governors is to level power. Decision makers,

planners and citizens do not necessarily have to fear power as it can work progressively for destabilising the current socio-technical regime and thus enable Socio-technical Transition. Powers should preferably be worked with rather than against and a strategy for avoiding the most powerful actors of the current socio-technical regime to control the output of so-called consensus-building processes should be created and followed. The role of planning, it is argued in this study, is to guide and lead the powers in the direction of increased sustainability while collaborating and communicating with a broad range of Agents of Change.

9.3.1. Creation of Additional and New Organisational Structures

A major feature for Socio-technical Transition is the creation of new organisational structures, which guide citizens towards more sustainable behaviours and habits. Examples on such new institutions will be discussed in terms of how they can be created, and how they can induce citizens to change behaviour. The following discussions are based on issues brought by the participants in the focus groups and the interviewees and should be regarded as mere assertions about landscape changes for destabilising the socio-technical regime.

New Ways of Paying: Personal Carbon Footprint

With the current socio-technical regime, it can be argued that the monetary system and the ecological system are disconnected in many ways. The New Public Management is prevailing in several societal structures, like housing- and transport planning and public interventions are used for creating prices on environmental consequences which can be handled by market forces. The Kyoto-system and carbon trading are examples of attempts to attach the monetary system directly with carbon emissions in order to attain a higher level of sustainability. From the second focus group, the discussion of 'new ways of paying' was brought up. The principle of 'the polluter pays' can be transferred to the personal level with a system of personal carbon footprint, where highly unsustainable products are expensive on the mandatory carbon account, which has to be used together with the well-known monetary account for requiring products. Such a system is being discussed vehemently in the UK and in Australia, where the public discourse refers to fairness and common responsibility. (Department of Energy and Climate Change n.d.; Levitt, 2009; Adam, 2010)

New View on Consumption: Taxation on Consumption

As a further perspective to the above is a change of the current taxation system towards higher taxes on consumption and lower taxes on work in order to pursue ecological and sustainable targets, which was a discussion brought up in the interview with Inge Røpke. These changes could, however, inhibit the low income groups from consumer goods while favouring the wealthy part of society, who arguably are constrained by economic disincentives to the same extent. If a system was created where taxation on food, transport, heating and consumer goods were income dependent, it would enhance more equality across generations and geographical dimensions.

New Socio-technical System: Smart Grid

The establishment of the Smart Grid, where citizens become 'prosumers' also turn them into stakeholders rather than end users, to use the terms from Communicative Planning and NPM. ICT enables the communication between the 'prosumers' and the central power plants, and the peak hour energy usage can be levelled due to intelligent distribution and usage of energy. A discussion brought up by the first focus group is the drawback of the relationship between the 'prosumer' and the energy companies can be discussed in terms of supervision and Big Brother society and knowledge about issues which today are regarded as private. On the other hand, Bjerre argues that citizens in 2030 will be used to surveillance in many forms, and these issues would most likely not even be debated by then. In order to optimise energy usage and enable widespread automation in the housing- and transport systems, the individual has to compromise with the free choice and possibilities of controlling the household's energy usage. However, as a prerequisite for the Socio-technical Transition in the scenario, and likely also for the future energy system of Sweden and other countries, the Smart Grid plays a crucial role in the transition of the current socio-technical regime.

New legislations: Standards for ICTs

Arguably, increased communication and increased automation can entail a development that will head towards a trajectory where people become controlled by machines. Although people programme the machinery themselves, power is given to a rather few persons who control the Smart Grid. With the many new ICT appliances which have to communicate with each other, with the citizens and with the energy suppliers a new set of standards must be applied, as the first focus group discussed. However, it can be discussed by whom and how these standards should be instituted. Somehow, they have to be founded and agreed upon in the international community as globalisation grows in strength. If the most powerful stakeholders decide upon such issues, there is a risk of following the path of NPN rather than the communicative approach. Along with standardisations for ICT, legislation for productions and components of them could be adopted to minimise the environmental impacts from not only the usage phase. Ecological production methods and sustainable waste management strategies should thus be discussed at international, national and local fora.

9.3.2. Summation

In sum, creation of such new institutions might sound rather radical in the ears of the current neo-liberal welfare states of the Western societies and one might wonder whether the current regime is too strong to for this to be changed radically. Such changes are likely to give reason for pursuing a more sustainable living but in order to create them, it can be argued that the regime has to be destabilised further from both the landscape- and niche levels.

9.4. Summary

One of the objectives in this study is to explore how a fully utilised Situation of Opportunity can contribute to the 2060s vision of a low energy, low carbon society concretised as a 2 kW/1 t CO₂ society. Based on the exposition of sustainability, rebound

effects and the role of planning, the degree of contribution by the Socio-technical Transition in the scenario towards the target is questionable because:

- ICT is currently increasing energy usage rather than decreasing it, and is regarded as a more appropriate instrument for the efficiency and substitution strategies. This is also likely to be the case in the scenario although HEM is assumed to enable a reduction of energy usage through automation and persuasion.
- Many rebound effects are connected to technological development such as a desire to possess more and bigger ICTs, which result in induced energy usage.
- The Socio-technical Transition in the scenario is to a large extent a continuation of the prevailing socio-technical regime, which reflects the neo-liberal paradigm.

More controversial changes such as those of the monetary system have been suggested as enabling a greater contribution to sustainable development than the one illustrated in the scenario.

However, as it is acknowledged that technologies alone cannot create sustainable development, a focus on social structures has been applied, and it can therefore be argued that the explored Situation of Opportunity in the scenario contributes to the target because (as counter arguments to the ones above):

- ICT is applied within the strategies of efficiency (e.g. automation of dwellings and energy usage) and substitution (e.g. teleworking). Both have the potential to contribute to a reduction of energy usage.
- The new incentive structure as a result of changes in the organisational structure induces a behaviour change of the citizens towards increased sustainability.
- In the case of Södermalm, the scenario has presented a destabilising process of the Socio-technical regime. The initiating events give rise to new organisational constellations and new ways of behaving.

The Situation of Opportunity is likely not contributing to achieving the low energy, low carbon society when it 'ends' in 2030. However, this was neither the intention according to chapter 1, where it was argued that the Situation of Opportunity illustrated in the scenario should be regarded as one step towards the vision, and that 2030 reflects an important milestone towards achieving the target.

10. Reflections

Having completed a study of how the innovative application of ICT can contribute to a Socio-technical Transition guided by the vision of a low energy, low carbon society, it is valuable to assess its degree of scientific quality and reflect upon the chosen research strategy. The scenario in this study, including the factors and assessment, illustrates one reasonable reality but not the only reality, especially not since the scenario illustrates a future reality and this cannot fully be neither predicted nor prescribed. Besides reflecting on the scientific quality and value of the study, methodological reflections contribute to the understanding and improvements of the applied methodological approaches. While the first part of the chapter consists of reflections regarding quality and value, the second part of chapter reflects on the approach of Situation of Opportunity and the final part on how the scenario in this study.

10.1. Scientific Reflections

Assessment of this study's scientific value takes a point of departure in the criteria suggested by Lincoln & Guba (1985) and Miles & Huberman (1994), which are slightly adapted to qualitative studies although the names of the criteria are equivalent to the quantitative criteria. Although the assessment criteria resemble the ones for quantitative studies, they are applied in this study for lack of anything better to be detected in the literature by the authors of the study.

10.1.1. Reliability/Dependability

Reliability refers to the congruence between the chosen problem statement, research questions, methods, analyses, and findings. In other words, reliability refers to the usefulness of the research strategy to produce consistent findings and whether the study has found what it has searched for.

The first part of the study (chapters 1-3) presented and justified the problem statement and how this would be answered and the overall research strategy reflected subsidiary research questions and methods. This was further connected to the scientific approach of Critical Realism as well as Futures Studies and the analytical framework of Situations of Opportunity. As the conclusion in chapter 11 elucidates, the study has produced findings which correspond the problem statement, and it is, therefore, plausible to assess that a high level of coherence between the problems, methods and findings is obtained.

Having experts as reviewers of the scenario was an addition for ensuring reliability as they pinpointed aspects which seemed implausible, resulting in a subsequent minor rewriting of the scenario.

Selection of Vision

There is, however, a minor problem regarding the overall aim of the research project and the purpose of this study reflected through the problem statement. The overall purpose of SitCit is to explore how a fully utilised Situation of Opportunity can contribute to the 2060s vision of a 2 kW society. Implicit in this target for the future is an expectation and a quest of necessity for reducing the energy usage in Western societies by a factor 4 or 5. The problem statement of this sub-project of SitCit, on the other

hand, reflects the exploration of energy efficient transport habit and more sustainable ways of managing building. This seems to be more related to the strategies of efficiency and substitution. Since efficiency and substitution do not necessarily entail a reduction, it can be argued that there is a mismatch between the overall target for the study and the findings, because these reflect the problem statement. However, as both strategies eventually can contribute to also a reduction of energy usage, the mismatch does not influence particularly on the reliability of the study as the findings correspond the problem statement. However, efficiency and substitution should be part of a compiled reduction strategy.

As also discussed in chapter 9, Røpke, Høyer and partly Höjer were rather sceptical about the application of ICT as a means to decrease the energy usage – at least compared to how ICT is applied in everyday practices today in which ICT tends to increase the energy usage rather than reducing it.

Are the Ideas for the Scenario Old Wine in New Bottles?

The problem statement's wording regards the innovative application of ICT, and as it was the intention, the literature reviews and the focus groups produced a rich foundation of data. As many of the participants were knowledgeable in the field of ICT, it would be expected that they would contribute with innovative and state of the art ideas. It seemed that the ideas were either already developed or too futuristic. For example, a similar multi-modal journey planner aiming at contributing to more sustainable travel patterns is already on the drawing table (CESC, n.d.) and similar systems to HEM are already being tested (Kramers, 2010); for example in Stockholm (Sandström et al., 2003). However, common for the two ideas is that none are implemented to the extent that they have become embedded features of the everyday life of a vast majority of citizens. Thus, although it is questionable whether some elements in the scenario are new bottles of old wine, it illustrates how ICT for changing energy usage can become widespread and how people change behaviour. From a perspective of planning, this may be just as crucial to learn as the applicability of each ICT.

A problem for discarding ideas that seemed to futuristic can be that the scenario does not break the trends to the extent which is necessary in order to reach the low energy, low carbon society. Thus, to use the words of Røpke, it is about finding the right balance between applying known and functioning solutions as well as innovative technologies which applicability is still uncertain. This indicates the difficulty of intending to envision a desirable future, when only the present is known.

10.1.2. Internal validity/Credibility/Authenticity

This criterion refers to the truth of the findings and whether there is an internal coherence between the findings derived from the application of different methods. Internal validity can be increased by using methods in a proper way and through cross-checking data through triangulation of methods, sources, researchers and/or theories (Guba, 1981). Furthermore, the scenario's consistency is regarded as a factor for how credible the study is.

The Use of Methods

The three main data sources have been literature reviews, focus group research and semi-structured interviews and their purpose was explicitly justified in chapter 3. The data collected through literature reviews holds a high degree of credibility as the main sources are peer-reviewed articles from scientific journals and published books from academia.

When including people in focus groups and interviews as qualitative data sources, the number and type of respondents can always be questioned. In quantitative studies, the more respondents increased the level of validity, but this may not be the case in qualitative studies. It is always possible to conduct more focus group workshops or interviews, but it is believed that two focus groups and six interviews have been sufficient to reach a level of theoretical saturation. Regarding the type of people, it was in chapter 3 argued that homogeneity of focus groups is important, and it was also stated that this was reached due to the common denominator of knowledge in ICT and planning among the participants. However, it is questionable whether this was the actual situation. A mix of theorists and practitioners participated in both focus groups and they came from various fields. On the one hand, this could have resulted in a situation of a lack of understanding of each others' ideas. On the other hand, it can be argued that a broader spectre of idea emerged because the participants had so various approaches to planning and ICT. It might prove useful to divide practitioners into one focus group and theorists into another to reach a greater level of homogeneity. In general, all the focus group participants as well as the interviewees are considered as experts, and it can therefore be argued that the study is too expert centric. Södermalm citizens could have been included in the investigation as they can be regarded as experts in everyday life. Politicians and decision makers could also have added valuable information as they can be regarded as experts in planning processes. However, given the resources available for this project these two segments of experts were not included. The participants in the focus group research as well as the interviewed experts made statements also as private persons and citizens and some had experience with the planning processes. The data sources of focus group research and interviews were then chosen as being valuable for generating ideas for the scenario and assessment hereof. Thus, only including researchers and practitioners is assessed to not influence the internal validity of the study.

Triangulation

Triangulation of methods was used in the assessment of the scenario, where interviews are used to support literature studies of behavioural aspect and Transition Management. As the interviewees also commented on the scenario, the interviews also supported the focus groups and literature studies ahead of the scenario's creation. In parallel, focus groups and literature studies can be regarded as a way triangulating methods to generate data for the scenario. *Triangulation of sources* has been the aim whenever possible; for example, two different sources were used for the justification of using focus groups, and several sources were used to describe the concept of Transition Management. *Triangulation of researchers* has been used throughout the entire study, as there are two authors whose work was repeatedly commented upon by professors as supervisors. A frequent use of this approach has been in collaboration

to make a draft of notes for each chapter, whereupon one author compiled data for it and started to write. The other author commented upon the text, and the authors often switched working document. The latter was, for example, the case when writing the scenario. *Triangulation of theories* has especially been used in the theoretical chapters, which were applied in the assessment of the scenario. The two chapters and the assessment are readable separately, but they form the foundation for some more general perspectives and discussions on Socio-technical Transitions in chapter 9. Other perspectives could as well have been chosen, but using the concept of Situations of Opportunity as an analytic frame, these two seemed reasonable to explore the process of and mechanisms in Socio-technical Transition.

All four types of triangulation have been fruitful for gaining a richer knowledge but also for cross-checking, and in times of disagreement, for example between interviewees, this has been explicitly stated – also to enhance transparency.

Consistency of Scenario

Recalled from chapter 3, consistency in this study reflects the coherence between the narratives and the integration of Objects of Change and Agents of Change.

The interviewees perceive the coherence between the narratives as good, the time span as well chosen, and the order of the events as reasonably logic. As the interviewees pinpointed very specific issues that seemed unreasonable, these were changed in the first draft of the scenario (see Appendix B1), which is assessed to have increased the consistency. However, several interviewees question that only one scenario was created although they recognise the usefulness of illustrating the Socio-technical Transition from various perspectives.

As there are no empty cells in the columns of Objects and Agents of Change in the table in Appendix IV, the consistency between these is assessed to be good. Even if empty cells appeared as the table was filled out, it indicated that additions should be made in the scenario.

In sum, the numerous use of triangulation, the employment of focus groups and interviewees to supplement and verify/question theoretical knowledge and a good consistency of the scenario have increased the degree of internal validity of this study, which is assessed to be acceptable.

10.1.3. External validity/Transferability/Fittingness

Reflections of generalisations and transferability to other settings across space and time of the study is appropriate as qualitative studies tend to focus on only a snapshot or piece of reality. It is likely, although not given, that findings can be transferred to other settings.

As stated in chapter 1, the scenario should be seen as an illustrative case of how a Socio-technical Transition can emerge and begin to be realised, and in that sense, Södermalm represents an example of a Western society. The Objects of Change in terms

of behaviour change, ICT applications and governance configurations (e.g. a steering group or PPP) are adaptable to other settings as they are neither time nor space dependent. The Agents of Change are locally determined, but if they are seen as representatives of more general actors, it is likely that similar public authorities and private companies can initiate transitions if the will and power is present. As also discussed in chapter 8, some social structures are nearly impossible to influence on a local level of Södermalm, and it can thus be argued that the size of the case is too little as also indicated by Höjer during the interview. On the other hand, using a nation may entail too much of complexity and on the same time lack the detail of everyday practices that the scenario in this study has provided. Further, as an underlying purpose of the study has been to illustrate how planning can contribute to Socio-technical Transition, it is reasonable to use a local context for that purpose.

Another reflection regarding the selection of case, and thus the external validity of the study, is the location of the case. The location of Södermalm does in itself not contribute to a need of reducing travel, and thereby energy, due to the proximity to the inner city and the distribution of public transport – more efficient transport habits from ICT may be more relevant to examine in suburban areas where teleworking may be more relevant. On the other hand, ICT may be not as relevant to study in suburban areas because they tend to be characterised by detached housing and low densification, high automobile ownership and less accessibility to public transport and other urban services such as shopping facilities. In these areas, it would be more fruitful to study other means such as car sharing and improved public transport which is the theme of the Bromma case in SitCit. So, there will always be pros and cons of using a specific area as a case, but as the point is to learn about the process of initiating and realising Socio-technical Transition, the case area's geographical location seems less important.

It is assessed that the findings are transferable to other settings in Western and developed urban areas as most of the objects, measures and actors are not context-dependent.

10.1.4. Objectivity/Confirmability

Researchers of qualitative studies can hardly be totally objective. Due to the authors' interpretation of the vast amount of qualitative data as well as the use of own ideas in the scenario, 100 % objectivity of the study cannot be obtained. On the other hand, as Flyvbjerg (2004) and van der Heijden (1996) advocate for incorporation of personal values in research and personal ideas in Futures Studies, this subjectivity does not directly influence the overall quality of the study negatively. Confirmability or transparency is a better concept to describe whether the derivation of findings is clear and explicit.

Enhancement of objectivity can happen through triangulation of methods, which was addressed under the criteria of internal validity. A method to enhance confirmability is to render considerations and justifications for the chosen research strategy as well as the processing of data visible to the reader in combination about being explicit assumptions and values. This has been secured in chapter 2 and 3 by explicit justifications for the chosen research strategy and methods. Likewise, the processing of data has become

transparent for the reader through 1) the description in chapter 3 of how the scenario was created through processing the compiled data through focus groups and literature, 2) the description in chapter 3 of how the interviews were interpreted and used in the assessment of the scenario, and 3) the attachment of interview and focus group transcriptions, idea bank, and replies to questions regarding interpretation of interviews in appendices. Thus, choices and approaches are presented to the readers, which increase transparency. When the idea bank was created as a step in developing the scenario, the authors may have been unconsciously biased in the screening of ideas from the focus groups. As the authors are not trained in the field of technology, some ideas may have been discarded simply because they from the authors' perspective seemed too futuristic or too business-as-usual. This bias, on the other hand, is arguably minimised through the creation of two separate idea banks before they were compared towards one.

Based on this, it is assessed that a high level of transparency has been obtained in this study.

10.1.5. Utilisation/Application/Action Orientation

A final reflection upon the extent of a study's scientific quality regards the study's utilisation or applicability in practice. Ways to examine this is through evaluations by people who can find the research useful.

As the purpose of this study has been to illustrate a Socio-technical Transition as a scenario, it can be argued that the scenario contains a number of plausible solutions to energy efficient transport habits and ways of managing buildings. However, by assessing the scenario and by presenting it to external researchers and practitioners has been a way to evaluate the utilisation of the solutions. The interviewees pinpointed several aspects which they thought should be changed in the scenario to make it more applicable to reality, and based on these, minor changes happened in the scenario. Only one practitioner was among the six interviewees, and it can then be questioned whether practitioners within the fields of ICT, energy and planning are more knowledgeable of what is realistic than theorists. In this project, it was not possible to interview more practitioners, although attempted with the energy company Fortum, but the intention with all three cases of the overall research project, SitCit, is to present them to practitioners during the autumn 2011 as a way to evaluate the feasibility of the scenarios. A side-effect of this could be that the practitioners become more inclined to use scenarios in general but perhaps to initiate some of the solutions.

Another aspect which relates to the question of utilisation is the problem statements wording of 'how' and the scenario assessment's initiating focus on 'why' to detect the underlying mechanisms influencing on Socio-technical Transition. The assessment of the scenario also highlighted aspects of a Socio-technical Transition which are important to consider if chances for success should be enhanced. As they reflect more general recommendations for incitement of Socio-technical Transitions, these are likely to be applicable elsewhere in Western and developed urban areas than Södermalm.

10.1.6. Summation

This chapter has reflected upon the scientific value of this study as well as some more general consideration regarding Futures Studies and scenario development. It is assessed that this study holds a high degree of scientific value because it is:

- *Reliable* because a congruence between problem statement, research design and finding has been obtained;
- *Credible* because the data compiled through methods comprises what it intended to and because the scenario is assessed to be consistent;
- *Transferable* because the structures and measures on the landscape and niche levels to a large extent are general although the observable events are context-dependent.
- *Transparent* because gathered data is accessible to the reader, prerequisites for the scenario and choices regarding production of knowledge are made explicit; and
- *Action oriented* because it addresses the question of how.

10.2. Reflections on Situations of Opportunity

As one of the founders of the concept of Situations of Opportunity, and the research leader of SitCit, Örjan Svane states that the what-who-iteration, which was one of the tasks in the focus group workshops, also includes the question of 'how'. However, as also observed by the participants, it can be difficult to distinguish between an Object of Change and an Agent of Change, and many of the Objects of Change in the what-who-chains developed in the focus groups reflect a measure rather than an object such as economic incentives (Appendix A1 and A2). An economic incentive can be regarded as a measure, whereas the incentive structure as an Object of Change. The reason for this difficulty may be because the three structures (urban, organisational and social) are so interconnected: for example, behaviour change of citizens is induced by changing the urban structure as a result of plan was adopted and implemented by Agents of Change.

The Objects of Change are regarded to encompass the urban, organisational and social structures, and a change in the organisational structure could be: Ericsson and City of Stockholm (Agents of Change) establish a Public Private Partnership (Object of Change). This example of a what-who-integration is only a statement of fact and it neither reflects *how* nor *why* – unless, however, the Public Private Partnership is regarded as the measure to change the organisational structure. Addressing the question of 'how' would result in a description of the events ahead of the formative moment of establishing the Public Private Partnership such as negotiations and conflicts, and addressing 'why' would result in a description of why the two Agents of Change even decided to join efforts. A what-who-how-why-integration would sound: After a number of meetings where the goals and responsibilities were discussed (how), Ericsson and City of Stockholm (Agents of Change) establish a public private partnership (Object of Change) in order to develop and commercialise a home energy management system (why). The home energy management system could per se be perceived as an Object of Change, but it could as such reflect the reason for changing a prevailing structure. Another example is: The residents' everyday practices are changed – here the practices

are an Object of Change and the residents are regarded as Agents of Change. Again, the integration does not reflect how the change happened and why. A what-who-how-integration would sound: The residents' everyday practices are changed through regulations. Here, regulations reflect the question of how. The example also reflects a change of the organisational structure as passing on a new law is a decision taken by Agents of Change in order to constrain or support behaviour. Because the distinction between especially what, who and how at times seems blurry, a recommendation to the developers of the concept of Situations of Opportunities is to be more explicit about and pay attention to what, who, how and why as all four dimensions contribute to the understanding of how Socio-technical Transition can emerge and succeed. Furthermore, an idea could be to do what-how-who-iteration within the three structures to enhance the integration of objects, measures and agency, and to reduce the difficulty of distinguishing between the notions.

10.2.1. What is a what, who and how?

Embedded in the concept of Situations of Opportunity is the focus on integration of Objects of Change and Agents of Change, and as a consequence, actors were added to the scenario. With regard to Critical Realism, it can be discussed whether there are direct or indirect linkages between the Objects of Change/Agents of Change and Structure/Agency. Ontologically, the notion of 'structure' (which can be regarded to contain similarities to Objects of Change) has been discussed thoroughly in literature on societal sciences, and several definitions have been applied on structures as:

- patterns of aggregate behaviour that are stable over time;
- lawlike regularities that govern the behaviour of social facts;
- rules and resources which are implicated in social practices and have no existence independent of them;
- systems of human relations among social positions (Porpora, 1989; Dobson, 2001).

However, the first definition can be criticised due to its fragmentation that any social action is a structure and due to the fact that only processes of aggregation can be regarded as a structure. The second definition is also questionable due to the reification, for its disconnection from actions and the implicit idea that actors can be governed like naturalistic forces. The third definition is related to Giddens' structuration theory and implies that structures and agency are constrained in an interdependent duality where structures have no reality outside agencies. In the context of the scenario, this would mean that the oil industry and the affiliated automobile regime are reduced to visible patterns that do not have a meaning without human agency. From the example of the oil industry, it can be argued that it entails powers and affect development, values, norms, planning and behaviours indirectly without necessary actions. Instead of the four mentioned definitions of structures Archer (1995, p. 15) as a critical realist argues:

- That structure necessarily pre-dates the action(s) leading to its reproduction or transformation.
- That structural elaboration necessarily postdates the action sequences which gave rise to it.

This implies that human agents through processes either reproduce or transform social structures (Dobson, 2001, p. 207). Where Giddens (1984) suggests that the production of structures cannot be separated from the activity of agency, Archer (1995) argues that agents may have an active or a passive role, and that 'structures cannot be identified except through examinations of their effects' (Archer, 1995 in Dobson, 2001, p. 206).

With regard to the concept of Situations of Opportunity, the notions of Objects of Change and Agents of Change can be discussed with consideration to the interpretation of 'structure' by Critical Realism. From Situations of Opportunity, it can be derived that an object changes due to actions of agents. However, as argued for, objects can also change as a result of passivity by agents – e.g. the passivity of City of Stockholm in order to cope with sustainable Socio-technical Transition can result in increased stability of the prevailing regime while following the current path. Hence, a useful addition to the concept of Situations of Opportunity could be the distinction between Active Agents of Change and Passive Agents of Change.

The 'structure-agency' relations is also an important part of scenarios for Socio-technical Transition as transition of structures is human made but Wangel (2011) has observed that the actor perspective in scenarios has lacked, and that Futures Studies practitioners tend to focus on structures (Objects of Change) and measures (closely related to mechanisms). Also transitions of socio-technical systems have been criticised for neglecting, or at least downplaying, the actor perspective (Smith et al., 2004). Lindén emphasises the importance of this integration but also how the measures support each other. In particular, Lindén stresses that not only the Agents of Change, as understood as the actors who carry out the change, but also the citizens should be paid attention to as their everyday practices are affected by the decisions and can be understood as the ones who practically change the energy usage. Höjer states that the idea of adding actors to scenarios, or at least by giving them a more explicit role, is quite new but important in Futures Studies. However, this also has its implications for pedagogical reasons if it is believed that some actors can be given power. On the other hand, it could prepare the ground for a discussion with the actors of reality, who are written into the imaginary scenario. When everything comes to an end, adding actors seem to be a question of the approach to Futures Studies and whether the researcher are path- or target oriented (Wangel, 2011). This study can be regarded as a contribution to highlighting social structures and agency in scenarios.

10.2.2. Summation

Agency is an important part of a scenario for Socio-technical Transition as a focus primarily on structures, or Objects of Change, neglect the fact that such transitions are human made. Besides suggesting clarity of the four questions, it can be argued that passive agency is able to change objects as agents can transform as well as reproduce structures.

10.3. What is the Usefulness of the Scenario in a Context of Planning?

One of the methodological hallmarks of this study is the application of a scenario for illustrating a desired future image of a sustainable Socio-technical Transition. This final part of the reflections of the findings reflects upon whether scenario building and backcasting are useful in a context of planning and whether the application of the scenario has been a useful approach for this study.

10.3.1. The Purpose of Doing Scenarios for Planning the Future

As stated in chapter 2, much literature advocates for using scenario for describing the future, and this view is supported by the interviewees. However, Lennartsson considers scenarios as good for information purposes and visualisation for laymen and politicians, but not as a planning tool because: ‘...it’s good with visions, and I think it’s good with having someone painting the picture but it’s dangerous if you use that picture as standard for where you want to go’. In addition to this, Höjer states that too much focus on the pathways towards a certain target can result in an incorrect interpretation of them as plan(s). On the other hand, comprehensive plans and detail regulatory plans can be argued to be scenarios for planning purposes as they describe the future urban development and plans are in that sense images of the future, which planners utilise to steer planning decisions towards. This indicates that it is important to be aware of the purpose of doing scenarios and who they are aimed at. In Höjer’s optic, scenarios should contribute to discussions about the future which lay out the foundation for more qualified and sustainable decisions by politicians and practitioners.

In this study, a scenario has been used as a tool to illustrate how a Situation of Opportunity as a part of a Socio-technical Transition can emerge and be realised. It is therefore more path-oriented than target-oriented, although it has been guided by the vision of a low energy, low carbon society. Furthermore, it aims to contribute to an understanding of how planning powerfully can contribute to changing the prevailing structures of society. In that sense, the scenario has been developed for learning purposes rather than contributing to a discussion about the future although this can be a side-effect.

10.3.2. One vs. Several Scenarios

Røpke and Bjerre question the usefulness of only presenting one scenario as it reduces the possibility to compare and thus discuss or at least highlight that different development paths are identifiable. Planning practice in City of Stockholm and especially in the development of the major project in Norra Djurgårdsstaden is to apply system’s analysis to choose between different solutions for the same system and here environmental issues are emphasised more than economic aspects although it should be ‘cost-efficient-environmental-investments’, as Lennartsson puts it. One justification for developing several scenarios could be that it can provide the foundation for choosing the solution with the best environmental outcomes as a sort of cost-benefit-analysis. Furthermore, more alternatives could contribute to highlight uncertainties. The arguments presented here are very similar to the ones for explorative scenarios as described in chapter 2. Opposed to Røpke, Bjerre and indirectly also Lennartsson is Höjer – especially when it comes to

comparing several backcasting scenarios. Höjer argues that there tend to be only minor internal differences between them and that the real alternatives usually are to forecasts because backcasting scenarios focus on trend breaks and not extrapolation of past and present trends. It seems that the decision of doing one or several scenarios depend, again, on the purpose of doing scenarios. As the purpose of the scenario in this study has been to illustrate how a Socio-technical Transition can happen for learning purposes, it seems reasonable to only have made one scenario. This was developed based on the prerequisites and assumptions outlined in chapter 6, and if it had been chosen to develop more scenarios, these presented parameters could differ in each scenario.

Related to the specific scenario, several interviewees asked what the purpose of doing the scenario is. This may be because the interviewees only reviewed the scenario itself and the study's abstract. Although preferable, it would be too time-consuming for the interviewees to read not only the scenario but also especially the introduction to the study and the chapter presenting the scenario settings and factors. Based on the request of the interviewees the purpose of doing a scenario has been made more explicit in the introduction in the scenario and to the study.

10.3.3. Presenting Scenarios as Narratives

Related to the usefulness of scenarios is the method of illustrating the future as narratives. Justification for doing this was provided in chapter 3 and the interviewees highlighted additional advantages. Høyer has great sympathy of using narratives, Lindén was surprised how easy it became to pinpoint issues related to behaviour change and Bjerre states that it is good although it misses some more relation to the overall societal changes. Hence, narratives may be more relevant for illustrating local transition due to the degree of detail that it tends to enhance, whereas a scenario for a greater geographical area may only be able to contain the overall aspects of transition in order to reduce the degree of complexity which may be hard to comprehend for the uninitiated of planning, societal forces, and technologies. As also observed by Lewakowski et al. (2010) and Bang et al. (2010), narratives seem to be of value for creating a more vivid representation of the future which forces the integration of Agents of Change as characters in the transition. Narratives become very persuasive in illustrating the future as the reality; one which may be easier to comprehend for the ordinary citizens. This is supported by Throgmorton (1996, p. 46), who considers 'planners as future-oriented storytellers'. The underlying structures and mechanisms become evident through the narratives, which have the ability of presenting the features around the identifiable structures and mechanisms. Rather than schemes, tables and numbers narratives present a 'whole' story. However, as the narratives have the strength of pinpointing critical aspects, they should preferably be connected to theories and assessments in order to enhance the theoretical quality. It can be assessed that using narratives for illustrating a Socio-technical Transition is a powerful tool that can be used in Futures Studies and arguably also more in a context of planning. Further, it makes sense to use a local level as the geographical scale of the scenario to keep the complexity of planning on a level which is comprehensible.

However, Lindén called for even more narratives in order to bring in other societal groups such as elderly or singles, and Høyer called for a thematisation of rebound effects. Hence, an idea for other scenarios illustrating Socio-technical Transition could be a stronger focus on different societal groups' 'struggle' with ICT and everyday practices and less focus on the governance process. This would equally contribute to an understanding about how decisions taken by Agents of Change affect the everyday life of the citizens. On the other hand the scenario could illustrate the 'inside' process of Socio-technical Transition by taking a deeper step into the structures and mechanisms of the meta-governors' decision-, strategical- and tactical levels. Another idea could be to illustrate a Socio-technical Transition from the three perspectives of energy efficiency, substitution and reduction and how rebound effect related to each strategy could be combated through the introduction of different measures. Arguably, this would decrease the possibility that a scenario becomes an extension of current trends and hence a business-as-usual scenario. This can question whether the scenario developed in this is a business-as-usual scenario as also discussed in the previous section. At first sight, the scenario illustrates a reality which is different from today and which is intended to have changed the energy usage, preferably reduced it. However, a qualitative assessment cannot fully conclude whether this is the case, and quantitative modelling of the scenario would therefore be preferable as complementary as it was concluded in the first part of this chapter. Yet still uncertain, this has been the intention to complete in SitCit.

10.3.4. Learning from a Fictitious Case

Usually, the case study method is applied to examine 'a contemporary phenomenon in its real life context' (Yin, 1981, p. 104). A problem of studying a fictitious case of a Socio-technical Transition is that 'real life' does not exist, and there can be multiple futures. There might be a conflict in exploring how Socio-technical Transition as a Situation of Opportunity can emerge and be realised when the scenario is a construct. Although conflicts may be disturbing, everything becomes possible in a scenario, because possible conflicts and problems seem so easily to be overcome by the Agents of Change. Thus, it can be argued that it is not possible to learn from something not real. Furthermore, as the Socio-technical Transition in the scenario is initiated due to a number of external factors, it is even questionable whether it is possible to learn how Situations of Opportunity can emerge – they result as changes in the landscape and niche levels. On the other hand, the case clearly shows that the Situation of Opportunity is a period of time in which inertia against change is low, and that planning is able to pursue sustainable development. This requires that Agents of Change join efforts, are willing to take decisions about radical changes and that the end users are also jumping on the bandwagon. So when critics point out that it is too late to change the path of development this scenario, as well as many others, demonstrate that it is not.

10.3.5. Summation

Returning to the initiating question of the usefulness of scenarios in the context of planning, it can be stated that scenarios can work as an eye opener for planners and decision makers although they should not be regarded as fully functional strategies or schemes for development. Utilising one normative explorative backcasting scenario

as an alternative to the forecasting scenarios can pave the ground for discussions on underlying structures and mechanisms. Used carefully, scenarios and planning can become persuasive storytelling that can enable a discussion about how the future should be and not only how it could or would be. Finally, the usefulness of scenario development in the context of planning is related to the learning perspective as scenarios can visualise other futures than the conventional ones and it can be learned that the future is unstable and can be directed in desired directions.

10.4. Summary

This chapter has reflected upon the scientific value of this study as well as some more general consideration regarding Situations of Opportunity and scenario development. It is assessed that this study holds a high degree of scientific value because it is:

- *Reliable* as it holds congruence between problem statement, research design and findings;
- *Credible* as the compiled data comprises the intentions and as the scenario is consistent;
- *Transferable* as the structures and measures on the landscape and niche levels are general;
- *Transparent* as gathered data is accessible to the reader, and the scenario settings are explicit;
- *Action oriented* because it addresses the question of 'how'.

Because all four questions contained in the explorative concept of Situations of Opportunity (what, who, how and why) are applicable for analysing Socio-technical Transitions, it makes sense to study Socio-technical Transitions as Situations of Opportunity. Besides suggesting clarity of the four questions, it can be argued that passive agency is able to change objects as agents can transform as well as reproduce structures. Finally, it can be concluded that scenarios can work as an eye opener for planners and decision makers although they should not be regarded as fully functional strategies or schemes for development. Scenarios can become persuasive storytelling that can enable a discussion about a desirable future and related to the learning perspective, as scenarios can visualise other futures than the conventional ones, and it can be learned that the future is changeable and manageable.

11. Conclusion

This study took a point of departure in asserting that current trends in energy usage are unsustainable, are entailing problems such as depletion of fossil fuels and are causing dangerous climate changes if the trends continue. It is recognised that technology plays an important role for contributing to breaking the trends; nevertheless, a change of social structures is likely to be just as necessary. Hence, one solution is a Socio-technical Transition towards a sustainable low energy, low carbon society. If studied as a Situation of Opportunity in a scenario, it can be illustrated how such a transition can be realisable.

Therefore, this study has had the two overarching aims of exploring 1) how a Socio-technical Transition towards a low energy, low carbon society can emerge and be realised within the time span of 20 years, and 2) how scenario building and backcasting can illustrate a Socio-technical Transition in a context of planning. These two questions are being addressed after a summary of the study is presented.

11.1. Summary

Based on the ideas of the meta-methodological approaches of Futures Studies and Critical Realism, the research strategy of this study has been a process of scenario building normatively guided by values of sustainable development and an optic of considering ICT as a Seed for Transition as counter-factual to today's society. The Socio-technical Transition illustrated in the scenario is studied as a Situation of Opportunity whereby this concept constitutes the analytical framework in this study. Theoretical and empirical evidence for constructing and assessing the scenario has been compiled through literature reviews as well as two focus groups and six semi-structured interviews. Based on the compiled knowledge, the scenario and the subsequent analyses, assessments, discussions and reflections, new knowledge is produced through abduction and retrodution about how and when Situations of Opportunities can emerge, how they can be harnessed and how the barriers for Socio-technical Transition can be coped with. The process of the scenario building has been divided into five parts in the study:

The Introductory Part elaborated the initial problems and outlined the research strategy, and it had the purpose of identifying the aim, goal and function of the scenario. The aim has been to study how Socio-technical Transition can be illustrated as a Situation of Opportunity in a scenario. The overarching goal is to illustrate a Socio-technical Transition that contributes to a low energy, low carbon society. The function of the scenario in this study is to generate alternative inputs to how a more sustainable future in Södermalm can be developed and to give inputs to assessments and discussions of how the barriers towards Socio-technical Transition can be coped with.

The Theoretical Part elaborated the two perspectives of this study; governance by and behaviour change of Agents of Change have been regarded as necessary Objects of Change during and for transition. These two perspectives have guided analyses of the organisational and social structures within the concept of Situations of Opportunity. Besides creating a foundation of knowledge to be used in the construction of the scenario, this part pinpointed important elements for Agents of Change to consider in realising Socio-technical Transition.

The Scenario Development Part outlined factors for Socio-technical Transition as a preliminary analysis of how the Socio-technical Transition illustrated as a Situation of Opportunity in the scenario can emerge and be managed. Furthermore, through elements of scenario building and backcasting, a scenario was created based on data compiled through literature reviews and focus group research. The scenario was presented as a supplement to a fictitious newspaper issued in 2030, which contains articles looking back on how the Socio-technical Transition was initiated and carried out. The articles present four narratives, which illustrate how the innovative application of ICT could contribute to more energy efficient transport habits and facilitate more sustainable ways of managing and using buildings in Södermalm.

The Assessing Part has analysed, assessed and discussed the scenario in terms of governance and behaviour change and more overarching issues such as the degree of sustainability in the scenario and possible rebound effects of the envisioned transition. Furthermore, this part assessed the scientific value and quality of the study based on five criteria. This part can be regarded as an evaluation of the scenario based on authors' reflections, six expert interviews, and knowledge obtained through literature reviews.

Finally, *the Concluding Part* summarises the findings from the other parts and they are through an outlook placed into broader perspectives of how to reach the low energy, low carbon society two generations hence.

In chapter 10, it was assessed that this research strategy has been appropriate for obtaining a high degree of scientific value of the study.

11.2. Conclusion

This section concludes on the two objectives for this study.

Socio-technical Transition Towards a Low Energy, Low Carbon Society 20 Years hence

From theory, it has been found that Socio-technical Transition can occur when niche-developments destabilise the prevailing regime and when landscape changes affect the mentality of citizens as well as the national and municipal decision makers. To transform the existing socio-technical system towards long-term societal changes requires steering and management by Agents of Change of organisational and social structures, and the process should be reflexive, learning and experimenting and adjusted accordingly. As Objects of Change, the organisational settings such as partnerships, interests, roles and power can create opportunities where timing, trust and mutual dependency must be considered carefully.

Derived from the idea that behaviour change as a part of Socio-technical Transition is required to achieve a low energy, low carbon society, it has been found that beliefs, attitudes, norms as well as perceived and actual control determine individuals' intentions of performing a behaviour. As these can be regarded as Objects of Change, they can be influenced by Agents of Change through ICT and public intervention in terms of

regulations and legislation, economic means (incentives and disincentives) and information, including persuasion. These policy instruments can enable or constrain a particular behaviour from being performed. In order to attain Socio-technical Transition, the current regime should be destabilised through changes at the landscape and the niche levels. Changing the current regime requires that Agents of Change organise as counter-movements to the prevailing structures and create an incentive structure as a new stable context which rewards environmentally friendly behaviour and enables new habits to flourish and that this structure influences different societal groups.

The scenario illustrates how the prevailing structures can be changed due to new organisational constellations such as the Strategic Office, appointment of a steering group, establishment of a Public Private Partnership and a number of less formal arrangements as collaborations between Agents of Change. More influential is, however, the decisions taken and policy instruments applied by the actors as top-down initiatives to induce a change of behaviour of the citizens and for getting ICT widespread. Both government and governance are important for success with Socio-technical Transition. Furthermore, it can be derived that the scenario is reasonable and consistent in presenting changes of the organisational structure which are needed to make the proposed measures happen, citizens' behaviour and its determinants as Objects of Change, and interventions along with Agents of Change. Simplified, this entails that the Situation of Opportunity is realised as a result of changes in the organisational and social structures.

Analyses and assessments of the scenario have revealed that the Situation of Opportunity in the scenario can be characterised as a Socio-technical Transition because the current socio-technical regime is being destabilised as a result of landscape pressures characterised as external factors such as increasing energy prices and climate changes. Furthermore, because technological niches such as HEM are breaking through to the mainstream market as a result of new organisational constellations and the use of policy instruments by these Agents of Change. The analyses and assessments further revealed that the increased prevalence of ICT along with changes of the social structures such as norms, attitudes, beliefs and incentive structure have resulted in a behaviour change of the citizens in Södermalm. Thus, both the 'social' and 'technical' parts of Socio-technical Transition have been achieved.

However, as also discussed in chapter 9, it is questionable whether the illustrated Socio-technical Transition within the time span of 20 years contributes to achieving the low energy, low carbon society two generations hence. On the one hand, the technological development and the changes of the organisational and social structures result in changes of the current socio-technical regime due to new organisational constellations and new ways of behaving. On the other hand, the Socio-technical Transition is to a large extent a continuation of the prevailing societal structures and not a radical break of trends, which is necessary in order to achieve sustainable development. Indeed, ICT has the potential to contribute to all the strategies of efficiency, substitution and reduction, but today as well as in the scenario, ICT is mainly contributing to the two former strategies.

Concluding, this entails that for Situations of Opportunity as part of Socio-technical Transitions to emerge and be realised, it requires that Agents of Change take advantages of the emerging chances for change, join effort, follow a shared vision, promote environmentalism, are aware of 'which buttons of human behaviour to turn' by applying policy instruments and through encouraging technological development, have the city district announced an environmentally profiled, and build trust to the end users. Furthermore, test beds seem suitable as incubation rooms for allowing niches to break through the mainstream market.

Conductors of real Socio-technical Transitions must be aware about gaining citizens' trust, engaging several actors in the process in order to ease the implementation as well as about power and interests, which can be reflected through movements working either for or against the transition. Furthermore, they cannot hesitate to steer and manage transition in which unpopular decisions are taken in the quest for extensive changes if a more sustainable future should be reached. Regarding inducing behaviour change, conductors of transition must acknowledge that citizens' intensions are determined by different underlying factors and contexts and for these reasons must be affected differently.

Socio-technical Transition as a Scenario in a Context of Planning

Based on analyses of the organisational and social structures in the scenario, it is concluded that Transition Management and behaviour change are suitable as theoretical perspectives for identifying and examining these structures in terms of underlying determinants and mechanisms of change. Thereby, the two perspectives seem applicable in the concept of Situations of Opportunity as expansion of hitherto developments of the analytical framework for analysing urban planning processes.

The approach of addressing the questions of what, who, how and when as contained in the concept of Situations of Opportunity seems suitable for analysing also future planning processes because it forces the researcher to distinguish more carefully between the aspects. However, this distinction is difficult to obtain as the questions are so integrated.

From the reflections regarding the usefulness of scenarios in a context of planning, it was derived that scenarios can work as an eye opener for planners and decision makers although they should not be regarded as fully functional strategies or schemes for development. Utilising one normative backcasting scenario as an alternative to the forecasting scenarios can pave the ground for discussions on underlying structures and mechanisms. Used carefully, scenarios and planning can become persuasive storytelling that can enable a discussion about how the future should be and not only how it could or would be. Finally, the usefulness of scenario development in the context of planning is related to the learning perspective as scenarios can visualise other futures than the conventional ones, and it can be learned that the future is unstable and can be directed in desired directions.

12. Outlook and Perspectives

Having completed, analysed and assessed a scenario illustrating how the innovative application of ICT can contribute to a sustainable energy usage, this final chapter of the concluding part reviews the study in a wider perspective and identifies critical topics for further research. Furthermore, the next phase of Socio-technical Transition will be elaborated with regard to years after 2030. As such, this final chapter will elaborate on how other Seeds for Transition than ICT or supplementing ICT can contribute to achieving a low energy, low carbon society.

12.1. Socio-technical Transition in a Wider Perspective

This study has examined Socio-technical Transition at the local level of Södermalm, but a number of limitations occur, when focussing on the local level of a society. With regard to changes in the organisational and social structures, many policy instruments do not apply only at Södermalm. New taxation structures, the discourse in media, implementation of Smart Grid and standardisation of ICT are just a few developments which must take place at a broader level. Södermalm is arguably a well-chosen test bed for implementing niche-level technologies but for Socio-technical Transition to emerge at a larger scale, the national, or perhaps even international, level must be studied. Especially in rapidly developing countries such as Brazil, Russia, India and China (BRIC countries) could it be useful to initiate Socio-technical Transition towards a low energy, low carbon society, as these countries' energy usage has increased remarkably the past decades and are expected to continue along with economic development (Pao & Tsai, 2010).

During the Situation of Opportunity, as part of Socio-technical Transition, the meta-governors and other Agents of Change could preferably strive for handling the question of how the experiences learned from the Södermalm case could be transformed to other city districts, or even whole city regions, across Scandinavia or other Western societies.

Handling Socio-technical Transition on a societal scale could give rise for the decision makers to think and act in radically new ways. Hence, the backcasting methodology could be utilised in a slightly other way than in this study, namely as providing images of the future as presentations for debate with decision makers and the public at large. This could, for example, be done by trying to raise debates at public meetings, or by persuading some journalist to present the scenario (or different scenarios) as a feature article in a real-life newspaper now in 2011 (and not only as a fictitious newspaper supplement in 2030).

12.2. Aspects for Further Research

In order to operationalise and transform the findings of this study, further research could shed light on how the scenario in this study can be utilised in the decision making process towards Socio-technical Transition into the context of 'real world planning'. This study could be presented for the decision makers and discussed in terms of how it can be utilised in a real planning context.

With regard to especially the social structure, planning for implementing ICT as means for behaviour change can learn from the fields of marketing research which possesses great knowledge on how to create 'necessities' for owning a specific product. The appliances for the home energy management system, as well as the system in itself, is not already built in into the existing building mass in Södermalm, yet it has to be brought there.

A field of research which could give further knowledge to the actual process of Socio-technical Transition is action research, where the researcher turns into an Agent of Change by being involved in the very planning process. Several interesting areas could be further investigated this way, and the researcher could preferably examine the strategic and the tactical fields in the process of Transition Management. Such studies could provide insight of how the processes really happen, how negotiations are made, how power works and how the organisational and social structures are changed intentionally. Thereby, the questions in the concept of Situations of Opportunity combined with the purposes of backcasting could be merged with the key questions of action research or phronetic planning research according to Flyvbjerg (2004, p. 290):

1. Where are we going with planning?
2. Who gains and who loses, and by which mechanisms of power?
3. Is this development desirable?
4. What, if anything, should we do about it?

This study has focussed on ICT's contributing to a low energy, low carbon society as one case among others in a large research project. The two other cases focus on the increased use of car sharing and public transport and large scale refurbishment of poorly built houses, respectively. Yet other means could be consumption of energy and resources connected to food or how changes in the urban structures can contribute to sustainability

12.3. The Next Phases of the Socio-technical Transition

With the implementation of the means presented in this study, the socio-technical regime is arguably becoming increasingly destabilised. This can pave the ground for further and even more radical means (at least seen from a 2010 perspective). A very close coupling of the monetary system with the ecological system of resources could be a topic for debate in 2030, and here ICT can play a major role for establishing the connections and communications.

Another feature can draw on the experiences with the Smart Grid, which is focussed on 'prosumers' of electricity. This system could be extended with a Smart Heating Grid, where heating and cooling are distributed automatically and efficiently. Smart appliances for the home energy management system could be developed to deal with electricity, heating and cooling.

Continuing the thought experiments of the Socio-technical Transition after 2030 could encompass the public transport system. Intelligent driverless mini-busses can be imagined to pick passengers up at their specific locations, which are communicated through

GPS and ICT. Telecommunication could be in the next phase where 3D projections of persons could meet in virtual rooms. New ethical issues will most likely rise, such as legal issues of 'avatars in second life', and the disability to simply turn off the digital life.

12.4. Other Seeds than ICT

Not only ICT or technological development has the potential for contributing to the achievement of a low energy, low carbon society. The two other cases in SitCit concern refurbishment as well as the introduction of car sharing and improved public transport, and it is likely that these two seeds have at least as large a potential for contributing to a sustainable energy usage as ICT. Other seeds within transport could be a more energy efficient system of transportation of goods, or a seed for a (radical) future without any leisure flight journeys. Also regarding transportation on a more daily basis, a seed could be the counter-factual assumption that the construction of transport infrastructure facilitating continuous growth in unsustainable modes of transport could be changed or even stopped. In addition, it could be explored how new housing and workplaces could be developed in ways that minimise encroachments on natural areas or farmland and high car dependency.

Also other realms than housing and transportation are imaginable as Seeds for Transition; for example, in the food supply system. Wallgren (2008) has calculated that a 60 % reduction of energy in the food supply system, which includes processing, is possible although stressing that a 'local food supply is not a very powerful solution to reduce energy use in today's food supply system' (Wallgren 2008, p. 34). This is mainly because small-scale and local transportation is less efficient compared to large-scale, global transportation. Related to the food supply system is the question of the type of food. Because the production of meat needs more arable land than the production of vegetables, energy usage and CO₂ emissions can be reduced from shifting to a food supply system based on crops. Also because the world population increases every year, which requires more arable land for food production, there is a good reason for changing the ways of eating. Other Seeds for Transition can be found in the study by Gullberg et al., 2007 in which the images of the future could act as counter-factual questions for transition.

Appendix I

The Philosophy of Science and Critical Realism

A crucial point of departure for understanding the interplay between the utilised theories, the empirical data and futures studies of the sustainable Socio-technical Transition as an overall strategy, is the reflective activity of philosophy of social science. In general, this is concerned with 'the principles regulating the search for and acquisition of knowledge about reality through a series of intersubjectively accessible and justifiable methodological steps' (Delanty & Strydom, 2003, p. 3). The importance of transparency is regarded by several authors and researchers of futures studies as a key issue in scenario development (Börjeson et al., 2006; van Notten, 2003; Bishop, 2006). Hence, a historic overview of the development of philosophy of social science is provided which is followed by a presentation of Critical Realism as the philosophy of science of this study.

Development of Philosophy of Social Science

In order to understand and argue for how critical realism can be regarded as a golden mean, especially between the empirical analytical approach and the social constructivist approach, a brief historic development of philosophy of social science of Futures Studies is introduced through main philosophical characters, see figure 1. Many philosophers have contributed to the development of the philosophy of social science and the list is not fully exhaustive. The choice of the selected philosophers stems from an attempt to clarify the development in the philosophy of science of Futures Studies as they are regarded to be main determinants of this development.

Auguste Comte (1798-1857) is regarded as the first philosopher of science of modern times and he described the 'scientific method' as uniting all sciences into the same logic of inquiry, where the aim is to explain, predict and describe causal mechanism as ever-valid and perfect laws. As founder of positivism, he stated that research can only be proved through quantitative means and logic conclusions, it should be testable, it

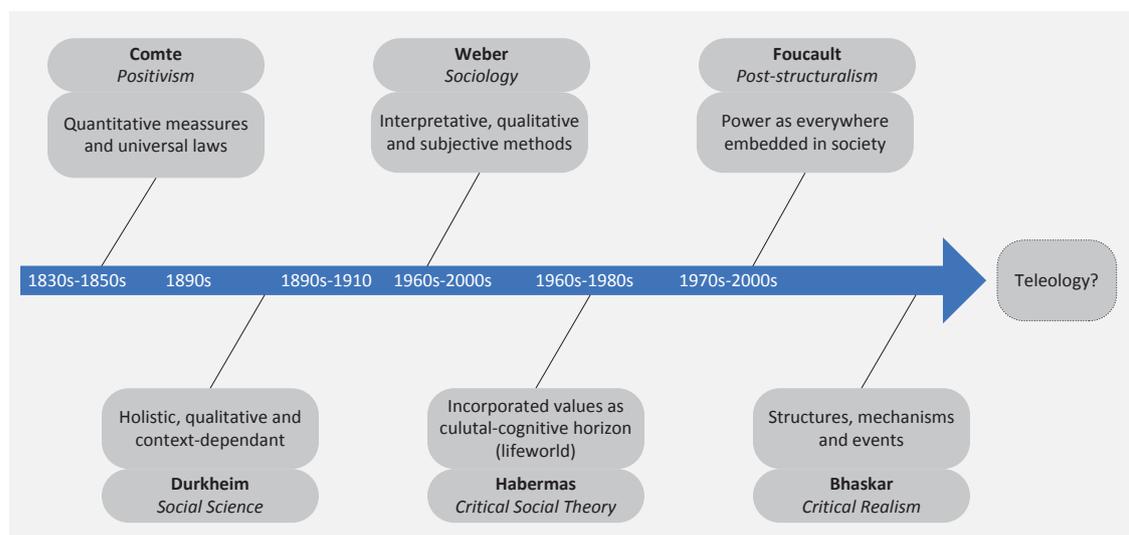


Figure 1: A development of a philosophy of science of Futures Studies

should be value-free and finally it should be context-independent (Comte & Lenzer, 2009). The separation of social science from natural science has since been a key issue of philosophers of science. The critique of positivism as a philosophy of science of futures studies and transformation management is the point of departure in this historical overview. When applying positivism to futures studies extrapolations, predictions and precise calculation of the future are made. As these take a point of departure in current trends this deterministic approach can hardly contribute to the transition of the socio-technical system but instead constrain the future to the current tendencies.

Émile Durkheim (1859-1917) reformulated Comte's sociological positivism and together with Karl Marx and Max Weber, he laid the foundation of modern social science (Stanford Encyclopaedia of Philosophy, 2007). Durkheim regarded sociology as the science of institutions, social facts and cultures, and opposite positivism, social science should be holistic and focussed on society as a whole rather than on individual events. As it will be further analysed later in this appendix, the holistic approach is regarded as an important and dominant mindset of futures studies. The focus on subjects, institutions and socio-cognitive elements rather than physical observable objects marked a shift in the philosophy of science of futures studies although the methods were still mainly quantitative. Instead of universal laws, Durkheim proposed a view that sociology should aim to discover the inherent natures of society itself and takes a closer step to the critical realist approach of studying the underlying mechanisms for empirical events (Durkheim, 1892).

Max Weber (1864-1920) played a central role for continuing the process of separating natural science from social science and together with Georg Simmel, he presented sociology as a qualitative field, which should study and interpret the meaning of social actions and thereby give causal explanations (Weber, 1991). The transition process analysed in this study is initiated, carried out, ruled and employed by individuals and organisations, hence it is a vital perspective to analyse what triggers behavioural change. Weber worked with the theory of 'verstehen' (interpretative sociology) and of 'antipositivism' (rejection of empiricism) and called for interpretative, qualitative and subjective research methods (Hayes, 2000), and especially subjectively and normatively approaches to science has remained central points in the discussion of philosophies of science.

Jürgen Habermas (1929-) followed Weber's approach while criticising Gadamer's and Heidegger's 'hermeneutic circle', where interpretations of texts reveal the context in which they are written, hence, it is impossible to step outside one's own traditions (Habermas, 2005). Habermas' critique is that such an approach undermines the options for social criticism and transformation, and calls for a critical social theory. Especially the transformation process is a focal point in this study and one of the aims is to break to the 'hermeneutic circle', while creating an alternative image of the future. If every interpretation of the future is based upon present trends, the future will then only be an extrapolation of present unsustainable trends projected on the future. Furthermore, Habermas incorporated Husserl's term 'lifeworld' in critical theory – understood as the competences, practices, and attitudes which are embedded in one's cultural-cognitive

horizon (Honneth, 2005) and together with chapter 2, this appendix presents the authors' normative values in order to clarify them and make the study transparent.

Michel Foucault (1926-1984) has had large influence on post-modernistic and especially on post-structural writings and focused on critical studies of social institutions while adopting Nietzsche's 'genealogical approach' to study details in a meticulous way (Foucault, 1971; Delanty & Strydom, 2003). The ultimate interpretation within this tradition is found in the deconstructive project, of which Derrida was part. Claims are made that all interpretations of texts are evenly valid and can be regarded as relativistic or nihilistic, and finally as undermining the attempt of reaching knowledge (Wolin, 1991) which is no point of this study. However, Foucault's discussions of power and discourse can with good reasons be included in this study of the transformation process where power structures are sought uncovered and analysed. The power structures of agents and objects on which the future is based will be a central issue in this study.

Roy Bhaskar (1944-) is one of the key pioneers within critical realism and claims that reality exists outside, before and independent of the observer. Furthermore, he states that the most important elements in reality neither can be observed nor can they be constituted as mental constructions (Danermark et al., 2002). As the aim with this study is to analyse the pathways leading to the sustainable future of Södermalm, critical realism is applied as a focal philosophy of science. The amalgamation of this so-called 'transcendental realism' with 'critical naturalism' can be described as a unity between social and natural science (Hansen & Simonsen, 2004, p. 130). The purpose of critical realism is to uncover the hidden causes of experienced actions, called 'independent causal mechanisms', and not only to generalise a range of single observable events (Danermark et al., 2002). Critical realism can be said to maintain objectivity while incorporating a critical interpretation of objectifying social structures. In this way critical realism insists on human actions as determining for retention and transformation of social structures (Frauley, 2004), which fits well with the intention to uncover how the change towards sustainability with ICT as a motor can happen

Teleology is 'an approach that states that human behaviour is explained by causal or functional relations as well as desires and beliefs, and therefore is purpose-oriented' (Dreborg, 1996 in Shiftan, Kaplan & Hakkert, 2003). The purposes, motivations and initiating mechanisms must be clarified, analysed and understood thoroughly in order to study where the change process can be initiated and the mindset of teleology can be argued to fit well with critical realism as a philosophy of science of futures studies. Whether the introduction of teleology to futures studies is the next step towards a philosophy of science of future studies is difficult to determine, but the teleological question of 'purpose' is might prove to be of interest in futures studies research.

The development of a philosophy of social science has been ongoing for centuries and the academic debate on the subject will most likely continue. The development towards critical realism has been a long journey but in order to further specify the philosophy of science approach in this study, a focus towards a philosophy of futures studies can be made.

Critical Realism

Critical realism concerns the approach to philosophy of science in this study and can serve as a nexus for studying the transformation process of a complex socio-technical system as ICT, behavioural changes and sustainability.

A point of departure of Critical Realism is the critique of positivism as a philosophy of social science, since it is regarded to be inadequate to only measure the effects in an open socio-technical system through quantitative means (Danermark et al., 2002; Groff, 2004). A study of organisational and behavioural changes and ICT's contribution to energy- and CO₂ reductions can hardly be argued to be a closed system where linear relations between variables exists and pure and true predictions can be made through mathematical and physical calculations. It is dynamic, there are several intertwining mechanisms and it is a complex system based on human interactions which cannot be completely predicted. Instead of trying to conduct the impossible positivistic task of creating universal models and complete predictions in complex and open socio-technical systems, a Critical Realist approach to quantitative studies is instead to focus on tendencies and propensities and to build scenarios (Patomäki, 2006, p. 2.) In this study a scenario consisting of four narratives is constructed, which reflects four different perspectives on the Socio-technical Transition. Forecasting can contribute to Futures Studies by analysing the current trends for energy consumption and CO₂ emissions which, with the word of Höjer (2000), function as 'ringing alarm clocks'. When calculating the potential for ICT of reducing energy usage and CO₂ emissions from transport and housing, quantitative analyses and mathematical calculations must be conducted. Although this task is outside the scope of this qualitative project the quantitative analyses will most likely be the focal point for another study within the Sit Cit project. However, it is important to clarify, analyse and argue for the various assumptions and prerequisites made beforehand of the scenario construction, which is done in chapter 6.

Critical Realism as a Golden Mean

The social constructivist approach appraises the ontology of a world consisting of social constructs and doubts that there exists a reality outside social human made constructs (Ackroyd & Fleetwood, 2000). This ontological pitfall of reducing reality to be completely consisting of social constructs is not very appropriate when studying a socio-technical system as ICT's influence on sustainable urban development. On the other hand, physical evidences like greenhouse gases, the technical aspects of ICT and the built environment can hardly be recognised as completely existing of social constructs. But, as Sayer (2000) argues, there is always an element of interpreting phenomena within social sciences, especially when studying the underlying social mechanisms and structures of the given physical evidences. Elucidating on the driving forces causing the negative events, such as increased emissions of greenhouse gases and dependency on fossil fuels, is important for knowing how behavioural aspects like habits, interactive aspects like networks and discourses and socio-cognitive aspects like culture and values can change. As Outhwaite (1996) argues, we need a 'critical hermeneutic' which combines the strength of historically opposite philosophies of science, and indirectly calls for a Critical Realistic approach to study the complexity of a transforming society. The study of underlying structures of socio-technical transition and behaviour changes

calls for analyses of various power relations and human interactions, which are hallmarks for the post-structural philosophy of science. The pitfall of post-structuralism, however, lies in the danger of nihilism by seeing all normative approaches as evenly appropriate and that 'anything goes'. As Groff (2004, p. 3) puts it: 'What is the point of attempts to persuade through argumentation, if all claims about the world are by definition equally valid?' However, when dealing with sustainability matters in order to develop a better world for present and future generations it is acknowledged that a normative approach towards sustainability is acceptable striving for. Within Critical Realism it is recognised that knowledge and theories are fallible and always can be improved (Sayer, 2000), and Critical Realism, among other facets of reality, recognises power as an important aspect for studying underlying mechanisms. Normative and subjective approaches are hallmarks for post-modernism and post-structuralism (Allmendinger, 2002), and it is argued that research based on ethical, moral and responsible values, which are included in the term 'sustainability', is crucial for futures research. However, it must be avoided to accept every interpretation as equally desirable since people, businesses and organisations might have vested interests in a future which is dependent on fossil fuels. To study and analyse power relations and human values is mainly developed within the tradition of post-structuralism. Analyses of power, interests, relations and human values are adopted in this study, while keeping the critical positioning towards the 'everything goes' principle in mind.

Epistemology and Ontology of Critical Realism and Futures Studies
Philosophy of science can be said to address the themes of epistemology (how creation of knowledge is interpreted) and ontology (how the reality is perceived). The historic development of philosophy of social science has shown a development in the focus on either epistemology or ontology. The positivistic approach focuses mainly on a reduction of ontology to epistemology as reality is considered to only consist of the aspects of the measurable world (Benton & Craib, 2001). The social constructivist and post-structuralist approaches regard interpretations as more important than a reality which is regarded as non-existent outside the discursive interpretations. A Critical Realist's ontology for Futures Studies would accept multiple possible futures and be concerned with envisaging better possible futures (Patomäki, 2006, p. 11).

Following one of the founding fathers of Critical Realism, Roy Bhaskar, a shift from focussing mainly on epistemology to a focus more directed towards ontology is needed, and within ontology, a shift from focussing on events to focussing on underlying mechanisms (Danermark et al., 2002; Bhaskar in Archer et al., 1998). There are unobservable mechanisms which cause the observable events; as such, the social world can be understood only if people understand the structures that generate such mechanisms. In terms of the Socio-technical Transition in this study, the effects can be regarded as e.g. increased emissions of greenhouse gases, increased amount of resources consumed and continuous technological development. It is the underlying mechanisms of these events which are sought to be uncovered and eventually the structures behind the causal mechanisms are identified. However, in order to change the events, the mechanisms must change and in order to change the mechanisms, the structures must be changed.

According to the critical realists, the reality can be regarded as consisting of three spheres:

- The Real,
- The Actual, and
- The Empirical (Bhaskar, 1975; Sayer, 2000; Jessop; 2006).

The first level, the empirical, consists of the aforementioned observable or measurable events. The next level, the actual, is where the events are happening when societal powers are activated and they can be recorded from various real tendencies and countertendencies. The highest level, the real, consists of generative social structures, powers or causal mechanisms. Danermark et al. (1997, p. 67) argues that higher levels encompass more mechanisms than lower levels. Applied to the field of Futures Studies, it must be understood how the underlying structures, like the organisational structures and the social structures can influence both the actions of the actors of change and the effects of the change itself.

Danermark et al. (1997) are also arguing that the point of departure in Critical Realism is that there exists a reality independent of our knowledge about it and that this reality is not immediately empirically accessible. This reality does not consist of a directly visible and measurable dimension where the mechanisms, such as governance of the Socio-technical Transition or behavioural change, exist but is accessible through meanings, concepts and notions and our reality is thereby always disseminated through these concepts (Sayer, 1992). Through concepts, theoretical frameworks and models a mediation of our relationship to reality is possible but this knowledge can always be improved. A core notion of the scientific creations of concepts is 'abduction' through structural analysis, which will be further explained in the following paragraph on abduction and retroduction.

A central topic of the epistemology and ontology of Critical Realism is the view on fallibility (Sayer, 1992, 2000). Our knowledge of the world consists of theories and concepts but they are simplified models of reality and not immune towards empirical investigations. In this futures study, the scenario is based upon theoretical and empirical investigations and in order to follow both the critical realistic approach and the recommendations from futures studies researchers, the scenario will be checked for consistency, see the chapters 3 and 10. Although knowledge is fallible, it is possible to develop reliable knowledge and make progress in accumulating knowledge as there is no basis for non-problematical science and as there is a strong connection between what we observe and how our theories determine the observations (Sayer, 2000). Especially interpreting and re-contextualising observations and their underlying mechanisms are important aspects within critical realism, where abduction and retroduction play important roles for the epistemological task of creating knowledge.

Before elaborating further on abduction and retroduction the relationship between structures and agents must be clarified further as this duality is a long-standing defining controversy within philosophies of social science. In this study the notions of structures and agents are transformed into objects and agents of change, and a more thoroughly

elaboration of the analytical approach, Situations of Opportunities, is presented in Appendix II. Structures, agents, practices and conventions all form society and the agents dealing with these elements of society can be distinct from these structures, hence, they are able to reflect on and transform them. Actors can have impact on society and the amount and direction is determined by:

- their capacity to act;
- their specific positions they occupy in these structures;
- the resources they control;
- their capacity to monitor what they are doing and its effects; and
- the specific actions that they perform (Jessop, 2006, p. 47).

The actors involved in this Socio-technical Transition are presented in chapter 6 and will be further assessed in the chapters 8 and 9. Bhaskar (1979, pp. 33-34) defines society as 'both the ever-present condition (material cause) and the continually reproduced outcome of human agency. And praxis is both work, that is, conscious production, and (normally unconscious) reproduction of the conditions of production, that is, society'. Thus, for the study of the transformation process an important assessment should focus on the structures in society and on the agents who are able, disable or desirable to change them. Another assessment should regard the mechanisms and structures of behaviour changes in order to determine how behaviour can be affected in order to enable ICT to act as motor for transition.

Abduction and Retroduction

The traditional concepts of concluding are based on deduction (deriving logical conclusions from single events based on universal laws) and induction (deriving universal laws based on co-variation in many similar observations), and are re-evaluated within critical realism. In order to interpret and re-contextualise the underlying mechanisms and structures of the observed events, the American philosopher, Charles Sanders Pierce, developed the term 'abduction' and presented it through several articles in the journal 'Popular Science Monthly' back in 1878 and abduction has since been adopted by proponents of critical realism. Within this concept, observing, describing, interpreting and explaining are important tasks in order to construe events or actions within alternative frames of analytical frameworks (Danermark et al., 2002). Especially the work of clarifying and revealing the underlying structures and mechanisms is of high importance of critical realism and the Italian researcher, Umberto Eco, argues for especially three types of abduction;

1. abduction, when observations are made meaningful through interpretations;
2. abduction, as the researcher's creativeness to interpret observations in new ways; and
3. abduction, as an operation of the mind where new ideas are introduced (Eco, 1986).

The three kinds of abduction are applied in different parts of the study, however, mainly in the period of time after collecting data and before assessing them. Abduction is in this study utilised when interpretations of the data from the focus group research and the interviews are made. This pragmatic assessment of truth, where the scientific proc-

ess becomes creative and where new ideas and interpretations of observations are made, is closely connected to the assessment part of the study. Following the approach of abduction is a more intuitive reasoning of creating new ideas and meanings and this creative Retroduction, as Pierce describes it, is 'the spontaneous conjectures of instinctive reason (Pierce in Ayim, 1974, p. 34). An important ability for the researcher is the instinct and the puzzlement over external events or facts and s/he must suspend the beliefs in contemporary and present theories which cannot account for the observed and surprising fact. However, as the researcher cannot yet propose a new theory, s/he must rely on the instincts and then later develop a theory.

Critical Realism acknowledges retroduction as a hallmark following the analytical process of abduction. In order to reveal the underlying mechanisms of given events abduction deals with the creative process of making meaningful interpretations. The concept of retroduction is also related to the so-called 'transfactual argumentation' or 'retroductive inference' which is the intuitive argumentation that leads to the structures behind the observed phenomenon (Danermark et al., 2002). Through descriptions and analyses the basic conditions of the observed events are revealed. Retroduction, however, is used in the actual process of assessing the scenario through the organisational and social structures and in the process of creating 'new theory'.

Summary

This appendix has argued for Critical Realism as a philosophy of science for normative transformative backcasting scenarios for Socio-technical Transition towards sustainability. The amalgamation of 'transcendental realism' with 'critical naturalism' is a unity between social and natural science where a triangulation between several methods, quantitative as qualitative, is acknowledged. The aim with Critical Realism is to identify, analyse and assess the mechanism and underlying structures for the empirical events and transformed to the this study, it is sought assessed how mechanisms and structures on the organisational and social level can be changed in order to reach the Socio-technical Transition. Closely related to the analytical framework of Situations of Opportunity is the recognition of the actors and structures, or Objects of Change and Agents of Change and this study is applying the question of how change can happen. Through the creative, analytical and argumentative processes of abduction and retroduction, the triggering mechanisms and underlying structures are explored. Knowledge is argued to be fallible and reflections on the conducted methods for creating knowledge in this study are presented in chapter 10.

Appendix II

Situations of Opportunity – Chances for Change

‘System innovations: ‘are not merely about changes in the technical products, but also about policy, user practices, infrastructure, industry structures and symbolic meaning etc.’ (Geels cited in Urry, 2010).

As justified in the introduction to this study, sustainable development urges for a shift in the current consumption trends of energy. ‘Tipping points’ (Urry, 2010), ‘policy windows’ (Kingdon, 1995), ‘nodal points’ (Patomäki, 2006), and ‘Situations of Opportunity’ (Weingaertner, 2005) are all similar concepts for describing a moment in a process where actors take action to change the existing patterns of development – it is the period where the shift in trajectory is initiated and pursued. The latter concept utilises the forces of scenario development from the field of Futures Studies to operationalise sustainable Socio-technical Transition. Hence, the purpose of this appendix is to elaborate the analytic approach for this project.

In this study, the conceptual framework of Situations of Opportunity is used to narrow down the study of how a Socio-technical Transition can contribute to sustainable development to a single in-depth case study of Södermalm illustrated as one Situation of Opportunity in which a number of events occur.

The first part of the appendix starts by providing a short historical overview of the concept’s development and its definition, and then it proceeds to the methodology and featuring aspects. The appendix ends with a discussing summary about the concept of Situations of Opportunity.

Development of the Framework

The concept of Situations of Opportunity originates from the cross-disciplinary research project, MAMMUT (Managing the Metabolism of Urbanisation), conducted at the Royal Institute of Technology (KTH) in Stockholm in the period 2002-2006 with the ‘aim of studying the process of urbanization and its relations and synergies with sustainable development’ (Weingaertner, 2005, p. 6). The research resulted in, among other things, the licentiate thesis by Carina Weingaertner (2005), which had the purpose of testing, developing and articulating the conceptual framework of Situations of Opportunity based on retrospective pilot studies of Stockholm (Sweden), Dar es Salaam (Tanzania) and Curitiba (Brazil). In these studies, the cities’ creation of public transportation systems were analysed from different perspectives as Situations of Opportunity in an urbanisation process. However, the concept can be transferred to other fields than public transportation.

In the dissertation, Situations of Opportunity were defined as ‘instants in the urbanization process when stakeholders have a greater chance of influencing the city’s development towards more of environmental sustainability’ (Weingaertner, 2005, p. 3).

The concept has been further developed to be a framework for prospective studies, analysing how urban development desirably should take place in order to pursue sustainability. The futures oriented concept of Situations of Opportunity is used in the ongoing cross-disciplinary research project, SitCit (Svane et al., 2009), and it is defined as:

‘A description and evaluation of a period of transformation in the city’s future development when a limited number of actors can plan and implement a consistent set of measures that profoundly and lastingly contribute to urban sustainable development – changing the city’s built environment and infrastructure systems, its institutional set-up and city life, but retaining its ability to sustain the good life of its citizens’ (Svane et al., 2009, p. 5; markings by the authors).

Compared to the previous one, this definition is more elaborated and has extended the moments, or the situations emerging in an urban development process, to be periods rather than instants, which seem shorter in time. This is also what distinguishes the concept of Situations of Opportunity from the concepts listed in the beginning of the chapter, because it is wider in scope and time (Weingaertner, 2005, p. 24):

- A wider scope because the Situation of Opportunity is analysed from multiple fields (see below).
- A wider temporal dimension because the description not only illustrates the formative moment, where the decision regarding urban transformation is taken, but also the preliminary events and decisions that influenced the final and crucial decision as well as the outcome of it.

In addition to the former definition, the concept of sustainable development has been broadened to emphasise not only environmental sustainability, despite that ‘the good life of its citizens’ may be referring to the social dimension of sustainability, to urban sustainable development in general. Despite the notion of sustainable development in general in the definition, the environmental dimension of sustainability is being emphasised in the SitCit project as it is being guided by the vision of a low energy, low carbon society in year 2060 (Svane et al., 2009). The following section presents how the definition has been operationalised into a methodology or more specifically, a research strategy.

The Methodology of Situations of Opportunity

Decomposing the latter definition results in three questions, inspired by the SitCit research strategy (Svane et al., 2009), which aid at analysing the synergies between sustainable development and urban development. The questions extracted from the definition compared to the questions asked in the SitCit research project are displayed in table 1. The questions articulated in the research strategy can be said to be a translation of the definition of Situations of Opportunity.

Definition of Situations of Opportunity	SitCit research strategy (Svane et al., 2009)
Changing the city's built environment and infrastructure systems, its institutional set-up and city life	What are the objects of change in the city's physical, institutional and socio-cultural structures?
Who is the limited number of actors?	Who are the agents of change?
What are the set of measures?	How
When is the period of transformation?	When is change favourable?

Table 1: Overview of questions extracted from the definition of the concept of Situations of Opportunity compared to the questions asked in the SitCit research project.

The description, mentioned in the definition, of the transformation process (or the Socio-technical Transition in this study) can be perceived as embracing the three questions in table 1. In the SitCit research project, with a reference to the Futures Studies' backcasting approach (Höjer & Mattson, 2000), the description takes the form of a scenario illustrated in the form of narratives. Therefore, the description or the scenario is a description of how actors (who) implemented and changed a set of measures (what) at different moments (when) in the process of achieving a sustainable development; i.e. a description of the Socio-technical Transition.

Methodologically, the content of the future scenario is defined by iteratively asking 'What are the Objects of Change?' and 'Who are the Agents of Change?'. The evaluation of the transformation process is a quantification of the scenario's outcome in terms of the expected energy reductions measured in kilowatt and CO₂-equivalents. The evaluation is in the research strategy articulated as the question – 'How great are the potentials?' (Svane et al., 2009, p. 10) and could equally be articulated as: how much energy is it possible to reduce as a result of a Socio-technical Transition? In that sense, Situations of Opportunity have two dimensions, which reflect the scope:

- A qualitative dimension studying the management of Socio-technical Transition (how); and
- A quantitative dimension studying the potential energy/CO₂ reductions of urban transition (how much).

This study focuses on the qualitative dimension. The scenario for the fictitious Situation of Opportunity can take a point of departure in a Seed for Transition, which is articulated as the assumptive question:

What if ICT was innovatively used in buildings and transport systems to automatically control energy use as well as to inform and persuade users to use less energy?

The What if-question should not be mistaken with the what-if-scenario under the predictive type of scenarios (Börjeson et al., 2006). However, the Seed for Transition has the purpose of demonstrating the plausible connection between a well-known problem (energy consumption), and how it can be changed (ICT) (Svane et al., 2009). In other words, ICT exists, and it is assumed that its potential to a wider extent can be taken ad-

vantage of, and methodologically, ICT becomes a theme within the case of Södermalm.

The four questions (what, who, how much and when) embedded in the concept of Situations of Opportunity are elaborated further in the following section.

Features of the Framework of Situations of Opportunity

Weingaertner (2005) recommends that studies of how urban development processes should be managed, including how Situations of Opportunity can emerge, should feature analyses of and the synergies between the four aspects:

- The urban structure,
- The socio-cultural aspect,
- The institutional aspect, and
- The environmental aspect.

The three former aspects are in turn also referred to as structures within the society (Svane, 2010) and the structure-agent relationship is a hallmark for Critical Realism (see Appendix I). The integration of Objects of Change and Agents of Change in the concept of Situations of Opportunity can be argued to entail such a structure-agent relationship and is regarded as key aspect in the analysis of the transition scenario. According to Weingaertner (2005, p. 37ff), these four aspects are in a relationship of mutual dependency or interplay. Similar in the SitCit research strategy (Svane et al., 2009), a city is perceived, by referring to Frey & Yaneske (2007), as a complex system or network in which a number of structures 'operate' simultaneously; the structures affect each other but are not directly caused by each other. By this, Weingaertner and the SitCit research team presumably mean that urban development cannot be reduced to an equation of, for example: changes in the socio-cultural structure are the effect of changes in the urban structure which is caused by changing the institutional structure. To simplify, A does not only influence on B, B does also influence back on A as well as on C. A Socio-technical Transition should, therefore, be understood as a non-linear process. Thus, it is not sufficient only to influence one structure; it is the combination or synergies of changes that lead to Socio-technical Transition. This implies that the idea of narrating, where order is brought into a sequence of events (see chapter 3), should not be understood literally but rather as an eye opener to what can happen during a transition. It is therefore of great importance to make it clear that the fictitious Socio-technical Transition, presented in the scenario, consists of a number of subsidiary processes, taking place simultaneously and in interplay. For convenience and clarity, the narratives can be complemented by a sort of diagram or flow chart to illustrate the interplay between the different processes in the transformation process. In this study, the integration of Actors of Change and Objects of Change is clarified through a table which can be found in Appendix IV.

Returning to the methodology of the analytic framework, it is derived from the previous section that the Socio-technical Transition as a Situation of Opportunity is analysed through asking the questions displayed in table 2, which are related to different aspects of the concept. All are in one way or another related to the entry quote about system innovations. The questions and aspects are in turn elaborated below.

Question	Aspects
What are the Objects of Change?	The urban structure The socio-cultural structure The institutional structure
Who are the Agents of Change?	The institutional aspect
How great are the potentials?	The environmental aspect
When is change favourable?	Field of Options

Table 2: The approach of Situations of Opportunity.

What to Change?

In an urban development process or Socio-technical Transition, three structures are assumed to be able to change. Under each overarching structure, a number of Objects of Change can be identified to be changed.

The urban structure can be defined as:

- 'the geographical distribution and fabric of the building stock (the pattern of development);
- the mutual location of different functions (residences, workplaces, public institutions and services) within the building stock (the pattern of location);
- the transport system (road network, public transport provision, and parking conditions);
- water, sewage and energy supply and telecommunications systems;
- the urban green and blue structures (more or less natural areas within and close to the city, and lakes, rivers and creeks)' (Næss, 2006b, p. 2).

In the concept of Situations of Opportunity, the urban structure relates to how infrastructure, geography/topology and location of buildings influence on each other and on energy use. Weingaertner (2005) exemplifies this with urban development along transit corridors and/or at stations, resulting in a more feasible transit system due to a greater potential of passengers and reduced energy due to the possibility to travel by public transportation. An example is The Finger Plan for the greater metropolitan area of Copenhagen, originally from year 1947, where the lines of commuter trains have enabled urban growth concentrated along the lines with green areas in between. Another highlighted example is how the topology of an area can delimit land use patterns to be more or less dense such as Södermalm. It is assumed that Situations of Opportunity can emerge either when the urban structure is defined/redefined or when technical improvements and other changes influence the existing urban structures (Weingaertner, 2005, pp. 28-30).

The institutional structure is in the concept of Situations of Opportunity related to how actors or stakeholders take part in the management of transition in different and often limited phases of the process (Weingaertner, 2005, pp. 30, 38). From the MAMMUT draft theory, it is suggested that the institutional aspect of future Situations of Opportunity is analysed by means of concepts from the field of political science (Weingaertner, 2005), meaning to study how stakeholders are organised and how they initiate

and implement the change. This was also discovered in an exploration in the early 2000s of the brown field development of Hammarby Sjöstad in Stockholm, Sweden (Svane, 2008). Here it was found that concepts of goal conflicts and policy instruments from the field of political science were suitable for being applied in the analysis of the development process and explaining how Situations of Opportunity can emerge and evolve. An example of a Situation of Opportunity is when the institutional setting changes when two or more stakeholders see a mutual beneficial relationship through co-operating about a given problem. Scott (2001) sees institutions as social structures that are composed by cultural-cognitive, normative, and regulative elements and related to the concept of Situations of Opportunity; each pillar could arguably be an Object of Change. This implies that the institutional side of a Socio-technical Transition can be analysed through these three pillars in order to detect how they affect, but not cause, changes in the urban and socio-cultural structures. As Scott (2001) defines institutions, it can be hard to determine the difference between institutions and social structures. With Forester's (1989) assertion that planning and power cannot be divorced, an inherent and therefore inescapable subsidiary aspect of the organisational aspect and also the Agents of Change must be the question of power, and how different stakeholders may take advantage of their position to exert power over other stakeholders in order to get their ideas implemented – more or less intentionally and maybe without regard to pursuing sustainability.

The socio-cultural structure relates to the residents' urban lifestyles constituted by behaviours, habits and attitudes and how these can be changed to be more sustainable (Weingaertner, 2005). The socio-cultural aspect of what can be changed in an urban development process may be the most important aspect as lifestyles are likely to be influenced by the urban structure and the organisational instruments put forward by stakeholders to promote a sustainable lifestyle. Weingaertner (2005, p. 33) exemplifies this by stating that refurbishment of buildings, as a technical improvement with the existing structure (see the urban structure), 'creates *situations of opportunity* while facilitating more environmentally sustainable ways of life for its users' (emphasis in original). Scott (2001) argue that the institutional structure consists of the cultural-cognitive, normative and regulative pillars but all these pillars can be argued to encompass the social aspects of life which does not consists in the nature, independent of people.

As a key feature in the concept of Situations of Opportunity, it is important to do a parallel to which actors can do the change in addressing the questions of what to change (Svane et al., 2009), i.e. an integration of what and who to ensure consistency. Actors cannot influence the transition process if they are not aware of what and how to change (by which instruments) and vice versa a change (of objects) is not possible without any actors to carry out the change or be influenced by it. This also justifies the use of structured brainstorming as a method for collecting data for the scenario content. The following paragraph explores the actors who carry out change.

Change by Whom?

According to Weingaertner (2005, p. 8), it is assumed that actors who have an interest in the planning issue have the ability to identify possibilities and influence planning

through many different measures towards sustainability. These actors are labelled the Agents of Change and can be actors on a governmental level (e.g. national or municipal politicians), experts trained within the fields of planning and architecture or the specific issue of concern such as ICT, or in the private sector (e.g. transport providers or contractors) but they may also be Non Governmental Organisations (NGOs) or (groups of) individuals (e.g. neighbourhood organisations). In SitCit, however, it is assumed that city planners play a leading role in identifying the Situation of Opportunity and are the key actors (Svane et al., 2009) but for reasons not further stated. It can be argued that city planners act as 'spiders in the web' and hold key positions for the management of Socio-technical Transition. Furthermore, an embedded assumption in the concept of Situations of Opportunity is that a transition is required to be carried out through collaboration between a numbers of actors in self-governing networks compared to a more hierarchically governmental planning approach (Svane et al., 2009). This may have to do with the idea that a transformation process is understood as being non-linear and consisting of various simultaneously subsidiary processes in interplay, i.e. in a network.

However, as it can be discussed whether a planning approach based on collaborative and consensus principles may hamper the quest for pursuing sustainable development. Additionally, it can be discussed whether a shift in paradigm, as societal transformation towards sustainability can be perceived as (Markley, 2008), can be initiated and carried out by all 'types' of actors, or whether Agents of Change are required to be consisting of a limited host of actors. In other words, it can be discussed who *could* or *should* influence planning, and how they are able to do so.

In times, the distinction between the notions of Agents of Change, stakeholders and actors seem blurry, as they all can have an interest or stake in the given Situation of Opportunity. It is important to reckon that the Agents of Change should not be reduced to only consist of initiators of change, but also the actors who implement change. However, Agents of Change may be dependent on other actors in order to enable the change. For example, the ICT-company, Ericsson, may take a leading role in inventing and promoting new types of hardware and software that can influence the energy usage, but the company may also be dependent on partners and subcontractors. Then, can they be named Agents of Change? And how about the actor, who in times is referred to as the ordinary citizen, the household, the resident or the end user – the 'people'? During the Socio-technical Transition, this type of actor should preferably change behaviour, and while other actors can make use of different instruments to change the urban, institutional and socio-cultural structures, the residents are the actors who the instruments are aimed at. However, to enable Socio-technical Transition, it is likely to require that also the Agents of Change alter their mind-set and ways of behaving in order to disrupt the existing trends. Therefore, emphasis in the scenario should not only be put on how Agents of Change make use of Objects of Change but also how it affects the everyday life of the people who inhabit the city being transformed. This also entails that that the complexity of simultaneously operating structures in interplay is to be illustrated in the scenario. In this project, Agents of Change should be understood as actors who take advantage of the possibility to transform the existing structures or patterns through different measures towards greater sustainability, and the citizens are included in this definition.

The merging of the Objects of Change and the Agents of Change constitute when change is favourable, which the next paragraphs elaborates.

When is Change Favourable?

According to Svane (2006), not all moments in the Socio-technical Transition are Situations of Opportunity because the number and character of options are not available at all times, and because the Agents of Change must be aware of the existence of the options. The options can be both desirable and necessary changes, and one Agent of Change might see a change as necessary while another sees it as desirable. Situations of Opportunity constitute when change is favourable, and it implies that the Agents of Change reckon a number of options to change the structures of the society. The merging of Agents of Change and Objects of Change is called a Situation of Opportunity's Field of Options, which reflects when the desirable and necessary changes are coordinated by stakeholders (figure 1).

Turning to the similar concept of 'policy windows', Kingdon (1995) states that such a window for enabling transformation is more likely to emerge when joining problems, policies, and politics. This entails that for an issue to occur on the decision agenda, it is the result of 'joint effect of several factors coming together at a given point in time' (Kingdon, 1995, p. 179). When distinguishing between 'problem windows' and 'policy windows', Kingdon (1995) refers to opportunities rising from either a certain problem or a change in the institutional/political setting. The latter was also mentioned under the institutional aspect, but can be expanded with the example of a change in administration (Kingdon, 1995) such as a shift from one wing to another in the local government, which through different initiatives can affect the future state towards the better or worse. Examples of problem windows can be accidents, such as the 2011 nuclear accident at Fukushima, Japan, due to the earth quake or the 2010 oil spill in the Mexican Gulf, or it can be problems such as congestion or excessive use of non-renewable energy sources. Kingdon (1995) further pays attention to the fact that advocates must take advantages of the window or situation, but also that opponents can counteract the possibility to take action. An example on counteractions could be bringing additional and ill-timed alternatives into the discussion and thereby change the discussion in another direction. This is very much related to the already mentioned question of

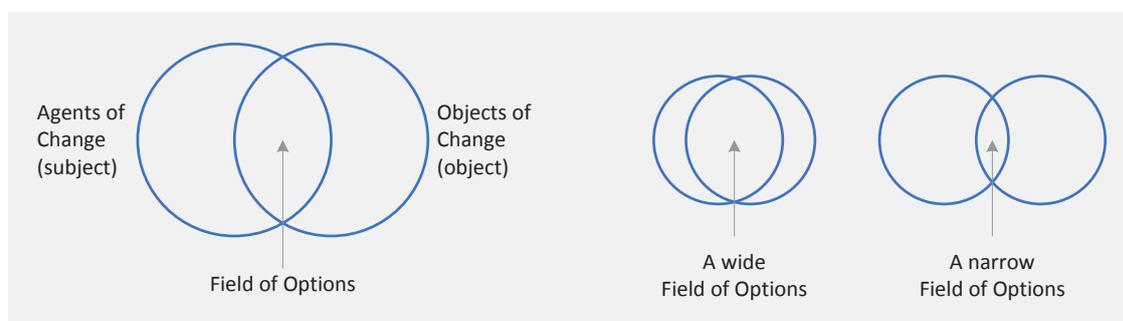


Figure 1: The concept of Field of Options. Within the framework of Situations of Opportunity, transition emerges when Agents of Change have a number of alternatives with contrasting outcomes available to initiate a future development in a certain direction. The wider Field of Option, the greater potential for change.

power among the involved actors, and especially the question of agenda-setting or 'nondecision-making' (Bachrach & Baratz, 1962).

Figure 2 illustrates a development in which a number of Situations of Opportunity emerge. The Field of Options of each Situation of Opportunity determines the direction of the development towards being more or less favourable. Thereby, the scope of the Field of Options represents how well the Agents of Change are 'able to sustain' the good life of the citizens, cf. the definition of Situations of Opportunity, through freedom of action or through continuation of the present trends. The idea of the concept's methodology is to enable a more sustainable development through identifying plausible and desirable Situations of Opportunity and thereby to widen the Field of Options.

The span of a Field of Option is a quantification of the environmental impacts of the alternatives/options in terms of the urban metabolism (see the paragraph regarding how much to change), and the term of Field of Options seems to be associated with the concept of explorative scenarios. Here, a number of possible developments are explored to provide an overview of the different outcomes, and the range of scenarios illustrates the range of uncertainty (Börjeson et al., 2006).

How Much to Change?

Urban metabolism can be defined as 'the exchange of resources and waste between the city and its hinterlands' and 'assessing it in terms of environmental impacts indicates to what extent sustainability is attained' (Weingaertner, 2005, p. 33). This can be used as a measurement for the Situation of Opportunity's possible reduction in energy usage and CO₂ emissions. The question concerns the evaluation of a Situation of Opportunity and can be seen as the environmental aspect of urban development.

Another similar tool for measuring the outcome of a Socio-technical Transition could be the estimation of the reduction of Södermalm citizens' ecological footprint. In general, both developed and developing countries are consuming, wasting and polluting more than nature is capable of assimilating. Thus, the ecological footprint was developed as an estimate of 'the resource consumption and waste assimilation requirements of a defined human population or economy in terms of a corresponding productive land area' (Wackernagel & Rees, 1996, p. 290). Zapico et al. (2009) argues that if the

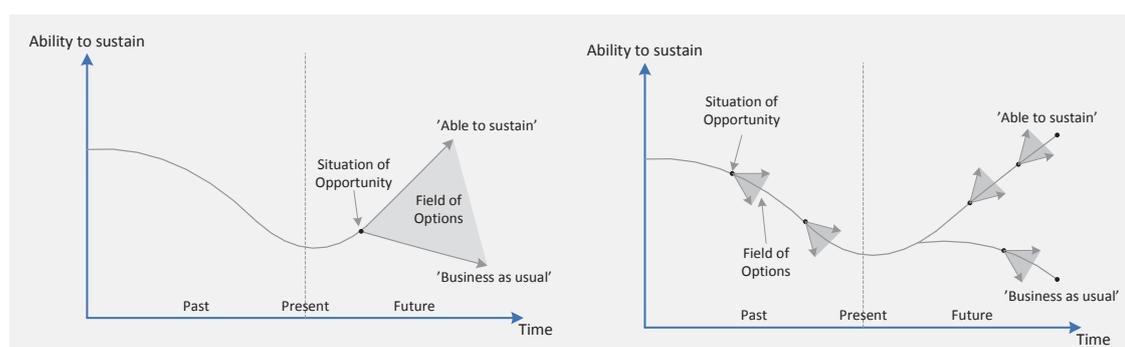


Figure 2: Illustration of the concept of Situations of Opportunity (reproduced from Svane, 2005 in Weingaertner, 2005, p. 7).

personal ecological footprint is made visible through ICT, for example on the personal mobile phone, people are more likely to change behaviour because they can monitor and compare their performance in energy reduction and thereby aid at accomplishing a target. In other words, if the social aspect as an Object of Change is being influenced by ICT, it can help at reducing the environmental impacts of urban development.

Because this study focuses on the process or the management of the transition of a socio-technical regime (the integration of what, who and when) of achieving sustainable development, the question of quantifying the Situations of Opportunity will not be addressed further. However, quantification and modelling in order to determine the potential for reduced energy usage and CO₂ emissions are important and will follow in another study within the SitCit research project at KTH through energy usage modelling (Svane et al., 2009).

Summary on Situations of Opportunity

This appendix has presented the analytic framework of Situations of Opportunity to be used in this project. Shortly, Situations of Opportunity can be defined as emerging chances for change in planning for sustainable development, in which Agents of Change have a wide Field of Options. In addition, besides being a period of urban transformation, the concept is a future oriented approach which aims at analysing a Situation of Opportunity from four different aspects (urban, institutional, socio-cultural, and environmental) guided by different questions (what, who, how, and how much).

Besides being emanated from other concepts, the concept of Situations of Opportunity also has assumptions, concerning how planning is understood. At least two categories of assumptions have been identified:

1. The city and the transformation process should be understood as a complex, non-linear system; and
2. To fully utilise the potential of a Situation of Opportunity requires that actors join efforts through collaboration.

Criticism of Situations of Opportunity

The concept of Situations of Opportunity is a relatively new concept within the literature and research of sustainable development, scenario development and transition theory. This means that thoroughly critical reviews on the concept can help strengthen and improve it. Although similar concepts like policy windows and tipping points have been used within these research fields, the concept of Situations of Opportunity differs by applying the urban structure and the socio-cultural, the institutional and the environmental aspects and by searching for coherent connections between Objects of Change and Agents of Change.

As earlier described the diversity between the institutional and the social-cultural aspects are a bit hard to distinguish, and the concept of Situations of Opportunity can be criticised as being a bit vague in these issues. It can be argued that a more appropriate distinction in this study could be on the organisational structure, which encompasses

the governance processes, networks, collaborations and steering mechanisms towards increased sustainability with ICT as a motor. On the other hand, it might be proposed that the social structure, which encompasses all the social life, the behaviours and the interactions between the societal structures and the individual structures, is a better notion to use within this study.

Finally, the concept of Situations of Opportunity operates with the integration of Objects of Change and Agents of Change. A critical comment on this approach is the notion of 'Object of Change'. It can be hard to determine what is meant by the notion of 'object' as it could refer to both the structures in the socio-technical regime (e.g. the legal, capitalism and need for personal contact), the underlying mechanisms (e.g. market forces, personal branding and mobility) and the effects (e.g. increased energy usage, increased emissions of greenhouse gases and clogged streets). 'Objects' can eventually become 'agents' in some circumstances. For example, the organisation of house owners can be regarded as an object, if it is perceived as one collective organisation, which can be affected by e.g. legal matters, or it can be regarded as an 'agent', if it is perceived as affecting others, e.g. the tenants.

It can be argued that the concept of Situations of Opportunity is closely related to the mindset of Critical Realism, as it recognises that a normative planning process towards increased sustainability is a non-linear and complex issue to deal with. The important integration of structures and agents is also a part of the concept of Situations of Opportunity although the term 'object' can seem a bit vague. Finally, the concept deals with the abduction and retroduction through analyses of Situations of Opportunity in the urban structure, the institutional, socio-cultural and environmental aspects.

Appendix III

Meta-governance for Transition Management

Meta-governance, or more popular phrased, 'governance of governance', refers to how the governance process is managed. In terms of transition management of the socio-technical regime of energy usage, ICT and behaviour, such reflections are of high importance as the main purpose in this study is to analyse how such a process of change can come about. Especially the reflexive aspect is purposeful as it calls for questioning the governance itself.

As a meta-governance approach, reflexive governance calls for questioning how concepts, practices and organisations are governed and how they can be affected. The notion 'reflexive governance' is derived from 'reflexive modernisation' (Beck et al., 1994) and fits very well to this project's declared aim of analysing how the transition can happen. As the complex process of transition of a socio-technical regime calls for an inter-sectoral approach, it also calls for a multi-dimensional approach to meta-governance and this has been sought illustrated in the scenario presented in this study. In this appendix, four governance approaches are being included in this theoretical elaboration of meta-governance in Transition Management and together they form the basis of how the 'governance of governance' of Transition Management of the socio-technical regime is understood. Related to the planning process for the Socio-technical Transition, these approaches can arguably be denoted as 'planning approaches for managing Socio-technical Transition'. The development over time is noted and can be regarded as an attempt to develop a framework for the meta-governance of the transition process of a socio-technical regime.

Incremental Governance (Lindblom, 1979)

To opt for small steps, changes and milestones towards a moving target of implementing ICT for energy reductions in Södermalm by 'muddling through' the decisions might seem reasonable for governance towards the transition of a socio-technical regime. This view is partly acknowledged by Bjerre, Lennartsson and Lindén, who all states that a step-by-step approach is necessary and it is nearly impossible to lay forward a final plan to be followed strictly. Technologies, politics and strategies are not born perfect and a 'trial-and-error-and-learn' approach to the transition is therefore important, Røpke states. Hence, incremental governance is also linked to a broad knowledge integration of not only experts, which must be developed, shared and refined during the transition. There can be a pitfall of power and conservatism in this approach as decisions taken along the transition will influence the next steps in the incremental process. Lindblom's absence of goal-oriented policies can also impede a high level of reached sustainability as negotiating in an incremental governance process within the neo-liberal society, which empowers the most cost-beneficial arguments and actors. Höjer and Røpke both argue that the societal institutions must be reformed away from a neo-classical and consumer based society towards an ecological based system, and this might be a starting point for the incremental governance approach.

Adaptive Governance (March & Olsen, 1995)

Linked to the incremental approach, the adaptive governance opts for small changes in the policies, technologies and collaborations rather than a lock-in based on present expert knowledge. By being critical to the rationalistic approach of estimations, calculations and locked objectives, the adaptive governance approach to the transition of the socio-technical regime follows the trends of the critique of forecasting within the tradition of futures studies and scenario development for sustainability. Especially Bjerre and Höjer argue that both the scenarios and the planning process must include build-in flexibility in order to curb with the danger of exact predictions. It can be argued that experts possess the ability of foreseeing the future in certain fields but especially three pitfalls of only integrating expert knowledge and missing adaptivity of policies are recognised; a) ignorance towards uncertainties of future impacts; b) conflicts of inconsistencies of interests and c) ambiguity as unclear and instable interests. The adaptive approach focuses especially on learning from experiences and to adapt changing circumstances (Folke, et al., 2005). Lennartsson states that the interests can be split between economical and environmental targets and that the discourse on the discussed elements in the planning process might be differently understood from person to person. March & Olsen's adaptive governance could therefore be expanded by the actor perspective of clarifying a common vocabulary, development of risk analysis and clarifying the interests.

Interactive governance (Kooiman, 2005)

Policies, strategies and transition pathways should, according to the approach of interactive governance, be developed in accordance and collaboration with the concerned stakeholder groups. By doing so, they will be more accepted, effective and embedded in the implementation process. This type of governance can be argued to be closely related to theories on collaborative planning presented by Healey (1997) and communicative planning by Innes (1995). There is, however, a fine balance of how, who and how many stakeholders should be involved in this joint event of decision making. Too few and strict chosen stakeholders could hamper the broad acceptance as vested interest may be favoured, and Lindén argues that the steering group should be much broader and include several other actors from several other interest groups. Too many and broad invited stakeholders, on the other hand, could make the decision making process ineffective and too conflict laden to operationalise the transition in the Södermalm. Drawing on experiences from a major ongoing development project in Stockholm, Lennartsson sees it as useful to include the heads of the involved departments in the steering group as their decisions are more powerful. The aspect of power in this kind of communicative governance is elaborated in section 9.3.

Collaborative governance (Ansell & Gash, 2008)

During the past two decades collaborative governance has been developed as a new strategy for governing, where multiple private stakeholders together with public authorities engage in a formal consensus-oriented decision making. As a planning practitioner, Lennartsson recognises the immense numbers of collaborations and meetings while at the same time reflecting on the need for common understandings of the goals and paths to be followed. Being close to the interactive approach, collaborative gov-

ernance aims at making or implementing public policy programs or assets and can be regarded to be connected to collaborative planning with especially Patsy Healey as a prominent advocate. However, the approach of collaborative governance distinguishes from the other approaches by arguing for the importance of leadership. Time, trust and interdependence are key contingencies for establishing collaborative governance and the leadership of the meta-governor plays an important role for making the participants collaborate. Bjerre highlights the importance of creating shared interests between public and private institutions, as the Public Private Partnership between City of Stockholm and Ericsson in the scenario. The collaborative approach to governance can be useful for implementing the small changes towards the transition of the socio-technical system as representatives from all relevant interests are included in decision making process.

To summarise the meta-governance for the transition management in Södermalm, it can be argued that a reasonable approach opts for small changes and milestones, although with a common denominator long-term goals of a more effective energy system based on ICT and behavioural changes. The process should be open and creative while including expertise, private participants and public agencies in collaborative manner. It is important to create a situation of timing, trust and mutual dependency while actively empowering the less powerful participants. Both the government in terms of direct and sometimes unpopular decisions and governance in terms of broad collaborations are needed and it is of crucial importance to assess the power relations in order to create a transition towards a more sustainable Södermalm.

Appendix IV

INITIAL PHASE					
What (Objects of Change)	Who (Agents of Change)	How	Why	Effects/problems	
Events	Depletion of resources				
	Climate changes				
	Air- and noise pollution				
	Rising fuel prices				
	Rising energy prices				
	Increased development and use of ICT	Niche companies			+ Great potential for automation and thereby energy savings - Rebound effects: Increased levels of energy usage and electronic waste due to increasing number of ICT
Urban Structures	A changed energy system – development of Smart Grid	Energy supply companies Grid owners	Subsidies from National Government		+ Opportunity for having a more even energy production + Integration of renewable sources – also in homes
	Commercialisation of electric vehicles	Car producers	Technological development		+ Can make driving close to CO ₂ neutral + Energy sources for 'fuel' can be renewable sources - Does not reduced the increased congestion

INITIAL PHASE					
What (Objects of Change)	Who (Agents of Change)	How	Why	Effects/problems	
Organisational Structure	Adoption of Energy Strategy 2010-2040	National Government			
	Environmental Quality Objectives	National Government			
STRATEGIC AND TACTICAL PHASE					
Urban Structure	Instalment of heat pumps and solar cells	Fortum Building owners	Subsidies and negotiations	To enable the implementation of the Smart Grid	
	Appointment of Strategic Office	City Planning Administration			+ Public stewardship: Pioneering and making a good example
Organisational Structure	Appointment of steering group	Strategic Office appoint the members			+ Joint action against climate changes etc.
	Establishment of Södermalm Trade Association	Shop owners in Södermalm			+ Building on experiences (knowledge building)
	Production of 'ICT for Sustainable Södermalm'	Steering group	Negotiations among steering group members and public meetings with citizens		+ Acknowledgement of the growing concern for local environmentally issues
	Adoption of 'ICT for Sustainable	City Council	Negotiations between the steering group and City Council	To have the project environmentally profiled as a flagship	- Too many different interests

Organisational Structure	Expansion of steering group	YIMBY- representative	The YIMBY protest results in an invitation to be represented in the steering group	Enhancing legitimacy and democracy	
IMPLEMENTATION					
Urban Structure	Change of homes and cafés into home offices and work hubs, respectively	Workplaces Cafés	Teleworking Videoconferencing	To reduce the need for physical travelling (dematerialisation)	<ul style="list-style-type: none"> - People commute over longer distances + Reduced energy usage and reduced noise- and air pollution + Reduced energy usage and reduced noise- and air pollution + HEM using cloud computing: Dematerialisation - People do not use HEM as the intended way + Fewer accidents
	Bikes are allowed in the underground trains	SL	Regulation	To enable a substitution of transport means	
	Expanded public transport system through lay on of automated trams and extension of lines Increased frequencies Real-time scheduling E-ticketing	SL City of Stockholm Swedish Transport Agency	ITS New tolls	To enable a substitution of transport means To decrease the number of vehicles	
	SöderShoppers	Södermalm Trade Association SL		To enable a substitution of transport means And to ensure accessibility for all societal groups	
	Change of the energy supply through the Smart Grid, installation of HEM, heat pumps, solar cells Change of telecommunications systems (wireless internet everywhere)	Fortum Ericsson Building owners Communication providers	Investments Subsidies Technological development	To make the energy supply more efficient and potentially to reduce the energy usage	

IMPLEMENTATION					
What (Objects of Change)	Who (Agents of Change)	How	Why	Effects/problems	
Urban Structures	New parking structure (park'n'ride, car free streets, fewer parking places and increased parking charges)	City of Stockholm	Regulations Economic means	To reduce the number of vehicles in the townscape	
	More cycle paths	City of Stockholm	Regulations	To enable a shift of transport modes (substitution)	
	Green waves	City of Stockholm	ITS	To enable a shift of transport modes (substitution)	
	Electronic billboards at roads	Swedish Traffic Administration	ITS	To enable a more efficient transport system	
	Establishment of Södertälje Car sharing Company (SCC)	SL Fortum Bilpoolen AB (managers) Households as members	Smart SL transport card included in the fee	The Smart Grid enables commercialisation of electric vehicles	+ Replacement of private cars (substitution) + HEM gets widespread and contribute to a more efficient energy system +/- Increased use of ICT
Organisational Structure	Public Private Partnership: development and commercialisation of HEM	Ericsson Fortum City of Stockholm (STHLM ADS)	Södertälje Energy Contest Rebates/lease/service Advertisements	The actors join efforts to reduce the risks and to enable a more efficient energy system	
	Development of multi modal journey planner	SL, Ericsson STHLM IT Swedish Traffic Administration	Free app on HEM and smart phones Interactive billboards at stations and bus stops	To enable a substitution of transport modes	
	Adoption of policy packages	City Council	Mixture of policy instruments	To enable a shift of behaviour	

IMPLEMENTATION				
Social Structure	New incentive structure	City of Stockholm	To get ICT widespread and enable a change of behaviour	
	New habits	Households	To reduce the energy usage	
	Changed environmental awareness	Schools Pupils/students Game programmers Centre for Energy Savings Media Social Networks	Teaching Games Counselling Commercials Applications on HEM and smart phones	To increase the environmental awareness
USAGE AND EVALUATION				
Urban Structure	Improvements of HEM	Ericsson	Technological development	To improve the efficiency of the energy system
Organisational Structure	ICT for Sustainable Södermalm	Steering group 'External' analysis actors	Analyses	To learn from doing
Social Structure	New habits	Households	Incentive structure	To reduce the energy usage

Appendix (CD)

Appendix A1 - Focus Group 1 (Transcription, questions, what-who-chains and stories)

Appendix A2 - Focus Group 2 (Transcription, questions, what-who-chains and stories)

Appendix A3 - Idea Bank

Appendix A4 - Preliminary Narratives (photos)

Appendix B1 - Scenario 1st draft

Appendix C1 - Interview Guide

Appendix C2 - Inge Røpke

Appendix C3 - Anna-Lisa Lindén

Appendix C4 - Maria Lennartsson

Appendix C5 - Mattias Höjer

Appendix C6 - Anders Bjerre

Appendix C7 - Karl Georg Høyer

Appendix C8 - Questions for Interpretation

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This study examines how Information- and Communication Technologies (ICT) can contribute to a Socio-technical Transition towards a low energy, low carbon society in the city district Södermalm in Stockholm, Sweden. This Situation of Opportunity is inspired by backcasting and is illustrated as a scenario, which is presented as four images of a future Södermalm. A key feature in the scenario is the integration of actors (who), objects (what) and measures (how). Data for the scenario is compiled through literature reviews and two focus groups and is analysed, assessed and discussed through literature reviews and six expert interviews. A key feature is a Home Energy Management system, which is able to control the energy usage of the home and inform residents about energy performance. As a key actor, City of Stockholm is likely to take a lead in the Socio-technical Transition in collaboration with various other actors such as niche oriented companies. Inspired by the scientific approach of Critical Realism, the underlying mechanisms and structures in the scenario from perspectives of behaviour changes and Transition Management are analysed. Special attention in the process should be directed to the strategic phase, where transitions arenas are created, and the tactic phase where the agents negotiate and implement the objects. The analyses and assessments further reveal that the increased prevalence of ICT along with changes of the social structures such as norms, attitudes, beliefs and incentive structure can result in a behaviour change of the citizens in Södermalm. However, rebound effects and the role of the public authorities are discussed, and it can be concluded that the public authority plays an all-important role in the Socio-technical Transition and that rebound effects has to be systematic coped with. A high degree of environmentally sustainability can hardly be attained within the prevailing neo-classical regime. Finally, it is concluded that this Situation of Opportunity can contribute to the destabilisation of the socio-technical regime and can pave the ground for further organisational and social changes in order to enhance sustainable Socio-technical Transition.