Transition in the making

A critical dispute on urban transition processes toward sustainable mobility

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A Critical Dispute on Urban Transition Processes towards Sustainable Mobility

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Transition in the Making. A critical dispute on urban transition processes toward sustainable mobility.

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This thesis has been submitted for assessment in partial fulfillment of the PhD degree. The thesis is based on the submitted or published scientific articles, which are listed above. Parts of the articles are used directly or indirectly in the extended summary of the thesis. As part of the assessment, co-author statements have been made available to the assessment committee and are also available at the Faculty. The thesis is not in its present form acceptable for open publication but only in limited and closed circulation as copyright may not be ensured.

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Preface and Acknowledgements

This research project is a result of a three-year PhD fellowship embedded in the research project "Enabling and Governing Transitions Towards a Low Carbon Society" (SusTrans) and conducted at the Department of Development and Planning at Aalborg University, Aalborg. This PhD thesis studies sustainable mobility transition strategies to offer critical reflection on existing solution approaches and possible alternatives. The thesis demonstrates reverse effects of technological fixes, inequitable development through unlimited mobility ideals, and limits to urban growth calling for an alternative path. The inquiry promotes more radical change and restructuring to achieve an environmentally sustainable and just mobility future.
The SusTrans project is engaging with transition processes across and within five societal arenas relevant for sustainable transitions: market regulation, household consumption, innovation dynamics, city structure and transport, and legislation on biomaterials. The overall research project comprises mostly Danish cases, with an obligation to provide knowledge for transition strategies based on the necessity to improve and intensify research and recommendations to achieve the climate goals set nationally and internationally (SusTrans, 2013). This PhD project is affiliated to the subproject D, which investigates transition attempts and processes that envision a "low-carbon society" on a municipal scale with a focus on relationships between the cityscape and mobility. This PhD thesis focuses on the Danish case of Fredericia in Southern Jutland. This municipality is attempting a transition toward becoming one of the leading climate municipalities in Denmark and initiating various measures to reduce CO_2 emissions. Moreover, the sustainability flagship project Fredericia C reflects a contemporary approach to sustainable city districts that may function as sustainability niches and/or motivators for urban transformation processes (Fredericia C P/S, 2012).

This PhD thesis deals with the very challenging and contemporary topic of sustainable mobility transitions. However, it is concerned not only with contemporary issues, but also with a fundamental discussion regarding radical societal change and the challenges such change faces. The research topic, in addition to engaging with current progress within urban mobility development, is also about the near and faraway futures, which are yet to come. It is a critical discussion comprising structures we are building and reproducing everyday. As these are often fundamental structures of our life, it is hard to see how we could be able to change them. And this is one of the challenges in transformative change. Transitions force us to think of systemic change and to go beyond thinking about product innovation, even though some of the products envisioned might be promising.

My personal motivation to research within the field of mobility transitions can be traced back to my time as a master's student. Ambivalent mobilities were the theme I studied with the greatest interest. Already at that time, I was curious to understand contradictory

practices and to grasp the complexity behind urban mobility. Thus, in this thesis, I wanted to immerse myself in the underlying conditions that lead to ambivalent planning practice and to understand the gap between mainly growth-led planning practices and ambitious sustainability goals; to critically discuss contemporary approaches as well as looming trends; and to engage with democratic questions of, for example how to define an appropriate demand for mobility and consumption, and who can decide on those definitions.

Altogether, engaging with normative stands within planning, such as values for just and sustainable planning, is of personal concern to me. Most academics appear to be forming a position within their fields of expertise and scientific understanding, more or less consciously, that relates to personal values and forms or at least influences the foci and argumentative attributes of their work. This does not mean that there is no room for critical scrutiny of this position; on the contrary, a critical view of knowledge claims and formulated planning goals is key, and this necessity also applies to my own perceptions as a researcher.

Moreover, I think this research has a bold angle due to its critical content. A kind of functional or realist utopia may capture the kind of motivation that can be utilized in moving toward desirable and different futures. It can be difficult to achieve a productive approach between making a strong critique of contemporary transition approaches without becoming too desperate and demotivating, and offering a viable chance for desirable transitions while avoiding too much compromise, which may lead to a continuation of business as usual, just with a "green coat." Also on a personal level, this project provokes a critical reflection on my own consumption patterns and responsibilities within the bigger picture of sustainability transitions. Offering a space, in the manner of this research, to debate challenging questions and suggestions is essential to coping with challenging conditions identified in theory and practice. Demonstrating alternatives and being positive and open to change for the sake of progress is central to genuine transformation. Transformative change is an ongoing dispute that can only be influenced by participation.

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Carrying out this PhD project involved a multitude of experiences in the professional journey I underwent to learn about my academic personality – forming and changing opinions, accumulating new knowledge as well as questions, and reflecting upon values – a journey that left its traces on my personal progress, too. Looking back, those years were a challenging time in which I coped with various severe experiences in my professional and personal life, and I am very thankful for the support I received.

I would like to acknowledge a few people whose advice and care were important to my professional development and personal well-being in this period of my life. First, my supervisors: I want to acknowledge the support of Petter Næss, Søren Løkke, and Karl

Georg Høyer to complete this PhD. Karl Georg passed away in October 2012. I am happy to have met him, learned from him and laughed with him. I will keep him in good memory. Also, thanks to Søren for taking over the role of my supervisor in troubled times. In particular, I am very thankful to Petter for being my supervisor and mentor. He retained his role as my supervisor until the end, despite many changes in this period, including personal loss and work-related relocation. Petter is a very good academic; he is a responsible, fair, caring and straightforward person who offered me good guidance and reflection as an academic sparring partner.

Moreover, I want to say a few more words about the research environment I was working in, which, generally speaking, was an encouraging experience, though also challenging due to the department's restructuring, relocation and financial crisis in recent years. In particular, I would like to thank my research group Urban Planning and Mobility (UPM), which unites engaged and critical scholars in the field of urban planning and mobility with empathetic and encouraging colleagues who take care of each other beyond the office space. At section D I acknowledge the collegial atmosphere, cross-research groups and, especially, a supportive PhD community. At the beginning of my PhD work, the study group formed by SusTrans' PhD's and postdocs was valuable for discussing theory and approaches within transition studies. Also, the SusTrans sub-project D with which I am affiliated was an important space for interchange and development of ideas; thus, special thanks are due to my colleagues Anne-Katrine, Andrés, and Morten.

Finally, I appreciate and am thankful for the support and care of friends and family in Aalborg, Aarhus, Copenhagen, Hamburg and Berlin. In particular, big thanks to Frank. He was a priceless support throughout the whole period. Thanks for being there for me, and for your patience.

Summary

The current attention and urgency given to urban transitions sets the scene for this PhD thesis. Cities increasingly seek to transform to more sustainable urban systems, yet the actual urban form, energy consumption or mobility patterns can reflect a different orientation motivated by economic growth. To investigate the causes of the gap between the aspiration toward sustainable futures and the realities of actual practices, this thesis critically reflects upon existing solution approaches, trends and alternative paths for long-term changes within urban mobility. A discourse of unrestricted mobility, competition between city authorities, and a liberal and growth-oriented planning approach, along with reluctance to regulate, works to complicate if not impede attempts at sustainable transitions. This implies a need for strategies that change habits and re-model interests among citizens, stakeholders and authorities. This research project evaluates current strategies for land use and transport planning and thereby discover barriers and conflicts hindering the realization of a sustainable mobility transition, and identify opportunities for transition in a more sustainable direction. This will be exemplified by the urban case of the municipality of Fredericia, which aims to undergo a sustainable transformation. Being a Danish Climate Municipality, Fredericia is concerned with different climate initiatives that can reduce its carbon emission. Also, the sustainability flagship project Fredericia C, which aims to create a carbon-free urban district, represents Fredericia's engagement with sustainable futures. Moreover, Fredericia is part of the regional network Triangle Region in southern Denmark and affiliated with the so-called East Jutland City Assembly, which is understood as one of the new growth regions in Denmark.

A particular focus is directed towards the application and further development of concepts of transition theory within the field of urban studies. Borrowing the viewpoint of transition theory, the thesis addresses the complexity of transformative change. The underlying causal relationships are investigated through a structure-agency analysis, which provides a deeper understanding of the structural conditioning of agency and different agential capacities to change structures. Scenarios are applied to create coherent narratives around differing sustainability rationales, which contextualize the different transition strategies for sustainable mobility toward long-term futures. The analysis shows the insufficiency and possible reverse effect of technological fixes and the negative consequences of an unlimited mobility ideal, leading to the conclusion that a genuine engagement with the limits of urban growth calls for demand reduction and acceptance of capacity limits and sufficiency thinking. Specific attention is paid to inter- and intraregional competition as these dynamics influence development and decision-making. Moreover, niche concepts such as sustainable city districts that increasingly evolve are set into the overall development context and are evaluated according to their possible impact on transitions.

The project illustrates relevant measures and processes that might contribute to break the circle of increasing road traffic volume, facilitate the transition from high-carbon to low-carbon mobility regimes and overall offer a critical investigation of contemporary land-use planning and transport development as a contribution to improved planning actions.

The thesis offers analytical and practical considerations for mobility transitions in the making and, more generally, provides a critical reflection on societal disputes over radical change.

Dansk Resumé

Den nuværende opmærksomhed på og betydning af urban omstilling sætter scenen for denne PhD-afhandling. Der bliver lagt stadig mere vægt på at forandre byer til mere bæredygtige urbane systemer, men alligevel afspejler den nuværende urbane form, energiforbrug og mobilitetsmønstre ofte en anderledes orientering, motiveret af økonomisk vækst. For at undersøge årsagerne til kløften mellem ambitionen om en bæredygtig fremtid, og hvordan den aktuelle praksis reelt ser ud, giver afhandlingen en kritisk refleksion over de eksisterende løsningsinitiativer, trends og alternative muligheder for langsigtede forandringer inden for urban mobilitet. En diskurs om ubegrænset mobilitet, konkurrence mellem myndighederne i byerne, en liberal og vækstorienteret tilgang i planlægningen og en modstand mod at regulere, vanskeliggør forsøget på bæredygtige omstillinger. Det medfører et behov for strategier, som ændrer vaner og omformer interesser i befolkningen, hos aktører og hos myndigheder. Dette forskningsprojekt evalueres de nuværende strategier for arealanvendelse og transportplanlægning med henblik på at undersøge barrierer og konflikter, der hindrer udførelsen af en bæredygtig mobilitetsomstilling og dermed mulighederne for at skabe forandring i en mere bæredygtig retning. Det eksemplificeres i en case om Fredericia Kommune, som har udtrykt intentioner om at gennemgå en bæredygtig omstilling. Som dansk klimakommune er Fredericia Kommune optaget af forskellige klimainitiativer, som kan reducere dens CO_2-udledning. Flagskibsprojektet indenfor bæredygtighed, Fredericia C, hvor der satses på at skabe et CO_2-neutralt bymiljø, repræsenterer byens engagement i en bæredygtig fremtid. Desuden er Fredericia med i det regionale netværk, trekantsområdet, i det sydlige Jylland og er tilknyttet det såkaldte østjyske bybånd, som regnes for ét af de primære vækstområder i Danmark.
I afhandlingen er der lagt særligt fokus på anvendelsen og udviklingen af koncepter inden for omstillingsteorier i bystudier. Ved at benytte omstillingsteorivinklen tager afhandlingen fat på kompleksiteten i urbane omstillingsprocesser. De underliggende kausale sammenhænge bliver undersøgt gennem en struktur-aktøranalyse, som giver en dybere forståelse af de strukturelle konditioneringer af aktørers praksisser og aktørernes varierende kapaciteter for at ændre strukturer. Scenarier er anvendt for at skabe sammenhængende fortællinger om forskellige bæredygtige rationaler, som sætter de forskellige fremtidige omstillingsstrategier inden for bæredygtig mobilitet i kontekst. Analysen påviser den kortsigtede og potentielt modsatrettede effekt af teknologiske effektivitetsløsninger og de negative konsekvenser af et ubegrænset mobilitetsideal, og fører til den konklusion, at et ægte engagement med grænser for byvækst kræver reduktion af efterspørgsel og accept af kapacitetsgrænser. Der er lagt specielt vægt på intraregional og interregional konkurrence, da denne påvirker udvikling og beslutninger.

Derudover er nichekoncepter, såsom bæredygtige bydistrikter, der i stigende grad dukker op, evalueret i den overordnede udviklingskontekst i henhold til deres mulige indflydelse på omstilling.
Afhandlingen illustrerer relevante mål og processer, som måske kan bidrage til at bryde cirklen med den øgede trafik og samtidig muliggøre overgangen fra høj- til lav-CO_2-mobilitetsregimer. Den omfatter en overordnet kritisk undersøgelse af nutidig arealanvendelsesplanlægning og transportudvikling og skal ses som et bidrag til at forbedre planlægningspraksisser. Afhandlingen byder på analytiske såvel som praktiske betragtninger som bidrag til samfundsdebatten omkring radikale ændringer.

1. Introduction

The current academic attention to urban transitions and the related city discourses on sustainability sets the scene for this PhD thesis. Cities increasingly seek to transform into more sustainable urban systems, yet the actual urban form, energy consumption or mobility patterns often reflect a different orientation. To investigate the gap between the aspiration for sustainable futures and actual practices, this thesis critically reflects upon existing solution approaches, trends and alternative paths for long-term changes within urban mobility. The current urban development is strongly coupled to a "Mobility as Modernity" discourse. Ecological modernization is the dominant sustainability rationale, offering solutions in the form of technological innovations such as smart cities, smart grid or overall green growth. Within mobility planning, electrifying the transport sector, offering alternative fuels or introducing individual mobility management schemes are the prevalent approaches. Liberal market structures and individualism in society create specific consumption patterns, which reproduce an understanding of mobility=progress=growth and reject alternatives that might threaten this rationale. Against this background, this PhD thesis engages with sustainable urban mobility futures with a critical, empirically informed analysis on concepts for urban transitions in a Danish planning context, identifying key mechanisms and evaluating current solution approaches in a long-term perspective.

In the following sections, this chapter introduces the basic objective of the thesis, stating the problem and the relevance of dealing with sustainable urban transitions in general and at a case-specific level. Some selected approaches are presented representing the engagement with, and knowledge around, the theme of sustainable urban mobility from a transition perspective. This is followed by the research questions that define and guide the chosen approach in this PhD project. The chapter ends by presenting the overall structure of the thesis. It also introduces the five articles; it comprises and explains how they are linked to the research questions.

1.1 The objective of the thesis

The thesis deals with the well-known and repeatedly articulated challenge of developing sustainable mobility systems and patterns, which is a persisting problem that is highly relevant to the overall urban future. This thesis offers a new perspective on sustainable

urban development by looking at it through the lens of transition theory, investigating the underlying causal relationships through a deeper structure-agency analysis, and applying a scenario methodology creating strong narratives around differing sustainability rationales, which can have a bearing in planning transition processes and policy decisions for the future.

The overall objective (as well as the challenge) of this thesis is to offer an alternative and critical view to given approaches on sustainable mobility transitions. It does not offer a blueprint for how to do it; instead, existing solutions and dominant trends are critically evaluated in the contemporary societal context and planning practice. Moreover, more radically different alternatives are introduced and discussed, as they are providing, based on the contemporary unsustainable conditions, a necessary rethinking and reorientation that goes beyond given systems, established structures and behavioral patterns of urban mobility. The value of such radical alternatives lies in the possibility of breaking with the path dependencies and allowing critical reflections on business-as-usual practices and thoughts. These alternatives might be considered utopian and impracticable under current circumstances; however, they can be considered as coherent visions, which might become accessible and desirable when conditions change due to socio-political shifts or intensified crises that create new contexts for radical change, or at least the perception of what might be a (radical) option could change.

"*A principal challenge in transitions is to deal with contradictions between existing socio-technical regimes – with established lock-in effects of non-sustainable technologies, institutions, practices and values – and new sustainable regimes to be shaped*" (SusTrans, 2013). The research in this thesis originates from the curiosity to understand ambivalent planning practices and attitudes toward more sustainable mobility futures. The urgency of performing an urban transition that reduces CO_2 emissions calls for verification of the effectiveness of contemporary measures and solution approaches so that unsustainable path dependencies can be avoided or reduced. Moreover, promising initiatives should be supported in the best possible ways, which requires coordination at the systemic level, incorporating land use and transport planning, and not just at the product level in form of alternative fuel usage. The contribution of this work is to critically evaluate current attempts to transition toward more sustainable futures. In sum, the following preliminary questions are central to a critical, informed debate on urban mobility transitions:

- ***What** is actually going on?* What are the current transition approaches in an urban mobility context, and are these approaches sufficient? How can transition processes and progress be investigated?

- ***Who** (and what) is involved and **how**?* Who are the transition actors, what defines the transition's agenda, and how does that result in an (un)desirable transformation?

- *What **to do** about it?* What are the transition opportunities and barriers? How can this knowledge be utilized to enact efficient, sustainable urban mobility transitions?

1.2 Urban transitions: Their relevance and case-specific context

Under the rising pressure of climate change, cities are increasingly being focused on. They are places of opportunity and they are responsible for acting upon undesirable patterns of consumption and production and developing alternative and more sustainable approaches of mitigation and adaptation strategies. The International Panel on Climate Change (IPCC) has concluded that greenhouse gas emissions will likely need to be reduced by 50-80% by 2050 in order to avoid dramatic and unalterable climate change (IPCC, 2007). Especially in the transport and land-use sectors, farsighted considerations need to be taken when implementing measures, such as building new housing stock or transport infrastructures, as the development decisions will have long-lasting impacts on urban futures.

> "*Infrastructure developments and long-lived products that lock societies into GHG-intensive emissions pathways may be difficult or very costly to change, reinforcing the importance of early action for ambitious mitigation*" (IPCC, 2014).

According to the Danish Climate Commission and the National Energy Report, Denmark is aiming to be independent of fossil fuels by 2050 (Regeringen, 2011). This is a challenging aim seen from contemporary conditions; however, many experts and politicians formulate visions and goals accordingly under rising political and societal pressure. Consequently cities and regional networks are developing climate strategies within the existing planning frameworks, such as Climate Initiatives in the Triangle Region, CO2030 in Aarhus, and Copenhagen's climate plan, to mention a few. Nevertheless, especially in the field of mobility, difficulties and divergent opinions exist regarding transition strategies toward more low-carbon transportation patterns and infrastructures. A variety of visions are developed that describe "green" and "smart" futures of city development, such as an increasing trend toward the development of so-

called sustainable, car-free or zero-emission city districts, which are often planned from scratch within existing urban built environments (e.g., on former industrial sites), or of a more comprehensive urban development strategy.

However, these ambitious aims often stand in sharp contrast to actual development. The cause of this gap may originate in unclear development strategies and planning practices, which deviate from formulated aims and even impede long-term visions as a consequence. Conflicts arise based on different emphasis given to the significance of, e.g., economic growth, social equality, environmental preservation and a general understanding and translation of sustainable urban development. Planning has to deal with multi-goal conditions, clearly, though logically linked sub-goals and coherent long-term planning may reduce conflict to some extent. Generally speaking, uncoordinated and disconnected land use and transport planning often result in urban sprawl. Moreover, municipal competitions for increased jobs and housing growth, leading to longer driving distances as a result of dispersed housing, dependence on car-commuting and missing transport alternatives, can create socio-technical lock-ins as well as inefficient situations and impede or even inhibit the realization of low-carbon mobility.

This thesis focuses on the case of Fredericia within the so-called Triangle Region in southern Denmark. This case represents an ambivalent planning practice in the field of sustainable urban mobility. Fredericia is also part of the so-called East Jutland City Assembly, which is understood as one of the new growth regions in Denmark (Ministry of the Environment, 2006). These national discourses around growth and competition influence the municipal level as well as the polycentric Triangle Region in its development ambitions. Furthermore, with more than 90% car-based traffic, this region has an outstandingly high level of car dependency in comparison to other Danish regions (cf. figures 1 below) (Trekantomraadet, 2014: 116).

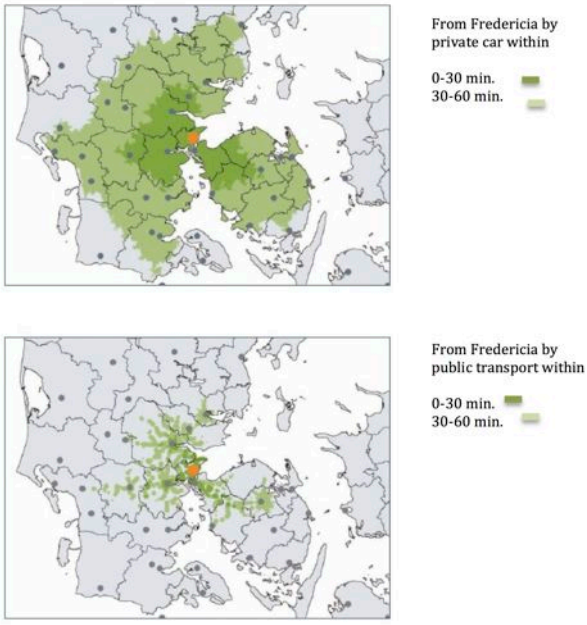

Figure 1: Travel time and distance by private car versus public transport (Region Syddanmark, 2010: 8).

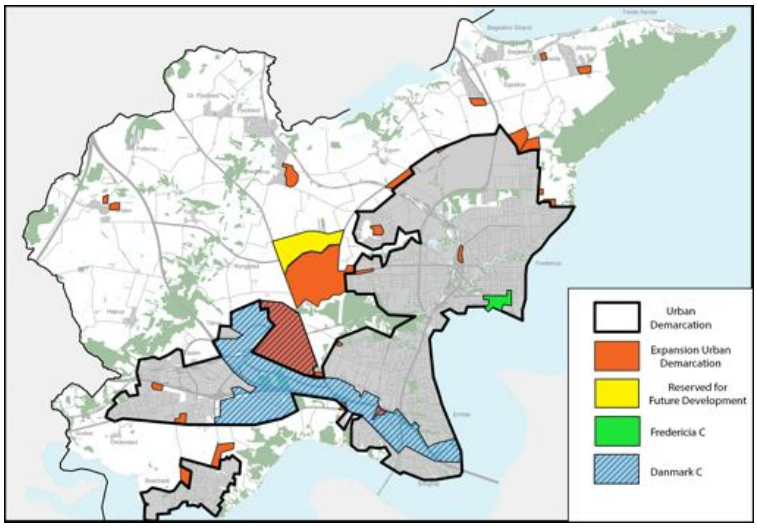

Figure 2: Illustration of the contemporary and planned land use in the Municipality of Fredericia in 2014 (based on Fredericia Kommune, 2013).

The municipality of Fredericia is planning to undergo transitions toward a more low-carbon future, but the development approaches appear to be twofold. On the one hand, the city participates in climate initiatives and pilot projects aiming to reduce the municipality's CO_2 emissions, such as an electric car fleet, natural gas buses and mobility management schemes, and offers compact redevelopment at the former industrial harbor through the project Fredericia C. This is an urban renewal project reflecting dense mixed-use development near the city center, which is branded as a sustainable flagship project of the municipality (cf. figure 3). On the other hand, municipal rezoning plans at the urban fringe represent a continuation of urban sprawl, and together with highway expansion this represents a contrast to the latter planning approach. Instead of promoting sustainable mobility, car dependency and an increasing need for transport in general is favored (cf. figure 2). Moreover, Denmark's largest industrial park, Danmark C, is located within the municipal boundaries of Fredericia and is geographically central in Denmark. This industrial park's goods transport operates mostly via the highway infrastructure in the region and absorbs an immense amount of land for its logistics businesses.

Figure 3: Illustration of Fredericia C – a sustainability flagship project at a former industrial harbor of Fredericia, which represents a new city district with a plot ratio of 1.3 comprising 50% housing, 40% retail and 10% cultural use (Fredericia C P/S, 2012).

The overall planning context is challenging for a sustainable mobility transition. Even though the municipality shows some sustainability efforts, contemporary conditions reflect high automobile dependencies due to land use and transport decisions that favor

such lock-ins. The niche-like projects, which might be promising attempts in the right direction, seem to lose their positive impact under given structural conditions. On top of that, the competitive and growth-oriented rationale dominates decision-making processes and impedes a sustainable transformation.

1.3 Status of knowledge: Sustainable urban mobility in a transition perspective

> *"[W]e need a new approach to what cities should do to become more liveable, economically successful, and environmentally responsible: smart cities, that is, energy-efficient, consumer-focused and technology-driven." (Risø DTU, 2011: 5)*

This quote represents a common approach in current development plans for many cities. Cities should satisfy multiple functions simultaneously, and with rising pressure from the consequences of climate change as well as the economic crisis, the urban conditions become even more complex; it is questionable whether such visions are realistic, if at all desirable. The latter part of the quote especially describes the widespread fixations on technology and consumption, which may direct strategies away from possibly necessary behavioral shifts and toward a general rejection of limitations on demand structures. In particular, mobility opportunities are seen as an unquestioned need of societal development. Being mobile is understood as a kind of indisputable positive and absolute right (e.g. Urry, 2000; Cresswell, 2006; Canzler et al., 2008). It is coupled to progress, economic growth and personal freedom, so that any restrictions regarding mobility opportunities often face rejection. The aspect of competition in general is a strong driver for development plans and visions. However, the internal logic of growth and that of sustainability contradict each other, though attempts have been made to combine their goals under the idea of "green growth" (for a critique, see Daly, 1993). This is a questionable concept, but a powerful one, as it seems to satisfy contemporary discourses striving for both.

A shift in mobility regimes is one of the biggest challenges in the transition to sustainability and requires comprehensive and simultaneous effort within land use planning, transport systems and shifts in mobility behavior. It may provoke new institutional settings that guide and regulate systemic change toward a reduced demand.

1.3.1 Mobility demand – unsustainable couplings

> "*Annual energy consumption from transport grew continually between 1990 and 2007 in EEA member countries. Between 2007 and 2009, the total energy*

> *demand from transport fell by 4%, but the upward trend could easily resume with economic growth. Achieving Europe's targeted 60% CO_2 reduction by 2050 compared with 1990 will require the consumption of oil in the transport sector to drop by around 70%. The current 96% transport-sector oil dependence is unsustainable*." (EEA, 2014)

The quote describes the European conditions, which are also reflected in the Danish context. The national Climate Plan states that the Danish transport sector is responsible for a third of the total energy consumption and the sector is nearly exclusively based on fossil fuel usage. More than 50% of the transportation-related CO_2 emissions arise from individual automobile use (Regeringen, 2013). The overall transport demand is steadily rising (ibid.) and thus the transport sector is one of the most threatening domains within the climate change challenge and a key sector that needs to undergo radical changes to arrive at the goals set at the national and European levels.
Economic growth and social status are closely related to mobility standards that are understood as a competitive necessity on national, local and individual levels. Couplings of mobility to economic growth often inform dominant arguments on a national level for expansion of road-based infrastructure (for an example, see Infrastrukturkommissionen, 2008). In everyday life the social necessity to be mobile creates expectations of mobility standards in private and professional life. People, cities and nations are pressured to fulfill increased mobility standards in order to attract businesses and people, to dominate, to be "part of the game" of modernization and globalization processes (Sennett, 1998; Cresswell, 2006; Canzler et al., 2008). Consequences of seamless social and spatial mobility though include various environmental problems (i.e., high-carbon mobility, fragmentation of landscapes) (EEA, 2009), increased traffic volumes and often expansion of road infrastructure (Litman, 2012), social inequalities and a decrease in life quality (Bergmann and Sager, 2008), as well as harmful competition between urban regions that generates further sprawl instead of coordinated land use development (Næss, 2006; Næss and Høyer, 2009).

1.3.2 Discursive frame and other limitations for sustainable development

According to Walker and Shove (2007), the sustainability discourse has an inherent ambivalent condition, as it is a contested concept that needs to be changeable, is based on multiple criteria, and is globally universalized but locally implemented. The Brundtland Commission has been especially influential in shaping the meaning of the term sustainability since the 1980s. It originated as a response to the globalized growth agenda and the immense ecological degradation and an attempt to achieve a better balance for

development and environment for the future. Thus, "'*Sustainability' was deliberately and purposefully used to disrupt previously distinct discourses and domains and to create a new contested language in which ambivalence was necessarily rife*" (ibid: 216).
However, even though or possibly because the concept is contested, there is a necessary dispute over the measures implemented and their qualitative evaluation. Different sustainability rationales create different perspectives, foci and arguments. Nevertheless, causal relationships and unsustainable consequences of current approaches encourage a critical scrutiny of business as usual and favored trends. The discourse of ecological modernization frames contemporary sustainable development approaches with a strong belief in technological solutions (Andersen and Massa, 2000). However, approaching technology as an enabler is not the only option. Other moral questions are often excluded in the environmental debate (Hajer, 1995). Individualization and consumerism in a market society are powerful drivers pushing against environmental sustainability. The prevailing technology-oriented contextual limitations have a strong impact on planning measures' strengths and effectiveness.

According to the IPCC (2007), key mitigation technologies and practices within the transport sector that are currently *commercially available* are: "*More fuel efficient vehicles; hybrid vehicles; cleaner diesel vehicles; biofuels; modal shifts from road transport to rail and public transport systems; non-motorised transport (cycling, walking); land-use and transport planning*." Furthermore, until 2030 the following should *be commercialized*: "*Second generation biofuels; higher efficiency aircraft; advanced electric and hybrid vehicles with more powerful and reliable batteries*." This list of measures reflects the dominant technological focus and market-based approach, which is centered on *available commercialized products*. Sustainability becomes operationalized in forms of *ecomanagerialism*, *ecojudicialism* and *ecocommercialism* (Luke, 2006). The dilemma Luke describes with these terms is the self-maintaining condition around sustainable degradation, meaning societies' construction of a system with measures, products and laws that follow from and legitimize the development of production and consumption.

1.3.3 Necessity of an integrated land use and transport planning approach

> "*There are many complex relationships between transport and land use but effective planning can help ensure that development encourages sustainable travel behaviour. Using land-use planning successfully as an instrument to influence transport activities requires long-term thinking (25–30 years).*

> *Establishing targets on environmental impacts is one way to start formulating a long-term vision.*" (EEA, 2009: 10)

Cities are strongly influenced by physical planning in their structural and functional development. Allocation of societal functions, zoning and land-use planning overall has to be evaluated simultaneously. Particularly in regards to sustainable mobility, an integrated planning approach is crucial to combining land use and transport planning in order to reduce transport-related emissions and transport volume at a municipal level (Tennøy, 2010; Næss, 2006; 2012; Holden, 2007). To approach the vision of a low-carbon society with a focus on the transportation sector, primary strategies in planning and development need to obligate land-use development that demands less transportation, such as avoiding urban sprawl. Physical and fiscal restrictions on car traffic reduce the traffic volume, which should be coupled to implementation of public transport services instead. Additionally, conditions for walking and bicycling need to be attractive, and control of road and parking capacities should be implemented to support a modal shift toward more sustainable modes of transport and reduction of automobility. More generally speaking, ongoing education of planning and political authorities as well as civil society is an important factor in initiating and supporting these development processes (e.g., ibid.; Banister, 2008; Hickman et al., 2010; Tennøy, 2010).

There is a large volume of agreement and evidence that "[c]*hoices about the scale and timing of GHG mitigation involve balancing the economic costs of more rapid emission reductions now against the corresponding medium-term and long-term climate risks of delay*" (IPCC, 2007: 18). Contemporary solution approaches construct argumentation and legitimacy accordingly and focus on efficiency solutions to reduce the emission levels in the short term. In practice the focus is mostly on technological improvements in the energy consumption of the vehicles instead of on methods of reducing transport demand in the long term (e.g., Intelligent Transport Systems (ITS), alternative fuels, electrifying vehicles). This belief in technological solutions and improved efficiency management, coupled with reluctance to impose regulations that might reduce the "freedom" of individual motorized transportation, can be described by the term "greening the car." This approach might reduce the emission level per unit, but the traffic demand overall is not reduced and might even increase as transportation becomes more efficient and/or affordable. This idea of green car concept is thus also consolidated in a common approach to traffic forecasting that is dominant within transport planning. Countering congestion by predicting traffic volumes and building or managing infrastructure accordingly is likely to result in increased or at least not reduced traffic volume (Litman, 2012; Næss et al., 2014). The car retains its status. The aspiration of sustainable mobility thus cannot be

achieved by supplying the unsustainable demand, but only by reducing the demand. Altogether, a real impact on changing urban mobility can be achieved with an integrative and long-term application of the above-mentioned measures (e.g. Næss, 2001; Holden, 2007; Banister, 2008). Technological solutions alone will not cause the transition toward low-carbon, let alone a post-carbon mobility. The whole mobility system needs to be taken into account when developing strategies and explicit policy measures.

1.3.4 Transition theories and the urban context

> "*The emergence of persistent sustainability problems in such sectors as energy, transport, water and food have turned the attention of scholars from various scientific communities to the ways in which society could combine economic and social development with the reduction of its pressure on the environment. A shared idea among these scholars is that due to the specific characteristics of the sustainability problems (ambiguous, complex) incremental change in prevailing systems will not suffice. There is a need for transformative change at the systems level, including major changes in production, consumption that were conceptualized as 'sustainability transitions'.*" (STRN, 2010)

Transition studies deal with complex societal change and system transformation over long periods of time to learn about or promote more sustainable futures (Meadowcroft, 2011). The Dutch knowledge network on system innovations and transitions (KSI) is one of the leading research networks focusing on the field of transitions and supports the Sustainable Transitions Research Network (STRN), formed in 2009. The Social Policy Research Unit (SPRU) is also known for transition studies with a reinforced focus on reflexive governance and the role of actors, and in Denmark the Centre for Design, Innovation and Sustainable Transition (DIST) formed in 2013. Theories underlying transition research are, for example, system theory, process theory and actor network theory. More recent developments include governance theory, institutional theory and practice theory, as well as the geography of transitions and the theory of transformative power (e.g. Avelino and Rotmans, 2009; Coenen et al, 2012; Raven et al., 2012). Thus, researchers call for more inclusion of, e.g., agency, demand-side, power, contemporary cases, spatiality, and future orientation in transition research (see e.g. STRN, 2010b).

Transitions are defined as "*a gradual process of societal change in which society or an important sub-system of society structurally changes*" (Rotmans et al., 2000 in Kemp & Loorbach, 2006). There are three main directions in transition studies: 1) the socio-technical approach with ex-post studies of historical transitions, generally spanning

several decades; 2) the complex system view; and 3) the governance perspective with regard to factors such as transition management (Grin et al., 2010). The so-called multi-level perspective (from now on referred to as MLP) is one of the most discussed transition concepts; it falls under the socio-technical approach within transition studies. The MLP uses three analytical levels, called *niches*, as loci for radical innovations, *regime* as the currently dominant socio-technical structures and practices constituting societal functions, and *landscape* as an exogenous structural context at macro scale for niches and regime (see 2.3.3 for more details). The dynamics between these levels describe systemic transformation processes. "*Under certain conditions and over time, the relationships within socio-technical systems can become reconfigured and replaced in a process that may be called a system innovation or a transition*" (STRN, 2010a). Different pathways are analyzed to learn about transformations and improve policy decisions for the future.

Thus, transition in general describes a form of process in the sense of reproducing a kind of configuration. However, this might be not enough under certain circumstances of urgency and pressure. To be more distinct about the direction and pace of transitions, another qualitative definition is necessary, one that also includes the aspect of change versus reproduction or the continuing of business as usual. This definition naturally needs a reference, a relational frame to evaluate transitions at baseline. Transition is not by definition engaged with sustainable transformation processes; however, transition scholars currently link transitions explicitly to sustainability as an overarching aim in undertaking transition inquiries.

This research project takes sustainable mobility as a reference point. The complexity of the urban setting will have an influence on transition conceptualization and understanding. The urban context is not static; on the contrary, urban transitions reflect a multitude of open systems, which are continuously in dynamic progress. This complexity needs to be incorporated when investigating sustainable urban transitions. Accordingly, sustainable urban mobility and its translation into a transition perspective have a normative connotation throughout the research. Thus, it is not sufficient to focus on *process* alone; it is also important to keep the long-term *outcome* in mind to influence the process accordingly. The inertia of physical structures in cities most probably will influence transition processes differently and in a more complex way than some sector-based socio-technical shifts on the product level, e.g., in energy supply.
Within the literature of transition theory, the urban context has not been sufficiently examined. Some researchers, such as Hodson and Marvin (2010), have asked to what extent cities can shape socio-technical transition and how to identify this capability. Coenen et al. (2010) are concerned with a general need for a spatial dimension in

transition analysis, underlining, for example, cities as loci for the birth of transitions, since cities have explicit geographies that determine interplays of socio-technical systems, actors and infrastructures. Moreover, cities represent political structures and practices underlying many development decisions. Thus, transition studies also need to deal with a political dimension, which may define the character of the transition scope and the possibilities for intervention.

> "*There is a politics to the governance of transitions that works with and contributes both to the ambivalence of sustainability as a discursive category and to the playing out of power in two key arenas, in the definition of the 'system' in question, and in specifying modes and moments of intervention*" (Walker and Shove, 2007: 222).

Accordingly, a dominant historical approach to socio-technical shifts might not be enough to conceptualize transitions within an urban context, with its social and physical complexities and power struggles. Getting beyond the socio-technical changes of transition and assuming a need for a more political perspective, as well as the inclusion of a spatial dimension for transitions toward sustainable urban mobility, will be underlined as an important parameter in steering development.

1.3.5 Scenarios for normative, anticipatory long-term perspectives

The European Energy Agency (EEA) pinpoints that "[c]*reating an environmentally sustainable transport system requires a package of policies.* (…) *Addressing the most important environmental aspects simultaneously will be the most cost-effective approach. Defining a pathway towards sustainable transport requires a long-term vision to guide the process as well as strong leadership. It is therefore important to identify and highlight the opportunities and challenges along the way*" (EEA, 2009: 6). A scenario methodology appears to be very suitable when dealing with complex processes such as climate change, societal change, sustainable urban development and mobility futures (e.g. Börjeson et al., 2006; Banister and Hickman, 2013). Scenarios offer the ability to communicate and assess complex development over a long period of time, to create coherent narratives of differing pathways, and to function as a warning device by illustrating consequences of development patterns, testing the robustness of approaches under changing conditions and possible crises, etc. They are often used as a policy-informing tool and also as a participatory process to bring different actors together and to form common visions or strategies. According to Dreborg (1996: 816), backcasting as an explicit normative scenario approach should be considered especially in the following situations:

- When the problem to be studied is *complex*, affecting many sectors and levels of society;
- When there is a need for *major change*, i.e., when marginal changes within the prevailing order will not be sufficient;
- When *dominant trends* are part of the problem – these trends are often the cornerstones of forecasts;
- When the problem to a great extent is a matter of *externalities*, which the market cannot treat satisfactorily;
- When the time horizon is long enough to allow considerable scope for *deliberate choice*.

This list of conditions overlaps with several of the challenges to transition studies mentioned above. Certainly, the goal of sustainable urban mobility transition falls into the outlined scope of complexity. There might be fruitful linkages between transition studies and futures studies that can achieve desirable, sustainable futures.

1.4 The research questions

Even though the need for urban sustainability transitions is widely shared, "*struggles over the present and future shape of our cities intensify*" (Brenner et al., 2012: 9). Taking a transition perspective on sustainable mobility, the overall research question guiding this research is: **How can urban transitions toward a low-carbon and environmentally sustainable mobility future be supported?** This comprehensive problem is split into operational sub-questions that will guide and explain the theoretical perspectives chosen and the empirical research carried out. These five research sub-questions are:

1. How does the multi-level transition perspective (MLP) cope with transition processes toward urban sustainability?
This first question deals with two aspects, first with an understanding and definition of urban transitions and second with the applicability of the socio-technical transition conception multi-level perspective (MLP). The regime concept applied in this thesis is

thus used with reference to the theoretical literature[1] on transitions. This question is mainly concerned with theoretical and analytical parameters; however, engagement with the analytical application of the MLP is based on the case study inquiry and thus fed by empirical data[2]. The question serves the research with a perception and framing of the main components, drivers and actors in transformative change and thus identifies explicit characteristics of urban transition processes. This question is an essential starting point that frames the further theoretical decisions, the methodological framework and the final analysis.

2. What are the current approaches for sustainable urban transitions, and are these solutions sufficient when seen from a sustainable mobility perspective?
This question aims at identification of the dominant trends, strategies and visionary formulations of current planning practices identified in the case. Moreover, an estimation of the extent to which they support or deviate from sustainable mobility development and practice is intended. This question has a stronger empirical focus than the previous one; however, it builds on experiences and preliminary findings based on critical engagement with the analytical model in question 1. Focus will be on current trends and critical reflection on the limits and opportunities of sustainable "model districts" within the overall municipal boundaries. Engagement with this question will also work back into or advance the answer to question 1.

3. What are the main barriers and opportunities for sustainable mobility transition processes in cities?
Question 3 engages with the given gap between vision and actual planning practice. Insights on this gap are obtained by exploring alternative approaches, such as learning from counterfactual explorations of possible long-term strategies to realize a low-carbon and sustainable mobility future utilizing a scenario approach. The three scenarios developed build on the current dominant practices, the identified trends and the aforementioned counterfactual, more radical alternative within the thematic focus of sustainable urban mobility. The scenarios are based on theoretical input, case study records, multiple interviews and a focus group discussion. In terms of transition analysis, the scenario approach is a suitable alternative that reflects an important linkage between transition studies and futures studies.

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[1] The concept of *regime* is often used in political science literature; however, here the regime is defined by the

[2] The thesis comprises Fredericia as the main case and Copenhagen as the supplementary case. The supplementary case provided mainly conceptual analytical input for urban transitions, which is covered under the research sub-questions 1 and 2.

4. What are the underlying structure-agency relations and mechanisms generating barriers and opportunities?
The fourth research question tackles the challenges of planning practices and their limitations in achieving sustainable urban transitions. To achieve a deeper understanding, the dynamics of structure and agency are revealed with their consequences for planning. Underlying mechanisms relevant to sustainable mobility transitions are identified; these mechanisms explain processes and thus explain barriers to and opportunities for sustainable urban development. These insights link back to the previous question. To reveal the structure-agency dynamics, an analytical dualism is applied that allows a sophisticated analysis and enables better understanding of transition and a higher chance of exerting influence on a transition's quality and pace. Moreover, immersion in the structure-agency nexus enables, alongside the analytical approach, an ontological reflection on transition processes.

5. Is radical change possible?
This fifth research question builds on the knowledge gathered through engagement with the previous questions. The question points toward the need for more radical change, which is revealed throughout the thesis. However, such radical changes call for systemic and value-related deep structural changes that are likely to evoke political and societal struggles. This research question is a normative-reflective one that offers a ground for critical discussion of a democratic and political dispute within sustainability transition processes. Also, ethical questions and values will play a role and are essential (counter-)guidance in decision-making processes, which are currently dominated by arguments of growth and competition.

1.5 Research Structure and Articles

1.5.1 The thesis' structure

The PhD thesis consists of a collection of five articles and an overarching synthesis (cf. p. 1) and can be organized into three parts. The first part sets the scene for the overall thesis. This chapter 1 introduces the context in which this research is embedded, clarifies the initial curiosity of the researcher, and identifies the main problems at hand and how this research will tackle the issues reflected in the research questions that guide this thesis. The different articles are briefly mentioned and linked to the research questions (cf. table 1).

The second part of the thesis comprises chapters 2 (theory) and 3 (methodology). These chapters are comprehensive and reflect the underlying conceptual work and theoretical triangulation applied in the articles. Chapter 2 can be read in chronological order regarding its logical linkage of different theoretical backgrounds of this thesis. This chapter introduces the meta-theoretical position, the explanatory theories underlying this thesis and the conceptual-theoretical use of this work. Chapter 3 is linked to the theoretical chapter insofar as some of the theories introduced beforehand are explained in their methodological implications and realization in the research project. The overarching case study design and different methods applied are introduced. Critical reflections on methodological implementation and experiences are provided. Finally, the research design is summed up and illustrated.

The third part comprises chapters 4, 5 and 6. This part contains the analytical results and discussions as well as conclusions and reflections. The articles' summaries can be found in chapter 4 (see short introduction below). Chapter 5 (results) contains a meta-discussion of the thesis' contributions cross all the articles. The chapter is structured according to the research questions. This discussion identifies linkages between articles and an overarching contribution to the research field the thesis is embedded in. Critical reflections are included throughout this chapter. Chapter 6 (conclusions) is a shorter summary of the concluding remarks organized under each research question. This chapter ends with recommendations for further research.

Finally, the remaining chapters contain the reference list (chapter 7), all articles in their full length (chapter 8) and the appendices (chapter 9).

1.5.2 Embedding the articles

The articles/papers are arranged around urban transition in the following manner: 1) theoretically and conceptually, by engaging with transition theory in an urban context, 2) strategically and analytically, by identification of focal issues for urban cases, based on empirical studies and the use of a transition-analytical model to track and evaluate its relevance for urban transitions (main case: Fredericia; additional case: Copenhagen), 3) holistically, by embedding the case specifics in overall sustainability approaches using scenarios, and 4) analytically, by achieving a deeper understanding through structure-agency analysis within transition processes.

How can urban transitions toward a low-carbon and environmentally sustainable mobility future be supported?					
Research Sub-Questions (RQ)	Paper				
	1	2	3	4	5
RQ 1: How does the multi-level transition perspective (MLP) cope with transition processes toward urban sustainability?	▨	▨	▨		▨
RQ 2: What are the current approaches for sustainable urban transitions, and are these solutions sufficient when seen from a sustainable mobility perspective?		▨	▨	▨	▨
RQ 3: What are the main barriers and opportunities for sustainable mobility transition processes in cities?	▨	▨	▨	▨	▨
RQ 4: What are the underlying structure-agency relations and mechanisms generating barriers and opportunities?				▨	▨
RQ 5: Is radical change possible?	▨			▨	▨

Table 1: Schematic illustration of papers' coverage of research sub-questions in the thesis.

Paper 1 – *Næss & Vogel: Sustainable urban development and the multi-level transition perspective. Environmental Innovation and Societal Transitions 4 (2012), pp. 36–50.*

Paper 2 - *Valderrama Pineda & Vogel: Transitioning to a Low Carbon Society? The Case of Personal Transportation and Urban Form in Copenhagen: 1947 to the Present. Transfers 4.2 (2014), pp. 4–22.*

Papers 1 and 2 deal with the characteristics of **urban transitions**. Urban transitions have explicit characteristics and components, such as their inevitable spatiality and particular complexity. These two papers take a critical stand on the current transition conceptualization in regard to urban transitions, the **limitations of the MLP** and the missing spatial dimension. Paper 2 takes a historical perspective on urban transitions to learn from the transitions identified for the future prospects of the city (exemplified by the supplementary case of Copenhagen/DK), whereas paper 1 applies a new conceptualization of an urban regime as multi-segmented, in the main case of Fredericia/DK, reflecting current dominant urban structures (Næss & Vogel, 2012).

Paper 3 - *Vogel: Municipalities' ambitions and practices: hypocritical sustainability transitions?*

Paper 3 questions the prioritization of planning goals. Measures are geared toward concerns other than the expressed **sustainability goals**. The paper attempts to **explain ambivalence in planning practices** and strategies formulated, and discusses the dynamics of sustainability goals that in practice seem to legitimize continuation of ambivalent planning practices. Dominant underlying forces are pointed out, dynamics of multi-segmented regime structures and the overall growth imperative, which engross planning decisions.

> Paper 4 - *Vogel: Urban niches for sustainable transition? A scenario approach for long-term alternatives. Currently under review.*

Paper 4 utilizes a **scenario methodology** as an analytical approach for urban transition processes. Scenarios are an appropriate tool to create coherent narratives in a long-term perspective. This approach helps in identifying barriers and opportunities for alternative solutions. It serves as a policy-informing tool and a frame for **critical reflection and comparison** of different sustainability rationales. Moreover, it encourages learning through retroductive thinking, a thought operation that identifies the conditions necessary for something to become what it is, and thus provides alternative paths for envisioning planning.

> Paper 5 - *Vogel: Structure-agency reconceptualization in transition studies: the case of urban planning and mobility. Currently under review.*

Paper 5 engages with **structure-agency relations** in transitions. This paper defines my **ontological take on transitions**, namely that both structures and agency have their own causal powers, which work back upon each other. The structure-agency analysis offers a deeper understanding of **causal mechanisms** underlying (non-)transition processes. The assumption of a need for more radical change is strengthened.

Paper 4 links to paper 5, incorporating **deeply rooted social structures** as decisive factors in transformative change toward more sustainable mobility futures.

2. Theoretical framework

This chapter introduces the theoretical foundation of the thesis. It starts with a meta-theoretical reflection on transition, mainly anchored within the structure-agency nexus, and introduces the position taken in this research (section 2.2). Following, in section 2.3, the different theories chosen as relevant for investigating sustainable mobility transitions are presented and thus form a specific angle on the study object. It starts with planning theory as the basic context of the study, introduces the study theme of sustainable urban mobility, presents the transition perspective chosen as theoretical angle, and introduces prevailing structures dominating contemporary urban development, along with their opposing alternatives. This is followed by ethical considerations in transformative processes, and the section ends with linking to futures studies and the scenario approach as an appropriate method of engaging with long-term transformative change. Finally the different theories' applications are clarified (section 2.4).

2.1 The subject matter of the thesis

The subject matter of the thesis is the transformation processes by which cities develop toward more sustainable urban mobility. Its objective is to reveal some important causal mechanisms that will both explain challenges in practice and provide ground for a better conception of change. Here, "better" refers to the reduction of ambivalent planning practice and the implementation of more effective transition strategies. Such transformative change concerns different systemic constellations that shape contemporary mobility. These are created through structure-agency relations and their mechanisms. The research needs to identify the relevant structures and agencies that could trigger the desirable changes, in addition to identifying the undesirable ones. This is done through conceptual abstraction, which could be described as the basic action of doing social science (Danermark et al., 2002). Depending on the object of the study and the research question, the process of abstraction serves as a means to identify the elements that are important to understanding the occurrence of the subject matter, which entails understanding how mechanisms, events, and objects are related to each other and which powers they possess; this will give insight into the causal explanation of change processes. Doing social science dictates that the object of study is relational, meaning that the existence of the object is created through its relation to other objects. These need to be identified and reflect the context of the study. Depending on the research interest, only some of the many relations can be investigated, namely those which form the object's

occurrence and would influence its change. This section will give an insight into the conceptualization of the subject matter by describing the main theoretical perspectives chosen in this study.

2.2 Relevant philosophical viewpoints and research traditions

Undertaking research always contains an engagement with how the world is viewed and understood, as well as how to make sense of this knowledge. Ontology is understood as the philosophical ideas about the nature of being, becoming, existence, or reality, and the basic categories of being and their relations, while epistemology engages with the knowledge obtainable about the world. These meta-theoretical notions are not always explicitly formulated, but they are implicitly embedded in doing social science through one's choice of theories, methodological approach, or overall research design. This study represents an explicit view on the structure-agency dispute of urban transitions and positions the analysis accordingly. Questions of reliability and validity are linked to the ontological and epistemological position, which will be discussed in more detail in the methodological chapter.

As this research project engages with transformative change, the most central question is about how change is possible and who or what is critical in this process. Change is concerned with the more physical material structures of the urban built environment, a main example being its infrastructure systems, but more elusive structures such as sustainability rationales, mobility ideals, and urban competition are also part of the study object. This perspective on the urban transformative change towards sustainable mobility needs a theoretical conception that acknowledges these complexities, but also makes them manageable for the analysis. Thus, the forms of inference applied in the study need to be able to engage with conditions beyond the empirically observable dimension while having an explicit future-oriented and normative character. Explicit analytical interest lies in understanding opportunities for sustainable change, which in turn calls for understanding of the underlying mechanisms that create dependencies in order to identify triggers for change or for the production of sufficient pressure to develop new trajectories.

Meta-theoretically speaking, the position of critical realism is appealing due to its explicit ontological realism stating that there is a reality beyond our knowledge and that we can achieve theoretical knowledge (fallible though it may be) about that reality. Through judgment informed by theoretical and methodological criteria, a differentiation between more or less credible theories and knowledge claims is possible, thus allowing qualified knowledge to be gained.

Also, the critical pragmatist understanding of a pronounced agency perspective can be of interest in regard to initiating processes. For example, the concepts of hope, creativity,

and a generally proactive engagement with the world are appealing in regard to sustainable urban mobility futures.
Both critical realism and critical pragmatism reject the idea of universal truth and knowledge, though they do so differently. Critical realists have a very sophisticated ontology, whereas the pragmatist view is more engaged with epistemological practicality.

2.2.1 Critical realism & change

> "*In short, the point of departure in critical realism is that the world is structured, differentiated, stratified and changing."* (Danermark et al., 2002: 5)

Three domains in critical realism
Critical realism is a meta-theoretical perspective which separates the world's existence from the knowledge people can have about it. This is referred to by Bhaskar (1975) as a distinction between *transitive* and *intransitive* dimensions and is basically rooted in the fallibility of our knowledge. Roughly speaking, the intransitive dimension contains the objects of science, and the transitive dimension comprises the theories created about what is studied. Theories may change or be fallible, but that doesn't mean that the object dealt with in the theories needs to change (Sayer, 2000). Critical realism rejects pure empiricism as well as relativism in natural science; in social science, it rejects law-like regularities, as in positivism, as well as anti-naturalist interpretative reductionism where social science is reduced to interpretation of meanings. Instead, it acknowledges the "*openness, contingency and contextually variable character of social science*" (Sayer, 2000: 3) and "*is based on the understanding of natural necessity in life*" (Danermark et al., 2002: 55).

The three domains of critical realism are the real, the actual, and the empirical, the combination of which reflects a differentiated worldview. The real comprises all that exists and represents the realm of phenomena and objects, in addition to their structures, mechanisms, and powers. The actual refers to what actually happens, or what occurs when the powers of structures are activated and lead to actual events. These events might not be observed, but they do take place. The empirical contains the observed experience of phenomena and is conditioned by the other two domains, even if these are not known. What is crucial to underline in this ontology is that causal power can exist even if not exercised. An event that happens has underlying structures with constraining and enabling effects, but these do not determine what will happen; they merely create a likelihood based on their interplay with other causal mechanisms and the fact that they were triggered (Sayer, 2000).

All three dimensions are important, basically because deep structural change requires that all three domains be incorporated into the theoretical conception and critical engagement with given phenomena. It is not enough to investigate the empirical domain without asking for and revealing the underlying mechanisms and structures. Influencing the latter is crucial for transformative change. Through the three domains, conflation of the world with our experiences of it can be avoided, which is important to be able to create distance from the phenomena, identify their context, and be able to create change in a more guided manner. This makes critical realist ontology attractive, as it offers the possibility to understand processes of change: why things appear, how they might not appear, and how they become something else (Sayer, 2000).

Structure, mechanisms and events

Critical realism has developed a remarkably detailed conception about how change comes along. Four concepts will be introduced and explained in terms of their interaction and understanding of change processes. These are *structures, powers, generative mechanisms, and tendencies*. The structures are underlying the generative powers of the object and are responsible for determining its nature. Moreover, powers exist whether exercised or not. This is a necessary internal relation. The mechanisms cause things to happen and exist based on the structure and its powers. However, the generative mechanisms need to be triggered to operate, and that depends on the context and its conditions, making this an externally conditioned relation (Danermark et al., 2002: 55f). There exist a multitude of mechanisms, which are, if triggered, simultaneously operating and producing events in the actual domain, at least some of which can then be observed in the empirical domain. However, mechanisms may work against or reinforce each other, possibly even to the point of counteracting an event even if the necessary mechanisms are present, meaning that an object's behaving in a certain way is only a tendency and not a determinism (ibid: 56).

Causal explanation in critical realist terms is about "*identifying causal mechanisms and how they work, and discovering if they have been activated and under what condition*" (Sayer, 2000: 14). To identify how these mechanisms came into existence, one must identify the structures that hold the causal powers and mechanisms. These processes of identification are transfactual, meaning they go beyond the factual event and link back to the three domains from above, thereby making it important to go beyond the empirical to achieve deeper understanding and explanatory ability. Figure 4 visualizes the events as empirically observable trajectories (being concrete) with their underlying mechanisms and

structures. The latter are not necessarily observable, but are existent and understood through abstraction.

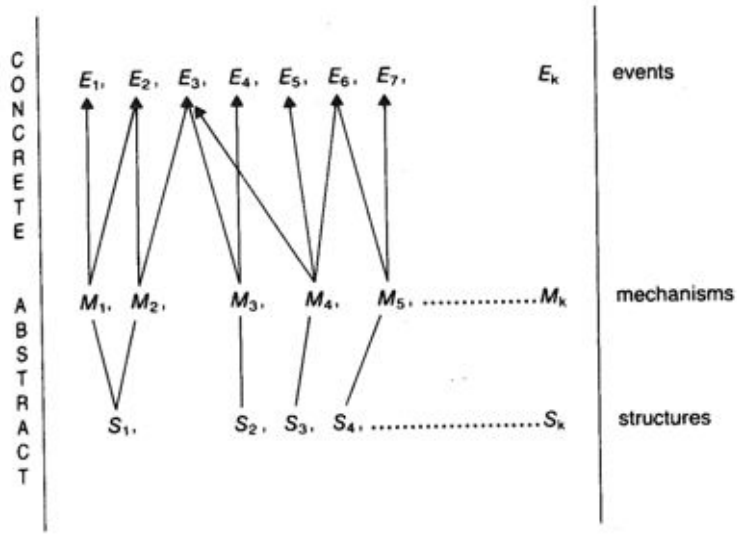

Figure 4: Structures, mechanisms, and events (Sayer, 1992: 117).

Emergent powers, strata and reduction

Emergent powers describe an anti-reductionist approach and are crucial in the critical realist argumentation. New phenomena that emerge through different aspects coming together have their own properties which cannot be reduced to the constituents that were underlying the phenomena's appearance. The emergent powers are especially important in the relational character of social science objects that are often defined in relation to others and their contexts (Danermark et al., 2002). As illustrated in figure 4, different events may have some common mechanisms or share the same underlying structures, but this does not make them the same. The anti-reductionist approach is also evident in the stratified worldview. Such an understanding describes different layers of reality. These strata are organized hierarchically, an example being the cells of the human body as related to the physical entity of the body, the psychological mechanisms, and the socialized practices reflect lower to higher strata. It is about examining a configuration of different causes contributing to the existence of a phenomenon to identify the different mechanisms allocated to different strata, which can help explain phenomena beyond their observed appearance. However, depending on research interest, not all strata are relevant to the investigation. The cell structure of a human, for example, does not in itself explain the power of people (Sayer, 1992) and is thus less significant for a sociologist, for example; it might, however, be at the core of interest within a medical inquiry. Social

science deals mainly with more or less open systems, reflects a complexity of relational phenomena, and is thus mainly engaged with higher strata (Danermark et al., 2002).

2.2.2 The structure-agency nexus

Social science is relational in its nature, and the engagement with structure and agency is one of the basic underlying dynamics that are under dispute, the others being concepts such as determinism, free will, path dependencies, power, and change, among others. Archer (2000), for example, elaborates in detail on the sociocultural interaction of individuals in society, taking a non-conflational approach regarding structure and agency. She has developed the so-called morphogenetic approach (see in more detail below). One of the appealing reasons for working with Archer's approach specifically and critical realism in general is owed to the equal attention given to structure and agency.

Structure

Structures are defined as "*a set of internally related objects*" which are, so to speak, making up the nature of an object (Danermark et al., 2002: 47). Structures hold powers and have properties that have a conditioning effect on mechanisms and agency. Understanding what makes a phenomenon appear is linked to identifying the underlying structures and how these are linked to causal mechanisms that might be triggered in order to produce an event. Structures can be changed through agency, which holds the ability to shape and elaborate on given structures. There is a separation between material and social structures, but the social structures always have a material dimension because they are produced or reproduced by social *material practices* (ibid: 34), and structures in the form of built environment only exist because they were once socially constructed. Certainly, nature exists also, manifesting in hills, mountains, or coastlines, for example, and creates material structures which are not manmade and may influence the location and development of cities. These constructs of nature could be influenced by the destructive consequences of human encroachments on the natural environment, such as anthropogenic climate change. The emergence of social structures is due to both individual efforts and society as a whole, and is seen in phenomena such as forming institutions, creating and reproducing the overall economic system, establishing market systems, designing systems of socioeconomic stratification, writing legislation, and holding prevailing norms and discourses. Generally speaking, material and social structures are intertwined and influence each other; as Næss (2014) puts it, the urban built environment belongs to a particular category or sub-set of social structures being socially constructed. In the urban context, this means that the urban form, infrastructures, and

sociopolitical and economic systems in their contemporary appearance were formed by agents in social processes and thus can also be changed by agency.

Agency

Archer (2000) offers a complex differentiated conception on agency. It is a stratified understanding of the social subject, differentiating *self, person, agent,* and *actor*. She distinguishes between agents and actors with different capacities of agential power and describes a complex process of emergence of people's social identity. In short, this is based on the process of primary agents becoming corporate agents and then further evolving into actors. *Primary agents* could be seen as situated beings, born into a context already structurally conditioned and understood as "*collectivities sharing the same life-chances*" (Archer, 2010: 263). These dynamics describe a process of how society impinges upon the human self. The ability of humans to be reflexive upon themselves and their contexts creates the capacity for recognition of constraints and enablement of given structures. As new emergent properties are generated, they form *corporate agents*. These agents are defined through their reflexive ability, self-declared goals, and corporate interaction and organization. The process could be defined as how agents collectively transform society. To become an *actor* then means to be able to occupy a role, a specific identity with its own emergent properties. Social actors as role incumbents hold the powers allocated to the role; however, upon losing that role, the occupant loses these powers. This process reflects how social reproduction or transformation affects potential social identities available (Archer, 2000: 260f.). Although, in some cases, (primary) agents may inadvertently transform structures due to their "*agential effects as aggregate response*" (ibid: 266), which can be triggered by corporate agents, who shape the context for all agents.

The morphogenetic approach

Archer also developed the morphogenetic approach, which reflects a dualistic and sequential perspective on structure-agency relations, meaning that structural conditioning, social interaction, and structural elaboration take place in endless cycles (Archer, 2010: 228). Morphogenesis describes the transformation of structure with an outcome of a structural elaboration, and morphostatis stands for the reproduction processes of the given structure. With regard to agency, Archer talks about a double morphogenesis, as agency leads to structural elaboration while it is itself elaborated in the process (see agency above).

The structuring over time is crucial and describes a basic understanding of systemic properties. It is important to recognize that the outcome in the form of elaborated structure

is not necessarily the product of agents' activity being present, but is conditioned by previous structures which were elaborated by agency and formed the constraining and/or enabling context for the next round of activity (Mutch et al., 2006). Figure 5 below reflects two ontological propositions, these being that "*structure logically predates the actions, which transform it*" and "*structural elaboration logically postdates those actions*" (Archer, 2010: 238).

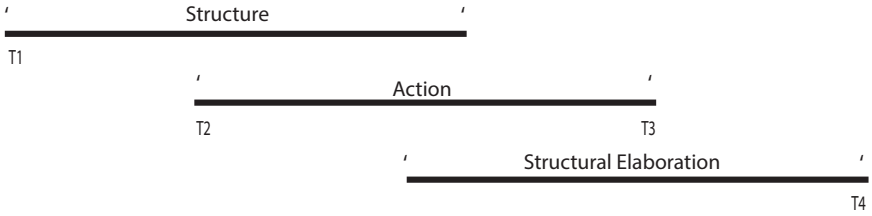

Figure 5: Basic structure of the morphogenetic diagram representing the different time periods over which structure and action operate. A particular structure (T1) predates and conditions action (T2), which reproduces or transforms the structure. However, it can also lead to a new elaboration of the structure (T4), which is modified or contested in another cycle, etc. (Based on Archer, 2010).

Conflations

Archer (2000) developed a terminology of conflation which describes four types of structure-agency relations: downward, upward, and central conflation, and avoidance of conflation by maintaining analytical dualism. The different conflations reflect different ontological and epistemological standpoints. Allocating a problem statement in one of the perspectives conceptualizes the frame for approaching a solution accordingly and thus creates an interpretative understanding.

Downward conflation describes structures which determine and organize agency. People allocated under this conflation are referred to as structuralists, a group including such people as Émile Durkheim (1895) and Louis Althusser (1972). Positivism with objective "truth" and laws about reality and certain "structure-deterministic" interpretations of Marxism, often associated with the capital logic tradition, would fall under this category. According to Archer, particular radical discourse-theoretical traditions could also be allocated under downward conflation, which conceives of individuals as being reduced to "carriers" of structures and discourses, essentially little more than "Society's Beings," determined by society's structure and lacking any agential power (Archer, 2000).

Upward conflation describes the power of agency dominating and creating the structures. People and positions allocated under this conflation are referred to as methodological individualists as well as rational choice advocates. Max Weber (1905) is an early

representative of this view. A typical upward conflation tradition is also represented through the so-called homo economicus, according to which social structures are seen as no more than the aggregate patterns of the actions of utility-maximizing individuals, as in (neo)classical economics (Vogl, 2012). Archer (2000) terms this individual "Modernity's Man," who is not determined by society, but is instead a self-determined rational actor who forms the social structures.

Central conflation describes an understanding of structure and agency as mutually constitutive and insists on their inseparability. People or positions allocated to this conflation are referred to as structurationists, such as Anthony Giddens (1979, 1984) or Pierre Bourdieu (1977). Some (early) pragmatists, e.g., John Dewey (1922), also follow this approach. Giddens' work on structuration theory is representing a central conflation of structure-agency dynamics. The *duality of structure* represents a recurrent process of transformative and constituting properties of structure and agency, which constitute social practicing and are at the same time produced or transformed through these practices (more about Giddens' structuration approach in section 2.3.3).

Analytical dualism describes an analytical separation of structure and agency to investigate them separately and in their interaction, with an acknowledgement that both have their own properties and powers. Some people and positions allocated to this approach are, for example, Margaret S. Archer (2000), Roy Bhaskar (1979, 2008), and critical realism in general (Danermark et al., 2002). Some forms of pragmatist interpretations, here represented by Antje Gimmler (2005), represent a point of view that acknowledges structures as exerting some influence, but argue that this influence is not deterministic. Instead, actors are able to adapt in different ways to the conditions laid down by the structures.

2.2.3 Critical pragmatism for change

Pragmatism contains differing strands that have developed over time in relation to other meta-theoretical schools of thought; however, it is mainly concerned with meaningful action and practical judgment in a specific context. Pragmatists are interested in how purpose and consequence are linked in a process and argue that "*what matters in this endeavor is what makes a difference*" (Healey, 2009: 279). Some early pragmatist positions appear similar to Giddens with attempts "*to move beyond dualism and dichotomies such as mind/body, fact/value, theory/practice*" (ibid: 279). Later pragmatist opinions seem to differ, reflecting an opinion that engages critically with "*the complex relations between parts and wholes in open, dynamic systems and warned against the*

reductive translation of system conceptions (…)" (ibid: 281). Generally speaking, a social learning tradition, the realm of the everyday life with a strong focus on agency, represents a pragmatist perspective. "*From the pragmatic point of view human action is one of the most important basic constituents of everyday life and in so far, pragmatism could be classified as an action theory approach*" (Gimmler, 2005: 1).

The appeal of the study of transformation is the pragmatists' interest in practices of democracy and governance, being interested in the value of hope and collective social learning that will form momentum for capacities to invent and/or transform, such as political structures (Healey, 2009: 284). Forester's (1993; 2012) engagement with critical pragmatism is especially interesting with concern to planning and the reflexivity of planners in terms of how they make sense of the complex social and political world within which they are acting. Forester is thus interested in the active construction of social structures in the realm in which planners operate. Forester underlines the value of learning, maintaining "*that performance makes a difference, not just in the craft of technical work but in the social understanding and emotional sensibilities that are mobilized in planning activity*" (Healey, 2009: 285).

Some pragmatists, however, are criticized for their strong relativism that perceives theorization overall as meaningless based on the opinion that it is not possible to say that one description of reality is more credible than another one (Danermark et al., 2002). The underlying argument builds on a lack of a universal language, which is seen as being necessary to receive meaning and thus knowledge about the world. This radical countermotion to universalism is primarily linked to Richard Rorty (1980). This is seen as problematic to the extent that only the particularities of the experienced empirical phenomena are taken into account and not the underlying structures and mechanisms which might have triggered the existence of the phenomena. Thus, this approach could be very misleading. Moreover, the pragmatist approach seems to have little in the way of concrete spatial concerns, which might be necessary to enforce an intensified structural dimension and would go beyond a relational understanding of space within governance processes (Healey, 2009).

While I did not adapt the pragmatist perspective to such an extent that the research presented in this thesis was specifically guided by this approach, the outstanding (proactive) agency focus can be inspiring for thought experiments in relation to scenario developments for initiating change processes in planning. The pragmatist perspective, as put forward by scholars such as Forester and Gimmler, can serve this research with some additional, pragmatic, action-oriented knowledge (Delanty and Strydom, 2010). According to Forester, critical pragmatism can offer "*a critical, realistic analysis of public possibilities, neither, a presumptively defeatist cynicism, a facile resignation, nor a*

simply convenient search for what seems to get by, an expedient pragmatism that seems to work, if not very well" (2012: 7).

2.3 Towards a theoretical junction to study urban transitions processes for sustainable mobility futures

The following introduces the theories applied concerning the specific topic investigated.

2.3.1 Planning desirable futures

According to Friedmann (2003), planning theory can be differentiated into theories *in* planning, theories *of* planning, and theories *about* planning, the first being concerned with the specializations within planning (land use, transport, regional development, etc.), the second dealing with theories as overarching normative ideas of doing planning, and the third engaging with planning as it is actually practiced. The theory *of* planning is disputed as an ideological discussion (Friedmann, 2003; Alexander, 2003), but the normative view on what is the "right" planning is a context for the other types of planning theories (Bengs, 2005), especially in regard to sustainable and just planning, normativity and possibly in regard to ideology.

This thesis engages with all the three types of planning theory in one way or another, though they are utilized and reflected upon differently. Planning theory, in the sense of how planning and development ought to be, is adopted and represents the basic scope of the subject matter. The case and the empirical domain of the study are located within the urban planning context and reflect the given knowledge as well as given challenges. Planning theory serves as an explanatory theory for emergent mechanisms and causal relations, an example being the relation of urban form and transport behavior (Næss and Saglie, 2000). Moreover, it defines sustainable mobility and a normative take on planning that guides the conceptual development for more effective transition strategies towards sustainable urban mobility. However, as observed in the empirical inquiry, planning practice often clashes with planning theory and displays that other forces govern urban development, which might impede a desirable, sustainable planned development. One main part of this thesis is identifying the dominant parameters that influence societal development, affect the context of planning, and eventually manifest in urban mobility conditions. This links with the theoretical conception of transition studies, which will serve this research as an additional theoretical perspective on complex sociotechnical system change.

Critical urban theory provides a more overarching perspective into contemporary challenges of urban development and tendencies, thus capturing the parameters with which urban planning is confronted (Brenner et al, 2012). Generally speaking, critical urban studies are concerned with: a) the interplay of capitalism and urbanization processes, b) examining the produced and reproduced social structures and forces that emerge in such urbanization processes, c) exposing injustice, d) and deciphering contradictions, crises, and conflicts in order to e) demarcate and politicize these conditions to achieve more socially just and sustainable urban life (ibid, 5). This theoretical approach serves the research with a critical consideration of planning practice and its context.

Ultimately, all types of planning theory could (or rather should) engage with the topics listed above since these form the planning context and determine the challenges with which planning needs to cope. Campbell (1996) describes the sustainable planning challenge as the "planner's triangle," a term which reflects the conflicts and potential complementary interests between environmental protection, economic development, and social equity that come together to form sustainable development. He reflects on the role of the planners, their position, to take a normative stand within the triangle, because prevailing at the center could lead to a hollow or superficial sustainability understanding. Also, Klostermann (1985) and Bengs (2005) offer insightful reflection upon the role and value of planning from societal contexts such as the modern-industrial and capitalistic-globalized. In "Arguments For and Against Planning," Klostermann writes about limits and the necessity of planning from four perspectives. He relates to economic (market-based) arguments, a pluralist (political) perspective, traditional (technical) arguments, and a Marxist (structural) perspective. Klostermann sums up that the planning in practice is limited due to blueprint designs, lack of sufficient political debate, and regulations that tend to be overly conservative and mired in routine. In the article "Planning Theory For the Naïve?", Bengs reflects upon planning in the globalized context of capitalism and national democracy. He states: "*The present day dilemma is that national governments feel compelled to reduce taxes and dismantle reallocation mechanisms for the national reproduction of labour (...) in order to be 'appealing' to investors*" (2005:1). One Europe-wide phenomenon is that nation states promote development through reducing barriers for investment and allowing a wide range of stakeholders to make decisions on how the local planning practices unfold (Bengs, 2005: 2). Bengs also relates the *communicative turn* in planning to the unsatisfactory planning practice under public governments, which evoked critique of representative democracy and called for empowerment and collaborative planning practice (Healey, 1997). He concludes that planning (theory) would profit from scientific rationalism through focusing on current

dysfunctions of systems and identifying the problems rather than creating opportunistic planning ideals with new institutional settings (Bengs, 2005: 10).
The scope of this research project is designed to elaborate on a sustainable urban mobility transition with urban land-use and transport planning as its focal point. However, the above-mentioned dispute is framing a context in which this research is embedded, namely the observation of planning practices impeding an urban development that would create conditions for sustainable urban mobility. Moreover, this condition of sustainability-oriented planning practice relates back to the structure-agency discussion in that it addresses the structural conditions within which planning agents operate. As Campbell puts it: "*Planners will have to decide whether they want to remain outside the conflict* […], *or jump into the fray* […]" (1996: 26).

2.3.2 Sustainable urban mobility

Sustainable urban mobility is the subject matter of the thesis, and it is viewed from an urban planning perspective on the municipal and regional levels. This means that mobility is dealt with primarily in terms of how it is being influenced by the urban transportation systems and overall urban form, and through policy documents' guiding principles and actual mobility patterns. The scope of the study focuses on the personal, physical mobility of people and neglects such things as transport of goods, virtual mobility, or motility as capacities of being mobile (Canzler et al., 2008; Urry, 2007). One of the most pressing problems in the transportation sector lies in the continually increasing traffic volume and its negative externalities, such as resource consumption, emissions, congestion, capacity problems, etc. The notion of mobility as a positive concept of modernity plays into the transport volume discussion, as it creates incentives to create ever more mobility and a reluctance to discuss concepts of less mobility. The notion of mobility is complex and needs some elaboration to clarify its use in this study.

Mobility reflecting modernity – a paradigm shift
Mobility theorization is reinforced through the so-called *mobilities turn* within social science (see e.g. Kaufmann, 2002; Urry, 2003; 2007; 2008; Cresswell, 2006), which is a kind of "sociology of mobilities" (Urry, 2007) introducing a new "mobilities paradigm" (Sheller & Urry, 2006). This paradigm creates attention towards the limits of "static" science and "*delineates the context in which both sedentary and nomadic accounts of the social world operate, and it questions how that context is itself mobilised, or performed, through ongoing sociotechnical practices, of intermittently mobile material worlds*" (ibid: 211). This paradigm shift offers a new perception and different theoretical conceptualizations in social science. Mobility describes much more than movement from

A to B; it is a concept, a methodology, and even an ontology for some (e.g. Urry, 2007; Kesselring, 2008), and is used to engage with and understand contemporary society and its development prospects. Second modernity (Beck, 2000) and risk society (Kesselring, 2008), for example, are societal conceptions that contain mobility as a basic component and concept.

Urry (2000; 2004; 2007) offers comprehensive literature concerning the automobility system and its interconnections in globalized societies and for its individuals. He describes the different components that make the system(s) around automobility so powerful and dominant. He defines the automobility system as a non-linear system of complexity with an extraordinary ability of self–expansion (ibid.). This is based on multiple components and the fact that the automobility system produces its own units that make up its existence, such as being one leading industrial sector, being essential for individual consumption, linking to multiple sociotechnical sub-systems of society, changing the time-space relation, and creating a quasi-privatized mobility and a culture of a good life, a notion that is very powerful and for which people strive (Urry, 2004).
As such, there is a reluctance to reduce mobility. The mobility ideals that have been formed create specific kinds of mobile subjects (Richardson and Jensen, 2008). These mobile subjects adhere to a discourse of *mobility as freedom*, being caught in a *hypermobility* and/or a tendency to "*interpret themselves as subjects with* [own] *mobility politics*" (Kaufmann et al., 2008: 7), which corresponds to a highly mobile person that creates potential mobility capacities which are often beyond the actual performed mobility (Sager, 2008). The problem is one of a paradox, namely that the striving for being free, meaning mobile, obliges one to increased mobility to generate demand to create supply from which to choose (ibid.). Sennett (1998) describes the danger of this state as a constant, often non-directed floating, which he calls *drift*. It is representing a condition of high flexibility and elasticity, which creates a fugacity of phenomena and relations. This once again creates instability and new challenges for the working life, family structures, value of place, and the city overall. According to Sennett the so-called *flexible capitalism* seems to create more freedom, but actually just diffuses the determining structures. This complicates the picture and creates ambivalence of seemingly independent individuals, but is actually still (if not more) caught in the less obvious, complex, networked structures of a new capitalism. Graham and Marvin (2001) describe the networked society in their book *Splintering Urbanism*, which reflects the complex sociotechnical processes behind contemporary urban geography.

After all, mobility is understood as a social concept reflecting modernity (Canzler et al., 2008). Mobility is seen as necessity for modernity, and as society is under an ongoing

modernization process, mobility is "ordered" accordingly. However, negative externalities of increased and seemingly unlimited mobility do have an adverse effect on society in the form of hypermobility, environmental degradation, and political conflict (ibid). Rammler develops a concept of *Wahlverwandtschaft* [elective affinity] (2008: 59), which describes a form of conflation of modernity and mobility. "*Modernity is endangered by its own success as a result of unintended side effects arising from the mobility necessary for just this success*" (ibid: 70). The described dynamic correlates with the *second contradiction of capitalism* (O'Connor, 1998), namely that the system's inbuilt necessity is threatening its own existence. Rammler also describes the consequence of ecological modernization[3] as the preferred solution approach for coping with given conflicts; however, it does not change the basic dilemma of the elective affinity (ibid: 73).

> "*Automobility is a Frankenstein-created monster, extending the individual into realms of freedom and flexibility whereby inhabiting the car can be positively viewed and energetically campaigned and fought for, but also constraining car 'users' to live their lives in spatially stretched and time-compressed ways. The car is the literal 'iron cage' of modernity, motorized, moving and domestic.*" (Urry, 2004: 28)

> "*On the level of principles there is continuity concerning the relevance and the social and political importance of mobility. The zero-friction society and seamless social and spatial mobility remain powerful societal goals and values (Hajer, 1999). But on the level of institutions and institutional procedures and routines there is irritation, confusion and doubt. This leads to a structural discontinuity, where institutions search for alternative solutions for social, ecological, economic and cultural problems caused by increasing mobility.*" (Kesselring, 2008: 84)

Sustainable urban mobility as integrative transport and land-use planning

Mobility planning in municipalities is mainly defined through tools of transport and land-use planning. However, within the last decade, at least in regard to the Danish context, an increase of particular interest in *mobility* planning led to intensified engagement with

[3] Ecological modernization represents a contemporary, dominant sustainability rationale. It is an approach towards environmental protection, which is rooted in a precautionary thinking, aiming at improvement of systems of production with scientific and technological tools (Andersen & Massa, 2000). An efficiency paradigm dominates this approach in practice (ibid.). The ecological modernization paradigm assumes that continual economic growth is compatible with environmental sustainability and that solutions to the environmental problems can be found within the confines of industrial capitalism (see, e.g. Strannegaard, 1999; Barry and Matthews, 2003).

policies, strategic documents, and mobility management schemes (e.g., project Formel M from 2011-2014 as part of Gate 21, a nonprofit association representing public-private projects on innovation toward green growth since 2009) which may have a paradigmatic influence on the actual planning practice. Nevertheless, models for and theory of urban transport and land-use planning are the two main sectors within planning that may be decisive for mobility development in cities and regions. The transport demand, travel time, and travel costs are the most central elements in policy discussions; however, the contemporary sustainable mobility debate contains not only environmental concerns, but also social concerns such as health, equity, and power, that make up elements in mobility development (Banister, 2008).

This thesis refers to sustainable mobility as integrative transport and land-use planning on a municipal level. There is tremendous work on sustainable transport from different angles, such as Banister's (2008) sustainable mobility paradigm, Næss' (2006; 2012; 2014) studies on relations of urban form and travel behavior, and Litman's (2012) work on induced traffic, just to mention a few. Based on various studies and authors in the field of urban planning (see e.g. Høyer, 1999; Næss, 2001; Holden, 2007; Banister, 2008; Tennøy, 2010; Hickman et al., 2010; Næss, 2012; Litman, 2014), sustainable urban mobility is defined through:

- Imposing or encouraging land-use development that demands less transportation and less car use to avoid urban sprawl
- Imposing physical and fiscal restrictions on car traffic
- Improving public transport services
- Improving conditions for walking and bicycling
- Control of road and parking capacities
- Ongoing education of planning and political authorities as well as civil society

According to Banister (2008), successful radical change in line with the sustainable mobility paradigm needs public acceptance and involvement to achieve not only policy change, but also behavioral change. However, structural changes in different forms can support a behavioral shift towards desirable mobility patterns (Næss, 2015). According to Banister (2008), basic approaches used to influence transport planning are: A) Reducing the need to travel via the use of substitutions, such as smart technologies that offer virtual

travel (working from home, internet shopping, etc.) B) Introducing transport policy measures that stimulate modal shifts away from car-based transport toward more sustainable modes of transport, such as walking, biking, and public transportation. A multitude of measures can be used to support such shifts, including parking space reduction, road pricing, and speed limits. Overall demand reduction is key and can allocate road space for other uses and transport modes. C) Generally speaking, land-use policies are highly effective and decisive long-term measures in transport planning. Urban form influences transport patterns and demand (Næss, 2012). Increasing densities and concentration creates accessibility by proximity and reduces the kilometers travelled and thus the emissions produced. Moreover, densification offers better chances for a high quality public transport system providing a critical mass of users. D) Technological innovations have a strong impact on efficiency conditions in the transport systems, introducing improvements such as alternative fuels, better engines, smaller vehicles, and electric cars, which can reduce the amount of emissions and resources used when employed in connection with demand control. The demand reduction is most crucial, as efficiency can easily lead to rebound effects otherwise. A variety of studies show the shortcomings and rebound effects of efficiency solutions alone, though these still need to be embedded into overall integrative transport and land-use schemes reducing demand for travel in order to make an effective difference (see Holden & Høyer, 2005; Høyer, 2008; Banister, 2008; Driscoll et al., 2012).

Næss' profound engagement with the study of urban form and its influence on transportation and travel mode is clarifying the inevitable need to incorporate land-use planning into transport planning and vice versa (1993; Næss, 2006; Næss, 2012). Generally, sprawled urban structures generate more traffic than more compact urban built environments. Considering a metropolitan context, Næss (2006) shows that the amount of travel is especially influenced by the distance from the residence to higher order centers, which offer the widest range of public and private services. The opportunity for a variety of choices is decisive for travel decisions of highly mobile modern inhabitants of cities and metropolitan areas, and this factor weighs even higher than proximity. Thus, the inhabitants' amount of travel (especially by car) is influenced more by the location of the dwelling relative to concentration of jobs and other facilities usually found in and around the main city center than by its location relative to local centers. There are causal relations, as empirically and theoretically demonstrated, of urban density and the transport-related energy consumption; as the city grows denser and the functionality of public transport increases, the dependency on automobility decreases (Newman & Kenworthy, 1989; Næss, 1993; Cervero, 1996). Certainly the level of densification within the city as a whole is crucial as well as the location of functions and relative distance to them that generate demand. The ABC locational policy for workplaces describes an

approach to integrative land-use and transport planning (Schwanen et al., 2004). It is about a locational choice for office development and other types of workplaces attracting many employees and visitors at centrally located sites with connections to the public transport system that can minimize car-based transport and stimulate public transportation, biking, and walking.

Increasing or establishing the share of regional public transport is crucial to reducing the automobility in suburbanized metropolitan areas or polycentric regions. Pucher and Kurth (1995) offer insight into regional public transport services from case study research in Germany, Austria, and Switzerland. They clarify the need for a service quality improvement, system enlargement, marketing, and financial support of public transport supplier networks [Verkehrsverbund]. Often, governmental subsidies are unavoidable and can act as a distributional choice to improve the overall regional development. An increase of fares can lead to ridership losses, so any financial surplus needs to come from taxes on car-ownership and transport, as car-drivers often slip from paying the actual costs of their mode of transport. The mostly externalized environmental and social costs of automobility would be internalized and lead to a more fair distribution of pricing, thus acting as an incentive for mode shift.

Other severe problems in transport planning are generated and induced traffic (Litman, 2014), phenomena of traffic volume increase due to road capacity expansion. Generated traffic is defined as "*Additional peak-period vehicle trips on a particular roadway that occur when capacity is increased. This may consist of shifts in travel time, route, mode, destination and frequency.*" Induced traffic is "*An increase in total vehicle mileage due to roadway improvements that increase vehicle trip frequency and distance, but exclude travel shifted from other times and routes*" (ibid: 4). The dilemma of the road capacity expansion approach in aiming to solve congestion is that the newly produced capacity is taken up by the newly generated traffic, thus creating adverse effects that may be even worse than the negative externalities from the original congestion. There are transport models that aim to provide input for the cost-benefit analysis of a planning project and serve the decision-making process with data predicting future traffic based on trends. However, many of the models used in planning practice disregard or underestimate these feedback effects, and this is in addition to failing to incorporate the effect of the new road-based infrastructure on land-use planning in the long run (Næss et al., 2014; Litman, 2014). Results often show an unrealistically high forecast of expected traffic volume in the case of no road expansion, or underestimated traffic in the case of road building. This form of transport forecasting is related to the "predict and provide" paradigm (Owen, 1995). The latter is a transport planning approach that seems to be more concerned with investment strategies than reflecting on the need to build new infrastructure (Næss et al., 2014).

These different scholars identify causal relations explaining the components of urban development that make up our mobility systems, in addition to the challenges, dependencies, and mobility patterns that become obvious as a result of these structure-agency relations created and/or reproduced by professionals as well as general users of the infrastructures. Unfortunately, sociotechnical systems reflect the dominant mobility complexity, not necessarily the sustainable.

2.3.3 Achieving sociotechnical system change

The main strands underlying transition theory are a complex system perspective, a sociotechnical perspective, and a governance perspective. Transition theory is interested in understanding persisting problems, which might be expressed in sociotechnical system crisis, climate change, or financial crisis, and influencing development paths that might change trajectories. Transition is understood as a profound process of structural change through innovative practices and structural adaptation (Grin et al., 2010: 3). Some overall concepts within transition theory are coevolution, the multi-level perspective, multi-phase, and co-design and learning (Grin et al., 2010). Here, the multi-level perspective (MLP) will be introduced in more detail as this theoretical concept is applied in the thesis (see chapter 3). The MLP contains the central concept of the sociotechnical regime. Regime change reflects and defines the transition process.

A sociotechnical regime is understood as a collectively emerged and strongly institutionalized set of rules, which materializes in the form of specific processes, products, technologies, practices, and search heuristics (see Rip and Kemp, 1998; Geels, 2002). Moreover, a regime is defined through fulfilling "generic societal functions," such as electricity, transportation, or housing, and is mostly sector-oriented (Geels & Schot, 2007). However, there is no coherent definition of a sociotechnical regime concept (Markard and Truffer, 2008). Conceptions evolve over time and differ regarding inclusion of actors, technology, or similarities to system conceptions. Some understandings are based on the notion that "*technologies and products embody the rules and actors perform the routines that make up the regime*" (Markard & Truffer, 2008: 605).

Systems are constituted of networks, actors, and institutions whose explicit functions hold a system together by creating and maintaining relations between actors and structures. Systems are not concerned with radical change, per se, as transitions may be, but are defined by an innovation and a production part. They can span/contain multiple regimes. According to Markard and Truffer, "*A technological innovation system is a set of networks of actors and institutions that jointly interact in a specific technological field and contribute to the generation, diffusion and utilization of variants of a new technology and/or a new product*" (2008: 611).

There exist both open and closed systems. Cities or urban cases are more generally reflected in an assemblage of open systems. It is nearly impossible to find closed systems in social life; one example would be a controlled experiment in a lab, in which the conditions are accurate and stable. A closed system is defined "*when reality's generative mechanisms can operate in isolation and independently of other mechanisms – closed systems require non-change*" (Danermark et al., 2002: 66). Certainly, social life, the complexity of cities in their political, spatial, and social relations, involves multiple relations between structures and agency, and these are not static, but constantly changing, even though they may be of high endurance.

The multi-level perspective (MLP) is understood as process theory with foundational ontologies in evolution and structuration theory (Abbott, 2001; Giddens, 1984; Braudel, 1958). Geels (2010: 496) characterizes the MLP as a middle-range theory and places the MLP "*as a crossover approach between evolution theory and interpretivism*", although an extensive ontological position of the concept is not really present. Historical ex-post case studies are a typical field of investigation and are seen as legitimizing typology building and thus learning about transition pathways identifying the interaction of co-evolutionary trajectories (Grin et al., 2010). Three analytical levels structure the theoretical concept: sociotechnical landscapes as long-term, exogenous trends, sociotechnical regimes as current dominant structures, and sociotechnical niches as loci for innovative practices (ibid.). The MLP uses time and structuration as the two axes of the basic model. There is increased structuration, also called the level of aggregation, from niche to landscape level, and thus the model uses an understanding of structuration to distinguish the analytical levels; however, it does not explain the process of structuration as such. The primary aim of the MLP is to explain regimes' changes (respectively renewed configurations) through an analysis of the interplay between these three dimensions over time. Different transition pathways are described and the non-linear process dynamics within societal systems are envisioned. Figure 6 represents the classic MLP process dynamics due to the interplay of the three analytical levels.

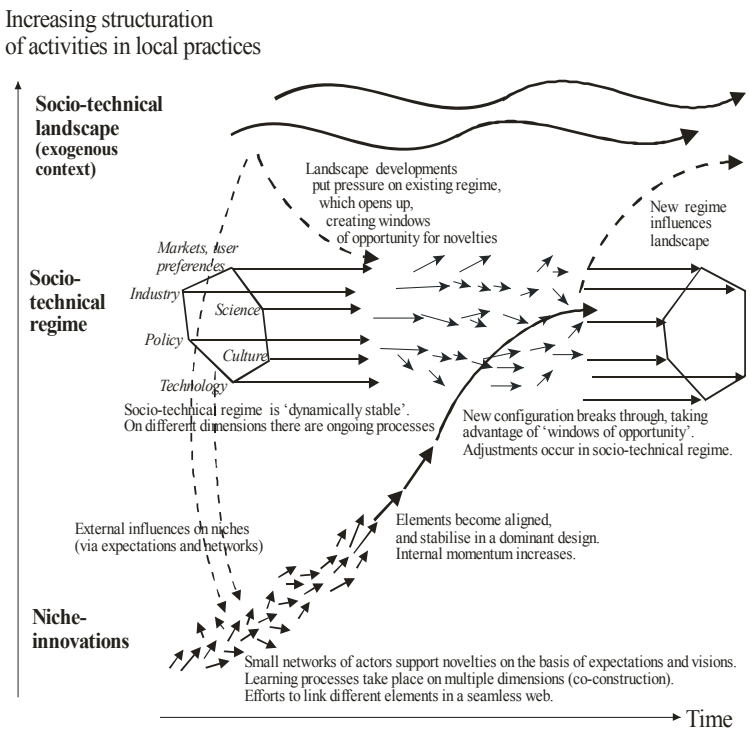

Figure 6: Multi-Level Perspective (Geels, 2002)

The sociotechnical regime is central and comprises the dynamically stable, established, and hegemonic practices, discourses, institutions, and artifacts. According to Rip and Kemp (1998), a regime is defined as "*the coherent complex of scientific knowledge, engineering practices, production process technologies, product characteristics, skills and procedures, established user needs, regulatory requirements, institutions and infrastructures*."

Niches are relatively similar to regimes in their basic characteristics, but do not have the same pervasiveness and power in societal systems. Niches can support regimes or serve as opponents in their approaches. Many transition scholars believe that niches are the main loci for transition or innovative development, being less dependent on paths and more able to use other resources, as well as having the ability to react more easily to pressure and change than the regime, which is considered to be more locked in.

The landscape level could be described as: "*broader developments in the demographic sphere (e.g. the transformation of family relationships, aging of society), social sphere (e.g. the growth of travel mobility and virtual networking), economic sphere (e.g. the globalization of production and consumption), cultural sphere (e.g. the surge of individualism), or environmental sphere (e.g. the depletion of natural resources)*" (Bertolini, 2011: 6). This level contains deeply rooted social structures that are seen as hardly changeable by niche actors.

Gidden's structuration theory

The MLP mainly refers to Giddens' structuration theory in its conception and understanding of structure and agency (see e.g. Geels & Schot, 2007; Smith et al., 2010; Geels, 2011; Grin et al., 2011; Geels, 2012; Raven et al., 2012). According to Giddens (1979), structure is referred to as rules and resources upon which agents draw when engaging in actions. Agency basically contains the social practices of agents, who are always embedded in structures but hold different capabilities in utilizing them. Giddens describes structure "*as properties of social systems"* and system as "*reproduced relations between actors or collectivities, organized as regular social practices*" (1979: 66).

As one major objective, Giddens wants to overcome the problem of objectivism and subjectivism in social science, which others referred to as downward and upward conflation (Archer, 2000), and has therefore developed the concept of duality of structure (Giddens, 1979; 1984). This describes the two main properties of structures as transformative and reconstituted. The process of structuration is both medium and outcome of agency. He conflates agents and structures in a continuous process of social practicing, which acknowledges that both have influences on each other, but makes it difficult to identify exactly how.

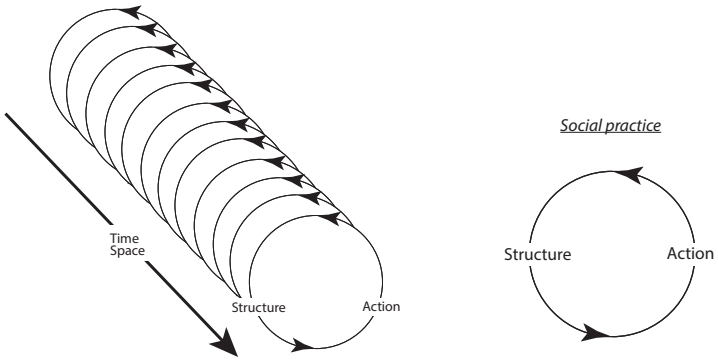

Figure 7: Illustration of Giddens' structuration theory as a process of continuous flow of conduct (Source of illustration: Rose, 1999)

Moreover, Giddens expects a rather high reflexivity of the agents concerning the structures in which they are embedded. The capabilities of agents depend on powers, norms, and meaning, namely the structures that determine their conduct. Giddens speaks of the reflexive monitoring necessary for restructuration, though he also points out that agents usually act in routines and do not rationalize their ongoing flow of conduct (Grin et al., 2010). Giddens developed structural principles that shape social systems and structuration processes, which can be summed up under resources and norms that agents draw upon throughout conduct. Even though Giddens recognizes "*the possibility of change* […] *as inherent in every circumstance of social reproduction*" (1979: 210), it is difficult or impossible to identify exactly how and when such change might take place due to the conflation of structure and agency.

The contemporary urban regime as multi-segmented

There is a challenge of making appropriate delineations of regimes empirically, as criticized by scholars such as Markard and Truffer (2008), who state "*that [the] regime definition is not just a question of the appropriate aggregation level but also a question of perspective. […]*" Taking the case of an urban transition towards more sustainable mobility would be one such different perspective and complexity. There is a need for interpreting the concepts of the MLP differently to employ this perspective on urban transitions of a city-wide scale.

There has been an increased discussion around transition-theoretical concepts in regards to scale and place, cities as explicit objects of transition, and how to adopt or/and modify the concepts to make a sensible contribution (see e.g. Coenen et al., 2010; Bulkeley et al., 2011; Hodson & Marvin, 2012; Coenen & Truffer, 2012; Späth & Rohracher, 2012). This thesis engages precisely with questions about theoretical conceptions of and analytical take on urban transition (see articles in chapter 8; Næss & Vogel, 2012; Valderrama Pineda & Vogel, 2014). Spatiality becomes an issue, which has traditionally not really been conceptualized or included in transition studies as such. The scope and scale of the city is not the typical object of analysis; sector-oriented views were and are more prevalent, meaning that the definition of a regime depends on the subject of analysis. As the subject of analysis has often been a particular technology that got replaced by a new technology, it makes sense to delineate the regime around that sector. However, studying the city and its mobility as a socio-material system, which entails analyzing transitions of the urban built environments, multiple sectors, and market segments, the regime needs elaboration. Moreover, cities reflect a state of continuous incremental change owing to the complexity of urban development, which is a process and result of daily life, production, and consumption of commodities, influenced by the diversity of societal groups, political and economic systems, cultural norms, etc. Thus, "*what should be considered as urban*

transition within the perspective of transition theory are changes in the way urban structures change" and practices accordingly (Næss & Vogel, 2012: 40).
The analysis of urban transitions has to engage with a different complexity. The given regime reflecting the dominant structures and practice in transport and land use can be described as multi-segmented. Multi-modalities are prevalent in transport and land-use policies, reflecting different household structures, income levels, and lifestyles (ibid.). Development is oriented towards these different demand structures, such as market segments, and offers multiple solutions at the same time. This conceptualization of a multi-segmented regime reflects the actual urban conditions more accurately, in addition to reflecting the prevalent liberal policies and planning approaches. Moreover, spatiality as an object of study, namely in this case the urban form, and the inertia and influence on mobility patterns thereof, are crucial components for sustainable mobility development. Social structures, as allocated under the landscape level and thus rather excluded in traditional studies inspired by transition theory, need explicit focus and incorporation in sustainable transition strategies. They have a strong conditioning and stabilizing effect on regimes, and niches might, even if promising, lose their influence or be co-opted (see more details about the applied multi-segmented regime understanding in chapter 3).

2.3.4 Prevailing rationalities and opposing alternatives

Critical urban theory serves for contextualizing and placing my study normatively as well as providing the analysis with the actual underlying mechanisms and structures that dominate contemporary urban development. To depict these structures and achieve an explanatory ability, this thesis draws on debates and scholars from political economy, political ecology, and environmental and ecological economics (e.g. Jevons, 1871; Daly, 1992; O'Conner, 1998; Andersen & Massa, 2000; Røpke, 2005; Luke, 2006; Kovel, 2007; Næss & Høyer, 2009; Harvey, 2010; Sager, 2011; Vogl, 2012). The basic objective of critical urban theory, that of "*understanding the nature of contemporary patterns of urban restructuring, (...) analyzing their implications for action (...) and the possibility for alternative, progressive, radical, or revolutionary responses to it*" (Brenner et al, 2012: 3), fits well with the underlying approach of this research project. The challenge of sustainable urban mobility is embedded in dominant rationalities of modernity that form and influence legitimacy for planning measures and/or define priorities within planning practices that impede the aim of a more socially and environmentally sustainable urban development.
One of the most dominant influences on contemporary urban development is neo-liberalism (Jessop, 2002; Harvey, 2010; Sager, 2011). "*Neo-liberalism can be viewed as a restructuring of the relationship between private capital owners and the state, which*

rationalises and promotes a growth-first approach to urban development" (Sager, 2011: 149). The urban scale most clearly reflects the neo-liberal consequences for society. Cities are considered to be "*engines of economic growth, key centers of economic, political, and social innovations, and key-actors in promoting and consolidating international competitiveness*" (Jessop, 2002: 465 based on Report of World Commission, 2000).
Some main values put forward by neo-liberalism are *individualism, entrepreneurialism, private ownership,* and *a freedom of choice*, which generate specific consequences for urban planning policies (Sager, 2014). For example, urban economic development is reflected by city marketing approaches, focusing on attracting a creative class, and aiming at a high level of competitive force. Provision of infrastructure is increasingly based on private sector involvement and development, especially urban re-development, and is more and more investor-led (see also Galland, 2011). A liberalized housing market enforces gentrification and segregation (Sager, 2014). These examples reflect a shifting of responsibility to the individual level, which is expected to cope with the systemic problems and their adverse effect on social wellbeing and environmental conditions (Jessop, 2002: 465). This liberal approach with its strong focus on individual rights creates inequalities and has implications for increased commodification of new demands, thus creating more consumption and production, more dependencies, resource consumption, etc. However, a multitude of parameters come together through "*an even more intensive possessive individualism (...), along with money-making, indebtedness, speculation in asset values, privatization of government assets and the widespread acceptance of personal responsibility as a cultural norm across social classes*" (Harvey, 2010: 132). According to Harvey (2010), the main danger lies in any form of determinism of one approach to explain or solve everything, such as class determinism, environmental determinism, or human individualism and greed. A mono-causal and overly simplistic view cannot cope with or reflect the above-mentioned dynamics.

Alternative approaches

There does exist a variety of thinkers and activists who offer more radical "deep green" alternatives to work against the dominant growth imperative (Alexander & Rutherford, 2014), ranging from simplicity and sufficiency approaches (Alcott, 2008; Alexander & Ussher, 2012), to eco-socialism (Kovel, 2007), and even eco-anarchism (Bookchin, 1989; Trainer, 2010). Also, there exists a diverse community of degrowth[4] proponents who strive for a radical transformation of society (Fotopoulos, 2007; Kallis, 2011; Demaria et al., 2013; Muraca, 2013; Schneider et al., 2010; Spangenberg, 2010; Van Griethuysen,

[4] "*Generally degrowth challenges the hegemony of growth and calls for a democratically led redistributive downscaling of production and consumption in industrialised countries as a means to achieve environmental sustainability, social justice and well-being.*" (Demaria et al., 2013: 209).

2010). These deep green alternatives are all very diverse and partly overlapping traditions and approaches, but they generally share the conviction that "*the nature of the existing system is inherently unsustainable*" (Alexander & Rutherford, 2014: 1). The end-vision is often commonly describing a state of social justice and environmental sustainability within the world's bio-capacity limits, containing more frugal, but sufficient lifestyles and systems (ibid.). However, the paths or strategies suggested for achieving this future can differ greatly. Roughly speaking, they can be separated into reformist, eco-socialist, and eco-anarchist strategies.

The reformist strategy contains a parliamentary approach, which is enacted within the given system through political shifts, ideological, and cultural changes that will shape new social structures to arrive at a green transition. General examples would be redistributions via taxes and investment choices, retrofitting, quota-regulations, self-sufficiency, increased sharing, more minimalistic lifestyles, etc. This approach reflects a kind of reformed capitalism (ibid.).

The eco-socialist strategy shares several approaches of the reformist thinking regarding short-term measures; however, in the long run, these proponents see the need for a socialist revolution. For an eco-socialist perspective, systemic change is required away from market capitalism toward a new cultural hegemony. Eco-socialist thought departs from Marxist historical materialism thinking insofar as it identifies moral progress as a precondition for a socialist revolution (Sarkar, 1999). An agency idea emerges that should go beyond class interests to achieve a critical mass at all levels of society in order to create a state-driven socialist framework (Alexander & Rutherford, 2014).

In contrast, the eco-anarchist strategy neglects state power or political hierarchies overall and wants to achieve a self-governing society instead. It is about a direct participatory democracy of extreme locality, so to speak. Thus, rather varying conditions appear based on different local circumstances and abilities. Initiating transformation is a concurrent process of value and institutional change and takes place from within the system through such concepts as grassroots initiatives that gather momentum and finally overthrow the existing system, forming a new, local economy as an antithesis to capitalism (Trainer, 2010). Overall, this approach is understood as a global movement enacted locally.

All three different approaches share the acknowledgment that given governments, powerful corporations, or wealthy citizens may not willingly accept such radical changeovers, meaning that conflicts are an unavoidable part of transitions. Moreover, considering the urgency for change, questions regarding who is involved, what needs to change, and in which order changes should occur become crucial considerations in transition strategy building. The inclusion of the state, institutions, and representative democracy more generally might be logistically and effectively necessary to achieve faster changes; however, the systemic overthrow could be impeded precisely due to those

structures and agents that try to retain power. Gathering momentum through approaches such as radical localism can be a rather random and slow process, even though it might bring along deep structural value and cultural changes[5].
Beyond this, not only do distributional contestations appear, but also questions regarding ethics, democracy, and legitimacy, which need to be taken up when calling for more radical change.

2.3.5 Ethics, democracy, and legitimacy in radical transformation

Calling for more radical change needs a confrontation with legitimacy issues. This section will reflect on ethical dimensions and a democratic question that can arise when engaging with radical change. Generally speaking, planning actors should always engage critically with legitimacy, ethical values, and democratic conditions underlying the action; however, planned or desired radical change puts up a more dramatic moral challenge. As the previous sections already demonstrated, contemporary urban development is dominated by principles of growth and competition. Because of this, and due to the undesirable, if not harmful, current conditions and consequences seen from a social and environmental sustainability perspective, ethical dimensions and differing principles and values become essential for the sustainable transition processes put forward in this thesis. Legitimacy should not be defined through competitiveness or growth, but through ethical and democratic values.
Ethical dimension are value-laden, moral positions of right or wrong regarding justice, equity, power, responsibility, etc. and can be understood and used as guiding principles in decision-making processes such as in planning. Fainstein (2010), for example, develops her understanding of the *just city* from the following values: democracy, equity, diversity, growth, and sustainability. Democracy is not (only) about the majority or strongest party; it is especially about the quieter voices, which need to be heard. Idealistically, democracy should be capable of "*insuring adequate representation of all interests in a large, socially divided group; of protecting against demagoguery; of achieving more than token public participation; of preventing economically or institutionally powerful interests from defining the agenda; and of maintaining minority rights*" (Fainstein, 2005: 125). These challenges are also seen as *classic conundrums of democracy* and are under lasting dispute (ibid.). This reflects an omnipresent struggle, but also offers the chance of being able to change something for the common good, which requires interference. This interference is built on indignation, and this indignation has a frame of reference, so to

[5] It is the dilemma of where to start first and if agency is necessary to create new values before developing new structures, or if the structures should be used to influence agency to be more aligned towards the desired change to achieve the sustainable transformation. This represents a basic structure-agency discussion (and a kind of chicken-egg question). .

speak, an example being an idea of what is just and what is not. To develop such a position, knowledge, arguments, and values need to be communicated and/or demonstrated (see alternatives under 2.3.4). Values in the form of empathy for each other, care, and responsibility for social and natural environments (happiness through e.g. sharing, etc.) should also get attention and people need to be encouraged so that social learning and social capital can prosper while fear of "otherness" is reduced. Social inequality might not be solved, as it often has socioeconomic structural backgrounds, but it can be handled differently and on a more ethical level, which can then support a deep structural change. Ethical dimensions may span from individual to global scales, engage with current generations as well as distant futures, and include humans and many different types of species, which can make a big difference in the obligations identified (Arler, 2004). The case of urban transformation is challenging, as it connects the global with the individual on the city grounds. Urban development and lifestyles impact wider than the local geographical boundaries and will influence future generations, biocapacities, resource quantity, etc. over time. This needs to be considered when planning decisions are undertaken and ethical considerations are made.

2.3.6 Achieving more radical change

"*People do not worry about the future, but only about their current problems…*" (Meadows, 2013). There is a rather widely known phenomenon that people generally start to act if they are personally affected or concerned. Radical change as such or thinking of the need for more radical change is often linked to systems collapsing and the occurrence of crises. However, crises are likely to include suffering, at least for some, and that should not be the desired approach to achieve more radical change. Nevertheless, numerous crises are already here in the forms of climate change, reduced biodiversity, natural resource scarcity, social inequality, economic instability, etc. Planning could reduce the impact of crises by creating long-term strategies (e.g. informed by scenarios). Even if politicians currently in power do not (yet) appreciate policy recommendations based on contributions from critical research, such research might become relevant, policy-informing knowledge at a later time. The following section will engage with a theoretical approach for planned change processes for more radically different futures.

Futures studies

This thesis is concerned with forward-looking transition processes in sustainable urban development and mobility planning. It is located theoretically between the field of transition studies, futures studies, and planning. Transition studies originate from historical, ex-post studies, and approach processes of change having taken place to try to

learn from understanding the dynamics and conditions that made change possible or caused resistance against them (Smith et al., 2010). This thesis, however, is dealing with planning toward long-term future change. Therefore, the focus is put on scenarios as planning and policy informing tools, which is one of the main concepts in futures studies (Börjeson et al., 2006). Nevertheless, historical studies and futures studies are actually linked, or at least could benefit from each other and utilize an insightful ground for understanding change and influencing transformation processes (Svane et al., 2010; Sardar, 2010).

Sardar (2010) speaks of the four laws of futures studies as being *wicked, MAD, skeptical,* and *futureless*. These essential characteristics of futures studies offer a valuable introduction into the scope of this approach and how it is beneficial in studying processes of change. Being *wicked* relates to underlying *wicked problems*, characterized by offering possibilities instead of single solutions, being of multi- and trans-disciplinary natures, and avoiding subordination into one discipline. Instead, critical inquiry is the aim. *MAD* stands for Mutually Assured Diversity and describes the need to account for the difference in concepts that create collective humanity, such as cultural diversity and multiple histories. Culture as an "*enabling feature of knowing, being and doing*" (ibid. 183) is central for the human condition. To be *skeptical* is another essential component of future studies. Doubting truth claims or simple solutions for complex problems helps to avoid foreclosed definitions of futures, which is substantial for identifying different options, their consequences, and who might benefit or lose. Finally, with *futureless*, Sardar means a more technical sense or applicability of future studies, meaning their impact on the current state of thinking, doing, planning, etc. This influence can generally be assessed as being valuable (or not) for decision-making and triggering change. The two latter characteristics of skepticism and being futureless need some additional reflections. A general skepticism against claims of certainty should not end up in relativism in the sense that any truth claims are equally obscure (see section 2.2.3). There needs to be a possibility to identify criteria needed to make decisions, e.g. referring to certain values on which they are based and/or due to causal explanations. This links to the point of being futureless, here meaning anchored in contemporary challenges. Friedmann (2002), for example, talks about *critique and constructive vision* as being inevitably paired. Critique arises from current conditions and forms reason for the aspiration for a utopian image. To be able to develop appropriate steps towards this, extensive understandings of contemporary challenges are critical.

Thus, futures studies are especially appealing due to the critical inquiry into given solution approaches, allowing researchers to envision different opportunities and their consequences in order to break with the unsustainable and damaging contemporary

practices. The visionary pictures as such might be conceivable, although dominant discourses, norms, path dependencies, system structures, regimes, etc. create lock-ins, which may seem inviolable. To bridge the present condition to a desirable future state, or to visualize the consequences of continuing business as usual, futures studies can be helpful. Futures studies are concerned with possible, probable, and preferable futures. Research deals with questions of: "What will happen?", "What can happen?", and "How can a specific target be reached?" One of the most basic concepts applied are scenarios, although visions, utopias, or myths are other theoretical conceptions in the field. Generally speaking, futures studies and scenarios offer multiple concepts, methods, and creativity (Svane et al., 2009). Futures studies can serve with valuable insights for policy implementation by offering a long-term perspective on problem issues and linking it to actions to be taken (or not taken) now. Thus, futures studies can deal with the so-called "implementation gap", which describes the gap between the availability of knowledge on sustainability while unsustainable practices are nevertheless continued (Banister & Hickman, 2013).

Futures studies might be better known for their epistemological take being reflected in different techniques to achieve knowledge about the future. To what extent is it at all possible or impossible to know the future? What is valid and reliable? For a start, even if we cannot know the future for certain, some level of predictability might be possible or even necessary to have a basis for planning, transition strategy, or policy development. While theories and methods are always fallible, they can be more or less appropriate points from which to consider thought operations about possible, probable, or preferable futures. Depending on the ontology, answers or arguments will differ; for example, a positivist may argue based on law-like regularities between phenomena to be able to predict the future course of action, whereas a critical realist would argue for the necessity of going beyond the empirical and employing transfactual argumentation, identifying the structures and mechanisms of a phenomenon. The latter can also be used to examine future-oriented conditions and is called *retroductive thinking* (see chapter 3). The ontological process underlying this inference is desirable. Being able to undertake retroductive thinking allows and needs creativity, a divergent image of reality, and a building of relations that might be impossible under current circumstances, but would be under new ones.

Scenario theories

Originally, the scenario approach was developed from the strategic warfare in the 1950s (Banister & Hickman, 2013); today, however, scenarios are known in many different fields of expertise. Under the rising pressure of climate change, the scenario approach seems to attract more attention. For example, in climate adaptation and mitigation studies,

scenarios are used to explore paths to meet the goals set (e.g., IPCC, 2001; WWF, 2009). Transport planning has traditionally used transport forecasts to predict traffic development and create investment strategies (e.g. Infrastrukturkommissionen, 2008). Some businesses, such as Shell, explore possible futures under different circumstances for their strategy development (e.g. Shell International BV, 2008). Scenarios basically function as decision help and often contribute to policy formulations (Banister & Hickman, 2013).

There exist two different types of developing scenario approaches: the theory-based, expert-driven approach and the participatory, learning-oriented approach. The participatory scenario process can be a very decisive part and value of the scenario approach, being a capacity-building process which might be vital for implementing steps toward the defined vision or arriving at a common vision. On the other hand, the theory-driven approach offers the possibility of incorporating knowledge unfamiliar to or neglected by practitioners and laypeople, which might be necessary for more radical changes. This means that scenarios support practitioners or researchers with insights about causal relations, as well as offering visionary processes and enabling actors to formulate stronger arguments (which can help to change the dominant unsustainable conditions), essentially acting as decision help in policy formulation processes (ibid; Börjeson et al., 2006).

When investigating the transition toward environmentally and socially sustainable urban mobility, the nature of the study object is that of the utopian condition, at least under current circumstances, which calls for dissident thought operations and actions. In order to push forward the current discourses of sustainable urban development planners might have to shift their approach from plans as preserving scenarios to more radical transforming scenarios which question the prevailing structures and call for major societal changes (Gunnarsson-Östling & Höjer, 2011: 1054). Thus, this research project applies normative scenarios and the backcasting approach introduced in chapter 3.

2.4 How are the theories used in the study: A transition conceptual framework

> *"[T]heories are seen as tools that help us see, operate, and get around specific social fields, pointing to salient phenomena, making connections, interpreting and criticizing, and perhaps explaining and predicting specific states of affairs. ... Social theories provide maps of societal fields that orient individuals to perceive how their societies are structured. ... Social theories are thus heuristic devices to interpret and make sense of social life. ... Social theories can also*

illuminate specific events and artifacts by analysing their constituents, relations, and effects." (Kellner, 1995: 24f)

2.4.1 Undertaking social science

The ontological positioning serves as orientation in the world and leads to the epistemological perspectives used to achieve meaningful explanations, as well as the ability to engage purposefully in knowledge creation. Here, the structure-agency nexus serves as a basic realm in which to position the research in social science. Critical realism and critical pragmatism are the two philosophies of science that were considered to be most enlightening for the study of transformative change. Critical realism serves the study with a sophisticated view on structure and agency and provides next to ontological reflection on transitions also an analytical model for the structure-agency analysis (Sayer, 2000; Danermark et al., 2002; Archer, 2000; Bhaskar, 2008; Næss, 2015).
Critical pragmatism offers insight on political agency, which could serve as a proactive perspective and political engagement with the world (Forester, 2012; Gimmler, 2005). "*From a pragmatic point of view actions in everyday life are creative in a double sense: they are creative in adapting to a given situation and they are creative in changing contexts and situations and rebuilding the social structure anew*" (Gimmler, 2005: 26).
Adapting analytical dualism reflects the ontological opinion that both structure and agency hold their emergent powers and properties. It offers an analytical model and thus a methodological take on studying structure-agency relations in change processes. The time dimension is decisive; structure predates agency and has a conditioning effect through constraining or enabling actions, and actions happen in relation between agents and have the ability to transform or reproduce the structures (Danermark et al., 2002).

Doing science comprises thought operations. These are organized and legitimized based on ontological and epistemological premises. Generally speaking, theorizing and abstraction are very essential operations in critical realism, which is based on the ontological perception that the world is stratified and exists without our experience of it, as exemplified by the three domains: The empirical domain consists of what is observed, the actual domain also contains the events happening, but not necessarily being observed, and the real domain includes the structures, mechanisms, and causal relations that are underlying the events. However, these are not necessarily triggered, but exist. Theorizing helps and allows the achievement of knowledge about the unobservable structures and mechanisms (Danermark et al., 2002).
One important form of inference is retroductive thinking, which is a thought operation that constructs the properties and relations allowing a phenomenon to exist (Danermark et al., 2002). This process of reasoning is very important and enlightening for the study of

transitions, especially if the current conditions hinder more radical change; retroductive thinking is a necessary operation to investigate the reasons behind and possibilities with which to counter this resistance. Moreover, in participatory processes with other people, such as experts in the planning domain, these thought experiments can have a great effect on learning, reflexivity, and creativity needed to arrive at new solution approaches (see scenarios, especially backcasting in chapter 3).

2.4.2 Insights from the structure-agency nexus

The structure-agency nexus has influenced this work in three ways with regard to my ontological position in transition studies, theoretical considerations, and analytical models, as well as critical reflections on transition in the making, its practices, and politics.

At first, the structure-agency discussion in social science relates to different ontological and epistemological strands. Engaging with the structure-agency nexus equipped me with a basic ontological position in transition studies. Basically, this entails that structure must be changeable, which is (mostly) happening through agency, and that agency is conditioned, although not determined, through structure. My position mainly builds on the critical realist view on structure-agency introduced beforehand, which means that both structure and agency hold emergent properties and powers that work back upon each other. A crucial point, however, is that structure and agency operate at different time intervals, meaning that there can be specific time-lags in terms of structures conditioning agency. Being interested in sustainable urban development and mobility transitions, this underlying understanding of the world and how it is interrelated explains challenges and has a bearing on finding solutions.

At second, the structure-agency analysis has served this research with a further development of and critical reflection on given transition-theoretical understandings and analytical conceptions, such as the MLP. For example, the missing conception of the explicit spatial character in urban transitions, spatiality as object of the study or the geography of transitions, is emphasized and can thereby be approached more appropriately. Also, deeply rooted social structures of the sociopolitical or socioeconomic systems are tackled and are included as part of the analyses of different transition strategies, thus identifying crucial barriers and/or enablers for transition processes. The so-called *landscape level* within the MLP is mostly excluded in mainstream transition theory approaches as comprising exogenous, dominant structures hardly changeable by actors. Thus, the aforementioned social structures are not sufficiently integrated into the

analytical conception and basic underlying problematizing in transitions. However, doing so neglects an important consideration; even though these structures are challenging to change or analytically conceptualize, they are decisive in transformative change.

Thirdly then, the structure-agency discussion relates to a political dispute in practice. A rather sophisticated view on transition dynamics and causal chains was attained through the structure-agency analysis applied in this thesis. This allowed the revealing of dilemmas that reflect dependencies built and dynamics between market, state, and civil society. It essentially shows the political character of transitions and what that might mean for governing these in society with its political system. Power, legitimacy, and ethics become topics of discussion and conflict. Transitions in the form of deep, structural, transformative change will always provoke given system structures to change, which will create re-distributional tasks and also winners and losers. The powerful actors of politics, economy, and market will try to resist losing their positions, which will form barriers for more socio-ecologically sustainable futures. One way to tackle this challenge is to use scenarios as a transition-methodological tool to help effectively utilize knowledge about structure-agency relations in practice.

2.4.3 Summary: choice and function of theories

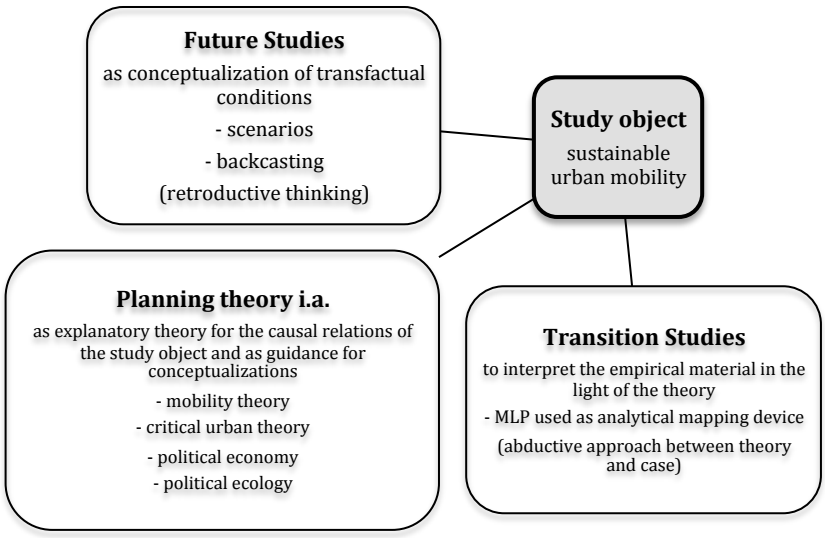

Figure 8: Theoretical junction

The structure-agency discussion serves my research with an ontological reflection on transition and change. It is an overarching concept for the thesis and operationalized in different ways, as described above.

Scenarios reflect also my epistemological take in doing research. The scenarios reflect a normative view coupled to explanatory theories and causal relations, albeit also a creative view on given challenges and new prospects for the future.

Transition theory is utilized as a heuristic perspective mapping the main components of urban transitions. The abductive inference is especially valuable for the further development of urban transition conceptions and in structuring the analysis. However, explanatory power for underlying causal relations needs to be provided by additional theoretical triangulation.

Thus, explanatory theories from knowledge domains of urban development and planning, mobility, political economy, and political ecology have served the research as guidance and input for retroductive conceptions, in addition to providing general insight on underlying mechanisms.

3. Methodology

3.1 Elaboration on the research questions and methodological choices

As the purpose of this research project is a critical discussion on transformative urban change, revealing barriers and opportunities and reflecting on given solution approaches as well as possible, if not necessary, new directions, the research is concerned with (yet) non-existing conditions. The overall research question of **"***How can urban transitions toward a low-carbon and environmentally sustainable mobility future be supported?"* reflects the insufficient conditions of the current state, as well as the assumption of being able to improve the circumstances for the future. The five research sub-questions define this overall research curiosity in a more detailed way, guide the inquiry, and thus help to answer the overall research question. The questions follow a disassembling manner; at first, the questions are concerned with *what is actually going on*, at second *who or what is involved,* and finally *what could be done about it*. Approaching a problem issue or scientific curiosity this way offers the opportunity to reveal underlying mechanisms and powers that explain the phenomena in its appearance and might reveal new insights that can be utilized for changing trajectories in the future.
Generally speaking, the research is organized in a case study design. The explicit case study units are introduced and explained in the following. The research questions guiding the research can be allocated under the different case study units (see table 6 section 3.2.5). Below, the methodological tasks are linked to each research question.

1. How does the multi-level transition perspective (MLP) cope with transition processes toward urban sustainability?

The multi-level transition perspective contains a regime identification that enables an initial mapping of the regime components and possible path dependencies. This transition-theoretical perspective offers the opportunity to structure the analysis and analytical narrative of urban transformations. The model copes with complexity in an operative manner as it defines three analytical levels that define transition processes in their interplay. It should be noted that urban transitions are challenging for this multi-leveled perspective and call for enhancement of the model to make it valuable for the inquiry. The limits and opportunities of taking this transition-theoretical perspective were realized in an abductive approach, which means that both theory and case were mutually

influenced. "*Abduction is to move from a conception of something to a different, possibly more developed or deeper conception of it. This happens through placing and interpreting the original ideas about the phenomenon in the frame of a new set of ideas.* (…) *In scientific work this set of ideas may have the form of a conceptual framework or a theory*" (Danermark et al., 2002: 91). Seeing the complexity of sustainable urban mobility through the lens of the transition theory offered opportunities to identify challenges in a new light and thus to learn from them (as taken up by research questions 1 and 2; see papers 1, 2, and 3).

2. What are the current approaches for sustainable urban transitions and are these solutions sufficient when seen from a sustainable mobility perspective?

The case of Fredericia is analyzed through the transition theoretical perspective. Through applying the multi-level transition perspective, the empirical data is organized in the three analytical levels of niches, regime, and landscape. This offers the opportunity to discuss the gap between planning vision and planning practice in a new light. The mapping helps to estimate to what extent the current conditions and approaches support or deviate from the targeted sustainable mobility development. The sustainable "model-district" (Fredericia C) is put into the context of the overall municipal development, planning contradictions are revealed, and underlying goals point out challenges. The analytical engagement made with the case to answer this question will also work back into or advance the answer of question 1 and offer first insights about the case for question 3 (see paper 3).

3. What are the main barriers and opportunities for sustainable mobility transitions processes in cities?

To achieve an appropriate idea regarding barriers and opportunities, the choice was made to employ a more forward-oriented, long-term transition perspective applying scenarios. The scenario methodology offers an evaluative analytical framework for comparing transition qualities. Backcasting as an explicit normative tool helps to concretize pace and direction of transitions due to its use of retroductive thinking, which identifies underlying preconditions for the intended aim to be attained. Retroductive thinking is a thought inference that goes beyond the empirical observation and is also described as *transfactual argumentation* (see section 2.2.1; Danermark et al., 2002). For methodological reasons, this means that theoretical knowledge is linked to knowledge about case-specific circumstances and conceptualized in the scenario method applied in this thesis, as will be introduced later (see papers 3 and 4).

4. What are the underlying structure-agency relations and mechanisms generating barriers and opportunities?

The structure-agency analysis helped to reveal underlying causal mechanisms and forms a deeper understanding, allowing explanation supported by theoretical triangulation. Thus, path dependencies can be rethought and structure-agency dynamics reflected upon and envisioned so that alternative futures can be illustrated under specific societal circumstances. The structure-agency nexus discussed in this thesis forms both meta-theoretical and concrete analytical positions for analyzing and conceptualizing transitions. The latter use is taken up again in this chapter, and more theoretical reflections are described in section 2.2.2 (see paper 5).

5. Is radical change possible?

The final part of the research project comprises overarching reflections on urban transformation processes. This form of reflection is a result and presupposes that the previous thought operations and analytical steps have already been conducted. Moreover, this part is argumentatively biased toward the researcher's normative position of this thesis regarding sustainable urban transformation. Referring to radicality of change opens a dispute on the practicality of transitions in the making as well as it arises from the theoretical abstractions undertaken in this thesis that explains the occurrence of the subject matter.

3.1.1 Case study approach as overall research strategy

This research will be primarily based on a single explorative case study at the level of the functional urban region, namely the Fredericia Municipality as part of the Triangle Region/Denmark. The research project employs mainly qualitative data gathering methods. A literature review was conducted to establish the theoretical frame around transitions within an urban context. Document analyses of past and current low-carbon mobility strategies (e.g. municipal and regional strategic plans, transport plans, energy plan, environmental plans, local plans, and national-level transportation and land-use plans) were carried out (see list of documents in appendix 9.1). In-depth, semi-structured interviews with key-actors, including planning professionals, local and regional politicians, actors of industry and business, and non-governmental organizations, have also been conducted to gather insight into the existing opportunities and challenges for transitions.

One of the basic values and achievements of case study research is the accumulation of context-dependent knowledge and learning about the study object and its relations, which in this case is about urban transition processes and prospects. "*A case study 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, 1994: 13). There exist many different types of case studies, including explorative, representative, critical, extreme, or paradigmatic cases, and a multitude of methods applied within the case study design (Yin, 1994; Flyvbjerg, 2006). Case studies are very suitable for coping with complexities and contain both data collection and design features, and thus they could also be understood as an overall research strategy (Yin, 1994).

The validity or reliability of case studies is influenced by the actual study context and research question, quality of execution, given scientific discourses, and the research community, which might value some methodological approaches over others. For example, different validity and reliability claims by a positivistic research approach that builds on facts generated through quantitative methods might be favored over an explorative case study that contains unexpected turns and results through the use of qualitative inquiries. However, the case study of this thesis does not attempt to create a formal generalization based on the inquiry and theoretical data triangulation; instead, the value of learning through the case and contributing this generated knowledge to a research field of urban transition is foregrounded. As the following quote reflects, the case study engages in forming and improving a pool of knowledge which might be fallible or replaced by other knowledge claims (see ontological discussion in section 2.2): "*The value of the case study will depend on the validity claims that researchers can place on their study and the status the claims obtain in dialogue with other validity claims in the discourse to which the study is a contribution*" (Flvbjerg, 2006: 233). This research approach is not about hypothesis testing or generating truth claims, but critically exploring challenges and potentials for sustainable urban transitions in a mobility perspective.

Choice of the case and study units

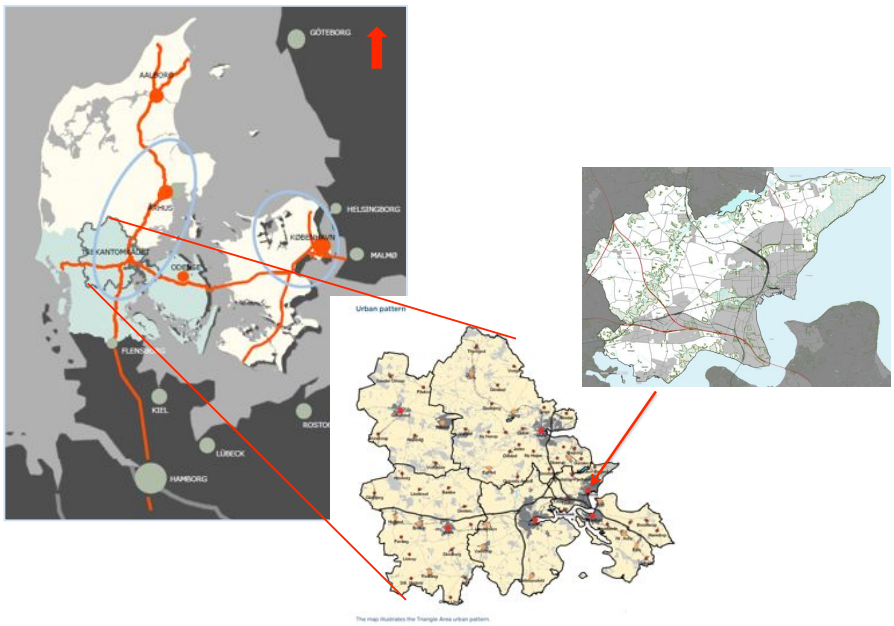

Figure 9: The case of Fredericia and its geographical location: The new map of Denmark, the Triangle Region and Fredericia Municipality (from left to right) (Trekantomraadet, 2007; Fredericia C, 2011; Fredericia Kommune, 2013).

The choice of the case is based on practical, theoretical, and project-administrative criteria. The PhD project's affiliation to the research project SusTrans (Sustainable Transitions) (cf. p. VII) that engages with transitions to a low-carbon society had an influence on the choice of the case. Fredericia's aim to perform a transition towards a more sustainable urban future, becoming one of the leading climate municipalities in Denmark, and the sustainable flagship project Fredericia C were major influences in selecting the case. The municipality of Fredericia is a middle-sized municipality within a Danish context, with a population of approximately 50,000, and is a part of the so-called Triangle Region. This polycentric region is a network of six municipalities, which account for around 355,000 residents (Trekantomraadet, 2014). With more than 90% car traffic and a high level of commuting, the region represents a car-dependent planning context (ibid.), and thus the case reflects an interesting scope for investigation of sustainable mobility transitions, as the visions and strategies stand in sharp contrast to the actual planning practice.

The case study can be divided into five parts. At first, the case study contains a data collection for relevant material and knowledge of the case and the research subject. Its goal was gathering more insight into the empirical field of the inquiry and getting familiar with the case and its context, which is an "information-oriented-selection" aiming at maximizing information expected to be found in the case (Flyvbjerg, 2006). This data collection was realized by applying a) documents studies, b) semi-structured qualitative interviews (for selection of interviewees, see table 2), c) focus group discussion, and d) attending different events that were relevant for the research project, such as local discussions, a guided tour focusing on the new city district (as part of the public dialogue meetings at Fredericia C), and a conference introducing electric cars (Fredericia, 2012).
In the second part, the case is analyzed according to the transition analytical model applied. Main challenges and prospects for urban transitions are identified. This analytical part was realized in an abductive manner and demonstrated the need for additional theoretical debate and underpinning to achieve better explanatory knowledge and analytical conception (see sections 3.1.2 and 3.2.1).
The third part contains a complex engagement with the case data and latter analysis developing scenarios in a long-term perspective. This phase of the case study builds (and to an extent, depends) on the gathered knowledge and experiences in the previous phases (see sections 3.1.3 and 3.2.2).
The fourth part is the identification of some crucial structure-agency relations, which supported the case study with a deeper understanding of the barriers and opportunities faced. An analytical dualism enables a sophisticated analysis of how structures condition and/or enable agency and how agency reproduces and/or transforms structures.
Finally, the fifth part is a more general reflection, which is concerned with the overall research process and analytical findings. This part comprises the meta-theoretical position of the researcher and the normative view on the problem issue (relates to research question 5).

Interviewees and focus group discussion

To achieve an understanding of the local context and expert knowledge concerning transformation towards more sustainable urban mobility, interviews and a focus group discussion were conducted. The interviews covered local, regional, and national-level actors relevant for the development of mobility futures. Even though the scenarios are mainly theoretically based, the empirical information gathered influenced their development, although this influence was much less pronounced than initially planned and expected. The interviewees were not asked to develop the scenario discussed, but to reflect upon that more radical pathway displayed by the researcher and to abstract their knowledge accordingly, which turned out to be a challenge (for further reflection, see

3.3.3). Moreover, the different interviewees can be allocated with regard to the rationales and pathways preferred in each scenario. Table 9.3 reflects the interviewees' opinions on what are the main barriers and opportunities in urban transition towards more sustainable mobility. Although the scenarios were not developed based on these opinions, this data serves to provide interesting insight into the contemporary transition context and actors' tendencies (see appendix 9.3).

Within the research project, 8 semi-structured interviews were conducted in the period of 2011-2013 (see table 2). One interview was conducted in Danish and the rest in English, and nearly all comprised a backcast exercise. The interview guide was structured in five phases: a) context and understanding of urban transition, b) introducing the scenarios, c) drafting pathways for the backcast and making use of a timeline, d) detailed questions regarding quality of change depending on the previous process of drafting, and e) follow-up questions (see appendix 9.5). The backcasting exercise of drafting pathways towards the backcast future was particularly challenging. Thinking about preconditions for a future situation to become reality was difficult, as the result could (or most likely should) differ extensively from the given conditions. More detailed reflections on retroductive thinking can be found in section 3.3.

A focus group discussion is understood as moderated discussion that generates data through the group's interaction (Krzyzanowski et al., 2008). Moreover, the researcher can test assumptions, e.g., whether beliefs or opinion are dominant, adopted, changing, or rejected in the group (ibid.). The focus group methodology offers the researcher the opportunity to listen and learn from the participants. As the discussion is only moderated and sometimes a bit guided, the researcher is in the background and the participants discuss themes or reveal new views or conflicting issues. "*The aim of the focus group is not to reach consensus about, or solution to, the issue discussed, but to bring forth different viewpoints on an issue. Focus group interviews are well suited for exploratory studies in a new domain since the lively collective interaction may bring forth more spontaneous expressive and emotional views than in individual, often more cognitive interviews*" (Kvale, 2007: 72). Even though Kvale mentions *focus group interviews,* most authors separate strictly between interview and focus group discussion (Krzyzanowski et al., 2008). The focus group discussion is also a suitable method to investigate the gap between theory and practice, as it allows the participants to talk and reflect more freely and in a dynamic process with the others (Liamputtong, 2011). This is also a chance for more creative thought processes, such as retroductive thinking (see 3.2.2); however, such a process needs to be introduced and guided to ensure that different issues do not dominate.

The focus group discussion of this thesis had four participants and two moderators. The four participants were chosen according to their expertise. The aim was to cover the main municipal actors relevant for planning a sustainable urban mobility future, such as a transport planner, a land-use planner, a climate coordinator with responsibilities for mobility management, and a representative of the local nature conservation agency. The focus group discussion was undertaken in Danish and lasted around 2.5 hours. The discussion was organized in different phases (see appendix 9.4): first, the basic idea and aim of the focus group is explained to achieve a level of common understanding; second, the backcast scenario is introduced, as this is in focus for the discussion, and rules for discussing are clarified (additional information was sent to all participants beforehand so that they could become familiar with the method of backcasting); third, pathways are discussed with regard to how to achieve the future picture of the backcast, identification of main actors involved, possible barriers, etc. (a timeline was used to map the different steps); and fourth, a follow-up and summarizing to come to an end. Certainly, the details in each phase depend on the actual course of action; the participants may be very active, need some input or inspiration, or need to be guided to stay within the frame of the research interest.

Interviewee	**Professional position**	**Geographical scale**	**Gender**
A	Climate coordinator; local Mobility Management	Local	Female
B	Local politician; former mayor of Fredericia; board member Fredericia C	Local, regional	Male
C	Civil engineer; Danish Transport Authority (Center for Green Transport)	National	Male
D	Transport planner of Fredericia	Local	Male
E	Business director of Fredericia	Local	Male
F	Triangle Region Director (2011)	Regional	Female
G	Triangle Region Director (2012)	Regional	Male
H	Chairman of DN Fredericia (The Danish Society for Nature Conservation)	Local, regional	Male
Focus Group	With A, D, H & I		
I	Land-use planner of Fredericia	Local	Male

Table 2: Overview of interviewees and focus group participants in the period from 2011-2013.

3.1.2 Transition-theoretical concepts – An abductive approach

This thesis applies the transition-theoretical perspective in an abductive manner, motivated by an interest in learning about urban transformation through the transition-theoretical perspective of sociotechnical system change. Abduction describes a form of inference that is interpreting a phenomenon in the light of a new interpretative frame. It is about achieving knowledge or explanatory power through re-contextualization of a phenomenon with another set of ideas/theories/conceptual frames to achieve new meaning and discovery of relations that were not discovered otherwise (Danermark et al., 2002). The methodological implication of the transition concept applied here is that it is used as a device to structure the analysis, to observe and map transition in an urban case and to identify components and relations important for change processes. The case will, in turn, inform the theory, allowing the researcher to critically reflect on its applicability to the complexity and explanatory power for urban transformations. Thus, it contributes to improved conceptualization of factors such as spatiality within urban transition cases. Utilizing this transition theoretical perspective reveals theoretical limitations and thereby helps to improve more appropriate conceptualization for urban transitions. Table 3 sums up the functional elaboration of the multi-level perspective applied in an urban case.

MLP in classical terms (e.g. Geels, 2002)	**Author's interpretation** (e.g. Næss & Vogel, 2012)	**Analytical consequence**
Landscape as externalized macro structures	Deeply rooted social structures with strong conditioning effect on regime and niche	- Major influence in prospects for sustainable urban transitions - Stabilizes/interrupts regime - Needs analytical focus - Can and need to be changed
Regime as semi-coherent rule-set	Urban multi-segmented land-use and transport regime (multiplicity as hegemonic structure)	- Precise demarcation depends on object of study - Can be used as mapping device; descriptive quality; limited explanatory power
Niches as loci for innovations	Multiple niches being both opposing and supportive to the regime (also unsustainable niches)	- Linkage to landscape level - without landscape level changes, niches might lose influence on regime (co-optation of niches or alibi-niches)

Table 3: Overview of applied multi-level perspective (MLP); note that all levels contain structure-agency relations.

3.1.3 Scenarios and backcasting

Scrutinizing transitions in a long-term perspective using the scenario method helps in improving evaluative methodology of transition qualities and scenarios, especially backcasting as an explicit normative method, allowing identifying alternatives to change trajectories. Moreover, pace of transformative change and a more guided transition strategy are more likely to be developed due to the anticipatory method.

A scenario can be understood as a projection of a future course of action, events, and conditions that are possible, plausible, and/or preferable. Even though scenarios are a widely used concept, there is no clear-cut definition. Instead, there is a scenario typology of predictive, explorative, and normative scenarios, which reflects the different utilization of scenarios (see table 4). Predictive scenarios, such as traffic forecasts, are used to plan and adapt to given trends, and they are usually applied within one system structure. However, one challenge of this approach is the self-fulfilling aspect of the predictions, such as that exemplified by the *predict and provide* approach to transport planning. Explorative scenarios aim at identifying alternatives that can possibly happen. In the field of policy and strategy development, this approach is used to prepare for rapid change and to handle possible consequences. Potential challenges to this are assumptions of causalities and biases of variable value applied in the process. Normative scenarios are concerned with reaching a defined target, such as a regional plan or sustainable mobility as a desirable future. Normative scenarios can be preserving or transforming scenarios, whereas the former build on contemporary social structures and the latter sees necessity in changing these (Gunnarsson-Östling & Höjer, 2011). Thus, normative scenarios can be trend-breaking, have a long term focus, and deal with radical-transformative change. Problems for such change are often the short-term costs and long-term uncertainties involved in redistributional processes, which can create strong reluctance to the suggested or necessary changes.

Categories	Predictive	Explorative	Normative
Tradition	American (1950s)	French (1970s)	Swedish (1970/80s)
Types	Forecast/ What-if, projective, trend, business as usual	Strategic/ external, prospective	Normative preserving/ transforming, backcast
Aim to explore	Probable futures	Different possible futures	Preferred futures and how to reach them
Utilization	Trend exploration (e.g., population, transport)	Strategic action (e.g., Shell's dealing with the oil crisis)	Sustainable transitions (e.g., sustainable mobility)
Challenge	Self-fulfilling aspect	Assumptions of causalities and bias of variable value	Short term costs, long term uncertainties

Table 4: Scenario typology (based on Banister & Hickman, 2013).

Backcasting

Backcasting is a futures studies approach, which is especially appropriate when the planning conditions are complex and dominant trends and structures are part of the underlying problem, meaning they might hold strong inertia against the changes sought (Robinson, 1982; Dreborg, 1996; Robinson, 2003; Vergragt & Quist, 2011; Wangel, 2011). Backcasting is explicitly normative, envisioning and defining the desirable futures first and then developing paths and possible conceptions for achieving this future. It is an insightful and creative process developing new perspective on given problems and new solutions. Backcasting is defined due to its concern "*not with futures* [that] *are likely to happen, but with how desirable futures can be attained.* (…) *Involving working backwards from a particular desirable end-point to the present in order to determine the physical suitability of that future and what policy measures would be required to reach that point*" (Robinson, 1990: 822-823).

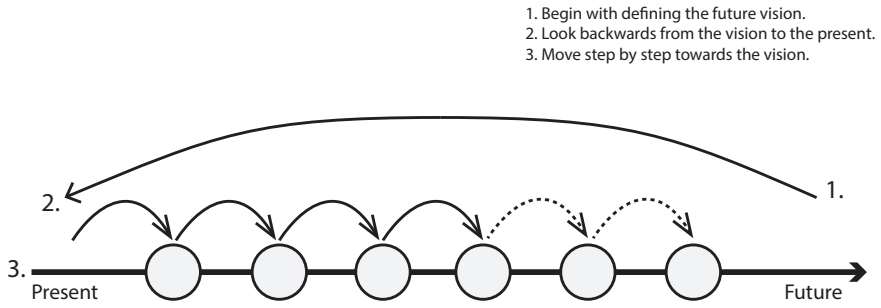

Figure 10: Visualization of the backcasting process, first starting with the future vision in mind and then developing necessary steps toward accomplishing that vision. It is an explicit normative method that builds on retroductive thinking as a form of inference.

3.2 Research design

The aim of this research project is to understand and improve the chances for sustainable urban transitions. The PhD takes its starting point and curiosity in ambivalent planning practice. Thus the case study design is the overall research strategy for this thesis to investigate Fredericia's current efforts and actual practices towards more sustainable urban futures. Through reviewing relevant planning documents, experts' interviews, focus group discussion and local visits at site the empirical data is collected and in triangulation with relevant theories used for analysis (cf. table 6 below). In short, my thesis applies: 1) A regime concept as heuristic model and mapping device for current urban conditions to identify main components and challenges for sustainable transitions, 2) scenarios as an analytical tool to compare and evaluate alternative paths, and 3) a structure-agency analysis for achieving deeper understanding, a more sophisticated analytical conception, and a meta-theoretical reflection on transitions.

3.2.1 A heuristic tool - Mapping multi-segmented regime structures

As introduced before, this analytical concept offers a rather simple mapping device for the complexity of urban change processes. It is a heuristic concept that simplifies the complexity of transformative change; however, it does not serve the study with an explanatory value. A conceptualization of regimes in urban land-use and transport

development as *multi-segmented*, albeit unsustainable, structures was seen as more suitable to reflect the actual constellation of the current regime components (see section 2.3.3). The latter regime understanding also facilitates an exploration into the underlying social structures that influence the materialized urban environment and infrastructure systems making up the city's formation. Moreover, key components of urban transition processes are revealed and incorporated in further analytical steps, such as the existence of multiple niches (supportive and opposing to the regime). The need for an increased landscape focus in sustainable transitions was another preliminary finding, as sociopolitical/economic structures have major influence in urban transitions. The conceptual notion of landscape contains structures in the form of macroeconomics, macro-politics, and deep cultural structures. Adding theory of political economy and planning theory strengthens this point.

Below, three visualizations exemplify the mapping of urban conditions using the multi-leveled transition concept. The mapping exercise applied in this thesis is used in three manners: 1) as structuring the analysis, 2) as a tool for the development of the conceptual framework that is appropriate for investigating urban mobility transitions (an elaboration of the classic MLP), and 3) as a communicative device of the complexity of transition processes.

Transformation processes can be communicated and structured according to the three analytical levels of niches, regime, and landscape. The multiple levels reflect the complexity of transitions and the different components and scales (as introduced in the theory chapter). Within the field of transition studies, the terminology and concepts are very well known; however, communicating with other scientific fields of knowledge can create comprehension challenges. Generally speaking, the MLP needs to be defined clearly in its explicit demarcation depending on the study object. Here, the conception of what is considered to be a regime is the basic starting point from where the other two analytical levels are defined accordingly. Nevertheless, the multi-level perspective needs to be seen as a whole, as this is also its strength, although the underlying processes need further elaboration and theoretical explanation.

Having mapped the urban conditions of the two cases investigated in this thesis helped to communicate the explicit transition challenges and characteristics seen from a sustainable urban mobility perspective. From there, the analytical model was explained, and finally, a shift of foci took place, namely to engage intensely with the landscape level conditions and the possibilities in which they might be influenced, as well as a more political concern on a niche level, which might pair up with more sustainable landscape structures

to intensify pressure on less sustainable conditions (see e.g. dotted arrows in figure 11). These insights about relevant transition dynamics between the levels were a result of the mapping. Thus, the mapping was also an internally valuable process of abductive thought operation, as it helped the researcher(s) to arrive at reconceptualization of transition dynamics with the help of visualization of the different urban components and case specifics in a new context.

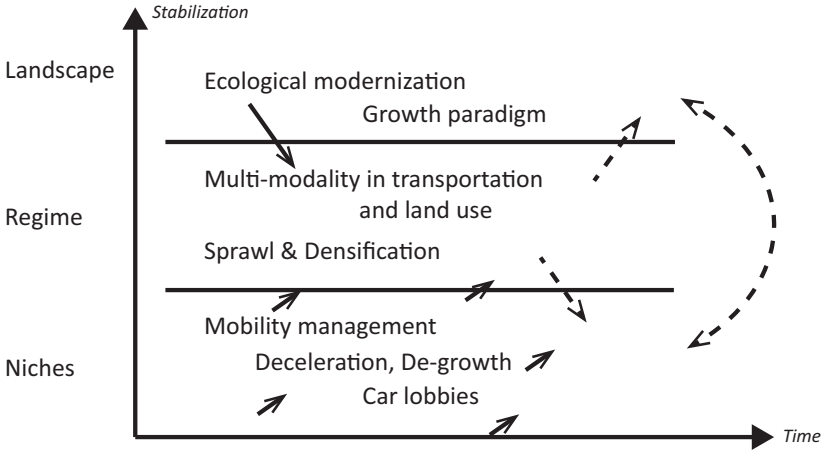

Figure 11: Simple illustration of applied multi-level perspective mapping the given urban conditions seen from an urban land-use and transport perspective (the arrows reflect orientation and influence from level to level; the dotted arrows highlight influences that do not receive enough attention in classical MLP applications).

Figure 12 illustrates the process of putting the thoughts on trial, so to speak. This figure represents the development of the conceptual framework in the case of Copenhagen. The dimensions of space, culture, and technology were allocated on all three levels (niche, regime, and landscape), which helped to understand and explain the historical development in Copenhagen more accurately, which was certainly not defined through technological niches alone. More generally speaking, this process of mapping supports argumentation against the technological niche bias in many classical MLP studies, which is misleading and wrong in the case of urban mobility transitions. Moreover, the analytical elaboration also clarified how spatiality is represented on all levels; e.g., in a conceptualized character on the landscape level (planning ideals, discourses, etc.), which has a strong bearing on actual implemented urban form. As spatiality is not yet sufficiently conceptualized in transition studies, the incorporation of space as an inevitable dimension was essential. The thought operations made while mapping were critical for the overall conceptualization of urban transitions. Figure 13 illustrates this in

two examples, these being Jahn Gehl's influence in urban structures and in a cultural ideology of what a qualitative urban space should look like and how it would be experienced. Urban form and culture were the two dominant parameters. The other example reflects how landscape level structures, such as ecological modernization, have strong influences on contemporary approaches to what sustainable transitions might contain.

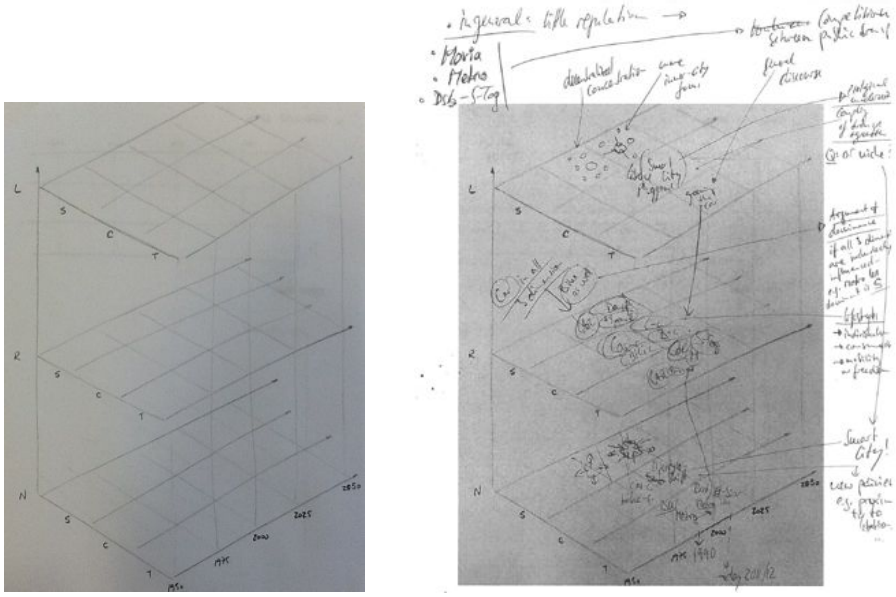

Figure 12: Illustration of the development of a conceptual understanding of the MLP with space, culture, and technology on all three analytical levels (Valderrama Pineda & Vogel, 2014).

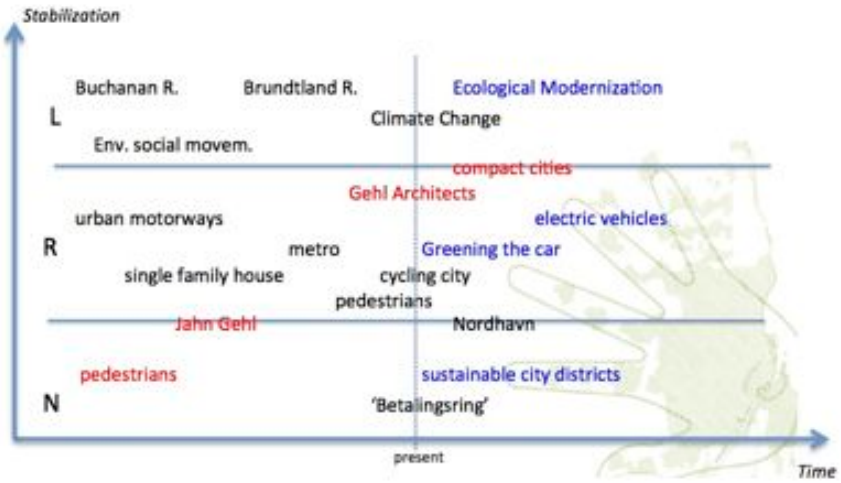

Figure 13: Applied multi-level perspective mapping the condition for the case of Copenhagen: two highlighted examples of a) Jan Gehl's influence (in red) and b) contemporary "green solutions" (in blue) (Valderrama Pineda & Vogel, 2014).

3.2.2 Developing scenarios

The development of the scenarios profited from the already collected knowledge in the previous phases of the case study, which entailed first experiences with the explicit conditions, actors, challenges, and chances in the case study.

Developing the scenario structure

To be able to assess the value of given solution approaches and evolving trends, different scenarios need to be developed. The three scenarios developed in the thesis represent 1) continuation of given practices in a business as usual scenario, 2) a scenario representing an emerging trend in the form of behavioral change/new lifestyles, and 3) a more radical approach in form of a backcast as an alternative seen from an eco-social sustainability rationale. All three scenarios develop based on defined variables that deal with mobility in the form of land use, transport infrastructure and culture, technology, and growth. These variables reflect theoretical knowledge regarding key components of mobility conditions (see chapter 2). Moreover, the empirical inquiry helped to define the final chosen variables, and thus the scenario features were developed as an interplay between theories and empirical evidence concerning these variables.

The time frame comprises the period from 2011 to 2050, which is based on the necessity of a longer time frame for transformative change, preferably one encompassing at least 25-50 years. The basic demographic and socioeconomic conditions (number of inhabitants, household structure, energy supply systems, waste treatment systems, etc.) are presupposed to be constant across all scenarios. Each scenario is concerned with a sustainability understanding and solution approach, albeit within its own frame of rationality, which represents a challenge for comparison. This is addressed in paper 4 by embedding the sustainability rationales in societal preconditions.

Scenarios / Variables	**Technological Fix**	**Mobility Innovations**	**Limits to Urban Growth**
Land use, city structure *- location, amount & type of housing and business*	Sprawl & densification	Polycentric	Urban containment, densification
Transport infrastructure *- space for & type of infrastructure* *- amount of parking*	Electrifying & expansion	Smart clustering	Reduction of road and parking infrastructure
Mobility culture *- mobility discourse* *- lifestyles, norms* *- modal split*	Multiplicity	Individual management	Demand reduction
Political structure *- policies* *- planning system* *- governing networks*	Market & technology based	Network & individual based	Regulative & norm based
Economic paradigm *- forming sustainability rationale* *- dominant discourses*	Environmental Economics (ecological modernization)	Environmental Economics (individual eco-management)	Ecological Economics (degrowth rationale)
Growth rationale *- dominant discourses*	Green growth	Smart growth	Degrowth

Table 5: Building the scenarios – The scenarios are structured according to six themes relevant for urban mobility development (dependent variables). Independent variables specify each scenario theme. The scenarios share fixed conditions in form of basic demographic and socioeconomic conditions.

The identification and definition of dependent and independent variables is part of building the basic structure. Generally speaking, the independent variable influences the character of dependent variable; however, defining what the independent variable is depends on the research subject and approach chosen. Here, the dependent variables (i.e. consequences) are the effects, judged against some societal goals underlying the scenario development (such as environmental sustainability). The independent variables are the features that make the various scenarios differ from each other and from the current situation/current trend (Guttu, 1993).

Process of building and refining the scenarios

All three scenarios are normative in that they explore and express futures that are considered preferable, seen from (differing) sustainable urban mobility perspectives. However, the third scenario with a backcasting approach adds an explicit normative point of departure by defining the future to be reached. The scenarios are theoretically based scenarios underpinned by theoretical references and empirical data collected through expert interviews, focus group discussion, and relevant document studies. A list of the documents revised can be found in the appendix A (see table 9.1) to this paper. The interviews and the focus group contained a scenario assessment part in which the third scenario, being most radically different, was discussed in a retroductive manner. The interviewees/participants were asked to envision conditions and steps towards such a future as well as possible barriers and opportunities, based on their local knowledge. The focus group discussion aimed to increase the creative potentials of the local actors in the visionary process of future paths so that they could encourage new thoughts and learn from each other.

As the process of figure 14 below illustrates, there were two phases of data collection and incorporation of knowledge into the building of the scenarios. These multiple steps and engagements serve the validity and reliability of the scenarios, especially when dealing with disputable issues such as sustainable mobility strategies. The internal logic of each scenario is very important. The development of the societal preconditions of the scenarios helped to understand the unfolding of the scenarios towards the future, as well as enabling the comparing of the different sustainability rationales attached to the scenarios. As such, the identification of the societal conditions is kind of a preliminary or parallel analysis while developing the scenarios. The final representation of the scenarios is mainly in qualitative terms in the form of text, tables, and maps. All scenarios are discussed regarding their opportunities and barriers, which is a reflective result of the scenarios methodology. The so-called *maneuver space* of actors describes different frames of logical linkages where actors can be allocated. This is a collective result based on the

scenario development (see appendix B, table 9.2), and the table visualizes the context in which the scenarios operate and the operationalization of the underlying rationales, meaning that it can be seen as representing different frames for action of actors in practice.

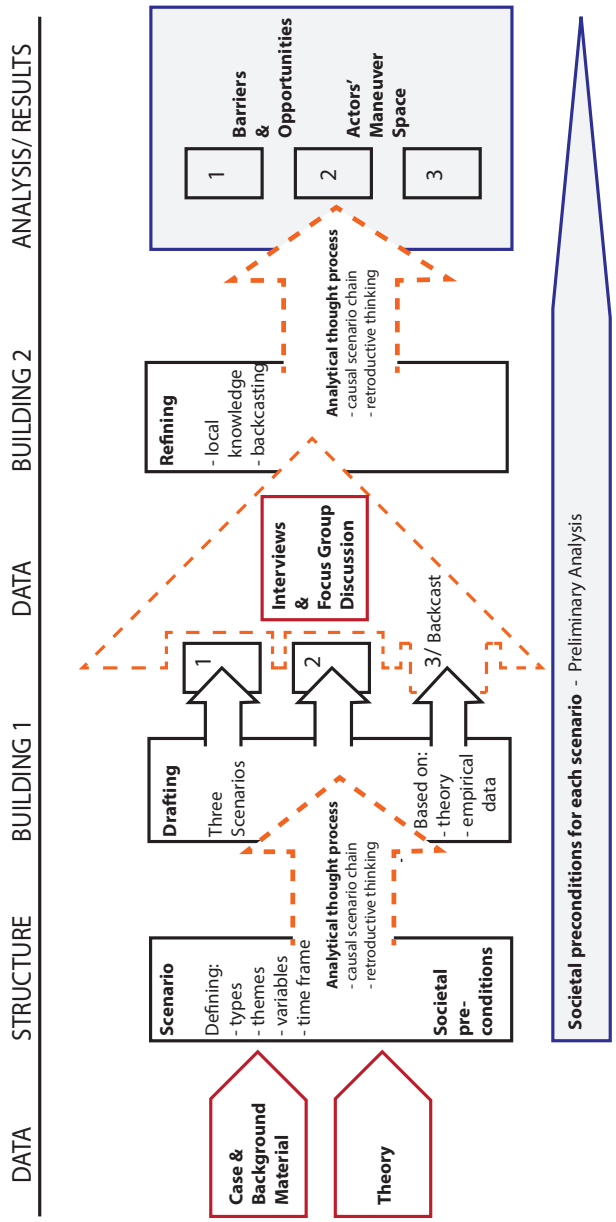

Figure 14: Scenario development – a process overview.

Retroductive thinking as analytical approach

The scenarios' logic can be described in a specific causal chain, such as in the case of land-use and transport planning: causes of different pathways create events that make up the different trajectories, which then create future land-use and transport infrastructure, resulting in mobility patterns that have related environmental impacts. These impacts differ based on the different causal chains in the scenarios. However, this does not mean that scenarios progress in a linear manner; causal relations can be also affected or mediated via multiple factors. The normative scenario approach offers the possibility of developing divergent development paths due to methods such as defining the intended aim first and then constructing and following the paths toward this future. The normative scenarios (such as backcasting) in particular contain an analytical approach of counterfactual and retroductive thinking. "*Counterfactual thinking is fundamental in scientific practice, as we understand what something is in relation to what it is not*" (Danermark et al., 2002: 101). This dialectic thinking builds on stored knowledge, experiences, theories, and ability of abstraction to identify the actual constitutive properties. To identify what something is not helps to know more about what it is. Thus counterfactual thinking is kind of a precondition of undertaking retroductive thought operations. Retroductive thinking offers the possibility of identifying the underlying preconditions for something to be/become what it is (ibid.). To those attempting to conceptualize change and lay out possible paths towards more sustainable behavioral and physical patterns in urban life, this form of inference offers creativity, dialectic, and depth in reconstructing the necessary conditions and contingent circumstances that could plausibly create such futures. Questions to ask would be, for example: What makes the future picture possible? What are the internal relations that make such a future what it is? Which social and physical structures would encourage such a trajectory? Which values should be dominant? Which political system would favor such a future? All these questions relate to underlying structure-agency relations and the mechanisms produced accordingly. The scenarios thus reflect different structure-agency dynamics and offer the chance to examine dynamics discussed on the (meta)theoretical level in the explicit case context. This links to the next section, which clarifies the analytical model applied to investigate structure-agency relations within transformation processes.

3.2.4 Transformational model of structure & agency

The transformational model of structure and agency builds on work by Archer (2000) and Bhaskar (2008) and could be understood as an analytical model for change. The theory chapter already gave a detailed introduction of the explicit position I take in the structure-

agency nexus. In practical terms, the conceptualization of structure and agency helped to improve the analysis of the transition-relevant dynamics, such as between social structures and planning experts (see paper 5). This latter focus developed from the engagement with the case that revealed major challenges, as well as the case study design that focused on planning experts rather than on the general public. Deeply rooted social structures in the form of a sociopolitical growth agenda or mobility ideals become processable and set into context. The complexity as such is not reduced, but is made more manageable in an antireductionist approach. Identifying the properties of both structure and agency allows identifying options for intervention to change trajectories.

Especially valuable in this research was the non-conflation of structure and agency that enabled a sophisticated analysis of underlying mechanisms for change. Moreover, the time dimension is most crucial in understanding structure-agency relationships and therefore also in influencing structure's conditioning effect on agency and agency's ability to transform structures. The three most important analytical contributions applying this transformational model and underlying theory are:

- Non-conflated structure-agency perception for better conceptualization of transition.
- Niches, regimes, and landscapes each contain structure-agency relationships.
- Structure and agency operate and transform in different time intervals.

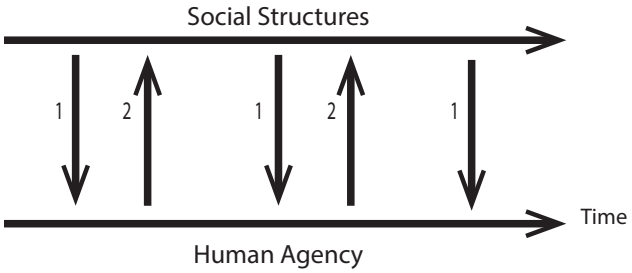

Figure 15: Transformational model of structure and agency. The figure describes the basic mechanism between structure and agency continuously happening over time. 1=structural conditioning and/or enabling of agency and 2=reproduction and/or transformation of structures by agency. The figure is based on Bhaskar's (2008) transformational model of social activity.

3.2.5 Table of research design

The research design table below gives a summarized overview of the information required to answer the research questions and lists the theoretical and empirical data sources used to gain the information.

Research questions	**Required information**	**Sources of information - theoretical**	**Sources of information - empirical**
1. How does the multi-level transition perspective (MLP) cope with transition processes toward urban sustainability?	• Define components of urban transition • Define sustainable urban mobility • Scope of the transition theoretical perspective • Understanding the MLP in its analytical limits and opportunities • Defining the investigated regime	Explanatory theory • Planning theories, transition theory (focus on MLP), sustainable transport theories • Other scholars applying MLP	Case study (first phase) • Data collection for Fredericia as main case • Copenhagen as supplementing case
2. What are the current approaches for sustainable urban transitions and are these solutions sufficient seen from a sustainable mobility perspective?	• Identification of actors (who), objects (what), process (how) of change • Actual aim of transition • How are decisions legitimate • Directions and quality of current approaches and trends	Methodological theory • Adjusted transition concept (based on study object and theory)	Case study (second phase) • Data of the case of Fredericia *(as main case for all following case-study phases)* • First interviews • Local visits, events
3. What are the main barriers and opportunities for sustainable mobility transitions processes in cities?	• Deeper understanding of complex change dynamics • Sustainability rationales • Societal preconditions as reference frame • Identifying alternatives	Explanatory theories that back up/cover • Mobility planning • Sociopolitical & economic conditions • Sustainability rationales • "Green alternatives" Methodological theory • Scenarios, backcasting • Retroductive thinking	Case study (third phase) • Interviews • Focus group discussion • Continued review of planning documents

4. What are the structure-agency relations and mechanisms generating barriers and opportunities?	• Identify structure-agency relations underlying some main barriers and opportunities • Identifying dominant mechanisms formed	(Meta)Theoretical input • Critical realism Methodological theories • Analytical dualism • Transformational model of social activity and morphogenetic diagram	Case study (fourth phase) • Analysis of case study data • Three different scenarios and their societal preconditions
5. Is radical change possible?	• Define radical change • Implications for transition practice • Alternatives to the given undesirable "business as usual" and insufficient trends • Reflections on research undertaken	• Meta-theoretical position regarding transition practices (based on previous questions) • Literature on dispute around democracy, ethics, etc. in planning	• Normative opinion formed through theories and analytical experiences with the case • Analytical synthesizing from the different articles

Table 6: Research design table with required information and data sources to answer sub-questions.

3.3 Challenges met and how to cope with them

Undertaking research contains unforeseen events that have to be dealt with throughout the project period. This section serves as a reflective part on several methodological challenges and how they are managed. It is important to handle these challenges with rigor and be transparent about them so that pitfalls can be avoided in the future and others may learn from the experience.

3.3.1 Prediction and uncertainty

Some of the intrinsic conditions with which scenarios have to deal are issues of prediction and uncertainty, although they also require a form of creativity in imagining and defining futures to be reached. The backacting approach put forward in this thesis represents a possibility to break with (unsustainable) contemporary conditions and their perceived path dependencies. Backcasting helps arguing normatively that the present conditions *should* be changed and suggests in what ways this change should occur. As Dreborg puts it, "*Present trends or behavior are mistaken for laws of nature. The alternative approach (backcasting) would rather describe the strengthening or weakening of a trend as a choice for the policy-forming authorities*" (1996: 822), which would call for policy intervention in trajectories with a normative long-term goal legitimizing and directing such interventions. The following quote underlines this by pointing out that "[T]*he needs*

of future generations will be determined by what we leave them, culture and nature included. Furthermore, the uncertainty of the future makes ethics, rather than knowledge in term of rational reasoning, the basis for assessing feasibility" (Wangel, 2011: 880). Certainly, knowledge influences the process of scenario development and mechanisms of evaluation applied, which then determines the appraisal of the feasibility and reliability of the scenario. However, the point made here is one arguing the value and necessity of a more normative discussion and an ethical question about futures. It is less about an exact prediction of the future, but about a genuine engagement with shaping sustainable development for the future. To do so, underlying causal mechanisms need to be known because they form rational reasoning, which can help to strengthen arguments used in a value-laden transition process.

3.3.2 Handling of bias

Moreover, scenarios, especially normative scenarios as in this research project, represent a bias within their logical linkage and development process. Certainly the researchers' bias might be the main and most obvious one, but the different rationalities of each scenario are also carriers of biases. Making these explicit is valuable for the reflective process of the researcher him/herself, as well as any person engaging with this study. As a result, biases are not the problem, but they do need to be transparent to be handled. In a descriptive part, they should be avoided, whereas the normative positioning will naturally contain a bias toward values respectively. After all, conducting the case study can lead to "*casting off preconceived notions and theories. Such activity is quite simply a central element in learning and in achieving of new insights*" (Flyvbjerg, 2006: 236), as it was also experienced with the limited explanatory power of the transition theoretical perspective applied.

3.3.3 Engaging with utopian conditions and retroductive thinking

This research deals specifically with conditions in the future, which is a very different task from dealing with contemporary conditions. To investigate possibilities for arriving at a desired future, retroductive thinking is applied. This form of inference is practiced by the researcher, but also as part of the empirical inquiry in interviews and focus group discussion. To realize this form of thought operation, knowledge from a broad range of disciplines is very beneficial, if not necessary. The interviewees and focus group discussion served as additional sources of knowledge next to the theoretical sources.
As researcher, I had planned to use the interviewees' knowledge and creative opinions much more intensively; however, the process of retroductive thinking turned out to be a difficult endeavor for the practitioners involved, meaning that I had to focus more on my

theoretical knowledge regarding the future conditions and paths towards it. This means that the analysis might be more dominated by the researcher's process of retroductive thinking than originally planned. However, I could realize that such thought operations are necessary to be exercised to learn and improve them. Or, to say it differently: in practice, people are not trained to think in such a way, and so they face various barriers to thinking outside of the norm.
Possible explanations can also be related to the problem issue as such, namely that the planning institutions and the context in which they operate may be part of the mechanisms that hinder more sustainable transformation processes. This would require a very high level of reflection among the interviewees, requiring them to step out of their frame of reference, so to speak, to imagine some radically different context for planning, and maybe their own involvement as planners as well. It is a highly normative and also political discussion, which most likely carries conflicts. Perhaps the context of the interviews and focus group could not offer the room for engaging deeply enough with these conflicts to allow a transparent debate on them. Nevertheless, one interviewee was outspoken about it and underpinned this reflection with a request from the practitioner's perspective, stating that he/she would like to receive guidance or training in such forms of thinking.

3.3.4 Danish case study context

This research project focused on a Danish case study and thus is concerned with empirical data material in Danish. The translation process and generally the level of comprehension can exert influence on the data handling as well as acquaintance with terminologies. More crucial though is the interaction with the actors involved. The interviewees differ in their ability to speak and level of comfort with English, and thus one interview and the focus group discussion were conducted in Danish. It was a very conscious decision to conduct the focus group discussion in Danish in order to facilitate an appropriate context to create a good environment for the thought operations planned (thinking outside the norm, retroductive thinking) and to reduce possible language-related burdens for the participants. However, this influenced my own ability as researcher to steer and develop the discussion according to the desired agenda as my major working language is English.

3.4 Research design figure

Below, a visualization of the research design with its main units and methodological steps can be found. The research project is organized in five case study phases, which relate to

different research questions and methodological tasks. A more detailed cross-paper discussion of the contributions of each paper can be found in chapter 5.

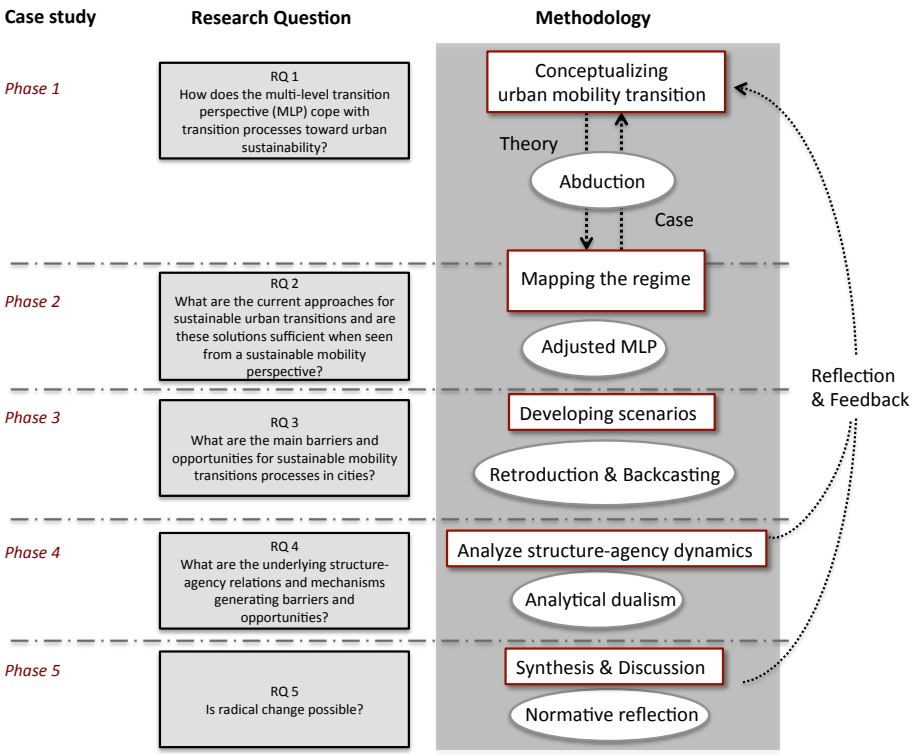

Figure 16: Research design figure illustrating the case study units in five phases, linking the research questions to the methodological steps of the thesis.

4. Articles' summaries

The PhD thesis consists of five articles for publication in peer-reviewed scientific journals. The articles are arranged around urban transition in the following manner: 1) *theoretical-analytically*, 2) *empirical-analytically* with identification of focal issues for urban cases, based on empirical studies and trying a transition analytical model (main case: Fredericia; additional case: Copenhagen), 3) *comparative-analytically* with embedding the case specifics in different sustainability rationales and development approaches using scenarios, and 4) *meta-theoretical* and *analytically* with achieving a *deeper understanding* through structure-agency analysis within transition processes.

Article 1 – Næss & Vogel: Sustainable urban development and the multi-level transition perspective. Environmental Innovation and Societal Transitions 4 (2012), pp. 36–50.
(Theoretical focus (state of the art/setting the scene), urban transitions)

This article discusses some challenges and possible adaptations of transition theory as a framework for analyzing the prospects for environmentally more sustainable development of urban land use and transport infrastructure. At first the main characteristics of urban transitions are identified, which differ in complexity from many sectorial approaches within transition studies. Taking a transition perspective the article engages with the multi-level perspective as one of the most known transition concepts within socio-technical system transformations and thus evaluates its utilization for urban sustainability transitions. The analysis identifies key components for a contemporary urban built environment and transport regime and suggests some adaptation of the analytical concepts, which would better comprise the given urban conditions. The article argues that rather than depending first and foremost on niche innovations, a transition toward sustainable urban development is a matter of changing the composition of existing multi-segmented land use and transportation regimes. Those well-experienced forms of built environment and transport infrastructure that are in line with sustainability objectives should be strengthened while those that are not should be actively constrained and reduced. Urban development in a Danish provincial city is used as a case to illustrate some of the points made in the theoretical part of the article. Due to the wide gap between present conditions and those required to realize a sustainable urban development, more attention should be directed toward landscape level conditions and possibilities for

changing them. As an outlook scenarios are suggested as more suitable analytical approach for long-term forward-oriented transformative change.

Article 2 - Valderrama Pineda & Vogel: Transitioning to a Low Carbon Society? The Case of Personal Transportation and Urban Form in Copenhagen: 1947 to the Present. Transfers 4.2 (2014), pp. 4–22.
(Theoretical focus, analytical transition model (MLP), urban transitions, learning from history)

This paper engages with the capital city of Denmark, which is often being communicated as one of the frontrunner cities in performing a sustainable urban development. The paper's objective is to account for the transitions in urban form and personal transportation in Copenhagen since 1947. Sustainability objectives are currently framed as efforts to reduce CO_2 emissions. Urban transportation is a key area of intervention. In public debates, political parties, experts, and citizens make assertions about what is possible by referring to past experiences. The contribution to this current debate is to explore the official histories of Copenhagen in order to account for the transitions in mobility during the last six decades. The paper applies a critical application of the multilevel perspective (MLP), which is the most used theory to study socio-technical transitions. The application is critical because the context of urban mobility necessarily includes a discussion of urban form development; therefore, the analysis suggests ways in which the MLP should be adjusted in order to go beyond the technological focus to account for spatial as well as cultural dimensions reflected in the historical dynamics evidenced in the empirical material collected for this study.
The analysis identifies three major transitions in terms of urban mobility and city structure between 1950 and 2012. The first transition is from a densely populated compact city where the dominating modes of mobility where public transportation in trams and private transportation in bicycles and walking (1950 and before) into a city that spreads out to the north, the west and the south-west into less densely populated suburban neighborhoods where the car plays an increasing role in transportation (already in the end of 1950s and continuing well into the 1970s). The second transition starts in the mid 1970s with the stagnating growth of car ownership and use, and a re-birth of interest in the bicycle in Copenhagen. This transition lasts until the beginning of 1990s. This period is characterized by economic stagnation, impoverishment of the central municipalities (Copenhagen and Frederiksberg) and gradual growth of the suburbs but at a much slower pace than what was estimated by the plans of the beginning of the 1970s. The third transition starts at the beginning of the 1990s, when there was a renewed interest in

investment in public transportation as a major driver of the development of the capital city. During the 1990s this process produced the design and construction of the metro of Copenhagen and the new town of Ørestad and a reversal in the trend of wealthy tax payers moving out of the center of Copenhagen to the exact opposite during the first decade of the 21st century. During this period the economic growth of the city was decoupled from the physical growth. However, this growth has been differentiated geographically. The central municipalities have developed a regime dominated by bicycle and public transport, while the suburban regions exhibit dominance of private car transport, but with a comparatively large (for the European and World context) share of cycle transport.

Article 3 - Vogel: Municipalities' ambitions and practices: hypocritical sustainability transitions? Currently under review.
(Case focus, sustainability goals in practice, transition ambitions versus practices)

This paper addresses the issue of sustainable urban mobility and the still persisting problems of implementing this objective, illuminated by current ambivalent planning practice in the municipality of Fredericia in the so called Triangle Region of southern Denmark. The core questions are: Is Fredericia performing a transition towards low-carbon mobility? Will the current attempts of a transition lead to a more sustainable urban development and mobility patterns or are the initiatives of a hypocritical character, seen from a sustainability perspective? A multi-segmented transport and land use regime offering solutions matching the preferences of different population groups represents the current urban conditions (Næss & Vogel, 2012). Since this also involves continual facilitation of urban car traffic and provision of more single-family houses, the multi-segmented nature of the regime hinders more radical changes. The paper contributes to the discussions around urban complexity within transition processes and illuminates how sustainability goals play out in practice. The paper delineates how cities are caught between competing goals of growth and sustainability and try to combine both in a green growth agenda.
There is a general increase in the awareness about climate change and its consequences and the role of cities as places of consumption and production. Cities can be held accountable for greenhouse gas emissions but can also facilitate transitions towards more sustainable futures. Denmark aims at being independent of fossil fuels by 2050. This implies in particular a challenge for the transport sector, which is responsible for around a third of the total energy consumption and nearly exclusively based on fossil fuels. These goals create a certain urgency of performing a transition that reduces CO2 emissions,

which calls for evaluation of the effectiveness of contemporary measures and solution approaches. Often the goals are neither sufficiently linked to sub-goals nor anchored in the actual challenges faced by the city's infrastructures and institutions. Conflicts between competing goals complicate the planning process and practice and the idea of what might be feasible and what is not causes ambivalent planning practices.
This paper illustrates these dynamics by the Danish case of Fredericia within the Triangle Region. The municipality of Fredericia has expressed intentions of pursuing a sustainable transition; though, Fredericia seems to be caught in the middle. On the one hand the municipality engages in initiatives reducing its emission level to perform a sustainability transition, however, on the other hand the striving for growth continuous to be the overarching goal and is understood as a necessity. To cope with the tensions and challenges thus produced, growth and sustainability are strived for simultaneously or end up being joined in a green fix as in the case of Fredericia C as new sustainable city district. However, the implication this might comprise seem not well conceived. The paper illustrates the dynamics behind this twofold strategy and the drawbacks that such development could comprise. The dynamics of sustainability goals in practice are critically discussed, which are subordinated under the municipality's growth strategies and end up as propaganda goals legitimizing continuation of ambivalent planning practices.

Article 4 - Vogel: Urban niches for sustainable transition? A scenario approach for long-term alternatives. Currently under review.
(Case focus, scenarios as analytical concept, learning)

The endeavor of achieving sustainable urban mobility is frequently expressed, but what are the prospects? This paper will engage with different approaches for sustainable urban mobility and asks: Are the current solution approaches sufficient and which direction do they lead to? This is addressed through a scenario approach to explore and communicate different paths for the future and their consequences for sustainability parameters in urban mobility development. The scenario approach as analytical approach for urban transition perspectives is a fruitful policy-informing tool and a frame for critical reflection and comparison. It is a tool to create coherent narratives in a long-term perspective that generates a base for learning through e.g. retroductive thinking; engagement in a visionary process that enables alternative futures to become attainable under certain circumstances. The paper argues that efficiency solutions tend to increase consumption, mobility management tends to rather reproduce than change the given mobility system, and that there is a need for demand reduction to achieve more sustainable urban mobility.

The three scenarios presented, with their societal conditions and prospects, build on a hybrid of theoretical knowledge concerning different solution approaches towards sustainable mobility and empirical inquiry including interviews, a focus group discussion with local actors and document studies of different records relevant for the development potentialities in a Danish case.
All three scenarios are concerned with achieving a sustainable mobility future and are presented with their basic features, their barriers and limitations, as well as windows of opportunity. The first scenario is dominated by efficiency thinking and technological solutions, which are reflected in current trends and business as usual in form of *green-washing*, which are often linked to pilot or niche projects such as sustainable city districts, alternative fuels or electric cars. The second scenario is focusing on lifestyle changes and a mobile subject in networked systems, offering an alternative in the form of mobility management, which creates a new *smart-management* approach to people's own time. The third scenario goes even beyond these two and is more radically questioning the consumption and production patterns and how to reorganize these to change the structures we are acting within and upon. This approach contains an overall rethinking of system structures, normative settings and guiding principles for future generation to achieve the visions of an environmentally sound future with high social equity.
Subsequently, the discussion of the societal preconditions for each scenario creates a possibility to compare different sustainability rationales embedded in the different approaches and concludes with a critical reflection on societal barriers and potentials for change.

Article 5 - Vogel: Structure-agency reconceptualization in transition studies: the case of urban planning and mobility. Currently under review.
(Deeper analytical assessment (structure-agency), meta-theoretical reflections)

The purpose of this paper is to provide a remedy to the underdeveloped theorizing of structure-agency relationship within urban transitions studies and thus to better understand and explain the challenge of sustainable urban transition processes. This is done by looking at mobility transitions with focus on deeply rooted social structures in the form of socio-cultural and political-economic structures, which appear to be especially challenging in sustainable transition processes. The interplay of structure and agency will be illuminated in six examples, i.e. growth approach, prisoner's dilemma, chicken-egg question, rebound effects, key actors, and unlimited mobility ideals. The consequences for an urban land use and transport regime are demonstrated. The paper illustrates the influence of structural time lags, differentiated capabilities of agency and that

transformative change needs radical structural change linked to clearly directed changes in daily action. Due to the limited explanatory power of the multi-level perspective an analytical dualism of structure and agency is utilized to investigate their mechanisms and respective influences. The paper clarifies the value of such an analytical approach to achieve an explanatory ability in transition processes and conceptualizations.

The paper demonstrates the limits of Giddens' (1979, 1984) structuration theory as primary reference to structure-agency relations within transition studies. Giddens' conflation of structure and agency impedes analytical separation, which hinders deeper understanding of both structure and agency as possessing their own properties and capabilities in influencing each other (Archer, 2010). Major points of contention contain the extent to which actors/agents possess sufficient resources and abilities to act, and the extent to which structures differ in their capacity and pace to be changed. Further, the problem is that the transition-theoretical model Multi-Level Perspective (MLP) as currently understood does not fully account for the enabling and restricting properties of structure on agency and thus is limited in revealing possibilities to engender change.

Transition theory needs to conceptualize and identify not only that there is influence, but also when structure and agency exert power upon each other, which will then again also help explaining how. The temporal dimension of structure and agency is theoretically and practically decisive. Structure and agency operate and transform in different time intervals. There is an explicit permanence of many urban structures that continue to exert power on agency even if they are in the process of being transformed. Such time lags need to be incorporated into anticipatory urban transition concepts.

On the conceptual level, this paper illustrates that niches, regimes and landscapes all contain structure-agency relationships. Radical change comes from more than radical actors, because social structures cannot be reduced to individuals. Voluntary actors cannot create sustainable mobility if the structures push in the opposite direction. Therefore the structures must be changed, perhaps radically. Generally this happens through agency. It is a political dispute around implementing transitions, which kind of quality or radicality of transition processes are enforced, and finally which goals are pursued through systemic changes. This paper depicts some details of challenges in transitions in the making that can be used for transition strategy development and critical involvement of actors.

5. Synthesizing results across articles

This chapter presents findings across the overall thesis. Reflections on the articles as a contributive result are discussed, as are transverse conclusions that can be drawn from the thesis. How adequate analytical and theoretical approaches are used and/or contribute to the research and what could be done to support transition actors will be presented. The articles' contributions to each research question are summed up in a table. Finally, the chapter ends with a summary of the contributions and an explicit reflection on the transition-theoretical input made by this thesis.

5.1. Meta-reflection on sustainable urban mobility transitions

The thesis shows that urban transition processes have to be planned in a long-term perspective to have a positive impact on sustainable futures. Urban transformation is complex due to its open systems, political agenda, socio-spatial components, and other factors. Reflections on normativity and careful considerations concerning environmental limits, social equity and legitimacy play a decisive role in guiding sustainable transitions. In the following, the results of this research will be unfolded and reflected upon in a cross-article discussion structured according to the research questions.

5.1.1 How does the multi-level transition perspective (MLP) cope with transition processes toward urban sustainability?

The critical engagement with and use of the multi-level transition perspective offers new insights into the specific components of urban transitions and thus also into the applicability of this perspective for the analysis. The thesis poses useful and more challenging experiences with the regime conceptualization. In paper 1 some main components essential to urban sustainability transformation processes set the scene for the first theoretical engagement with the model. Several challenges regarding the MLP were presented, and a more suitable conception of urban regimes as multi-segmented was put forward. Papers 2 and 3 applied the MLP empirically, though the application was developed in a critical way. Paper 2 took a historical approach for the case of Copenhagen and added a pronounced cultural and spatial dimension to the dominant technical focus. Paper 3 adopted the regime understanding of paper 1 as underlying structural condition analyzing the given circumstances of the Fredericia case, pointing out the intensified need to focus on the landscape level as a powerful structural influence and to recognize the limits of promising niches under the prevailing circumstances. Paper 4 had no direct

engagement with the model as such, as it took a scenario analytical approach instead. However, paper 4 was informed by the analyses of the previous papers where, in particular, a stronger focus on landscape conditions was pointed out as necessary. The discussion in paper 4 of societal conditions necessary for the realization of the "limits to growth" scenario is an example of this focus. Paper 5 offered a deepening of the model by linking the analysis of transition processes toward urban sustainability to the structure-agency nexus. The analysis supports the reinforced engagement with the landscape-level structures, as these are especially challenging and influential in formulating sustainable transition prospects. Based on these utilizations, there are three main points, which will be elaborated below, that were identified as being essential when working with the MLP in an urban case of a specific scale and complexity:

- Demarcation of the regime and resolution of the related definition ambiguity
- Spatial conceptualization
- Explanatory power

Demarcation of the regime and resolution of the related definition ambiguity

For a start, there is a difficulty in demarcating the regime; the question of what kind of regime is investigated is essential for the utilization of the analytical concept, the analysis and, thus, the results. Whether the regime is an urban regime, a mobility regime, a transport-land use regime, or another type of regime needs to be defined to implement a meaningful analysis. Several scholars who have engaged with the model realize the challenges in empirical application of the MLP (e.g., Genus and Coles, 2008; Markard and Truffer, 2008; Smith et al., 2010; Coenen et al., 2012; Fünfschilling & Truffer, 2014). It comes down to the definition question; knowing what the regime contains will also define the landscape and the niche level accordingly and vice versa. Otherwise there will be no orientation and thus the analytical levels will lose their value in structuring the analysis. Nevertheless, the identification of the analytical levels in the empirical material is generally challenging and rather dependent on and influenced by the person applying the model as well as the object of study. The latter is the critical factor. This definition needs to be made transparent and needs to be plausible in describing the phenomena; otherwise reliability and validity problems are likely to appear. However, this applies to many models and is not a specific MLP challenge as such. Thus, the regime is often a negotiated result of the different actors involved, which have their own framing of what the regime contains. Maybe "*it is not* (a) *precise definition of niche, regime and landscape that is paramount, so much as what each conceptualisation does*" (Smith et al., 2010: 444). It is about the reflections achieved through engaging with transition analysis, which should feed back into the practices to improve sustainability transitions (ibid.).

This challenge also explains why a better clarification of how the MLP can be applied in different situations has become an important topic within transition studies (e.g. Geels and Schot, 2007; Hodson and Marvin, 2010; Zijlstra and Avelino, 2011; Geels, 2011; 2012; Markard and Truffer, 2008; Næss and Vogel, 2012; Switzer et al., 2013). This thesis elaborates on the analytical levels based on the study object investigated: for example, a) multiple niches supporting and opposing the regime, which also calls for avoiding non-sustainable niches and not only valuing the niche-level as a locus for innovation[6]; b) the explicit incorporation of the landscape level, realizing that it is changeable, and that it also acts as a regime supporting structural power and is most essential in sustainable transition processes; and c) the application of a regime understanding as multi-segmented (papers 1 and 3), which appears to be a more adequate description of the contemporary urban development. Moreover, there is the explicit spatiality of urban transitions and a particular inertia of structures as not yet analytically conceptualized in classic MLP applications. The spatiality issue is increasingly discussed within the field of transition and this thesis also makes a contribution toward this agenda as elaborated below.

Spatial conceptualization

Spatiality is an inevitable dimension and study object in the case of sustainable urban mobility, and therefore I will mention it under this discussion regarding the first research question. However, it could also be discussed under the second question, as it is linked to the sufficiency question of solution approaches. Spatiality is important in both conceptual planning of transition and understanding of current dependencies and causal relations that influence practices. Spatiality is absolutely essential when engaging with urban transformation processes, because urban spatial structures represent an especially large time lag in relation to agency, as highways, streets and buildings, for example, are not as easy and fast to change as, for example, exchanging a type of fuel or the kinds of light bulbs used in buildings. The pace of sustainability transition is particularly important, as consequences of human-made climate change are already tremendous. Thus, the quality of urban transition is by all means linked to spatiality, as urban structures condition directions of transition progress for a relatively long time. All papers unavoidably touch upon the spatiality of transition. Paper 1 reflects the basic urban components, so to speak, which are unavoidable in urban transitions, and spatiality is certainly one of them. Paper 2 illustrates the initial conceptual steps by elaborating on the classical MLP and figuring out

[6] Generally speaking, it is disputable whether innovation is always desirable or necessary and what exactly is meant by innovation. In the case of sustainable urban development and mobility, the rearrangement or the given components of the regime or the known sustainable urban forms and infrastructures do not need to be innovated, but strengthened, as introduced in paper 1. However, if innovation contains not only a new technological product, but also an overall rearrangement of structure-agency relations, then it might be called an innovation in this new configuration.

spatial and cultural elaborations beyond a one-sided technological focus in innovation processes (see figure 12 in chapter 3). It is important to note that all three levels have spatial considerations and implications. Paper 3 illustrates the empirical conditions and reveals how spatiality as urban form and infrastructure is essential in sustainable mobility transitions. If ignored, it can create rather contradictory planning practices that impede a sustainable transition. Paper 4 incorporates the different spatial conditions and consequences of the development paths presented in each scenario. Paper 5, which conceptualizes the structure-agency nexus, provides a theoretical framework for understanding the structural inertia and the specific time lags of many urban structures.

Explanatory power

In this thesis the MLP is used as heuristic model. On the one hand, it functions as a simple mapping device. It is a first structuration attempt to identify the main components relevant to the analysis and to recognize possible transition dynamics. On the other hand, the model in its simplicity is difficult to apply empirically due to the challenge of defining the analytical levels in an empirical case. There is a demarcation problem, which actually contradicts the basic idea and value of the concept, namely that it attempts to embrace the complexity and to make it manageable. There appears to be an accumulation of theoretical conceptions to improve or refine the MLP, from process theory to middle-range theory, "interpretative freedom" (according to Geels), narrative approach, practice theory, theory on power, and so on. (Geels, 2010; 2011). This thesis elaborates on the MLP from the perspective of the study object, i.e. urban mobility transition, and through the engagement with the structure-agency nexus (see section 5.1.4). However, the MLP may not be universally useful or capable of doing all it is intended to do. Geels' attempt to define the MLP as middle-range theory may be reflecting a reaction toward reductionist accounts that are too narrow and linear to explain transformative social change. According to Merton (1967), a middle-range theory is used to e.g. test hypotheses through investigations of empirical relations. This was a response to the critique in grand theories that, according to Merton, are hardly possible to test. More generally speaking, "[m]*iddle range theory is the designation of a certain type of theory and a specific methodology aiming at bridging the gap between general theories and empirical observations*" (Danermark et al., 2002: 125). However, it is questionable whether this theoretical concept actually holds true for the MLP, which is, in the main, used as a narrative approach, and moreover whether it leads to an explanation of the underlying mechanism (Danermark et al., 2002). Such explanation builds on an understanding of these causal mechanisms, which is necessary to achieve more meaningful knowledge and to learn about essential dynamics that initiate, limit or accelerate transformative change. To achieve this understanding, this thesis has used relevant explanatory theories and the

structure-agency analysis. Thus, the MLP seems to be a supplementary tool in a research design that needs additional theoretical triangulation to offer explanatory knowledge.

Besides, the MLP might be more appropriate for historical analyses on transitions than on future perspectives, where many unforeseen factors can play a role. It is a matter of learning from history for contemporary policy decisions. However, historical investigations can also run the risk of leaving unsuccessful transitions and their underlying dynamics unobserved if the focus remains only on transformations that have actually happened (Bertolini, 2011). The complex dynamics and struggles of transformation processes, as well as maintenance of the status quo, are not necessarily easily observed. As this thesis is interested in long-term sustainable futures, a scenario approach was found to be necessary to address transitions toward a future that seems, under present landscape conditions, to be rather utopian. There can be a fruitful linkage between futures studies, especially backcasting as a normative scenario approach, and transition studies (Vergragt and Quist, 2011). Normativity is a guiding principle and necessary parameter given the demonstrated urgency of sustainability transformations (see also 5.1.5).

5.1.2 What are the current approaches for sustainable urban transitions and are these solutions sufficient, seen from a sustainable mobility perspective?

Contemporary urban sustainability transition approaches

The case of Fredericia represents the dilemma of wanting to transform toward more sustainable futures while orienting toward more growth. These are two ambitions pulling in different directions, which might, according to its proponents, be united under the *green growth* idea. However, the continuation of this approach is leading to contradictory planning practices, as reflected in this case, and opens up a fuzzy transition context. Fredericia's approach to the urban transition challenge can be seen as representative for many contemporary cities. The multi-modal transport and land-use development, the rejection of more regulative guidance, the competitive inter- and intra-regional conditions for growth, and the focus on technological and efficient solutions to reduce CO_2 emissions instead of reducing the overall demand, etc., are among Fredericia's approaches. Moreover, the municipality of Fredericia engages in developing more sustainable futures by, for example, becoming a climate municipality, reducing the CO_2 emissions, participating in pilot projects for electric cars and mobility management schemes, and developing a new, dense city district. The development and branding of the sustainable flagship project Fredericia C is used as a motivator, a vision and maybe even a

kind of token – showing progress in sustainable development. The latter point is a disputable statement, however, as this is based on the "island position" the Fredericia C project takes in the overall municipal and regional development. If Fredericia aspires to undergo a transition, then it cannot ignore the context of the whole municipality and region, including parallel unsustainable practices such as sprawling development, highway expansion and uninterrupted car dependency. The argument used to legitimate the current practices is anchored in liberal politics and a growth paradigm, which creates the necessity of attracting people and businesses in offering a variety of market segments, e.g., in the housing, logistics and transport sectors. Insufficient solutions in terms of environmental sustainability are the consequence of this planning orientation that contradicts a regulative approach necessary to guide future development toward more sustainable urban mobility. Obviously, behavioral change is also decisive, but this needs to be connected to structural change. This is not to say that individual behavioral change is not important (it is, very much so), but rather that the agential power is closely linked to structural power, for which reason structural conditions are as important as individual behavior.

Evaluating contemporary solution approaches

The sufficiency question is underpinned by explanatory theories applied in this thesis, which explain the mechanisms of socio-spatial dynamics underlying sustainable mobility. As shown in paper 1, cities represent highly complex organizations of different open systems; a multitude of urban forms, infrastructures, societal groups, lifestyles and political interests forms consumption and production patterns. It is certainly challenging to engage in a transition of such complexity; however, there are more and less sufficient approaches.

Paper 3 discusses the function of goals that can shed light on the given gap between vision and practices. Sustainability goals end up having a legitimacy function while continuing a business-as-usual approach, meaning that the goals are not translated into binding measures that would change existing unsustainable structure-agency mechanisms. Additionally, promising niches such as the new city district Fredericia C, general densification of the city or the promotion of public and non-motorized transport lose their effect. One explanation for these dynamics is the structural power of a growth agenda that supports competition and a low level of regulation, which are seen as necessities to attract people and businesses to the municipality.

Paper 2 deals with the case of Copenhagen and mainly represents a theoretical-analytical contribution to the thesis, as it engages with urban transition and the MLP. Nevertheless, the case reflects interesting insights into current transition prospects in the capital of Denmark. The case was chosen because Copenhagen is internationally represented as a

relatively sustainable city with an outstanding percentage of bicycle traffic. The analysis in paper 2 concerning current conditions revealed the differences between the inner municipalities and the more peripheral parts of the Greater Copenhagen Area. The inner city reflects the internationally reputed bike culture, whereas the outer areas reflect a high level of automobile commuting. A comprehensive view on the transition prospects necessitates the inclusion of the whole metropolitan area, and the conclusion arrived at is thus that no clear sustainability transition has occurred.

Next to the theoretical underpinning, the long-term perspective applied in the scenario methodology in paper 4 offers reflective judgment on sufficiency. The scenarios reveal the shortcomings and opportunities in three development approaches with differing rationales. The analyses illustrate that short-term effects through, for example, efficiency solutions might lead to increased consumption in the long run if no general demand regulation takes place. In contrast, a more regulated control through, e.g., pricing of motorized transport, strict land use regulations or investments in better public transportation systems is likely to be rejected politically and societally as it often contains some sort of threat to people's habits, wallets or created "needs." The different sustainability rationales contextualize the alternative paths and their internal logics. Thus, the contemporary dominant approach of ecological modernization explains the tendencies toward technological solution foci and improvements within the given systems, whereas alternative rationales would argue for the need to rethink and go beyond the given system to achieve a sustainable transition. This challenge links to a normativity discussion on the radicalness of measures necessary to undergo the desired transition. What is accepted, what is necessary, and who decides? This point will be discussed further down in section 5.1.5. The structure-agency discussion provides essential understanding of mechanisms that unfold in the scenarios, and thus paper 5 helps to argue for deviant practices from business as usual and enables a critical perspective on alternatives.

5.1.3 What are the main barriers and opportunities for sustainable mobility transition processes in cities?

All the papers contribute to answering the question concerning barriers and opportunities. Yet each paper's contributions are of a different character due to the different stages of the research process and the explicit analytical and theoretical engagement each paper represents. Paper 1, for example, is reflecting barriers and opportunities, introducing the urban transition components and identifying possible challenges. Paper 2 is reflecting on historical development and identifies space and culture as essential objects of change as well as drivers for change in regard to the subject matter of sustainable mobility

transitions. Paper 3 identifies the case-specific barriers and opportunities of Fredericia and the Triangle Region, which are also taken up by paper 4. Paper 5 enlarges upon several especially challenging dynamics and explains the underlying mechanism of some barriers and opportunities accordingly.

Paper 4 especially deals with different opportunities and barriers for transitions in developing three scenarios and engaging with their societal preconditions. These alternative pathways uncover consequences and challenges as well as chances and new ideas. The scenarios develop from the given practices, trends and more radical alternatives compared to present practices. The first scenario reflects a continuation of given practices and trends where the opportunities lie mainly in the incremental character of change, which is linked to efficiency solutions, often of a technological character, and remains within the given system structures. The short-term effect is appreciated politically and by individuals as benefits due to, e.g., cost and emission reduction at first. However, in the long run, the efficiency dynamic can create even more consumption and turn out to be a barrier. The second scenario represents a mobility management approach that is aimed at self-management and highly flexible mobile subjects. This idea of being an individual, autonomous mobility manager appears to be attractive for contemporary society and thus is an opportunity to make people change their habits accordingly. However, the highly networked and monitored system underlying this approach has its shortcomings, too, as it creates dependencies, let alone the shifting of responsibility to the individual level, while creating a system that augments a mobility ideal that calls for more consumption. The third scenario creates structural frames for individuals to offer guidance and regulation that may lead to more sustainable futures. This scenario is the most challenging one as it deviates from given conditions most radically and is likely to contain short-term costs for long-term benefits (not necessarily monetarily valued). However, it supports the formation of new values and aims at changing deeply rooted social structures into a sustainable systemic structure.

The development and comparison of scenarios indicates that an unsustainable system structure requires more than partial improvements, as the main dynamics will otherwise remain. The system needs to be renewed or redeveloped in a more drastic manner to offer chances for new mechanisms that support sustainable practices. In MLP terms, it would translate into the need to change or influence landscape structures in such a way that they support and influence more sustainable regime components and that niches match up to support such structural change with more radical agential power than might be the case with regime actors. However, this is not to say that change cannot also arise from within the regime, as it is not a monolithic structure, though it might be more difficult, as exemplified further below, due to agents being conditioned by the structures in which

they are embedded. Niche actors, in comparison, may have more scope for variegated practices.

Also, the experts interviewed named opportunities and barriers they identify for sustainable mobility transition (see table 9.3 in the appendix C). These opinions reflect to some extent the given conditions and are mostly covered in the scenarios, but the interviewees' opinions may also be biased, as each individual has a personalized and professional context from which they judge. However, reviewing the empirical data, the three most important opportunities indicated are 1) urban branding to attract people and businesses, 2) capacity building through key actors, such as skilled and creative people, and 3) introducing structures that support the transition process (e.g., plans, infrastructure and prices). Urban branding, though, was clearly identified as the most important opportunity, and in the case of Fredericia the interviewees linked this to the flagship project Fredericia C. The opinions on barriers varied more between the different interviewees. However, three strong barriers (or challenges) mentioned are 1) changing people's values and behavior, 2) structural conditions and regulations (e.g., political commitments, tax, bureaucracy, urban sprawl and congestion), and 3) the economic crisis as an overall challenge that has a strong bearing on professional and personal conditions.
On a more general structure-agency level, barriers and opportunities can be explained too. Paper 4 unfolds structure-agency relations more descriptively in the scenarios and paper 5 engages more conceptually/theoretically with the discussion. The "chicken-or-egg" question discussed in paper 5 reflects a typical dilemma in the transition debate: what should be changed first, structure or agency, to arrive at the desired aim? This dilemma was present in the discussions with the experts interviewed and implicitly underlies the scenarios. In the end, this dilemma reflects the recursive and interdependent character of structure and agency and suggests that the clear guidance and logical linkage of both is essential in a transition strategy, not necessarily getting beyond the dilemma (cf. section 5.1.4).
Structures are very important in the transition process, as reflected by the opportunities and (especially regarding) the barriers listed above. The analyses in the thesis indicate that structures should get an important guiding function and thus can serve as incentives to act more sustainably (see papers 4 and 5). The structural power and influence also explain the limits of some niche solutions and point toward the necessary handling of conditions at the landscape level (e.g., growth paradigm, competition and mobility ideals) that condition the chances for niches (cf. paper 3).
The focus on key actors represents the agency discussion in regard to opportunity and barriers. Archer's conceptualization of the development of agents becoming actors and their specific and differentiated agency capacities links to the challenges identified by

some of the interviewees, such as the issue with unskilled and/or poor people within transformative processes (representing in this context a form of primary agents) (cf. paper 5). Social sustainability becomes an important issue to consider, which comprises sensitivity to the ability of socioeconomically deprived groups of people who will be hit harder by possible costs and structural changes introduced as part of the sustainability transformation. Also important is avoiding a "sustainability elite," which means mobilizing people across societal classes to live more sustainably, which would be desirable seen from a socially and environmentally sustainable perspective (Alexander and Rutherford, 2014). The agential power of the people needs to be supported and guided through, e.g., a democratic system or general structural conditions for sustainable production and consumption. Certainly, people's capacity to influence transition differs; and, most crucially, social structures cannot be reduced to individuals.

To increase the opportunities for transitions on an agential level, it is important to offer some kind of maneuvering space for actors, as introduced in paper 4 (cf. table 9.2 in appendix B), to work toward synergies and build bridges; to work positively with agents' different capacities rather than to reduce their chances by focusing on their limitations. Thus, transformative change appears through changes in social structures and corporate agency, where key actors or policy entrepreneurs play a decisive role in initiating counter-forces to the structural conditioning and may trigger agential capacities.

5.1.4 What are the underlying structure-agency relations and mechanisms generating barriers and opportunities?

In order to investigate the underlying structure-agency relations, paper 5 involves theories and analytical models inspired by critical realist ontology. There is certainly a multitude of structures and practices to choose from; however, reflecting the case of sustainable urban mobility transition, some examples of deeply rooted social structures and their consequential dynamics were elaborated. This decision is linked to the previous analysis in the thesis that revealed difficulties in achieving the desired aim of sustainable mobility. The chosen examples reflect some underlying mechanisms that can be linked to prime challenges in transition processes identified in the case as well as in theories. These six examples are the growth approach, the prisoner's dilemma, the chicken-egg question, rebound effects, key actors and unlimited mobility ideals. Moreover, papers 4 and 5 offered the chance to unfold these structure-agency relations, thus giving an opportunity for a fruitful combination of a more meta-theoretical reflection in paper 5 and the application and illustration of key structure-agency dynamics in the scenarios of paper 4.

Radical change comes from more than radical actors

One crucial insight of paper 5 is that voluntary actors cannot create sustainable mobility if the structures push in the opposite direction. This means that the given structures need to change. Such structural change is, in the main, taking place through some sort of agency, which might be by radical actors due to the need they see for radical change. However, radical change comes from more than radical actors, because social structures cannot be reduced to individuals. This does not mean, though, that radical actors are not necessary. Archer (2000) introduces the development of agents becoming actors, their relations and different abilities. Actors, with their specific capacities, have an important role in initiating and also guiding and/or motivating the more general agents. The primary agents have power, even if they may not be conscious of it, as critical mass in transition processes. In becoming corporate agents, an increased level of organization and directionality enforces their influence. The actor then is the most sophisticated player in her/his strategic action and will be an important driver in political disputes on transition progress and concepts.

In the case of Fredericia, the Danish Nature Conservation Society (DN) could become such an actor. The local organization, by being actively involved in and critically confronting planning suggestions[7], engages professionally and politically in the participatory planning system. This engagement can be fruitful if the municipality initiates structural changes, such as protection of undeveloped land or coastlines through binding plans, but may lose out if ideas or critiques are ignored or even co-opted (e.g. see Klottrup, 2006; Niras, 2007). The case of so-called Himmerigshuse reflects a kind of co-opting as it incorporates the ideas of the Danish Nature Conservation Society for a new development area with housing on former farmland.

[7] A concrete example would be responses to the new housing development in Skærbæk in the southwest or the development area with around 230 hectares set aside in the northwestern part of the municipality, which is marked as a future development in the municipal plan.

Figure 17: Map illustrating (in red) the development area in the northwest of Fredericia of 230 hectares. (Source: Niras, 2007)

The development plan operates with the motto of bringing nature to the people instead of bringing the people into nature[8] (Klottrup, 2010). It is odd that the Nature Conservation Society developed any suggestion for that area, since it contributes to urban sprawl. However, it was explained as "being the lesser evil," less damaging than new development at the coastline or in other areas worthy of protection. This example of legitimizing development demonstrates what Jane Jacobs discusses as "sentimentalizing nature," which she describes rather drastically as a "*desire to toy, rather patronizingly, with some insipid, standardized, suburbanized shadow of nature – apparently in sheer disbelief that we and our cities, just by virtue of being, are a legitimate part of nature too*" (Jacobs, 1993 [1961]: 581).

The conditioning effect of structures over agency was also exemplified in the empirical inquiry and in the challenge of planning professionals and experts to "think outside of the box," so to speak. Undertaking the exercise of retroductive thinking was especially challenging, and the interviewees pointed out that they were not trained to think radically differently; they stay within their structural frame of expertise (Interviewee A). Consequently, actors need to be supported to act and think beyond business as usual. The focus group discussion revealed that local businesses (as transition actors) need to get

[8] "Motto for Himmerigshuse: Vi skal ikke have huse ud i naturen, men i stedet natur ind mellem husene!" [The motto for Himmergshuse: We should not have houses in the nature, but instead nature between the housing!] (Klottrup, DN, 2010: 11).

some sort of support or assurance in the transition processes, as the possible or likely risk (as perceived by the actors) creates resistance to change.

The temporal dimension is a crucial parameter that more accurately explains theoretical as well as practical transition dynamics and challenges, such as the basic notion that (contemporary) structures logically predate agency, as humans are acting within some structurally conditioned context even if structures are created by human agency. For many urban structures, such as the built environment, structural changes take time, and the structures thus hold an explicit conditioning effect through such time lags. However, discursive structures, such as a mobility ideal and its behavioral and systemic consequences, are also confronted with time-lag issues. For example, new distributional processes that need to take place when shifting the mobility focus, such as pricing, time scheduling, infrastructure accessibility and the building of new daily routines, might be perceived as negative at first, and the more positive benefits may first emerge at a later point in time (cf. paper 5). The political disputes or conflicts in systemic transformation in general may be unavoidable; however, planning has a political connotation. Revealing the causal relations explained by structure-agency dynamics can prepare for argumentative pressure, which can be utilized by agents and actors in, e.g., political niches.
Altogether, the structure-agency nexus enabled me to reflect on transition dynamics on a meta-theoretical level and from a conceptual-analytical view; thus, it supported me in forming a critical opinion on transition in practice. The latter issue links to the next discussion on radicalness. Radicalness can lie in the eye of the beholder, and with a deeper understanding informed by the structure-agency analysis, arguments are put forward in favor of more radical change grounded in an anticipatory view on causal mechanisms supporting sustainable transition in the long term.

5.1.5 Is radical change possible?

Is radical change possible? The answer offered by this thesis is yes; it is not only possible, but also necessary. However, radicalness needs a kind of reference: radical regarding what and why. The thesis demonstrates that drastic changes need to take place in order to arrive at the desired futures. In sum, the different articles, especially articles 4 and 5, revealed the necessity for changing social structures to arrive at more radical change, which goes hand in hand with stimulating agency as a driver for change. A political dispute and the aspect of agents becoming actors are central dynamics for more radical change. However, radical actors are decisive, but not a panacea; they need to stimulate and/or guide the general public to create a real momentum for transformative change and finally form more sustainable social structures. Here structures have an essential role –

"non-material" social structures as well as spatial/physical structures in the form of the built environment. In the case of sustainable mobility, the physical shape of structures can be a great support and a necessity to guide agency. The spatial characteristics of a city are in many ways decisive for its urban future – sustainable or unsustainable.
Thus, radical change means deep structural change, which would also translate into an achieved transition. However, the quality and direction are important, as they need to be radically different from the given dominant underlying structures. To avoid the danger of reproducing basic structures and just naming them differently, as appears to be the case with *green growth*, a rigorous rethinking becomes necessary. Such rethinking points toward a need to come from efficient solutions to *sufficient* solutions as described by Alcott (2008): first of all, we need to consume less and not just more efficiently; meaning, e.g., not just driving an electric car, but avoiding driving a car at all (or at least driving it less). Furthermore, Alcott directs the attention toward a rebound effect that may come along with the sufficiency approach too: the saved "value" is used elsewhere, such as in an increase in leisure travel, if transport costs and time are saved in everyday life travel. Thus, some more general social structures in the form of ideologies and/or socio-economic structures may need to change.

Social dilemmas about needs and wants

Society and individuals develop standards and norms about, e.g., what is appropriate, valued, dismissed or not acceptable. However, these structures do not necessarily function for the common good, seen from a perspective of social and environmental sustainability. Needs and wants should be seen in their context, which means they need to be critically reflected on, questioned and maybe changed. But how can we change people who do not want to change? Who can force them and how, if at all? People can be influenced by influencing the structures that condition them, which then again can create different forms of agency and so forth (see section 5.1.4 before). A certain social structure, for example, tends to induce certain perceived needs and preferences in the population (through media, advertising, social norms, etc.) in order to ensure that a growing production of commodities has a sufficient number of buyers, or to create an affinity for a social standard. However, these needs could also be termed wants that are "masked" and understood as needs, as in the new assumed needs of contemporary western consumerist societies, which hinder more radical change seen from a sustainability perspective. Thus, the challenge lies in influencing and guiding agency through structural influence. Such structural influence should include incentives to act more sustainably, such as introducing prices that bear the full costs of road-based transportation or offering land-use regulation that makes inner city densification more attractive than development on the periphery. If some sort of consumer good, such as single-family houses built on green fields, is

considered to be out of the question anyway, people will probably not feel that they miss it if they cannot get it. The role of planning then would be to offer such critical direction and guidance for the common good based on expertise, causal mechanisms and sustainability and ethical values that protect the environment and support prospering societies in a long-term perspective.

Democracy challenge

The right-to-the-city movement put forward by, e.g., Henri Lefebvre (1996 [1968]), David Harvey (2012), Neil Brenner or Peter Marcuse (Brenner et al., 2012) has had a kind of revival since the economic crisis of 2008 and its ongoing influence on contemporary urban development. "*They* [the crises] *have made the loss of social, economic, and political rights painfully tangible not just for traditionally disadvantaged and marginalized groups, but increasingly also for comparatively privileged urban residents, whose notion of good urban life is not realized by increasing privatization of public space, in the 'upgrading' of their neighborhoods, or the subjection of their everyday lives to the intensifying interurban competition*" (Mayer, 2012: 63). The quote clarifies the insufficiency, let alone the destructive tendencies, of a capitalistic, market-led and overall liberal development agenda.

The concept of the right to the city relates also to the new management approaches, such as autogestion, self-management and grassroots democracy, to name a few, which can also be seen as a revival from the '60s and '70s (Lefebvre, 2009 (1966)). However, this form of governance might be an escape from responsibility and/or a handing over of responsibility from the social state to the individual. This dynamic is also reflected in the second scenario concerning the contemporary trend of mobility management and, in general, the expectation of a highly flexible and self-managed mobile subject (see paper 4). However, this seemingly autonomous decision-making and managing is actually taking place under highly monitored systems and networks, which often build dependencies rather than freedom.

In contrast to this individualism and market-led focus, the state can be seen as a political actor and a system that can potentially influence development progress. The role of the state, though, is a disputed issue in the question about radical change and in *deep green alternatives* (Alexander and Rutherford, 2014). For example, basic ideas of radical reformism take place within a reformed capitalism, where the state has a regulating role in, for example, fair distribution of wealth and investment in more sustainable structures. Eco-socialism calls for a redefined state-driven socialist society that builds on common ownership and democratic control. Eco-anarchism rejects the state and wants to form a self-governing, non-hierarchical society with an explicit localism (ibid.). What should or could be the involvement of the state? How can it fairly distribute common goods such as

public space, clean air and drinking water, as well as handling of general negative externalities such as disadvantages of socially deprived people, reduced biodiversity and climate change consequences? Are there other forms of governance, such as the *commons* paradigm (e.g. Ostrom, 1990; Harvey, 2012; Bollier, 2014)?

The question of who has a right to define the appropriate level of consumption and production is frequently disputed. This thesis clarified the danger of orienting toward or adapting market-led structures, as these cannot help to regulate toward a more sustainable urban future. Moreover, it is not necessarily very democratic to let decisions be made by a local community, especially if competitive inter-municipal or inter-regional dynamics are dominant. Sustainable futures are about future generations, who will be affected by negative environmental impacts due to high consumption levels among contemporary generations. As Owen puts it: "*we personally enjoy all the benefits of our own consumption, yet share the consequences with everyone else, and primarily with people not yet born. That's a conflict that 'the market' can't resolve*" (2012: 203). To clarify this point, a contrasting question is presented: Why can people without dissent accept that, e.g., advertisements or given market structures define their consumption patterns and create perceived needs, but mostly reject it or call it unacceptable when an authority regulates their consumption patterns through taxes, pricing or policies? Certainly the market (as the underlying structure) is often more difficult to distinguish than the state might be, which explains to some extent the market-capitalist power. Nevertheless, the state and the market exist as a governance pair, so to speak, which defines the common structures within which change might appear. "*The Market/State regards individualism, private property rights, and market exchange as the indispensable drivers of economic growth and technological innovation, which lie at the heart of a mythical vision of modernity and human progress*" (Bollier, 2014). This links back to the above discussion on needs and wants, which by no means is straightforward but in any case is socially constructed. This also means that changes are possible and need to be considered if a sustainable transition is the goal.

Ethical values

The thesis touches upon ethical and normative discussions in transformation processes at different themes and stages. The hypocrisy discussion in paper 3 reflects a moral dispute on sustainability goals and their actual function in practice. Analytically speaking, the scenario methodology as applied in this thesis is an explicit normative tool to put forward a critical and more guided transition strategy (cf. paper 4). The sustainability rationales embrace different value considerations, as also introduced in paper 4 and discussed in regard to possible alternatives to the contemporary dominant neo-liberalism conditioning

urban development (cf. section 2.3.4). The structure-agency discussion reveals arguments and necessities for normative intervention as some dilemmas or interdependencies (e.g., the chicken-egg question) that need to be countered by a normative positioning, which serves as orientation and decision support (cf. paper 5).

To recall and engage with ethical values in planning processes and decision-making is especially important (as counter-values) due to the currently dominating values of growth, competitiveness and individualism. The challenge is the "*famed power of capitalism for recycling everything aimed at its destruction*" (Latour, 2004: 231). This quote by Latour points towards the ability of capitalism to continuously develop itself anew and co-opt possible counter-forces that would call for reduced production and consumption. The development of operational strategies in the form of eco-managerialism, eco-judicialism and eco-commercialism would be such examples, introduced by Luke (2006) and discussed in paper 4. This is also an argument for the need to renew social structures, such as unsustainable mobility ideals, an eco-destructive growth agenda or counterproductive competition, and to engage with alternatives, which might be radically different and might include rethinking values.

This orientation to ethical values can help to introduce change and turn away from the dominant capitalist-liberal view toward a new set of values that is necessary for the radical transformation toward a sustainable and just future. When engaging with ethics and values such as justice, then, different dimensions need to be taken into account. Two main dimensions of justice are the inter- and intragenerational justice, which describe the obligations of sustainable development also pinpointed in the Brundtland Report: first, "*the intergenerational demand that future generations matter, and therefore should be treated with due concern*"; and second, "*the intragenerational demand that all members of the current generations ought to be treated in a fair and decent manner*" with specific focus on the most vulnerable (Arler, 2004). The aim is to unite these two dimensions, which might not be as easy in practice as it is desirable in theory. In addition to our moral obligations for present and future generations of humans, a number of environmental philosophers have argued that we have moral responsibilities toward non-human nature as well; a position also acknowledged by the Brundtland Commission (1987: 57). Arler (2004) offers three dimensions that can be used to consider a comprehensive perspective on ethical questions and obligations accordingly, namely 1) time, 2) space/culture, and 3) species/natural phenomenon. Here, relatedness is an important factor for justice; the more someone is related or in proximity to someone/something, the more people care about it, e.g., their own family members and their near future compared to the conditions of a family in another cultural context, in another country, with a different set of values (ibid.;

cf. 2.3.6, Meadows, 2013). This certainly does not mean that biospheres, people or landscapes further away should be ignored or are less important, by any means, but the character of the obligations we can and should have might be different.

However, moral values are not necessarily respected, they may be confronted with other values, such as growth, and a kind of hypocritical condition may then emerge, as in many cases regarding sustainability (and reflected in this thesis, cf. paper 3). So how to deal with hypocrisy? How to avoid the gap between "talk and action"? Bromley and Powell (2012: 7) pinpoint practices that explain the hypocritical conditions, though exemplified for organizations, namely that "*[p]olicy-practice decoupling allows an organization to adopt multiple, even conflicting, policies in response to external pressures, without unduly disrupting daily operations by trying to implement inconsistent strategies.*" However, these dynamics can also hold true for planning practice, which also needs to deal with a multiplicity of goals and often conflicting aims. Moreover, hypocrisy might be reconsidered as having a positive aspect when understood as aspirational (and not as lying) hypocrisy (Christensen et al., 2013). Such an aspirational hypocrisy describes the aspiration toward a desired outcome and the motivational factor within it. This kind of positive connotation could be related to the practice of visioning or utopias known from, e.g., futures studies. However, it is important not to generalize, but to be precise. The basic question is about the result of such a mismatch and whether that mismatch still has an overall benefit or instead might be leading to a development that is opposite to or even impedes the formulated aim.

5.2 An overview of the articles' contribution

Papers / Research questions	1 – Sustainable urban development and the multi-level transition perspective	2 – Transitioning to a low carbon society? The case of personal transportation and urban form in Copenhagen 1947 to the present.	3 – Municipalities' ambitions and practices: hypocritical sustainability transitions?	4 – Urban niches for sustainable transition? A scenario approach for long-term alternatives in a Danish planning case.	5 – Structure-agency reconceptualization in transition studies: the case of urban planning and mobility.
1. How does the multi-level transition perspective (MLP) cope with transition processes toward urban sustainability?	++ Establish theoretical junction; Identifying urban transition challenges; Conceptual elaboration on multi-segmented regimes (MSR)	++ Identifying conceptual components: space, culture and technology; Applying MLP in an urban case; spatiality conceptualization; historical perspective	+ Applying the MSR in an urban case (case study); Understanding transition prospects of the case; MSR as underlying structural condition	/	+ Urban built environment and other social structures as especially challenging; time lags; Enhancement of analytical transition concept through structure-agency perspective
2. What are the current approaches for sustainable urban transitions and are these solutions sufficient when seen from a sustainable mobility perspective?	/	+ The case (Copenhagen) reflects no clear transition strategy, current prospects are defined by a multiplicity and multi-modality in transition approaches	++ Case study; Identifying contradictions; revealing underlying goals and challenges; limits of niches, explaining gap between vision and practice	++ Critical view on case study; future oriented long term perspective; normative view	+ Explaining underlying mechanisms for challenges/ contradictions
3. What are the main barriers and opportunities for sustainable mobility transition processes in cities?	+ Urban transitions reflect barriers and opportunities	+ Learning from history for policy implications; conceptual trial of the MLP	+ Critical reflection on case context & urban trends	+ Presenting different approaches in scenarios; Comparing opportunities and barriers; Scenarios illustrate different structure-agency relations	+ Structure-agency analysis offers deeper understanding; ontological positioning
4. What are the underlying structure-agency relations and mechanisms generating barriers and opportunities?	/	/	/	+ Long-term effects become visualized	++ Identifying mechanisms of barriers and opportunities
5. Is radical change possible?	+ Assuming need of more radical change to achieve sustainable futures	/	/	+ Strengthening argument for more radical change through scenario development and comparison	++ Revealing the need for normative, ethical and political decisions

Table 7: Articles' contribution to research questions; ++ equals main contribution, + equals part of contribution and – equals no explicit contribution; however, overall, all the articles helped in understanding the problem stated in the beginning and the overall research question that was guiding this research.

5.3 The contribution of the thesis – a summary

The ambition of this thesis is not to give a final answer to the challenge of sustainable urban mobility transitions, but to present and discuss the main problems underlying this challenge and to pinpoint pitfalls as well as chances to tackle this objective.

Transitions are deep structural changes mostly enacted by agency. However, sustainable individual practices will not lead to transformative sustainable change if the structures are not altered to support such agency. This means in more concrete terms that, e.g., technological efficiency improvements and behavioral changes need to be linked to demand reduction to make a sufficient difference in sustainable mobility systems.

My initial curiosity originated in a wish to understand why planning practices are continued that contradict the planning visions. To understand the ambivalence toward progress and the challenges of a sustainable mobility transformation, the contemporary attempts and trends have been critically investigated. The analysis reveals an unsustainable transport and land-use regime that is dominated by a growth imperative and market logic. Ambivalent planning practices, competing goals and competition bring about results that impede a sustainable transition. The existing and maybe even promising attempts to develop toward more sustainable mobility patterns and systems are prevented or coopted, as underlying structures are not changed. Sustainability goals are formulated but not backed up sufficiently and end up functioning as legitimizing the continuation of a business-as-usual agenda, which is dominated by a liberal planning approach aiming first and foremost to attract businesses and people. Growth subordinates sustainability and tries to legitimize itself under a *green growth* idea. However, the internal logics of such an idea are pulling in different directions, which explains the contradictions, as mentioned above.

To counter these developments, scenarios enable the envisioning of alternative regime structures and practices. With their long-term and normative perspectives, the scenarios reveal pitfalls, reverse effects and alternative opportunities. The underlying structure-agency dynamics explain causal relationships that create dependencies and opportunities for change. For example, a focus on technological innovations alone makes no radical difference, as the innovations mostly continue to operate in the same systemic structure. With increased efficiency, innovations can even increase consumption and have a reverse effect in the long run. Within the mobility management strategy, mobile subjects are formed that are persuaded to manage their own mobility under a seeming autonomy, but they may actually reproduce an unsustainable and highly monitored mobility system. Radical alternative views that aim to renew the overall systemic structures and, accordingly, also modify behavioral patterns are likely to be met with resistance. Such a radical alternative involves major changes in personal routines and values, learning about

and adopting new cultural norms, and forming structures that support more sustainable actions and reduce unsustainable ones due to incentives/disincentives such as costs, societal norms or policies. The latter alternative is comprehensive and comprises the previous examples of technological improvements and behavioral change, but within a context of demand reduction and sufficiency thinking that appreciates and cares for the capacity limits of, e.g., resource availability, growth, personal relations and identity formation.
The thesis thus concludes that deep structural changes are needed to achieve a more radical change toward sustainability. This includes a redistribution of finances and political foci that support the formation of structures guiding sustainable actions. However, the given political and corporate powers are likely to reject changes that might replace them with different actors and structures. Conflicts are unavoidable, but can be countered through transparency and argumentative pressure that originate from causal explanations and disputes of ethical values.

5.4 Contribution to transition research in an urban context

This PhD thesis contributes to the literature on transition studies through its empirically informed and theoretically elaborated urban transition analysis. The thesis could profit from existing critical views on transition studies, which, for example, underlined the missing geographical dispute and spatial component in transitions (e.g. Coenen et al., 2010; Zijlstra and Avelino, 2011; Raven et al., 2012) or critiqued the main focus on successful transitions, which may be based in the model's historical application and disregard of the dynamics behind unsuccessful transitions (Bertolini, 2011). The latter critique points out the need to be alert and learn from conflicts and struggles in transitions, which are likely to be met when dealing with sustainability transitions.

First of all, the research subject of this thesis originates from a planning context that faces the challenge of sustainable urban mobility, which defines the transition scope and its regime components. The scale and complexity of urban mobility transitions confront the classical MLP application due to the particular inertia of urban spatial/physical structures. Spatiality is a key object of transition when dealing with urban mobility, which is conditioned by the pace and quality of the transition progress of these structures. This had not been conceptualized in earlier studies inspired by transition theory. Furthermore, the landscape level needs explicit attention, as the production and reproduction of macro-economic and socio-political structures at landscape level are decisive for the systemic structures and practices prevalent at the regime level. However, cities are also places with agential capacity as well as structural conditions for developing counter-structures to

unsustainable landscape structures currently present. Moreover, the underlying urgency of achieving and performing a sustainable transition is more precarious than in some of the historical ex-post studies that were first and foremost interested in identifying different processes of systemic change and not necessarily achieving a particular outcome. However, the wide-reaching impact of urban transformation calls for a normative positioning, with a focus on a specific transition result such as reduction of CO_2 emissions and transport demand. Certainly, historical studies provide knowledge for policy decisions today, but starting with the aim in mind and working backwards to guide policy decisions is much more effective. Backcasting as scenario methodology is a fruitful approach for normative and anticipatory transition strategies, especially when current practices and structures impede the sustainability goal (Dreborg, 1996; Börjeson et al., 2006; Banister and Hickman, 2013). The focus on niches as the main loci for radical innovation is not sufficient and not comprehensive enough, as shown in this thesis (see also landscape focus above). Niches can be co-opted by the multi-segmented regime, which is strongly conditioned by the landscape level. Radical agency is still essential in achieving deep structural transformation. Such radical actors may originate from the niches or the regime, but first and foremost they need to engage with the structural powers at the landscape level. Re-addressing the structure-agency discussion in transitions provides deeper insight into underlying dynamics and supports the aforementioned focus.

The thesis exposed the shortsightedness of some transition strategies currently in practice. In particular, the application of the scenario method and the elaboration of the structure-agency nexus enabled a more sophisticated and long-term transition perspective. By applying backcasting as a normative scenario approach, transformative change for the short- and long-term future can be planned and envisioned more instructively, as contradicting measures can be counterfactually removed and the timing of events can be arranged accordingly.

This thesis shows that ineffective transition strategies can be countered by the following measures:

- Employing the scenario method and revealing the minimal effect and/or even backfiring effect of some of the technologically focused and individualized management approaches. Scenarios have an alarming effect due to their long-term perspective; they offer a communicative tool in producing coherent but complex narratives and allow creative thought operations to rethink overall system constellations and ordinary solution approaches to envision alternatives.

- Engaging with the structure-agency analysis that provides a causal explanation of dependencies as well as chances to intervene. Windows of opportunity might be detected and incorporated into the long-term strategies. The timing of transition interventions and planning becomes essential to guide agency to transform structures and arrive at more sustainable social structures. Sensibility to differentiated capacities of agency and spatial-physical structures is crucial in defining transformation processes.

- Explicit conceptualization or at least attention to spatiality in transition, as it is a part of the structural conditioning and an essential factor in the quality and pace of transition processes. Needless to say, urban transitions and sustainable mobility inevitably incorporate spatiality as a subject of transition. Moreover, the thesis presented that spatiality is important and present on all three levels of the MLP; the conceptions of space, the actual urban form and the more detached compositions in the form of niches all have a spatial component.

6. Conclusion

"How can urban transitions toward a low-carbon and environmentally sustainable mobility future be supported?" is the overarching research question of this thesis. The conclusion chapter will answer this question by answering each of the five research sub-questions and begins by synthesizing these answers into an overall conclusion. Finally, an outlook on future research and possible elaboration of this work is given.

6.1 The contribution of this thesis to research on sustainable urban transitions

This thesis contributes mainly to the academic research on sustainable urban development and the transition toward that development. Along with a critical discussion on urban mobility and current transition attempts, the thesis offers analytical and practical implications for more effective sustainable mobility transitions. The main methodological and analytical considerations on transition research within the field of sustainable urban mobility concern the following points:

- The incorporation and explicit conceptualization of spatiality are essential to providing guidance toward a more sustainable mobility future and to have an impact on the quality and pace of transition processes. The inertia of many urban structures entails severe time-lags compared to agential change and has an immense conditioning effect on agency.
- A normative and long-term perspective is of particular importance to evaluate contemporary solution approaches, to avoid efficiency reverse effects and to identify alternatives for achieving the sustainability goal set. Here, scenarios are a very suitable learning and policy-informing instrument, e.g., in providing warnings about the consequences of business-as-usual approaches, envisioning ways to break with unsustainable path dependencies, and supporting long-term planning based on counterfactual thinking and identification of coherently linked sub-goals.
- Structural and systemic change is necessary to achieve sustainable urban mobility futures; this calls for the incorporation and alteration of the components at landscape level to achieve the desired compositions at regime level. Niches can be supportive in providing agency to counter the unsustainable structural conditioning. Though radical agency is not enough, but when linked to structural

changes and changes in daily life practices, it facilitates transformative changes toward more sustainable mobility futures.

Also, a time-lag of "transition benefits" needs to be incorporated, as radical change may result in initial "investment costs" whose benefits appear later. Reducing ambivalent planning practices and the reverse effects of current solutions would be a success for contemporary transition approaches in sustainable urban mobility.

6.2 The individual research questions

6.1.1 How does the multi-level transition perspective (MLP) cope with transition processes toward urban sustainability?

The MLP is compelling because the concept provides a terminology and an analytical concept with its three levels that covers the "big picture" (landscape) as well as more detailed innovation activities (niches) and the structural mainstream (regime) in a dynamic stability. Thus, complex transformation processes can be explained in a comprehensible narrative form. However, in engaging with urban transitions toward sustainable urban mobility as a research subject, the level of complexity and the transition components challenge the MLP in its current application.
Spatiality is one most essential subject of transition in the investigation of transformations toward sustainable mobility. However, thus far the spatial component of urban transition has not been incorporated sufficiently, if at all, into transition conceptualizations. The particular inertia and thus the time lags implicit in many urban (physical) structures compared to agency are among the unavoidable characteristics that will dominate and influence the pace and quality of urban transformation. Moreover, the landscape level needs to be more integrated and become a major focus for sustainable mobility transitions. The deep structural changes necessary for such transformations have, so far, often been stored and excluded on the landscape level as exogenous context. This is misleading, as these structural conditions need to and can be changed as demonstrated in this thesis. The landscape level is not merely a disruptive component; instead, it is especially powerful in stabilizing the regime in its currently unsustainable patterns and dynamics.
The MLP offers insights into the given dominant structures and possible interventions needed; however, scenarios serve the research with a more suitable methodology for anticipatory strategy, including explicit normative goals and guidance. This thesis gained from a supplementary use of both. The structuration processes in between the different analytical levels of the MLP are not sufficiently clear. The structure-agency analysis of

this thesis discussed the need to conduct a more sophisticated analysis by, for example, applying an analytical dualism to achieve a deeper understanding and thus become empowered to influence structuration and restructuration processes toward urban sustainability.

6.1.2 What are the current approaches for sustainable urban transitions, and are these solutions sufficient when seen from a sustainable mobility perspective?

Contemporary transition approaches are dominated by an ecological modernization rationale. This sustainability rationale focuses on solutions due to technological innovation and efficiency improvement. Additionally, the pronounced individualistic and market-led consumption patterns in society are supported and nurtured by mobility ideals that create mobile subjects as personal time managers and highly networked people. Overarching this rationale is the growth imperative with its competitive planning approach, which neglects more regulative perspectives and measures.
Urban branding, such as the flagship project Fredericia C in Fredericia, is the central approach in strategic discussions around transformative planning processes. This urban renewal project might be a promising approach in itself, but, seen in the context of the overall municipal (and regional) development, it is just not enough and it runs the risk of being co-opted and used as a sustainability token while society continues to build unsustainable path dependencies elsewhere. Its sufficiency is therefore questionable, as the effort to attract more economic forces to the municipal ground impedes the environmental and social sustainability goals due to rejection of regulatory measures that would, for example, limit mobility demand, highway expansion and urban sprawl.
Therefore, the following points should be taken into account when planning to achieve a sustainable mobility transition: a) Technological fixes are add-ons and system improvements that do not bring about sustainable transitions if the system itself is not sustainable; b) Mobility management has to approach demand reduction to make a difference; otherwise it just reproduces an efficiency rationale; c) Policy entrepreneurs and political niches can tackle alternative consumption and production by initiating different practices and structures; and d) Spatial-physical structures are crucial in limiting and guiding consumption and production patterns and need to be incorporated.

6.1.3 What are the main barriers and opportunities for sustainable mobility transition processes in cities?

The study demonstrated the particularly challenging social structures as well as the physical structures of the urban built environment that are decisive for sustainable mobility transitions. The prevalent neoliberal and growth-oriented planning context is

influencing nearly all decisions. This leads to the prioritization of growth over sustainability goals and the legitimization of this policy by competitive conditions and dependencies. Inter- and intra-regional competition leads to an unfortunate planning agenda that creates a kind of prisoner's dilemma, which loses the internal view on challenges and opportunities to strengthen the whole region; for example, the different municipalities could agree upon binding planning policies for land use and transport to reduce competitive dynamics impeding sustainable transition. The given consequences are a contradictory or undirected agential power with little influence on unsustainable structures. As a result, planning practice seems to become (if functioning as intended) a growth generator and not a growth regulator.

On a practitioner's level, there is a challenge for transition agents to adopt radically different ideas of the future, as they are conditioned by the given rationales adopted through expert knowledge, political powers and authorities they adhere to, or by societal norms and personal values. Thus, they need to be supported in changing processes in practice: first of all, to trigger change, such as initiating opportunities to envision alternative futures and conditions to achieve these futures (e.g., retroductive thinking). Moreover, practitioners need support to reduce the perceived and perhaps likely risks involved in more radical changes; this support might include financial and/or moral support, especially in the initial transition phase.

6.1.4 What are the underlying structure-agency relations and mechanisms generating barriers and opportunities?

The conditioning effect of structures on agency becomes obvious; however, as the given structures reproduce unsustainable practices, agency needs to counter these structural powers by radically altering these structures and forming new ones. Here, interventions need to incorporate the structural time lags on agency, and the influence of primary and corporate agents as radical actors will not, by itself, be sufficient to enact transformative change.

The time dimension is crucial in the process of transformation of structures and actions. Since they operate in different time intervals, the conditioning effect of structures on agency and the reproduction and/or transformation of structures through agential power can be guided much more efficiently. Transition strategies need to integrate these differences and allow, if not support, agency to transform structures toward more sustainable configurations, such as institutional configurations and policy entrepreneurs (key actors) that promote demand reduction and systemic change; otherwise, path dependencies might be reproduced or generated. Such path dependencies often take a very

long time to transform again, such as in the case of a new highway construction or expansion or new housing on former farmland at the periphery.
Agency is essential in bringing forward the necessary systemic change. However, the need for clear guidelines or incentives through regulation is inevitable, as contemporary tendencies and dynamics of structure-agency relations are pulling in rather unsustainable directions. Moreover, individuals alone cannot change social structures. A critical mass of people countering given unsustainable structural powers can transform the structures into more sustainable constellations of structure-agency dynamics. Changing both social structures and daily life actions will lead to transformational change in the long run.

6.1.5 Is radical change possible?

More radical changes need to be undertaken if a sustainable mobility transition is to be achieved, though the need for more radical change is a challenge. Systemic change creates political dispute. The current powerful actors will not resign voluntarily. This question also relates more generally to the social and political feasibility of sustainable transitions. It does so insofar as the (implicit) argument against more radical change is often political and societal rejection, creation of conflicts or unacceptable burdens for people. However, this is exactly the sensitive challenge of the comprehensive character of radical change that comprises reorganization beyond systemic structures and societal norms.
It will be fundamentally necessary to take the reigns or at least to influence a process of radical change envisioning, communicating, creating and living alternatives. Scenarios of alternative paths are very suitable for unfolding different structure-agency relations and their consequences in a long-term view as well as discussing likely risks if business-as-usual practices are continued and the costs they may bring. This approach involves understanding new systemic constellations, learning about new daily life patterns and producing political pressure that directs urban development toward more sustainable structures. Here spatiality can play a decisive role, as it can have a strong structural constitutive effect and guiding function for practices.

6.2 Future research

This thesis deals with the complex issue of urban mobility transitions. Many different angles can be taken to address this relevant and interesting subject. Overall, the thesis has a normative character and a strong theoretical-analytical focus. Certainly, many new perspectives open up along the way; some engage with new perspectives on the research subject, and others are more directly linked to the problem issue that may deepen or elaborate on the analysis and theoretical reflections. Taking *transition in the making* a bit further and building on the knowledge accumulated in this thesis, future research could relate to the following issues:

The transition literature also has a **governance** focus and increasingly engages with so-called multi-level and multi-scalar governance, which could provide an interesting elaboration on the identified challenges and could be linked to the backcasting approach. The political dimension in transitions is increasingly a part of the discussion, which might be linked to advocacy planning approaches. Alternative governance ideas inspired by concepts such as degrowth, the commons paradigm or other deep green alternative approaches could be especially interesting, as those concepts involve radical changes.

Learning or perhaps necessary re-learning is mentioned in transition management literature, which puts a focus on the deeply rooted structures and practices that might need to change to enable a greater transformative change. In this regard, learning becomes a transition practice or tool and a practical necessity for change. This might be a consequence, conscious or unconscious, of many transformative processes, though putting explicit attention on it can be powerful in stabilizing transitions and also in initiating them.

From a research design perspective, an **action research** approach might be an interesting perspective to choose, especially when focusing more on the implementation of transition measures and the initiation of processes. Futures studies methodologies in the form of visioning, scenario development or backcasting might be applied in a more participatory methodology. Being part of an explicit case dynamic and identifying and working with the relevant actors and networks, such as political niches, NGOs, advocacy groups, activists, researchers and critical planners, can be a way of supporting the transition process through structural guidance.

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9. Appendices

The appendices comprise different tables collecting empirical material studied, representing analytical results (appendices 1-3), interview as well as focus group discussion guides (appendices 4 and 5). As an additional publication you find the article "Bæregygtig omstillinger bliver grøn sminke" [Sustainable transitions become green make-up] written in Danish for a professional journal "Teknik og Miljø" [Technique and Environment] (appendix 6).

9.1 Appendix A: List of main documents reviewed

Author	Title [in English]	Year of publication
Fredericia Kommune [Fredericia Municipality]	Rum – Vision 2012 [Space - Vision 2012]	2003
Fredericia Kommune	Naturplan Fredericia – Rum til det grønne [Nature plan Fredericia – Space for the green]	2005b
Fredericia Kommune	Cyklen for alle. Cykelhandlingsplan for Fredericia Kommune [Bicycle for all. Bicycle Action plan for Fredericia Municipality]	2005a
Fredericia Kommune	Borgernes og Kommunens Grønne Regnskab. [Residents's and Municipality's green calculations; Environmental status document]	2008
Fredericia Kommune	Kommuneplan [Municipal plan] 2009-2021	2009
Fredericia Kommune	Fredericia Former Fremtiden. 5 idéer til radikale innovationsprojekter i Fredericia Kommune. [Fredericia is forming the future. 5 ideas for radical innovation projects in Fredericia Municipality.]	2010
Fredericia Kommune	Kommuneplan [Municipal plan] 2013-2025	2013
Fredericia C	Competition brief	2010
Fredericia C	Background material	2010
Fredericia C	Process tool and note on economy	2011
Formel M	Mobility Management in Denmark (Formel M, Gate 21); documentations online: http://www.formelm.dk/	2012-2014
The Ministry of the Environment, Denmark	The 2006 national planning report – in brief. The new map of Denmark – spatial planning under new conditions.	2006
Miljøministeriet, [Ministry for Environment]	Vision Østjylland [Vision East Jutland]	2008

Region Syddanmark [Region of Southern Denmark]	Det gode liv. Regional Udviklingsplan Region Syddanmark [The good life. Regional development strategy region Southern Denmark]	2008
Region Syddanmark	Kontur – Kommunale nøgletal for udvikling i Region Syddanmark. Fredericia Kommune 2010 [Kontur – Municipal key-statistics for the development in the Region Southern Denmark. Fredericia Municipality 2010]	2010
Region Syddanmark	Det gode liv som vækstskaber. Regional Udviklingsplan 2012-15. [The good life as growth initiator. Regional development strategy 2012-15]	2011
Trekantenområdet [Triangle Region]	Forslag til Kommuneplan 2009-2021. Hovedstruktur og Retningslinjer. [Suggestion for the municipal plan 2009-2021. Main structure and policies.]	2009a
Trekantenområdet	Klimaaktiviteter i Trekantområdet [Climate activities in theTriangle Region]	2009b
Trekantenområdet	Mål- og Handlingsplan for Trekantområdet Danmark 2011 [Goal and Action plan of the Triangle Region Denmark 2011]	2011
Trekantenområdet	Vores Fremtid. Trekantområdets vækststrategi [Our future. Triangle Region's growth strategy]	2013
Trekantenområdet	Kommuneplan 2013-2025 for trekantområdet. Hovedstruktur & Retningslinjer. [Municipal plan 2013-2025 for the Triangle Region. Main structure and policies.]	2014

Table 9. 1: List of main documents reviewed in the inquiry (cf. paper 4).

9.2 Appendix B: Manoeuver space for scenarios

	Technological Fix	**Mobility Innovation**	**Limits to Urban Growth**
Change approach	Incremental change within given system	Change through innovation (within given system)	Radical change needed through system transgressing measures
Solution approach	Improvement through efficiency	Improvement through flexibility	Improvement through system renewal/change and value change
Main object of change	Technology	Behaviour	System

Scale	At product level	At network level	From systemic to individual level
Main driver	Market-based technologies	Smart-networks & innovations	Regulation/value-based renewal
Main actor involvement	Markets and developers	Individuals and networks	Experts and public
Time horizon	Short term focus	Short-Long term focus	Long term focus
Consequences for (mobility) policy plans (as indicated in table 2)**:**			
Land use	Indicative and lax land use guidelines (only local plans binding)	Indicative guidelines (binding regulations on municipal level)	Strict regulative land use (binding policies from national over regional to local level)
Transport	Expansion of infrastructure & electrifying	Smart networks & mobility management	Demand reduction & accessibility through proximity

Table 9. 2: Manoeuver space for scenarios with their main change approaches (cf. paper 4).

9.3 Appendix C: Identification of main opportunities and barriers

Inter-view-ees	**Scale**	**Interviewees (anonymous)**	**Opportunities**	**Barriers**	**Focus Group**
C	N	Civil engineer; The Danish Transport Agency; Center for Green Transport	- "*Make whatever you do attractive to people*" (branding) - work with people's mindset - fair pricing of transport	- to change habits - congestion, missing infrastructure (for bikes) - willingness to pay is high and irrational	no
B	L	Local politician; Former mayor of Fredericia; board member Fredericia C	- development of (new) political parties, NGOs - public participation - visions	- political tiredness - crisis - too much planning; focus should be on the welfare system	no
E	L	Business director of Fredericia	- smart energy, smart city development as	- economic crisis slows down companies activities	no

			profit chance - branding to attract people & businesses - learning from Fredericia C as sustainable flagship project from scratch	- planning regulations hinder mixed use planning - sprawling culture in DK, people have to learn to build in heights	
H	L & R	Chairman in the Danish Society for Nature Conservation in Fredericia	- branding; attract skilled people - Fredericia C - new businesses, creative people from abroad	- poor, unskilled, unemployed people - not enough tax revenues - greening the car approach	yes
G	R	New director of the Triangle Region, 2012	- attractive city to live - creative class people - acceleration of development, branding	- political commitment (legislation period of politicians) - behavioral change - commuting	no
F	R	Former director of the Triangle Region, 2011	- key players - more effective plans - solutions for the specific context of TR	- bureaucracy - different transport suppliers - trying to adopt solutions from e.g. Copenhagen	no
D	L	Planner of Fredericia Kommune, focus transport	- actors who put things on the local agenda in the right time - university establishment - urban branding	- people live on welfare system - house prices - vague visions - challenge for local smaller businesses	yes
A	L	Climate coordinator of Fredericia Kommune; Mobility Management	- public transport - quality of time while transporting - car-free center - locality	- crisis, money - to shift values - growth approach	yes
I	L	Planner of Fredericia Kommune, focus land use	- urban branding (e.g. car-free city center, mixed uses, densification)	- competition hinders regulation - political growth focus	yes

Table 9. 3: Identification of main opportunities and barriers for sustainable transition processes identified by interviewees (based on interviews 2011-2013 and focus group); scales: N=National, R=Regional, L=Local

9.4 Appendix D: Focus Group Guide

FOCUS GROUP GUIDE

Date:	*March 2013*
Timing:	*kl 10:00-12:30; approximately 2,5 hours*
Place:	*Fredericia Kommune*
Participants:	*participant (Plan og Byg), participant (Trafik), participant (Klimakoordinator & mobility management) & participant (DN Fredericia)*
Moderators:	*Nina Vogel & Petter Næss (as assistant moderator)*
Language:	*Danish*

1. **Aim of the focus group discussion (ca. 15 min)**
   - Clarify what a focus group discussion is about & why useful *(to learn about the local context (as researcher) & to learn from each other (as participants); offers possibility to go in depth and allow complexity of response; group participants can stimulate new thoughts for each other, which might not have otherwise occurred; etc.)*

   - State the aim of this focus group discussion *(put it up in written form to be able to recall the main interest and focus during the discussion; namely the exercise of backcasting and retroductive thinking; developing the paths for the normative scenario future drafted by me)*

   - Short introduction of organizers/moderators and participants

2. **Introducing the backcast (ppt presentation) (ca. 15 min)**
   *- short introduction of the three scenarios, but focus will be only on the backcast! (*use examples for illustrating possibilities…)
   → *create common understanding for the next step of drafting, discussing the pathways for the backcast!*

   → *clarify rules for the focus group discussion (balanced participation; only one person talks; moderator has a guiding function; documenting the discussion by recording it and through written notes (moderators); etc.)*

3. **Drafting pathways for the backcast**
   (themes and questions to discuss/raise) (ca. 1,5 hours)

   → *themes are: land use, transport infrastructure, mobility culture, governance structure and growth approach (scenario table)*

→ opening question for discussion:

- Is Fredericia performing a sustainable transition?

- Why do we have difficulties to implement 'our green visions'?

- Can we reach this future in 2050? Yes/No and why?

→ main discussion questions:

- What has to be in place to realize this future (backcast)?

- Who (or what) would be an opportunity/an agent of change/trigger change and why?

- Who or what is a barrier in this process and how can you overcome this?

→ *use 'time line' while drafting pathways (allows the visualization of the complexity and possibly parallel developments, loops, contradictions?, ...); additional material: post-its, different colored pens, poster paper*

→ *orientation on some of the interview statements; e.g. use quotes from the interviews and ask the participants what they think; to activate the discussion…*

- "*I can guarantee you, you cannot solve the transition problems, whatever they are, (…) through law making or regulation. That is impossible.*"
- "*The market-capitalism system cannot solve what we are dealing with. So people have to make decisions, so to speak, of a political kind*"
- etc.

→ **Detailed (follow-up) questions within the discussion regarding quality of change** (transition process and its components) – *depends on the discussion while drafting the paths;*

- What or who is functioning as opportunity/barrier for a sustainable transition (e.g. *structural change, values, norms, practices …)*

- When is the chance highest for such transition? *(window of opportunity?)*

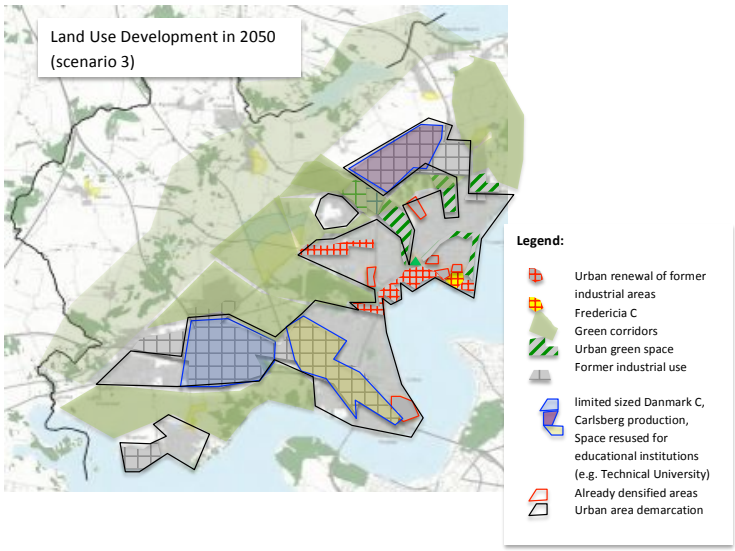
4. Follow up/ Closure of discussion (ca. 30 min)

- Anything you would like to add what we didn't talk about, but what has value for the discussion and the question in focus?

→ *maybe ask a question about an issue I/we didn't see covered enough*

Main facts o n backcast scenario:

The third scenario called **Limits To Urban Growth (backcast scenario)** describes a future picture of Fredericia in 2050, which reflects in general an integrative planning approach of land use and transport planning and thus also a holistic understanding of sustainable urban development and mobility. This scenario of a future in southern Denmark will suggest conscious regulations of land use and transport infrastructure and development. It will be concerned with land use development avoiding urban sprawl and thus demanding less transportation and less car use. This means local and regional planning will be important with measure in form of e.g. layout mixed area use with work location and housing in near proximity, restrict the urban area demarcation to the minimum needed, provide attractive multistory houses in the given urban space, reuse of former industrial space, impose physical and fiscal restrictions on car traffic, improve public transport services in the whole region and with an on-going education of planning and political authorities as well as civil society it will offer a different approach to growth and consumption. The political climate and planning authorities will go beyond technological solution within the transport sector and towards new mobility culture and norms.



9.5 Appendix E: Interview Guide

Interview guide (2013)
Timing: approximately 1,5 - 2 hours

1. **Context & Understanding**

   - Is Fredericia on its way to become one of the *leading climate municipalities in Denmark*? (yes, no – why?)
   - What does sustainable transition in cities mean for you?

   - Is there a sustainable transition going on in Fredericia? If yes, to which extent and if not, why?

   Additional question:

   - Which role has Fredericia C in your opinion for the city's development?

2. **Introducing the scenario (see scenarios below)**

   - Do the summaries and figures resonate with your estimation? (Yes, no – why?)

   - short introduction of the three scenarios (start with BAU, trend and backcast), focus will be on the backcast

   - collect estimation and their positioning to the scenarios/ check on plausibility

   - collect possible add-ons, new insights, different perspectives

   → create common understanding for the next step of drafting the pathways for the backcast!

3. **Drafting pathways for the backcast**

   - What would be an ideal sustainable transition for an urban case, such as Fredericia within the Triangle Region?

   - Who (or what) would be an agent of change/trigger change and why?

   - draft pathways with the interviewee towards the vision described by scenario 3 (backcast)

- use 'time line' while drafting pathways (allows the visualization of the complexity and possibly parallel developments, loops, contradictions?, ...)

4. **Detailed questions regarding quality of change** (transition process and its components) – *depends on the discussion while drafting the backcast; kind of a follow up though -*

   - Why do we have difficulties to implement 'our green visions'?

   - What or who has to change to fulfill the sustainability vision? *(biggest barriers, biggest opportunities, structural change, values, norms, ...)*

   - How can we support or design a strategy for sustainable change? *(process, strategy, timing, systems)*

   - When is the chance highest for such transition? *(window of opportunity?)*

   Additional question:

   - How do you see your role in the transition process of Fredericia?

5. **Follow up**

   - Anything you would like to add what we didn't talk about, but what has value for the discussion?

   - agree on/ask for possible meeting in the future (workshop, round table, interview) to discuss the more developed scenarios (could be in cooperation with a few interviewees; focus group discussion?)

9.6 Appendix F: Article in Teknik og Miljø (Danish)

Article: Bæredygtig omstilling bliver grøn sminke
[Sustainable transition becomes green make-up]

An online version is available at: http://www.ktc.dk/teknik-miljoe/nyheder/fuldvisning/?tx_ttnews%5Btt_news%5D=1747&tx_ttnews%5BbackPid%5D=23&cHash=8d9091ee85f4be9a6dd446796661e4c5

Kommunal greenwashing:
Bæredygtig omstilling bliver grøn sminke

Af: Nina Vogel, Ph.d.-stipendiat, Institut for Planlægning, Aalborg Universitet
Teknik & Miljø, 16.10.14 19:36

Kommuner har tendens til ikke at nå deres mål for bæredygtighed.

Resultatet ender med at blive en hyklerisk udgave af bæredygtig udvikling.

Bæredygtige koncepter er efterhånden blevet almindelige og ofte en obligatorisk del af de fleste planlægningspolitikker. Men hvis man ser nærmere på den aktuelle planlægningspraksis, rejser der sig en række spørgsmål om, hvorvidt disse koncepter holder, eller om de blot ender som grøn sminke og løfter, som sjældent indfries.

Fredericia satser på at blive én af de ledende klimavenlige kommuner i Danmark ved at reducere byens CO2-emission med 25 procent i 2015 (med reference til 2006). Fredericia er for tiden kendt for sit flagskibsprojekt Fredericia C.
Det er et byfornyelsesprojekt, som er planlagt til at blive et tætbebygget, CO2-neutralt byområde med blandet anvendelse. Endvidere har Fredericia Kommune iværksat andre tiltag, såsom Mobility Management-projekter, Fredericia som cykelby og forskellige klimainitiativer som forsøgsprojekter inden for trekantsområdet.

Tiltagene er eksempler på indsatser, som iværksættes for at nå kommunale mål om bæredygtighed. Imidlertid står såvel (niche-)udvikling som mål i skarp kontrast til den løbende udvidelse af vejbaseret infrastruktur, ekstensivt byggeri på bar mark, det høje niveau for pendling i regionen, hvor 90 procent af trafikken udgøres af biltrafik, og få offentlige transportmuligheder.

Kommunen synes at ignorere de lokale udfordringer og er i stedet styret af andre målsætninger.

Kommunernes planlægningspraksis er domineret af vækst og konkurrenceevne. Regionens polycentriske karakter, og dét at være del af det såkaldte østjyske bybånd, forstærker kommunernes indbyrdes konkurrence og den generelle stræben efter at tiltrække erhverv og nye borgere.
Det fører til en temmelig liberal arealanvendelse og transportplanlægning, hvor der er mindre vægt på målsætninger for bæredygtig udvikling, såsom at reducere transportrelaterede miljøudledninger, at arbejde med begrænsning af efterspørgslen, nedlægge parkeringspladser eller at undgå byspredning (urban sprawl).

I stedet fortsætter kommunen med at lægge vægt på store arealer til både erhvervs- og boligbyggeri i periferien - fordi det ses som konkurrencemæssige fordele eller nødvendigheder ift. at dække kulturelle behov. Dermed hæmmer det overordnede planlægningsrationale visionen om en bæredygtig udvikling.

Vækst frem for alt

Visioner, strategier eller politikker indeholder måske nok den nødvendige bæredygtighedsagenda i selve målformuleringen, men disse overordnede mål mangler at blive omsat til eksplicit, integrerbar og fornuftig praksis.

Der findes overfladiske definitioner af bæredygtighed, som først og fremmest refererer til den såkaldte "tredobbelte bundlinje", dvs. den økonomiske, sociale og miljømæssige dimension af bæredygtighed. Imidlertid sikrer denne dominerende opfattelse af bæredygtighed ikke en balance mellem dimensionerne. I praksis overtrumfer den økonomiske bæredygtighed stort set altid de to andre.

Dermed risikerer bæredygtighedsinitiativer at blive under- eller sideordnet den dominerende strategi, der satser på at øge byens økonomiske konkurrenceevne. Målene er reduceret til en legitimerende funktion, hvor målformuleringerne er så brede, at næsten alt kan siges at være i overensstemmelse med dem.

Bæredygtighedsbegrebet har dermed en begrænset vejledende funktion, men det lever op til 'grøn vækst-agendaen' og lægger ikke forhindringer i vejen for fortsættelsen af de dominerende fremgangsmåder, der karakteriseres af en liberal tilgang med vægt på reducerede lovgivningsmæssige byrder, kombineret med et fokus på teknologisk effektivitet, der skal muliggøre, at dagligdags behov og ønsker kan opretholdes.

Problemet ligger ikke nødvendigvis i ét eller flere mål som sådan, men nærmere måden, hvorpå man forsøger at opfylde målene; indsatserne kan skabe konflikter såvel som modsætninger.

Teknologiske løsninger, der er orienteret mod øget effektivitet, er én vigtig måde at forsøge at reducere emissioner og ressourceforbrug på. Dog skaber disse fremgangsmåder ofte rebound-effekter og optræder som en hurtig løsning i den samme overordnede struktur, hvilket sandsynligvis skaber endnu mere forbrug i det lange løb og er i stærk kontrast til målene om en mere bæredygtig udvikling.

Formuleringen af målene for bæredygtighed får et hyklerisk skær, da de ikke er seriøse forsøg på at ændre de gældende praksisser med ubegrænset stræben efter forbrug og vækst. Det ville sige, hykleriske omstillingsprocesser reflekterer propagandafunktionen af bæredygtige målsætninger, som er formuleret, så de både imødekommer pres fra offentlig og politisk side og også legitimerer, at man forsætter, som man plejer.

Ridser i den grønne sminke

Det er imidlertid nødvendigt at være opmærksom på uoverensstemmelserne ift. det aktuelle mål. Man kan dog antage, at den nuværende kløft mellem praksis og vision er grund nok til at være opmærksom, men igen overskygges dette ofte af målene om vækst.

Heri ligger der en anden udfordring for en transformation, nemlig den radikale afvigelse fra de slagne veje og løsninger. Det er nødvendigt med en politisk diskussion, som kaster et kritisk blik på såvel økonomisk-distributive prioriteringer som nuværende mål for planlægningen, og som stiller spørgsmål til helhedsorienteret planlægning på lang sigt.

Planlægning og ikke markedsefterspørgsel skal lede byudvikling. Hvis Fredericia for alvor ønsker at tilstræbe en bæredygtig omstilling, vil byen kunne profitere af en forstærket, integreret fremgangsmåde i forhold til arealanvendelse og transportplanlægning.

Det vil dog forudsætte et øget fokus på koordinering af udbydere af offentlig transport i hele regionen; man kunne overveje bindende, regionale politikker i stedet for at være konkurrencedygtige, i kraft af at man har undgået reguleringer; man kunne lægge et langsigtet perspektiv med et kritisk blik på kortsigtede mål i stedet for at skabe ineffektive nicher med mulige rebound-effekter; og man kunne have et fokus på lokale udfordringer med lokalt forankrede strategier i stedet for at indgå et modarbejdende kapløb efter vækst.

De mere bæredygtige løsninger er ofte ikke de lettest opnåelige - men de er ønskelige, og de er nødvendige!