

Can urban form affect the way of travelling?

Background

Environmental challenges to urban planning

During the last decades urbanisation has been dramatic. For the first time in history, more than half of the world's population is living in urban areas, in Norway more than 80%. In a global context the development is heading towards an urban population of 70% within 2050. Cities are a great consumer of energy and more than 70 % of all greenhouse gas emissions in the world come from urban areas (UN-Habitat, 2009).

Future urban development is facing great challenges regarding health, environmental issues, transport, land use, housing politics, and economical issues. This includes among other challenges also discussions on new ways of designing urban form. All these issues are essential for keeping up good living conditions also for coming generations.

The future growth and transformation of our cities have to be in accordance with a long-term sustainable perspective. A crucial question is how we will enable the cities to reduce the consumption of resources and the emission of greenhouse gases, plus to provide conditions for a good urban life.

Planning sustainable cities

Car transport has increased during the last decades, which has clearly negative impacts on the quality of our environment and contributes significantly to emissions of green house gasses. In a sustainable city we cannot go on travelling in the same way. The "cities of the future" need to develop new urban structures and transport systems that encourage walking, cycling, and the use of public transport. This is easy to state but difficult to achieve, since the ability to move around is an integral part of peoples' lives and modern society, and the need and demand to travel will not diminish.

From a long term perspective it is important to acknowledge that urban planning has an influence on creating or reducing the demand for transportation. Transport in the cities should no longer be based on car travel. The structure should be transformed in order to integrate environmental-friendly transport in a better way with working places, services and residential areas located so that walking, cycling and public transport seem natural.

"Broeset – Towards a carbon neutral settlement in Trondheim".

The goals of the project

The Municipality of Trondheim together with The Norwegian University of Technology and Science (NTNU) and the research company SINTEF have established a research project on carbon neutral housing settlements "*Broeset – Towards a Carbon Neutral settlement in Trondheim*". This project is among other questions, exploring how urban forms can contribute to a more carbon neutral housing settlement through reduction of car traffic, favouring public transport, cycling and walking.

The energy - and climate action plan for Trondheim municipality sets an emission target for 2020 that is 25% lower than emissions in 1991, and 70 - 90% lower in 2050 than in 1991

(Trondheim kommune, 2010). This is in line with what the Intergovernmental Panel of Climate Change (IPCC) believes is a necessary reduction if we are to reach the target of a maximum of two degrees Celsius increase in temperature level on Earth. But while greenhouse gas emissions should be reduced by 25%, it is expected that the population in Trondheim will increase from 140 000 inhabitants in 1991 to around 200 000 inhabitants in 2020 (more than 40%).

The vision for the project is that every inhabitant of Broeset will contribute to an emission of less than 3 tons of CO₂ per year, compared with 8 -11 tons of CO₂ which is the average emission level per capita in Norway today. The goals set are ambitious, but it makes no sense if they are also attainable.

The Broeset project is also a showcase of how important environmental goals can be realized. Reduced emissions from transport must be a large and important contribution. With its suburban location with poor public services and in an area characterized by low utilization, there is a large and difficult task on the Broeset project. It should therefore be considered radical solutions for pedestrians and bicycle traffic, public transport, car transport, car ownership and parking within the development area and the area's connection with the surrounding urban structure that may contribute to reduced emissions from the transport sector.

The Broeset area.

Broeset has been chosen by the Trondheim local authorities as a location for a new neighbourhood that combines low energy demand with a socially sustainable living environment. Designing a settlement that enables people to lower their carbon-footprint is not only a matter of technology, material and energy use, but includes as well lifestyle, housing patterns, and transportation. One of the goals for development of the Broeset area is to make it easy and obvious for the residents to choose other modes of transportation than the private car. The urban development of Broeset will be a case study on how urban form might influence people's choice of mode of transport.



Figure 1: Broeset is a 35 hectare site located 3 kilometres south of the centre of Trondheim. Despite this moderate distance to the centre, the area is characterised by a suburban nature.

The ambitious objective for the research project is to develop Broeset as a future-oriented and carbon neutral neighbourhood, how urban planning and urban form can contribute to a reduction of environmental impact from transport. A reduction of emission from transport is therefore an important task in this project. We need more understanding and knowledge about

the populations` way of travelling connected to offers of transportation and urban form. What actions should be taken regarding the development pattern on the level of neighbourhoods and townships to reduce the demand for transport in urban areas and transfer more traffic to walking, cycling and public transport?

Relationships and conflicts

Aspects of the built environment that previous research has found to influence travel behaviour, include *urban size and form, localization of urban activities, density, street grid layout, connectivity of walk and cycle paths, restrictions on parking and the design of the transport system*.

These are important aspect for a sustainable urban planning program, with strong relation between different parameters. When we deal with one, it influences the others. For example will introducing parking restrictions reduce the possibility to choose the private car as a mode of transport, but such restrictions will also influence choices of where to live and influence the distribution of the population within the different areas of the city.

Developing a compact city is an indisputable way of reducing the distances between working places, urban service and residential areas. Compact cities can promote walking and cycling and improve the traffic basis for public transport. But it will probably also prevent families with children from moving there. Some of these relations are illustrated in the figure below and are studied in the research project at Broeset, Trondheim.

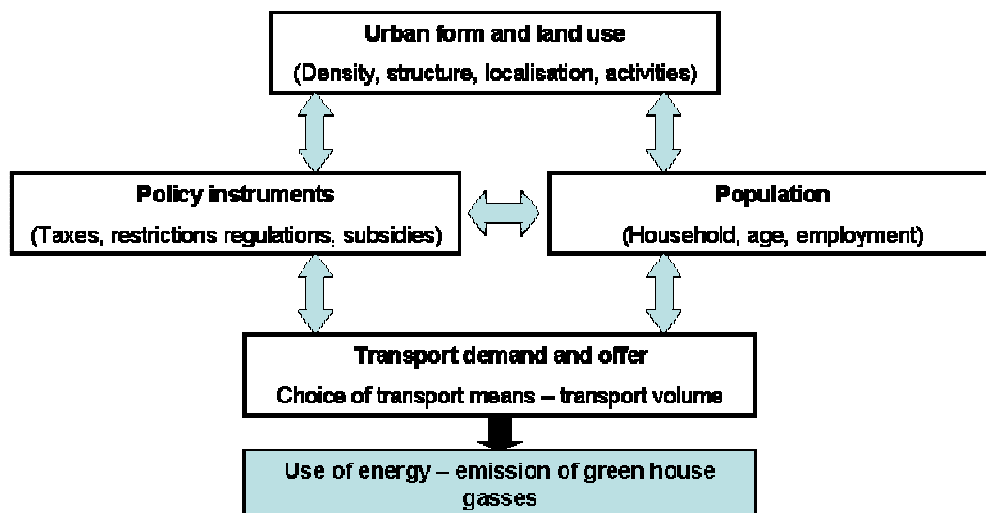


Figure 2: Relations between different parameters of urban development.

Density.

Densification is an important means to reduce transport needs and reduce emissions from road transport. Densely populated areas usually have more features within short distances and are creating less transport work. High density in urban areas results in short distances for daily tours and can reduce the need for motorised transport and has a beneficial effect on the transition from road transport to walking and cycling. Dense cities provide also a better basis for public transport with increased frequency.

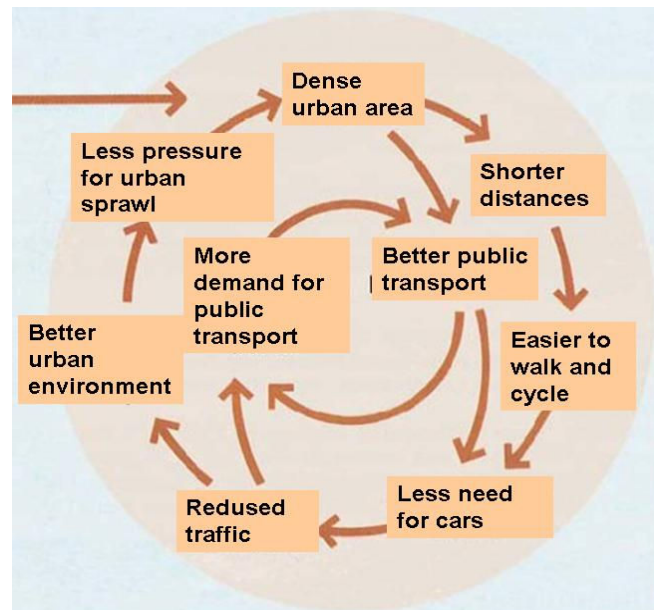


Figure 3: Relationship between land use and transportation. The good circle. ((Kittang, 2010) based on Ministry of the Environment 2000)

On the other hand we know that compact cities are not very popular among families with young children. These will have a tendency to move to less dense areas (Eiksund and Relling, 2009). Even if empirical data confirms the connection between urban structure and transport, this example indicates that transport choices are complex decision making processes, and there are also other aspects than urban form that are important to consider.

The Norwegians are used to travel by car. The proportion of car owners in Norway is high compared with other European countries (SSB, 2009b). This background has also consequences for our views on the design of residential areas. In Norway, detached houses are still the most common housing type (SSB, 2009a). High density has an influence on whether people own a car, and the lower density a site has, the greater is the possibility that people own a car (Maat, 2009). Norwegian travel surveys also show the same (Denstadli, 2002, Tretvik, 2001).

The average size of housing in urban areas has become smaller within the last decades. In the central part of the city we find smaller and more expansive houses. Families with children therefore often move from central parts of cities to suburban districts in order to buy bigger and cheaper houses. This is accompanied by increasing use of the private car.

Land use

Expectations for an environmentally friendly city often lead to the desire for a diverse urban environment with many different urban functions, service and trade, jobs and housing. Based on the ABC principle "the right business at the right place", a major expansion of functions and activities that are not based on demand in the area, is little consistent with the location of Broeset in the urban structure. A sustainable city with a diverse social, cultural and commercial urban content, should gather urban services that are used by the broad public and provide many working places in the city centre, easily served by public transport (Strømmen, 2001).

With its location outside the "*bow of public transport*" (Figure 5), Broeset should not make room for functions and jobs that can provide commuters to the area. Broeset should have features that are based on local customer base and allowing those who live on and around Broeset can get as many of their errands covered locally and accessible on foot or by bike. Grocery stores, schools, and kindergartens are among the most important features that should be in walking or cycling distance.

This implies also that Broeset must provide the necessary infrastructure, such as kindergarten and school, which make the parents less dependent on driving their children by car. Land-use mix and local services are important to be available within a short distance. This will give the residents the opportunity to choose different modes of transport, even if they are families with young children. We have to find ways to influence travel behaviour, and in this context the wish for comfort should not be underestimated. Therefore it is important to keep in mind that cycling, walking, and public transport should be perceived as comfortable alternatives to car use.

Population and households

The Trondheim local authority has conducted a study on the connection between housing structure, typologies and population development, especially the distribution of households with children (Eiksund and Relling, 2009). This study shows that the population distributes on different types of houses. While introducing higher density in existing central areas, families with children are moving to suburbia or to surrounding communities where the prices are lower, while elderly people and young people without families stay in central parts. Families with children from 1 - 5 years live mainly in semidetached houses. Characteristic for this housing type is the connection to the garden plus the size of the house. Detached and semi detached houses have also more space and more rooms than housing blocks. These are important aspects for families with children when choosing a house. With increasing number of floors as for instance in housing blocks, the number of families with small children decreases significantly.

This has great consequences for the demographic development of those central areas, the transport system and also for provided infrastructure. For instance schools in the central areas of the town lack pupils, while schools in suburban areas do not have sufficient capacity.

This pattern of segregation also influences transport offer since families with children are more prone to travel by car. When they move away from the city centre, the use of car will be even more important, while elderly people and young people are not so depending on using private cars. This indicates a connection between urban form and travelling behaviour but also that phases in life and family situation are important (Meland, 2006, Vibe et al., 2005).

The challenges for urban planning and for developing concepts for the new neighbourhood at Broeset are obvious. Should we choose a development concept that might not be attractive to families with children, but only for elderly people, households without children, and young people? Half of the households in Trondheim consist of 1 – 2 persons. The segregation of the population has also dramatic consequences for the city life. Small households per apartment are also negative in terms of energy consumption and greenhouse gas emissions.

Choice of travel modes

According to the Travel Survey 2010 used 40,6 % of residents in the Broeset area daily private car to work or to school. 22,6 % used bike and 23,6% were pedestrians, while only 9,5% used public transport. The low percentage using public transport is probably due to the low supply in the area. The numbers of pedestrians and cyclists are higher than the average in the municipality, but the use of public transport is significant lower. Despite the short distance to the city center and workplace concentrations, however the use of private cars is relatively high, and far higher than acceptable for a low - emission residential area

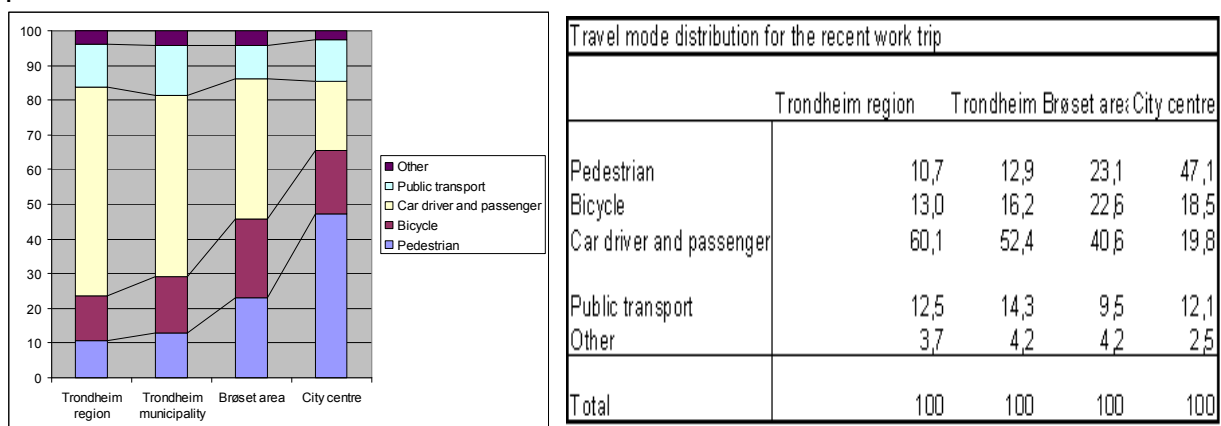


Figure 4: Travel Survey 2010, Trondheim region, the municipality of Trondheim, Broeset area and the city centre

In the city centre of Trondheim more than 47 % of all tours were done by foot according to a study of travelling behaviours made in 2010, while the percentage of car travel in the city centre was according to same survey 19,8 %. The average for Trondheim is 52,4 % of the tours were car trips. It is important to recognise that parking restrictions in the city centre make it expensive and difficult to have a private car. This is probably an important aspect influencing the choice of modes of transport.

We believe that one of the biggest challenges in developing this carbon-neutral neighbourhood is to improve the public transport network. In some part of the town there is already a sufficient offer of public transport and most of the bus lines from different parts of the city are passing through a so called “bow of public transport” which aims at serving the most important living and working areas. The development of Broeset is not connected to this “bow” and will thus not have a good connection to public transport. This will cause problems in convincing people to use public transport instead of the private car, if the situation is not improved significantly.

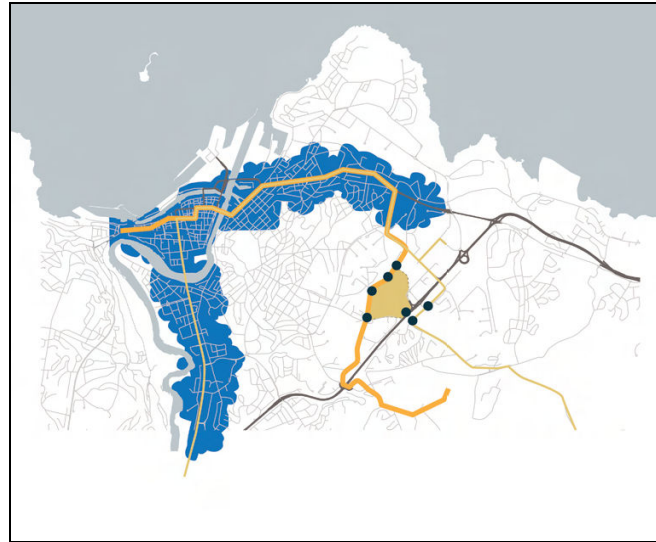


Figure 5: The "bow of public transport" (blue) and the location of Broeset (yellow) (Trondheim kommune, 2009)

Parking restrictions.

The Norwegian society has largely become dependent on private vehicle use. It also means that people have expectations of high accessibility by car to work, shopping and to leisure facilities. The private car is the means of transport that provides the most flexibility and opportunity to travel when and where you want. Many see this as a prerequisite for being able to handle a hectic work and family life. Good parking coverage is deemed to be attractive to a residential area. Those who will be responsible for the development of Broeset area will consider parking as an important resource.

However, it is planned to introduce significant parking restrictions within Broeset area. Trondheim has a parking standard which means 1,5 parking space per dwelling in the outer parts of the municipality. It will be considered to reduce the requirements for parking spaces from a minimum number of 1,5 spaces per dwelling to a maximum of 0,5 to 1,0 space per household in connection with the development of Broeset (Trondheim kommune, 2009).

Studies show that one of the most effective means to reduce private car use, is to introduce parking restrictions in relation to the workplace and in relation to housing (Denstadli, 2002). Parking restrictions limit access to private cars and tends to limit the use of cars, number of car trips and the number of vehicle kilometers. By offering free parking to all, fee parking, or limit the number of parking spaces, we record the use of the car to and from your destination varies considerably. We choose to use a car when we have opportunities to do so, while we choose to walk, use the bicycle or public transport services when access to the use of cars is limited, for example, through the parking restrictions. Parking restrictions, however, is a controversial measure in a city that has been very dependent on the use of the car.

Using various measures to limit car use thus has a dynamic effect and may affect multiple factors in the development of the town. Parking restrictions will not only affect the modal choice, but probably also affect who wants to move to the area, the demand for apartments and economics of the project. This could affect the residential structure which in turn has implications for land use and development of service etc.

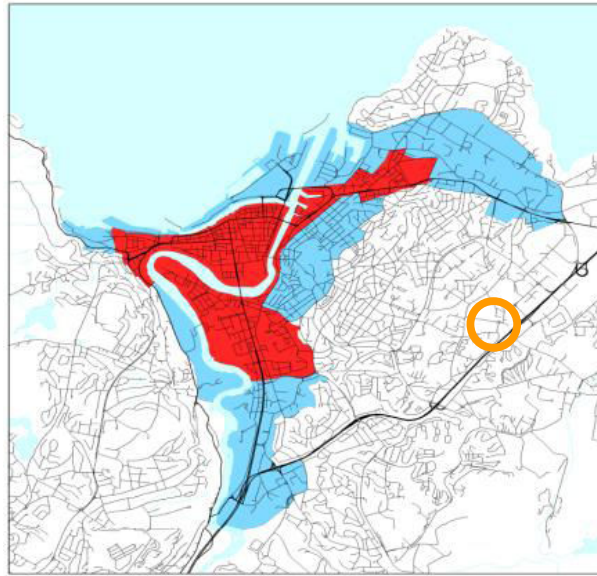


Figure 3: Parking Zones with maximum standards for parking (Trondheim kommune, 2010)

Challenges in the development of Broeset

In many cities in Europe local authorities try to develop a “green neighbourhood” as an environmental show case, inspiring other cities how to handle the environmental challenges. This is also the case in Trondheim. But from our point of view, the task of developing a carbon neutral settlement in an undeveloped suburban area and with a weak connection to the public transport net. This raises a lot of questions:

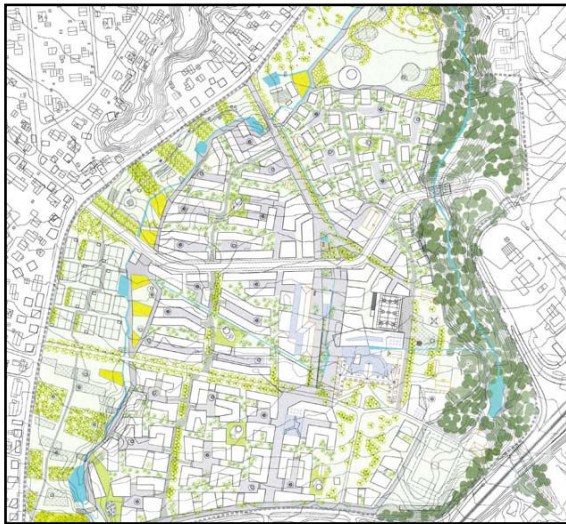
- How can a satisfactory basis for public transport be established at Broeset without constructing a very dense and compact community?
- How can we develop urban diversity at Broeset without providing commuters to the area and increase the transport volume.
- How can we make the city more compact without causing that families with children will move to other communities?
- How can we change travel habits from private cars to cycling, walking and public transport without introducing heavy restrictions on parking that makes this neighbourhood less attractive for real estate developers?

The climate challenge requires new ideas

In addition to the ongoing research project, Trondheim selected four architect - / planning teams that participated in parallel missions. Their projects showed significant intentions of reducing emissions from the transport sector through the reduction of transport demand, improvements in transport and by changes in travel habits and transportation choices. Consequences with regard to reducing emissions were also documented for different choices of solutions. The aim was to show how the design of the town could contribute to greenhouse gas emissions down to 3 tons

of CO₂ a year. A panel of experts based on the research project looked at these projects from which urban form criteria that are important for transport:

- Density and land use
- Parking solutions
- Street grid and road network
- Public transport



Team AsplanViak



Team SLA



Team Code



Team Cowi

Figure 2: Proposed design of the Broeset - area,

Density and land use

Studies of sustainable urban development have shown that the density in an area can have a significant impact on important factors such as the passenger base for public transport, development of service and trade. Besides, short distances should improve the possibility to reach several important destinations by foot or by bike.

However, it seems to be skepticism to add up to a dense urban pattern based on the Norwegian tradition of living in residential and urban areas with relatively low density. Both the reduced residential and urban qualities and the rejection effect that a dense residential area has, made the planning teams careful to propose a dense development. The density varies from 1200 dwellings and 2640 inhabitants, to 2780 dwellings and 6160 residents. Most of the projects say that they want to keep the buildings low as a housing quality. What density means for reduction of greenhouse gas emissions has not been thoroughly studied in these projects.

Car transport and parking

All projects focus on how to reduce the use of private cars in favor of walking, bicycle use and public transport. Three of the proposals show a car-free city with few parking spaces located on the edge of the area that means a long walk to fetch the car.

How to maintain the welfare and car-free area? Surveys of residents in the surrounding area show that there is limited interest in a residential area that does not provide opportunities to use the car. When the supply of public transport is so limited, the reduced accessibility with car is a challenge. Some of the projects emphasize alternative modes of transport like electrical bikes and cars and sharing the cars within a car-sharing pool.

The various planning teams suggested a parking coverage ranging from 0,3 to 1,0 space per dwelling. The radical proposal is not discussed by the team. Will it be able to occur wild parking in the neighborhood and impair housing qualities and road safety here and create opportunities for a "hidden" car on Broeset? Will it reduce housing demand from families and just make it attractive for seniors and youth who are less depending on car travel? Parking restrictions will not only affect the modal choice, but probably also who wants to move to this area. This could affect the demand for different types of apartments, the economy of the project and have consequences for land use, development of services and transport services

However, parking restrictions can not only be applied in the downtown areas and in some "green" residential areas. There must be necessary restrictions on parking at the mall, jobs, etc. outside the center. This will make trading in the vicinity more attractive, enhancing customer base and help expand the local supply. As well as reducing transport work, it makes the community more attractive and strengthens sustainable transportation.

The challenge will be to find a good balance between different interests and means. Different measures will easily come into conflict with each other. The relationship between land use patterns, transport and modal choice is complex and parking is only one, but one important factor that may influence the development of transport performance.

Increased public transport

The four project teams proposed various solutions with respect to public transport of Broeset from frequent departures of existing bus routes to the development of a light rail. Public transport is an important aspect that needs improvement to increase the availability of Broeset. To what extent the Broeset-project can help to improve accessibility to and between areas

around Broeset, is also an important issue for this project. A development of the district Broeset with a high number of residents will increase traffic basis for public transport services, which will also be useful to the district around Broeset. It will contribute to the development of more sustainable transportation choices for the whole district, and could also increase the demand for functions and activities in the district.

It is important to increase the density, if one wishes to increase the proportion of non-motorized transport (Traffic Safety Center, 2004) This will improve traffic base and make public transport more profitable and efficient. New business and resettling existing business needs to build up on public transport. The growth of new jobs will mainly be in areas that have good public transport coverage. With a significantly enhanced public transport services to Broeset, it will be able to develop a more diverse content in the city part.

A progressive and active district

To be a successful site, it is important to emphasize the positive consequences this has for the residents. It may be to save costs by not having to build parking facilities, reduce noise, pollution and other impacts from traffic. Good public transport and proximity to local services should also help to make it easier for people to choose other modes of transport than the car.

Interviews with people living in the vicinity of Broeset, also suggest that the behavior and habits may be one of the biggest challenges when it comes to choice of transport. Several respondents would not consider moving to an area free from parking spaces. Practical reasons are often mentioned, and a lot of the inhabitants take it for granted that they should own a car (Thomsen and Löfström, 2011).

The development of Broeset as a carbon neutral settlement will depend on that people are willing to consider other ways of living. This desire is not very visible in the interviews. Yet these show that some population groups seem more interested in living car-free than others. Those who were most open to live without a car are older people in addition to the youth who had recently moved home and are exploring their own way of living. Some families with children saw themselves as more environmentally conscious and were open to practice a more environmentally friendly lifestyle. Based on these findings it seems that the success of Broeset being an area with significantly reduced private transport, will to a large extent depend on the attitudes of the residents who will move there.

High density and radical parking restrictions notwithstanding, Broeset will be developed into an area with high housing qualities. Broeset should also convey an important message and highlight the seriousness of the target of reducing CO2 emissions from transport. The positive impact from attractive pedestrian areas, improved public transport network, more space for other use than parking, savings in costs for parking, reduced noise and pollution, increased road safety and good housing quality should be important characteristics of an attractive residential area.

However, it is a prerequisite for the project that people who move to Broeset is open for testing new solutions, experimenting with a new lifestyle and therefore are willing to use other means of transport than private cars. It is likely that an innovative project like this attracts particularly interested residents. As the interviews showed, this can be people who would like to live without a car, for example elderly people, students or families who want to change their way of life. One should not consider it as a disadvantage that the project attracts residents who are interested in

the concept. It should rather be an advantage. The pilot project Broeset needs people who are positive to live in a (nearly) emission-free residential area. A successful project - something that ultimately only the residents can help - is important to convey the experience further and to inspire others to live a "low-carbon-emission-life".

Trondheim municipality has set ambitious targets for the development of Broeset. The goals are set in relation to what IPCC says is necessary to prevent our ecological footprint from destroying our livelihood. Then it is actually up to our politicians to set such conditions for development of future cities that most people will want to move to such a climate-neutral district as the one we are developing at Broeset.

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