FLEXPOSTS
FLEXIBLE ENERGY
POSITIVITY DISTRICTS

HOW URBAN PLANNING CAN REDUCE ENERGY CONSUMPTION

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Introduction

Positive Energy Districts (PEDs) can play an important role in the energy transition for urban areas. Implementation of PEDs require that urban planning and energy planning processes are integrated. So far PED research has predominantly been concerned with achieving an energy positive balance for urban districts and stakeholder engagement, whilst less attention has been paid to how urban planning measures can promote energy efficiency by reducing the energy demand. In this short guide we outline 10 planning principles for how urban planning can contribute to reduce energy consumption and thereby support PED implementation.

This publication forms part of the PED-replication toolkit developed in the project FLEXPOSTS (FLEXible energy POSitivity districTS). These 10 planning principles can assist decision-makers and other relevant stakeholders in their ambitions of reducing the energy consumption and climate impacts in their contexts. The 10 planning principles are intended to work as an overall guide, which must be adapted to the context in which they are applied.

In the planning literature, significant attempts have been made to bridge urban and energy planning over the last three decades. In this guide, we build on this research in our attempt to translate decades of planning research into practical advice for planners and decision-makers. The 10 planning principles builds on a review of more than 75 academic publications, which in different ways have analysed how urban planning can reduce energy consumption. In our review, we have only focused on how planning of an urban district or the city's spatial features can reduce energy consumption, not taking building materials or processual elements such as stakeholder engagement into consideration.

It is also important to highlight that in the planning literature, there is by no means consensus on the significance that different aspects of urban planning will have on reducing energy consumption. Differences in the spatial context may for example play an important role, and no general advice can be offered without there being exceptions to the rule. Nevertheless, by carefully reviewing 3 decades of academic research, it is possible to identify some general principles, which is an indication of the potentially important role that urban planning can play in reducing energy consumption in our cities. It is with these considerations in mind that we present 10 planning principles in this guide.

Planning principles for reducing energy consumption

#1 A dense urban structure can reduce urban sprawl and transport need

#2 An urban structure developed around neighbourhood centres can reduce transport need

#3 Brownfield redevelopment can support a dense urban structure and reduce urban sprawl

#4 Mixed use urban development can promote active forms of transportation and reduce transport need

#5 Transit-oriented development can promote the use of public transport

#6 Urban development around nodes in the public transport network can support the use of public transport

#7 Restrictions on car use can promote the use of public transport and active forms of transportation

#8 Small and dense housing units can reduce the heating need

#9 Green structures can reduce urban heat islands and energy consumption

#10 New urban development should be aligned with the existing infrastructures

How urban planning can reduce energy consumption

When considering how urban planning can reduce energy consumption and thereby support PED implementation, it is first and foremost important to stress the importance of the urban structure. #1 A dense urban structure can reduce urban sprawl and travel need. Residents living further away from the city centre tend to have a higher transport need, and thereby energy use from transportation, than residents living near the city centre. Promoting a dense urban structure can thereby help reduce cities' land take (urban sprawl), reduce energy consumption from transport, and promote active modes of transportation. This also means that urban districts cannot be viewed in isolation. Their potential for reducing their energy consumption and thereby becoming PEDs must be understood in relation to the wider urban structure of the city or city region and by how far they are placed from the urban centre.

This also means that centrally located urban districts will have a greater potential for increasing their energy efficiency. In addition, the urban structure can preferably be developed around a main centre and multiple district centres, which contain workplaces, and the basic public and private services needed. #2 An urban structure developed around neighbourhood centres can reduce transport need. Such an urban structure can reduce the transport need, if the residents work locally and primarily use the local services. If not, this polycentric urban structure can result in significant crisscrossing transport, which is difficult to support by public transport. A polycentric urban structure can thus support the development of PEDs, if the boundaries of PEDs are aligned with the district centres.

Many cities have in the last three decades transitioned from industrial cities to cities largely dependent on knowledge and culture industries. As a result, large brown field sites, including harbour fronts, have been freed up for urban development. #3 Brownfield redevelopment can support a dense urban structure and reduce urban sprawl. Prioritising brownfield development of old industrial areas over greenfield development at the edge of the city can contribute to a denser urban structure and avoid urban sprawl. It is also important that brownfield sites are supported by public transport in the early development phase to reduce car-dependency.

When planning for brownfield sites or redeveloping existing urban areas, it is also important to promote mixed use urban districts. #4 Mixed use urban development can promote active forms of transportation and reduce transport need. Mixed use urban districts, where office-based workplaces are built side by side with other functions such shops, banks, housing and restaurants,

will contribute to a more liveable urban environment, promote active forms of transportation, and reduce travel need.

Another main principle in the development of cities and urban districts should be to align the urban structure and the public transport network. This could be done by promoting transit-oriented development (TOD). #5 Transit-oriented development can promote the use of public transportation. The TOD-model constitutes a framework for concentrating urban development in corridors along the public transport network (often rail-based transport modes). This framework can promote the use of public transport, reduce car-dependency and thereby reduce the energy use from transportation.

The TOD-model prioritises urban development around nodes in the public transport network to promote the use of public transport and active modes of transportation. #6 Urban development around nodes in the public transport network can support the use of public transport. As a rule of thumb, residents living and/or working within 600 meters from a node in the public transportation system are more likely to use public transportation for their daily commute. Concentration of urban development within a 600-meter perimeter from nodes in the public transport system can promote the use of public transport and reduce the energy need from transportation.

Promoting public transportation will often not be enough to reduce car-dependency and energy consumption from transportation. Measures must be introduced which more directly seek to restrict car use. #7 Restrictions on car use can promote the use of public transport and active forms of transportation. Cities must adopt the so-called 'carrot and stick approach' by implementing policy packages incentivising the use of public transportation and disincentivising car use. The latter could include introducing road pricing, congestion charging, and car-free zones in the city.

It is not only important that planners and decision-makers promote a dense urban structure, which is aligned with the public transportation network. Consideration must also be paid to the type of housing units in the urban districts and the associated energy use. #8 Small and dense housing units can reduce the heating need. As a rule of thumb, small and dense housing units, such as apartment blocks, have a smaller energy use per m^2 and per person for heating than single-family housing. In addition, planning for apartment blocks will contribute to a denser urban structure, can support the development of mixed-use neighbourhoods, and reduce the land take from cities.

Spatial features between buildings in an urban district such as green infrastructures can also play important roles in reducing energy consumption. #9 Green structures can reduce urban heat

islands and energy consumption. With global warming and increasing temperatures, the energy demand for cooling will increase. This will especially be the case in cities, where lack of vegetation and green structures can result in urban heat islands, which reinforce the need for cooling. By integrating green infrastructures into urban districts, the effects from urban heat islands and the energy demand for cooling can be reduced.

Finally, it is important to align new urban development within the city with existing infrastructures, e.g. the district heating network. #10 New urban development should be aligned with the existing infrastructures. Urban development for housing or industry is often not well-aligned with the capacity in the electricity grid or district heating system. Whilst prioritising brownfield development will increase the likelihood that existing infrastructures can be reused, there is a general need for aligning the urban structure with the various infrastructure networks that supports its well-functioning, such as energy, waste, and transport flows. Aligning and optimising the urban structure and the various functions within it with the city's existing infrastructures can promote a more effective energy use and reduce the need for costly infrastructure expansions.

Conclusion

Integration of urban planning and energy planning processes is a prerequisite for developing liveable and well-functioning Positive Energy Districts (PEDs). So far PED research has only paid limited attention to the important roles that urban planning can play in reducing energy consumption in urban districts. Based on a literature review of more than 75 academic publications from the last three decades, we have presented a guide with 10 planning principles for how urban planning can reduce energy consumption and thereby support PED implementation. The planning principles presented are general and must be tailored to the specific urban context. In general, the planning principles highlight a need to promote a dense urban structure, which is aligned with the public transportation network and other infrastructures. At the same time, it is important to plan for mixed-use neighbourhoods, which offer all relevant services within short distance, including green infrastructures. We hope that the 10 planning principles presented in this guide will increase the awareness of the important role that urban planning can play in PED implementation and in realising larger ambitions of climate neutrality at city and regional scales.