Journal of Civil Engineering and Architecture 19 (2025) 237-241
doi: 10.17265/1934-7359/2025.05.003

Planning Tools for Climate-Neutral and Livable Neighborhoods

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Abstract: Today city planners are confronted with two global trends: on one hand, living space is getting less due to urbanization; on the other hand, demands on living space are constantly rising as for example through stricter climate and energy political objectives based on the Paris Agreement. Therefore, it will be necessary to take into account—near urban planning and social aspects—also the climate compatibility as one central aspect in the construction of buildings, settlements, districts or neighborhoods. To identify and to push successful concepts, Austria has developed a planning tool that allows planning, assessing and ensuring high quality standards of neighborhoods. As the tool has been highly successful, additional planning tools are being developed for specific topics such as "PED—Positive Energy Districts", "NEB—New European Bauhaus" and "CND—Climate Neutral Districts". Central quantitative and qualitative criteria—which have been elaborated in the recent years—will be presented in this paper.

Key words: Urbanization, Paris Agreement, neighborhoods, planning tools, criteria.

1. Introduction

By 2050, more than 68% of all people worldwide will live in urban areas [1]. To manage urbanization successfully, urban planners have to keep attention to the urban quality of buildings, settlements, districts or in general for neighborhoods. In the same time it is necessary to reduce the GHG (greenhouse gas) emissions to a minimum to avoid the rise of the global temperature up to more than two degrees Celsius [2]. Therefore, in addition to the urban quality also the energetic optimization of neighborhoods is an important factor for the development. International studies show that 1 ton of CO_2-equivalent or 2,000 Watt per person would be a sustainable consumption. Switzerland has already made the principle of a 2,000-Watt Society as political objective in many Swiss cities. Amongst others, this principle was shifted to neighborhoods and implemented as a planning and assessment tool [3]. For this reason, a similar system was developed and implemented in Austria from 2016 to 2019.

2. Methods and Materials

The necessary adaptations—from the Swiss system to an Austrian system—were realized in the project called "UrbanAreaParameters" [4].

In this project, quantitative criteria to evaluate the climate neutrality of neighborhoods were developed, concentrating on rating grey energy (energy consumption of production, substitution and disposal of building material), operational energy (heating, cooling, electricity) and as well as rating everyday mobility. The parameters were derived Top-Down (translation of national objectives on neighborhood level) and Bottom-Up (check of technical and economic possibilities based on model buildings) and discussed with local experts.

The qualitative criteria were developed in a second step and allow planning, assessing and ensuring the quality of new developing neighborhood concepts in sense of quality of life. The criteria are based on experience from best practice examples and a broad stakeholder participation process.

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Using this planning tool, institutions—striving to build climate-neutral and livable estates—can identify necessary steps for the optimization.

3. Qualitative Criteria for the Evaluation of Climate Neutrality

In general, climate neutrality is reached when the annual GHG emissions of the realized neighborhood concept do not exceed a specific limit value.

The limit value of a neighborhood is the area-weighted limit value of each occurring building type. Limit values for residential buildings, office buildings and educational buildings were developed. The limit values (which include all relevant energy users) are based on the national scenario "Renewable Energy" from the Austrian Environment Agency and are dependent from the number of users. The specific limit values for each building type are: 684, 115, 44 kg $CO_{2\text{-eq}}$/(person·year).

On the other hand, benchmarks for the same building types are available. They can be seen as orientation for the planning and are available for each building type and for each component. The benchmarks are divided into "scenario renewable energy capable" and "scenario renewable energy compatible".

"Scenario renewable energy capable" benchmarks generally allow the implementation of typical—within the framework of this project evaluated—building material, heating, ventilation, air conditioning (HVAC) and mobility concepts in (rural) areas with a minimum of public transport possibilities. In this case, the top-down predetermined limit values can only be undercut if the planned building and mobility concepts will be optimized in a second step. "Scenario renewable energy compatible" benchmarks generally allow only the usage of zero-carbon building materials, CO_2-neutral HVAC concepts (e.g. district heating, heat pumps) and mobility concepts in (urban) areas with a high share of public transport possibilities. In this case, the top-down predetermined limit values can be undercut easier.

During the planning and evaluation process, the planning values will be calculated for each of the three components (grey energy, operational energy and daily mobility) over a ten-year period. As can be seen in Fig. 1, the values for operational energy and daily mobility values will decrease over time. This is because the electricity from the grid will become increasingly renewable over the time and mobility vehicles will also operate using renewable fuels. The GHG emissions from grey energy are distributed over 100 years.

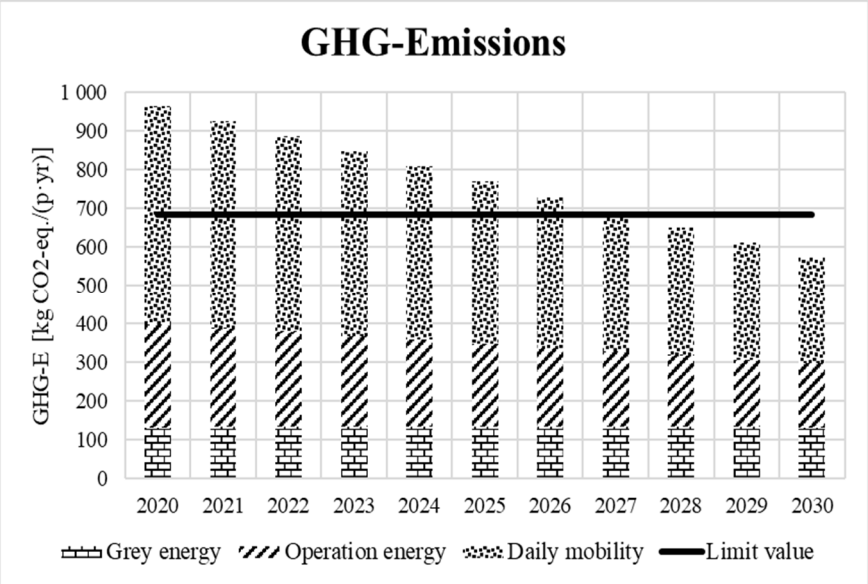

Fig. 1 Result (example) of a quantitative evaluation of neighborhoods [4].

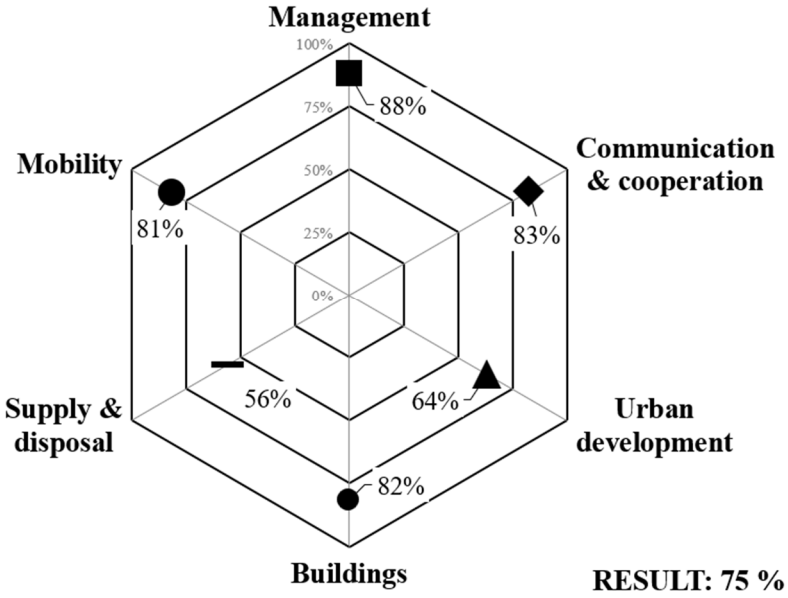

Fig. 2 Result (example) of a qualitative evaluation of neighborhoods [4].

Generally, the mobility concept and therefore the location have the highest influence on the achievement of a climate-neutral neighborhood. Each Austrian location can be described with regional and public transport quality types. Based on a national wide survey based on traffic performance per person and year, typical GHG emissions are available for each location [5]. The result is that the average Austrian travels 12,700 km/year in their daily traffic. Furthermore, it shows that in urban regions people cover less kilometers, because of a more compact spatial structure, whereas the distance people are covering a year in more rural regions is often well above the average.

4. Qualitative Criteria for the Evaluation of Livability

The second way of evaluation is through qualitative criteria, which is derived into six topics: management, communication & cooperation, urban development, buildings, supply & disposal and mobility. Qualitative criteria are measured by a point-rate system. Each topic can achieve a maximum of points which are summarized to a total to determine the overall performance. Subsequently the performance gets visualized on a graph (see Fig. 2), where one can easily see the strengths and chances in each topic to identify improvement potentials. Criteria in detail are listed:

(1) Management: It is all about the ideal realization. Visions, objectives and responsibilities have to be included in the management process. Optimal realization can only be achieved by organizing monetary and personal resources. The implementation of a coordination group is mandatory.

(2) Communication & cooperation: To cooperate with residents and their participation in a planning process helps rise the residents' satisfaction. In addition, implementing an information website including energetic tips (e.g. efficient products, energy and mobility consulting) for stakeholders can be an advantage.

(3) Urban development: Urban development's main subtopics are public usage, orientation in outdoor spaces and a high usage mix. These shall be achieved by building public parks, community gardens as well as integrating commercial and service businesses.

(4) Buildings: Especially the quality of the buildings can help reduce energy if building standards are high and optimized (e.g. heating/cooling, electricity).

(5) Supply & disposal: By using rainwater for irrigation and renewable energies and/or waste heat, costs can be saved as well as it is climate-neutral. Recycling and waste reduction have to be concerned.

(6) Mobility: Regarding mobility it is important to have sustainable mobility offers and parking spaces for bikes and cars. Therefore, bike sharing and car sharing stations, attractive bus stops and intervals and charging stations for electric cars should be offered.

5. Other Planning Tools

In the recent years, further planning concepts in the scale of neighborhoods with focus on climate neutrality and livability were developed.

One of them is the concept of "PED—Positive Energy Districts". The concept was elaborated within the European Strategic Energy Technology Plan Action 3.2 in the Joint Programming Initiative Urban Europe. One central goal is to implement 100 positive energy districts across Europe till 2025. The Austrian contribution leads to a national planning tool that allows planning renewable, efficient and energy-flexible energy system for neighborhoods. The planning tool was integrated to the national service hub for neighborhoods (see Chapter 6) in 2024 [6].

The second planning concept is the concept of the "NEB—New European Bauhaus". The NEB is an initiative of the European Commission with the goal, that solutions are not only sustainable but also inclusive and beautiful. In Austria, a criteria set for buildings was developed in 2024. The criteria set for neighborhoods is under development at the moment and includes near the listed topics also a section for the quality of processes [7].

The newest planning concept in the field of neighborhoods is the concept for "CND—Climate Neutral Districts" with the International Energy Agency Cities Technology Collaboration Programme "Decarbonising Cities & Communities". The goal is to collect data about other existing planning tools and to develop new methods and tools to close identified gaps [8].

6. Service Hub for Neighborhoods

Austria has established a service hub for neighborhoods in 2019.

The central elements of the Austrian service hub are decentralized auditors, that are the primary contact for architects and property developer, which plan new neighborhoods. The auditors have recourse to the standardized catalogue of measures and a network of specific planning experts.

Furthermore, a national service point has been set up for the coordination of the network, the neighborhood projects and for the further development of the system like the integration of new topics and trends as listed in Chapter 5. Municipalities get here a standardized, all-rounding and effective consulting provided, for the strategic planning of climate-neutral and livable neighborhoods.

7. Conclusion

Living space in cities is and will stay attractive. Statistic Austria calculates that the number of households in Austria's conurbations will be rising up to 20% until 2030 (base 2009). Nowadays the average Austrian emits about 9 tons of CO_2-equvalents annually. If we want to reach the climate target of the United Nations (2 °C climate goal), Austria has to reduce emissions to a fourth until 2040. This can only be achieved, if housing in neighborhoods already today emits less than 684 kg CO_2-equivalents per person (grey energy of the building material, operational energy for heating and cooling and daily mobility are already taken into account). The implemented planning tool allows planning, assessing and ensuring the quality of new neighborhoods in sense of climate neutrality and livability. International planning concepts like "PED—Positive Energy Districts", "NEB—New European Bauhaus" and "CND—Climate Neutral Districts" will been integrated in the Austrian system within 2026.

Acknowledgments

Many thanks to: www.klimaaktiv.at/english/; https://klimaneutralestadt.at/en/; https://cities-tcp.org/.

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