# Sustainable Urban Development – Compact Cities or Consumer Practices?

**Jesper Ole Jensen**
**Toke Haunstrup Christensen**
**Kirsten Gram-Hanssen**
Danish Building Research Institute, Aalborg University

***Abstract***
*Sustainability in urban planning has a long history and it has been a widespread solution to build high and compact in order to minimise the need for transportation, land use and heating. Recent research, however, points towards the need for a supplementary approach, which includes the consumer behaviour of the household. This approach necessarily has to work from below and include the citizens, as it is their daily practices that have to be challenged. This article reviews selected literature and studies on whether compact cities leads to more sustainable cities, and it use lifestyle interpretations of urbane forms to challenge the compact cities approach. As an alternative or supplementary approach the article introduce practice theory as a way to understand consumption and it gives examples on how this approach can be used to inspire local authorities to alternative and supplementary strategies of achieving sustainable urban development.*

***Keywords***
urban sustainability, compact cities, consumption, practice theory

## Introduction

When local Danish authorities in these years work with the challenge of developing more sustainable cities they generally draw on two different approaches: the physical planning and regulations on one hand and attempts to influence citizens' behaviour on the other. The strength and impact of these two approaches are highly diverse. Where physical planning and regulation has proven an effective tool for developing cities in decades, the attempts to influence citizens behaviour has drawn on sporadic campaigns attempting to spread knowledge and change attitudes, most often with limited effect. The idea of this article is to expand on the claimed paradox that the most effective tool for developing cities, physical planning, has little impact on actual sustainability, whereas what is most important for sustainability, the everyday life and consumer behaviour of citizens, is much more difficult to regulate.

There are good historic reasons for city planners to be especially engaged with physical planning as there since the birth of modern urban planning have been various challenges, including

**Corresponding author:** Jesper Ole Jensen, joj@sbi.dk, Danish Building Research Institute, Aalborg University

unhealthy cities in the beginning of last century and controlling the growth of cities in the later part of the century, where urban form and area planning were strong tools. Compact cities have now become a mantra in policy regulations to achieve sustainable cities. This ranges from international bodies as UN, EU, OECD, EEA (European Environmental Agency) to national bodies, as well as regional and local authorities. In Denmark, densification is being promoted in national policies, such as the National Planning Report 2010 (Danish Ministry of the Environment 2010) and the policy document 'The Modern Sustainable City' (Nature Agency 2008). Several municipalities have 'urban density' as a central goal for their urban strategies and plans. As will be discussed later in this article, it is, however, not so unambiguous how physical planning can contribute to the development of more sustainable cities. On the other hand, in recent years there are seen more sporadic attempts to inform and engage citizens in changing their everyday life consumption through different types of mass media campaigns, some of them being initiated by local authorities. From a social sciences perspective this type of programs has been called the ABC approach, focusing on Awareness, Behaviour and Choice, and it has been criticized for a too simple and individualized understanding of how changes in practices come about (Shove 2010). Following this critic a practice theoretical understanding has been developed which focuses on how everyday life habits related to energy consuming practices are established and changed (Gram-Hanssen 2011). In this understanding focus is on how all the daily habits that are causing energy consumption are sustained by collective structures of knowledge, engagement, technologies etc. As the practice theoretical approach includes the physical and technical structures our argument in this article is that this approach can be used to understand how practices and behaviour are partly structured by urban physical planning, though only to a limited degree as other structures of social and cultural kinds also simultaneously takes part in this structuring.

The following of this article will thus first challenge the often assumed fact that compact cities also are the most sustainable cities. This is first done based on a literature review and afterwards by drawing on lifestyle interpretation of different types of urban domains, showing the relations between socio-economic characteristics of citizens, consumptions patterns and urban form. Following from this we will go deeper into how energy consumption patterns in urban areas can be understood within a practice theoretical approach. Based on this understanding the article presents different examples of strategies for how local authorities can work towards sustainable urban development.

## Are compact cities more sustainable?

It has for some years been an unchallenged assumption that compact cities are more sustainable. A number of studies have suggested a strong correlation between urban density and sustainability, primarily in relation to transport (Newman & Kensworthy 1989; Næss et al 1996): The denser, the better options for walking or public transport and the less need for car transport. A number of other benefits of the compact city have been argued by other scholars, for instance increased accessibility, preservation of green areas outside the cities, re-use of existing infrastructure, regeneration of urban areas, lower energy consumption for heating, more life quality, better neighbour relations, more safety (van der Waals 2000; Burton 2001; Gordon & Richardson 1997; Thinh et al 2002).

In recent years, however, a number of studies have tested the assumptions between density and sustainability and paint a much more ambiguous picture. For instance, van der Waals (2000) has made a state-of-the-art survey on relations between urban form, and sustainability, based on transport, energy-use in housing, noise, odour-pollution, air-pollution and fragmentation of green areas. He concludes that '... the potential of the compact city policy to contribute significantly to the solution of environmental problems in the short term is limited' (van der Waals 2000).

Neuman (2005) sums up a number of recent surveys and concludes that even on transport alone there is no unambiguous correlation between urban density and sustainability. For instance, studies in Holland, known as a dense-city society, differences on transport in different types of urban densities shows only 5% variation. In areas with a very strong urbanisation, the energy use for transport per person per day is 50.9 MJ, in areas with strong or average urbanisation energy use is 54.5 MJ, in weakly urbanised areas 48.4 MJ and in rural areas 51 MJ (Bouwman 2000). Empirical studies from Breheny (1992) and Williams, Burton & Jenks (2000) also gives no ultimate answer; the short trips might be fewer in more compact cities, but travel to more specialised purposes (work, entertainment, leisure, shopping etc.) are generally not affected. The overall conclusion is that the transport to a much larger extent relates to income, and that the growth in car-ownership and air-travel has made it difficult to reduce the amount of transport-related energy use through the city design.

***Different definitions of sustainability and density***

Comparing the different studies, it is obvious that the concepts of 'density' and 'sustainability' are defined very differently (Dempsey 2010), which definitely blurs the comparability of the studies. 'Density' can be defined broadly, e.g. Burton (2001) who defines density by three different parameters, which are each measured by three indicators:

1. Density (urban density, density of buildings and density of jobs),
2. Mix of functions (households-jobs, households-enterprises and variation in area use between housing, trade and industry), and
3. Intensification (changes in residential density, changes in building density, and changes in job density over 10 years).

Other studies uses only single parameters, for instance degree of urbanisation (Bouwman 2000), distance to city centre or to local centre (Holden & Norland 2005). Part of this ambiguity relates to cultural and contextual differences. For instance, London's most dense neighbourhood is 130 dwellings per hectare, which in Mumbai represents low-density housing (up to 200 dwellings per hectare) (Dempsey 2010).

Sustainability is also defined in many different ways; in some studies as a broad concept covering environmental, social as well as economic issues (and in some cases also how the three dimensions interact). Other studies include only environmental elements, for instance energy use for transportation and housing. And even within transportation there might be different focuses as some studies only include car travel while other include flight travel as well. To illustrate the different approaches and results in research on urban density and sustainability, we will shortly present three recent and independent studies from different regions.

A Norwegian (Holden & Norland 2005) study compares eight residential areas in the Oslo-region and finds a positive correlation between density and sustainability. For energy consumption in houses, increased density leads to smaller consumption rates, primarily because it allows district heating. For transport, everyday travel depends on the proximity to the city centre, whereas for leisure travel there is a reverse correlation: The denser, the more air-travel. Furthermore, owning a garden seems to have a reducing effect on annual air-travel and long car-travel. Based on this material, the authors suggest that a 'medium-density' gives the lowest travel need.

A Taiwanese study (Lin & Yang 2006) has explored 92 city districts and finds a negative correlation between urban size and environmental sustainability. They define density according to Burton (2001), measured by three indicators: Density, mix of functions and intensification over a 10-year period. Sustainability is also defined on three areas:

1. Environmental (green areas outside cities, gasoline consumption and air pollution),
2. Economy (production, investments and public spending) and
3. Society (public service, crime and access to housing).

In their model, they investigate three types of density in relation to the various sustainability parameters. They conclude that increased density and intensification has a negative influence on the environmental and social sustainability, but a positive influence on the economic sustainability (Lin & Yang 2006).

An Irish study on city size and sustainability in 79 Irish cities (O'Regan et al 2008) finds a clear connection between settlement size and sustainability, including environmental, social and economic conditions. For the environmental elements the total index on Ecological Footprint (EF) showed no correlation with the settlement size, but on the single elements (energy for heating, waste, food, transport and water) there were various degrees of correlation. When the study included environmental as well as social and economic measures of sustainability, it showed a clearer correlation with the settlement size (O'Regan et al 2008).

These studies underlines that density and sustainability are defined very differently (Dempsey 2010; Neuman 2005) and that density is closely related to the different types of urban districts and different types of residents living here. Therefore, the overall generalisation of density versus sustainability in large remains an assertion. Nevertheless, there seems to be a growing consensus on increasing the density of cities (Neuman 2005; Holden & Norland 2005).

## Consumption patterns and urban lifestyles

Instead of seeing variations in urban activity- and consumption patterns as a result of different urban structures, an alternative approach is to see it as a result of different lifestyle groups living different places in the cities. In Danish research this understanding and approach has been prevalent for a long time. A number of studies have aimed at mapping consumption patterns in different city parts and interpret them as representing different 'lifestyle domains', where different groups in the city share structural circumstances (infrastructure, dwelling types etc.) as well as norms and attitudes that influence consumption practices in relation to heating, electricity, water, waste sorting, transportation etc. (Jensen 1996; Marling & Knudstrup 1998; Jensen 2002).

The studies can be seen as an attempt to combine a quantitative approach with a cultural understanding of consumption (Bourdieu 1984; Douglas & Isherwood 1996; Wilhite et al 1996). The quantitative approach included collection and mapping of actual consumption on energy, water, waste in households, as well as socio-economic data and building data. This was partly a reaction to more normative understandings of 'green lifestyle, like for instance different guidelines to green lifestyle, to sustainable building, or studies focusing on single 'green' attitudes and technologies (for instance waste sorting) without including the whole consumption pattern (Jensen 2008).

It is obvious to see lifestyle segregation in relation to urban density. Urban density and urban qualities influences many parameters, including social and economic conditions (Williams et al 2000), which residents they attract, and the overall sustainable performance. As an illustration of how urban density and different lifestyles relates to urban sustainability, a study has compared ten urban districts in Copenhagen on a number of sustainability indicators including heating consumption, housing space consumption, car ownership and income (Jensen et al 2009).

As seen in figure 1, there is – in line with the consumption studies – apparently a strong correlation between the districts on income, housing space consumption, heating consumption and car ownership.

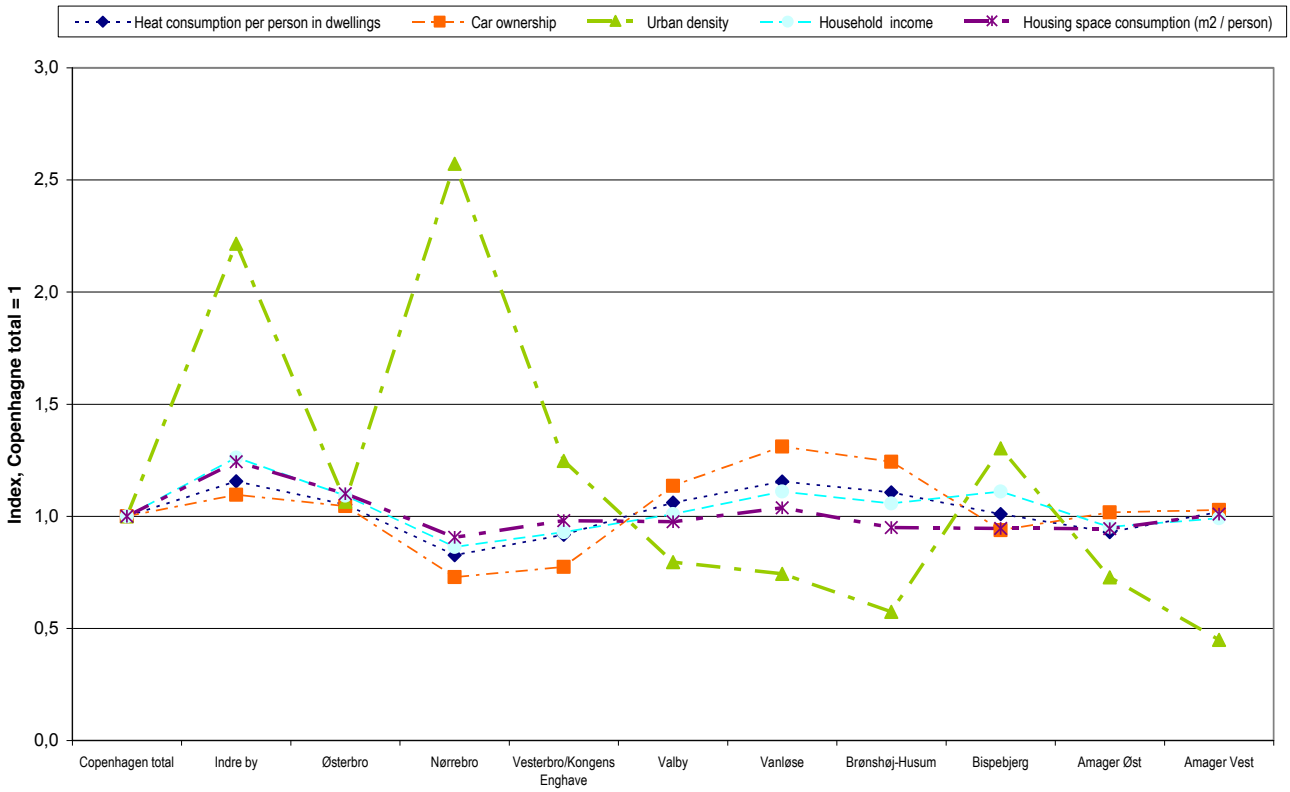


**Figure 1:** Index for urban density, heat consumption, car ownership and household income in the ten districts in Copenhagen. Jensen et al (2009).

The relation to urban density is more ambiguous: For the districts with the highest densities, we would (due to better proximity to services and public transport, and less heat losses from houses)

expect a higher degree of sustainability and less consumption. For some districts, this connection apparently holds; the two former working-class districts Nørrebro and Vesterbro appeals to students and low-income groups looking for urban life and affordable accommodation; these districts have high densities and low consumption scores. Districts with a more suburban character (Vanløse and Brønshøj-Husum) to a larger extent appeal to two-income families in owner-occupied single-family house with children, car and garden; these districts have a low density and a high consumption score.

There are, however, exceptions to the correlation between density and sustainability. One example is the district 'Indre By ('Inner City'), which has the second-highest density, but has high consumption rates on housing, heating and car ownership; the heat consumption per inhabitant is the largest in the municipality (app. 8,000 kWh / person / year), so is the housing consumption (72 m2/person), which indicates a high consumption of electricity. In spite of the proximity to all kinds of services and urban qualities (for instance, more than third of the workforce work on an address within the district), the car ownership is surprisingly high (194 per 1,000 inhabitants, or 10% more than for the city on average). Here, consumption dynamics, including a high household income, apparently overrules the sustainability qualities of the compact city, as this district has an over-representation of well-educated and high-income households. It should be noted that the buildings of Inner City and the districts Nørrebro, Østerbro and Vesterbro are of similar type and age, and have a lower heat consumption per square meter (106-110 kWh/m2) than the city in general (112 kwh/m2). However, as the residents in Inner City have a high consumption of square meters, they also have a high consumption of heating per inhabitant.

This study illustrates that although there to some extent is a correlation between density and urban sustainability, density plays a minor role in itself, but is embedded in historic, economic and demographic differences in the city.

### *Shortcomings in the life-style approach*

Although the lifestyle approach in many ways offers a better understanding of the sustainability patterns in the city than just looking at the urban form, there are also shortcomings in this.

Firstly, the life-style approach seems incapable of explaining the large variations in consumption. Several studies have demonstrated that it is very difficult to point out a clear connection between lifestyle, dwelling type and resource consumption. A PhD study exploring consumption patterns in low-density residential areas in Århus shows that dwelling consumption is a decisive factor for resource consumption, but also that there are major differences (6-700%) in consumption rates between households living in the same type of dwelling (Jensen 2002). This partly reflects differences in age and family types, for instance do families with small children typically have a lower consumption per person than ‘the empty nesters’. Interviews also reveal that different uses of the dwelling provide a reason for the differences (Jensen 2002). A Danish study on households’ consumption of electricity and heating shows that even within urban areas with similar density and identical buildings the households’ energy consumption varies with up to a factor four between the lowest and the highest consumption (Gram-Hanssen 2003). On the basis of survey and qualitative interviews, the study finds that these differences only to a minor degree can be explained by traditional socioeconomic variations among the residents (like income, age and

occupation), but are much closer related to differences in the residents daily behaviour in relation to e.g. bathing, preferred indoor temperature, airing, use of electric appliances, turning off standby etc. When studied in detail through qualitative interviews, each of these daily behaviours appear to be the result of many different elements including the material characteristics of the buildings and the electrical appliances purchased by the residents as well as the residents' personal biography (e.g. some residents' experience of material shortage in their childhood), phase in life, attitudes toward consumption and use of resources as such etc.

Secondly, the emphasis on lifestyle seems to place much of the responsibility of solving environmental problems on the individual consumer, despite their often limited options for change. Also, a consumer-oriented policy might legitimise an absence of public regulation. Instead, scholars have argued that attention should be paid to identifying the driving forces shaping consumption, including infrastructure, technology and norms of comfort, cleanliness and convenience (Wilhite et al 2000; Shove 2003).

For the compact city approach, similar critical voices have been raised on the transformation potential; that it is naïve to believe that urban form can regulate human behaviour and that the compact city concept, such as 'New Urbanism', is rather rigid and does not encourage public participation or dynamic urban development (Neuman 2005).

## A practice theoretical approach to understanding consumption

As the previous discussion has shown, the empirical evidence of the environmental benefits from high- density urban planning is ambiguous and is dependent on how urban density is defined and how resource use, environmental impact and sustainability are measured. Thus, high density urban planning might in some cases be part of the solution, but has to be combined with other measures if the aim is to reduce resource consumption and environmental impact.

In order to better understand how consumption patterns are constructed and develop, it is necessary to change the analytical focus from either the material or the social/behavioural approach and instead focus on the daily practices that residents carry out in their everyday life and which determine the level of resource consumption. This is done in the so-called practice theory approach that has gained ground in e.g. consumer studies within recent years (Warde 2005; Shove & Pantzar 2005). Practice theorists argue that the social practices, people's doings and sayings, should be at the centre of the analysis (Schatzki et al. 2001). For instance, the way people make their home comfortable can be regarded as an everyday practice that is determining for the household's energy consumption for heating. The practice of comfort is made up of many different sayings and doings that relate to understandings of what a comfortable home is and how to achieve this. For instance, routines of adjusting thermostat settings or airing are part of the overall comfort practices. Another example could be transport, which is an integrated part of many different everyday practices such as commuting, shopping and leisure – as well as transport in itself, e.g. car driving, can be regarded as a daily practice.

The emphasis on bringing practice theory into consumer and environment studies mainly draws on practice theory as formulated by Schatzki (1996) and further elaborated by Reckwitz (2002a). Both accentuate the collective aspect of practices. Reckwitz states that the single individual acts as

a carrier of practices, while Schatzki says that practices are coordinated entities of doings and sayings held together by certain elements. Schatzki (1996) writes that practical understanding, also described as embodied know-how or routines – the body knowing how to act, is one element in holding a practice together, whereas explicit rules, principles and instructions is a second. A third element is the teleo-affective structure, which is a compound of something that is goal-oriented and has meaning in a substantial or ethical sense. Teleo-affective structures include purposes, beliefs and emotions. Several authors including Warde (2005) and Shove and Pantzar (2005) have developed this approach further by renaming or re-grouping the elements holding practices together and adding technology as an important element as well (Reckwitz, 2002b).

The following four elements have been used and proven valuable in empirical investigations of residential heat comfort practices (Gram-Hanssen 2010a) and standby consumption practices (Gram-Hanssen 2010b):

1. Know-how and embodied habits;
2. Institutionalised knowledge and explicit rules;
3. Engagements;
4. Technologies.

Following Giddens' structuration theory (1984), each of the four elements should be seen as both structuring and sustaining social practices at the same time as they are themselves sustained and formed by the practitioners performing the practices. How the practice theoretical approach can be applied to the study of energy consumption in households is illustrated in the following by an empirical example.

The heating of dwellings is of major importance in relation to energy saving. As already indicated, a number of elements influence the actual energy consumption for heating in dwellings, and the material-technical characteristics like building type and insulation are just one among several components that constitutes the daily heat comfort practices and the level of energy consumption. One of the previously mentioned studies (Gram-Hanssen 2003) of similar dwellings demonstrating huge differences in actual energy consumption (factor 2-3 in heat consumption in identical buildings) has been further analysed in a practice theoretical frame (Gram-Hanssen 2010a). Qualitative interviews have been used to identify the most important elements that constitute residents heating practices and explain the major differences between households in relation to practices and energy consumption.

With regard to the technological element, the material characteristics of the house (e.g. the layout of the house), the heating system and the heating supply system (in this case district heating) are identified as the most important. For instance, all dwellings had two floors with a basement, and all interviewees used the first floor for sleeping and the ground floor as a living room, which both followed the architectural layout of these houses and the cultural norms of a modern Western arrangement of the home. However, as many interviewees found it important to ventilate the bedroom and to keep a lower temperature for health and comfort reasons, all interviewees kept the trickle vent open in their bedroom and this, combined with the fact that hot air rises from ground level to first floor, made it decisive for the energy consumption whether the residents in

general kept the inside doors closed or open (if open, the hot air from the ground floor moves upstairs and increase the air change in the home).

With regard to know-how and embodied habits, the study showed that the households had different embodied habits with regard to how they interact with radiators valves, doors, windows etc. For instance, for many of the interviewees their embodied habits could be seen as either a continuation of or a reaction to how their parents practiced indoor climate regulation. One example is a couple that immigrated to Denmark from Poland and who had lived in Denmark for 12 years. They turned off the heat every evening before going to bed or in the morning before leaving for work, and they normally only heated the ground floor and closed the door to the stairway in order to keep the heat in the living room. The couple explained that they were not from their childhood in Poland familiar with the Western "use-and-throw-away" culture. Thus, turning off heat and closing inside doors were embodied habits from their own childhood that still structured their present practices. This family was among the households with the lowest energy consumption for heating.

With regard to institutionalised knowledge and explicit rules, some interviewees referred to campaigns in the 1970s to promote a lower indoor temperature as part of their explanation of their present practice. The interviews also included a very tangible example of how rules can affect practices: One of the interviewed families had recently got a penalty tax from the district heating company for not cooling the district heating water enough. Even though the family did not technically understand what this meant, they disliked the idea of being penalized in this way and were quite eager to learn about it in order to change practice and prevent further penalty taxes.

With regard to engagements, the interviews showed that heat comfort practices were influenced by many different meanings like environmental concerns, interest in saving money, satisfaction in doing the right thing technically (e.g. efforts to 'optimize' the performance of the heating system in the house), and the meaning of the home and how this contributes to the constitution of comfort practices. An example of the latter is one family that emphasized the importance of maintaining a cosy and welcoming home, which implied rather high indoor temperatures.

This example of heating illustrates how everyday practices are constituted by a heterogeneous complex of elements and how the focus on practices is essential for a better understanding of energy consumption. The practice theory approach can be applied to many other everyday practices such as food consumption (Halkier 2010), use of electrical appliances (Gram-Hanssen 2010b; Røpke et al. 2010) and transport (Shove and Walker 2010). Material structures, including the urban form, transport infrastructure, type of housing and technical construction of buildings, are important determinants of the final energy consumption. However, this is just one part of the story, and there are other equally, or even more, important elements. In relation to sustainable urban development, the question is how also other aspects of urban living, except from urban structure and physical planning, can be included in the discussions. On the basis of the perspectives and lessons from practice theory, an effective strategy for sustainable urban development should address all elements holding everyday practices together. In the following we will focus on how one of the important actors in creating urban development, the local authorities, can use these insights in developing sustainable cities.

## Sustainable urban practices: Practice theory inspired strategies at the level of local authorities

The municipalities' citizen-oriented strategies and initiatives tend to focus almost exclusively on information campaigns that inform the citizens about the climate impact of different everyday activities such as car driving or showering and how to reduce the environmental impact by changing habits (like taking shorter showers). Thus, local strategies often only address one of the four elements of everyday practices we have identified previously (the knowledge element). By 'raising the awareness' of environmental problems, and how these relate to consumers daily behaviour, some of these initiatives also seem to aim at changing the engagements by inducing a kind of 'bad conscience' among the citizens, and thus motivate them to pursue a more environmental friendly lifestyle. Citizen-oriented local initiatives are in general based on an understanding of the dynamics behind energy consumption that comply with what Shove has defined as the ABC-model: 'For the most part, social change is thought to depend upon values and attitudes (the A), which are believed to drive the kinds of behaviour (the B) that individuals choose (the C) to adopt' (Shove 2010: 1274). As a result, initiatives to reduce households' energy consumption tend to focus on changing their values and attitudes. The origins of this thinking, the ABC-model, can be traced back to psychological conceptualizations of planned (rational) behaviour and needs. As emphasized by Shove, by focusing solely on the individual and his/her individual choice, this understanding of social change do not recognize how daily practices, the daily life and its 'needs', are co-constructed by many different elements. As a result, only few initiatives change focus from the individual and attempt to create a comprehensive approach that coordinates activities and initiatives across many different elements and levels, like combining information campaigns with infrastructural changes and activities aimed at influencing people's engagements.

In the following, we will present two cases that illustrate how municipalities can work towards sustainable urban development in a way that address all, or at least several, of the four elements that constitutes the energy consuming practices of everyday life. The cases have been selected on the basis of a brief review of recent years' citizen-oriented, local sustainable urban initiatives in Denmark. It is necessary to emphasize that the two cases have not been chosen because they represent "best cases" in a traditional sense, but because they on the strategic as well as the practical level include a set of initiatives that addresses several of the elements that are constitutive of the daily practices they focus on. Also, none of these cases have explicitly been developed on the basis of a practice theory approach by the municipalities. However, our argument is that practice theory can be used to analyse and further develop these kinds of approaches and to give them a "theoretical backing" like the one the compact cities approach has had for many years.

### *Bicycle policy in Odense*

The first example is from Odense, the third largest city in Denmark. The municipality has for several years had a comprehensive bicycle policy with many initiatives aimed at promoting bicycling as a mean of transport in the city. From 1999 to 2002 the municipality run a project called 'Odense – the national bike city of Denmark', with a total budget of 20 million DKK. One of the aims of this project was to increase the number of bicycle trips in Odense by 20% in 2002. (Troelsen et al. 2004; Odense Cykelby 2011)

With regard to the material element (technologies and infrastructure) of daily transport practices, the project included many different improvements of the conditions for bicyclist such as better parking facilities at public places, services like free pump stations for inflating bicycle tyres and adjustments of traffic lights in order to create 'green waves' for bicyclist instead of for cars. Initiatives related to institutionalised knowledge and rules included general information campaigns and changes in the traffic regulation (e.g. making it legal for bicyclist to make right turns at T-junctions if the traffic light is red and allow bicycling on pedestrian streets in the evening and night). With regard to engagements, the project had a dedicated focus on improving the 'image' of bicycling; through advertising and distribution of magazines the idea of bicycling as stylish and closely related to healthiness was promoted. Only in relation to know- how/embodied habits the initiatives seemed to be more limited, although the project also included activities with a focus on breaking bad and risky habits in the traffic like driving in pedestrian crossings and instructing school children in safe bicycle habits.

The Odense bicycle project differs from most Danish citizen-oriented initiatives at municipality level in at least two ways: Firstly, only very few policies promoting sustainable urban development focus on private transport and put up explicit goals for substituting private car transport with bicycling like the case was in Odense. Secondly, the Odense bicycle project combines and coordinates many single initiatives that support a change in the daily transport practices from many different angles. Thus, the project addresses all the four elements that constitute practices. This might be an important part of the reason why the project seems to be highly successful in increasing bicycle traffic and promoting people to change their daily practices. An evaluation from 2004 (Troelsen et al. 2004) showed that the number of trips had increased by more than 20% and that about the half of these additional trips replaced trips by car (the rest replaced trips by foot and public transport).

***Project Zero in Sønderborg***

The second example is from the municipality of Sønderborg in southern Jutland. In 2007, Sønderborg municipality in cooperation with other local actors initiated an ambitious project named 'Project Zero'. The overall goal of this project is to make Sønderborg municipality CO2 neutral by 2029 by reducing the energy consumption by 50% and creating an energy system based on local renewable resources.

One of the main activities has been to involve local citizens through the so-called 'ZEROfamilies' project. The aim of this activity was to motivate and help 100 families in the municipality to obtain significant reductions in their energy consumption and CO2 emissions. By doing this, these families should become role models for the rest of the local population and inspire other families to do the same. It was estimated that these families saved on average about 1 tonnes of CO2 emissions per year, mainly by changing everyday habits and routines (Project Zero 2011; Sønderborg Kommune 2010). The project also includes activities addressing other sectors of the municipality such as local companies and shops. One example of this is a supplementary training programme for the local skilled craftsmen with focus on energy efficiency renovation of buildings. About 30% of the local craftsmen have completed this training course, which is organized in collaboration with the regional vocational college for trades and industry and the Danish Technological Institute.

Similar to the bicycle project in Odense, Project Zero also attempts to support a change to more sustainable practices through a broad approach that involves a variety of different activities, and each of these addresses one or more of the elements that produce and reproduce everyday practices. Thus, even without referring to practice theory at all, this project exemplifies some of the overall ideas and principles that can be derived from the practice theory approach. An example relating to the element of technologies and infrastructure is an electricity meter that all the ZEROfamilies were supplied with. With regard to institutionalised knowledge, the Project Zero includes informational activities such as feedback to households regarding their energy consumption, general information about climate friendly habits via leaflets and on the internet, offering home owners a free energy audit of their house, better possibilities for getting a loan for energy renovations and the aforementioned supplementary training course for local skilled craftsmen. The latter at the same time exemplifies how the project also includes activities with a focus on changing know-how (in this case the professional skills of craftsmen). Finally, Project Zero also intends to change and create engagements through information and via the ZEROfamilies, which should act as 'role models' for the rest of local community.

Project Zero has not yet been evaluated, as is the case with Odense Bicycle project, and it should therefore not be used as an example to say that this type of projects always will succeed. However, like the Odense Bicycle project, Project Zero exemplifies a comprehensive approach that includes many different initiatives addressing most of the elements identified as important by practice theory. Also, both examples illustrate how significant improvements can be obtained by approaches that do not focus narrowly on urban density as the main strategy but instead focus on the totality of elements that together determine the citizens' resource consuming everyday practices.

## Discussion and perspective

The compact city has for several years been a signpost within sustainable urban planning. It is held that reduction in resource consumption and a higher level of sustainability can be achieved through policies that focus on increasing the urban density, which is often measured by the population density within the city. While acknowledging that the compact city and increased urban density in some cases can be a part of a sustainable urban development, our review of the existing literature shows that the empirical evidence of the environmental benefits from high-density urban planning is equivocal and that empirical conclusions depends on how urban density is defined and how the environmental impacts are measured. Thus, there is no strong empirical evidence in support of the conclusion that increased urban density in itself results in more sustainable cities. On the contrary, studies show that the energy consumption and environmental impact of households are influenced by a multiplicity of factors, including urban density as just one among many others. Following the insights from practice theory, four types of elements is identified as constituting the daily practices, such as heating, laundering and transport, which all are practices that determine the household's energy consumption and environmental impact. These four elements are: *Embodied habits, knowledge/rules, engagements, and technologies (material structures)*.

Practice theory suggests that practice change is most successfully facilitated if initiatives address all four elements constituting and holding practices together. Thus, sustainable urban policies that only address for instance the knowledge element (like information and awareness campaigns) or the technological/material element (like urban density strategies) tend to have a limited impact. Just informing people about the environmental disadvantages of car driving seldom motivates changes in daily transport practices. But if this information is part of a comprehensive approach that includes initiatives related to all four elements that constitute the citizens' daily transport practices more thorough changes can be achieved. We have exemplified this by two recent examples from Danish sustainable urban policies and projects. Even though these projects have not originally been developed on the basis of a practice theoretical approach, we have used them in this article as an illustration of what ideas we would propose based on insights from practice theory. In a dialectic relation between research and practice it is assumed that we can develop a better policy for sustainable urban development which will overcome the paradox that the strongest urban policy means, the physical planning, has little impact on sustainability, whereas the daily practices of the citizens, which has a huge impact on sustainability, is impossible to regulate. As argued in the article, the solution is to combine the physical changes with many other types of means influencing the collective structures and elements holding these practices together, and to realize that there is no strong empirical evidence in support of compact cities as an efficient sustainable urban strategy.

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