Universität für Bodenkultur Wien

Urban pop-up housing environments and their potential as local innovation systems

Case study Vienna

Deliverable D2

December 2021

This project is funded under the framework of the Environmental Systems Research 2017 Urban Environments funding programme of the Vienna Science and Technology Fund. Project ID: ESR17-010

Internal reference

Deliverable No.:	2
Deliverable Name:	Case Study Vienna
Lead Partner / Institute	BOKU / IRUB (Doris Österreicher)
Work Package No.:	2
Issue Date:	30.11.2021

Document status

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Please cite this document as:

Bertino, G. Fischer, T., G., Geier S., et al. (2021). Urban pop-up housing environments and their potential as local innovation systems, Case Study Vienna, project ID - ESR17-010, funded by WWTF, Vienna, 2021.

PREFACE

As part of the interdisciplinary research project "Urban pop-up housing environments and their potential as local innovation systems", six deliverables (D1 – D6) were generated in accordance with the project proposal, which reflect in detail the working process and outputs of the diverse tasks in the working packages. An overview of all deliverables and their key messages is provided in the Executive Summary (Deliverable D0). The individual deliverables were developed chronologically according to the project schedule and progress, and thus, completed at different time points in the project, reflecting the state of knowledge at the respective project status at that time.

Different SCI publications were also generated within the work-packages and are based on the deliverables, whereby some contents were deepened and further developed. In some cases, terms and terminology have also been adapted. The contents of the deliverables therefore partly represent “work in progress” at the respective times of completion of the working packages and writing of the deliverables. The contents of the published SCI-papers and the key statements in the executive summary (D0) are to be understood as the most recent and solid outcomes and conclusions.

CONTENT

1 CHARACTERISTICS OF THE CITY OF VIENNA

Ongoing urbanization is accompanied by multiple and often conflicting interactions between different geographical levels (Grimm et al. 2008) Anthropogenic climate change, for example, is strongly fuelled by urban systems, while at the same time cities and their inhabitants are often particularly vulnerable to its effects. City dwellers are also predominantly dependent on external ecosystems. Thus, preserving the functionality of external ecosystem services is crucial. To this end, the restriction of urban expansion is a strongly promoted approach. Accordingly, one possible pathway its internal spatial development which encompasses measures like densification. Despite ongoing efforts, these measures are still at a very low level compared to land take in Europe (Louwagie 2016). In already heavily modified urban ecosystems, this also often leads to additional pressure on various inner-city spaces and non-residential uses. This is especially true when considering Quality of Life, adequate housing, and biodiversity issues. To maintain or even improve such parameters, an inner-urban development is required that considers unused space and ecosystem services in an appropriate way (Stott 2015). This is often achieved by implementing green infrastructure which is particularly essential for Quality of Life. In the case of compact city development, the adequate design of cities that incorporates green infrastructure, remains a major challenge (Haaland and van den Bosch 2015). In addition, inappropriate greening measures can contribute to increasing social problems, too (Haase et al. 2017; Cucca 2012). Many measures still need further investigation about their effect on biogeochemical cycles (Pataki et al 2011).

The described manifold urban processes and phenomena inevitably lead to increased inner-city pressure in terms of land use. Thereby temporarily available spaces could provide relief. The question arises for what purpose temporarily and permanently unused areas in a city can be used most appropriately. This holds especially true for urban environments where land use and the different demands on land are even more pronounced. However, overall, there is a need for more adaptive and flexible uses of the scarce urban space. One promising approach lies in the temporary use, e.g., of vacant land (Németh and Langhorst 2014), but also of other forms of utilisation. Due to its complex manner, temporary use of urban space shows ambiguous and even contradictory characteristics (Madanipour 2018). That problem becomes additionally pronounced when considering temporary forms of housing, since long-term secured housing conditions are considered as goal of a socially oriented housing policies. It is also questionable how temporary use can be integrated into the overall model of sustainable or resilient urban development.

Within the context of this project, the city of Vienna is considered as a case study. The city faces challenges on various levels, including its dynamic growth, which is strongly influenced by international immigration, and the partly high or unevenly distributed densities, both in terms of population and building structure. In addition, there are numerous natural and political limitations regarding the availability of further settlement areas.

Vienna is the capital of Austria. It is a municipality and federal province at the same time, divided into 23 districts. Based on legal and administrative district boundaries, the city extends over 415 km². Towards the east and southeast the city lies into the Marchfeld basin, with the two easternmost districts east of the river Danube. To the west the city is bordered by the extensive forest Wienerwald. Nearly half of the city area is 'green land' ("Grünland"). This includes recreational and leisure facilities, agriculture, natural areas (forests and meadows) and water bodies (MA 23 2018).

1.1 DEMOGRAPHY

At present about 1.9 Mio people live in Vienna. Thus, the city has about 6 times more inhabitants than Graz, the second largest city of Austria. The population density is very unevenly distributed within the city's administrative boundaries, as parts of the city area are dominated by very large green spaces such as the Wienerwald. The population of the city has been increasing since the nineties and has experienced a strong dynamic especially in the past few years (Statistik Austria 2020). Since 2009 the population increased by more than 200.000 people. The population growth has been greater than projections had suggested and has been driven mainly by net migration gains from other parts of Austria and other countries (Eder et al. 2018). Although recent population projections show a slight levelling off the trend for the coming years, growth remains at a high level. This will probably be accompanied by a shift in the causes of growth away from migration towards births over deaths. Due to the assumed reduced migration which also incorporates young people, demographic aging will occur too. As a result, the city stays young and gets older at the same time (Bauer et al. 2018).

1.2 SOCIOECONOMIC PATTERNS

Migration is also more diverse than before, for example in terms of countries of origin (Eder et al. 2018). The development of the Vienna urban region is characterised by the simultaneity of different processes. In main parts of the city itself urbanisation continues. Elsewhere and especially when considering the Vienna city region suburban and post-suburban processes can be observed side-by-side, the latter especially in the southern surroundings of Vienna (Eder et al. 2018; Helbich et al. 2011; Helbich and Leitner 2010). In line with this, a development towards polycentric urban structure is observable. This will likely increase the importance and autonomy of the urban fringe compared to the core city (in that case: administrative Vienna) (Helbich et al. 2010). There are obvious differences between the different districts of Vienna in terms of population growth, urbanisation, and suburbanisation.

Despite the in many terms favourable position of Vienna from an ecological and social point of view, there are also unfavourable developments. Several signs of increasing social problems in Vienna underpin this. This includes:

- Climate change impacts – Increasing number of vulnerable groups
- Segregation and self-segregation
- Recent liberalization of housing market, recommodification (Kadi 2015) and increasing exclusivity of affordable housing (Franz and Gruber 2018)
- Increasing shift of arrival spaces to the private housing market for newly arriving

people (Franz and Gruber 2016)
- insider-outsider problem which appears through underrepresentation of immigrants and homeless in the welfare system (Weinzierl, Wukovitsch and Novy 2016)
- Gentrification in parts of Vienna
- Increasing poverty rate

Studies provide indications of a significant change in social stratification in Vienna. In line with Europe-wide trends, a decrease in the proportion of migrants among the middle class in Vienna can be observed (Riederer, Verwiebe and Seewann 2019). Changes in labour market were identified as main drivers for that development.

In summary and based on the described processes, it can be assumed that the share of vulnerable groups in the total population will increase. Derived from the literature analysis, social groups that are particularly affected by housing problems include homeless people, immigrants with low socio-economic status and older people (see also description and clustering of user-profiles in D1).

1.3 SPATIAL CHARACTERISTICS

Vienna has a very high proportion of non-built-up land within its administrative borders, unique in Europe for a city of this size. At the same time, the distribution of the unbuilt areas must also be considered. The built-up part of the city is very dense, given the historical development of Vienna and early measures to counteract the escalating external development. For this and as one of the first conservations measures of this type worldwide, in the year 1905 regulations on the Viennese forest and meadows belt (Wiener Wald- und Wiesengürtel) were introduced (Breiling and Ruland 2008). The Vienna green belt protects the Wienerwald and other major green parts at the outskirts of the city and is still an important regulatory factor of urban development in the city.

Regarding the residential part of Vienna, there is some evidence that, compared to other cities, the balance between housing, social equity and providing enough open space is successful (Cucca 2012). The aspects of a high degree of municipal and social housing, the strong influence of the municipal authorities and the soft urban renewal are seen as particular effective in this context.

Vienna, like many other major European cities, has undergone deindustrialisation in recent decades. This particularly affects the areas bordering Vienna to the south (Helbich et al. 2011). But also, the former large inner-city railway freight stations with their adjoining facilities were affected. This development left large gaps of brownfields which, however, have meanwhile mostly been mobilised for residential construction (e.g., former Nordbahnhof, Südbahnhof).

1.4 TEMPORARY ENVIRONMENTS

The diversity of temporary approaches and the highly contested urban space make it difficult to argue for temporary housing. The temporary aspect is related to different scales, namely the time scale, spatial scale and the scale of use and utilisation. This is necessary because there is a variety of terms and theories on temporary use and void spaces (Hwang and Lee

2020). Here we define temporary land use according to Bishop and Williams (2012) as intentionally restricted use regarding time horizon, regardless of the actual duration of use. On spatial scale, the already very broad definition of Németh and Langhorst (2014) is further extended by including underutilised objects and even buildings that show partial vacancy, e.g., vacant apartments. The term “temporary (housing) environment” (equal to pop-up housing environment) is used in the following, as it allows a more comprehensive view on spatial aspects of urban temporality than, e.g., the term temporary space would do. Further definitions of “temporary/pop-up living” options used within this research project can be found in the Executive Summary (e.g., see Fig. 1 there).

Numerous ways of temporary use in cities are discussed in the literature. The temporary conservation of urban wastelands and brownfields can significantly contribute to biodiversity in cities and even on a wider scale (Bonthoux et al.2014; Kattwinkel, Biedermann and Klever 2011; Schröder, Glandorf and Kiel 2018). Green spaces can be formal or informal, the latter also contributing to biodiversity (Rupprecht et al. 2015), recreation and health of certain cohorts (Douglas, Lennon and Stott 2017). Whether the focus is on aspects of nature conservation or human well-being the areas in question have a positive effect on the runoff, local climate, and health simply because of the existing vegetation and the associated lack of soil sealing. Temporarily available sites can be addressed by creative and cultural projects, too (Stevens 2018). Looking at the socio-economic dimension, temporary urbanism is a frequently used term (see e.g. Matoga 2019).

In contrast to the temporary forms described above, temporary (pop-up) living got much less attention. Usually, research on temporary housing still strongly focuses on disaster recovery. The question of demarcation is central here, as for instance renting can also be understood as a temporary use of space (Madanipour 2018) (see also definitions in Executive Summary of this project).

2 SCREENING OF META-STRATEGIES OF THE CITY

This chapter aims at highlighting the strategic and legal framework for planning and modelling within the city of Vienna. The largely invisible wealth of knowledge, which is provided by the studies commissioned by the City of Vienna, is to be systematically assessed, processed, and thus made usable. Finally, a comparison of this literature commissioned by the city and scientific publications about Vienna is made. While the systematic review approach is widespread regarding scientific publications, a systematic survey of non-scientific works, and studies is often lacking in planning. As a result, such works often cannot be utilised appropriately and used for later work. For that reason, a method for the comprehensive assessment of legal and strategic framework conditions was developed for the City of Vienna. Guiding research questions were:

- To what extent is the city of Vienna prepared for the topic of temporary use, especially temporary housing? How is this issue already implemented? What are the framework conditions for the integration of temporary housing in a permanent environment? Who are the major stakeholders and key actors?
- How can this framework contribute to a comprehensive decision support system for temporary housing?
- What are the key elements of a comprehensive decision support structure for the integration of temporary housing?
- How can legal and strategic texts of a municipality be processed for non-legal scientific inquiry? How can legal and strategic municipal documents be collected, made tangible for scientific purposes and at the end inform decision making process?

To get a comprehensive picture about developments regarding temporary forms of land use including temporary housing in the City of Vienna, a comprehensive content analysis was conducted. The aims of the analysis were:

- Identification of central actors with reference to the temporary
- Identification of target groups for which temporary housing might be relevant
- Identification of suitable spaces for temporary housing
- Collecting case studies, current and past examples in Vienna.

2.1 METHODOLOGY

For this research, the official website of the City of Vienna was systematically scraped for relevant documents and data. In the end the analysed document corpus contained 542 legal acts and 676 strategic papers and studies. Here an extended framework for conceptualising the temporary is used to cover as many aspects as possible when analysing the documents.

The methodical approach consists mainly of the following steps:

- Comprehensive gathering of strategic documents and studies
- Pre-analysis of documents
- Document analysis

The content analysis was carried out with the help of the software ATLAS.ti (V8). The procedure mainly followed the method described by Boyatzis (1998) and Friese et al. (2018). The method was necessarily adapted for the purpose of this study. In the present case, both inductive and deductive approaches were used.

Guiding questions during the code development were:

- How can all forms of terms used in the documents be captured?
- What is the Identification of the synonyms as the use of terms is not always consistent, stringent, and rigorous?

2.1.1 Document gathering and pre-analysis

For the collection of documents, the web crawler software HTTrack Website Copier (V. 3.49) was used. The official website of the Vienna City Administration was scanned for relevant publications at different levels. The downloaded documents were checked for completeness and readability. After loading the documents into the ATLAS.ti GUI, a word list was created. This was used to inform the next step of initial coding. As a first approximation, an automatic search and coding were performed, using a predefined set of key words, mainly based on prior knowledge and the output of the literature review. Based on the knowledge available in advance or acquired through research, the document stock was roughly sifted. The first screening resulted in a selection of anchor documents identified as central to the research topic. The characteristics of the analysed document corpus is outlined in Table 1.

Table 1: Characteristics of the analysed document corpus

	Studies	**Strategies**	**Legal Acts**
Number of documents	676		542
Geographical Scale	Place /individual building or object up to entire city	Local up to entire city	Entire city
Policy coverage	-	Integrative / subject-specific / sectoral	Integrative / subject-specific / sectoral

The documents were not read in their entirety, which would not be possible given the tens of thousands of pages. This procedure, however, represents a break with classical content analysis. The transferability of the method is on the one hand due to the special constellation in Vienna. This is expressed in the extremely extensive, systematically prepared, and available pool of studies and strategies. However, this is an essential prerequisite for the application of the presented research method.

2.2 EXEMPLARY RESULTS

In the following some exemplary results for the document analyses are shown. In Table 2 the major regulations, which are relevant for temporary uses in Vienna are highlighted. Although

large parts of Vienna today are characterised by very permanent structures, temporary urbanism and different forms of temporary use have a long tradition in the city (Matoga 2019a; Matoga 2019b; Exner and Schützenberer 2018). There are some direct references and regulations to temporary uses at different policy levels. On a legal level, there are provisions in the Vienna Building Code (§71 and §71c Vienna Building Code), the major legal act for spatial development in Vienna. These came up during the so-called European Refugee Crisis, beginning with 2015.

Table 2: Major regulations of temporary use in Vienna

Description	Text or explanation	Source	Type
Permit for temporary buildings	"*Buildings which serve temporary purposes, or which cannot remain permanently in existence* […] "	§ 71 Vienna Building Code	Legal act
Temporary facilities for the accommodation of persons	"*Insofar as this is necessary for the temporary accommodation of a larger number of persons due to events which have already occurred or are imminent, natural phenomena, or due to international or Union law or obligations of the municipality or the federal state towards the federal republic or for humanitarian reasons, the use of buildings and the execution of construction measures shall be permissible in accordance with the following paragraphs* [...] "	§ 71c Vienna Building Code	Legal act
Interim use		STEP25	Strategic

In Table 3 relevant socio-economic processes in and around Vienna, that shape the development and appearance of the city are shown. As above, the sources for the listed phenomena have been classified and screened within the process of the document search as described in Chapter 2.1.

Table 3: Socio-economic processes in Vienna shaping the development of the city

Processes and phenomena	Sources
Population growth	Eder et al. 2018
Migration	Eder et al. 2018
Internal Migration	Eder et al. 2018
Increase in the share of elderly people	Eder et al. 2018
Urbanisation	Eder et al. 2018
Suburbanisation	Eder et al. 2018; Helbich et al. 2011
Re-suburbanisation	Helbich et al. 2011
Post-suburbanisation	Eder et al. 2018
Deindustrialization	Eder et al. 2018
Segregation	Helbich et al. 2011

Emigration of Austrian middle-class households	Helbich et al. 2011
Social exclusion	Helbich et al. 2011
Gentrification	Helbich et al. 2011
Sharpening of socio-spatial polarization	Kadi 2015
Economic competition (city level)	Kadi 2015
Unemployment	Helbich et al. 2011
Long-term unemployment	Helbich et al. 2011
Homelessness	Weinzierl, Wukovitsch and Novy 2016
Shortage of building land	Weinzierl, Wukovitsch and Novy 2016
Recommodification of housing market	Kadi 2015
Liberalisation of housing market	Kadi 2015
Rising rents	Kadi 2015
Rising land prices	Kadi 2015
Densification	Eder et al. 2018
Land hoarding	Eder et al. 2018
Land take	Eder et al. 2018

3 ANALYSIS OF DEMOGRAPHIC AND SOCIO-ECONOMIC DEVELOPMENTS WITH A FOCUS ON TEMPORARY LIVING

The below tables outline the key demographic and socio-economic developments that have a direct or indirect relevance for temporary living environments in Vienna. In Table 4 the key framework conditions within the City of Vienna are listed, in Table 5 the competing area demands and impact on urban planning are described.

The summary highlights, that demography, ownership structure and building density and vacancy are highly relevant when assessing the need and relevance for temporary urban environments. Several triggers, such as multilocality, migration and natural disasters are cause of disruption in personal biographies, that also might require flexible, adaptable, and temporary living environments. In relation to planning wider urban strategies the priority, strategic challenges and impact must be considered in order to adequately integrated temporary living into the planning context as outlined below.

Table 4: Key framework conditions within the City of Vienna

Type	Key figures	Relevance
Demography	Population (1.1.2020): 1.9 million (51.2 % women) Change (2002-2020): + 17.8 %. < 20-year-olds: 19.2 % 20- to 64-year-olds: 64.3 % 65+ year-olds: 16.5 % born abroad: 37.1 % (Statistik Austria 2021a) Population projection (2030): 2.0 million < 20-year-olds: 19.6 % 20- to 64-year-olds: 61.7 % 65+ year-olds: 18.9 % Born abroad: 39.8 % (Statistik Austria 2021b) Population density: 4,607 PE/km² (Statistik Austria 2020b)	Population growth: positive migration balance (external migration > internal migration) positive birth balance migration balance > birth balance Sustained population growth: Stagnation of the proportion of children and young people in the total population, demographic ageing (decline in people of working age, increase in older people), heterogenization of the population.
Ownership structure und Development of rental costs	Areas owned by the City of Vienna: no data available, but presumably a high share (of importance of the Vienna Land Fund) (BID 2020). Average monthly rental costs (incl. maintenance costs): 8.6 €/m² (Statistik Austria 2021c)	Affordable housing as a key issue of urban policy (Stadt Wien n.d.a)
Building density and vacancy	Average net floor area (2014): 2.1 (5.9 in Vienna 1; 3-4 in Vienna 2-9, 15 and 20) (Stadt Wien n.d.b) Vacant flats (estimated value): 30,000-100,000 (Moment 2020)	The perceived building density may differ from the net floor area ratio (MA 18 2011). Vacancy registers not available.

Table 5: Competing area demands and impact on urban planning.

Trigger / Event	Relevance for Vienna (status quo) in dealing with the trigger	Outlook and consequences for urban planning
International mass phenomenon "multilocality" (education, occupation, leisure, ...)	Explanation of the relevance of Vienna: Metropolis, cosmopolitan city Quantitative relevance: around a quarter of a million people have another residence in Vienna11; the gender ratio is balanced (Statistik Austria 2021d) Declared offers for temporary housing available: Available, various forms of housing and price categories, e.g., "boarding houses", serviced flats", mobile homes Location in the urban area: distributed over the urban area; special offers in central locations or with underground connection for certain (affluent) target groups (with a short period of use of the flat) (Fischer 2018).	Priority: still high Strategic challenges for urban planning: land availability and land prices. Impact on spatial planning instruments: No adjustment expected
International refugee migration (e.g., Syria crisis)	Explanation of relevance to Vienna: Education and job centre, relatives and social network in Vienna, level of minimum income. Quantitative relevance: high Declared offers for temporary housing available: e.g., asylum centres and start-up flats of various sponsoring organisations. Location in the city area: Distributed throughout the city area	Priority: hardly assessable, as dependent on higher-level political framework conditions. Strategic challenges for urban planning: Ownership and availability of (vacant) real estate and land; persuasion and integration work. Impact on spatial planning instruments: Possible adaptation of the building code / amendment of the zoning plan required.
Occurrence of natural disasters (e.g., Danube floods in Vienna, alpine natural hazards)	Explanation of relevance to Vienna: Location on the Danube; relocations within the city area. Quantitative relevance: undetermined, as dependent on catchment area and extent of damage (damaged/uninhabitable apartments/houses; "shelter" with family and friends) Declared offers for temporary housing available: no Location in the city area: -	Priority: low Strategic challenges for urban planning: ownership and availability over (vacant) properties and land. Impact on spatial planning instruments: possible adaptation of building regulations required

Heat waves due to climate change	Explanation of relevance to Vienna: different quality of building fabric / overheated flats quantitative relevance: undetermined, as reasonableness limit not defined Declared offers for temporary housing available: no Location in the urban area: -	Priority: low Strategic challenges for urban planning: ownership and availability over (vacant) properties and land. Impact on spatial planning instruments: possible adaptation of building regulations required
Private disruptive events (e.g., violence in the family; divorce/separation)	Explanation of relevance to Vienna: Number of people potentially affected is high due to the size of the city's population; relocations within the city area. Quantitative relevance: difficult to determine, fluctuation and heterogeneity of the demanders Declared offers for temporary housing available: yes, e.g., women's shelters, youth shelters Location in the urban area: Distributed throughout the city	Priority: difficult to estimate, dependent on further development of demand (currently: consequences of the COVID 19 pandemic). Strategic challenges for urban planning: none if existing facilities have sufficient capacity; vacancy use in case of sudden increase Impact on spatial planning instruments: None

4 IDENTIFICATION OF FRAMEWORK CONDITIONS FOR AREAS SUITABLE FOR TEMPORARY HOUSING AND ASSESSMENT OF POTENTIAL MODEL AREAS

4.1 INTRODUCTION

The aim of this task is to identify potential areas in Vienna for the construction of temporary modules. The City of Vienna provides the spatial framework for the analysis, but also the cultural, social, and legal background and requirements are to be considered. In contrast to previous studies of temporary housing uses, which are mainly from the disaster management sector and focus on the short-term provision of accommodation in emergency situations, this project will consider the high standards of housing needs and integration into the spatial strategy and planning processes of the City of Vienna.

Due to the special question and the associated challenges regarding the methodological approach, the processing was divided into two topics. On the one hand, the development of the indicators for the evaluation of the areas and the development of a GIS-based tool for the analysis of the areas.

The development of the indicators refers to existing guidelines or strategies, which exist for the urban development. However, the indicators were adapted to the requirements of the project, particularly regarding the “temporariness”. This was necessary because the existing guidelines provided little or no information on how to deal with temporary land use and the technical requirements of the modules to be analysed as well as the intervention and duration of the scenarios are very different. In addition, an attempt was made to reflect the different user needs of the user groups in the indicators.

To be able to carry out the assessment of the areas, a GIS-based tool was created that makes it possible to adapt the relevant parameters to the respective requirements of the scenarios/modules under investigation. Since the tool should also be able to be used interactively in workshops or decision-making processes, a strong focus was placed on the performance and speed of the evaluations during development.

On the part of experts, little experience is available about the necessary specifications and how the "governing values" must or can change in relation to certain scenarios. In order to build up know-how and to achieve a deeper understanding of the specifications for temporary solutions, the interactive GIS tool was developed, which can display the variation of parameters in the context of workshops and enable a discussion about them.

These discussions can contribute in the sense of a "double-loop-learning process" to a better understanding of the effect of the variation of the relevant parameters (Stöglehner 2019). Likewise, it can highlight conflicts of goals and interests between the different subject areas. This can generate knowledge among the involved stakeholders for the topic "integration of temporary solutions into existing urban planning processes". In addition, beyond the optimization of individual parameters, the level of strategic objectives can also be reflected (Stöglehner 2020).

The GIS tool and the proposed method can be applied not only for site assessment but also for site search, e.g. in case of disaster. Especially with regard to events of larger scale and or longer duration, there is a great benefit that solutions for these events are embedded in at least a medium-term strategic context of urban development.

4.2 DEVELOPMENT OF THE SET OF INDICATORS AND GIS-TOOL

The aim of the GIS model is to make the identified indicators, which are needed to assess the suitability of sites for temporary residential uses, available for interactive use. The essential parameters of the individual indicators (e.g.: distances, weightings, etc.) can be changed and evaluated in different scenarios. An attempt was made to achieve the shortest possible calculation run by simplifying the model (simplified evaluations, lower resolution, etc.). In addition, processing steps that cannot be changed by variables were prepared in preprocessing to such an extent that further evaluations can build on them.

The selected indicators for the evaluation of suitable areas were developed in close cooperation with WP4 (see Deliverable D4). However, for the GIS analysis, the indicators had to be adapted to the respective data availability and data quality. In addition, the indicators were aligned to a strategic urban planning context, which enabled the assessment of sites and the search for suitable areas independent of concrete solutions (modules).

A dynamic analysis approach was chosen for the preparation of the land balance of potential sites. For this purpose, a GIS-based assessment tool was developed, which was implemented with the freely available open-source software QGIS (QGIS 3.16 - https://qgis.org/de/site/). The required input data is based exclusively on freely available data (Open Government data of the City of Vienna and Openstreetmap). This ensures good traceability and transparency as well as adaptability and expandability.

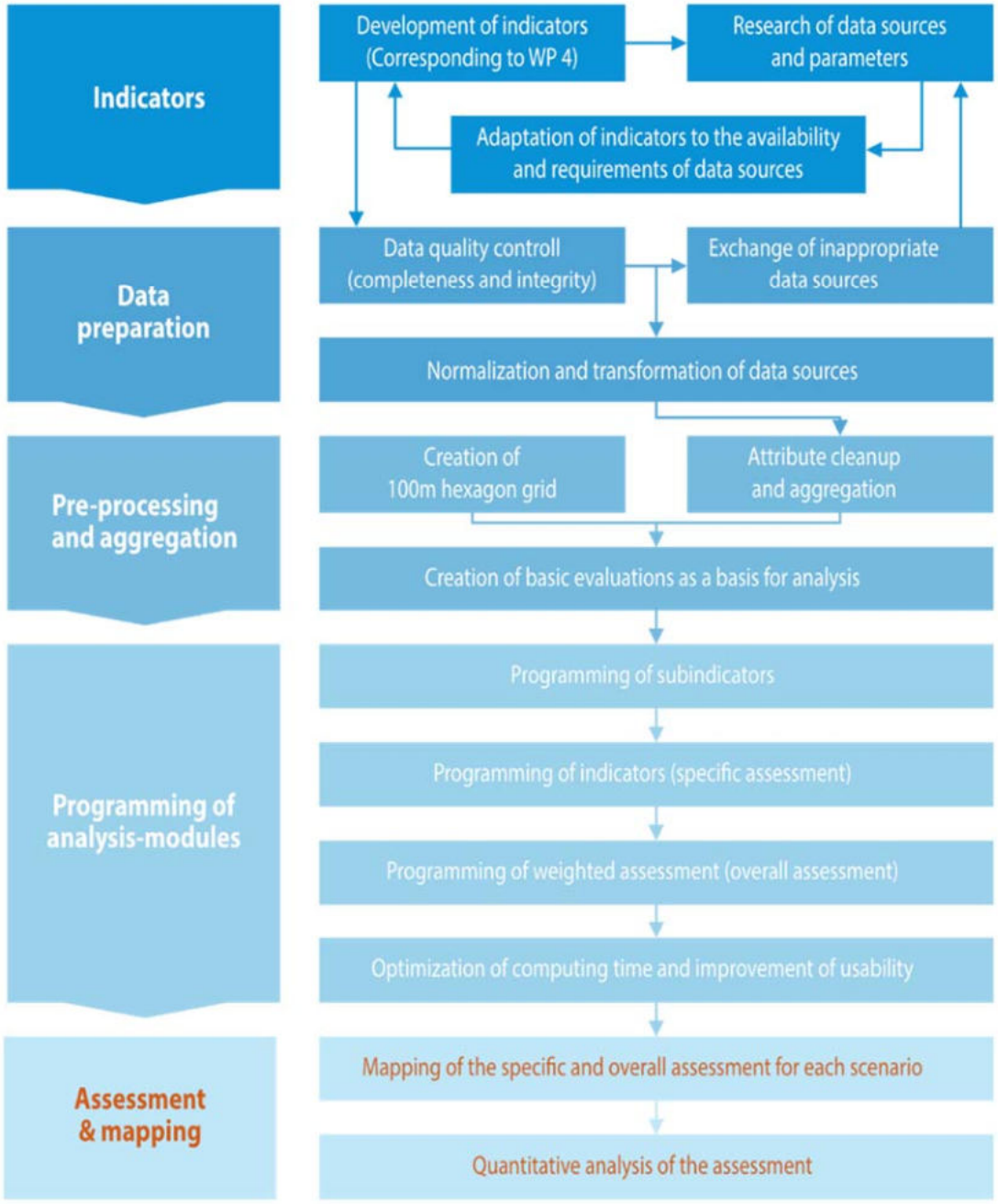

Figure 1: Development of the GIS-based assessment tool

The GIS tool makes it possible to vary the main input parameters and thus adapt the analysis of potentially suitable areas to the respective scenarios, occasions, user groups and technical requirements. For this purpose, the individual indicators (accessibility of central facilities, noise pollution, ecological land use, slope gradient, quality of supply with public transport and active mobility, accessibility for construction, operation and dismantling) can be adapted with regard to their input parameters and weighted among themselves according to the requirements. For each indicator, adapted calculation modules were created for data preparation, pre-processing or aggregation and for evaluation.

When programming the data preparation, pre-processing and aggregation modules, care was taken to prepare the basic data in such a way that an optimum between data and complexity reduction can be guaranteed while at the same time maintaining the highest possible level of detail and analysis possibilities. As a result, the computing time for the evaluations could be reduced considerably. This allows the tool to be used in workshops with experts and decision-makers to deepen the understanding of the individual indicators and their essential input parameters. In addition, this can be used to support a negotiation process to determine characteristic values and suitable areas. The tool can be used for an assessment of existing areas (site assessment) as well as for a site search.

For simplified calculation and comparability of the individual indicators, a hexagonal grid with a side length of 100m was created, which provides uniform spatial reference units. All spatial evaluations and assessments are referenced to this grid.

Figure 2: Detail of the Hexagon grid (own representation)

The use of a grid can lead to deviations and inaccuracies in the allocation of values from the source data to the spatial reference units. However, the accuracy and representativeness of the results is sufficient for the necessary requirements.

For the spatial analyses, the files must be transformed and exported into the reference coordinate system (here in the case used: EPSG:31256) after importing from OGD (data.gv.at).

4.3 INDICATORS

For the evaluation of potential areas for temporary land use, seven location indicators were developed and agreed upon by the project team. In addition to classical indicators such as the accessibility of central facilities and public transport, indicators were also used to ensure the sustainability and integration of the potential sites from an ecological perspective and a strategic urban planning perspective. In addition, indicators were developed to assess the efficient and safe construction, operation and dismantling of the sites.

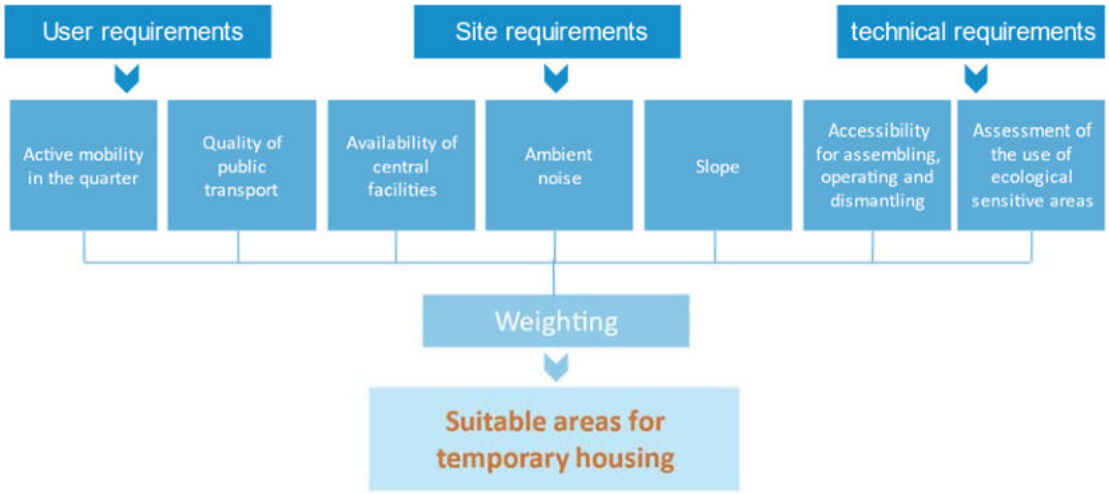

Figure 3: Framework conditions and indicators for the assessment of potential areas for temporary housing

Since suitable indicators for the selected indicators of temporary housing needs are largely lacking in the technical and planning literature, this approach allows for an iterative development of indicators. Existing indicators come from the field of long-term urban development and planning or from the field of disaster management and were selected as possible reference points or orientation values. However, these parameters are only partly applicable to the strategic planning methodological approach chosen here, which allows the integration of temporary housing needs into established urban planning processes with a high demand on planning methodology and quality.

The chosen values for the parameters were discussed in the project team on the basis of existing specifications and adapted to the respective requirements. In the following, the freely selectable parameters and their values are shown in the illustrations of the indicators. The figures show the input data, freely selectable parameters and the abstracted calculation path for each indicator.

4.3.1 Active mobility in the quarter

In order to ensure sustainable integration of temporary housing into the city, the suitability for active mobility is a suitable indicator. For this purpose, the general accessibility of areas was assumed as a basic requirement (KO criterion) (accessibility via the road network). If this is given, the existence of sidewalks was evaluated as a quality characteristic for pedestrian

traffic. In addition, the existence of cycling infrastructure and bicycle parking facilities in the vicinity was evaluated.

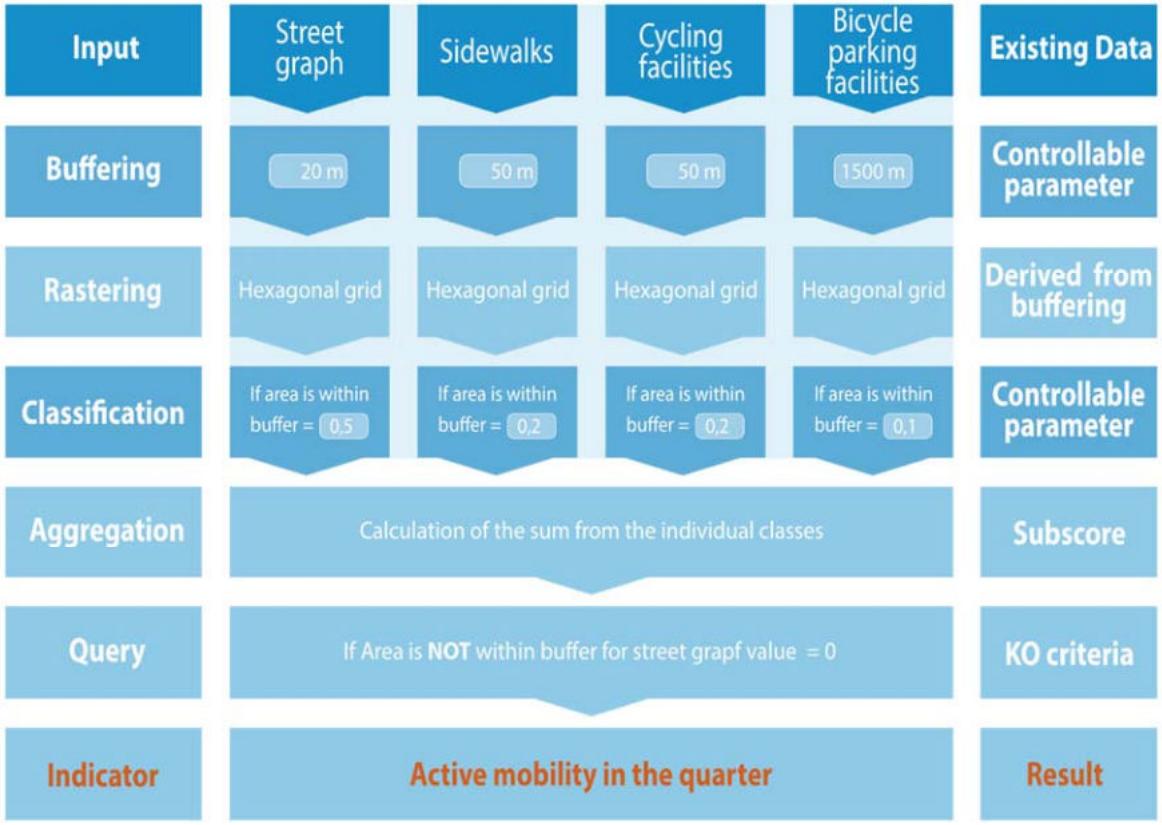

Figure 4: Scheme for the indicator active mobility in the quarter

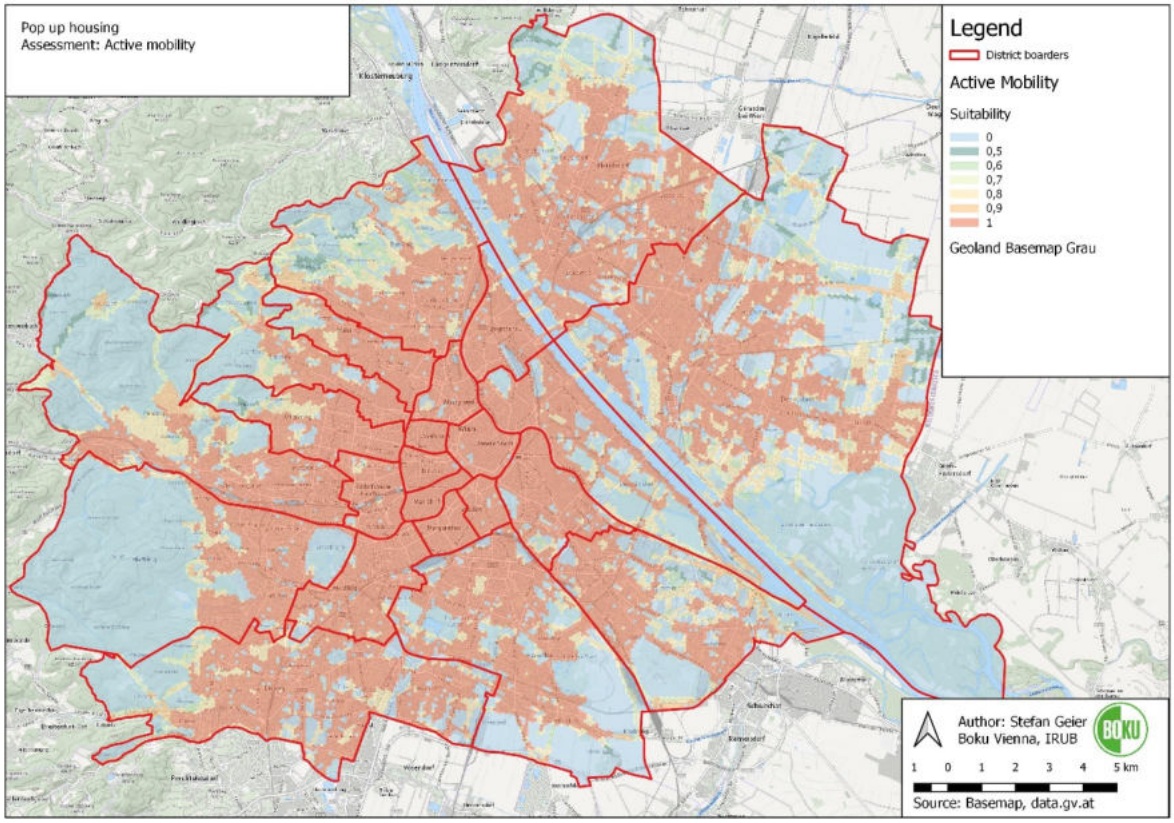

Figure 5: Results for the indicator active mobility in the quarter

4.3.2 Quality of public transport

In addition to active mobility, the quality of public transport provision is an essential factor for the sustainability of uses. The ÖROK model (Hiess 2017) of public transport quality classes was used to assess the quality. This Austria-wide model for the assessment of public transport provision is a composite indicator consisting of stop category, distance to the stop and assignment to the spatial context. Stops are classified on the basis of the quality of the means of transport (bus, tram, train, etc.) by which they are served. Then, based on the timetable data, the quality of service is calculated depending on the distance in a 100m grid.

This basis was referenced and evaluated for the assessment of quality on the hexagon grid used in the tool. These values are in turn freely selectable in the tool and can thus be adapted to special requirements. The highest quality class on a site was used as relevant. The assignment to public transport quality class was set as followed (A - <G = 1-0 = very suitable - unsuitable).

The data basis would also offer the possibility to define maximum distances to the stops as a criterion for special user groups. However, this was not integrated into the tool.

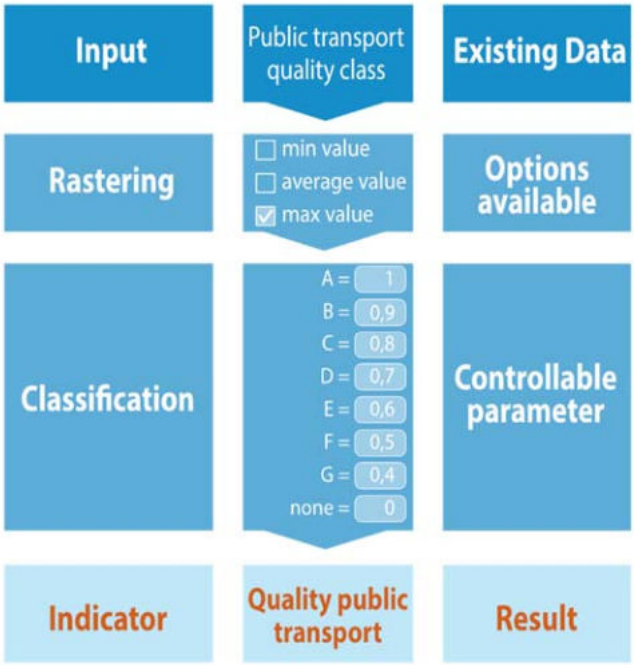

Figure 6: Scheme for the indicator quality of public transport

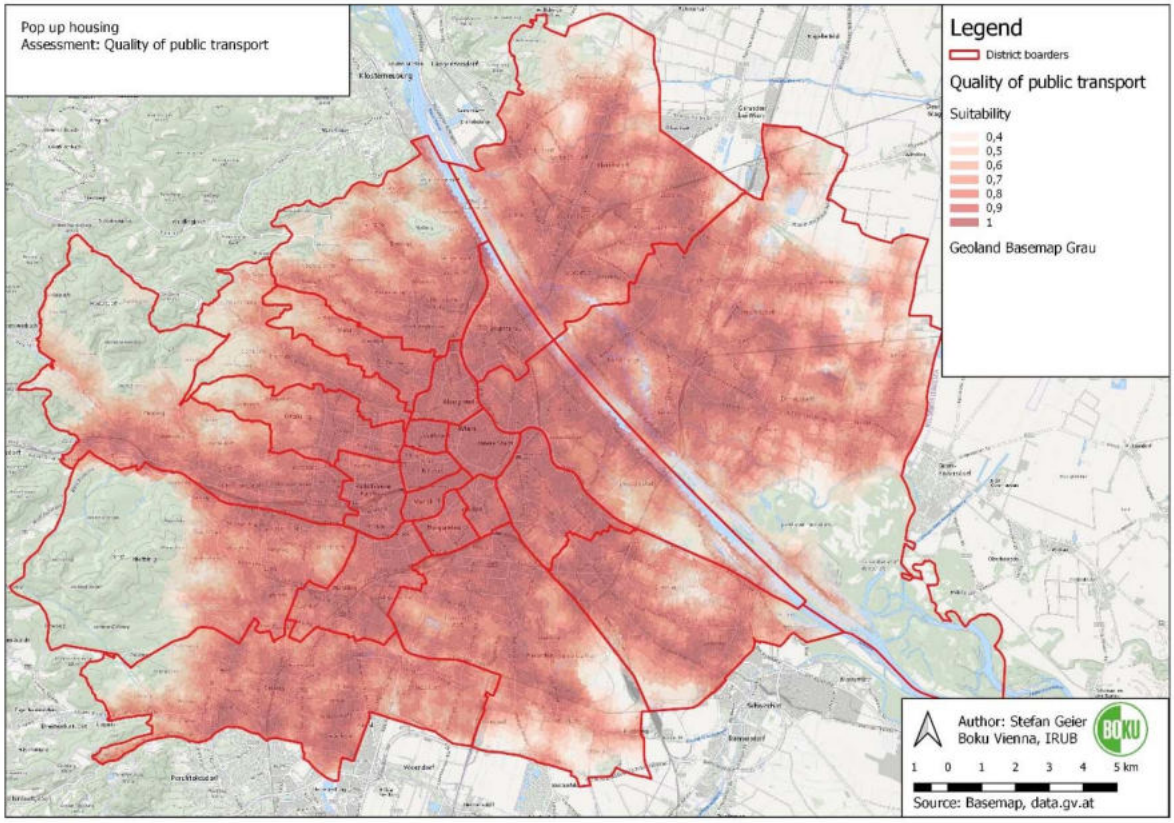

Figure 7: Results for the indicator quality of public transport

Due to the very well-developed public transport network, Vienna has a very good supply of public transport for the most part. Also due to the close network with high-quality means of

transport (underground and train) as well as the dense timetable, the differences in the evaluation are low.

4.3.3 Slope

The slope of the existing natural terrain is essential for the buildability and especially important, as in the case of temporary housing, for the rapid feasibility of projects. A slope that is too steep results in considerable additional planning and implementation costs (e.g.: terrain changes, supports and staircase systems). In addition, excessive slope may limit site accessibility.

Slopes up to 5% are very suitable for a quick use of the land, as well as in terms of accessibility. Areas with a steeper slope cause a disproportionately higher effort for planned projects and are therefore only suitable to a limited extent or not at all. The selected assessment of the suitability of corresponding slope inclinations can be adapted to other requirements in the tool. In addition, the assignment of the slope to the grid cells can be selected in the tool according to average, maximum and minimum. Thus, special requirements for the terrain can be taken into account.

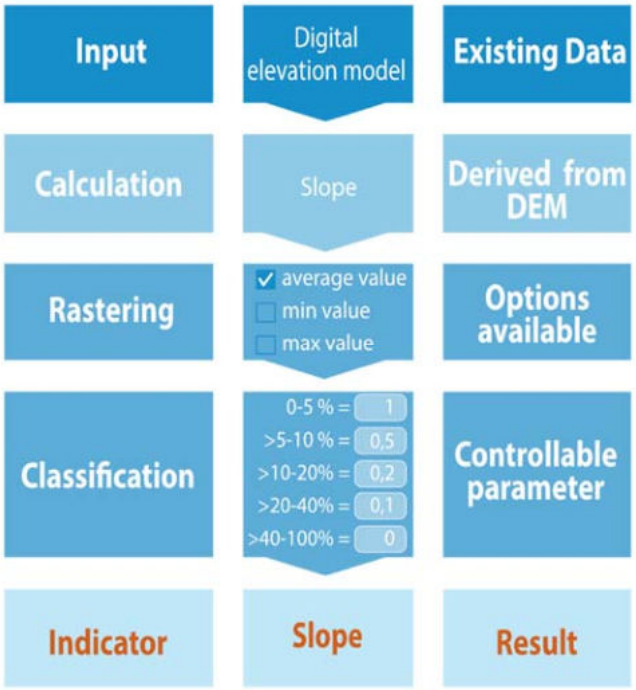

Figure 8: Scheme for the indicator slope

With the settings shown in Figure 8, the suitability shown below results for the indicator slope (0 = not suitable to 1 = very suitable). Due to the use of the 100m hexagon grid and the assignment of the average slope, locally unsuitable areas may occur in reality, which would have to be taken into account in advance during implementation.

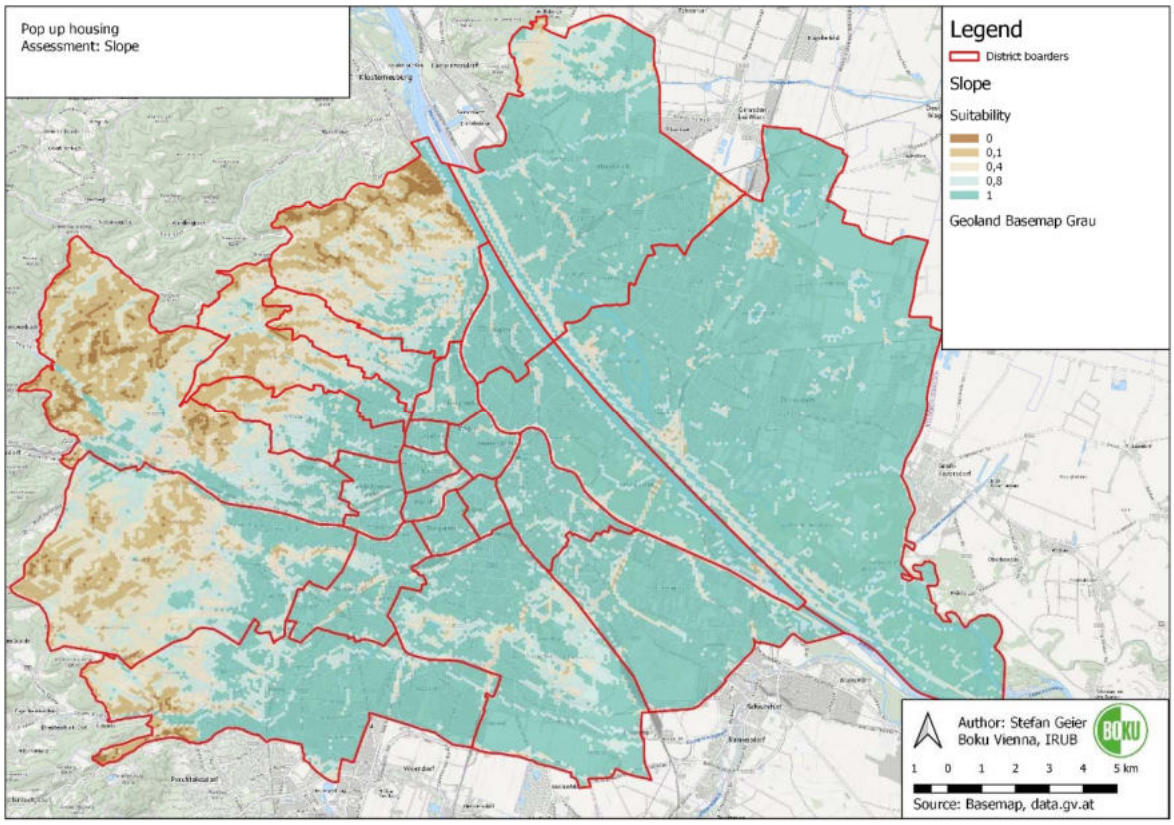

Figure 9: Results for the indicator slope

4.3.4 Accessibility for assembling, operating and dismantling

For the provision of an efficient and effective temporary housing module, accessibility during the entire life cycle must be considered. This includes the logistics surrounding construction and dismantling, but also supply and maintenance during the utilization phase.

The assumptions are based on the premise that heavy vehicles are needed for the assembly and disassembly of modules, which require paved roads. To keep any damage to unpaved surfaces to a minimum, a maximum distance of 50m to the nearest road was used as a criterion. This value can be freely selected in the tool.

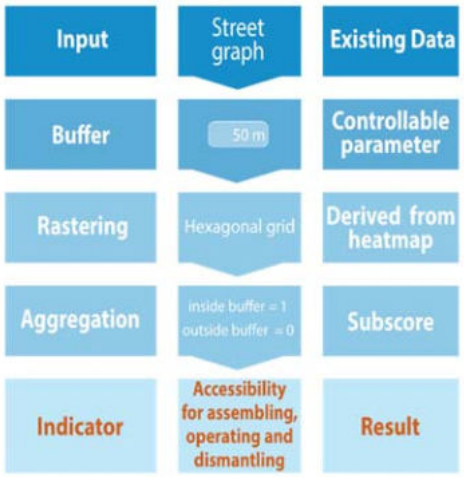

Figure 10: Scheme for the indicator accessibility for assembling, operating, and dismantling

Regarding the available data basis, however, there is the restriction that only paved roads are available. Possibly suitable dirt roads and forest roads are not included in this data set and were not considered in the calculation.

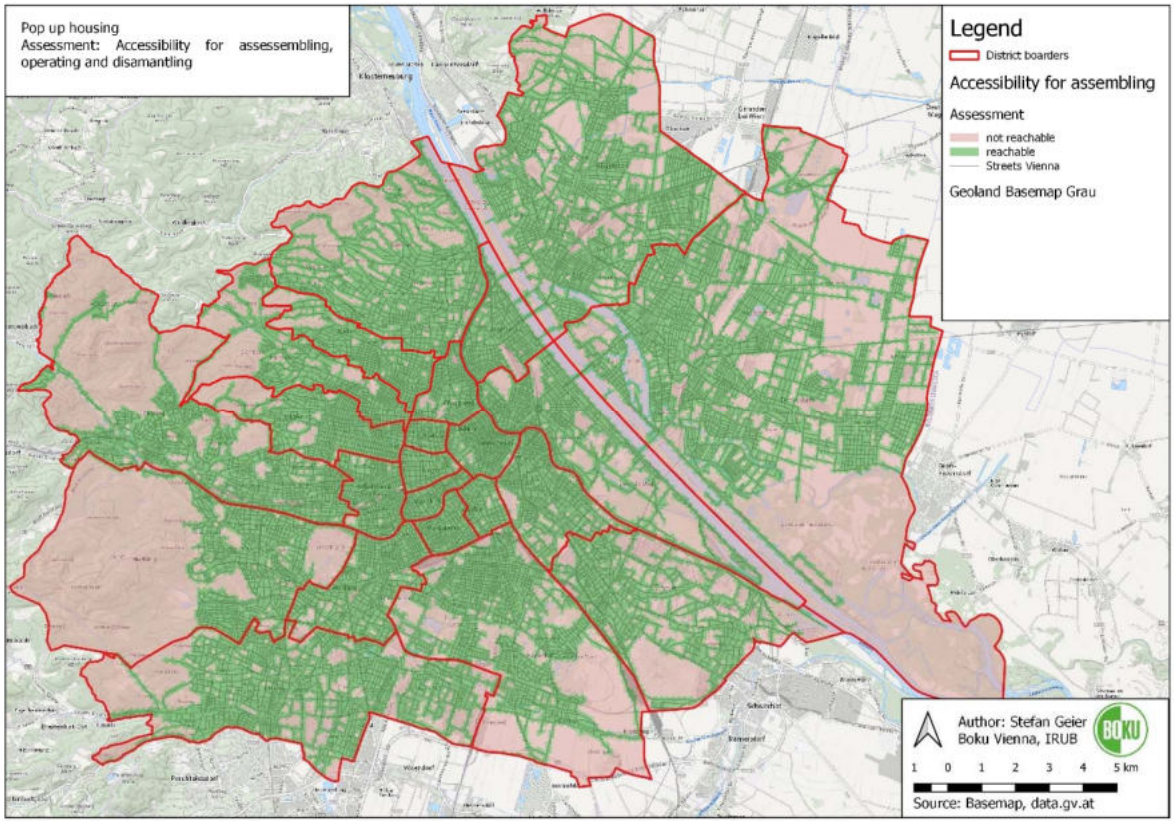

Figure 11: Results for accessibility for assembling, operating and dismantling

4.3.5 Ambient noise

The exposure to ambient noise is very relevant for the suitability of areas for temporary housing. Since there are no specifications for this form of land use and special constructions

(e.g. lightweight construction), the existing guideline values or thresholds of the City of Vienna (Wiener Umgebungslärmschutzgesetzt, Wiener Umgebungslärmschutzverordnung) were applied. To meet special requirements, which may arise due to user groups or the selected constriction, the suitability for the respective thresholds can be freely selected in the tool.

The tool is based on the data of the strategic noise maps (BMK 2021a), which are available for the environmental noise of roads, railroads, aircraft noise and industrial plants, for the whole day (24h) and for the night separately. By overlaying the individual maps, the maximum value for the day and night was determined for each grid cell. The suitability was assumed with the values given below.

- below the thresholds (<45 dB) = 1
- below threshold Lnight (45-50 dB) = 0,8
- below threshold Lday (45-60 dB) = 0,6
- above thresholds = 0,3

Figure 12: Scheme for the indicator ambient noise

With the selected values, the suitability with regard to ambient noise is given below. When using areas with increased exposure to ambient noise, modules must be selected with a suitable construction that ensures sufficient sound insulation.

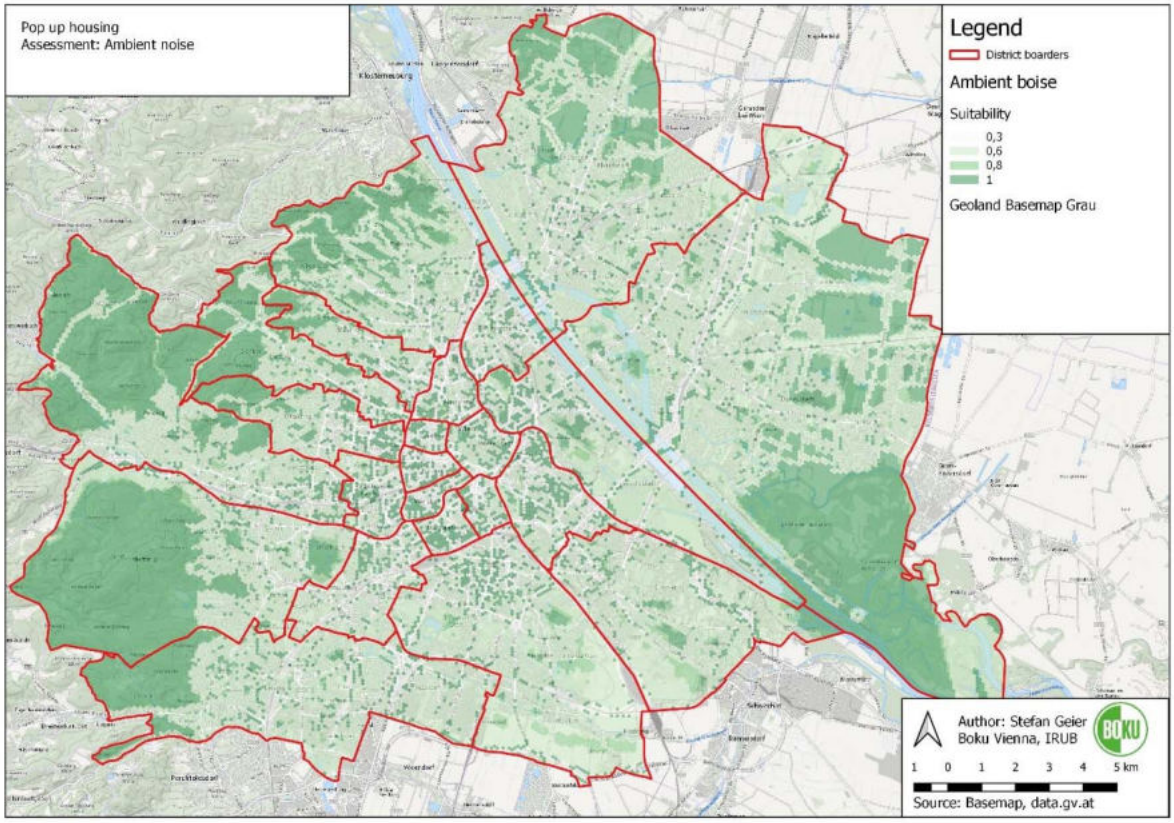

Figure 13: Results for the indicator ambient noise

4.3.6 Accessibility of central facilities

To be able to assess the suitability of areas with regard to the possibility of meeting daily needs, eight facilities from the areas of education, recreation, supply and health, referred to in the following as sub-indicators, were combined into a common indicator. All data were obtained from the open-data resources of the City of Vienna (data.gv.at), except for the data for the supermarkets, which were obtained from Openstreetmap.

In the following, the procedure, and the calculation steps for the formation of the indicator will be explained on the basis of the interim results.

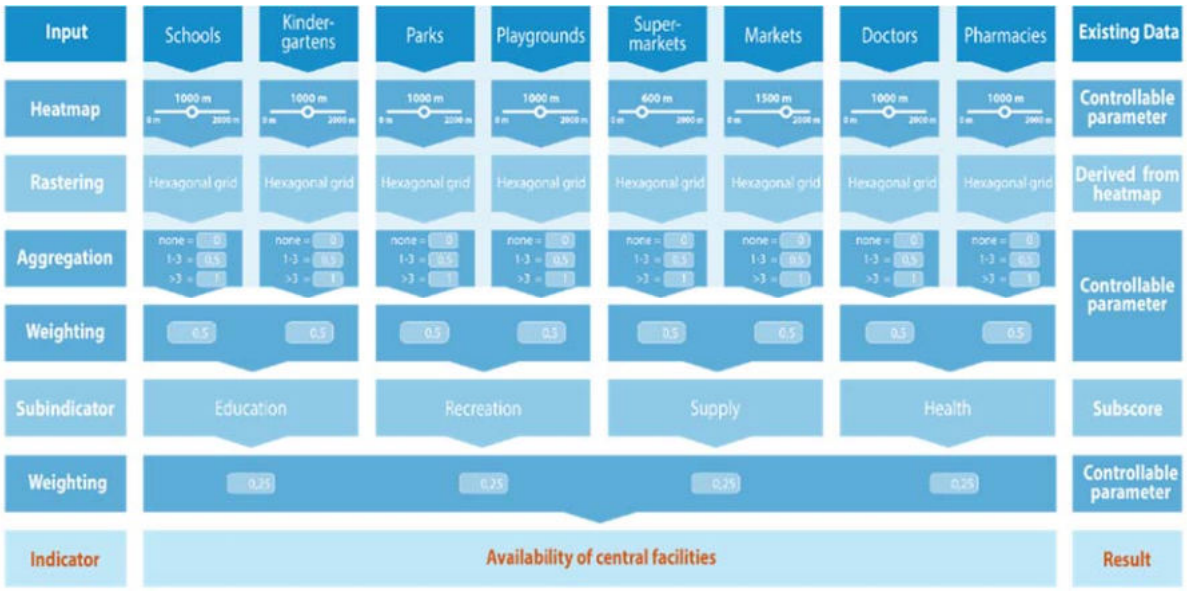

Figure 14: Scheme for the indicator accessibility of central services

In the above scheme, distances to facilities were assumed which seem acceptable in everyday life (e.g.: distance to schools 1000m, supermarkets 600m). This results in several accessible facilities per grid cell. By means of a heat map representation, the calculation step is shown using the example of the calculation of the distribution of the accessibility of schools. A maximum distance of 1000m was assumed. This results in areas in orange with no "acceptable" distance to schools and grid cells with up to 30 schools within the assumed distance.

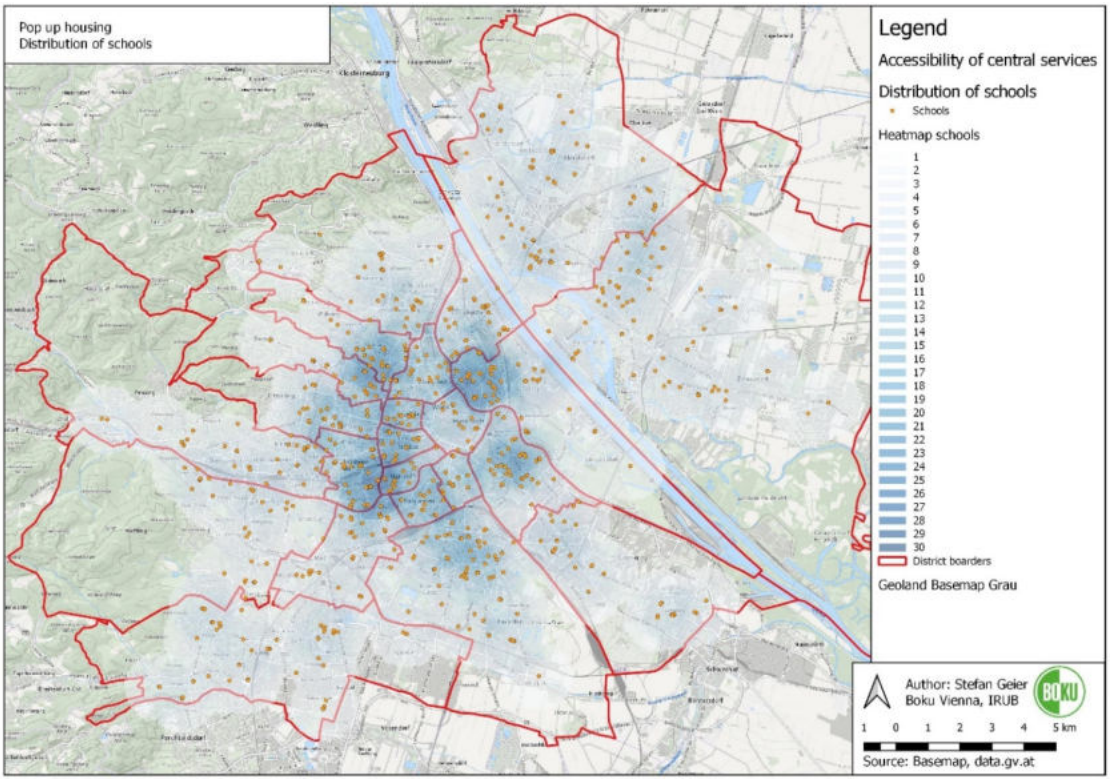

Figure 15: Representation of the spatial distribution of the accessibility of schools as a heat map

For the assessment of accessibility, the results of the heat map were classified. The classification of the class boundaries was made based on the assumption that 0 represents no supply, with 1-3 facilities a basic supply should be given and with more than three facilities per grid cell, due to the number, the supply should be guaranteed in terms of quantity and there should be a choice of facilities.

- 0 locations = 0, no supply
- 1-3 locations = 0.5, sufficient supply
- >3 locations = 1, good supply

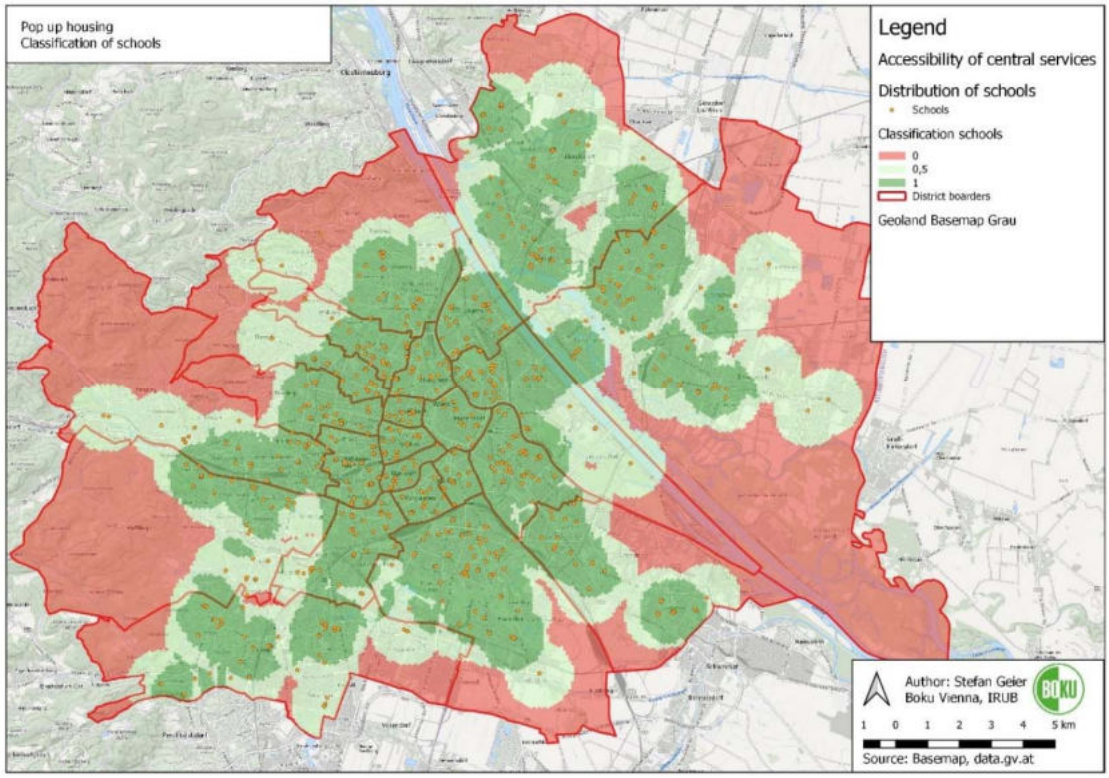

Figure 16: Aggregation of the heat map for the schools based on the class boundaries

The classified evaluations for the individual facilities are combined into the sub-indicators shown below. There is the possibility of weighting individual facilities to include or exclude them more strongly. In the interim results presented, all were weighted equally.

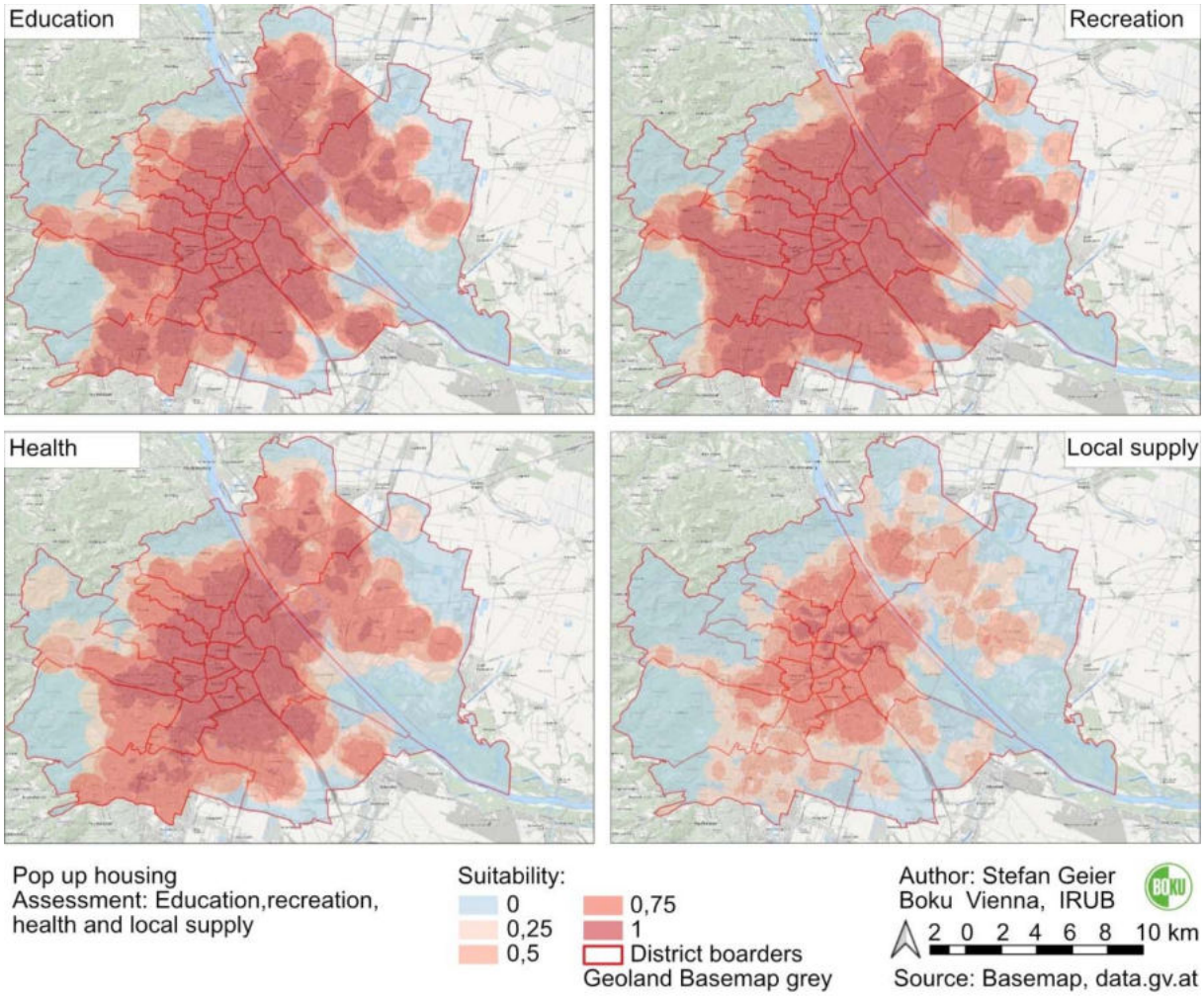

Figure 17: Intermediate results of the sub-indicators from top left to bottom right: Education, recreation, health and local supply

In the final calculation step for the indicator Accessibility of central facilities, the tool offers the possibility to weight the intermediate results of the sub-indicators. As in the previous step, this step enables an adapted consideration of the requirements of special user groups and can be freely selected. All sub-indicators were also weighted equally.

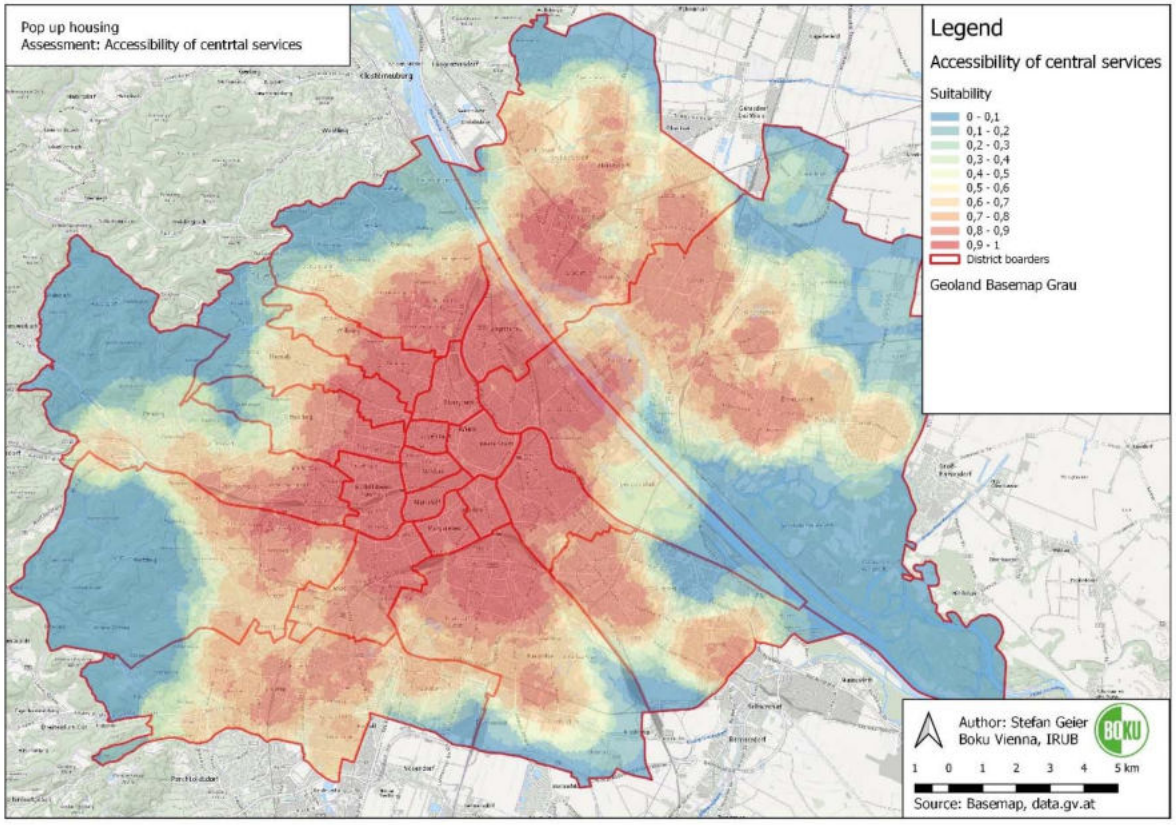

Figure 18: Results of the indicator Accessibility of central facilities

4.3.7 Assessment of the use of ecological sensitive areas

In order to assess the ecological sensitivity of areas, a multi-dimensional indicator was developed along the lines of environmental impact assessments. The sub-indicators significance of intervention of the intended use (scenario/module) and the sensitivity of the areas are evaluated using a preference matrix. In the preference matrices, the values of the evaluating experts can be mapped and documented. These values can differ or be adapted depending on the occasion. For example, in the case of a disaster, lower standards can be applied than for uses or scenarios that are to be integrated into strategic urban development.

Shown below is the scheme for the entire indicator. The significance of intervention is shown on the left and the sensitivity of the areas on the right, as well as the preference matrix chosen here to assess the areas. All assessments made were discussed and determined in the project team. The tool allows all assessments to be adjusted if other assessment teams arrive at different assessments.

In the following, the components of the indicator and the respective interim and final results are explained in detail.

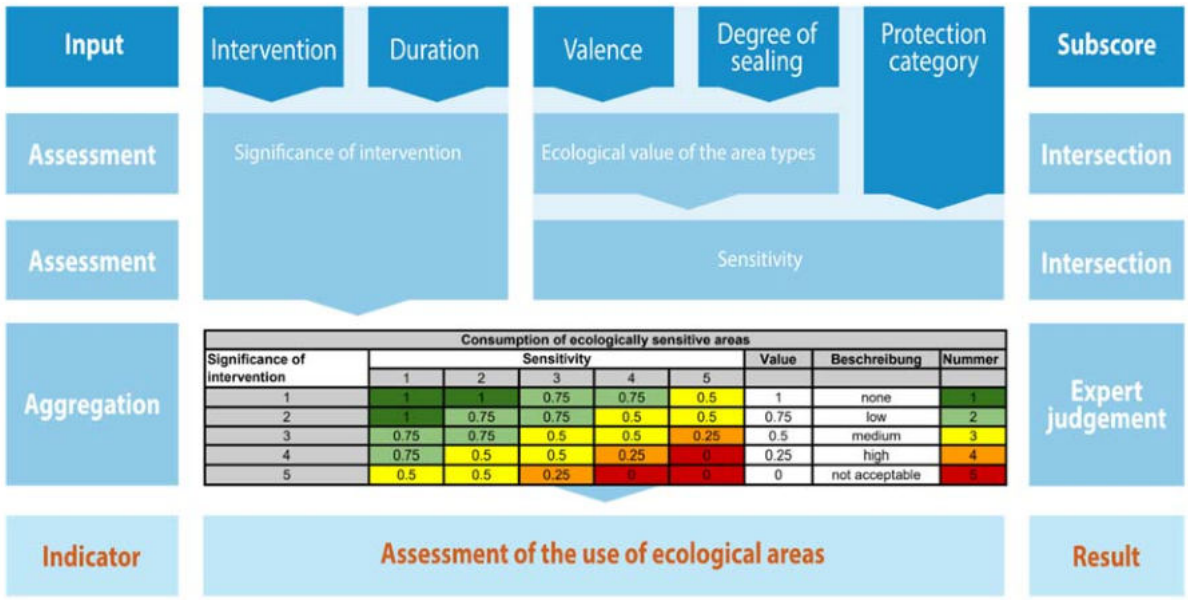

Figure 19: Scheme of the indicator assessment of the use of ecological sensitive areas

Sub-indicator Sensitivity

The sensitivity of the areas is determined on the basis of the ecological value of the areas and the existing protection category. See Figure 20 and Table 6: Rating of the worthiness of protection.

Dimension Ecological value of the areas

The ecological value of the areas is determined from the dimensions of the value of the areas and the degree of sealing. For this purpose, the value of the land was assigned according to the degree of sealing on the basis of the real use of the city of Vienna. The real use represents the use categories in aggregated form across the entire city.

The degree of sealing was determined on the basis of the multi-purpose area map. The multi-purpose area map is a highly detailed vector map that represents the type of surfaces. The surface types were divided into sealed and unsealed and thus the degree of sealing was calculated on the basis of the hexagon grid. The reference to the grid is necessary because in some cases the areas in real use were delineated very large, which distorts the results. The degree of sealing was divided into three classes: low (below 10%), medium (above 10% and below 30%) and high (above 30%). The following figure shows the calculation scheme for ecological value of land and extracts for the "sub-scores" for the evaluation of sealing and value of land.

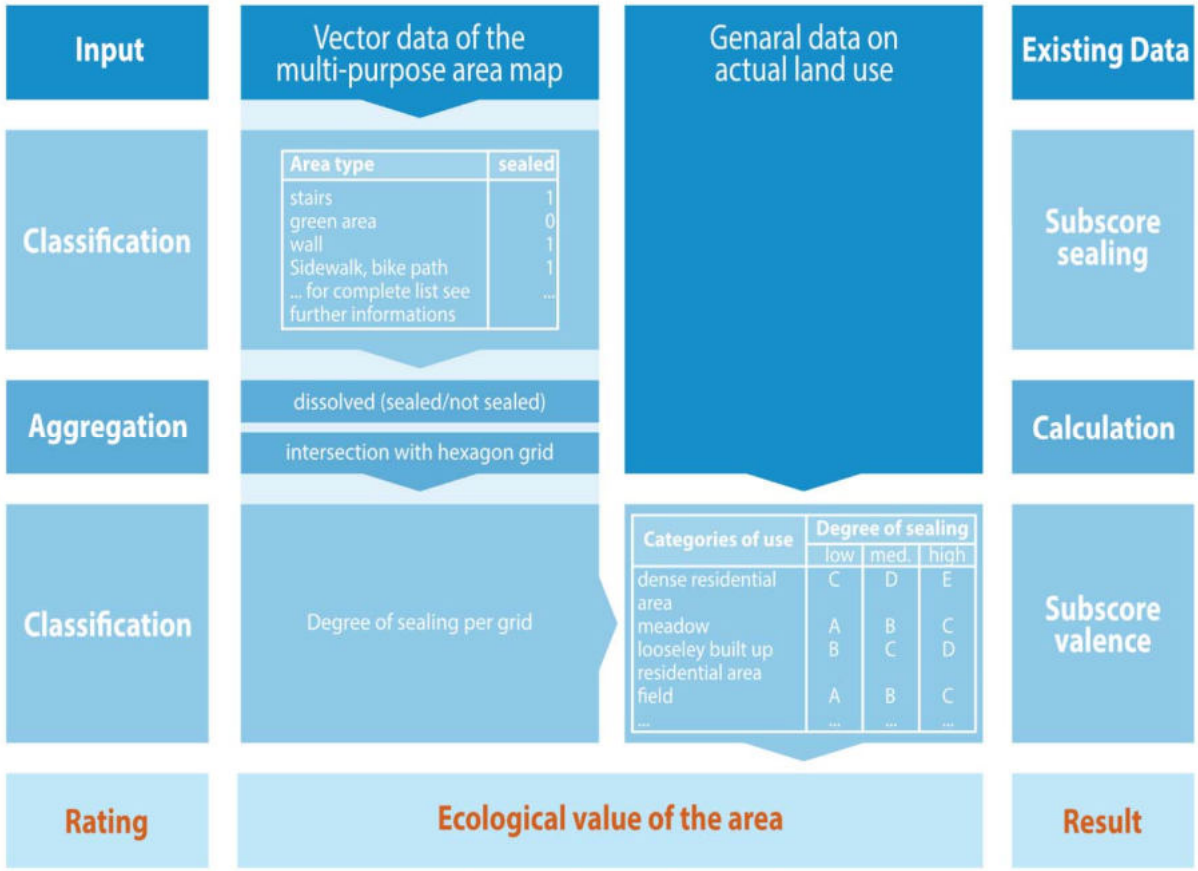

Figure 20: Scheme of the calculation of the ecological value of the area

As can be seen in the following figures of the degree of sealing, the chosen class boundaries result in large areas with the classification "high degree of sealing" in an urban environment. However, from an ecological assessment perspective, the class boundaries are considered reasonable. Figure 21 shows the degree of sealing in 10% intervals and Figure 22 shows the sealing with the selected class boundaries.

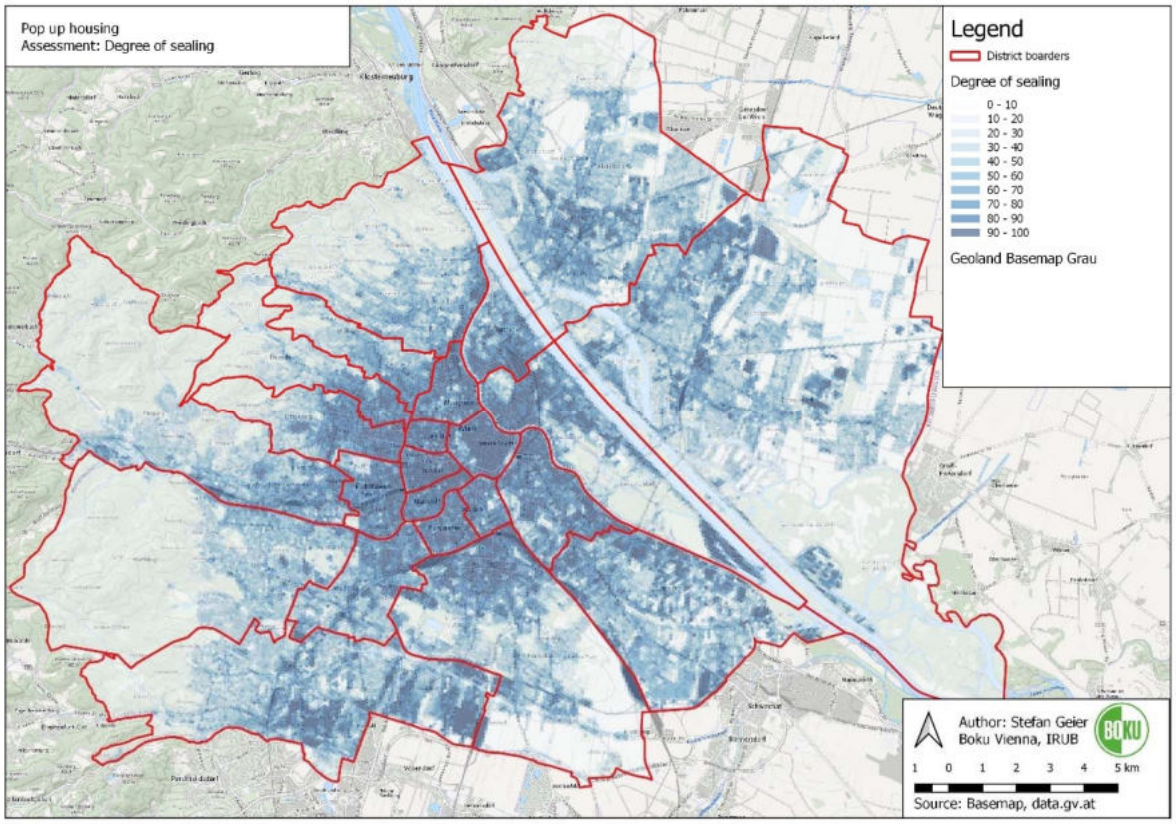

Figure 21: Interim results for the calculation of the degree of sealing

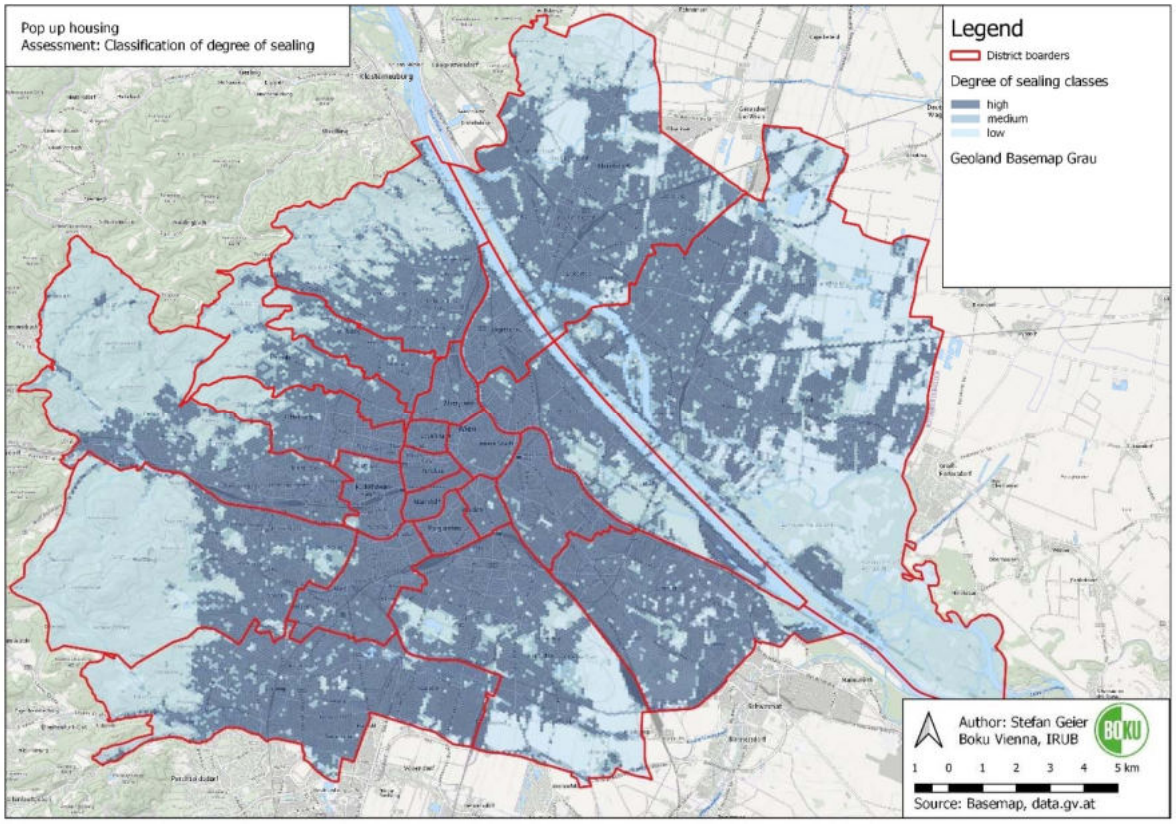

Figure 22: Results for the classification of the degree of sealing

The results for the ecological value of the areas reflect the dense development of Vienna, with a high proportion with areas rated D and E (low and very low ecological value). In contrast, the undeveloped and protected areas of Vienna largely have a rating of A (very high ecological value).

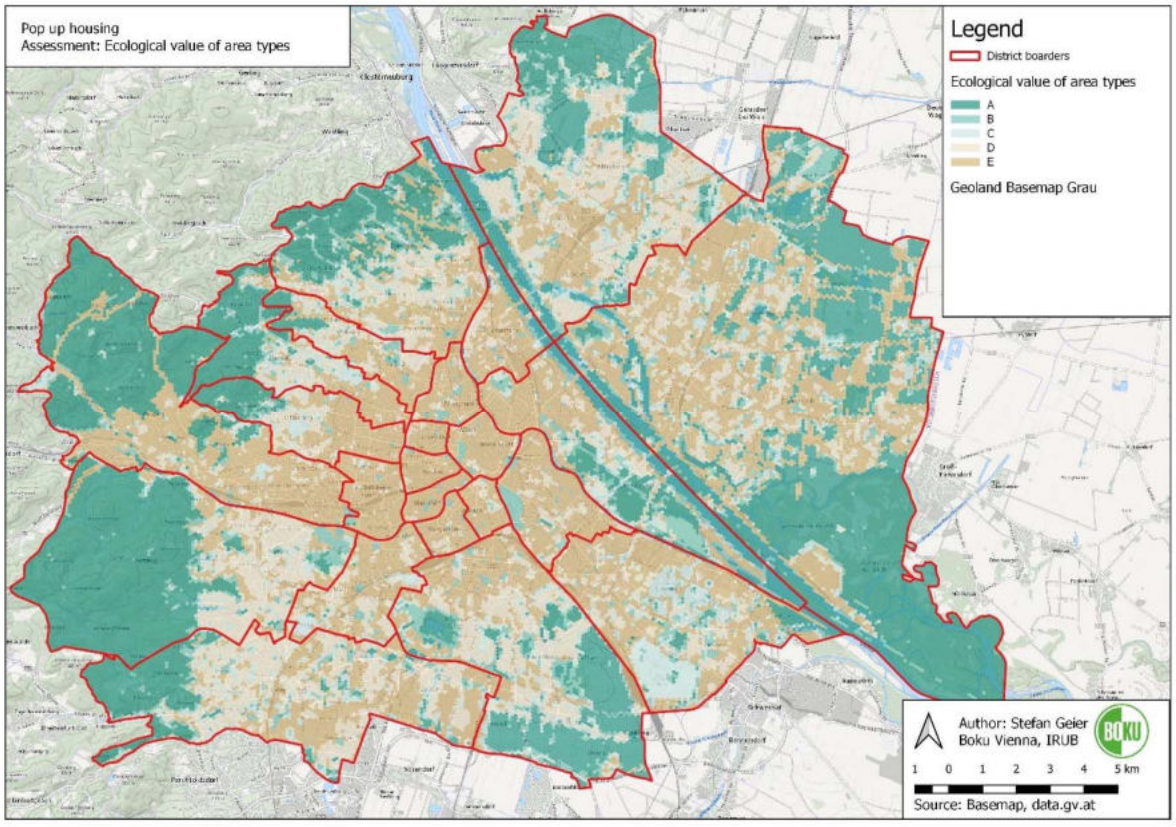

Figure 23: Results of the calculation of ecological value of area types

Dimension Protection Categories

For the evaluation of the protection categories, all defined protected areas in Vienna were surveyed and combined into one layer, since the protected areas partly overlap. Based on the legal definitions and descriptions of the protected area definitions, the individual protected areas were assigned a protection rating in coordination with the project team (1 = very high protection rating, 0 = no protection rating).

Table 6: Rating of the worthiness of protection

Protection categories	Value	Class
Nationalparc Donauauen	1	A
Special protection areas (Natura 2000)	1	A
Nature reserves	1	A
Protected landscape areas	0,8	B
Protected landscape elements	0,8	B
Ecological development areas	0,8	B
Protected biotopes	0,6	C
Biosphere reserve Wienerwald	0,4	D
RAMSAR areas	0,4	D
Water protection areas	0,4	D
no protection areas	0	E

The assessments can be adjusted in the tool. By determining the maximum value for each grid cell, the respective worthiness of protection is determined for the entire city area and flows into the further calculation.

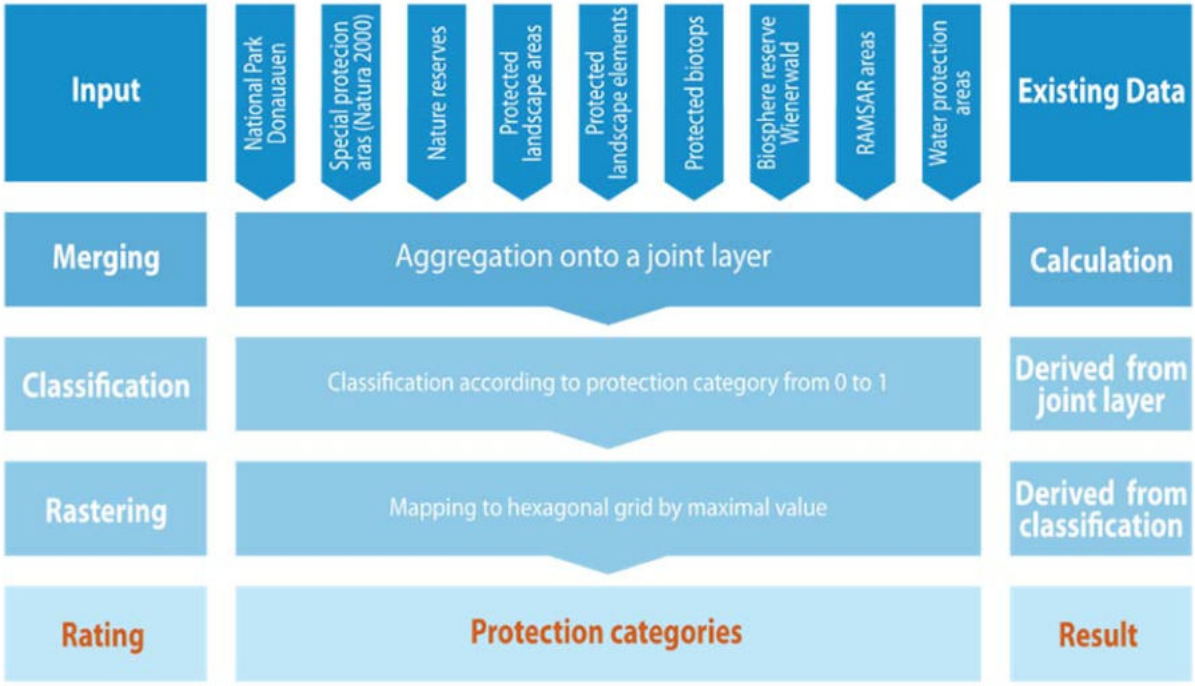

Figure 24: Scheme of the calculation of the protection categories

Representation of the protection worthiness on the basis of the above-mentioned evaluation. The highest protection categories (Lobau National Park in the east, and the two Natura-2000 protected areas in the southwest and northwest) are clearly visible.

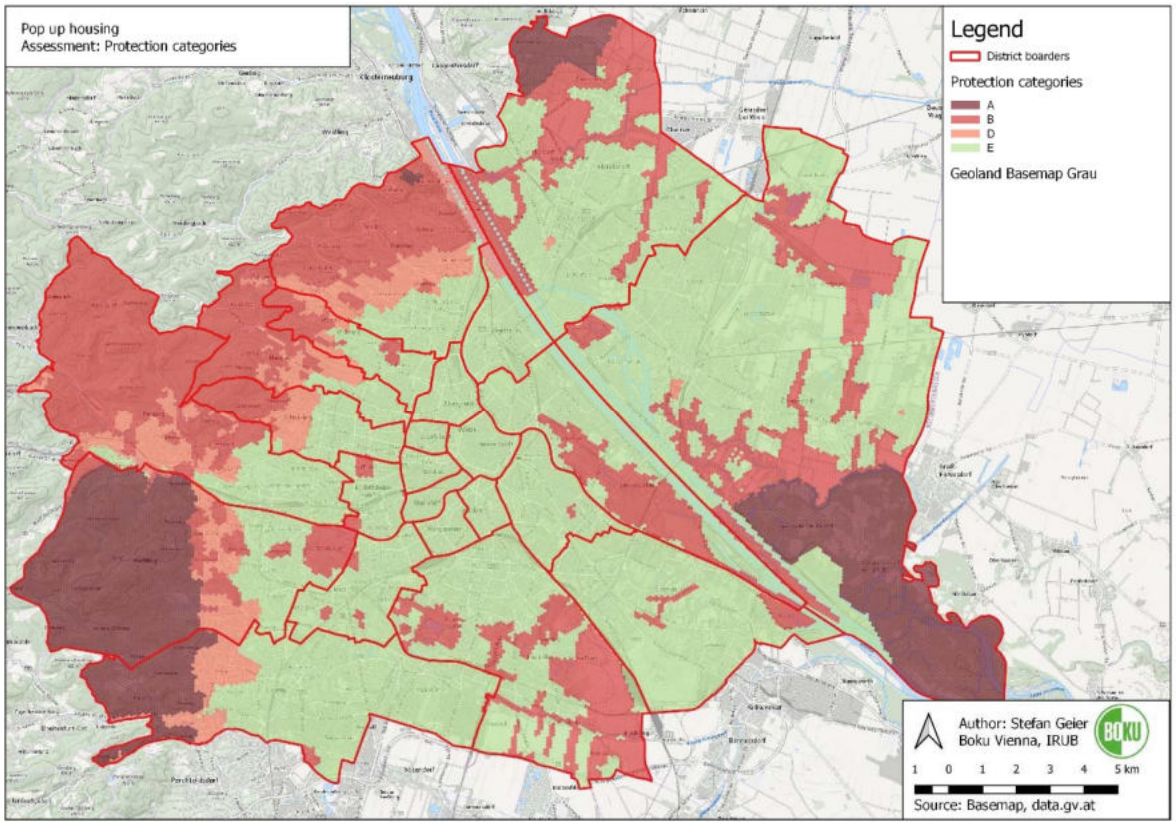

Figure 25: Results for the protection categories

The assessment for the sub-indicator sensitivity is carried out using a preference matrix that combines the dimensions of ecological value and protection category. This preference matrix was agreed upon in the project team and can be adapted in the tool (expert judgement). The evaluation is from valence E (none) and protection category E (no protection category) with sensitivity 0, which corresponds to no sensitivity, to sensitivity 1 (valence A, protection category A). In between, the values were equally distributed.

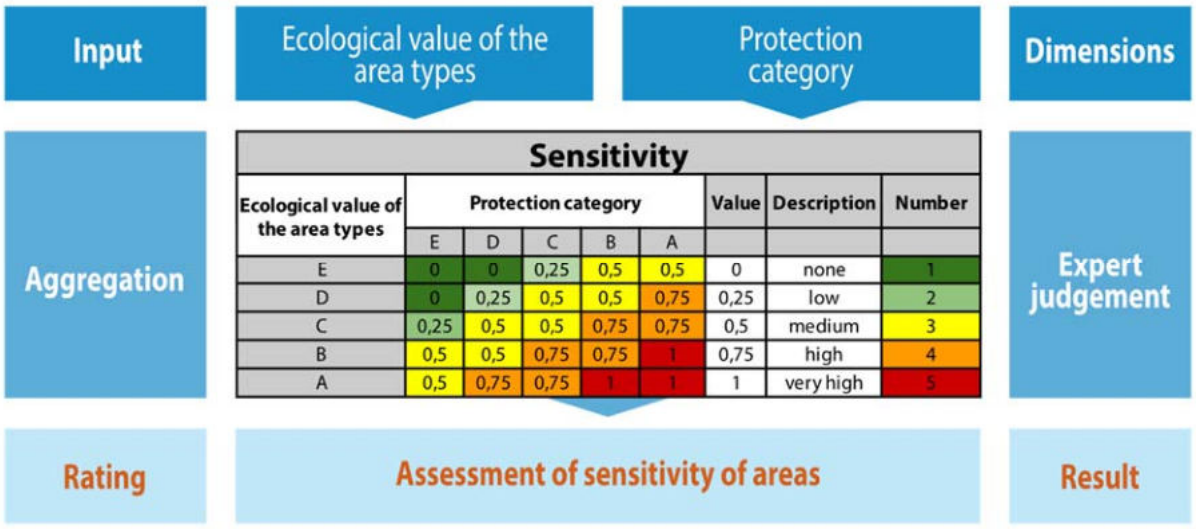

Figure 26: Scheme of the calculation of sensitivity

The results are in line with expectations and show extensive coverage of the protected and low-sealed areas with the highest sensitivity. From this, a consistent protection policy of the City of Vienna can also be concluded.

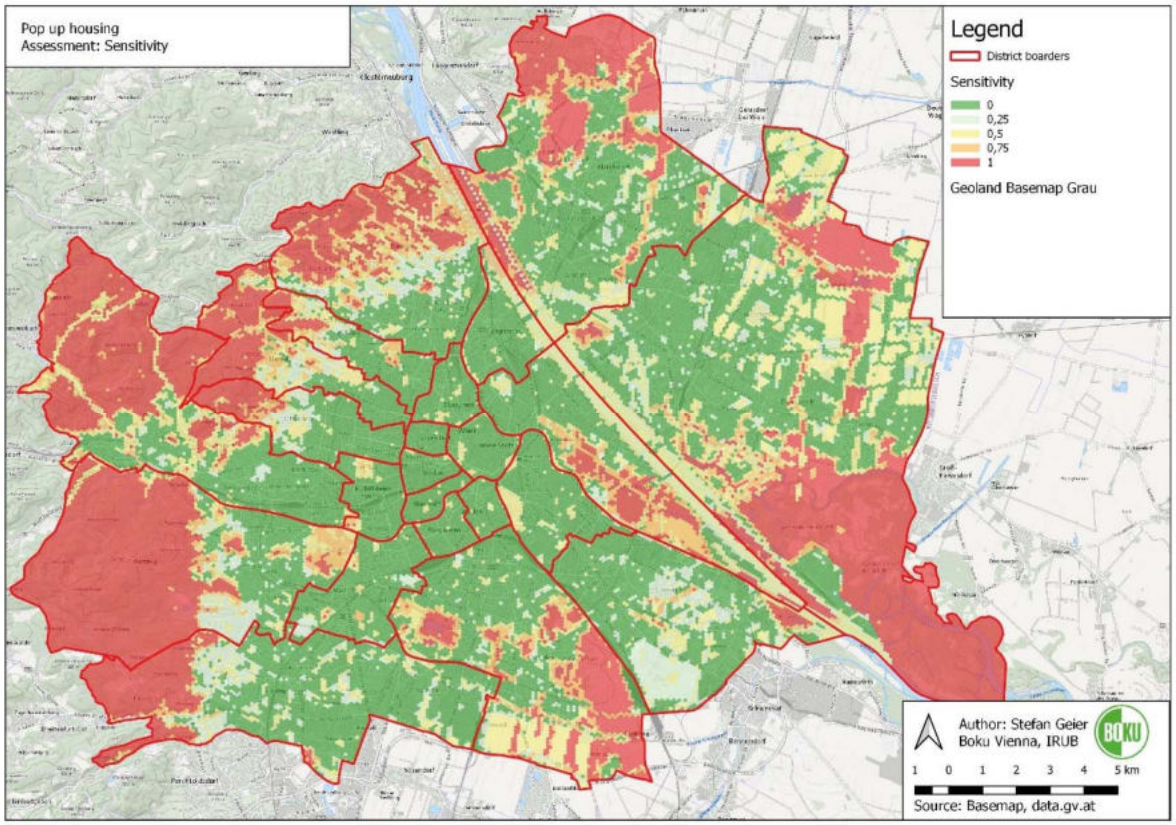

Figure 27: Results of the calculation of the sensitivity

Sub-indicator significance of intervention

Analogous to the sub-indicator sensitivity, the significance of intervention sub-indicator was determined from the dimensions of intervention and duration and was also evaluated using a preference matrix. Where intervention ranges from no or very low intervention (no fortification and completely reversible) to very high intervention (foundations and permanent changes to the soil). The scale for duration ranges from very short (up to three days) to very long (more than a year). For the models developed in the project, the level of intervention was determined using this classification and was determined using the preference matrix. The preference matrix was agreed upon in the project team and can be freely modified in the tool. The following figure shows the structure of the sub-indicator.

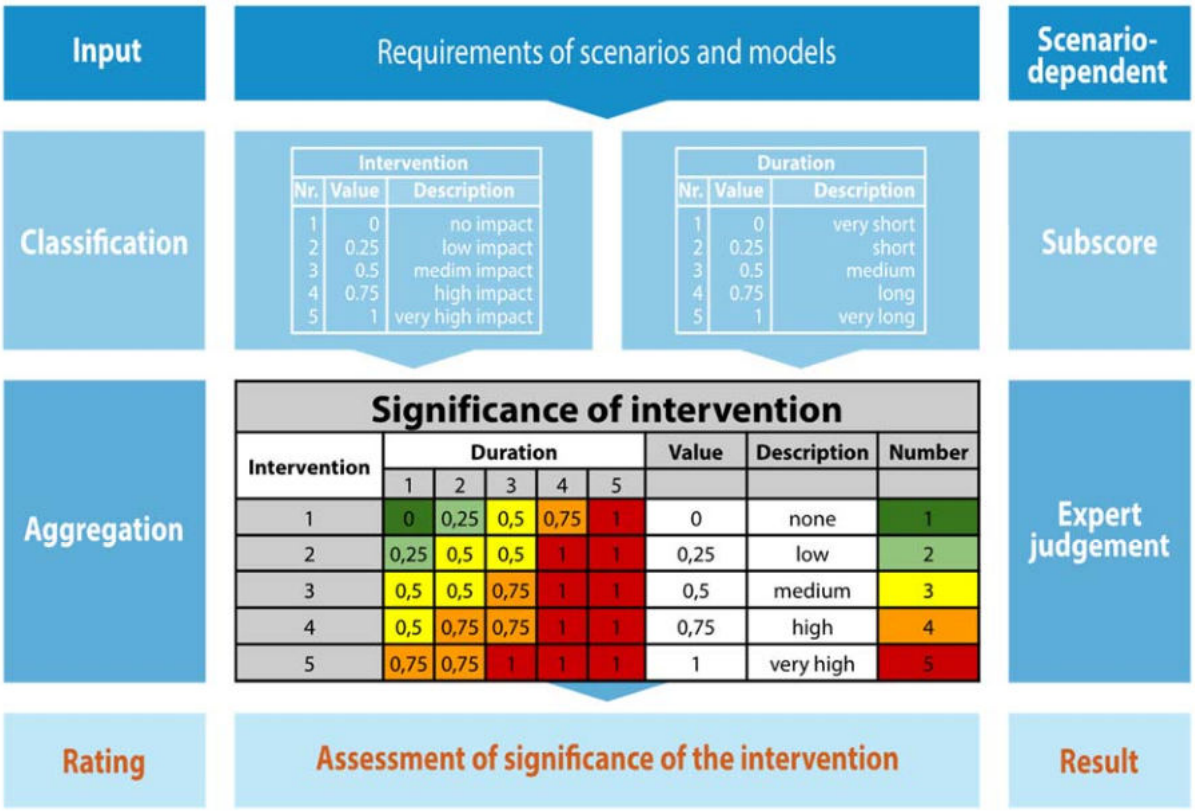

Figure 28: Scheme of the calculation of the significance of intervention

Based on the models developed in the project and the scenarios described for them, the impact and duration were determined. The table below shows the estimates and the associated values for the impact significance for the selected models.

Table 7: Values for the significance of intervention for each scenario/module

Scenario/Model	Requirements		Assessment	
	Impact	Duration	Value	Class
Beat the heat	3	2	0,5	3
Shophoppingbox	1	4	0,5	3
Life sharing2go	1	4	0,5	3
Life on tracks	1	2	0,25	2
Donautonom	1	3	0,5	3
Gapsolutly	5	5	1	5

Based on the assignment of the requirements of the models to the preference matrix, the classes for the significance of intervention result. Since the values partly overlap, sometimes the same classes result even with different input parameters. For example, the scenarios/models "Beat the heat", "ShophoppingBox", "Life sharing to go" and "Donautonom" are rated as class 3 based on the assessments made of the requirements and the preference matrix selected. The scenario/model "Life on tracks" is assessed with class 2 due to the low assessed intervention and the short duration. However, the "Gapsolutly" scenario is rated at Class 5 due to the construction method and the targeted long duration.

This results in the following results for the indicator from the combination of the sensitivity and impact materiality sub-indicators.

Results for the indicator Assessment of the ecological sensitivity of areas

The results for the indicator Assessment of the ecological sensitivity of areas are presented for the three different assessments. Figure 29 shows the result for the scenario "Life on tracks". Due to the sensitivity with the class 2, the map shows large areas with the suitability very good and good. However, these areas largely coincide with areas that are already built up. Similarly, with the requirements identified and the sensitivity preference matrix selected, it appears that this scenario also has medium suitability in terms of potential land use in protected areas.

For the scenarios/models with the Class 3 rating are shown in Figure 30. Due to the higher impact sensitivity, there is generally a lower suitability with regard to ecological areas. This is particularly clear in Figure 31 with the evaluation of class 5. Due to the very high significance of intervention, the ecologically valuable areas are not or only slightly suitable. This scenario/model also represents a significant impact on building land.

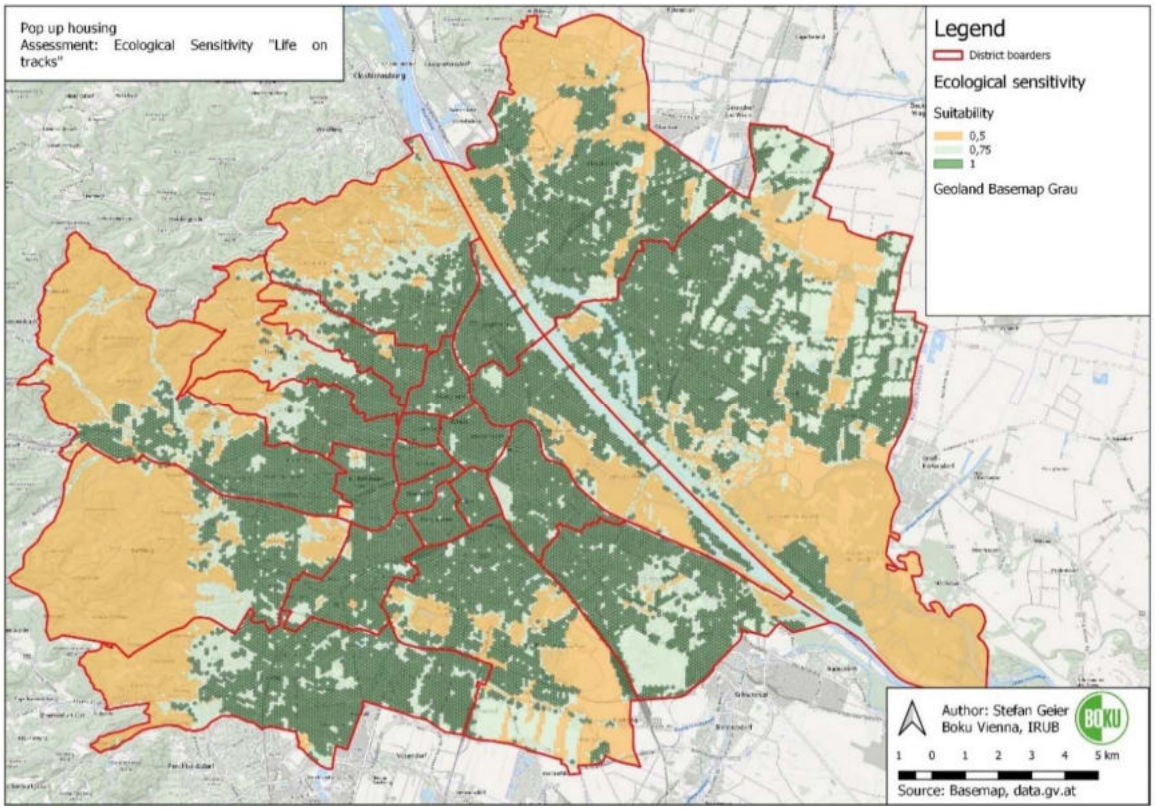

Figure 29: Results of the indicator assessment of ecological sensitive areas for the scenario "Life on tracks" Assessment 1

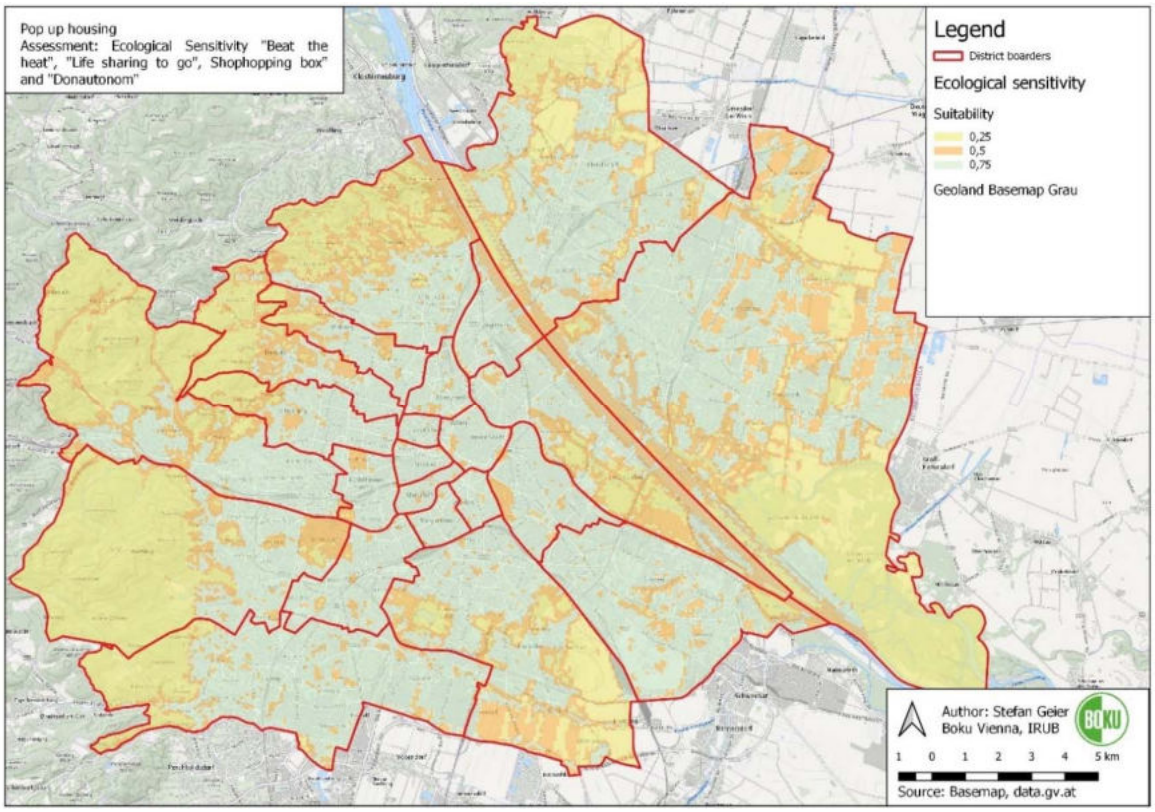

Figure 30: Results of the indicator assessment of the use ecological sensitive areas for the scenarios "Beat the heat", "Life sharing to go", "Donautonom" and the model "shop hopping box"

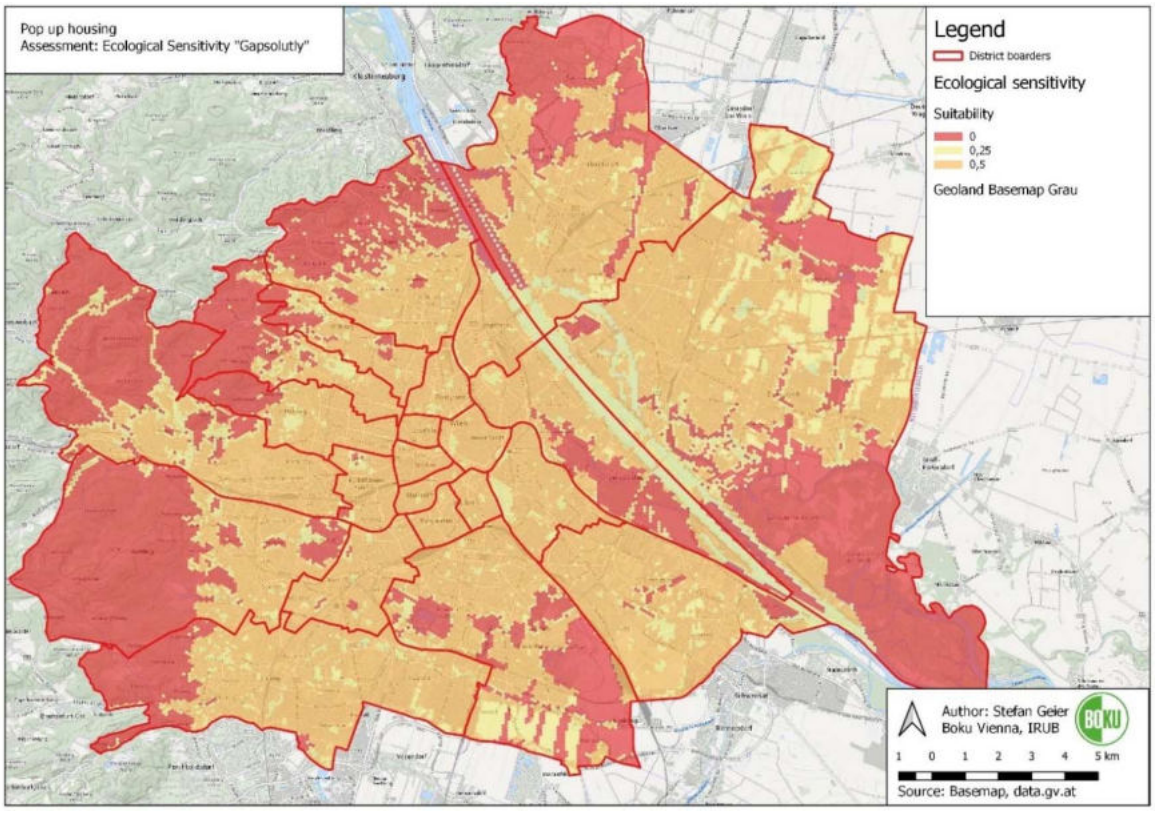

Figure 31: Results of the indicator assessment of the use ecological sensitive areas for the model "Gapsolutly"

4.4 TOTAL WEIGHTING OF INDICATORS

The last option in the tool to intervene in the evaluation can be done by weighting all indicators. Thereby, it is possible to let individual indicators flow more or less strongly into the result or to define mandatory or exclusion criteria. Thus, as in the example shown below (variant 3), a criterion (protection category) can be used to exclude areas.

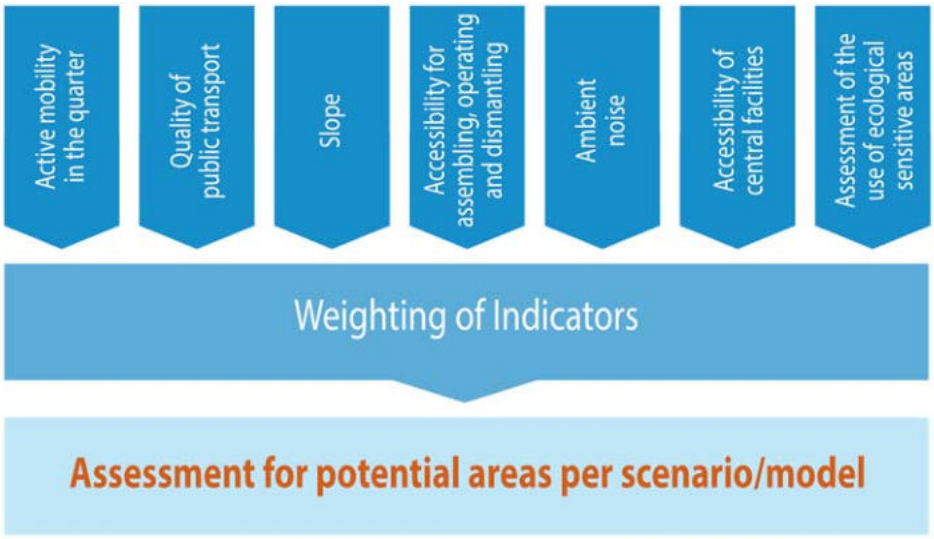

Figure 32: Scheme of the calculation of the final results

The weightings shown here are intended to illustrate the possibilities for setting priorities for indicators. For an application in a real planning case, these weightings would have to be coordinated by an expert judgement to explain the values and goals behind them. In addition, the selected weightings should be named and described in text. For special occasions, such as a disaster that triggers a high demand for land, the weightings can be adjusted accordingly. In this case, the evaluation of facilities and ambient noise could be waived to find sufficiently large areas to meet the demand. The ecological sensitivity indicator could also be ignored in extreme occasion cases.

The following table shows possible weightings. Variant 1 is a balanced weighting in which all indicators factor approximately equally into the result. In variant 2, a stronger weighting was given to ecological sensitivity to ensure a more nature-friendly selection of areas. In variant 3, the exclusion of ecological areas was ensured by a filter on the highest protection categories A and B (see section Protection categories).

Table 8: Values for total weighting

Variants	Indicators								Notes
	Facilitie	Assem-bling	Slope	Public transpor	Active Mobility	Ambient noise	Ecol. sensitiv e areas	Sum	
Variant 1	0,2	0,1	0,1	0,2	0,1	0,1	0,2	1	Balanced weighting
Variant 2	0,1	0,1	0,1	0,1	0,1	0,1	0,4	1	Ecological weighting
Variant 3	0,2	0,1	0,1	0,2	0,1	0,1	0,2*	1	*filter: if protection category is A or B value is 0

The following figures show some exemplary results to illustrate the impact of the indicators and the weightings. Presenting all results is beyond the scope of this deliverable, so the most concise results are focused on. In this assessment, all indicators were calculated the same for all scenarios/models, except for the indicator for environmentally sensitive areas due to differences in significance of intervention.

Figure 33 shows the results for the evaluation of the scenarios "Life on tracks" and the model "Gapsolutly" with a balanced weighting. The differences are particularly clear in the protected areas. Due to the higher significance of intervention, the "Gapsolutly" model shows a consistently lower suitability. While in the "Life on tracks" scenario the protected areas and agricultural areas still have a low to medium suitability, they are rated as very low to not suitable in the other scenario.

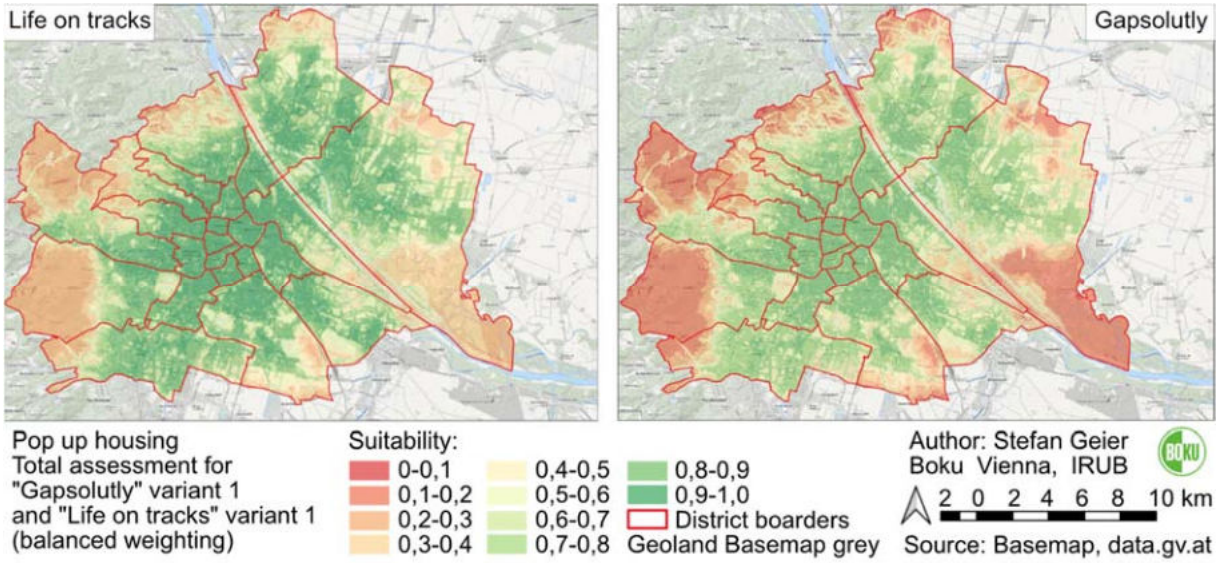

Figure 33: Results for scenario/model "Life on tracks" and "Gapsolutly" with variant 1 (balanced weighting)

On the example of the application of the "ecological weighting" for the "Life on tracks" scenario can be shown the extent to which suitability changes as a result (Figure 34). Thus, the general suitability decreases, but especially in the protected areas. As a result, ecological aspects are more strongly considered in the evaluation of the potential areas. However, it is easy to see that especially areas that lie in the transition from building land to protected areas still have a medium suitability. If these areas are to be completely protected from potential use, the protected areas must be filtered out in the weighting and rated as not suitable. This weighting, referred to as Variant 3, is shown in Figure 35.

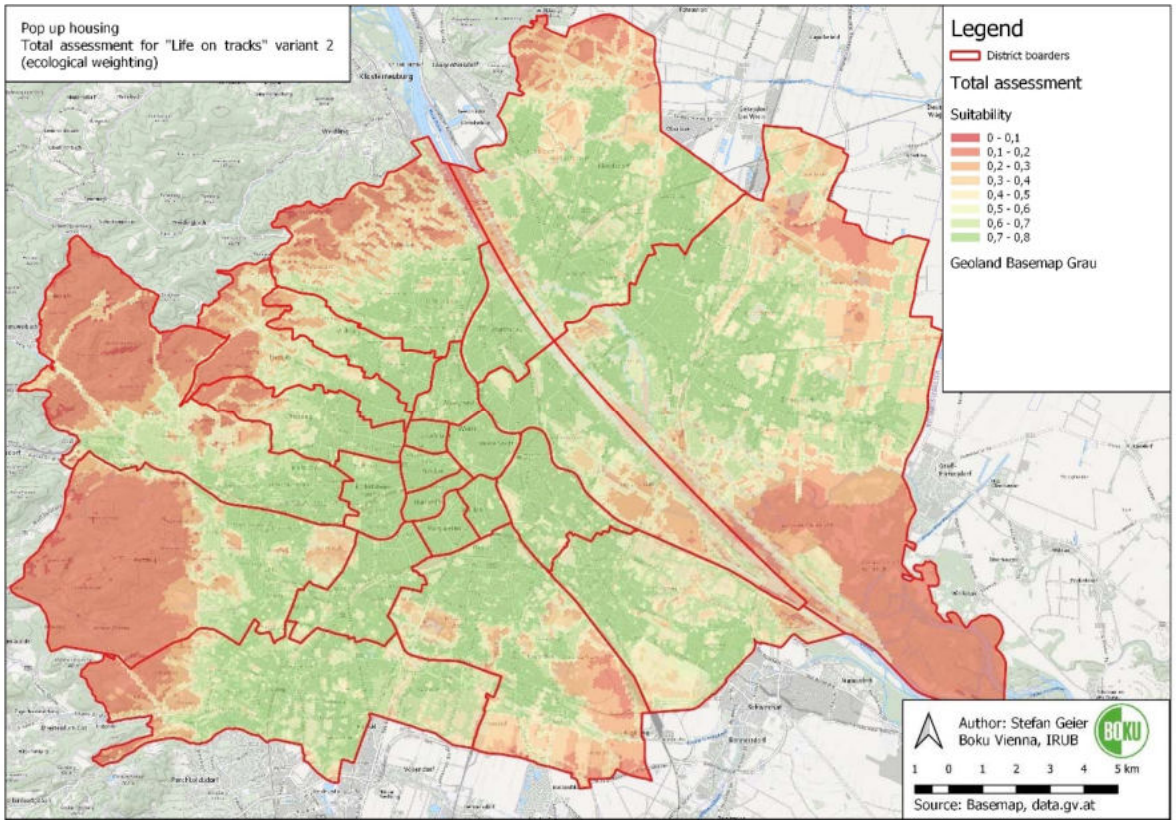

Figure 34: Results for scenario "Life on tracks" with variant 2 (ecological weighting)

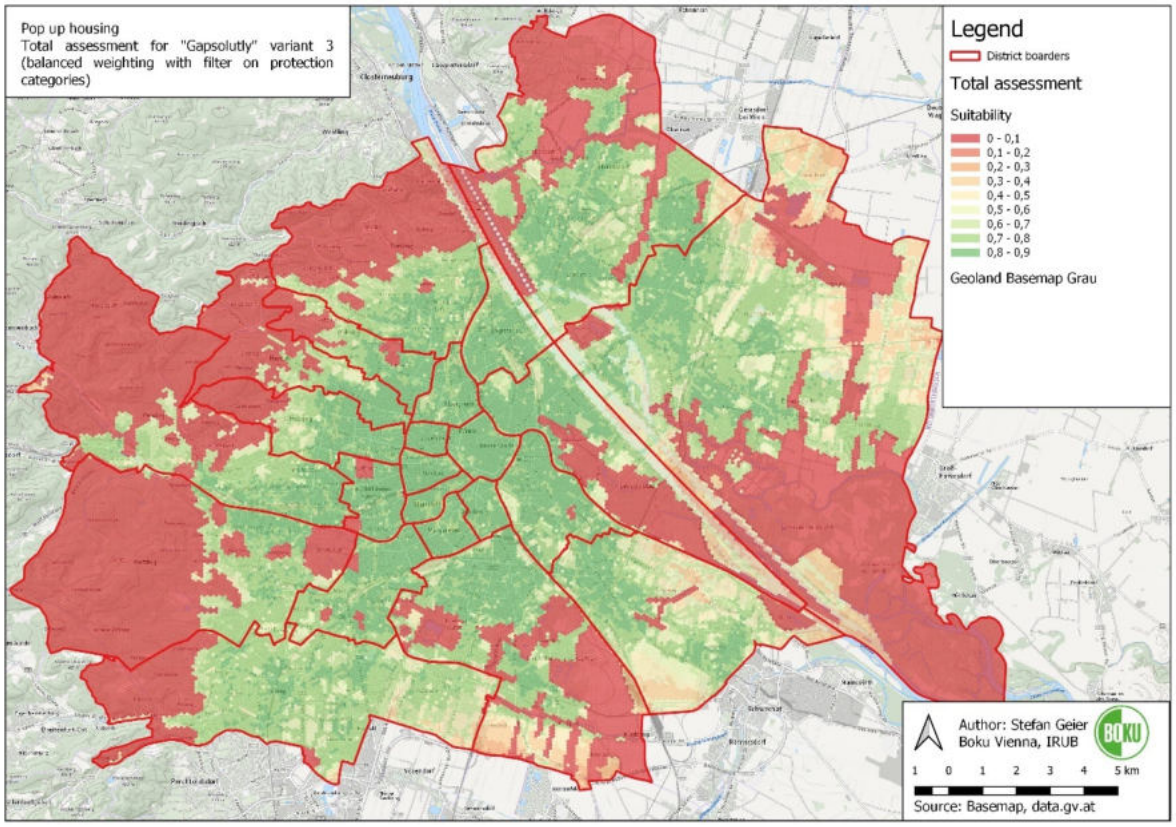

Figure 35: Results for model "Gapsolutely fitting" with variant 3 (balanced weighting with filter on protection categories)

Finally, Figure 35 shows the range of possible interventions in the tool and the possible adaptations to different occasions and values based on the weighting (variant 3) "balanced weighting with filter on protection categories".

4.5 CONCLUSIONS

Especially for a new topic, such as the integration of temporary housing needs into sustainable and strategic urban planning, the benefits of using GIS-based tools become apparent. By showing the adjusting screws of the GIS model and the effects on the suitability of the areas, negotiation and decision processes can be supported. The results provide an orientation knowledge through the area-wide representation of the data and can provide a better understanding of spatial relationships through the integrated view.

Using the Covid pandemic as an example, one can see that a need for temporary facilities can arise quickly. For example, buildings had to be adapted for testing and vaccination, and temporary facilities were also created in parking lots for this purpose. The scale and duration have led to conflicts of use, at least temporarily. For future occasions of this kind, the application of this tool could be an added value.

Beyond the scenarios studied, the tool can also be applied for other purposes. as already mentioned, the site search in case of disaster, at least on a larger scale and longer duration, but also for the evaluation of temporary uses with larger space requirements such as: Festivals, fairs or the like. Since conflicts and competing uses with existing demands can arise with such temporary uses, it seems sensible to check larger uses for their compatibility with existing uses and long-term urban development goals (e.g.: protection of ecologically sensitive areas and recreational use). The many adjusting screws of the tool offer sufficient possibilities to deal with different occasions and to analyse their sustainability or spatial compatibility also in the context of a longer-term urban planning.

Vienna offers very good preconditions as an investigation framework for a GIS analysis, due to the extensive data, which is made available freely and in good quality. The availability of Open Government Data enables the development of extensive tools and their further development and maintenance. Due to the standardized data interfaces and structure as well as the secured availability, this can be done without depending on data deliveries or a cooperation with the data owners. Nevertheless, data owners can benefit from such work or projects without any additional effort. It would be desirable if more administrations would make their data available as Open Government Data.

For further development of the tool, workshops with experts from different planning disciplines and administrative areas would be necessary. The practical experience would be necessary to improve the usability, sense and characteristics of the indicators and the comprehensibility of the results.

5 EMPIRICAL INNOVATION NICHE MAPPING OF EXISTING NICHE EXPERIMENTS IN VIENNA

5.1 INNOVATION NICHES AND SOCIO-TECHNICAL TRANSITIONS

The challenge within this project is to conceptualize temporary housing environments as micro innovation systems embedded in highly structured urban environments and to develop a framework that actively promotes radical new solutions.

In the context of our work, innovation is to be understood not simply as a new idea or method, but as involving the application of better solutions. The practical implementation of these solutions is a key factor in this conception, generating meaningful impact in society. Innovation is therefore not to be understood as e.g., an invention or idea as a stand-alone element, but includes the process of translating this new solution into goods, services or methods.

Typically, a differentiation is drawn between the terms continuous or incremental innovation and so-called radical or discontinuous innovation. The terms continuous and incremental innovation are used to describe a steady and incremental improvement of products, which typically already exist, over time. New software improvements can be an example of this type of innovation. Radical and discontinuous innovation, on the other hand, describes a form of innovation which can produce its own market and typically entails broad implications for society. One such an example would be the introduction of the smartphone, which has greatly changed the way we use and interact with our mobile devices. Radical innovations can be fostered on the micro-level within technological niches, before entering higher levels and potentially breaking through on a larger scale.

When observing system dynamics, technical systems always need to be regarded within their context, seeing as they are embedded in existing infrastructures and value chains and are close-ly interwoven with user practices (Rip and Kemp 1998 as seen in; Markard, Raven, and Truffer 2012, 955). A more apt way of describing these systems is through the use of the term “socio-technical systems”, including not only material artefacts and knowledge, but also aspects of in-volved actors and institutions (Geels 2004; Markard 2011; Weber 2003 as seen in; Markard, Raven, and Truffer 2012, 956). Since established technical systems are embedded in these highly institutionalized and complex systems, socio-technical transitions tend to be slow and more inclined to undergo incremental rather than radical changes (Dosi 1982; Frantzeskaki and Loorbach 2010; Markard and Truffer 2006 as seen in; Markard, Raven, and Truffer 2012, 955). This poses a problem for attempts to steer developments into certain normative directions, e.g., in pursuit of higher sustainability or increased social justice. The field of sustainability transitions attempts to address the question of transitions toward more sustainable solutions, examining ways of promoting and governing these processes. Markard, Raven et al. (2012, 956) describe sustainability transitions as follows: “*long-term, multi-dimensional, and fundamental transformation processes through which established socio-technical systems shift to more sustainable modes of production and consumption. One particularity of sustainability transitions is that guidance and governance often play a particular role* (Smith, Stirling, and Berkhout 2005)”. In their work Markard, Raven et al. describe four

prominent frameworks within transition studies, made up of transition management (TM), strategic niche management (SNM), multi-level perspective (MLP) and technological innovation systems (TIS) (see Figure 36). A key concept with-in all these frameworks is that of the technological niche.

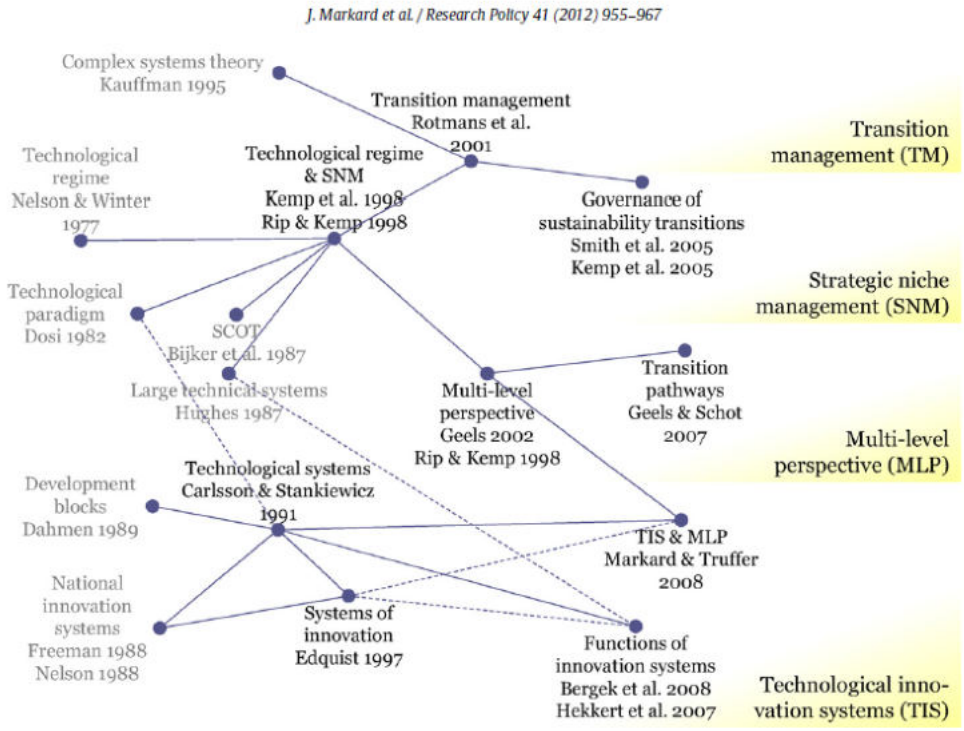

Figure 36: Map of key contributions and core research strands in the field of sustainability transition studies as found in Markard, Raven et al. (2012, 957)

Schot and Geels (2008, 537) describe technological niches as "*protected spaces that allow the experimentation with the co-evolution of technology, user practices, and regulatory structures*". The fundamental underlying idea behind technological niches is that these "protected spaces" allow fledgling technologies or solutions to be developed outside of "real world" pressures, such as for instance existing regulations, which can potentially hinder the development of alter-native solutions outside of existing mainstream solutions, or existing market pressures. Techno-logical niches often take the form of special programmes in R&D settings or demonstration pro-jects, funded by firms, governments, and research institutions (Schot and Geels 2008).

Technological niches serve an additional purpose to shielding new ideas from mainstream com-petition, as they address the problem identified by Rosenberg (1976, 195 as seen in; Schot and Geels 2008, 537): "*most inventions are relatively crude and inefficient at the date when they are first recognised as constituting a new invention. They are, of necessity, badly adapted to many of the ultimate uses to which they will eventually be put*". Experimentation within technological niches allows for an alignment of new ideas, for instance new

technologies, with the existing user practices, regulations, and infrastructures, for instance by incorporating relevant actors and providing a space for interaction.

In order to address the question of how the radical niche concept of innovation approaches can be translated to the context of temporary housing environments, the work by Sengers et al. (2016), provides an overview of conceptualizations of experiments prevalent in sustainability transition research. Based on the literature utilized in the proposal of this project (29 refer-ences), the snowball method was applied, with a focus being placed on review papers to gain an initial overview of the field and an understanding of the core concepts.

Based on this literature we identified 6 existing conceptualizations which we wish to use as a basis for our study. These are:

- Niche experiments
- Bounded socio-technical experiments
- Grassroots experiments
- Transition experiments
- Sustainability experiments
- Urban living labs

5.2 EMPIRICAL INNOVATION NICHE MAPPING

5.2.1 Selection of Cases

The empirical innovation niche mapping serves to identify and study existing (on-going and recently finished) niche experiments in Vienna with a focus on sustainable innovation (living labs, pilot- and demonstrations projects, self-organized initiatives, start-up spaces, etc.).

In order to conduct the innovation niche mapping for Vienna, a google-search was conducted with the terms “living lab$”, “grassroot$ experiment$”, “sustainability experiment$”, “transition experiment$”, “socio-technical experiment$” and “niche experiment$” in combination with the terms “Wien” and “Vienna”. Through this method around a dozen examples of ongoing and recently finished niche experiments were collected, which were in turn indicative for important funding schemes relevant for Vienna with experimental character. These funding pro-grammes were then examined in greater detail. The collection of projects was thus expanded, with one-pagers being collected which contain the project name, topic, funding programme, source of financing, project team, project duration, budget, project webpage and an excerpt from the official project description. Over 90 projects were collected in this manner, with no claim to completeness. The overwhelming majority of cases was collected in German, as the case descriptions are oftentimes only provided in German.

The funding programmes which were screened at this point are:

- Urban Mobility Labs (Mobilität der Zukunft)
- Stadt der Zukunft
- Smart Cities Demo
- JPI Urban Europe

The relevance of these programmes for innovation niche mapping in Vienna will now briefly be summarized.

Urban Mobility Labs

On initiative of the Federal Ministry for Transport, Innovation and Technology, urban mobility labs (UML) serve to serve the creation of novel, experimental environments where innovative solutions can be found in mobility and transport. The UML are conceived as having strong elements of citizen participation, as well as participation of science, businesses, and politics. Testing and implementation play a key role. The UML are part of the "Mobilität der Zukunft" programme. Five UMLs were established in Austria, two in Vienna (BMK 2021b). Within the collection of case studies 5 explorative projects are included, which served to prepare and inform the introduction of UMLs. The mobility lab "Aspern.mobil LAB" is documented with a total of 14 projects, the second Viennese mobility lab "Thinkport VIENNA" covers a total of 7 projects.

Table 9: Explorative projects for Urban Mobility Labs

Explorative Projects for Urban Mobility Labs
Urban Mobility Lab: smart urban freight logistics 4.0
Aspern.mobil: Stadt bewegt
CHANGE-Lab
Living Lab Wien ZWA – Zukunft wird Anders
Mobilität über Stadtgrenzen (nationwide)

Table 10: Projects within Urban Mobility Labs

Urban Mobility Lab	Projects
aspern.mobil LAB	Gut wohnen & flexibel unterwegs KoopHubs StandPI RemiHub auto.Bus – Seestadt Urban MoVe REBUTAS EROG eRollin' on Green Walk&Feel LARA Share VR-planning PHOBILITY AKTIV LOGISTIK CONCIERGE AAL.mobicargo
Thinkport VIENNA	HUBERT – DIE STADTLOGISTIK VON MORGEN GÜMORE – Verkehrsmodell Ostregion MiHu – Analyse von Kooperationsmöglichkeiten für urbane Midi-Hubs SCHNURRR RemiHub – Nutzbarkeit von ÖV-Betriebsflächen für nachhaltige Logistik FRASPED Logistik APP – Mobile Checklisten zur Abfahrtskontrolle SCT – Smart Container Trucking

Stadt der Zukunft

The research and technology programme first launched in 2013 and places a focus on buildings, urban energy systems, neighbourhoods, and the city in connection with the surrounding area. The premise is that new technologies should contribute to a more environmentally way of working, living and housing, i.e., through energy-efficiency. The research programme is to contribute to this transformation process towards a sustainable city, whereby a strong focus is placed on energy issues. The case study collection is made up of 8 projects from this programme.

Table 11: Calls within the programme Stadt der Zukunft

Call	Project
1st Call	Living Lab MUGLI SmartServices für ressourcenoptimierte urbane Energiesysteme von Stadtteilen StromBIZ-Demonstrationsprojekte
2nd Call	SPIN.OFF GrünPlusSchule@Ballungszentren
3rd Call	Green.resilient.city
5th Call	P2PQ – Peer2Peer im Quartier 50 grüne Häuser

Smart Cities Demo

Since 2010, the “Klima- und Energiefonds” has been supporting demonstrative innovative city projects within the Smart Cities initiative. The focus of the initiative is placed on the transformation of the energy system for the sake of climate protection. Active citizen involvement is a strong aspect of the programme. Smart Cities Demo describes itself as “a systematically integrative funding program with a highly experimental component involving local/regional decision-makers”, regarding cities as testbeds. A total of 41 projects were collected.

Table 12: Calls within the programme Smart Cities Demo

Call	Year	Project
1st Call for Tender Smart Energy Demo – FIT for SET	2010	GUGLE – Green Urban Gate towards Leadership in sustainable Energy (entry project) Smart City Vienna – Liesing Mitte (entry project) Smart City Wien (entry project)
2nd Call for Tender Smart Energy Demo – FIT for SET	2011	Smart City Profiles (not Vienna-specific) Smart Finance for Smart Cities (nationwide) DEMOSMART (not Vienna-specific)
3rd Call for Tender Smart Cities – FIT for SET	2012	IKT-Integration für Gebäude und Stromnetz Wien-Aspern (entry project) TRANSFORM+ (implementation project)

4th Call for Tender Smart Cities Demo	2013	SC Demo Aspern (implementation project) Smart City X (entry project) Smart City Standards (nationwide) Vorbereitung Begleitforschung der Smart-Cities-Initiative (nationwide)
5th Call for Tender Smart Cities Demo	2014	HEAT_re_USE.vienna (entry project) Smart City im Gemeindebau (entry project) Mischung: Possible! (entry project)
6th Call for Tender Smart Cities Demo	2015	Smart Block Step II (entry project) Make your city smart – Wien Aspern (entry project)
7th Call for Tender Smart Cities Demo	2015	Smartes Wohnen für Generationen (entry project) Urban Cool Down (entry project) GREENING ASPANG (entry project) Biotope-City is smart – Coca-Cola Areal in Wien (entry project) Pocket Mannerhatten (entry project) SINN Cities (nationwide) Smartes Leben am Wasser (entry project)
8th Call for Tender Smart Cities Demo	2016	Smarter Citizens Building Tour (implementation project) BuildyourCity2gether Wien Aspern (entry project) Mischung: Possible! Nordbahnhof (implementation project) GRÜNEzukunftSCHULEN (implementation project)
9th Call for Tender Smart Cities Demo	2017	Grüne Wohn- und Pflegeheime für alte Menschen (nationwide) Grüne [Tragwerke] Innovative Begrünungssysteme im urbanen Raum (nationwide) WOGE DEMO (implementation project) SD4Austria (nationwide) Smart AirportCity (implementation project) Pocket Mannerhatten “Block 61” (implementation project) LiLa4Green (implementation project)
10th Call for Tender Smart Cities Demo	2019	aIBOX (implementation project) OPENhauswirtschaft (implementation project) ShareMob (implementation project) Tröpferlbad 2.0 (implementation project) KlimaEntlaster go Smart Cities (implementation project, nationwide) NEW3TION (nationwide)

JPI Urban Europe

Joint Programming is a process of the European Commission meant to strengthen research and innovation cooperation. The Urban Europe Joint Programming Initiative has been running since 2010, aiming to strengthen cooperation in research and development in order to promote sustainable and economically strong cities. A total of 17 projects were collected for the purpose of the niche mapping in Vienna.

Table 13: Projects within the programme JPI Urban Europe

Projects
CASUAL
CIVIC
E4-share
Gentrification 2.0
GLOCULL
IN-SOURCE
Interethnic Coexistence in European Cities
IP-SUNTAN
MIMIC
OptiMaaS
PlaceCity
play!UC
RECREATE
SUNEX
SYNCITY
UrbanData2Decide
Vertical Green 2.0

Other projects

Not all cases are organized within research programmes. A small number of examples, such as bottom-up initiatives, were taken up in the case collection.

Table 14: Other projects and associated financing

Projects	Financing
Urban Mobility Lab Freight II	Wirtschaftskammer Wien
Vienna transitionBASE	Bottom-Up, crowdfunding, partially through funding programmes (Klima- und Energiefonds)
Bühne Frei fürs Gaswerk!	Bottom-Up Initiative

5.2.2 Preliminary Results

The overwhelming majority of projects appear to be driven by research programmes with elements of user involvement, of which some show a focus on housing. These housing projects are typically viewed in the context of the Smart City, without a temporary element, hence the room for experimentation is limited, seeing as the construction sector is highly regulated.

The Federal Ministry for Transport, Innovation and Technology appears to be a key player in the funding of niche innovation projects in Vienna, in cooperation with the Austrian Research Pro-motion Agency.

The Smart Cities Demo programme provides a good insight into how much time can be needed for implementation projects to take place within a research programme. They classified projects as “entry project”, “implementation project” or “accompanying project” (see table

above). Entry projects are primarily theoretical and can serve as doing the groundwork for follow-up implementation projects. When regarding the types of projects funded throughout the years, one can clearly recognize an increase of implementation projects after the 8th invitation of tenders. In the previous six years, only two implementation projects were funded which took place in Vienna. This could be an indication that research programmes must be established for several years before implementation projects take place. This may be related to the required background research and preparatory work consortia must conduct beforehand, which appears to take place in the form of entry projects.

Consortia tend to involve 4 to 6 project partners for projects dealing with theoretical research questions, with implementation projects showing a significantly higher number of project partners, which can range from 7 to 11 project partners. The Technical University of Vienna appears to be particularly active in implementation projects in the area of building within the Smart City Demo projects. The funding sums for implementation projects are significantly higher than for entry projects or accompanying projects. Within the Smart City Demo programme, implementation projects have spanned from 225.763€ to 3.690.000€, whereby the funding appears to typically amount to about half of the total project volume.

6 EVALUATION OF RESULTS OF WP1 AND TASK 2.3 WITH STAKEHOLDERS

On February 21, 2019, the first of a total of 3 planned stakeholder workshops took place in the Simonyhaus of the University of Natural Resources and Applied Life Sciences in Vienna as part of the WWTF-funded research project “Urban pop-up housing environments and their potential as local innovation systems”. Preliminary project results were presented to provide participants with general information about the project, before embarking on the interactive portion of the workshop, which was conducted in smaller working groups. The aim of the workshop was to develop relevant scenario building blocks for temporary living in Vienna with the stakeholders. In subsequent discussions, several success factors and obstacles to temporary living in Vienna were identified. The workshop was attended by 11 stakeholders from various backgrounds, to gather expertise from the areas of people, housing and areas.

Seeing as the workshop was conducted in German, the Workshop Report was formulated in German so as to provide a faithful representation of the stakeholder input.

The core questions for the brainstorming session were:

1. Which areas/spaces for temporary housing do you consider as being relevant now and in the future?
2. Which framework conditions and factors of temporary housing do you consider relevant now and in the future?
3. Which groups of people need temporary living or will need it in the future?

This exercise also served to prepare for the next step of scenario creation within working groups. Within 3 working groups, a total of 5 scenario drafts were created for temporary housing solutions that seemed feasible for the Viennese context (see summation table 15). These scenarios included user groups and social aspects, the duration of habitation, the building equipment and open spaces, properties of the spaces and areas, (technical) infrastructure and neighbourhood features. Based on these 5 drafts, finally six different scenarios were created, which subsequently offered the framework conditions for the development of the temporary housing models (see Deliverable D3). The creation of the pop-up housing scenarios was a multi-stage, inter- and transdisciplinary process, which started with this first stakeholder workshop (WS1). The workshop allowed for the first of several feedback loops that were implemented in the process of the scenario development. The interaction with the stakeholders at the workshop on the one hand represented a "reality check" for the research findings derived from the “desk-research” in WP1, and on the other hand also opened new perspectives for the next process steps. For the overall process and methodological details see Executive Summary and Deliverable D3.

Common themes appeared to be an emphasis on mixed user groups and the repurposed reuse of already existing buildings, though it must be cautioned that these results cannot be considered as a representative insight into a broad range of expert opinions. After establishing a timeline for these scenarios, these were presented and discussed in the plenum.

To conclude the workshop, an open discussion was held on the question of obstacles and success factors which the stakeholders have encountered in their professional lives regarding temporary living in Vienna.

Table 15: Draft of feasible scenarios as output from the 1st stakeholder workshop

		Life sharing to go (on)	Broken Hearts Rooms
	NutzerInnen-gruppe(n), soziale Aspekte	Interkulturell interessierte aufgeschlossene Menschen in Kombination mit AsylantInnen, Asylberechtigten. Start ups, Airbnb, Kultur, Architektur, Sozialbereich Integrationsaspekt Bunte Mischung – Antighetto	Nach Trennungen auf Wohnungssuche (ältere) Menschen mit großen WE (Wohneinheiten) / Wohnungen
	Dauer des Bewohnens	Von ein paar Tagen für Airbnb, bis zu ein paar Jahren je nach Lebensphase	½ - 1 Jahr
	Gebäudeaus-stattung und Freiräume	Gestaltungs- und Aneignungsmöglichkeiten Urban gardening-Angebot (für alle + Nachbarn) Rückzugsmöglichkeiten und Privaträume	Eigener Rückzugsraum (bis Garconnière) Event. Möbliert bzw. Übernahme-Möglichkeit
	Eigenschaften der Flächen, Räume, Gebiete	30% immer für Asylberechtigte Umnutzung bestehender Gebäude, Nutzungsflexibilität Zentrale Lage + vorhandene Anbindung Klare Grundstruktur Zonierung Kombination mit Storage	Nach Möglichkeit WE mit 2 Bädern / getrennten WCs
	(Technische) Infrastruktur-anbindung	ÖV Anbindung Ausbaubare HT (Haustechnik) / Infrastruktur	Online Plattform / Vermittlungsbörse: Suche – Biete Gute Bewährungsförderung / Begleitung
	Merkmale der Nachbarschaft	Lust auf gemeinschaftliches Wohnen Einbindung durch urban gardening + sonstige Angebote Ausgleichs-/Solidarbeiträge	
	Besonderheiten	Sandboxing Experiment mit Verantwortung Rechtsform + Organisationsstruktur	Untermiete / tw. Geteilter Wohnraum

		Temporär mit Flair	Lückenmodul
	NutzerInnen-gruppe(n), soziale Aspekte	Studierende mit Kinder(n) SeniorInnen (agil, alleinstehend, offen für Zusammenleben)	Geflüchtete
	Dauer des Bewohnens	2-5 Jahre Wechselnde Personen Minimum 50 – 50 Personen (Studierende / SeniorInnen)	Bis zu 5 Jahre (erst nach durchgehendem gemeldet sein in Wien erhält man Anspruch auf zB Gemeindewohnen)
	Gebäudeaus-stattung und Freiräume	Büro-Gebäude Kleinbüros als Zimmer nutzen Gemeinschaftsräume (Küche, Aufenthalts-, Bewegungsräume)	Privatsphäre + gemeinschaftliche Räume (Familien) Fokus auf Einbindung in Gemeinwesen Gemeinschaftsgarten
	Eigenschaften der Flächen, Räume, Gebiete	Gemeinsamer Betrieb (Café, Kindergarten, Waschküche) Zentrumsnahe Lagen	(Städtische) Baulücken „modulare Bauweise“
	(Technische) Infrastruktur-anbindung	Adaptierungen (Sanität, Küche – individuelle + gemeinsame Nutzung Barrierefreiheit / Aufzug	Erschlossen (Wasser, Strom)
	Merkmale der Nachbarschaft	Öffentliche Anbindung Nachversorgung Freiraum. Versorgung Soziale Sicherheit	Außerhalb Gürtel Öffi angebunden! Schulen! Infrastruktur ohne KFZ erreichbar (Einkäufe, Schule, KG (Kindergarten))
	Besonderheiten	Großfamilien / Community-Gedanke Widmung + Nutzungskategorie „temporäres Wohnen“	Incentives Anreizsysteme für Grundstück Eigentümer

		Wohnbox
	NutzerInnen-gruppe(n), soziale Aspekte	„Mobile“ (beruflich, in Ausbildung) – freiwillig!
	Dauer des Bewohnens	‚digital nomads‘, ‚Expats‘
	Gebäudeaus-stattung und Freiräume	6-24 Monate
	Eigenschaften der Flächen, Räume, Gebiete	Öffentlicher Raum vor der Erdgeschosszone
	(Technische) Infrastruktur-anbindung	Zugang zu Licht und Luft

	Merkmale der Nachbarschaft	Privatsphäre (Folien auf Fenster)
★	Besonderheiten	‚Hinterhof'

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8 FIGURES AND TABLES