A Transition to a Denser and More Sustainable City: Factors and Actors in Trondheim, Norway

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Abstract

This paper analyses urban densification in Norway as a key element of sustainable city policies. The city is viewed as a system in which changes of material aspects, such as density, are linked with social and technological aspects. Densification targets in Trondheim are used as a case study to explore the main actors and factors involved in urban development. A multilevel perspective approach used in sustainability transitions studies is applied as a model to describe them. The aim is to illustrate interactions and barriers arising in the implementation of densification policies. The argument suggests that despite a shift of paradigm in planning towards sustainability, urban regimes have remained rather stable. Some progress has been made, but further advancing the sustainability agenda may require new rules in the regime – for example, new planning policies integrated with taxation and financial instruments, and transport regulations – and a stronger emphasis on niche developments.

Key words

densification; urban sustainability; transition theory; multilevel perspective; Norway; Trondheim

1. Introduction

Density has been regarded as an important quality of the urban form at different periods. Concentrating population and functions facilitates the provision of infrastructure and the proximity to diverse urban services (Steemers 2003). In most cases, economic purposes have been behind densification processes and urban containment strategies (Berg et al. 2012; Burton 2002; Roberts & Sykes 1999). However, since sustainability, with the objectives of protecting environmental resources and combating climate change, became a central issue, interest in denser urban areas has gained new strength. Denser city settings demand fewer environmental resources to function – not only less land, but also less energy for transportation and for the operation of buildings and infrastructure (Newman & Kenworthy 1996; Karathodorou, Graham & Noland 2010; Newman 2014). Therefore, compact urban areas are considered a precondition for decreasing motorised travel, potentially reducing the use of fossil fuels and thus decreasing CO_2 emissions (Liddle 2013; Moriarty & Honnery 2008).

The Norwegian planning guidelines towards sustainability have embraced this idea. Urban densification has been one of the main targets in municipal policies on city development for at least two decades. However, despite the constancy in the targets, the advances have been uneven (Hernández-Palacio 2014). The application of such policies appears increasingly challenging and tests governance at the municipal level. The lack of feasibility in the implementation of densification policies is related to the functioning of the planning system and its relation with the regime behind urban development. Despite the new challenges, planning practices and instruments have remained much the same as decades before. It seems that planning as it currently operates in market-oriented societies has serious limitations in fostering increases in urban density (Gordon 2008). A transition to a more sustainable city might therefore be hindered by the absence of change in procedures.

This paper presents an exploration of the actors and factors that influence the transition to denser cities in Norway by applying transition theory and the multilevel perspective to the case of Trondheim. The city of Trondheim had an estimated urban population of 170,242 inhabitants in 2012. In that year, its average urban density was 2,592 inhabitants per km^2 (SSB 2015a); this is quite low in comparison to the average population density in the built-up areas of Europe at approximately 4,345 inhabitants per km^2 (Dodman 2009). The analysis uses Trondheim densification policies as a case study. It combines quantitative and qualitative information from publicly available sources, such as documentation on municipal spatial policies and national white papers, but also draws from the academic literature. The central question guiding the argument is:

- What factors and actors influence a transition to denser cities in Norway?

The remainder of the paper is organised as follows. Part 2 presents theoretical considerations for city change towards sustainability from a transition theory perspective. Urban densification is discussed from a socio-technical standpoint; the idea of transition from a multilevel perspective and the concept of socio-technical system are explored as tools to analyse city change. Part 3 presents the paper’s case study: the city of Trondheim and its background facts and densification targets. Then the key factors and actors associated with city densification and urban development projects are outlined using a multilevel perspective approach. Part 4 provides analysis and key findings. Part 5 makes conclusions and sets out recommendations for future research.

2. Urban densification from a socio-technical standpoint

Urban form has been highly influenced by transportation technologies. The existing socio-technical context, especially the fact that larger distances can be covered by car, in less time, at affordable prices, makes it particularly challenging to achieve densification targets in planning for the sustainable city (JRC 2006; Næss et al. 2011). Private car usage has been one of the main forces determining the sprawl of urban areas as well as social behaviour with regard to the use of urban space (Geels 2005). Urban sprawl and suburbanisation have mainly been driven by the mass use of cars and subsequent enhanced personal mobility (Brueckner 2000; JRC 2006; Oueslati et al. 2015). For instance, land uses and land prices are strongly connected to transportation and accessibility (Cheshire & Sheppard 1995; Srour et al. 2002). Consequently, there are many economic interests around expanding and improving infrastructure for the car, and enabling new areas for urban extension, which in turn generate greater car dependency (Dieleman & Wegener 2004; Kenworthy & Laube 1999). A car-based transport system is antagonistic to urban densification.

Transportation, being a major contributor to CO_2 emissions, has become a central issue in sustainability transition studies (Nykvist & Whitmarsh 2008; Geels et al. 2011; Geels 2012; Carvalho et al. 2012). There are two main transition pathways proposed in this debate. The first is an enhanced and cleaner technology for the automobile of the future; the second is a behavioural change towards less emphasis on personal mobility in favour of an intermodal, more collective-oriented system (Geels et al. 2011; Vergragt & Brown 2007). Sustainable city policies belong to the second strand. Urban densification, mixed land uses, and transit-oriented development are the main planning strategies in the shift towards sustainability (Dempsey et al. 2012; Carvalho et al. 2012; Valderrama Pineda & Vogel 2014). This spatial dimension in the transition towards sustainability in cities involves several other aspects, such as governance, energy, buildings, urban form, production, consumption, and everyday habits. Transition studies, however, have put a greater emphasis on the technical aspects of transition while the behavioural side has been analysed less (Whitmarsh 2012). This paper seeks to contribute to this second strand by exploring the factors and actors influencing the development of denser cities to enable cleaner transportation systems.

2.1. Transition and the multilevel perspective

Transition is, according to the *Oxford English Dictionary* (3rd edn 2010), the "process or a period of changing from one state or condition to another". Transition towards sustainability is probably the most important target in current urban planning. A denser urban environment, less dependent on car usage, is one of the significant characteristics of the sustainable city. How such a process may take place is a fundamental question for designing and implementing different strategies to enable the transition. Transition studies have already analysed these processes in the case of technological transitions, identifying some particular patterns and mechanism of change. The shift from one technology to another has been described by Geels (2002) using a multilevel perspective approach. The multilevel perspective provides an integrated description of technical evolution, in terms of variation, selection, and retention; simultaneously, it describes a process of social reconfiguration around the new technologies, a shift in the socio-technical regime. Several examples of the multilevel perspective of transition have been described by Geels, including the transition from sailing ships to steamships (2002), the replacement of horse-drawn carriages by cars (2005), and the change from cesspools to sewerage systems in the Netherlands (2006).

According to the multilevel perspective approach, transition is the result of the interaction of factors in three layers: (a) landscape, (b) regime, and (c) niches (Rip & Kemp 1998). The landscape is defined as the macro-scale. This is the general environment composed of material elements such as networks of cities and large infrastructure, and the availability of natural resources and other factors that foster the conditions for the existence of the system. According to Geels (2002), the landscape is an external context for interactions of actors. Within this level emerge factors such as economic globalisation trends, transnational political systems, and environmental challenges. The mezzo-scale is composed of the regime, mostly formed by social aspects that surround devices: users and producers, their beliefs, ideas, and institutions that mediate the relationship between society and objects. The niches constitute the micro-scale: a sort of protected space where experimentation and innovation are fostered. The niches are sometimes developed within regimes and, in other cases, they are partially or completely outside.

The process of change in the multilevel perspective is explained as a gradual phenomenon that evolves in several stages. Geels (2005) proposes four phases. In the first, radical innovations occur in niches, frequently outside the regime. These innovations arise as experimentations to find the best solutions. The process is fragile and does not constitute significant pressure to the existing regime. The second phase is characterised by the development of small niches that feed the process economically and technically. Increased forms of pressure trigger a process of change in the regime, although in many cases this is a slow process that can take decades. The change is complex because a given regime is embedded in society in many ways. Different strains in the system create "windows of opportunity" through which innovation advances and creates competition with the dominant regime. Then follows a third stage in which significant developments of the new technology create competition with the established technology. The fourth phase is described as one of consolidation of a new regime. The new technology creates markets and starts the development of a complete system that gradually replaces the old technical regime.

2.2. The city as a socio-technical system

The concept of the socio-technical system has been used in transition theory to understand the changes required to move towards sustainability in contemporary society (Berkhout et al. 2004; Rip & Kemp 1998; Smith et al. 2005). Socio-technical systems are defined as complex networks where artefacts and tools are merged in social webs that include knowledge of production, use, and maintenance. This involves infrastructure networks and maintenance and supply chains rooted in everyday habits, cultural values, markets, and legal and political regimes. A good example of these systems is the car and the entire environment developed around this mode of transportation (Geels 2005). Within this framework, transition goes beyond the simple replacement of a particular device or tool by a new tool with better features. The entire system surrounding such devices has to change. Therefore, this transition implies changes in social functioning, which are in turn changes from one socio-technical system to another.

Cities, however, are in some aspects substantially different from socio-technical systems usually analysed in transitions studies. The most noticeable difference is that cities, in most cases, evolve from persistent spatial structures, developed over very long periods of time; and, with a few exceptions, they have adapted from pre-existing conditions. In contrast, most socio-technical systems – such as cars, mobile telephones, computers and their respective infrastructures – were developed in rather short timespans. Another obvious difference is that cities are highly complex, composed of a vast number of material elements and networks, embedded in environmental, social, and economic systems. There is no one city like another, whereas the infrastructure and devices around systems, such as the car, are composed of a much more limited number of elements, with evident similarities everywhere. Cities are also systems in permanent evolution, in which new elements are added and replaced constantly, though most of the older elements remain. These differences cast some questions on the role of transition theory when it comes to the city (Næss & Vogel 2012: 40). However, there are also several common elements that make this a plausible theory to apply to a possible urban shift. For example, cities as socio-technical systems studied from a transition theory perspective are embedded in complex networks of actors, operating in multiple layers. The material aspects of cities are in turn embedded in a complex regime, defined by non-material cultural values, everyday habits, market processes, and legal procedures; this implies that a change towards sustainability requires changes in all these aspects too.

Despite the differences between the city and other socio-technical systems, there are several transition studies related to the built environment: for example, transition to sustainability and spatial questions (Coenen et al. 2012; Raven et al. 2012); issues of production and consumption related to urban development (Tukker et al. 2008); the sustainability of everyday life (Shove & Walker 2010); and the issue of urban retrofit and sustainable transitions (Eames et al. 2013). Transition studies also analyse city governance in moves towards sustainability (Bulkeley et al. 2011; Hodson & Marvin 2009, 2010; Næss & Vogel 2012; Nevens et al. 2013; Frantzeskaki et al. 2012, 2014). The advance towards enhanced sustainability in the city seems to rely on a combination of both technological and non-technological factors. In this regard, a more sustainable city requires more density in its spatial structures, but also cleaner technologies and greener social behaviours. The allure of transition theory is based in the comprehensive narrative that it offers to explain the complexities that change towards sustainability entails. This paper stands for the necessity of a framework combining the diversity of aspects identified in transition studies. Such an approach is required to analyse ongoing transition processes and to steer further advances in the quest for sustainability.

3. Trondheim's pathway towards urban densification

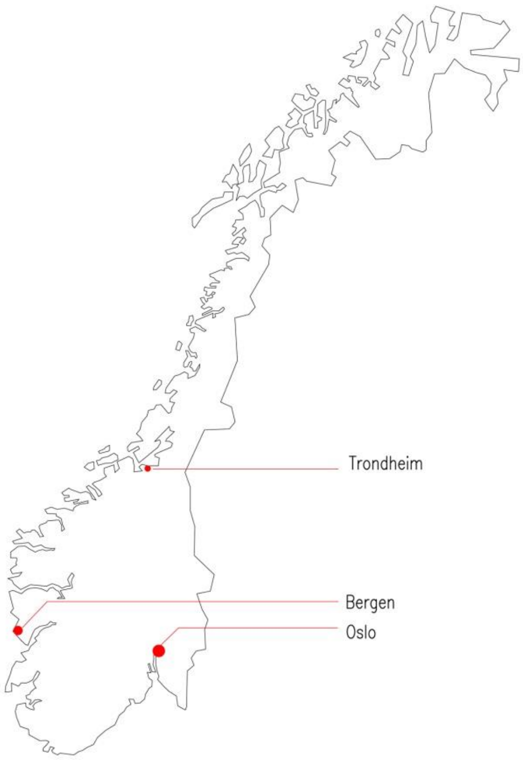

Figure 1. The case study in the Norwegian context

Trondheim (population in 2012: 170,906) is today the third largest city of Norway after Oslo (608,013) and Bergen (256,532) according to figures from Statistics Norway (SSB 2015a). The city is the capital of Sør-Trøndelag County. Trondheim has a long history as a commercial harbour and political and economic centre in central Norway (see Figure 1). Different plans have been stipulated to keep Trondheim's economic vitality. One of the most important is the modernisation of the port through the creation of a new regional harbour in Orkanger, a municipality located in the Trondheim fjord, west of Trondheim (Trondheim Havn 2015). Another key strategy is the strengthening of Trondheim as a centre of education and innovation. Today the city has become increasingly specialised in education and research services with important institutions such as the Norwegian University of Science and Technology, St Olav University Hospital, and renowned research centres in natural sciences, social sciences, technology, and innovation. The university is currently in the process of merging with other higher education institutions to form the largest public university in the country. These two projects – port modernisation and university consolidation – are expected to attract new highly skilled people to the city and to free the former dockyard areas for new urban development. This is part of an ongoing national strategy to sustain a balanced population distribution in all territories through the promotion of economic growth in all parts of the country (Nakken 2012; Johansen 2004).

Densification was established as a central target in the “Trondheim Municipal Plan of Land Use 1993–2005” (Trondheim Kommune 1995). Since then, the local planning policy has been committed to the principles of sustainability and has adopted different plans to reduce urban expansion, to increase the use of public transport, and to encourage cyclists and pedestrians. The policies have yielded modest improvements in densification and in environmentally friendly mobility. In the year 2000, Trondheim had a population of 142,277 and covered 59.04 km^2: a density of 2,410 inhabitants per km^2. In 2012 the population was 170,242 in an urbanised area of 65.67km^2: 2,592 inhabitants per km^2. During the period 2000–12 the population had increased by 27,965, and the urban land growth was 6.63km^2 (SSB 2015a). This outcome, despite being positive, indicates the challenging nature of reducing urban expansion. The potential for densification, in terms of population density, was equal to the population increase (19.7%) if no new land was added for urban use; however, the actual outcome was (7.6%). The Norwegian travel survey 2013–14 highlighted some advances in environmentally friendly mobility: walking and cycling have increased in the city, but cars and motorcycles are still used for more than half of all daily journeys (Hjorthol et al. 2014).

The city’s plans for 2012–24 are consistent with the commitment to sustainability targets. One of the goals of Trondheim’s municipal policy for transport is a reduction of CO_2 emissions by 20%, compared to the 2008 level, by 2018 (Trondheim Kommune 2008). It aims for more than 50% of total urban journeys to be made by environmentally friendly transportation, such as walking, cycling, and public transport. The equivalent figure for 2008 is 42%. These targets are reinforced by defining concrete goals for the densification process, such as keeping 80% of new housing inside the existing urban boundaries, and developing an urban corridor along the main public transport line, containing 60% of labour-intensive industries (Trondheim Kommune 2012). However, planning alone is not sufficient to achieve sustainability targets (Stenstadvold 1996; Säynäjoki et al. 2014). There are several other factors and actors influencing the urban development. Sections 3.1 to 3.4 present a multilevel overview of such issues in connection with densification.

3.1. A multilevel approach to urban densification

The multilevel approach to describe transitions has been used mostly to explain technological changes. Cities, however, evolve from the existing material urban environment, following different transition paths. Commonly, changes in the material dimension of cities are gradual, and frequently mediated by slow changes in the regime. The following sections describe such possible change across the three stages proposed in a multilevel perspective, using densification policies as an explorative case.

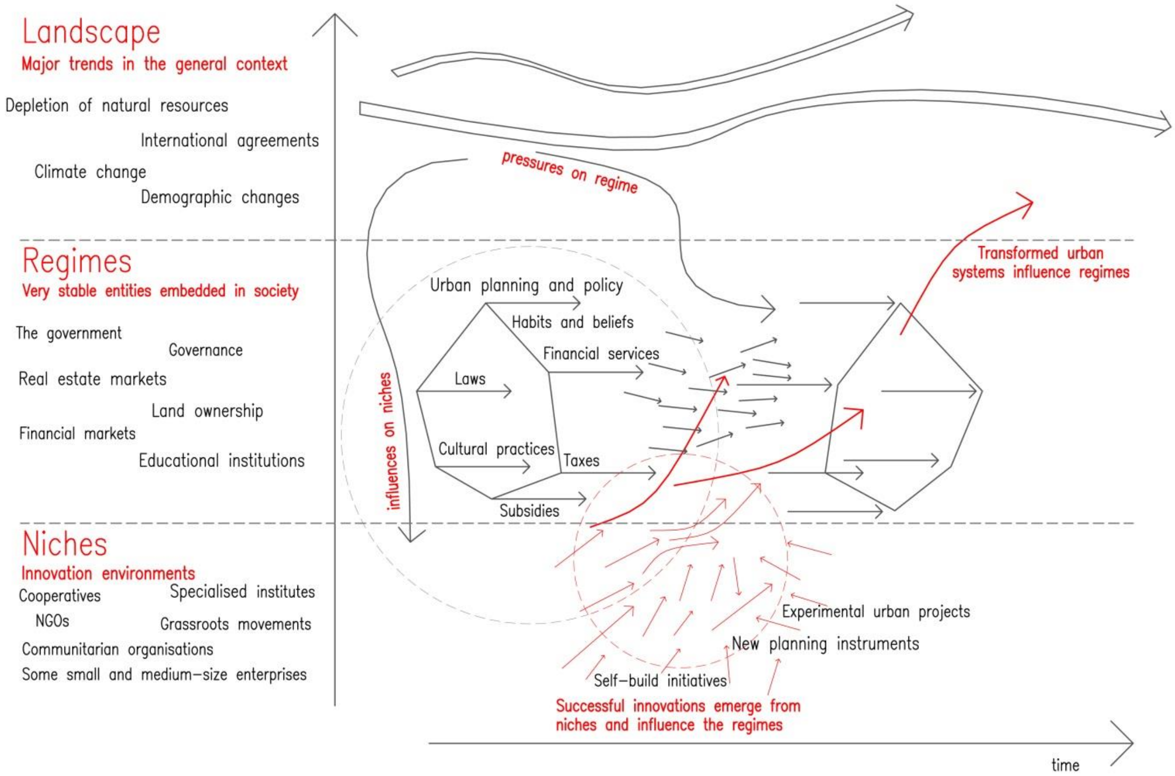

Figure 2. A possible multilevel transition towards sustainability in cities (adapted from Geels 2002: 1263)

3.2. The landscape

The landscape is defined by the external factors influencing urban transformation. The landscape or background where urban densification policies are embedded is determined by major global trends. Some of the most relevant are demographic changes (migrations, population growth, ageing population), depletion of natural resources, and climate change (see Figure 2). A sustainable development agenda has been created in response to these potential threats (Brundtland 1987; UNDSD 1992; SDSN 2013). Multilateral institutions and national governments have been involved actively in sustainability initiatives (Council of the European Union 2006; European Commission 2011). The city has become a key object in sustainable development as an increasing number of human activities happen within urban areas (UNCHS/UNEP 2000). Cities are expected to accommodate a large proportion of the population in compact urban settings to conserve arable land and natural resources in general. Climate change associated with CO_2 emissions has been tackled by targets for the reduction of fossil fuels consumption, both in the production of energy and in transportation. This multilateral environmental agenda is an important component of the landscape where planning policies for sustainable cities in Norway are embedded. Reduction of CO_2 and conservation of natural resources are targeted in several white papers produced by the Norwegian Ministry of Environment during recent years. Some examples of such policies are outlined in “A Better Environment in Cities and Towns” (2002), “Cities of the Future” (2008), “Norway’s Environmental Targets” (2012), and “The Contemporary Sustainable City” (2013).

The Norwegian context has some particularities affecting urban sustainability strategies. From one standpoint, densification may be regarded as an ambitious target, due to the combination of three factors. First, Norwegian cities are among the least dense in Europe, with an average 1,904[1] inhabitant per km² (SSB 2015b), while several urban regions in Europe, such as Paris, London, and Brussels, have densities above 5,000 inhabitants per km² (EUROSTAT 2013). Second, Norway has maintained steady economic growth since the 1970s (SSB 2014), and the Norwegian population has one of the highest per capita incomes in the world. Third, the rise of a neo-liberal and pro-business ideology (Sager 2014) emphasises deregulation and encourages private investment within urban development. In synthesis, the Norwegian landscape is determined by a rather scattered population pattern, low-density urban areas, but a clear commitment of the government with multilateral agendas to sustainable development. From another standpoint, demographic changes are a powerful force reshaping the urban form. The ongoing demographic trends in Norway are strongly marked by immigration, by the concentration of population in larger cities, and by the decline of family size and the growth of the elderly population (Van de Kaa 2002; KMD 2015). Such tendencies may be a positive agent in urban densification, since they lead to an increase of single-person homes

[1] According to figures from Statistics Norway in 2013 the area occupied by urban settlements is 2,127.54 km² and the urban population in the country is 4,050,626.

and an increased reliance on proximity to urban services (Haase et al. 2008; Hernández-Palacio 2014).

3.3. The regime

The regime is defined within transition studies as a system of social practices around material devices (Geels 2002; Geels & Schot 2007). This includes both the production and use of artefacts, and all the meanings and values around them. This is existing knowledge, creation of new knowledge, legislation, traditions, market and financial services, economic values, and values such as pride and prestige. There are a large number of institutions interlinked in the regime network: the state and all governmental bodies, financial institutions, markets, educational institutions, companies, and social organisations are some examples. Due to its very nature of many intricate links and diversity of actors, the regime requires stability and defined trajectories to function. Emphasis has been placed on the study of regime change towards sustainability within transition studies (see, for example, Berkhout et al. 2004; Geels & Kemp 2007; Smith et al. 2005; Verbong & Geels 2007).

The concept of regime applied to the city within planning theory – i.e. the urban regime – gives the impression of a less broad notion than the one defined in transition studies. Urban regime has an emphasis on the way the public and private sectors deal with the use and transformation of space (Mossberger & Stoker 2001). The public sector comprises the government in its local, regional, and national spheres. The private sector, on the other hand, involves a constellation of actors including land owners, private investors, and groups of different nature with interests in the city – mostly the use, expansion, and transformation of the building stock. The functioning of urban regimes involves formal and informal practices. Formal practices are regularised by institutional frameworks, laws, and procedures; on the other hand, informal practices are mediated by habits, beliefs, traditions, and social values (Mossberger & Stoker 2001; Irazábal 2009). The institutions and their regulatory framework constitute the *government*, which for spatial issues is called here he “planning system”. But *governance* (the process of governing), which for spatial purposes is the control of the functioning and materialisation of the built environment, needs support from the informal practices imposed by traditions and social values (Stoker 1998). The creation of the conditions for intervention in the built environment requires partnerships with non-government actors that control strategic resources to achieve the goals established by the government itself.

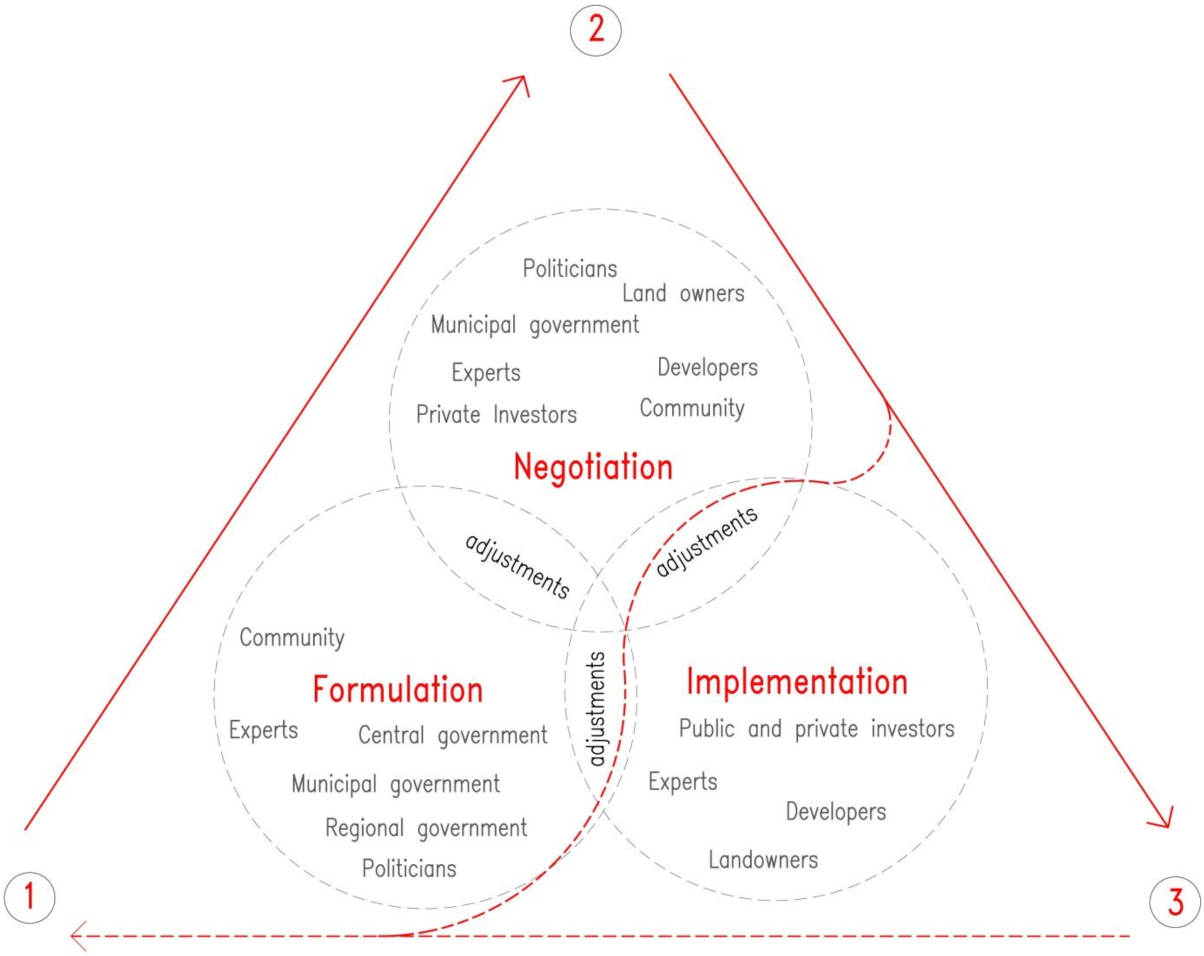

Figure 3. Actors and stages in urban development projects

A literature review on the implementation of urban projects led to the identification of three basic stages in this process: formulation, negotiation, and implementation (Nijkamp, Van Der Burch & Vindigni 2002; Muñoz Gielen & Tasan-Kok 2010; Van Der Veen & Korthals Altes 2011, 2012) (Figure 3). The formulation initiative can come from public or private actors. Usually planning and regulatory policies and strategies originate in government, where politicians and experts are mandated to act in the public interest. Densification policies are a good example of such planning strategies. The community is expected to participate through different mechanisms of consultation and, in some cases, by presenting initiatives. The approval of initiatives is granted by elected officials accountable to the community. Urban development is effected through infrastructure, housing, and related facilities. Since the public sector does not control all resources necessary to implement the strategies, participation by private actors becomes necessary. Private actors have economic interests and their initiatives are not always aligned with the targets established in the formulation of plans and regulations. Their participation therefore entails negotiation: implementation of schemes may be preceded by several cycles of formulation and negotiation. This is particularly common in large-scale urban projects, involving long-term implementation processes with several phases, where initial circumstances might change (Van Der Veen & Korthals Altes 2012).

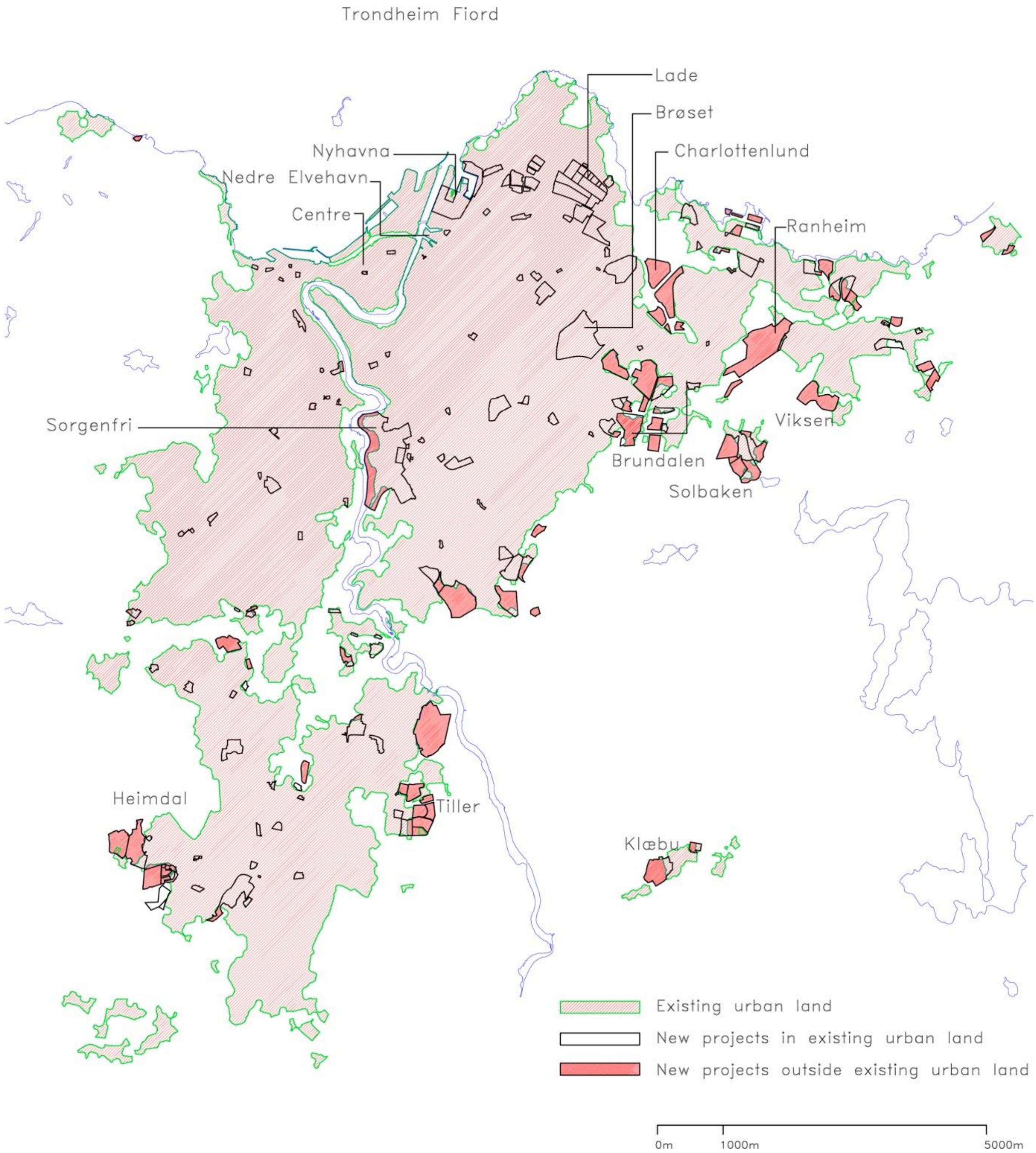

Figure 4. Ongoing and future urban development projects in Trondheim

An illustration of how the urban regime operates can be taken from the application of the densification targets established in the Trondheim "Environmental Policy for Transport" (Trondheim Kommune 2008). As part of a wider plan for CO_2 reduction, a target of keeping

80% of new homes inside the existing urban boundary was set. The goals were established based on densification trends during previous years. Nevertheless, maintaining that pattern has proven increasingly difficult: analysis of information provided by the city of Trondheim on new housing construction projected for the coming years suggests a tendency far from the original target (see Figure 4 and Table 1).

Housing projections 2014–60	
Total future housing area (ha)	745
urban land (ha)	434.4
greenfield sites (ha)	310.6
total housing potential	36,569
average density (houses per ha)	49.1
estimated houses on greenfield sites	15,246.1
percentage of houses on greenfield sites	42%
Housing projections 2014–24	
Total future housing area (ha)	703.7
urban land (ha)	408.4
greenfield sites (ha)	295.3
total housing potential	38,159
average density (houses per ha)	54.2
estimated houses on greenfield sites	16,013
percentage of houses on greenfield sites	42%
Housing projections 2014–18	
Total future housing area (ha)	435.3
urban land (ha)	263.5
greenfield sites (ha)	171.8
total housing potential	22,839
average density (houses per ha)	52.5
estimated houses on greenfield sites	9,013.9
percentage of houses on greenfield sites	39%

Table 1. Housing projections in the city of Trondheim

Table 1 uses two basic categories. The first is urban land equivalent to the area predominantly occupied by typical urban uses such as housing, industry, commerce, and other facilities. The second is agricultural land, corresponding to areas occupied by crops and farms, potential arable land, forest, and the natural landscape.[2] According to these figures, the target of 80% of new housing within existing urban boundaries might become increasingly difficult. Instead, it is likely to be 61% for 2018 and 58% for 2024. Densification in sparsely populated areas is relatively easy because of the abundance of undeveloped plots. With advances, the available areas become scarcer. The remaining spaces are mostly brownfield sites, in unpopular locations, entailing complex and expensive operations, which are less attractive to developers. A good example of the latter scenario is the redevelopment of Nedre Elvehavn, the former Trondheim dockyards, which has proved to be a complex process, extending over nearly three decades (Sager 2014).

The city of Trondheim and its planning office seem to have a limited scope for action with regard to reaching the original target of 80% new development inside existing urban land. Urban and peri-urban land is mostly private; and investment in new homes is also controlled by private actors. It is only via regulations that the city can push to achieve the target. This area is where incremental innovations to produce regime changes are required. Different planning instruments can be designed and combined to foster the redevelopment of brownfield sites, the densification of building stock, and the provision of affordable housing. Examples include urban growth boundaries, other urban containment strategies (Dawkins & Nelson 2002; Millward 2006; Altes 2009), development rights, and land-value capture mechanisms (Suzuki et al. 2015). Transport policy instruments also play a key role in urban intensification: they are commonly used to increase commuting cost by car while subsidising public transport (Goodwin 1981; Hupkes 1982; Brueckner 2000; May 2012).

3.4. The niches

Niches have been defined as protected spaces for radical innovations, insulated from “normal” market selection in the regime (Geels 2002). The military has been given as an example of a niche environment, favouring the development of many radical innovations in its early stages (computers, geolocation systems, satellite networks). Innovations also occur in the regime but in a more incremental way according to Geels. The concept of niche is more difficult to grasp

[2] Information extracted from http://trondheimsregionen.no/kart/boligbase.html. The map in the source includes housing projects with more than 10 units and provides data on the location and name of each project, the housing potential, the plot area, cultivated area, potentially cultivated area, building process duration (earlier year of occupation by new inhabitants and year of conclusion). The figures were revised according to information provided via email by Svein Åge Relling on 12 December 2014 and 23 February 2015.

in relation to the city. There is an implicit question of scale, which seems not completely defined within transition theory. Hodson & Marvin (2010: 480) pose the question, "Where do cities sit within the landscape – regime – niche hierarchy?" Indeed, can they be encompassed by both regime and niche? The answer may be related to the scale of the analysis, making it possible to place the city in all three levels of the hierarchy, according to the interaction of innovative activities within a wider social context – local, national, or transnational.

In addition to the question of scale is the question of how radical innovations in the case of city transformation can be. Niche-based transition happens when norms and practices developed in the niche get broadly implanted in the regime. Eventually a new regime is developed from such innovations. Berkhout et al. (2004) argue that this is only one of the transition mechanisms, but there are several other forms of change. Niche-based radical transformations may be less common in the case of cities where transformation appears more incremental. The location of the niche in regards to the system (the regime) also influences the use of the concept. According to Loorbach (2007: 22), "the niches can be part of the regime, exist outside the regime or even (partly) outside the system". This flexibility in the location and especially the experimental nature of niches makes the concept useful for analysing and developing transition strategies related to the city. The notion of niche is being used in different city-related issues such as governance and social experimentation (Evans & Karvonen 2014; Potter et al. 2015; Bulkeley & Castán Broto 2013). Niche-based transformations have also been applied in the analysis of energy use in residential buildings (Berry et al. 2013; Quitzau et al. 2012) and in urban transport (Nykvist & Whitmarsh 2008; Potter et al. 2015).

Probably the most discussed "niche experimentation project" in Trondheim during the last years has been Brøset. The idea of a carbon-neutral neighbourhood was launched in 2007 (Støa et al. 2014). Principles of the sustainable city, such as a compact urban layout, environmentally-friendly waste management, building and infrastructure adaptations to climate change, and a 70% reduction of CO_2 emissions per inhabitant have informed the design. The area of intervention comprises 34 hectares located 4km from the city centre. When completed, around 1,800 new housing units will be provided, with a density of approximately 53 dwellings per ha. There will be space for shops and small businesses. Transport will mainly be provided by public transport, cycling, and walking. Cars will be restricted both by the design of public spaces and by a significant reduction in parking places, from 1.3 currently applied for residential areas, to 0.65. The Brøset process has developed a number of innovative approaches to planning, urban design, citizen participation, sustainable transport, integrated energy design, and waste infrastructure. This project is probably the most ambitious niche development for a transition towards sustainability in Trondheim. However, a missing agreement with the landowners is hindering the start of construction.

4. Analysis and main findings

Urban change is embedded in a complex system of factors and actors operating in several layers or scales. Analysing urban transitions using a multilevel perspective could prove a useful instrument in understanding the intricacies and interlinkages of such complex systems. The case of Trondheim's densification policies has been presented here at three different levels. At the macro-scale, or the *landscape*, there are three main factors: the first is a supra-national agenda around the decrease of CO_2 emissions originating from transport; the second is a national agenda for the protection of arable land and forests; the third is related to demographic changes such as immigration, concentration of population in larger cities and population ageing. The mezzo-scale, or the *regime*, in this case the Norwegian urban regime, has been described as a stable system, which seems to operate through procedures of formulation, negotiation, and implementation, involving public and private actors. Accordingly, the feasibility of the densification agenda depends on a coalition between two main types of actors: the first is the government and its different levels (see Figure 3); the second is a more heterogeneous set of non-governmental actors controlling strategic resources for urban development, such as land, financial resources, and even ideas and perceptions. The micro-level, or the *niche*, is less common in the context of urban development, but is described here as specific initiatives or experiments performed to achieve changes in the established regime. Brøset, a project for a carbon-neutral neighbourhood in Trondheim, is used as an illustration. However, the main lesson from this local experience is the existence of a persistent disconnection between urban sustainability targets and the conventional instruments of planning. Despite several years of negotiation, the project has not been implemented because of disagreements with landowners (Støa et al. 2014: 351–2).

Demographic changes together with environmental policies are, according to this analysis, the strongest contributors to an increase in density in Trondheim. However, the process is hindered by barriers arising from the very functioning of the regime. Urban densification may at first glance provide an attractive potential for profit to landowners, urban developers, and investors: more units could be sold in a given development, using proportionally fewer resources. However, areas for development within the city, in the case of Trondheim, seem to be increasingly scarce. The few remaining spaces are mostly brownfield sites from former port and industrial activities, already identified in municipal plans. Additional potential for increasing densification might also be found in some low-quality housing areas in need of an ambitious agenda of refurbishment. However, the cost factors attached to site (re)development within the city (land prices, impacts on an already inhabited vicinity, multiple ownership, polluted soil, refurbishment and improvement of infrastructure) make developments in either case complex and expensive.

The governmental agenda in regards to densification has been tackled mainly by regulatory measures, such as zoning plans and building permissions. These instruments are intended to limit the sprawl of urban development into the surrounding countryside, but they do not address the complexities attached to urban refurbishment and brownfield developments. Even Brøset, an emblematic project in the sustainable city agenda, has been delayed because of issues related to land ownership and development rights. This mismatch between instruments and factors may explain the difficulties in achieving targets for densification. According to the figures presented in Table 1 around 42% of new housing development in the coming years may occur on greenfield sites. This is twice as high as the initial target that aimed to limited greenfield developments to 20%, suggesting a lack of feasibility of the densification agenda. Consequently, the private actors in the urban development process find ways of relaxing regulatory restrictions. This is a well-established pattern in traditional urban regimes, where the search for profit is the main driver for non-governmental actors, while the government agenda is driven by the needs of the general population, or in this case by sustainability. Such a situation suggests a need to explore new planning instruments to decrease the mismatch between economic profit and sustainability agendas.

5. Conclusions and recommendations for further research

The case of Trondheim might be interpreted as an example of an early stage transition, where factors such as demographic changes and environmental issues are influencing local policies. These constitute pressures from the landscape on a traditional market-oriented urban regime. Despite the pressures, there is a regime obduracy that could be gradually overcome by designing and introducing new planning instruments that connect spatial issues with economic aspects. Unsuccessful niche experiments such as Brøset could be regarded by many as an indication of a non-transition. This is, however, a single case, which may be reactivated in the near future.. Densification and urban expansion are occurring simultaneously, even though densification is happening at a much slower pace compared to the planned targets. Instead of considering this as a non-transition, the current situation of urban growth by densification and expansion might be seen as two competing trends, which, with adequate adjustments, can be steered in favour of a denser and more sustainable urban environment.

Multilevel narrative instruments, such as multilevel perspective approach, enable an easier understanding of a complex web of actors and factors. The multilevel perspective analysis of the case of Trondheim suggests further action at two levels: at the regime level, new planning instruments towards a gradual regime evolution are required; at the niche level, new and diverse niche experiments should be implemented. Both types of actions require scholarly attention during the design, execution, and post-implementation phases. A research agenda in the field of sustainable city policies should consider social acceptability issues, for instance what level of density is acceptable to residents, or which urban qualities are demanded in Norwegian cities. Economic instruments (e.g. taxes and subsidies) to accelerate the transition towards a denser and more sustainable city also require special consideration. Moreover, land development and transport demand greater attention. The transition towards a denser and more sustainable city in Trondheim has just started.

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