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ON THE FEASIBILITY AND EFFECTIVENESS OF URBAN DENSIFICATION IN NORWAY

FABIO HERNANDEZ-PALACIO

Abstract

Urban densification has been widely adopted as a strategy to achieve the sustainable city. There is a wide consensus on the benefits of the compact city in regards to environmental performance. Yet, there are some unanswered questions mainly in connection with implementation challenges and the real gains in attaining sustainable development. This is a particularly relevant discussion in a high-income and sparsely populated country such as Norway. In such a context the strategy appears difficult to implement. The implications of urban densification with regard to the sustainable city are analysed in this paper using the concepts of feasibility and effectiveness. The study was conducted by a combination of exploration of theoretical concepts related to the sustainable city and evaluation of empirical data in four Norwegian cities: Oslo, Bergen, Trondheim, and Stavanger. These cases were analysed in relation to densification, dwelling types, and transportation modes. Although densification is proven feasible in most of the studied cities according to the results, this may be happening not solely because of successful planning efforts, but also because of demographic trends. The effectiveness of this strategy with regard to sustainable patterns, particularly in urban mobility, offers, so far, less evident and direct benefits. Densification is only one of the many qualities that the sustainable city requires; however, it is a precondition for the existence of other essential features for urban sustainability.

Keywords:
compact city, effectiveness, feasibility, Norwegian cities, sustainable city, sustainable development, urban densification

Introduction

Densification as a planning strategy has become the most common response to the challenge of attaining sustainable cities. Following this trend, the Norwegian programme «Cities of the future» has adopted the phrase *compact and good cities* as its slogan (Norwegian Ministry of Environment, 2008). The Norwegian government has embraced urban densification as a key component in the pursuit of the sustainable city. However, there are two main issues that deserve attention in the discussion regarding urban density. The first issue is *feasibility*, or the viability of implementing urban densification as a strategy. The second issue is *effectiveness*, which is the capacity to achieve sustainable goals by implementing urban densification. During the discussion developed in this paper feasibility is understood as a precondition to effectiveness, but not a guarantee of this. However, both concepts are considered essential regarding the success of sustainable city strategies that have densification in focus.

Density is generally understood as the concentration of population, activities, building stock, and infrastructure within a spatial context. In this paper the data are usually expressed as the population per unit area (at the municipal, regional, or national level). Urban densification also refers to the concentration within urban boundaries as defined by the Norwegian legislation (see part 4. Characteristics of the Norwegian context). The central objective of the paper is to explore the feasibility and effectiveness of urban densification as a planning strategy in Norway. The analysis is based on empirical data in relation to densification, dwelling types, and transportation modes in four of Norway's largest cities (Oslo, Bergen, Trondheim, and Stavanger). The theoretical context of this analysis is the paradigm of the sustainable city, which has been guiding urban policies across the world for more than two decades. Norwegian urban policies are not an exception. However, there are context specificities that need to be understood in order to explore urban densification policies in Norway. One of Norway's most significant characteristics is the traditional low-density urban development in its cities and a seeming preference of Norwegian households for detached dwellings. The question that guides the development of the argument presented in this paper is «How feasible and effective is urban densification in achieving the objectives of the sustainable city in Norway?»

Feasibility is broadly defined as the (realistic) potential to actually implement a desired action or to accomplish a desired effect of a specific action. In the context of this paper feasibility is referring to the potential of improving sustainability through the action of urban densification. The feasibility of densification is measured by the variation of population per unit area over time. The change in dwelling type over time is also analysed as a closely-related variable. Rising population concentration involves a gradual increase of housing types of higher density in the

building stock. Housing types such as detached dwellings and houses with two dwellings are predominant in low-density urban areas, while terraced houses and multi-dwelling buildings are abundant in denser urban environments.

Effectiveness is in general defined as a measurable capacity of a system or a process to achieve established goals. In the context of this paper effectiveness refers mainly to the impact on environmental performance of the city as a result of urban densification. One of the most relevant impacts expected from densification policies is a development towards environmentally-friendly mobility. Concentrating people and activities are often proposed to contribute to shorter commuting, achieved by walking, cycling, or public transport. These transportation modes require less energy, less urban space for operation, and they produce less pollution. On the other hand, in sprawled urban areas, mobility is dominated by the car, with an increased demand for energy and space for infrastructure, and higher CO_2 emissions. Thus, transportation modes, car ownership, and car usage are considered important indicators in the assessment of effectiveness within the argument presented in this paper.

The paper is organised in five parts. 1. *Introduction* presents the aim of the paper, the central question, the main concepts involved, and the structure of the text. 2. *Sustainable development and the sustainable city* develop the theoretical frame of the paper exploring the concepts and interpretations in Norwegian policy, using as a case study the «Cities of the future» programme. 3. *The Challenges of Urban Densification as a Planning Strategy in Norway* serves as a bridge between the theoretical framework and the empirical case study: it explores the questions of feasibility and effectiveness of densification in Norway. 4. *Characteristics of the Norwegian context* presents some facts about Norway's urban environment with emphasis on two aspects: densification and mobility. These data constitute the empirical material for the analysis and discussion in the fourth and fifth parts of the paper. The study uses information from Oslo, Bergen, Stavanger, and Trondheim as relevant cases of the advances in the Norwegian context. Urban compaction and its influence in achieving the objectives of the sustainable city, particularly environmentally-friendly mobility, are discussed. Part 5. *Conclusions* summarises the argument and findings.

Sustainable development and the sustainable city

The most widely used definition of sustainable development is the one introduced by the World Commission on Environment and Development which defines the concept in these terms: «*Sustainable development seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future*» (Brundtland, 1987).

This concept involves the need for economic growth to increase social welfare while protecting the environment and natural resources. The Brundtland Report definition, despite covering so much, has become a classic. From it, various interpretations have evolved, and relate to three dimensions: economic, social, and environmental. The relation between these aspects has also been interpreted in various ways. For some, these are three independent pillars that support the concept of sustainable development. For others, the environmental dimension contains the social, and the social contains the economic (Giddings, Hopwood and O'brien, 2002; Adams, 2006).

Regardless of the wideness of this interpretation combining these three dimensions, the debate does not lead to universal procedures, standards or protocols. In general the ideas about sustainable development are more aims than definitions, and in that way generate an indefinite range of interpretations. Despite (or because of) the diversity of interpretations, the concept has spread worldwide. However, cities are concrete objects inseparable from specific environmental, social, and economic contexts. Cities can be considered as responses of societies to specific, temporal, and spatial contexts (Mumford, 1961). Therefore, what applies in sustainability for a Norwegian city can be very different in the case of a Mediterranean or an African city. Strategies to accomplish sustainable cities may consequently differ substantially from one context to another. Thus the concept is very frequently amalgamated with other ideas concerning development, e.g. competitiveness, quality of life, equality, resilience, or efficiency.

The concept of sustainable development is not easily translated into an urban form, making it difficult to sketch a concrete image of the sustainable city. The United Nations Sustainable Cities Programme defines the sustainable city as «*a city where achievements in social, economic, and physical development are made to last. A sustainable city has a lasting supply of the natural resources on which its development depends (using them only at a level of sustainable yield)*» (UNCHS/UNEP, 2000). From this definition it can be inferred that a sustainable city uses natural resources in an efficient way that can ensure durable human development. A sustainable city should probably also promote social equality in order to avoid risks originating in social conflicts. And, equally, it promotes economic growth in order to generate and maintain social welfare. But the definition does not present any relation to a specific form of appropriation of space. Instead, it suggests a connection to a scale larger than the city itself: a regional dimension or a niche that supplies the resources to support the city. Hence the effectiveness of a city in achieving sustainable development is not only related to internal functioning, but also to external impacts caused by activities inside urban areas (Nijkamp and Kourtit, 2013).

The context of the city – the social, the economic, and the environmental situation – determines the emphasis in the strategies applied in the search for sustainable development. For some cities, the priorities may be focused on social aspects such as poverty alleviation, equality, and welfare. For some other cities, sustainable strategies are largely directed at adapting to economic changes, using comparative advantages and better economic performance in a durable way. In other cases, the precedence in the frame of sustainable urban development is to improve environmental quality or mitigate natural or technological risks. For some other cases, as in the Norwegian cities studied in this paper, the emphasis seems to be on environmental issues such as energy efficiency, rational use of space, and adaptation to climate change (Holden and Norland, 2005). These targets are well described in different white papers from the Norwegian Ministry of Environment such as *A better environment in cities and towns* (2002), *The Government's environmental policy* (2007), *Cities of the future* (2008), *Norway's environmental targets* (2012), and *The contemporary sustainable city* (2013).

Despite the wide range of sustainable policy objectives, the debate on a sustainable urban form has been centred mainly on density. One of the focuses in the literature on urban form and sustainability has been on the feasibility and effectiveness of densification as a sustainable city booster (Breheny, 1997; Williams, 1999; Engebretsen, 2005; Karathodorou, Graham and Noland, 2010; Berg, Granvik and Hedfors, 2012). This discussion has been in the academic arena for several years and seems to be still open. Regarding feasibility the discussion has been centred on the difficulties, particularly from the social and political perspectives: to illustrate this point, see Breheny (1997), Bramley, et al. (2009), and Dempsey, Brown and Bramley (2012). Effectiveness, on the other hand, presents two antagonistic positions. One stands for the inoperativeness or slim benefits of urban density regarding sustainability, see for instance Breheny (1995) and Neuman (2005). The other, followed by a large number of planners and urban administrators around the world, is that denser cities are better to face the challenges of contemporary human needs, especially from the perspective of sustainable development; see for example Dieleman and Wegener (2004); Holden and Norland (2005); Ferguson and Woods (2010). These authors advocate higher urban densities mainly to reduce car dependency. From these antagonist positions some authors and institutions of urban planning have noticed a paradox. Densification seems to be a question of trade-off: there are advantages and disadvantages (Berg, Granvik and Hedfors, 2012). It seems necessary to sacrifice some individuals' aspirations to achieve social aims such as sustainable development (Neuman, 2005; EEA, 2009)

The challenges of urban densification as a planning strategy in Norway

The compact city has frequently been directly associated with the idea of the sustainable city, assuming that higher densities correlate with higher sustainable performance, especially in reduction of energy consumption in transportation. Mindali, Raveh and Salomon (2004) stress that density *per se* is not the elixir of urban efficiency, this being one of the main arguments of the critics of the compact city. Dieleman, Dijst and Spit (1999) and Shammin, et al. (2010), despite defending the potential of higher urban densities, argue that the relation between urban form and mobility is not a direct one, since factors such as income and life style are also relevant. Neuman (2005) claims that process is more critical than form in achieving a more sustainable city. There is empirical evidence in favour of this last argument. For instance, the combination of highly dense urban areas with mobility based on cars can generate many problematic situations, such as high demand for parking spaces and traffic gridlocks (Berg, Granvik and Hedfors, 2012). In such a situation, effective use of time, energy efficiency, and environmental quality can be seriously affected.

High density also seems inefficient regarding environmental performance when high-density mono-functional residential areas are located on the periphery of cities. Mono-functional density increases daily intra-urban trips. Clustered density in the shape of low-scale compact residential enclaves might also be inefficient in terms of reducing energy consumption in mobility. Such locations are functionally dependent on the larger agglomeration in terms of jobs, specialised shopping, and leisure activities (Williams, Burton and Jenks, 2000; Engebretsen, 2005; Næss, 2012). Hence, the spatial micro-pattern of land-use distribution and urban layout are, together with density, essential components of the sustainable urban form (Dempsey, et al., 2010). In the Norwegian case, the «Cities of the future» programme follows the widespread model of urban compaction: containment of urban expansion, promotion and intensification of public transport and cycling; strengthening of commerce, leisure, and services in the central area; parking restrictions and limitation of car use; and densification around transport infrastructure (Table 1). This programme, operating from 2008 to 2014, is part of a national policy on urban densification being applied since the launch of the policy «A better environment in cities and towns» (Norwegian Ministry of Environment, 2002).

«Cities of the Future» is an initiative to achieve the goals established by this policy in the urban environment. Thirteen municipalities in Norway's larger urban settlements created a partnership with the central government and the private sector to achieve its objectives. The inhabitants of these urban areas make up more than a third of the national population. The priority area of land use and transport has as its central objective

the efficient use of space. This aim is the most directly connected with urban form and urban densification. It implies a strong emphasis on the location of new dwellings inside existing urban borders; the use of environmentally-friendly modes of transport (public transport, cycling, and walking); and the decrease of distances from residences to urban services such as grocery shops, nurseries, schools, and green public spaces. It is expected that this planning strategy has a direct beneficial impact on the overall quality of the urban environment.

Table 1
The four priority areas of the programme «Cities of the future».

Land use and transport
To reduce the use of cars in the city
To strengthen the traditional city centre and district centres
To increase the use of public transport, cycling, and walking
To decrease the distance to daily urban services (grocery shops, kindergarten, schools, green public space)
Consumption and waste
To improve waste treatment and recycling
To decrease the use of disposable packaging
To encourage sustainable and durable consumption
Energy and building
To reduce energy consumption
To produce energy from sustainable sources
To implement heating districts in residential and commercial areas
Climate change adaptation
To strength the cities to deal with events associated with climate change (rain, landslides, higher sea level, and wind)

SOURCE: NORWEGIAN MINISTRY OF ENVIRONMENT (2008)

On feasibility

Feasibility in general means the capability to get things done, the practicability. Four possible feasibility factors for densification are suggested: population growth, limited access to new urban land, social acceptability, and governance (table 2). For instance, in the case of Norway, Oslo is more successful in densification than other Norwegian cities because its population is growing faster. If the population of a city is not growing or is declining, the city will not become denser, unless buildings in the periphery are demolished and people are relocated to the inner areas. Densification occurs when new land is incorporated into the existing urban land at a smaller proportion than the rate of population increase. The four cities studied for this paper experienced population growth during the last decade, but they also incorporated new urban land at dif-

ferent rates (Appendix: tables 4 and 5). A decrease in the incorporation of new urban land requires planning programmes resulting in the redevelopment of derelict urban land, the construction of denser housing typologies, and the availability of housing for lower income homes.

Table 2
Suggested feasibility factors for densification.

Main factor	Associated factors
Population growth	Economic growth and opportunities for prosperity
Decrease of new urban land	Redevelopment of derelict urban land
	Denser housing typologies
	Housing availability for lower-income population
Social acceptability	Variety of urban environments
	Diversity of dwelling solutions
	Social meaning and collective pride
Governance	Political will
	Inter-municipal coordination
	Technical capacity (know-how)

Social acceptability is a critical factor for feasibility. This is one of the most difficult issues regarding densification in developed countries where people have high incomes and freedom of choice is an important social value (Breheny, 1997; Garcia and Riera, 2003; Bramley, et al., 2009). The negative perception about high urban density seems to be a major impediment in the practicability of the compact city and therefore an obstacle to attain sustainable city goals. It presents an antagonism between quality of life in the present versus the maintenance of the same quality in the future. At first glance it is necessary to sacrifice quality of life in order to achieve sustainable development.

Social changes such as the Second Demographic Transition (SDT) could drastically change the perception of quality of life and, as a consequence, the acceptability of densification (Van de Kaa, 1987). According to this author, the SDT is an ongoing phenomenon in industrialised countries where fertility rates have fallen behind the population replacement level. The number of children born per woman is lower than 2, producing as a consequence a shrinking of the population during the coming decades. This drop in fertility rates will also bring considerable changes in the age of the population, with a resulting increase in elderly people. The housing accommodation and urban environment that used to be attractive to families with two or more children is perhaps different to the new qualities demanded by single people, one-child families, single mothers, and elderly people.

Norway is among the European countries experiencing diverse phenomena associated with the SDT since the 1970s, as illustrated by Van de Kaa (2002). Among these phenomena area fertility rate below replacement (taken to be 2.10); an increase in extramarital birth rates; growth in the levels of cohabitation and rate of divorce; an augmentation of life expectancy; and an increase in immigration. This new demographic stage is rapidly changing household characteristics and consequently the type, size, and location of dwellings. Haase, et al. (2008) maintain that householders in the SDT requires greater flexibility in the spatial characteristics and location of their home; changing house is more frequent; working and living in the same space is also common. This flexibility, according to these authors, is available in inner-city areas where there are a large number of buildings of different types and sizes, easily adaptable to spatial changes. This new type of household also demands greater proximity to urban facilities such as places of working, leisure, and education, which represent a new attitude regarding the urban environment.

The other key factor for feasibility is governance[1], understood as «*the capacity to get things done*» (Kearns and Paddison, 2000). This capacity for achieving aims involves factors such as political will, technical capacity (know-how), and inter-municipal cooperation (see table 2). Contemporary cities are difficult to govern not only because decision-making in urban planning involves heterogeneous and divergent interests, but also because cities have become regional systems fragmented in various administrative jurisdictions, inherited in most cases from pre-modern times – for example municipalities, communes, counties, districts (Gilbert, et al., 1996; Graham and Marvin, 2001; Betsill and Bulkeley, 2006). Many policies of urban issues, such as housing, mobility, land use, environmental questions, and public services among others, have traditionally been administrated by municipalities (*kommuner* in the Norwegian context), but they operate on a regional basis. This is particularly strong in densification and mobility issues. Densification rules can vary from one municipality to another and people have the freedom of choice among different municipalities within the same urban region. This implies daily commuting to access work and other urban services, producing impacts on sustainable urban performance as a whole.

1 First, governance is a broad concept being used in several contexts. Second, governance is not a central concept in this particular paper, but the chosen simplified definition is still useful for the argumentation.

On effectiveness

Effectiveness in general means the ability to achieve a desired effect. In the sustainable city, effectiveness or being efficient is understood as the capacity of the city to fulfil social demands with less use of energy and natural resources. Hence, a denser city seems certainly more efficient than a sprawling city at least in three aspects: the first is in consumption of space; the second in consumption of energy for transportation; and the third, concerning the economy, in the provision of infrastructure (Breheny, 1995; Burgess, 2000; Ferguson and Woods, 2010). Despite the

wide-ranging debate about the relationship between urban form and sustainability, with arguments both in favour and against density as a key element, empirical evidence – illustrated in the Norwegian case according to Holden and Norland (2005) and Næss (2012) – has favoured the compact city as a more efficient urban form, particularly in relation to energy consumption, both in transportation and in housing.

Table 3
Suggested effectiveness factors for densification.

Main factor	Associated factors
Proximity to urban services	Mix of uses (grocery shops, educational services, cafes, etc.)
	Availability of different kinds and sizes of recreational area
	Accessibility to public transport
	Local centres with availability of communal services
	Availability and diversity of public spaces, parks, and playgrounds
Green mobility	Sufficient and affordable public transport
	Availability and quality of pedestrian and cycle paths
	No car-friendly urban spaces
Transport-oriented development	The right use in the right location according to accessibility
Societal behaviour	Shift in social values
	Prevalence of common interests

As has been discussed already, density per se is not a booster of efficiency. The effectiveness of increased density is dependent on factors such as proximity to urban services, environmentally-friendly mobility, transport-oriented development, and societal behaviour (table 3). This simple list entails many complexities. Proximity to urban services, for instance, requires attention to the neighbourhood or the micro-urban scale in terms of proximity between dwelling and daily services such as grocery shops, schools, and nurseries; availability of playgrounds and public spaces of diverse kinds and sizes; accessibility to public transport; proximity to local centres with communal services, shops, cafes, and collective facilities; and proximity to green public spaces and parks. These characteristics are, curiously, very close to the classic characteristics of the «good city» described by Alexander, Ishikawa and Silverstein (1977), Lynch (1981), and Montgomery (1998).

Density is a precondition for the viability of public transport and other urban services that require human agglomeration in order to be economically feasible (Newman and Kenworthy, 1999). But the existence

of these services is a key aspect in the effectiveness of compaction regarding sustainability. Environmentally-friendly mobility should also be promoted by measures such as the redesign of urban spaces in favour of pedestrians and cyclists and other economic and legal instruments such as tolls, taxes, and subsidies. The effective performance of transportation requires special attention to the location of land uses and activity nodes, both in the neighbourhood and in the city region. This planning practice has been called transit-oriented development (Newman and Kenworthy, 1996; Cervero, 1998; Knowles, 2012). It has already been argued by several authors that in a free-market society, where freedom of choice is an intrinsic value, social behaviour and lifestyle are key factors in achieving sustainable goals (Ostrom, 1998; Banister, 2008; Witt, 2011). However, this freedom may be in conflict with sustainability in environmental terms. This is the case of social preferences for car usage, or for low density urban environments that are frequently regarded as part of the unsustainable issues in the built environment (Shammin, et al., 2010; Haugen, 2012). Therefore, the effectiveness of the sustainable city is above all a question of societal behaviour: a shift in social values and a priority of the common interest over the particular interest (Vallance, Perkins and Dixon, 2011).

Characteristics of the Norwegian context

Norway is a low-density country. According to Statistics Norway (Statistisk sentralbyrå, SSB), national density is 16 inhabitants per km², while in Western Europe this density is 171 inhabitants per km². In the Norwegian context, an urban area is an agglomeration of more than 200 inhabitants, living in a settlement where the distance between buildings does not exceed 50 m, regardless of administrative boundaries. According to this definition, 79.5% of the national population lived in urban areas in 2011 (SSB, 2012). The national average density in urban areas is also one of the lowest in Europe: 1,622 persons per km² according to SSB, while the denser cities in Europe, such as Bilbao, Istanbul, Milan, Palermo, and Belgrade, have more than 10,000 inhabitants per km² (JRC, 2006). Norway is one of the wealthiest countries in the world with an average gross income per year above US $60,000[2]. The combination of a high income and a sparse population results in a very particular context for the issue of urban densification as a planning strategy.

Norway has been considered one of the most successful countries in the application of sustainable policies. In diverse indexes on sustainable development, it is listed in the top position (Esty, et al., 2005; Togtokh and Owen, 2010; Kerk and Manuel, 2012). Oslo was granted the European Sustainable City Award in 2003, and has been studied in various analyses of sustainable urban policies (Engebretsen, 2005; Holden and Norland, 2005; Næss, Næss and Strand, 2011a; Næss, Næss and Strand, 2011b). The other three cities studied here – Bergen, Trondheim, and Stavanger

2 The estimates use figures from SSB (2012), calculated from the gross national income in 2010 for citizens 17 years and older, 358,900 NOK (Table 187), and the value of the USD in 2010, according to (Table 459) Foreign Exchange Rates. 31 December.

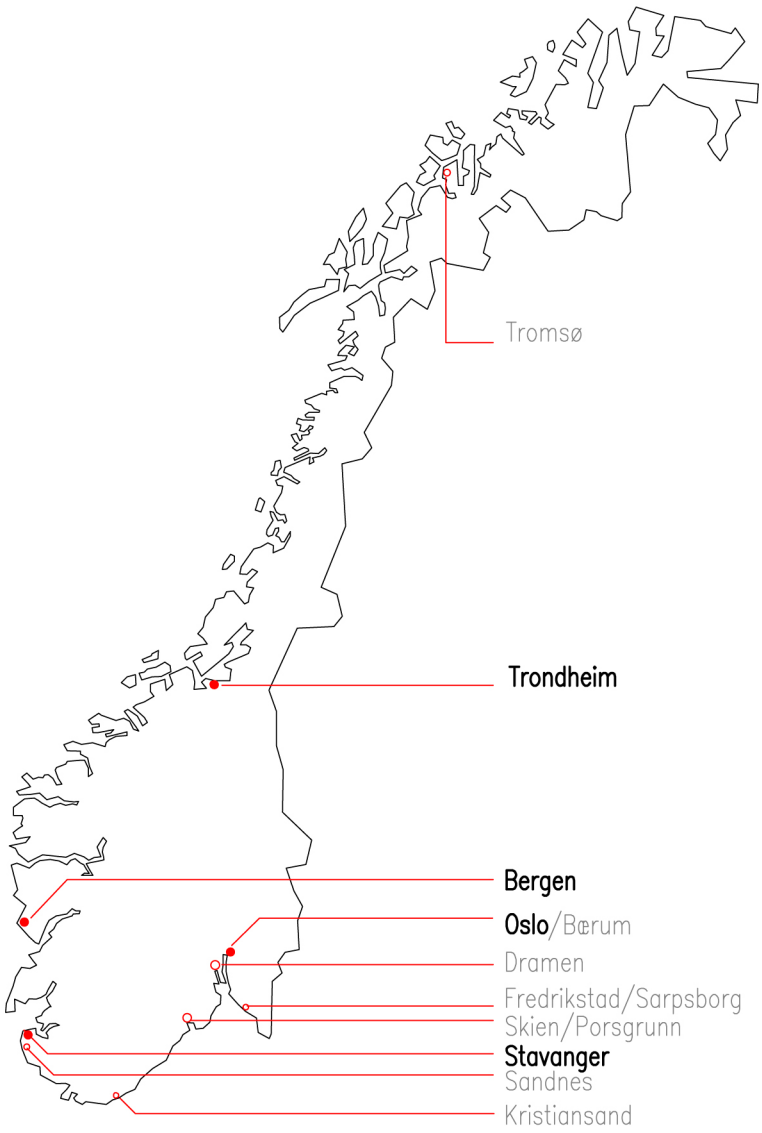


Figure 1
The case studies in Norway.

(figure 1) – are less well-known in regards to sustainable urban policies; but, being the largest urban areas in Norway after Oslo, they are interesting cases in the analysis of the implications of national urban policies such as urban densification. In Norway central government has a strong influence regarding natural resources and land use policies. Hence, despite different characteristics, the Norwegian urban areas have been subject to the same densification agenda.

Scope and limitations of the analysis

The previous section of this paper addressed the factors involved in the success of densification regarding the sustainable city. It has been said that feasibility depends on four factors: population growth, a decrease of new urban land, social acceptability, and governance. Effectiveness depends on other four factors: proximity to urban services, green mobility, transport-oriented development, and social behaviour (tables 2

and 3). Analysis of these aspects involves complexities that are difficult to consider in depth in the format of a single paper. Hence, this paper considers only some figures related to some of these factors.

The question of feasibility is treated by using statistics on population growth and the incorporation of urban land. Acceptability is addressed indirectly by using information on dwelling type variations, assuming that the decline of the detached house market is a rough indicator for the preference of denser urban environments. Analysis of governance is limited to the heterogeneous achievements in densification in urban regions by comparing the results of core municipalities with the region as a whole. The question of effectiveness is addressed by the study of some aspects of environmentally-friendly mobility using indicators such as annual variation of number of cars per inhabitants, use of cars and public transport, and transportation modes. The period analysed is mainly the last decade. However, it has not been possible to compare exactly the same years for each variable studied because of limitations in information and data. Despite these restrictions, the information offers a clear picture of the evolution of the feasibility and effectiveness of urban densification in Norway.

Facts about urban densification

Density variations

Urban density has been increasing steadily in the four case studies. However, this general trend hides differences when analysed at the scale of the core municipality or city region. For the period 2000–2012, core municipalities experienced a faster densification process than city regions as a whole, with the exception of Bergen (figure 2). For Oslo this rate was twice as high in the core municipality. Stavanger and Trondheim came in second and third positions; and Bergen presented the slower rate being the only case where the core municipality experienced less dense development than the city region as a whole (Appendix: Tables 4 and 5).

Trends in dwellings types

The Norwegian landscape is dominated by detached houses. This building typology makes up 53.7 % of homes according to information from SSB (2013). However, the picture changes within the four case studies analysed in this paper, and there are important differences within city regions and core municipalities. The Oslo region is the only case where multi-dwelling buildings provide the larger proportion of homes; the other city regions are still dominated by detached homes. In the core municipalities, on the other hand, the multi-dwelling typology is dominant. In the Oslo municipality multi-dwelling buildings are by far the most dominant – almost three quarters. Stavanger municipality remains the only case where detached houses are dominant, comprising more than one third, while multi-dwelling buildings comprise a quarter (figure 3).

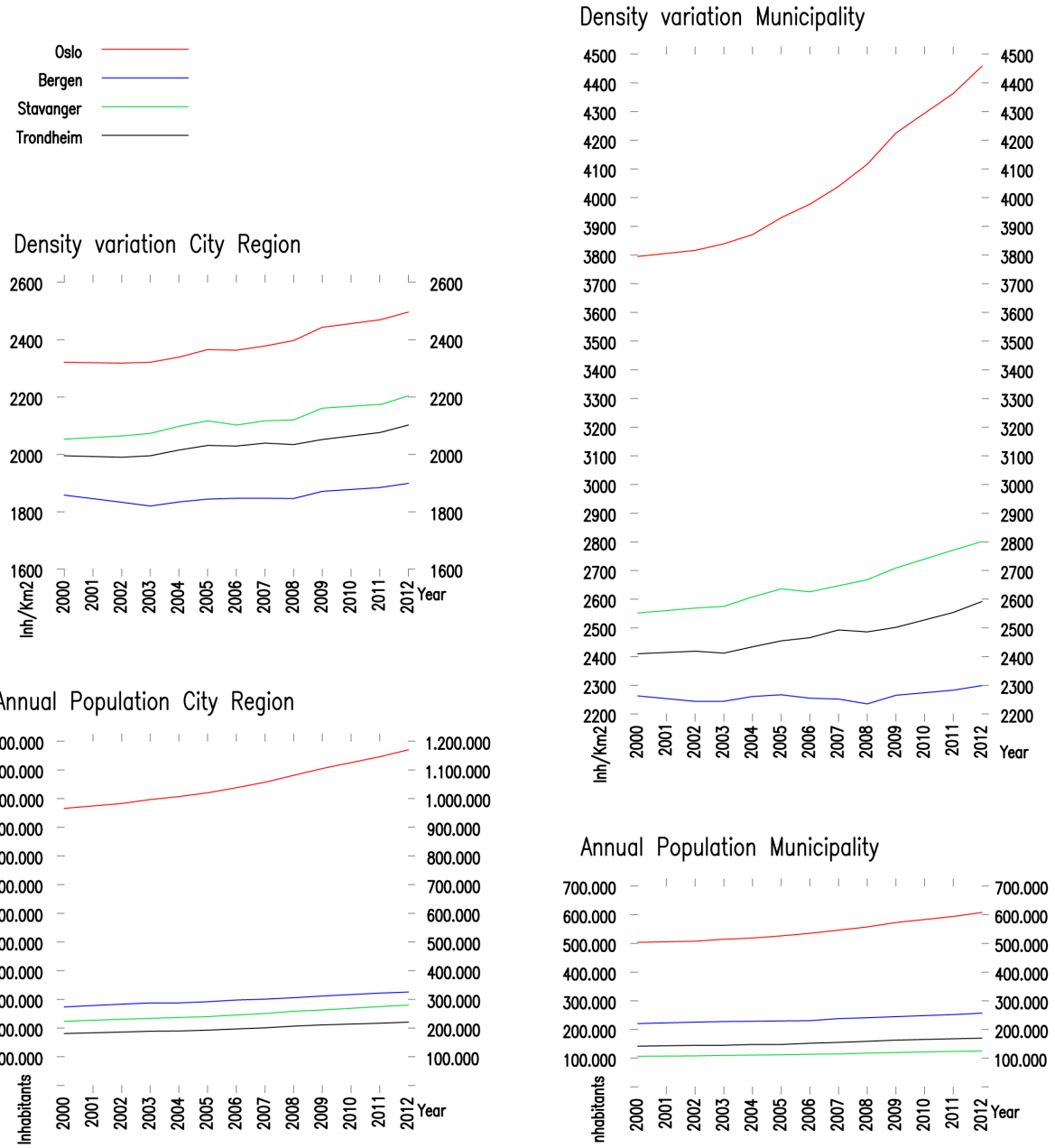


Figure 2
Density variations by municipality and city region. Source: SSB (2013).

Trends in housing typologies are changing the urban landscape in Norway (figure 4). During the period 2006–2013 more multi-dwelling buildings were constructed than detached homes in the country as a whole. This tendency is clear in all the regions of the case studies, with the exception of Bergen region, where detached houses have been growing slightly faster than multi-dwelling buildings. The increase in multi-dwelling buildings is significantly larger in the core municipalities of the case studies. In Oslo municipality three-quarters of the homes built during the period 2006–2013 are in multi-dwelling buildings, while in the core municipalities of Bergen, Stavanger, and Trondheim, the share is about the half. The increase is sharper in Oslo, where the population is growing faster (Appendix: Tables 6 and 7).

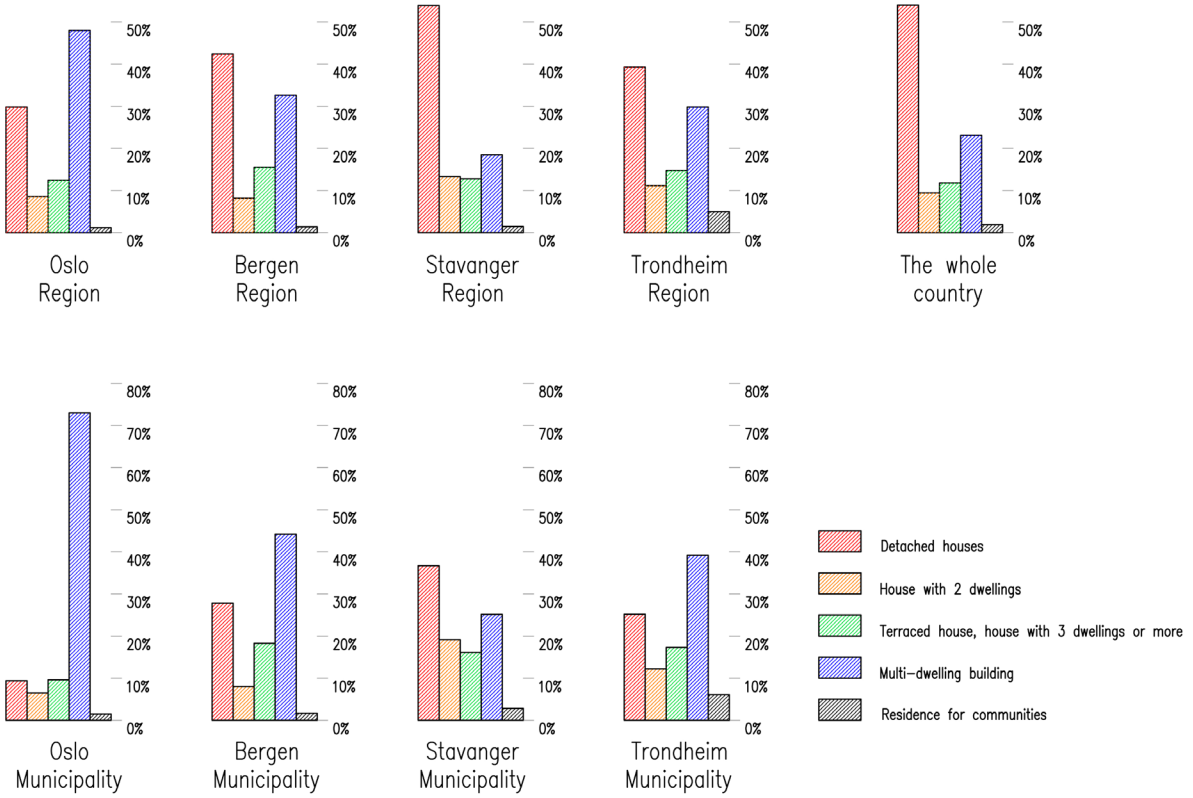


Figure 3
Dwelling types in the municipality and region, 2013. Source: SSB (2013).

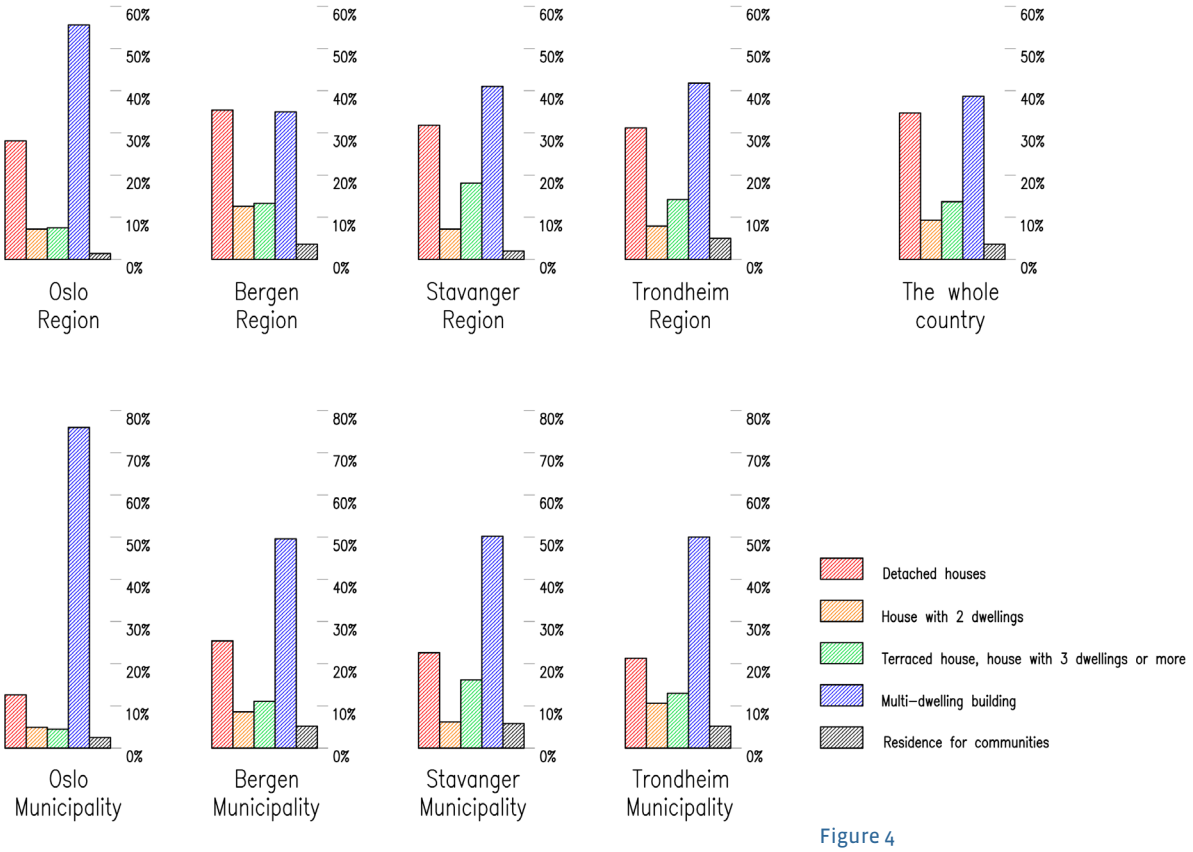


Figure 4
Variations in dwelling types, 2006–2013. Source: SSB (2013).

Demographic trends

In the coming years, it is expected that significant demographic trends will have greater impacts on urban lifestyle, the demand for urban services, and types of dwelling. There are three main trends with direct impact on the larger cities of Norway. Two are exposed by Brunborg, Texmon and Tønnessen (2012) in a study of the period 2012–2100. The first is the concentration of population in the main urban regions, particularly in the south of the country (Oslo, Bergen, Stavanger, and Kristiansand city regions) and with less intensity in Trondheim, located in central Norway (figure 1). This will involve a decline in many municipalities, particularly in central and northern Norway. The second is the growth of the elderly population due to life expectancy increases, immigration of working-age population, and stagnation of fertility rates. According to an intermediate scenario developed by SSB and presented by Brunborg, Texmon and Tønnessen (2012), it is expected that the percentage of the population over 70 years will double before 2040. The third trend is the increase in people living alone and the decrease of family size, a trend already observed during the last decades (figure 5).

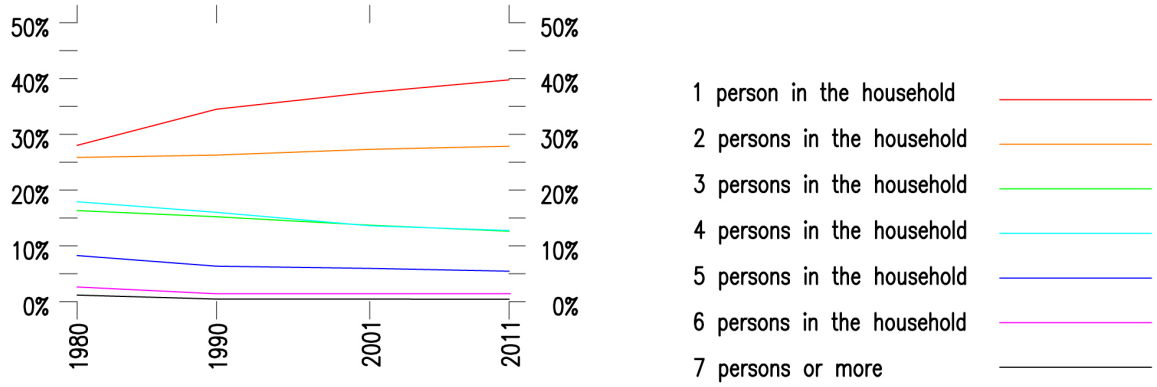


Figure 5
Persons by household, 1980–2011.
Source: SSB (2013).

Immigration has been a significant factor in population growth in the country. According to data from Tønnessen, et al. (2012), since 2005 net immigration has been higher than the birth surplus. According to these authors, this migration trend is expected to continue in the early years of the period analysed (2012–2100) but will decline later. Immigrants tend to be people of working age, predominantly men, who settle in the main urban regions where working opportunities are concentrated. This is a relevant aspect for urban dynamics such as urban densification and transport patterns. Limitation of information makes it difficult to establish further details, such as concentration, household conditions, or transport habits among the immigrant population. In general, statistics and reports on this topic present gross figures, on a national scale, and the analysis are not consistent over time (SSB, 2014). One of the most complete reports on this topic is that of Østby (2002). However, nowadays

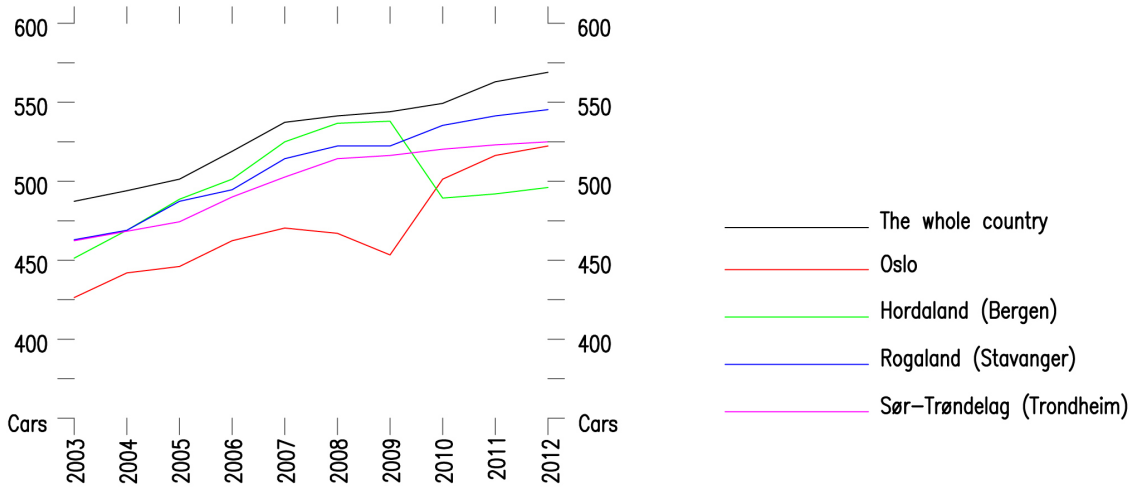
the cultural background of immigrants may differ widely from the 1990s and early 2000s compared to the current situation where the European economic crisis has a dominant impact.

Facts on mobility

Norway had the highest average car use in Europe in 2012, despite also having one of the highest fuel prices where taxes account for nearly 60 % (Brunvoll and Monsrud, 2013). Car ownership has been increasing steadily in the last decade, in the country as a whole and in all of the regions of the analysed case studies. The average figure for car ownership increased by 15 % in the country during the period 2003–2012 (figure 6). However, car usage increased by only 2.7 %, changing from 31.37 daily km per capita in 2003 to 32.26 km in 2012. The share of public transport in daily mobility varied slightly during the period 2001–2009, oscillating around 10.5 % of daily trips (Appendix: Table 8).

The change in the use of transportation modes in the four case studies displays mixed results during the period 2001–2009 (figure 7). Oslo made steady progress in reducing car usage in favour of walking, cycling, and public transport. By 2009 more than 60 % of daily trips in the city were made by environmentally friendly modes. The advance of green mobility approached 10 % during the period studied. Bergen achieved the second highest improvement with a 5 % increase in use of environmental friendly modes. Trondheim advanced a modest 2 % in the total period but experienced a reduction between 2005 and 2009. Stavanger came in last with a negative figure of -2 % during the period.

Figure 6
Number of cars per 1,000 people, 2003–2012. Source: SSB (2013).



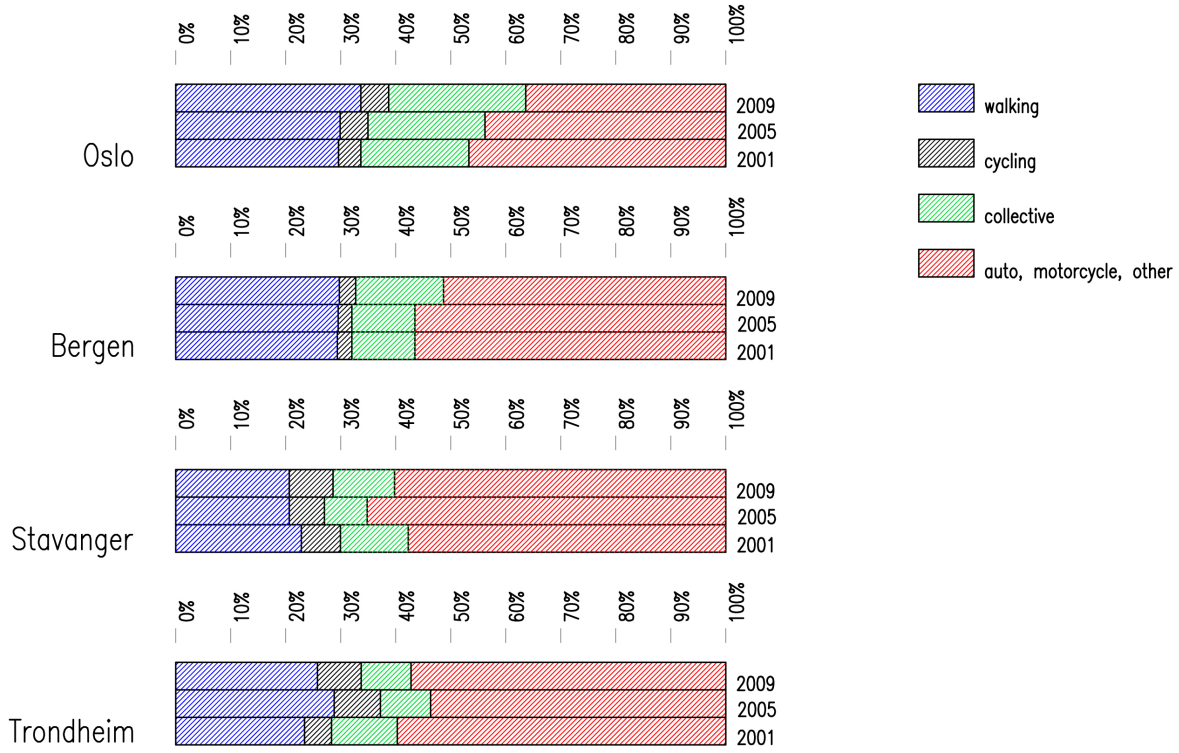


Figure 7
Urban transportation modes, 2001–2009. Source: adapted from Haagensen (2012)

Discussion on data and trends in densification

In general, densification occurs when the population increases faster than the incorporation of new urban land. Thus, cities with the highest population growth have greater potential for increasing density. This simple logic explains why Oslo, both in the region and in the core municipality, is becoming denser faster than the other three case studies. Stavanger and Trondheim are also growing denser, both in the core municipalities and in the city region, although at a slower rate. Compared to the other three cities, Bergen displays the lowest increase in densification, both in the core municipality and in the region, yet with a positive variation. In general, core municipalities are increasing density faster than the city regions. Bergen municipality is the only case in which densification has been lower than in the region. This is explained by the fact that Bergen has incorporated the biggest proportion of new urban land, almost equal to the proportion of new inhabitants (Appendix: Tables 4 and 5).

The type of home is also changing fast in the four larger urban areas in Norway. Multi-dwelling buildings already make up the largest proportion of homes in the core municipalities of Oslo, Bergen, and Trondheim. Stavanger remains the only case where detached houses provide the bigger proportion of homes. In the city region, however, detached houses maintain a larger participation, Oslo being the only exception, with a predominance of multi-dwelling buildings. The tendency, however, is for

multi-dwelling buildings to increase everywhere. Multi-dwelling homes were by far the most commonly built type of home during recent years. This tendency is stronger in the core municipalities of the four case studies, but is also occurring in the urban region to a smaller extent. Such a phenomenon may be linked to a change in the housing market due to demographic trends, but also to availability of urban land and home prices (figures 3 and 4; appendix: Tables 6 and 7).

Family size has been declining during the last decades. However, SSB data do not register details for each municipality and city region (figure 5). More people are living alone, particularly in Oslo, where 52 % of the homes are one-person households. In Bergen and Trondheim the figure is around 45 %. This number falls to less than 30 % in the outer municipalities of Oslo, Bergen, Trondheim, and Stavanger. This indicates the preference of families with children for detached dwellings, more prevalent in the peripheral municipalities, while one-person households prefer the denser urban environments of the core municipalities (SSB, 2013).

Densification is increasing in the four cities studied in this paper. This tendency is generally stronger in the core municipalities, and weaker in the peripheral ones. Family size has been declining, and there is a significant increase in one-person households. The type of home to accommodate smaller families seems to be the multi-dwelling building. This type of housing has had the highest share of new building during recent years. However, these positive trends in densification are not that clearly connected to trends in urban mobility. Car ownership has been increasing steadily in all four cities. (Bergen presents a sharp decline during 2009–2010, possible more a statistical issue than a real trend.) The figures are presented on a regional scale, limiting a detailed analysis between core municipalities and other municipalities in the urban regions (figure 6). A more detailed study developed by Haagensen (2012) with information built on a municipal scale, registers a sharper decline in private car usage in Oslo, a moderate decline in Bergen and Trondheim, and a slight increase in car usage in Stavanger.

The effectiveness of densification in attaining more environmentally-friendly mobility according to the variables studied is less clear. Car ownership has been analysed on the country and regional scale. In all the regions to which the four cities belong, there have been steady increases in vehicles per inhabitant, not dissimilar to the figures for the country as a whole. Vehicle ownership does not automatically mean increased car use, but this is far from being a proof of the advancement of environmentally-friendly mobility. The analysis of mobility modes in the core municipalities shows Oslo with the sharpest decline in car usage. Bergen and Trondheim have a slight decline, while Stavanger presents an increase in car usage. The positive tendency in Oslo, towards environmentally-friendly mobility has a correlation with an increase in density.

But in the other cases there is not a direct correlation, since density has been increasing at a different speed from environmentally-friendly mobility (figure 8).

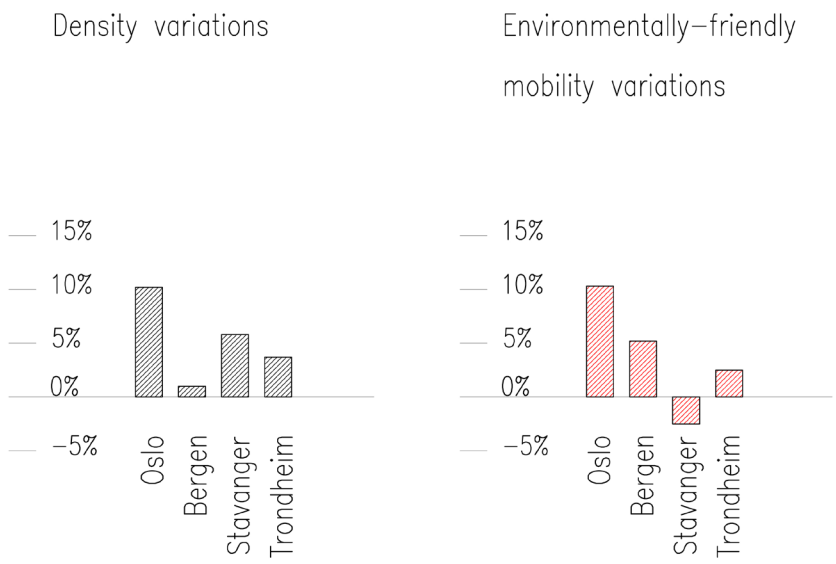


Figure 8
Correlation between variations in density and environmentally-friendly mobility, 2001–2009. Source: elaboration using data from SBB (2013) and Haagensen (2012).

Conclusions and recommendations for further work

The sustainable development agenda has deeply influenced the design of policies in most aspects of human activities. However, the sustainable city is still a very imprecise object, built on aims rather than facts. Although the compact city paradigm and densification as a planning strategy have been assumed as archetypes of urban sustainability in Norwegian cities, there are many unanswered questions. Higher densities seem to have some advantages in terms of efficiency if compared to sprawling cities. Nevertheless the effectiveness of compaction depends on a combination of various factors and not merely density. Further research is required to study these factors. Some of them may be related to qualities of the local scale; the neighbourhood, the block, the street, the public space. Others may be determined by the regional scale in which synergies and co-ordination between municipalities rather than competition are necessary.

Analysis of literature and the empirical evidence have revealed that densification is not a definitive answer to the problem of sustainability. But it is a key aspect in the implementation of complementary strategies, such as environmentally-friendly mobility, and proximity to urban services for the population. The effectiveness of densification in attaining sustainable city goals depends on the combination of such planning strategies. To answer the research question proposed in this paper, densification as a planning strategy in Norway is feasible, but this feasibility does not imply a direct correlation with effectiveness. Densification re-

quires additional planning initiatives and projects to produce effective improvements in urban sustainability.

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Appendix

Table 4
Density, population, and urban land by municipality, 2000–2012.

Density, inhabitants per km²

	Year													
City	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000–12 % dif.
Oslo	3 795	nd	3 816	3 839	3 871	3 930	3 977	4 039	4 116	4 225	nd	4 363	4 458	14,88%
Bergen	2 263	nd	2 244	2 245	2 261	2 267	2 255	2 252	2 235	2 265	nd	2 283	2 299	1,56%
Stavanger	2 552	nd	2 569	2 575	2 608	2 636	2 626	2 647	2 668	2 709	nd	2 771	2 801	8,89%
Trondheim	2 410	nd	2 419	2 412	2 434	2 455	2 466	2 493	2 486	2 502	nd	2 554	2 592	7,04%

Annual population

	Year													
City	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000–12 % dif.
Oslo	504 348	nd	508 134	514 744	519 261	527 236	535 916	546 048	558 165	573 185	nd	594 479	608 013	17,05%
Bergen	221 108	nd	225 879	227 965	229 420	230 403	234 984	237 631	241 101	245 485	nd	253 232	256 532	13,81%
Stavanger	106 804	nd	108 271	109 728	111 059	112 243	113 517	115 491	117 666	119 673	nd	123 910	125 375	14,81%
Trondheim	142 277	nd	144 560	146 487	147 854	149 336	152 310	155 076	159 236	162 568	nd	167 557	170 242	16,43%

Urban land growth, km²

	Year													
City	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000–12 % dif.
Oslo	132,90	nd	133,17	134,08	134,13	134,16	134,77	135,19	135,60	135,65	nd	136,26	136,38	2,55%
Bergen	97,71	nd	100,64	101,55	101,49	101,63	104,22	105,50	107,88	108,39	nd	110,93	111,60	12,45%
Stavanger	41,85	nd	42,14	42,61	42,59	42,58	43,23	43,63	44,11	44,18	nd	44,71	44,76	6,50%
Trondheim	59,04	nd	59,76	60,73	60,74	60,84	61,77	62,21	64,06	64,98	nd	65,60	65,67	10,10%

SOURCE: SSB (2013)

Table 5

Density, population, and urban land by city region, 2000–2012.

Density, inhabitants per km²

	Year													
City	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000–2012 % dif.
Oslo	2 321	nd	2 318	2 321	2 339	2 365	2 363	2 378	2 397	2 443	nd	2 469	2 494	6,94%
Bergen	1 858	nd	1 833	1 820	1 834	1 844	1 844	1 847	1 846	1 871	nd	1 884	1 899	2,17%
Stavanger	2 053	nd	2 064	2 073	2 098	2 117	2 102	2 117	2 120	2 161	nd	2 174	2 204	6,82%
Trondheim	1 995	nd	1 990	1 995	2 015	2 031	2 029	2 039	2 034	2 052	nd	2 076	2 102	5,12%

Annual population

	Year													
City	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000–2012 % dif.
Oslo	965 733	nd	983 070	997 387	1 006 914	1 019 825	1 037 994	1 056 580	1 081 243	1 104 966	nd	1 146 218	1 170 458	17,49%
Bergen	273 905	nd	283 516	287 658	290 213	292 057	297 596	301 366	306 358	311 643	nd	321 741	325 963	15,97%
Stavanger	224 341	nd	230 534	234 386	237 209	239 696	245 775	250 774	257 899	263 499	nd	275 372	280 497	20,02%
Trondheim	180 822	nd	185 842	188 626	190 673	192 692	196 764	200 906	206 619	210 502	nd	217 371	221 126	18,23%

Urban land growth, km²

	Year													
City	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2000–2012 % dif.
Oslo	416,08	nd	424,12	429,67	430,45	431,15	439,35	444,28	451,02	452,24	nd	464,16	469,27	11,33%
Bergen	147,40	nd	154,68	158,06	158,22	158,34	161,36	163,16	165,93	166,60	nd	170,82	171,61	14,11%
Stavanger	109,25	nd	111,67	113,05	113,04	113,24	116,94	118,45	121,66	121,95	nd	126,65	127,28	14,17%
Trondheim	90,65	nd	93,41	94,53	94,65	94,86	96,98	98,55	101,59	102,56	nd	104,69	105,18	13,81%

SOURCE: SSB (2013)

Table 6
Dwelling type variations by municipality.

		2006 Dwellings*	2007 Dwellings*	2008 Dwellings*	2009 Dwellings*	2010 Dwellings*	2011 Dwellings*	2012 Dwellings*	2013 Dwellings*	2013 %	2006–13 variation	%
0301 Oslo municipality	Detached house	26 182	26 271	25 553	25 662	25 783	25 997	29 818	29 795	9,40%	3 613	12,57%
	House with 2 dwellings	19 200	19 411	18 974	18 970	19 078	19 342	20 612	20 611	6,50%	1 411	4,91%
	Terraced house, linked house and house with 3 dwellings or more	29 212	29 457	29 153	29 465	29 759	30 081	30 206	30 506	9,62%	1 294	4,50%
	Multi-dwelling building	209 819	213 277	218 177	222 382	224 518	226 089	227 459	231 519	73,02%	21 700	75,51%
	Residence for communities	3 906	4 127	4 147	4 209	4 233	4 416	4 435	4 627	1,46%	721	2,51%
	Total dwellings								317 058		28 739	
1201 Bergen	Detached house	33 205	33 356	33 985	34 017	34 216	34 436	36 370	36 393	27,83%	3 188	25,45%
	House with 2 dwellings	9 408	9 378	9 530	9 680	9 831	9 941	10 423	10 489	8,02%	1 081	8,63%
	Terraced house, linked house and house with 3 dwellings or more	22 502	22 652	22 859	23 138	23 158	23 421	23 763	23 888	18,27%	1 386	11,06%
	Multi-dwelling building	51 573	53 096	53 683	55 094	55 772	56 194	56 982	57 791	44,20%	6 218	49,64%
	Residence for communities	1 532	1 541	1 971	1 990	2 024	2 084	2 152	2 185	1,67%	653	5,21%
	Total dwellings								130 746		12 526	
1103 Stavanger	Detached house	20 591	20 600	20 672	20 814	21 034	21 184	22 127	21 885	36,70%	1 294	22,60%
	House with 2 dwellings	11 074	11 071	11 084	11 142	11 179	11 237	11 599	11 433	19,17%	359	6,27%
	Terraced house, linked house and house with 3 dwellings or more	8 751	8 905	9 102	9 211	9 290	9 367	9 483	9 620	16,13%	869	15,18%
	Multi-dwelling building	12 124	12 530	13 430	13 994	14 533	14 730	14 580	14 995	25,15%	2 871	50,15%
	Residence for communities	1 363	1 369	1 370	1 404	1 389	1 529	1 699	1 695	2,84%	332	5,80%
	Total dwellings								59 628		5 725	
1601 Trondheim	Detached house	21 202	21 312	21 363	21 464	21 518	21 622	23 155	23 216	25,21%	2 014	21,28%
	House with 2 dwellings	10 242	10 356	10 458	10 552	10 574	10 664	11 195	11 249	12,22%	1 007	10,64%
	Terraced house, linked house and house with 3 dwellings or more	14 703	14 783	14 905	15 181	15 287	15 288	15 604	15 929	17,30%	1 226	12,95%
	Multi-dwelling building	31 359	32 599	34 417	34 849	35 114	35 327	35 479	36 080	39,19%	4 721	49,88%
	Residence for communities	5 104	5 255	5 320	5 400	4 937	5 493	5 657	5 600	6,08%	496	5,24%
	Total dwellings								92 074		9 464	

*OCCUPIED AND VACANT

SOURCE: SSB (2013)

Table 7
Dwelling type variations by city region.

		2006	2007	2008	2009	2010	2011	2012	2013	2013	2006–2013	
		Dwell-ings*	Dwell-ings*	Dwell-ings*	Dwell-ings*	Dwell-ings*	Dwell-ings*	Dwell-ings*	Dwell-ings*	%	variation	%
SP01 Oslo region	Detached house	158 187	159 048	159 478	160 847	162 425	163 404	175 774	176 315	29,80%	18 128	28,12%
	House with 2 dwellings	45 978	46 574	46 582	46 946	47 350	47 975	50 357	50 598	8,55%	4 620	7,17%
	Terraced house, linked house and house with 3 dwellings or more	68 509	69 406	69 774	70 599	71 359	71 939	72 475	73 317	12,39%	4 808	7,46%
	Multi-dwelling building	248 261	254 148	262 165	268 616	271 927	274 990	277 666	284 296	48,05%	36 035	55,90%
	Residence for communities	6 236	6 076	6 150	6 304	6 460	6 690	6 742	7 113	1,20%	877	1,36%
	Total dwellings								591 639		64 468	
SP02 Bergen	Detached house	70 412	71 049	72 068	72 563	73 264	73 769	77 505	77 940	42,41%	7 528	35,42%
	House with 2 dwellings	12 312	12 452	12 917	13 390	13 669	13 950	14 707	14 997	8,16%	2 685	12,63%
	Terraced house, linked house and house with 3 dwellings or more	25 654	26 011	26 449	26 921	27 080	27 490	28 107	28 489	15,50%	2 835	13,34%
	Multi-dwelling building	52 406	54 079	54 958	56 553	57 310	57 861	58 819	59 848	32,56%	7 442	35,02%
	Residence for communities	1 762	1 812	2 275	2 300	2 340	2 410	2 481	2 525	1,37%	763	3,59%
	Total dwellings								183 799		21 253	
SP03 Stavanger	Detached house	67 671	67 993	68 521	69 128	69 789	70 260	73 816	73 833	53,94%	6 162	31,85%
	House with 2 dwellings	16 796	16 880	17 076	17 241	17 377	17 530	18 201	18 183	13,28%	1 387	7,17%
	Terraced house, linked house and house with 3 dwellings or more	14 033	14 403	14 979	15 366	15 690	16 083	16 702	17 529	12,81%	3 496	18,07%
	Multi-dwelling building	17 426	18 629	20 501	21 725	22 699	23 148	23 666	25 325	18,50%	7 899	40,83%
	Residence for communities	1 598	1 617	1 623	1 677	1 665	1 822	1 991	2 002	1,46%	404	2,09%
	Total dwellings								136 872		19 348	
SP04 Trondheim	Detached house	46 453	46 737	46 918	47 210	47 447	47 716	50 447	50 731	39,28%	4 278	31,20%
	House with 2 dwellings	13 320	13 408	13 556	13 633	13 636	13 726	14 323	14 397	11,15%	1 077	7,86%
	Terraced house, linked house and house with 3 dwellings or more	17 098	17 269	17 535	17 880	18 088	18 158	18 569	19 046	14,75%	1 948	14,21%
	Multi-dwelling building	32 792	34 199	36 221	36 897	37 209	37 454	37 737	38 519	29,82%	5 727	41,77%
	Residence for communities	5 780	5 953	6 057	6 140	5 661	6 271	6 449	6 461	5,00%	681	4,97%
	Total dwellings								129 154		13 711	

*OCCUPIED AND VACANT

SOURCE: SSB (2013)

Table 8
Cars and public transport – daily distance per capita, 2003–2012.

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total all modes, passenger km (million)	66 685	67 709	67 693	68 841	70 867	72 372	72 974	73 128	74 411	75 277
Passenger km car (million)	52 127	52 606	52 400	53 302	54 866	55 956	56 536	57 034	58 029	58 701
Passenger km public transport (million)	nd	6 469	7 254	7 259	7 220	7 506	7 481	7 807	7 711	7 800
Total population	4 552 252	4 577 457	4 606 363	4 640 219	4 681 134	4 737 171	4 799 252	4 858 199	4 920 305	4 985 870
Daily km per capita all modes*	40,13	40,53	40,26	40,65	41,48	41,86	41,66	41,24	41,43	41,36
Daily km per capita car	31,37	31,49	31,17	31,47	32,11	32,36	32,27	32,16	32,31	32,26
Daily km per capita public transport	nd	3,87	4,31	4,29	4,23	4,34	4,27	4,40	4,29	4,29
Use of public transport		9,6 %	10,7 %	10,5 %	10,2 %	10,4 %	10,3 %	10,7 %	10,4 %	10,4 %
Use of private cars		77,7 %	77,4 %	77,4 %	77,4 %	77,3 %	77,5 %	78,0 %	78,0 %	78,0 %

*all modes includes:
water transport including ferries, Norwegian State Railways, other railways, suburban railways, urban tramways, road transport, including scheduled bus services, taxis, private cars, motorcycles, mopeds, air transport

SOURCE: SSB (2013)

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