Situations of Opportunity in City Transformation

– enriching evaluative case study methodology with scenarios and backcasting, exploring the sustainable development of three Stockholm city districts

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To keep global warming at 2°C, society faces challenges of a totally new magnitude. In Sweden like any high-income country, it becomes a powerful driving force in city transformation. Tackling this challenge of urban sustainable development poses problems for planners and researchers alike: What planning processes, what urban structures enable transformation, how can planners and other actors combine forces to deliberate themselves from path dependency, extending their freedom of action? In this paper, we explore how evaluative case study methodology merged with techniques from Futures Studies provide a cross-disciplinary research approach that defines the challenge in scope and time while retaining its complexity. Case studies are in-depth analyses of a small number of units, enabling studies of complex phenomena; for us, complexity means integrating the issues of What *to change and change* by Whom *in order to explore* How *change can come about and evaluate* How much *it could contribute to urban sustainable development. How can this approach be developed to explore the future? Futures Studies can indicate the probable or supply visions of the desirable, it can be normative or descriptive. For our purpose, it is normative, focusing on the long-term necessity of mitigating global warming. Through it, we develop scenarios that explore the path of transformation of three Stockholm City Districts, from today's climate changing society towards a 2060s vision of a low carbon, low energy society. From historical studies we learned that there are shorter periods – Situations of Opportunity – when inertia against change is low. This concept we now apply to future Situations, making these our cases proper. For each Situation in every district we develop three representations of their realisation in the upcoming decades: the Final Scenario is a narrative of the whole, seen from the future; the computerised Energy Usage Model quantifies outcomes in terms of reduced energy use; the Transformative Governance Network illustrates the process of change, its agents and their forms of co-operation. Elements of the approach could contribute to the practice of planning.*

Introduction – urban sustainable development and the challenge of climate change

To keep global warming at 2°C, society faces challenges of a totally new magnitude (IPCC 2007; Stern 2006; Åkerman et al. 2007). For Sweden, like any high-income country, the word-wide attention on climate issues creates a powerful incentive to city transformation. Tackling this challenge of sustainable urban development poses problems for planners and researchers alike: What planning processes, which urban structures enable the transformation, how can its actors combine forces to utilise their potential freedom of action? How can short or medium-term decision-making avoid producing future obstacles and lock-ins?

It has been argued that to combat climate change, the energy use of a country such as Sweden needs to be reduced by half within fifty years, the environmental impacts of energy use reduced by 80-90 per cent in the same period (IPCC 2007; Miljömålen 2009)[1]. Furthermore, if the ecological footprint of the inhabitants in the high-income countries is applied "not to the half-billion lucky citizens of the developed world but to the six billion people of the entire world, we find we need three planets Earth, which are unlikely to be available in the near future" (Hall & Pfeiffer 2000). The obvious conclusions are two: Cities of the developed world are in a state of non-sustainability, and forecasting's "business as usual" will worsen the situation; drastic and urgent changes are needed both for reducing the overburden on Earth and for increasing social equity. In the following, we take both as necessary points of departure.

Background – researching the transformation to a sustainable city

It is easy to find visions of the sustainable city, in policy documents as well as in research. However, they can seldom be used as guides for transforming a city such as Stockholm to a sustainable level of energy use: They are often generic, and therefore difficult to apply to a specific city's topography or built environment. Furthermore, most visions are not explicitly situated in time, even if it is understood that they illustrate a distant future.

On the other hand, a comprehensive city plan has much information on local topography, existing urban structures and their future development. This type of document is normally based on trend extrapolation. Thus, it illustrates the structures' inertia against change and city development's path dependency rather than indicates ways of reducing them. From this also follows that the plan probably is insufficient in relation to the urgency and magnitude of the challenge of global warming.

Thus we argue, that often the short-term planned development of a city as based on trend extrapolation, is in conflict with the long-term vision of a city that can sustain the good life of its citizens without depleting nature. Studies of this conflict could show the danger of taking long-term decisions without considering their lock-in effects in relation to the equally long-term visions. However, this paper has another approach: We make the transformation itself the object of study. With this approach, the present situation and the long-term vision are the end points of a process of change, the focus is on "bridging the gap" between the two.

The path of transformation, from today to the vision of a sustainable city is so far little ex-

[1] To stabilize atmospheric concentration of CO2-eq within the 445-490 ppm range, a concentration that in current IPCC models is related to a 2 to 2.4 degrees increase in global mean temperature, global emissions have to decrease with 50 to 85 percent in 2050 compared with the year 2000 (IPCC, 2007).

plored in research[2]. In part, this might be explained by the methodological complexity of the issue: First, with any definition, the city as "object of change" is extremely complex. Frey & Yaneske (2007) argue that the city is best understood as a network of interrelated parts, the relationships of which are chaotic and non-linear rather than causal. As we interpret it, this can be applied to the city as a physical entity, to the institutions of city governance, and to its use – the interaction between its citizens and the city structures. How can the path of transformation of such an unpredictable object be studied, retaining complexity? Secondly, with an average service life of a century rather than decades, buildings and infrastructure systems are the most long-lived artefacts that humankind produces, and thus have a great inertia against rapid change (Svane 2008). The inertia is in the large amounts of built-up matter as well as in the need for historical continuity; thus the transformation time of two generations. Thirdly, it is nigh on impossible to identify all actors needed for the whole transformation of the built environment and the institutional and socio-cultural structures.

Finally, there are profound objections to any attempt at addressing this challenge through urban planning. To what extent can the future be planned, to what extent do people and institutions act rationally, how strong is the social and institutional inertia against change? To avoid getting stuck in this discussion, we here take an ecological modernisation approach, with a limited rationality assumption, beginning with the question: “What if the Environmental Quality Objectives of Sweden were seen as non-negotiable prerequisites for all urban planning?”. In other words between the full rationality of “economic man” (Odell 2000) and the near-deterministic “muddling through” of political economist Lindblom (1959).

From the above we conclude that the planners and other actors of urban sustainable development need more of research-based information and new methodological approaches. Both should have as a focus what can be literally understood as urban sustainable development: The transformation from the present situation to a city that can sustain its citizens' everyday life for a long time without endangering its hinterland, nature, as resource base and waste sink. Furthermore, they should facilitate deliberation from forecasting and path dependency. Last but not least, they should enable the definition of manageable units of study without loosing track of complexity. We argue that the concept of Situations of Opportunity, as elaborated in the following, has this potential to provide research-based knowledge for change. Through it, we should be able to

- identify periods within the two-generation period of transformation when change is feasible – Situation “Seeds”,
- develop scenarios in the form of narratives of such periods – combining *What* to change and *Who* should take action,
- explore them as processes of change – *How* planning and implementation are accomplished in terms of Transformative Network Governance, and
- evaluate them – *How Much* they contribute towards the vision through modelling them as Energy Usage Systems.

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[2] Recently, Sweden has seen a few research calls, (e.g. from the Energy Authorities and the Swedish Environmental Protection Agency, and MISTRA) where at least some of the proposals had the transformation or the gap between today and a future vision of the sustainable city as objects of study.

In the "SitCit" project, we learn how to explore future Situations of Opportunity. Its full title is "Situations of Opportunity in the Growth and Change of three Stockholm City Districts – everyday life, built environment and transport explored as Energy Usage Systems and Transformative Network Governance". Its main purpose is to develop a cross-disciplinary research approach that defines the challenge of urban sustainable development in scope and time while retaining its complexity[3].

Background – Situations of Opportunity as historical cases of city transformation

In previous research, the Situations' concept was developed as a methodology for analysing ongoing and historical cases of city transformation. To support development, we studied cases of extensive, planned transformation (Svane 2007; Jonsson 2006). The planning and growth of the public transport systems of Curitiba and Stockholm were such cases (Weingaertner & Svane 2006; Weingaertner et al. 2008). Initially, however, the Situations' concept was "discovered" using Grounded Theory when exploring the environmental management of Hammarby Sjöstad, Stockholm (Svane 2007). Based on these studies, a historical Situation of Opportunity was defined as:

> *A period in the city's development when a limited number of actors planned and implemented a consistent set of measures that profoundly and lastingly influenced the future growth of the city – changing its built environment and transport infrastructure, its institutional set-up and its citizens' ways of life.*

Thus, Situations are periods in the growth and change of a city when inertia against change is low, and its actors' pooled freedom of action – the Situation's Field of Options – is wide. Furthermore, a Situation is described as a socio-technical system (Jonsson 2006). The technical dimension is the urban structure of buildings, roads and infrastructure systems; the social one is the companies and authorities owning and managing the physical structure, but also its users, the households. Finally, for the understanding of why the Situation had such profound implications, analysis should include its prehistory of planning and actors' team formation, a formative moment when the decisions-of-no-return were taken, and the outcome. As can be seen, the Situations' concept is similar to political science's Windows of Opportunity, Action Arenas, Policy Windows or the more recent Tipping Points (Urry 2007). However it is wider in including also the prehistory and outcome in analysis. Furthermore, it is an Opportunity in relation to its impacts on the future development of the city, not in relation to political or societal power relations (Jonsson 2006).

Purpose – developing future scenarios within a Case Study to explore the gap

In the SitCit project, we assume that similar periods with a wide Field of Options do occur also in the future, and that they can be utilised to contribute to urban sustainable development; the Situations' concept should enable the identification and exploration also of periods in the

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[3] The core team of Sit Cit researchers has members from the KTH departments of "Urban Planning and Environment", and "Energy Technology", respectively. Furthermore, for doing in-depth studies we will involve colleagues from the KTH departments of "Architecture" and "Transport and Economics" and the KTH Centre "Communications for Sustainability" (C4S), as well as from the "Wohnforum" at ETH, Zürich and the "Centre for Environment and Planning" at the University of West of England. Funding, a total of € 1.5 million, comes from three national government sources: The Swedish Energy Agency, FORMAS (The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning) and Vinnova ((Swedish Governmental Agency for Innovation Systems). The project started in autumn, 2007 and will end by summer, 2012.

future that have an large potential for change. This calls for methodological development; the concept as a cross-disciplinary conceptual system also needs adaptation. The result is research-based knowledge for change, to be used in studying urban sustainable development and in forwarding the understanding of its contributions to the necessary city transformation. Thus, the futures oriented Situations concept has the following definition:

> *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.*

At the core of the Situations' methodology for analysis of history is the Case Study. This research strategy is "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident." (Yin 2003). It is used when the object of study is complex, and often provides the basis for evaluation. To use it in the SitCit project's studies of the future, the case must first be elaborated. Scenario building and elements of backcasting from the research tradition of Futures Studies can produce descriptions of future Situations that are then explored in ways similar to ordinary case studies. Elements of urban planning practice are also incorporated for case development. Three Stockholm city districts provide concrete starting points. To illustrate the 2060s end point of the transformation gap, within which the Situations of Opportunity are to be identified and explored, we use two measurements: 1 ton CO_2 per person and year quantifies the low carbon society, an annual energy use per person of 15 MWh or an average 2kW over the year illustrates the corresponding level of energy use.

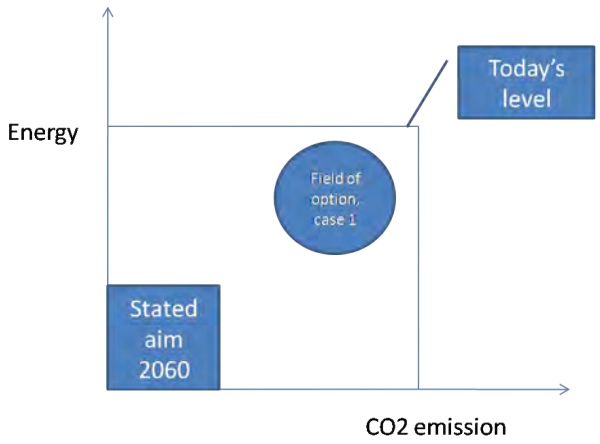

Fig. 1 The diagram illustrates the whole transformation gap from today till 2060, as well as the reductions in energy use and emissions of a hypothetical Situation of Opportunity in the next 10-20 years. The latter is the result of implementing the Situation's Field of Options.

Thus, the SitCit project's cases proper are a number of Situations of Opportunity for each Stockholm city district. The starting point for developing future Situations to cases, its "Seed", is a plausible but improbable question: "What if the planned renewal of the city district Rinkeby-Kista had the low carbon, low energy society as a guiding vision besides the need for changing roofs and appliances and addressing socio-economic problems?" In the following, we report on how to incorporate Futures Studies' scenario building and elements of backcasting into the evaluative case study methodology.

The full SitCit project attempts at illustrating a series of Situations of Opportunity that together bridge the full gap of the transformation. However, we now report on methodological development related to first generation Situations, looking 10-20 years into the future.

The rest of the paper begins with a brief presentation of case study methodology and its use in evaluation. Basic theory and methodological approaches from futures studies, scenario building and backcasting are then summarised; together these two sections form the theoretical background. Next comes the main body of the paper, the draft of the cross-disciplinary methodology as under development through our exploring Situations of Opportunity in the three Stockholm city districts. The whole ends with a discussion and conclusions concerning the Situation's concept and on the merits, shortcomings and risks associated with the proposed methodology.

Theoretical Background – on case study methodology

A main presumption of the Case Study methodology is that one can learn from "the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances" (Stake 1995). It enables the exploration of the many aspects (variables) and the complex relations of a case, using quantitative and qualitative data in parallel, and taking into account the real-life context. The brownfield development of Hammarby Sjöstad is one example of a case, a new policy for supporting wind power another.

One common criticism of the case study is that the uniqueness of the case makes generalisation difficult. However, often it is more fruitful to "...understand a phenomenon in depth than to know how often the not understood phenomenon occurs…" (Gummesson 2007). Furthermore, Flyvbjerg argues that generalisation is possible (2006):

> *'...one can often generalize on the basis of a single case, and the case study may be central to scientific development via generalization as supplement or alternative to other methods. But formal generalization is overvalued as a source of scientific development, whereas 'the force of example' is underestimated.'*

Depending on for which purpose they are being conducted, case studies can be divided into two main categories: intrinsic case studies in which the study is done to understand the case per se and instrumental case studies in which the aim is to understand a problem through the use of a case (Stake 1995). There are also collective case studies, in which a research problem is explored through a number of cases. In intrinsic case studies the researcher refrains from generalisation, but for example in the architectural profession, generally applicable knowledge is acquired through the study of intrinsic cases, via so called naturalistic generalisation (Stake 1995). Instrumental and collective case studies can include generalisation to theory, for example in the form of a conceptual system, or to methodology (Svane 2005).

Bell (1993) distinguishes between three categories of case studies: the exploratory, descriptive and explanatory, respectively. The descriptive study deals with ongoing or historical events and is similar to Stake's intrinsic type. Bell's other two case study categories are closer to Stake's instrumental type; the explanatory study seeks to unveil the cause-effect of the studied phenomena, the exploratory study is in search for new insights on the phenomenon.

When doing a case study, the opportunity to learn about a given research problem is in focus rather than the strive for a representative sampling of cases. Normally, there is more to be learned from the contrasting and unique than from the average or representative (Flyvbjerg 2006). When selecting cases, one should also look for the information-rich. This is necessary

for the study of complexity; it also enables the validation of findings through method and data triangulation (Yin 2003; Stake 1995).

Including elements of evaluation is yet another way of case study generalisation; the researcher compares the factual case with a set of value criteria, with the aim of transferring knowledge to other cases (Johansson 2004). The case can be a process, for example the environmental management of Hammarby Sjöstad's Project Team during 1997-2003, or an outcome such as the energy efficiency of the Sjöstad buildings. In the first example, the value criteria could be general knowledge on the power of the policy instruments at hand, in the second the project's objectives on energy use. Vedung (1998) and others apply the concept of evaluation to ongoing and finished activities only, but also admit that this distinction sometimes is problematic. One example: A plan is a representation of a future city; with Vedung's definition, the plan could be evaluated since it exists, the future city that it represents, not.

The Situations of Opportunity of the three Stockholm city districts are SitCit's cases. They are instrumental and explorative since they use the districts to study the problem of rapid and extensive city transformation. Together, they contribute to a collective case study. The Situations of Rinkeby-Kista's refurbishment, Bromma's car sharing etc. as well as the districts were selected for contrast and because they are rich in information. Each Situation is studied as a process of transformation through theory on network governance. Its expected outcome as elaborated in the Situation Scenario, is quantified in terms of reduced energy use against value criteria derived from the 2060s vision of a low carbon, low energy society. A wider, qualitative assessment using a check list for city district sustainability is also done. Generalisation to a conceptual system and a research methodology is a main aim; both should allow exploration of other future Situations of Opportunity, in other cities, just as the outcome evaluations. Thus, in all these aspects, the evaluative case study approach is straightforward.

However, one fundamental aspect of the normal case study is missing: There is no process of urban sustainable development there to be studied as yet – the whole lies in the future. Thus the Situation must first be created, constructed or designed. In other words: The case is a narrative, a scenario or an image of the future, and it is that which is to be evaluated. Scenario building and elements of backcasting from the research tradition of Futures Studies provide the missing link needed to create the Situation.

Theoretical background – on Futures' Studies, scenarios and backcasting

Futures studies is a concept with many different interpretations; it is also difficult to distinguish from other types of research. Some studies may clearly not be futures studies, such as basic science or linguistics. On the other hand, almost any discipline can be important for a futures study, even though the research question defines what is relevant in the specific case. Perhaps surprisingly, history can be an central discipline for futures studies, since in historical research just as in futures studies, time and change are important factors.

The results of futures studies are often used by others than its own experts. With this in focus, Börjeson et al. (2006) discuss the use of different types of futures scenarios. The scenario concept is also contested, but they use it as a synonym for the outcome of any futures study, be it a distant vision, an illustration of the near future or a narrative of the process of transformation. They also argue that it is useful to first elaborate a main research question, then pose another series of questions as basis for scenario building: "What will happen?", "What

can happen?" and "How can a certain target be reached?". Studies addressing these questions produce Predictive, Explorative and Normative scenarios, respectively.

Predictive scenarios study the probable; they are trend extrapolations or forecasts on traffic, population etc. They are typically based on a model of how different kinds of development normally interrelate, and on trend analysis. Generally, historical data are extrapolated towards a short-term future, implying that no major changes occur. Forecasts always depend on assumptions, even if they are not always explicit. When these turn out to be wrong, the forecast will not correspond with factual development.

Explorative scenarios focus on the possible and are usually less strictly generated than forecasts. They typically take as their starting point factors that are important for the object studied, assuming that the outcome of those factors is uncertain and forecasting is of little use. Scenario planning (van der Heijden 1996) is a common way of developing explorative scenarios. To handle uncertainty, alternative plausible futures are explored, rather than studying one probable future. In decision-making with long-term implications, explorative scenarios can be used to test robustness or adaptiveness: if a decision works in most alternative scenarios, it is robust; if the decision can be changed when development shifts from one scenario to another, it is adaptable.

Normative scenarios start out with a target, an outcome that is to be reached. In principle it could be anything, such as profit, well-being or sustainable development. Sometimes the target is of the non-negotiable kind, but still difficult or seemingly impossible to attain. In such cases, transforming normative scenarios are used. They respond to the question: "How can a certain target be met, when prevailing structures block necessary changes?".

Backcasting is a methodological approach within transforming normative scenarios. There are different ways of defining it, (Robinson 1982; Dreborg 1996; Höjer & Mattsson 2000) but among these, two main characteristics are found. First, backcasting just as normative scenarios starts with an overarching target of high importance, one that is difficult to reach without major changes; these changes are not in line with contemporary trends, as for example indicated by a predictive scenario. The second main characteristic is the development of images of the future in which the target has been met. Those images do not have to be probable – in fact, they are typically not. When generating them, however, the ambition should be to make them as plausible as possible, without sacrificing target fulfilment. One debated part of backcasting is how much emphasis should be put on describing the path towards the images of the future. Some find this important (List 2004), whereas others claim that the most important part is the images, since the presentation of contrasting images of the future makes alternatives to mainstream development visible; only when the alternative images have gained some acceptance, the path towards them can be meaningfully explored.

In SitCit, urban sustainable development is seen as urgent, extensive and necessary, its targets difficult to fulfil. Therefore, we explore the outer boundaries of what is plausible in relation to that normative target rather than extrapolating present trends. These boundaries define the Field of Options of a certain Situation of Opportunity. Forecasting might be part of exploring the opportunities of a Situation as for example in estimating the environmental performance of the next generation of cars, but in general we seek methods of deliberating from forecasting. Therefore, the narrative of a future Situation of Opportunity has many traits of the

explorative scenario of futures studies.

For reasons already given, backcasting as the opposite of forecasting is a major element in our research approach. In backcasting, images of the future are often gradually generated in a manner similar to that of our developing the Situation scenarios. Another parallel lies in the combination of qualitative narrative and quantitative modelling. On the other hand, the end vision of our city districts in 2060, where the low carbon – low energy targets are met is not elaborated in detail, which it would be in a backcasting study proper. Nor is the individual Situation in the first hand an concretisation of a given target. Instead, its contributions to reduced energy use and emissions are quantified from the Situation's Content Scenario, which is a plausible and consistent narrative of for example the opportunities of introducing a car sharing system in Bromma. In its turn, this scenario is generated from the Seed question, which identifies the motor of transformation rather than defining its end target.

Developing methodology in four steps – creating representations of Situations

At the end of exploration, a Situation of Opportunity has three parallel representations: The Final Scenario integrates the questions of *What* and *Who* and is a narrative of the Situation as a process of change, seen from the future looking back; the computerised Energy Usage Model addresses the *How much* question, quantifying and evaluating the Situation's outcome in terms of reductions in energy use and emissions; the Transformative Network Governance addresses the *How* question, designating the Situation's agents of change and their forms of co-operation as the Situation evolves over time. However, the research process has two preceding steps, identifying the Seed of the Situation and developing a Content Scenario, respectively.

The Seed of a Situation identifies a period in the future of a city district, when planned transformation seems plausible and changes can markedly contribute to urban sustainable development. Only the Situation Seed can be defined through analysis of the future development of the city district (Masini 2006); the rest must be created or generated. The Seed is given the form of a question, for example: "What if the residents of Bromma were prepared to in part substituting their use of private cars for a car sharing system combined with improved public transport?". In this case, the Seed is the synergy between a well-known problem and a change of attitude towards it: Bromma residents use their cars more than the Stockholm average but are here assumed to be open to changing this habit. The Rinkeby-Kista Seed is the synergy gains between the short-term need for refurbishment and the long-term necessities of the low carbon, low energy society. In the Södermalm Situation, we explore the potential contributions of information and communication technology to the same societal vision. Thus, the Seeds were selected for contrast and for being unique, following case study methodology.

The second step uses focus groups of experts and practitioners for a game of *What-Who* iteration: A scenario of the Situation is developed, starting with the Seed and by turns asking:

- *What* are the objects of change in the physical, institutional and socio-cultural structures?
- *Who* are the agents of change?

In the Bromma case, *What* questions include: What types of cars does the system provide? What changes in the public transport system could reduce car use and its impacts? To identify *Who* are the agents of change, we ask for example: Who could manage car sharing in

Bromma? Which role could the public transport company SL play?

The end result is a Futures Studies generated Content Scenario. It gives a consistent description of the Situation as a plausible future development of the district; each measure has an actor that can make it happen, all actors are included because they have something at stake in the Situation, and the whole relates to the initial Seed question. Its main aim is to enable the further exploration of the opportunities of the Situation, through an approach similar to ordinary case studies.

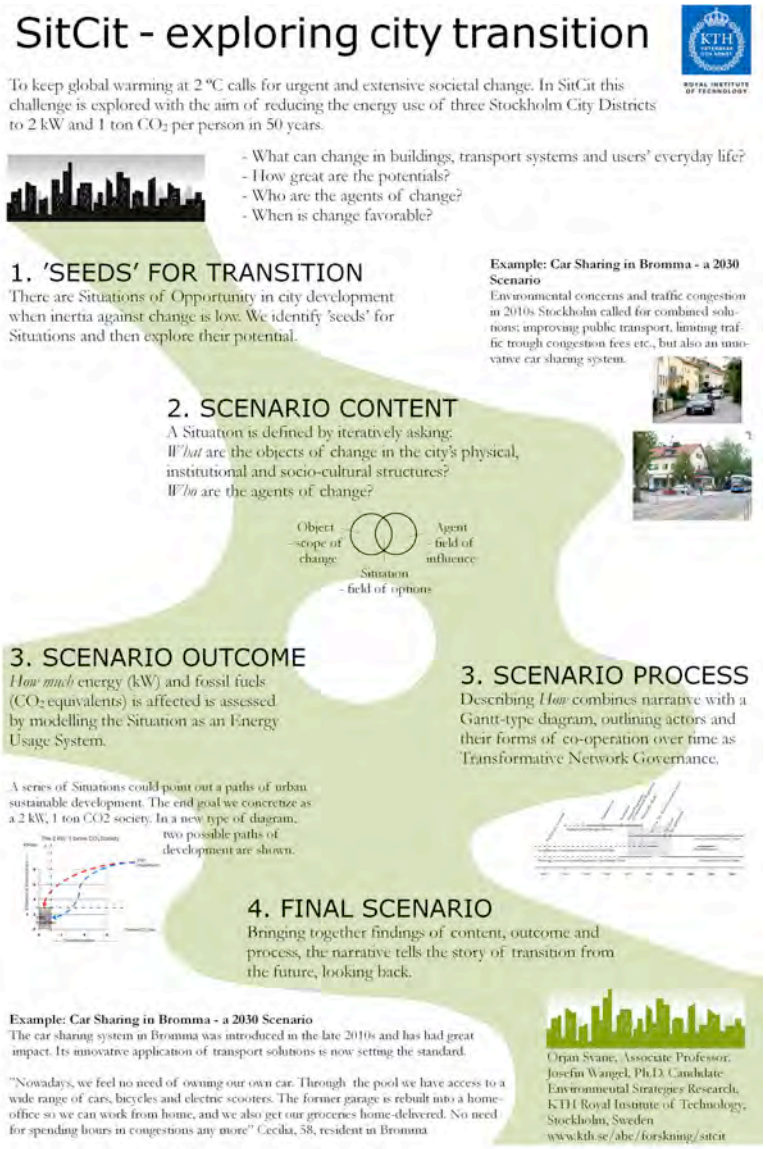

Figure 2. The SitCit research methodology begins with two transdisciplinary steps, identifying the Situation Seed and elaborating the Content Scenario through *What-Who* iteration. Then follow two disciplinary steps, elaborating the *How* question and evalutaing the *How Much* question, respectively. The last step is an update of the *What-Who* Scenario narrative.

Identifying the Seed and developing the Content Scenario are transdisciplinary exercises (Lawrence & Després 2004). The same applies to the fourth and final step of the research methodology. Its Final Scenario once more takes the form of a narrative, looking at the Situation from the future and describing it as a process of change inclusive of its prehistory and outcome, and once again addressing the *What* and *Who* questions as parts of a whole. Basically, it is an update and elaboration of the first scenario.

The preceding, third step in exploring a Situation has two parallel and disciplinary exercises: The modelling of the Situation as an Energy Usage System is done within the research tradition of Energy Systems Analysis, the Transformative Network Governance uses planning theory and elements of political science. Both are described more in detail in the following.

The *How Much* evaluation – modelling and simulations of energy usage systems

Energy systems analysis is a branch of systems analysis. Miser and Quade (1985) argue that systems analysis is not in itself a science but rather a research approach combining different methods; it is used within natural science, technology and management. A full definition is "neither possible nor desirable", but it can be characterised as an "invention-and-design art of applying scientific methods and knowledge to complex problems" (ibid.). Churchman (1968) designates five main aspects of systems analysis: the system's objective, environment, resources, components and management. Thus, the system is defined through identifying its parts, relations and variables as well as whose the system is.

A common distinction within systems analysis is that between hard and soft approaches. In general, the hard approach deals with well-defined, technical problems and generates quantitative results whereas the soft approach is used for ill-defined problems and includes cultural considerations and qualitative data (Checkland 1999). Additionally, hard systems analysis is about optimisation or control while the soft approach strives for learning and increased understanding of a problem (Pahl-Wostl 2007).

A systems approach is common within the research tradition of energy analysis. The heating system of a house or the future energy use in the transport system could be analysed as energy systems. In analysis, the system is represented by a model, a simplified representation with the purpose of understanding or that of informing decision makers. Ideally, the model, its parts and relations are defined by the problem at hand; within energy systems analysis typical approaches include input-output analysis, cost-benefit analysis and actor-network analysis. Emphasising that the model is not the system but a representation created for a purpose is especially important when existing models are used to address new research questions.

Traditionally, hard approaches dominate the analysis of energy systems, for example how different technologies influence the system's input and output flows of kWh. Normally, the production and distribution of energy are modelled, while energy use belongs in the system surroundings. The soft approach is when these studies are complemented or replaced by an analysis of the management, actors and networks of energy systems (Neves et al. 2004). Attempts at bridging the two approaches have also been made (Lane & Oliva 1998; Pahl-Wostl 2007).

Quantitative modelling is often performed with the aid of computers and special software. The software's features guide and restrict the modeller's choice of technologies, time resolution, and system boundaries. Therefore, selecting the proper modelling tool in relation to the system and the research question is important. In the SitCit project, pre-designed energy software is unsuitable since the SitCit research questions go beyond standard approaches. We therefore use a more generic mathematical software, Stella©, to generate quantitative data. Stella has a graphical interface and is designed as an exploring and learning tool where the model can be understood also by non-programming experts.

When modelling a Situation of Opportunity as an energy system, we combine elements from hard and soft approaches. The strict quantification is a hard feature, while other elements come from the soft approach: The model is not designed to optimise energy use, but rather to explore and learn about it; modelling is part of the learning process, involving also external experts. Furthermore, modelling is strongly guided by the properties of the system and the

research question. Just as in other parts of the SitCit project, the actors' perspective is at the fore; the definition of sub-systems starts with the issue of who can change that part of the system. Finally, unlike most approaches to the modelling of energy systems, end use is our core process; we model the Situation as an Energy Usage System (Lagergren 2005).

The modelling process has three steps, the *conceptual*, *qualitative* and *quantitative*, respectively. The first one results in a generic conceptual model of a city district as an Energy Usage System. It is developed through an iterative process, gradually defining what is part of the system and what belongs to the system environment. Following Churchman (1968), we in turns ask: "Does this measure matter in relation to the low carbon, low energy objectives?" and "Can the actors of the system do anything about it?" If the answer is yes to the first question and no to the second, the measure is part of the system environment. To a large extent, this is similar to the *What-Who* iteration we use when developing the Content Scenario.

The resulting generic model is illustrated in figure 2. At its core are the activities of daily life of the district's households, the Human Activities System (HAS). Surrounding it, a number of Energy Usage sub-systems (EUS) are found. They provide the energy services that enable activities such as travelling to work, cooking or spending leisure time indoors. Transport and housing are examples of unifying EUS categories. Locally produced energy is included in the system. However, distribution to the district through electric cables or district heating tubes as well as primary energy conversion through waste incineration or in a hydroelectric plant both belong to the system environment, following Churchman.

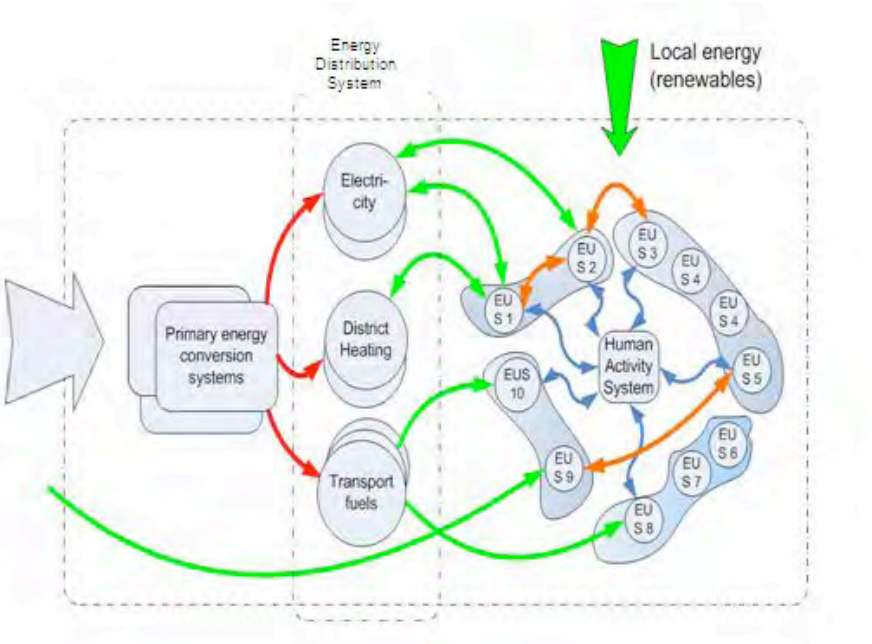

Fig. 2 The conceptual, generic model of a Stockholm City district as Energy Usage System. The city district households' activities of daily life are at the core of the model. Energy Usage Systems such as the car, the underground or the heating system of the home are modelled as subsystems. They transform energy into something useful for the household members, such as good indoor climate or commuting to work. Locally produced energy for example from solar panels also belong to the system. The distribution and large-scale production of electric energy or district heating belong, however, to the system surroundings since they cannot be influenced by the actors of the city district.

The second modelling step results in a qualitative model of one individual situation of Opportunity in one of the city districts. It needs the Content Scenario and the generic conceptual model as inputs, describing what things in the city district that are transformed in the Situation

and who the actors involved are. In the Bromma case, the fleet of shared cars is one subsystem, the private cars another, the public transport vehicles a third, each having its technical properties and managers that can influence the subsystems as well as use them more or less.

In the third, quantitative phase, each subsystem is modelled using the Stella software with the purpose of giving quantitative answers to *How Much* the Situation can contribute to the low carbon, low energy objectives. Data is collected through a literature review and interviews with practitioners and transport researchers. The properties of the vehicle fleets etc. are transformed into mathematical representations. The flexible Stella interface makes it possible to quantify not only the output of the Situation as a whole but also the influence on that output from changes in any one parameter. For example, the influence of users and managers of the car sharing system are represented by sliding controls that can be adjusted to simulate answers to detailed "What if…" questions such as "What if the fleet had a 40 instead of 80 per cent share of electric hybrid cars?" or "What if the residents increased their use of the tram by 10 per cent and their biking by 25 per cent, in parallel reducing their use of private cars by 30 per cent?". In other words, the actors are not part of the model, but the cumulative effects of their decisions can be illustrated.

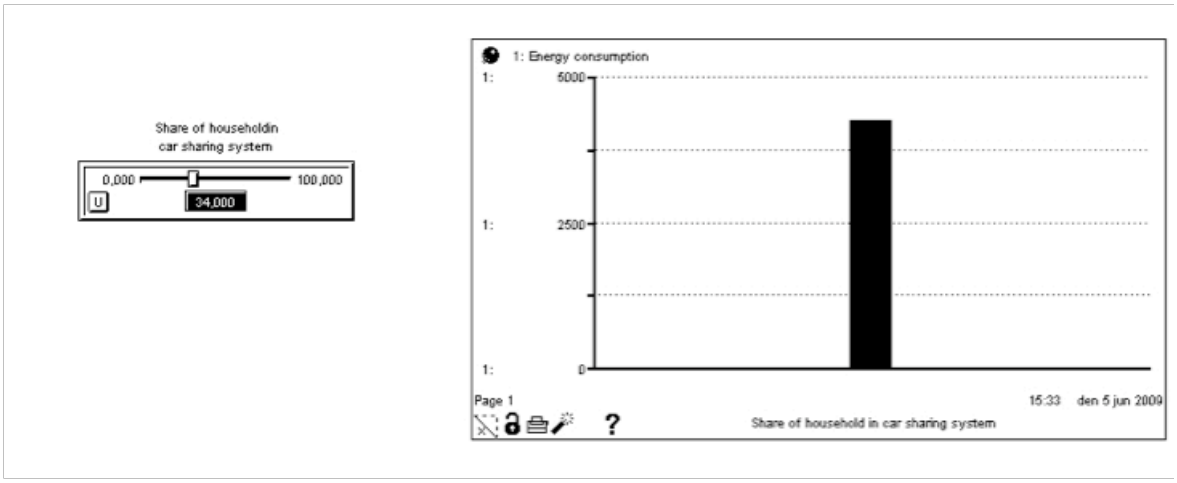

Figure 4. One example of the Stella interface, showing the sliding control that enables changing the share of households in the Bromma car sharing system. The output is shown as total primary energy use.

The *How* representation – Transformative Network Governance

How can a group of actors combine efforts to utilise the full potential of a Situation Seed? How can city planners exercise their authority and extend their indirect influence through being initiators, facilitators and co-ordinators of a Situation? When can co-operation take the form of projects, when is a less formalised network organisation relevant? How does the organisation of the Situation evolve over time? These and similar questions are addressed in this step of the exploration of a Situation of Opportunity. Planning theory and elements of political science, with governance as a key concept, provide concepts and tools of exploration.

Planning as practice and research tradition is future oriented, has normative traits and is cross-disciplinary. It includes studies of desirable futures illustrated as plans or visions, and the actor-driven process of change. Various definitions of planning exist (Alexander 1995),

and its meaning has evolved from a more deterministic view to an understanding that planning should consider past and present to help shaping the future – in a continuous and self-correcting process. Healey (2003) considers planning to be broader than the practice of regulating land-use, also including a critical perspective and the development of new approaches where present practice is failing.

Healey (2007) also identifies a number of actors who are involved in planning: politicians, party-networks, lobby groups, business interests, landowners, developers and residents; but above all, "planners" are frequently in the position to understand and merge concerns and understandings from the actors' differing viewpoints. In Swedish practice, a consensus model is the norm; however, in planning for the extensive transformations of urban sustainable development, a pragmatic "agonistic" planning approach which explores and utilises potential conflicts instead of avoiding them is useful (Engberg & Ploger In press).

The traditional, *government* approach of political science highlights the top-down hierarchical chain of command of public organisations. It implies that control and direction take place within governments and their formal institutions, that these institutions can take decisions and that they have the capacity to enforce them (Boyer 1990; Stoker 1998). The *governance* approach has been developed to explain today's more open decision-making processes, involving an intricate interplay between public, private, and non-profit organisations as well as citizens. In governance, this interplay is more or less self-organising and therefore not fully accountable to governmental bodies.

The concept of governance is extensively used in planning theory as well as by political scientists. The relationship between traditionally governing public bodies and modern governance networks can be described as the tension between the hierarchical, vertical logic of representative democracy vs. the horizontal logic of self-governing networks (Rhodes 1997; Börzel 1998; Peters & Pierre 2004). In a traditional government context, legitimacy and accountability are sustained through the chain of command from voters via politicians to the public administration. In contrast, a governance structure makes legitimacy and accountability intertwined and multiple (Stoker 2004). The concept of meta-governance has been used to address the issue; it "...designates the effort to regulate self-regulating governance networks by influencing the conditions under which they operate" (Jessop 2002).

Temporary, contracted project organisations are the norm in building design and construction; they have been researched by business economists and through organisation theory (Sahlin-Andersson & Söderholm 2002). On the one hand they are established practice for routine projects, on the other they have been used to tackle new and complex situations where uncertainty is large, as for example in the aforementioned development of Hammarby Sjöstad in Stockholm. Although the two are seldom discussed in parallel, the project organisation is a formalised network (Wihlborg & Palm 2008), and they also have other similarities.

In SitCit, we give planning a wide definition and see it as a continuous, self-correcting process. Within this definition, the planner is any representative of a city authority which is involved in identifying or exploring a Situation of Opportunity. Given the opportunities of a Situation, it could even be a private organisation; in the Bromma case, the assumed manager of the car sharing system is a planner if its representatives take a lead during the implementation process. In general, we assume that utilisation of the full potential of any Situation calls

for collaboration in terms of governance. However, we still se the city authorities as key actors, and thus have to consider the legitimacy and accountability of the Situations' project or network organisation(s).

The main purpose of elaborating the process of Transformative Network Governance is to show that an organisational model can be found, that can utilise the opportunities of the Situation. To demonstrate this, we develop a model of such an organisation. Thus we illustrate the realism of the Situation through replying to the question of *How* it could become reality. The actors have already been identified when the Content Scenario was developed; remains to elaborate each actor's role in the process and in relation to what issues, to define the relationships between the different actors and to illustrate how actors come and go during the process.

As already mentioned, we assume that the city planners have played a key role in identifying the Situation's Seed and the actors to be involved. In the Bromma case, the Seed is the aforementioned question "What if the residents of Bromma were prepared to in part substituting their use of private cars for a car sharing system combined with improved public transport?" This is not an issue with the city planners of Stockholm at present. Thus, the initial assumption can be counterfactual – it need not be totally realistic as judged from the perspective of today. On the other hand, once the basic assumption is given, the rest should be as realistic and explicit as possible. In the Rinkeby-Kista case, we start with an existing network organisation, that of the "Järva Boost". It is initiated by Stockholm's City Management Office, involving public and private real estate owners, residents and their organisations etc. However, the Seed takes the Situation beyond analysis of an ongoing process in asking "What if the planned renewal of the city district Rinkeby-Kista had the low carbon, low energy society as a guiding vision besides the need for changing roofs and appliances and addressing socio-economic problems?". Thus, in this case we take the liberty of introducing new actors, other forms of collaboration, new incentives for change etc., all to identify as many contributions and contributors as possible to our overarching objective.

The elaboration of the Transformative Network Governance scenarios for Bromma, Rinkeby-Kista and Södermalm is still largely in the future. Its conceptual and theoretical background has been outlined above, and we also intend to use focus group methodology involving Stockholm City planners as well as experts. Another methodological aid is the Gantt type diagram, that helps highlighting the development over time of the governance network. The actors' fields of responsibility and their forms of collaboration are best described in terms of a project organisation, as text. It, too, could however be illustrated in diagrams.

Conclusion – defining and delimiting units of study, retaining complexity

The concept of Situation of Opportunity was "discovered" when researching the environmental management of the City's project team in Hammarby Sjöstad. It was then developed through case studies to become a conceptual system and a research methodology to analyse historical and ongoing, planned cases of extensive city transformation, asking "What made change possible?". In the SitCit project we take it into the future. Through case studies located in three Stockholm City districts, we develop it to enable the identification and exploration of periods in the districts' future growth and change that have a large potential for change. The overarching assumption is that mitigating and adapting to climate change call for urgent and extensive transformations of the existing city and the way it is used, and that this is necessary

and possible rather than probable.

The historical studies of Situations of Opportunity were case studies proper. However, at most the initial Seed of a future Situation can be said to exist. The rest has to be created, and how to do this is the methodological development part of SitCit. Through scenario building and elements of backcasting methodology from the research tradition of Futures Studies, we elaborate a Content Scenario of each Situation of Opportunity, iteratively asking *What* can change and change *by Whom*. This scenario is then further explored and evaluated using case study methodology, based on the documents of the case. Through its modelling as Energy Usage System, we enable the quantification and evaluation of possible reductions in energy use and emissions and the mapping of the Situation's potential Field of Options. The Situation is also elaborated as a process of Transformative Network Governance. This allows us to assess to what extent the end results of transformation are plausible in terms of actors coming together to make things happen.

At present we focus on exploring first generation Situations, situated in the next 10-20 years. In later phases of the project we will look further into the future and also study the whole transformation from today to a low carbon, low energy society. As we move further into the future, uncertainty will increase. The focus will be more on how to identify Situation Seeds well in advance, less on exploring the Opportunities of a Situation in detail. This will call for further methodological development.

Research so far indicates that it seems indeed feasible to develop the concept of Situations of Opportunity to a research strategy that can be used to explore the potentials for extensive and rapid reductions in energy use and its emissions through urban planning with a wide definition. It also seems realistic that we produce a body of cross-disciplinary findings about this process of transformation, giving new knowledge on the magnitude and main difficulties of the transformation. Thus we argue that we will produce knowledge for change that could contribute to urban sustainable development. Its applicability should be larger than just the Situations explored in the three city districts. However, the SitCit project is not action research; we do not assume that the project in itself will initiate change, nor that it will give the actors of the city districts new knowledge. We also acknowledge that many methodological and other difficulties lie ahead.

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