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

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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   INTRODUCTION

1.1 AIM OF WP5

One aim of this project is to contribute to the transition of the construction sector from linear to circular models and to cope with the situation of (increased) demand for temporary housing in urban regions, by using temporary Pop-up Environments (PUEs). Urban development and planning strategies should be made more sustainable in social, economic and environmental terms, in an attempt to find adaptable and flexible paradigms for different urban contexts. Within the project, innovative models of pop-up living systems are created for Vienna framework conditions. These PUEs are conceptualized as spaces for social learning and experimentation, where new technical and social concepts can be applied and evaluated to explore more sustainable ways of living. Six different scenarios of pop-up housing environments were developed under consideration of different types of urban spaces, which were then further specified into six housing models.

WP5 seeks (1) **to identify issues for the transferability of the theoretical concepts into potential implementation in the City of Vienna and (2) to explore the international applicability of the developed scenarios,** which were designed for the context of the city of Vienna.

1.2 BRIEF DESCRIPTION OF VIENNESE SCENARIOS

Six possible temporary housing scenarios were defined within the project for the context of Vienna (for details see Deliverables D3 and D4). The scenarios were developed with the input by stakeholders and six potentially suitable area types for temporary housing in the city were identified. These are:

1. Vacant lots, understood as urban gaps due to the lack of buildings in densely constructed lots.
2. Empty buildings, like factories and industries that have fallen into disuse and are now abandoned.
3. Large (green) open spaces (whereby these spaces provide important functions which must be taken into consideration).
4. Rail traffic areas which are no longer in use
5. Vacant ground floor retail spaces, before a new destination is found.
6. Bodies of water, like rivers.

Moreover, technical aspects (e.g., architecture, building infrastructure, materials size and use, end-of-life disposal) and social aspects (e.g., possible user groups, duration of stay, adaptability, and flexibility for different uses) were defined. The scenarios and housing models were developed in a step-by-step process (see deliverable D3): 1. definition of the scenario (initiated during workshops with interested stakeholders and subsequently in an interdisciplinary fine-tuning approach by the project team); 2. concept design (in collaboration with the students of the "POPUP SHELTER – Design Studio" course at the TU Wien); 3.

architecture modelling for the definition of the physical 3D models; 4. model assessment for the definition of resources like energy, water, materials and waste flows.

Table 1: Summary of scenarios

Scenario No.	Scenario Name	Scenario Application	Implication
1	GapModule	Vacant lots	Temporary units to be realized in urban gaps due to the lack of buildings in densely constructed lots
2	Life Sharing to Go	Empty buildings	Temporary units to be realized in old and abandoned factories and industries that have fallen into disuse
3	Beat the Heat	Large open spaces	Temporary units to be realized in cooler areas of the city to escape heat islands
4	Life on tracks	Rail traffic areas	Temporary units to be realized in train wagons for residential purposes
5	Flat-pack	Vacant ground floor retail spaces	Temporary units to be realized in retail-shops facing the streets that are currently unused
6	DonAutonom	Open water bodies	Temporary units to be realized in old cargo ships moored to riverbanks

2 CONSIDERATIONS TO TRANSFER THE THEORETICAL CONCEPTS INTO POTENTIAL IMPLEMENTATION IN THE CITY OF VIENNA

In this chapter the transferability of the concepts is elaborated on a local level with the application case for the city of Vienna. Thus, the focus is on the view from an urban and spatial planning perspective.

To define the context, the definition of spatial planning is given: The subject of spatial planning is the functional division of a defined territory into building land, green-land, and traffic areas. The aim is to enable people to fulfil their basic functions (living, working, recreation, supply, etc.) with reasonable effort.

Due to (1) various developments and influencing factors that can be foreseen to varying degrees and calculated in terms of their spatial impact and (2) the complex and conceptually limited tangibility of the interactions between these, it is necessary to consider the consequences of these developments, respectively trends and disruptive events in spatial planning and how to deal with the consequences while considering the principles of sustainable spatial development. Regarding the first aspect, thinking in terms of possible futures (development of scenarios) is appropriate. Relating to the second aspect, it is a matter, on the one hand of taking account of developments and influencing factors in strategic spatial planning by way of nominal spatial planning (Spatial Planning Act/Building Code, strategic spatial planning instruments (e.g., STEP)). On the other hand, an important step is to concretely determine the location of infrastructure by way of local spatial planning. In the context of both strategic considerations and the accounting of long-term trends and (tendentially) unforeseeable events (e.g., natural disasters, blackouts, refugee waves), it is important to pay attention to reacting quickly and adequately to changing needs in the sense of public welfare and planning quality, while at the same time not significantly limiting future room for manoeuvre in connection with urban development.

2.1 KEY CONCLUSIONS ON THE LOCAL TRANSFERABILITY

Spatial planning is a cross-sectional subject, which is characterized by a systemic approach and weighs up social, ecological, and economic aspects when preparing political decisions. This approach, the subject of the project "pop up environments", the composition of the project team and the results obtained lead to the following conclusions:

1. This project was conceived and submitted as a basic research project, but it became apparent that a concretization of the target groups, the occasion leading to "pop up environments" and the spatial context in which these "structures" are placed was necessary as soon as possible. This specification and the spatial context of Vienna led to a change in the character of the project towards application-oriented basic research in the course of the work.

2. The spatial abstract thinking of "pop up environments" is difficult from the professional perspective of spatial planning in the project at hand, especially since every conversion of existing infrastructure or every change in the use of developed as well as

undeveloped areas has concrete (political) consequences that must be discussed based on concrete examples (neighbourhoods) (cf. scenarios/models).

3. The discussion about pop up environments focuses on concrete basic functions of existence or combinations of these (e.g., living, living and working, working, living and working and recreation). Regarding dwell times, the importance of the aspect of adequacy of the offered solutions comes into the focus of spatial planning (knowledge). Adequacy was also a central topic of discussion in the project team regarding "good solutions".

4. A clear discussion of "pop up environments" on the one hand and "pop up housing" on the other hand is made difficult by an object-focused discussion.

5. The study of the legal material (Building Code for Vienna) and strategic planning instruments (STEP and specialized concepts) makes two things visible: 1. the limited room for manoeuvre regarding the construction of housing offers that are designed for a short time in terms of their inventory (high urban development standards). This tends to be independent of whether a corresponding zoning is already in place, 2. disruptive events are not considered - the focus is on planning continuity and responding to ongoing (development) trends, first and foremost population growth through positive external migration balance.

6. The workshops, which were carried out in the context of the project, confirm the findings 1 to 3 and show the need for a multi-layered examination (target group, object, and strategy reference) of the topic "pop up" and the associated methodological challenges.

7. To develop a basis for discussion about the "feasibility" of pop-up environments, respectively pop-up housing in concrete spatial settings (here: Vienna), GIS-based modelling was identified as a suitable instrument.

2.2 NEXT STEPS FOR THE LOCAL TRANSFERABILITY

As part of the transferability concept, a concept for a fictional meeting with representatives of the city of Vienna has been elaborated to provide concrete next steps, that could result from the project outcome. The framework scenario as well as the methodology for this potential meeting are elaborated in the following.

2.2.1 Scenario

In the context of a WWTF event, the Vienna City Planning Department expresses its interest in a timely presentation of the project results (October 2021). This is justified by the fact that the topic of "pop up" is considered relevant and the City of Vienna is deliberating to include this topic in the further development of STEP 2025 (keyword "specialist concept for temporary living and working").

As a result, a table presentation for this fictional meeting was prepared. The following key requirements for the presentation were formulated by the Vienna City Planning Department:

1. The compact presentation of the relevance of the topic "temporary living and working" and the added value of "pop up environments" for the city as a built settlement, the Viennese urban population and the image of Vienna as a world city (1/2 page).

2. The realistic assessment of the "feasibility" with special consideration of the real use and zoning (1 page).

2.2.2 Preparation of a table paper (methodology and structural design):

From these specifications it is recognized that special importance must be given to the spatial and planning science perspective when formulating the contents of the table presentation. Therefore, the colleagues from the Institute for Spatial Planning, Environmental Planning and Land Use Management of the University of Natural Resources and Applied Life Sciences take over the task of developing a methodology for the selection and presentation of the project contents in the form of the desired one-and-a-half-page table paper and the coordination of all project members who would like to participate in the preparation of the table paper.

The table paper should have the character of a "policy and management brief" and include the following contents:

1. A presentation of the most relevant spatial developments and triggers (scenarios) that necessitate dealing with "pop up" in the Viennese context; this is based on a problem-centred qualitative content analysis of the final project report and classification in the international discourse (including research of current international specialist literature).
2. A statement on the transferability of international best practices to the Viennese context, with special emphasis on the relevance of the legal framework (e.g., building code) and qualitative requirements for urban design.
3. The presentation of the GIS-based assessment model as an approach to determine the suitability of areas that could in principle be considered for temporary living and working; in this context, a) the scenarios and the (residential) models developed in the project are referenced and b) the functioning of the GIS model is explained.
4. A compilation of relevant actors in the Vienna city administration including their relevance for the potential of implementation of "pop-up environments" is offered, which were identified based on the topic-centred analysis of the policy strategy papers for Vienna and the stakeholder workshops conducted within the project.

According to the content structure of the table presentation, a PowerPoint presentation (speaking time: maximum 10 minutes) will be provided.

The meeting at the Vienna City Planning Department is subsequently attended by the project management and the person(s) who played a leading role in the preparation of the table presentation (max. 4 persons in total).

In the run-up to the meeting, the colleagues agree to focus on the aspects relevant to urban policy and spatial planning and to refrain a priori from recommendations for action.

3 INTERNATIONAL TRANSFERABILITY CONSIDERATIONS

To achieve task 2 of working package 5, the international applicability of the developed scenarios, a series of interactive questionnaire sessions were conducted with international experts. The purpose of the questionnaire sessions was to gain feedback on the pop-up housing scenarios developed within the research project and to gather information about their applicability for the local contexts of the experts, examining the possible drivers and barriers.

As part of the ongoing project, the six housing models were at different levels of development while the questionnaire sessions were being conducted in autumn 2020: housing models #1, #2 and #3 (see Table 1) were completely defined regarding concept and architecture and almost completed regarding the model assessment. For models #4, #5 and #6, concepts and architectures were defined, but the model assessment was still ongoing (see Table 1 for scenario summaries). Among the various benefits considered for the selection of scenarios, the reuse of building gaps (scenario #1), empty buildings (scenario #2) and vacant ground floor retail spaces (scenario #5) have the objective to give back to the community spaces which are otherwise cut off from the urban context. There are also positive impacts regarding transport, energy conservation and raw materials, since the structures are already there, and large quantities of new building materials are not necessary. The realization of PUEs in (green) open and as far as possible shaded spaces has the objective of finding new and cooler areas of the city to escape heat islands (scenario #3), while the reuse of trains (scenario #4) and ships (scenario #6) allows a second life for the vehicles, the use of otherwise unused spaces and efficient transportation of the housing units to European destinations along the railway or river networks.

Based on the information available in the literature, it is possible to analyse what are the general requirements and the factors to consider for a sustainable planning of the PUEs. Unfortunately, there is still a lack of information regarding the "internationalization" of the concept of temporary pop-up housing: specifically, this term means the possibility of transferring the PUE to a new urban context, under comparable framework conditions, but considering the climatic and environmental and, above all, political and economic differences, which can lead to modifications and adaptations of the original project. Although there is an abundance of research regarding the reuse of deconstructed building components of PUEs in new life cycles, or even of PUEs disassembled and reassembled in different geographical contexts, nowadays the discussion regarding the possible international transferability of the PUEs is still open and needs more insights.

3.1 METHODOLOGICAL APPROACH – QUESTIONNAIRE SESSION

As stated in the introduction, WP5 also aims to explore the international applicability of the scenarios which were designed for the Viennese context, and to gain insight on possible drivers and barriers, so as to understand their strengths and weaknesses. For this purpose, the project members took part in the 2020 Closed Cycles and Circular Society Symposium, hosted by the Zurich University of Applied Science ZHAW and the International Ecological

Engineering Society IEES on 2 - 4 September 2020. The symposium was planned to be held in Zurich (Switzerland) but due to COVID-19 it was held online. Subject matter were the most recent practices, innovations and challenges encountered in this field, with the aim of developing new approaches. The target groups were experts and practitioners, such as scientists, planners, architects, and engineers, who have an interest in the transition towards a circular society and international discussion.

The authors presented the case study session "T/CS3.4 - Buildings as ecosystem services providers - Drivers and barriers for implementation and transferability of sustainable temporary pop-up living systems", open to all the symposium's participants with an interest in the topic. The workshop had to be carried out online, resulting in the design of an experimental interactive questionnaire session. The questionnaire session, lasting an hour and a half, was structured in a way which allowed a continuous exchange with the participants, following an introductory input from the presenter. The polling app "Slido'' was utilized, an easy-to-use Q&A and poling platform for live or remote meetings, events, classes, and webinars. Within the questionnaire session participants could answer the questions displayed on the screen with a simple Slido event code and/or link. The respondents answered in a synchronous manner during the session, with the results being transferred instantly. With this tool event organizers can moderate incoming questions, so they have full control over what is being displayed on the presentation screen, as well as activate polls. This format allowed respondents to ask questions of understanding before entering their answers and engage in brief exchanges surrounding the questionnaire topics. The questionnaire consisted of 7 parts, with an alternance between the presentation (e.g. including the description of the 6 temporary housing scenarios) and the questionnaire, with space for discussion between the parts.

After the positive experience with the interactive online questionnaires at the 2020 Closed Cycles and Circular Society Symposium, the session was repeated with interested experts who were selected and invited by the authors, chosen specifically to represent a broader range of countries (therefore also different geographical and climatic characteristics) and to represent varying fields of knowledge and expertise according to their occupations. In a total of 5 sessions, 18 experts participated, representing 11 different countries from 4 continents.

3.1.1 Content

The session began with a presentation of temporary pop-up environments as innovative models of living systems, approaching circular economy models from production to processing waste. The ongoing research project and the six scenarios developed for the city of Vienna were then presented, including considerations on the technical, urban and social aspects, as well as local uses and climatic conditions, that characterize them.

The "questionnaire blocks" were presented in stages, as the various topics emerged: block #1 concerned general information on the respondents, including occupation, country of residence and experience with temporary housing; block #2 was about the respondents' positions regarding the requirements that temporary pop-up environments should have; block #3 concerned the respondents' opinions on which factors were most important when planning a

temporary housing strategy; blocks #4, #5, and #6 concerned, respectively and in detail, assessments of the scenarios "GapModule", "Life Sharing to Go" and "Beat the Heat"; block #7 concerned the scenarios "Life on Track(s)", "Flat-pack" and "DonAutonom" and final considerations.

The questions for the sessions were selected and developed in the months prior to the symposium, based on interdisciplinary discussions between the project members. The questions are made up of multiple choice and open-ended questions. In this way, it was also possible to obtain clarifications and insights on the responses of the participants. The first questions aimed to obtain information regarding both the expertise of the participants (so as to have information on their experience on the subject and the expectations they place on the subject based on their professional role) and the topic of temporary PUEs (in order to obtain an overview of which criteria and requirements are considered most important to achieve successful temporary strategies). The questions then went into the specifics of the Viennese scenarios, with the aim of obtaining feedback regarding their strengths and weaknesses in order to better analyse how to implement these solutions in international contexts. Since the questionnaires were interactive, it was possible to resolve questions of understanding or comments immediately, to obtain more detailed remarks regarding the answers, and to bring the audience closer to the topic and the project.

3.1.2 Analysis and limitations

The questionnaire provides both quantitative data and elaborations gathered through open questions. The quantitative data primarily serves to complement the detailed considerations with a broad overview of tendencies. Where applicable, the "mean", "median", "maximum" and "minimum" values of the ratings are presented for this purpose. While the mean describes the average value (total of numbers divided by how many numbers there are), the median describes the middle value (the number which is in the middle). Correlations were investigated for question blocks #2 and #3 regarding the positions on requirements of temporary pop-up environments and the most important factors when planning temporary housing, to examine whether any relationships could be identified.

It must be stressed that when regarding the quantitative data, the number of respondents is very low and therefore cannot be regarded as representative. They only serve to provide a first explorative overview and complement the qualitative data. The correlations in particular must be regarded critically, serving only to scan for potential areas which could be of interest for future investigation. The low number of respondents stems from the format that was chosen, with greater importance having been placed on the interactivity of the questionnaire sessions and the qualitative data, which was deemed to be a more effective way of understanding the contexts and reasoning behind the assessment of the applicability of the models from the international respondents.

Due in part to the fact that the 2020 Closed Cycles and Circular Society Symposium was meant to take place in Switzerland and mainly addresses a European audience, European and especially Swiss experts and practitioners were overrepresented. In addition, the number of

respondents with direct experience with temporary housing is relatively low, though it is surprisingly high when because the participating experts were primarily recruited from a conference and network surrounding the circular economy. Practitioners with experience with temporary housing had already been involved in the scenario development phase at an earlier stage of the project.

3.2   RESULTS

Background information on respondents

The respondents came from 11 different countries from 4 continents (Albania, Australia, Austria, China, Estonia, Greece, Italy, Portugal, Serbia, South Africa, Switzerland), with 15 respondents being European.
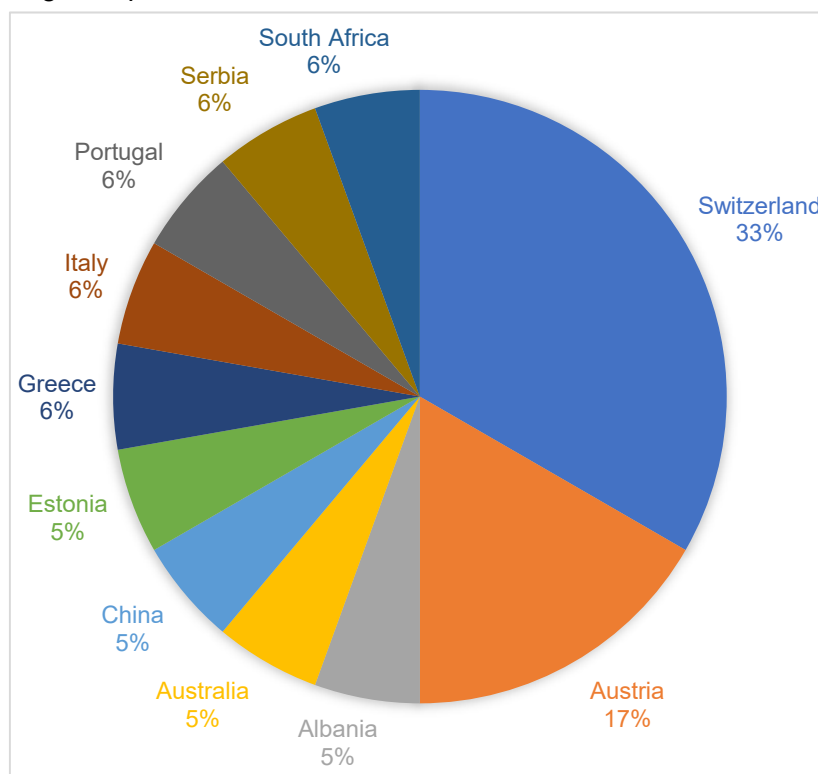

Figure 1: Respondents' country of residence chart

The following roles were represented: civil and environmental engineers (6 respondents), general managers (5 respondents), architects (2 respondents), an urban planner, a landscape architect, a geographer, an urban climatologist and an archaeologist. The topic of "temporary housing" was of great interest for participants from different professions who regarded the subject from different perspectives. The interest of the urban climatologists, for instance, primarily stemmed from the positive impact of temporary homes on the environment, thanks to the recovery and reuse of units and components, directly and indirectly affecting the urban climate. In the case of the archaeologist, the interest in PUEs was explained by the need to use lightweight structures on archaeological sites, with the aim of preserving the soil on which they are built as much as possible and allowing quick assembly and disassembly activities. 13

of the respondents have never been directly involved in temporary housing projects, three participants had up to 2 years, one participant between 2-5 years, and one participant over 10 years of direct experience with temporary housing projects.
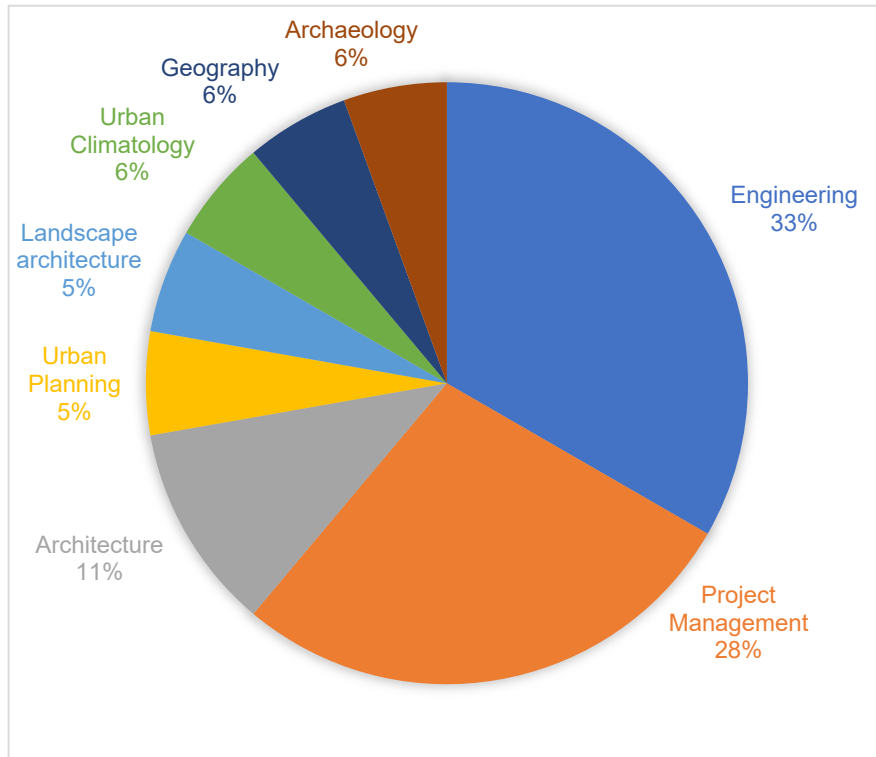

Figure 2: Respondents' role in their company chart

Requirements for temporary housing

The second questionnaire block concerned the respondents' positions regarding the requirements that temporary environments should fulfil. Respondents rated pre-defined requirements to evaluate their importance on an increasing scale from 1 to 5 (least importance to most importance).

Table 2: Comparison table for question block #2 (n=18)

Variable No.	Requirements	Mean	Median	Min.	Max.
V1	Modular components	4,3	5	2	5
V2	Demountable, storable and reusable	4,6	5	4	5
V3	Lightweight and easy to transport	3,9	4	1	5
V4	Fast and easy in assembly and disassembly	4,1	4,5	1	5
V5	Adaptable to different uses and target groups	4,2	4,5	1	5
V6	Leave no marks and preserve the quality of the ground	4,1	5	1	5
V7	Recyclability of components	4,7	5	3	5
V8	Affordability	4,3	5	1	5

In general, the scores for each requirement are quite high and they were globally considered important aspects for the realisation of PUEs and temporary housing strategies. The highest ratings were achieved by V7 "recyclability of components" with an average score of 4,7 – with every respondent giving it a rating of 5, with the exception of two individuals who rated it as 4

and one who gave it a rating of 3 – and the aspect V2 "demountable, storable and reusable" with an average rating of 4,6, having been exclusively rated as 4 or 5 by all respondents. Waste is a big problem in the construction sector and many respondents addressed this during the session. The chance to recycle building components and products seems to be the most important requirement for the participants, which must be taken into consideration when planning temporary housing projects. This could be an area where temporary housing can make a great contribution to the building sector as a whole, experimenting with reusability and recyclability of components.

These aspects are followed closely by V1 "modular components" and V8 "affordability" (whereby affordability refers to the costs for the construction, transportation, running and dismantling/recycling processes), both having an average score of 4,3 and a median of 5. Engineers and architects tended to rate V1 positively, underlining the advantages of building with modular components.

The aspect V5 "adaptable to different uses and target groups" received an average score of 4,2, with the ratings ranging from 1 to 5. The rating of this aspect could be particularly dependent on the main objectives of the temporary housing projects. The reasoning behind one of the low ratings is related to the possible obstacle for the future reuse in new contexts. The concern is that the difference in culture and religion would require too many adaptations. The lower scores can also simply reflect that temporary housing can have many different aims, including experimenting with new materials or aesthetics, which would not necessarily be related to an adaptability to different uses and target groups.

The aspects V4 "fast and easy in assembly and disassembly" and V6 "leave no marks and preserve the quality of the ground" are both tied with an average score of 4,1, whereby the latter has a median of 5, as opposed to 4,5. Assessments regarding the importance of these aspects appear to show a varied picture, spanning the entire spectrum. Regarding V4, this aspect may increase costs if it is not given (by requiring expert assembly and disassembly). The rating of V6 likely varies according to contextual factors, perhaps being of importance when on a green field, but less relevant when in a building gap or within a building.

V3 "Lightweight and easy to transport" received the lowest average score of 3.9, despite almost half of the respondents having given it a rating of 5. This aspect also has the lowest median value with 4. It is possible that the ratings may vary according to contextual factors. V3 is related to V2, which got high ratings across the board. For temporary housing to be demounted, stored and reused, transportation will usually be part of this process. If this factor V3 is considered not to decrease the factor of V2, then the lower rating could imply that the costs for transportation (in terms of money and time) should not be a prioritised element in the conceptualisation. This may be dependent on the duration of stay: for example, if the transport is only necessary once every three or five years, it is much easier to cover the costs than if the transport has to be organised every few months. There would likely be a noticeable impact on reusability if transport is very difficult and expensive. Concerning the aspect of being "lightweight", respondents contested that a building made out light materials cannot give the same feeling of safety that traditional buildings (made out heavy materials, such as concrete)

usually provide, especially after natural disasters (such as earthquakes); another participant pointed out that it is possible to have easy dismounting processes with heavy materials like prestressed concrete panels, produced in a factory and ready to be mounted.

Relevance of factors for temporary housing

The third questionnaire block concerned the respondents' opinions on which factors were most important when planning temporary housing. Respondents were asked to rate pre-defined requirements, to evaluate their importance in an increasing scale from 1 to 5 (least importance to most importance). The respondents were also allowed to specify their answers in the form of open questions.

Table 3: Comparison table for question block #3 (n=18)

Variable No.	Requirements	Mean	Median	Min.	Max.
V1	Total expenses	3,8	4	2	5
V2	Space required for storage	3,4	3	2	5
V3	Space required for implementation	3,8	4	2	5
V4	Aesthetics of the solution	4,0	4	3	5
V5	Lead time for temporary housing	3,8	4	2	5
V6	Environmental impact	4,6	5	2	5
V7	Well-being of users	4,3	5	1	5
V8	Reversibility	4,2	4	1	5

In general, all the factors were considered as being important by the respondents. The factor V6 "environmental impact" achieved the highest average score with 4,6, with a clear distance to the second-highest average score of 4,3 for V7 "well-being of users". Both V6 and V7 are the only aspects with a median of 5 and share a similar distribution of ratings. The high rating of V6 emphasises the potential of temporary housing for sustainable building. However, this score also reflects the concern that through their temporary nature, temporary housing could be the source of much waste, so the environmental impact must be given consideration during planning. The fact that V7 got the second-highest average score shows that temporary housing is not just regarded as providing temporary shelter from the elements with the purpose of covering the most essential needs, but that it is regarded as "housing" in a sense of homing people and providing comfort to cover human needs beyond the basic needs ensuring survival.

V8 "reversibility" received the third-highest score with an average of 4,2 and a median of 4. The overwhelming number of high ratings by most respondents indicate that V8 can be considered a core characteristic of temporary housing. The rather uniform rating among the participants is quite interesting when regarding it compared to the very varied ratings the related aspect "leaves no marks and preserves the quality of the ground" received as a requirement for PUEs in the earlier question block #2. This may be due to "reversibility" being broader in scope.

V4 "aesthetics of the solution" received an average score of 4,0, with the ratings 5, 4 and 3 having been chosen equally often. Not a single participant answered with a score of 2 or 1, displaying a uniform agreement that aesthetics have a place in planning temporary housing, which is even prioritised (on average) over V1 "total expense of production, (de-)construction,

running costs and storage", V2 "space required for storage", V3 "space required for implementation" and V5 "lead time for temporary housing". Three aspects are tied with an average score of 3,8, namely V1, V3 and V5. There is a strong agreement that total expense is an important factor to consider, with only one person rating it below 3. The aspect V3 sees a distribution of answers almost equally spread over ratings of 5, 4 and 3, with only one individual rating it as 2. Urban planners appear to have rated this aspect highly. The even distribution between the scores 3-5 indicate that space is an important factor, but it is perhaps not so scarce as to be considered a higher priority. The third tied aspect V5 "lead time for temporary housing" appears to be an important factor for the planning phase, but on average scores below factors such as V6, V7, and V8. The lowest rating was received by V2 "space required for storage" with an average rating of 3,4 and a median of 3. This is the only aspect which received on average more neutral or negative ratings than positive ones. The importance of V2 is highly contextual (frequency and duration of storage need) and different assumptions can be made regarding the availability or costs of storage

In the open comments, the respondents introduced various additional aspects, such as location, access to electricity and water/sanitation, affordability for the end-users, integration into the local, cultural landscape and waste production. These are all elements which are addressed within the WWTF-project, confirming their relevance (also at the international scale).

Strenghts and weaknesses of pop-up scenarios

The fourth, fifth and sixth parts of the questionnaire concerned the three scenarios "GapModule", "Life Sharing to Go" and "Beat the Heat" and specific questions regarding their respective strengths and weaknesses and applicability for international implementation. The participants rated each scenario on a scale from 1 to 5 (from least to most positive) and provided feedback about which aspects they considered especially positive in the scenario ("adaptability", "modularity", "reusability", "easy mounting and dismounting", "lightweight", "shared spaces", and "other"), with the option of formulating open answers to expound their choices. Feedback was also gathered for each scenario regarding possible drivers for implementation into the local frameworks of the respondents, as well as barriers and challenges ("legal", "social", "political", "space constraints", "economical", "environmental", "other"), again with the option of complementary open answers. Lastly, the respondents were asked if they could envision the respective scenario in another city aside from Vienna, with the option of elaborating in an open question format. All questions were answered by all 18 respondents with exception of rating the three scenarios (n=15) and naming a particularly positive aspect for the scenario "Beat the Heat" (n=16).

Table 4: Rating comparison (n=15)

Scenario	Mean	Median	Min.	Max.
Scenario #1 - GapModule	3,8	4	2	5
Scenario #2 - Life Sharing to Go	3,4	3	2	5
Scenario #3 - Beat the Heat	3,8	4	2	5

Scenario #1 - GapModule

"GapModule" was given an average rating of 3.9. Four of the respondents (27%) gave it a rating of 5, six rated it as 4 (40%), and five as 3 (33%), making the distribution relatively even across these three ratings. Nobody rated this scenario as 2 or 1. GapModule was well-received by the respondents.

Table 5: Scenario #1 – Gap Module: Which aspects do you consider specifically positive in this scenario? (n=18)

Driver	No. of times chosen	Percentage
Adaptability	12	67%
Modularity	10	56%
Reusability	12	67%
Easy mounting and dismounting	10	56%
Lightweight	5	28%
Shared spaces	9	50%

Regarding the positive aspects in this scenario, "adaptability" and "reusability" were considered especially positive by most respondents, followed closely by "modularity" and "easy mounting and dismounting". Half of the respondents chose "shared spaces". Only four respondents considered "lightweight" as an especially positive aspect of this model. Regarding this point, it was argued that this scenario does not look temporary, and it involves the use of heavy materials for the structural parts. The "tactical use of the vacant spaces" was emphasised as particularly positive in the open comments, while possible problems of integration between different user groups due to differing needs and schedules was also noted as a potential problem (see Table 6).

Regarding the possible drivers for implementation, a recurring theme was the driver of very limited affordable living space in dense cities. These answers stem primarily from Austria and Switzerland but were also brought up by respondents from Greece and Kosovo. In total, seven answers related to the issues of limited vacant spaces or affordability of housing. Three responses from Serbia, Italy and Portugal stated that there are available unused building gaps which could be utilised in this way. A respondent from South Africa noted the prerequisite of "matching national building regulations and municipal by-laws". Economic drivers are named in three answers by respondents from Switzerland, China and Albania. Some responses named specific user groups as drivers, with refugees being explicitly named in three answers from Australia, Austria and Greece; students being named in three responses from Serbia, Austria and Greece. Immigrants were also named in a response from Austria, and seasonal workers and those affected by natural disasters were named in a response from Australia. An answer from Switzerland mentioned the (cheap) implementation of welfare support structures as a driver for public authorities. One respondent from China spoke of "experimental urban projects", recognising experimentation as a possible driver for temporary housing. One response from Estonia stated that the scenario does not fit into the Estonian context, elaborating this further under the segment on barriers and challenges.

Table 6: Scenario #1 – Gap Module: What do you think are barriers and challenges for the implementation in your local context? (n=18)

Barrier	No. of times chosen	Percentage
Legal	7	39%
Social	8	44%
Political	2	11%
Space constraints	2	11%
Economical	2	11%
Environmental	2	11%
Other	0	0%

Regarding barriers and challenges for implementation, those most often identified by the respondents were "social" and "legal", with them being chosen seven times each.

The elaborations given for the "social" aspect were very diverse. Three responses voiced concerns over acceptability and the response from neighbours, with one of these focusing on aesthetic or safety aspects (Australia), one referring to possible noise pollution (Austria) and one mentioning concerns about the acceptance by neighbours (Switzerland). A respondent from Portugal voiced the concern that the conceived user mix might have low acceptance. These responses are unsurprising, seeing as this mode of living is directed at a very specific group of individuals who are open to this integrated kind of community living, and is not aimed towards the average citizen. The Estonian respondent who had earlier stated this scenario does not suit the Estonian context elaborated that community living is not culturally present in Estonia, and that refugees are also not a large user group, due to political reasons. This respondent also pointed out, that affordability of housing is not really an issue in Estonia, so there is no high demand for temporary solutions. The timespan of the model was mentioned in two responses, with a respondent from Kosovo finding it too short for social integration, considering that community projects may be more appropriate for the limited available space. The respondent from Australia stated, that "if this space is meant to be used for more than a few months, fewer people are likely to perceive it as desirable due to it's a temporary notion", which appears to imply the planned duration being too long. This respondent was also the only one to mention the environmental aspect, calling into question whether temporary solutions can be more environmentally friendly than permanent residences and if this can be communicated effectively.

The elaborations for the "legal" aspect address that legislation can be strict (Switzerland), that these processes function on a different time-scale than would be required for temporary housing, with the processes being lengthy and not being suited for short-term licenses (Greece and China), legislation being complicated (China), the legal aspects being interwoven with political aspects, such as political will (China), and property relations are mentioned in terms of rights of private land owners (Switzerland). The fact that anything "unconventional" is difficult for legal aspects is also mentioned (Austria).

The elaboration of the "space" aspect includes a response from Switzerland stating that space is limited and very expensive. As already mentioned above, a response from Estonia noted the opposite for their country of residence, that enough affordable living space is available.

Interestingly, both the lack of space and the lack of need for space are considered barriers. A respondent from Switzerland also mentioned an environmental aspect, noting that unused space gives room for many other species (flora and fauna), which would be an argument against a re-use of these spaces.

The elaboration of "environmental" includes a comment that sewage and water is not universally available in developing countries (South Africa). This means that the model requires off-grid solutions in these cases. A respondent from Australia questioned if this model can be more sustainable than permanent housing. The argument of open spaces catering to flora and fauna was brought up under the aspect "space" but is of course also an environmental issue.

The elaboration of "economical" mentions that building gaps can be very large, which goes hand-in-hand with expenses (Italy). The need for political goodwill by the local government is also brought up (Serbia). The "political" aspect includes the fact that certain user groups, such as refugees, are not always present (see comment from Estonia), that anything "unconventional" can be a great barrier (Austria), and that a political will is required (Serbia and China).

Table 7: Scenario #1 – Gap Module: The present scenario was developed for the context of the city of Vienna. Can you imagine this scenario in another city? (n=18)

Answer	No. of times chosen	Percentage
Yes	15	83%
No	0	0%
Not sure	3	17%

Regarding the possibility to develop this scenario in a context other than the city of Vienna, 15 of the respondents answered with "yes", nobody answered with "no" and three answered with "not sure". In general, many respondents appear to be able to envision this model for bigger cities in central Europe. Cities and areas mentioned by name are: Berlin, Rome, Madrid, Zurich (named two times), Milan, Copenhagen, Lille, Brussels, Wädenswil, Munich and Warsaw. Answers also included: "any large city in Central Europe with a tight market for affordable apartments", "many cities in Portugal", "many, as long as the appropriate local approvals are obtained", "any other city with similar gap spaces", "any growing city", "many regional cities in Australia that have a seasonal population and regions that are prone to natural disasters". The suitability for students is named twice by respondents from Switzerland and Austria.

Scenario #2 - Life Sharing to Go

"Life Sharing to Go" was given a rating which averaged 3.9. Five respondents gave it a rating of 5, six respondents rated it as 4, two as 3 and two as 2 (Albania and Kosovo). Life Sharing to Go was generally received well by the respondents. While it scored the same as GapModule, the ratings differ in their distribution. More respondents deemed Life Sharing to Go to be "very good", but at the same time more respondents also had a more critical view.

Table 8: Scenario #2 – Life sharing to go: Which aspects do you consider specifically positive in this scenario? (n=18)

Driver	No. of times chosen	Percentage
Adaptability	13	72%
Modularity	7	39%
Reusability	10	56%
Easy mounting and dismounting	11	61%
Lightweight	4	22%
Shared spaces	11	61%

Regarding the positive aspects in this scenario, "adaptability" was considered especially positive, followed by "easy mounting and dismounting" and "shared spaces". "Reusability" was considered a positive aspect by more than half of the respondents, while "modularity" and "lightweight" were chosen least often (see Table 8).

Regarding possible drivers for implementation, the most mentioned driver was the presence of unused industrial buildings and the idea of reusing or revitalising these spaces (Kosovo, Serbia, Australia, Switzerland, Greece, Portugal). This was followed by the need for affordable housing, named by four respondents (Switzerland, Albania, Estonia). Related to this, one respondent named the scarcity of available housing (Switzerland). Some respondents mentioned specific user groups who could need this type of housing, such as "people in need" (Serbia), "the young, not so wealthy people, such as students" (Estonia), "seasonal workers" and "employees of large companies" (China). Factors relating to changes in urban population, migration and integration were mentioned by respondents from Kosovo and Austria. Drivers which were only mentioned once were "economic benefits" (Albania) and the contribution of "creativity and inspiration for occupants" (Australia). One respondent pointed out that there are municipal by-laws and limits per building according to the National Building Regulations (South Africa), which relates to barriers and challenges. One respondent used the option to specify other aspects, noting "big spaces for larger number of people".

Table 9: Scenario #2 – Life sharing to go: What do you think are barriers and challenges for the implementation in your local framework? (n=18)

Barrier	No. of times chosen	Percentage
Legal	9	50%
Social	5	28%
Political	4	22%
Space constraints	0	0%
Economical	3	17%
Environmental	0	0%
Other	2	11%

Regarding barriers and challenges for the implementation, the "legal" aspects were identified by the most respondents (a total of nine) as being a barrier or challenge for implementation. Three of the responses pointed to the issue of needing the building owner or site owner to be on board with the realisation of such a project (Portugal, Austria, Italy), noting that incentives would be required. A respondent from Estonia stated that the housing must be affordable in order to be an option in Estonia, and that already existing artistic "cultural centre" projects in

privatised post-industrial areas are perceived as being exclusionary. The fact that the industrial sites in this model are also privately owned may be a concern for this reason. As with the last model, the need for government support is named (Serbia). One of the respondents also pointed to COVID-19 making the implementation of shared social spaces difficult (South Africa).

Regarding "social" aspects, five respondents deemed this to be a barrier or challenge for implementation. Acceptance by locals for these kinds of social spaces is brought up by three respondents (Serbia, Switzerland), with a respondent from Switzerland explicitly pointing to the rather reserved nature of the Swiss. Privacy and safety are also named by a participant from Australia as being key challenges. A respondent from Kosovo questions, whether this short time span can even achieve the goal of social integration.

Regarding "political" aspects, four respondents chose this as an important barrier. The comment of the respondent from Estonia regarding the "cultural centres" in privatised post-industrial areas also applies to this dimension. The comment, that politics of affordable housing must be used in this scenario, also applies here. The fact that site owners or building owners need incentives to grant access and use of their properties is also a political question which can be discussed in this context, as is the need for government support. A Swiss respondent states they can imagine that the use of these buildings for non-industrial or non-business purposes could trigger a political discussion.

Three participants chose the "economical" aspect, with a participant from Switzerland pointing out that the maintenance of the abandoned building must be maintained, and investments must be made in this regard. A participant from Greece argued that this model could be suitable for art residents or students. They also point out that this model could be suitable for housing refugees. The third participant who chose this aspect is from Estonia, noting that this type of housing needs to be affordable to be applicable for their country. Nobody chose "space constraints" or "environmental" as important barriers or challenges for the implementation of this project in their local framework. A participant from China mentioned that in their country industrial establishments are usually far from the city, creating a problem of accessibility.

Table 10: Scenario #2 – Life sharing to go: The present scenario was developed for the context of the city of Vienna. Can you imagine this scenario in another city? (n=18)

Answer	No. of times chosen	Percentage
Yes	15	83%
No	1	6%
Not sure	2	11%

Regarding the possibility to develop this scenario in a context other than the city of Vienna, 15 of the respondents answered with "yes", one respondent answered with "no", and two answered with "not sure". Cities and areas mentioned by name are: South Italy, London, Novi Sad, Podgorica, Szeged, Berlin, Warsaw. The responses were more general for this example, with most respondents envisioning it for any large cities in Central Europe, with several also stating that they can imagine this being applied anywhere in the world, in post-industrial areas which are close to the city, or gentrified neighbourhoods with old warehouses. One respondent

from Austria can even imagine this solution for smaller towns. A respondent from Greece mentions that Greece has large islands where industries used to be operated and are now abandoned.

Scenario #3 - Beat the Heat

"Beat the Heat" was given an average rating of 3.7, scoring 0.2 points lower than the other two scenarios. Four of the respondents gave it a rating of 5, five rated it as 4 and four as 3. One participant rated it as 2 and one person as 1. While Beat the Heat was generally received well by the respondents, two rated it poorly (Switzerland, Austria) and two respondents also abstained from choosing an aspect they find particularly positive about the scenario. This reflects that this scenario did not resonate with all respondents, with some viewing it quite critically.

Table 11: Scenario #3 – Beat the heat: Which aspects do you consider specifically positive in this scenario? (n=16)

Driver	No. of times chosen	Percentage
Adaptability	8	50%
Modularity	7	44%
Reusability	12	75%
Easy mounting and dismounting	11	69%
Lightweight	8	50%
Shared spaces	4	25%

Regarding the positive aspects in this scenario, "reusability" and "easy mounting and dismounting" were considered especially positive, followed by "lightweight", "adaptability" and "modularity". "Shared spaces" was chosen least often, reflecting the fact that this was not a strong focus of the scenario. The elaborations in the comments praise the fact that climate vulnerability is addressed (Australia), the inclusion of especially vulnerable age groups (Estonia), and the fact that the scenario is low energy and has low environmental impact (Austria). The design is also noted as being interesting and the notion of living in a cooler area in nature appears to be appealing (China). Concerns are voiced whether this is an appropriate climate change measure, seeing as it occupies a lot of land per person (Switzerland).

Regarding the possible drivers for the implementation, there appears to be broad agreement on the fact that the increase in heat waves and heat islands in the course of climate change is a challenge which needs to be addressed, explicitly being named by seven respondents. The need to protect vulnerable people, or people in general, is pointed out by three respondents from Austria and Serbia, which shows that this scenario is recognised as a measure to mitigate risks. Concerns are voiced by a participant from Switzerland, that there is a conflict of interest, seeing as space would be occupied which would otherwise serve the public as means for relaxation and leisure. A participant from Italy points out that people would be unhappy to leave their homes. Indeed, while the scenario is currently conceived as a voluntary project, meant to develop solutions for the future, it should not be overlooked that if the climatic situation intensifies and becomes deadlier, this is a measure which could develop to be mandatory. A participant from Australia mentions a few aspects they deemed to be particularly positive,

pointing out that this design has low consumption, that it is climate sensitive, and that there are no issues with privacy or safety. A participant from Albania identifies private investors and economical drivers as being important possible drivers for implementation, although this is not specified further. Relating to the implementation in their own countries, many respondents appear to identify with the problem of heat waves (e.g., Italy, Portugal). A respondent from South Africa found this scenario to be applicable in the South African local context. Due to it being so adaptable, even the respondent from Estonia could see it working in their northern context. A point raised by a respondent from China is that "this scenario only works in areas which have suitable natural areas (like forests, lakes, parks, trees, streams) in the vicinity".

Table 12: Scenario #3 – Beat the heat: What do you think are barriers and challenges for the implementation in your local framework? (n=18)

Barrier	No. of times chosen	Percentage
Legal	1	6%
Social	6	33%
Political	2	11%
Space constraints	7	39%
Economical	3	17%
Environmental	2	11%
Other	4	22%

Regarding barriers and challenges for the implementation, the aspect "space constraints" was identified by seven respondents, with the respondents believing it is difficult to find an appropriate space, as space is limited and expensive, and it is not easy to find free green areas with good accessibility (Switzerland, Austria). It is also noted critically, that occupying space, which is otherwise made available to the public, is a conflict in interest (Serbia, Switzerland).

The aspect "social" was identified by six respondents as being an important barrier for implementation, echoing the concerns already mentioned before, of spaces which are otherwise available to the public, now being used to accommodate a few (Switzerland, Serbia). There seemed to be much hesitation regarding the use of green open spaces for the construction of temporary housing units, as this could create conflicts with the local population, who would feel deprived of such spaces which only serve an advantage to a few users. While this could be justified if the health and safety of the user group is in jeopardy, it is also an option to search for alternatives. For instance, turf could be rolled out at parking lots to create green spaces.

A participant from Italy voiced that he doesn't believe the people would like this scenario, because they are already used to heat waves and they would not leave their houses. A respondent from Greece also had concerns, whether people would be willing to leave their homes, stating that it may be possible with the cooperation with professionals working with the elderly, echoing considerations made within the project.

Three participants chose the "economical" aspect as an important barrier, with one elaborating that there is simply no demand (Switzerland). This may be related to this scenario being a pre-emptive measure.

Two respondents chose the "environmental" aspect but did not elaborate further. One respondent who chose "other", however, did bring an environmental argument, stating that open spaces are key resources for handling heatwaves, meaning they should stay unbuilt (Switzerland).

Two respondents chose the "political" aspect, elaborating that there is limited space, and the choice must be made regarding who can be hosted (Kosovo). This could become a critical question, especially if heat waves become more dangerous to the health of residents.

One participant chose "legal" as an area with important barriers and challenges but did not elaborate further on this. One respondent, who answered with "other", however, brought forth the argument that it will be difficult to obtain a permit to build in a natural area not far from the city, as these areas are usually strictly protected (China). Among the responses in the category "other", a challenge is identified in needing to quickly accommodate a lot of people (Switzerland), the climate type is noted as a big problem, with Nordic countries possibly not struggling with heat waves to the same extent as more southern countries (Estonia).

Table 13: Scenario #3 – Beat the heat: The present scenario was developed for the context of the city of Vienna. Can you imagine this scenario in another city? (n=18)

Answer	No. of times chosen	Percentage
Yes	15	83%
No	1	6%
Not sure	2	11%

Regarding the possibility to develop this scenario in a context other than the city of Vienna, 10 respondents answered with "yes", four responded with "no", and four answered with "not sure", which is substantially lower than for the other scenarios. Cities explicitly named as implementation of this scenario being feasible are as follows: Lausanne, Geneva, Zurich, Paris, Novi Sad, Lille, Brussels, Budapest and Oslo. Suitable areas are identified as southern European cities, Mediterranean climate areas, southern countries and Central Europe, regional areas in Australia affected by fire, flooding, heatwave and air quality changes, and coastal areas in New South Wales. Two respondents from Switzerland and Greece could see this scenario being applied across the globe. One respondent from Switzerland, however, did not see this scenario as being particularly relevant to their home country, as heat is not such a big issue in Switzerland. A respondent from China also saw the implementation in their home country critically, stating that this scenario is well-suited for moderate climate, but not for very hot cities with high humidity.

Scenario Preferences

In the seventh and last part of the questionnaire, the participants were asked which was their favourite scenario among the six scenarios defined within the WWTF-funded project. It was possible to select multiple answers and to elaborate the choices. More than half of the participants chose "Life Sharing to Go" as a favourite scenario, followed by the "Flat-pack" and then the "GapModule". A total of three respondents chose "Beat the Heat" and "DonAutonom" respectively, and only one respondent chose "Life on Track(s)" as a favourite scenario.

Table 14: Which one was your favourite scenario? (n=18)

Scenario No.	Scenario Name	No. of respondents	Percentage
1	GapModule	4	22%
2	Life Sharing to Go	10	56%
3	Beat the Heat	3	17%
4	Life on tracks	1	6%
5	Flat-pack	5	28%
6	DonAutonom	3	17%

The use of vacant or unused industrial buildings for communal living appears to have been very interesting to the participants, being deemed as positive in both "Life Sharing to Go" and "Flat-pack". When regarding the most popular scenario, "Life Sharing to Go", affordability was also mentioned as a strong suit, with one participant deeming it the most inclusive scenario, as well as the one which would be easiest to implement. One participant noted that there are no conflicting uses, which must be considered as a positive factor. Other positive factors which were brought up were the central location, the visibility raising awareness of the "different (and sometimes unequal) temporalities each of us can occupy in the city", and the ease with which the structure can be mounted and dismounted.

A total of four people chose the "GapModule" as their favourite scenario, finding it to be a project which can easily and quickly be implemented, which is applicable to the local context, has a high acceptability, and which resembles already existing projects (in this case the Pop-Up dorms in Vienna, Austria). Great appeal was found in the use of abandoned areas to increase value and maintain the infrastructure. It was pointed out that due to a lack of funds, abandoned buildings tend not to be maintained or redeveloped, but by reusing them for short periods, this could be an economic solution to the problem. The social aspect also appears to have appealed to many participants, often in the combination with the attributes of there being much space and that it can be used for many purposes. It is noted that this is a solution for young people who make the conscious choice to live this way. It is seen as a way to solve the shortage of affordable housing.

A total of three people chose "Beat the Heat" as their favourite scenario, whereby one participant chose every other scenario, except for Beat the Heat, with the argument that it is the least practical and useful. Another participant, however, argues that it is driven by a real need and is a well-suited scenario for temporary contexts. The affordability is also noted as a positive aspect of the scenario, making it an inclusive project. One participant, who is an urban climatologist in Australia, emphasises that the scenario can contribute to saving many lives in vulnerable communities, calling it "a great solution for climate adaptability". The fact that "Beat the Heat" scored very low overall could be related to the nature of "Beat the Heat" as more of a pre-emptive risk management endeavour, which contains uncomfortable notions of vulnerable individuals, such as the elderly, being pressured out of their homes through outside forces (in this case climate), making it hard to envision. It is also much more difficult to imagine possible future scenarios for something which has not taken place in recent history, such as heat waves climbing to such extremes, that these types of measures become relevant countermeasures. The scenarios "GapModule" and "Life Sharing to Go", however, contain

user groups and situations with greater familiarity, such as people affected by homelessness and refugees with positive asylum status. As for the scenarios not yet in the modelling phase, " Flat-pack " was regarded particularly positively, due to the reuse of vacant spaces. The scenario was praised for there being no conflicting uses, many retail spaces being vacant, its affordability, the central location and visibility, easy mounting/dismounting operations and no need to occupy other spaces. A total of three respondents chose "DonAutonom" as their favourite scenario, noting that the reuse of old ships is a good idea for a more circular world. One person chose "Life on Track(s)" as their favourite scenario but did not elaborate this further. This was, however, the same individual who chose each scenario, except Beat the Heat. This scenario therefore did not appear to hold much appeal for any of the participants.

When asked if they would live in one of these pop-up environments, 13 of the participants answered "yes", four answered "no" and one abstained. The elaborations of the positive answers showed a strong interest in temporary housing and in communal life. The motivations vary greatly, with some participants stating that they would only do so if the situation required (for instance due to a heat wave or a disaster event), or that they would consider these options in order to save money, or as a good affordable alternative for their lifestyle which involves a lot of moving. A surprising number, however, appear to be interested in temporary housing not out of need, but out of a curiosity of how the experience compares to more traditional housing situations and what benefits can be found in respect to social interactions, freedoms, living climate or reducing environmental impacts. The idea of sharing living space appealed to some of the participants, who believe they would enjoy the experience. Others, on the other hand, viewed the scenarios with sharing concepts as having issues with privacy or safety, and would not voluntarily live in such an environment. Some note these scenarios as perhaps being more suited for younger people than for families who want to settle and have their own private space, with one participant stating: "but this might also shift in the future".

The participants were asked about what keyword they took with them from the session, with the most chosen keyword being "adaptability", followed by the related term "modularity". Another related term which was mentioned is "flexible". Another thematic block seems to surround the topic of environmental sustainability, consisting of the terms "circular city concepts", "circular economy", "social and sustainable housing", "reuse" (chosen twice) and "sustainability". The social dimension also appears to have stuck with many participants, with keywords involving "social interaction", "inclusive and exclusive landscapes", "affordable", "social and sustainable housing" and "temporary community". The temporary nature of housing is common in another set of keywords, consisting of "pop-up", "pop-up buildings", "pop-up housing", "temporary housing", "temporary pop-up housing" and "temporary community". Three keywords which do not fit into any of these loose categories were "solution", "inspiring" and "category of housing".

3.2.1 Discussion of results

The PUEs conceptualized within the project explore innovative and sustainable housing solutions that promote the transition of the construction sector from linear to circular models. Aims include making urban reuse strategies more sustainable in social, economic and

environmental terms, in an attempt to find adaptable and flexible paradigms for different urban contexts. The questionnaire sessions allowed interesting insights regarding the possible drivers and barriers of each scenario, highlighting their weaknesses and strengths, focusing on their applicability in the local contexts of the questionnaire respondents.

13 of the 18 (72%) invited respondents participated in the sessions, despite having no direct work experience with temporary housing. Although the conceptualization of temporary housing as innovative spaces for sustainability is a relatively new topic in literature, it can be seen that it captures the curiosity of the scientific community and that there is interest on the part of experts and professionals to explore the new possibilities that this concept opens up for the construction sector. This finding can be directly linked to one of the last questions, relating to the respondents' desire to live in one of the pop-up scenarios presented. 14 of 18 respondents (76%) said they were open to this possibility, demonstrating a remarkable openness to temporary housing, even if for many this would be a completely new experience. This data is in contrast with some studies on the perception of temporary housing, which is sometimes presented as a type of dwelling in which adequate standards of sustainability in the social, economic or environmental dimension are not met.

An interesting finding concerns the position of the participants regarding the requirements that the PUEs should have to achieve sustainability from a social, economic, and environmental point of view. It can be noted that all the requirements considered within the project have obtained very high average ratings and therefore they can be considered as being confirmed by the respondents as fundamental points for the realization of sustainable PUEs. This finding is in line with the sources found in the literature and underlines the importance of two aspects: the deconstructability of the units and the recyclability of its components at the end of their life cycle. These can be seen as true beneficial attributes of the PUEs as conceptualized here and the possibility of deconstructing the building for future reuse or recycling offers enormous possibilities to enable circularity in the construction sector and contribute to the creation of sustainable cities of the future.

Regarding the important factors for the planning of the PUEs, the respondents confirmed some findings reported in other studies. The answers confirm that the factors behind the planning of temporary strategies can be of the most diverse types and are strongly conditioned by local socio-political conditions, although they share a common interest in economic affordability and environmental sustainability. This is also underlined by the very high consideration of the respondents regarding the "environmental impact" factor of the PUEs on the places where they are placed. This is of course a reflection of the fact that several of the respondents were recruited at a conference surrounding circular economy, but in general it can be observed that safeguarding of the environment is now a central theme in every area of the world economy and it is not surprising that this factor is now seen as essential in the planning phase of any building, permanent or temporary.

On the other side, a result that appears to contrast with the findings in the literature concerns the possibility for the occupants to make adaptations to the unit according to their personal needs and tastes: in the context of the questionnaire sessions, this does not seem to be

considered as a particularly important factor. This result was to be expected, as target groups for these questionnaire sessions were planners, architects and engineers with an interest in circular economy, who may not focus so strongly on the social aspects of PUEs. The workshops conducted within the WWTF-funded project involved stakeholders from social fields who strongly emphasized the need for users to be able to claim ownership of the space through means such as adapting it. In light of the fact that it can unfortunately occur that a temporary pop-up environment becomes permanent, even if it was initially intended to have a limited duration, PUEs that are conceived without the requirements of durability and long-term comfort end up being a source of discontent among its users, who sometimes abandon or completely modify these "no longer temporary" houses. Within this paper it can be observed that the ideas of what temporary housing should be, and where priorities are placed, appear to be quite similar between international experts.

Regarding the Viennese scenarios, the respondents showed relatively high similarities in what they considered positive in the scenarios, but always showed strong differences in the barriers and challenges they identify for the implementation in their framework. This is indicative of it being extremely difficult, or more likely even impossible, to create designs which are universally applicable. The designs will always need an adaptation process if they are to be transferred into another context, the success of which relies heavily on the cooperation of various stakeholders. While many of the respondents could envision the scenarios in another city, the elaborations show that many see the realm of possibilities restricted to cities with similar conditions regarding, for example, culture or climate. This is unsurprising given the fact that the scenarios were very embedded in the framework conditions for the city of Vienna, addressing local needs and opportunities. It is, however, an exacerbating factor that the innovations for sustainability introduced in these temporary housing scenarios are not purely technical in nature, but rather draw on the resources and systems that are already given. It is easier to apply a technical innovation, such as an air conditioning system, in another context, than it is a system drawing on passive cooling technologies, such as is the case for scenario #3 "Beat the Heat". Both require certain preconditions, but while an energy source can be organized with relative ease, natural climatic conditions of an area cannot. Sustainable housing solutions, which rely so heavily on reuse of materials and structures and renewable resources pose a particular challenge for international transferability. Another important factor are the users. At multiple stages of the questionnaire session the respondents pointed out that a certain user group is not relevant for their country, or that the acceptability of certain ways of living would differ due to cultural reasons. While it is not far-fetched to assume that many scenarios could be adapted to suit other user groups than the ones they were initially intended for, this is a process which must not be underestimated and may prove to be more complex than anticipated. If we regard scenario #2 "Life Sharing to Go", for instance, the whole design relies on a certain willingness of the residents to interact with each other in a particular way, because the layout is conceived this way (e.g., centrally located community kitchens).

3.3   METHODOLOGICAL OUTCOMES

The realisation or replication case of PUEs can be realised in different framework conditions under consideration of necessary adoptions. The used methodologies can be applied with the essence of the concept in its different forms. The technologies might differ from case to case, depending on the legal framework conditions, the possibilities and needs at the different locations, etc.
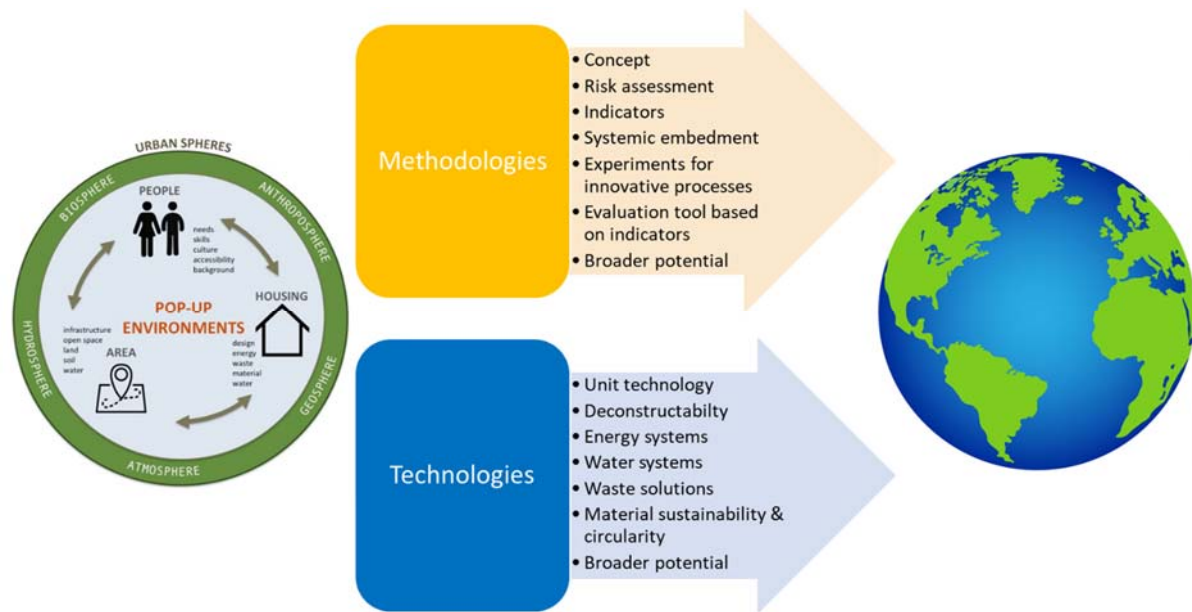

Figure 3: Exemplary transferable methodologies and technologies

Based on the data derived and experiences concluded from the questionnaire sessions it was possible to distinguish two categories of transferable elements: methodological approaches that can be transferred as they stand without particular modifications or adaptations to the original concept. The specific technologies need to be adapted to different local conditions, depending on the context in which they are applied and the specific framework conditions. Potential exemplary elements are listed in the Figure 3.

Concept	Risk Assessment	Indicators	Systemic embedment	Niche experiments	Evaluation
Idea or notion that forms the foundation of the design project. It is the force and identity behind a projects progress and is consistently consulted throughout every stage of its development.	Identification of the hazards that could negatively impact the project. It helps to identify the risks and provide measures, processes and controls to reduce the impact of these risks to the operations.	Variables, representation of quantitative and qualitative attributes, providing relevant information for decision-making and allowing to refer to a comparison reference.	Scientific approach that aims at the full understanding of the complexity of a project through the integration of diverse forms of disciplines. It includes matching system needs with problem-solving.	Protected space where radical innovations can be developed and mature and where learning processes can take place. It aims to introduce the social dimension to technological development.	Systematic assessment of a project with the aim to determine the relevance and level of achievement of project objectives, development effectiveness, impact and sustainability.

Unit technology	Deconstruction	Energy systems	Water systems	Material circularity	Waste solutions
Common abstract level for the implementation of services and infrastructures: facilities, installations, installation parts, business models.	Well-considered selective dismantlement of building components, in prevision of a future reuse, repurposing, or recycling. As sustainable alternative to common demolition it preserves the value.	System primarily designed to supply renewable energy-services to end-users, through a set of interacting component parts, located within an environment.	System primarily designed to provide water supply and wastewater management to end-users, through a set of engineered hydraulic components possibly involving nature-based solutions.	Products are designed circular that used or discarded products serve as raw materials for new products. This approach is an alternative to waste production and landfilling and loss of value.	Activities and actions required to manage waste from its inception to its reintegration or final disposal. It deals with all types of waste, including streams posing threats to human health.

Figure 4: Overview of exemplary and considered methodologies and technologies criteria

3.4 CONCLUSIONS AND OUTLOOK ON INTERNATIONAL TRANSFERABILITY

The main purpose of the work was to clarify which aspects can be transferred, totally or partially, within the scope of the replicability of the Viennese scenarios in other urban contexts under comparable conditions.

The data obtained from the questionnaire sessions provided useful feedback on the perception of temporary and pop-up environments from international experts from the perspective of circular economy. The responses of the participants were generally positive, showing interest in the potential of PUEs, as a way to contribute to increased sustainability in the construction sector. The responses revealed a number of relevant drivers and barriers for the applicability of the Viennese scenarios to other cities around the globe, spanning from climatic considerations to political and cultural particularities. It was possible to observe that broadly speaking the topics addressed by the Viennese scenarios, e.g., migration and refugees, homelessness and precarious living, affordability of urban housing, climate change adaptations, sustainable building, and the like, are global issues, which merely differ in extent and expression, leading to strong resonance with the participants. The scenarios appear to be considered adaptable and flexible enough to be applied in numerous locations, requiring some fine-tuning for the specific local contexts, and being particularly well-suited for the European continent. Heavy design adaptations could be needed if the scenarios are transferred into contexts with significant differences in local cultural and climatic conditions, which may include differences in the type of user groups for which the PUEs are intended. The idea of temporary housing functioning as spaces for more sustainable forms of building and living was received positively by the participants as an intriguing and worthwhile, but also challenging endeavour, requiring intense transdisciplinary cooperation and political will.

The results derived from the questionnaire sessions mostly confirmed the considerations gained during the experience of the three-year project. Although the PUEs address specific issues (heatwaves, reuse of abandoned buildings, etc.) which are strongly influenced by the various geographical and climatic conditions, it was possible to note a certain openness on the part of the participants to the possible transferability of the concept in their local context. The possible barriers (legal, social, political, space constraints, economic and environmental) for the international implementation of PUEs in other places under comparable framework conditions have been brought to light and analysed, forming the basis of the debate for the research of architectural solutions and techniques to be adopted. The PUEs therefore appear as an architectural solution that is easily adaptable to the context in which they are found and easily implemented thanks to a series of adjustments that can correct any barriers due to local differences.

From the considerations made above, the study of the international transferability of PUEs must therefore include the following points, to address and resolve any barriers that may be found at the local level.
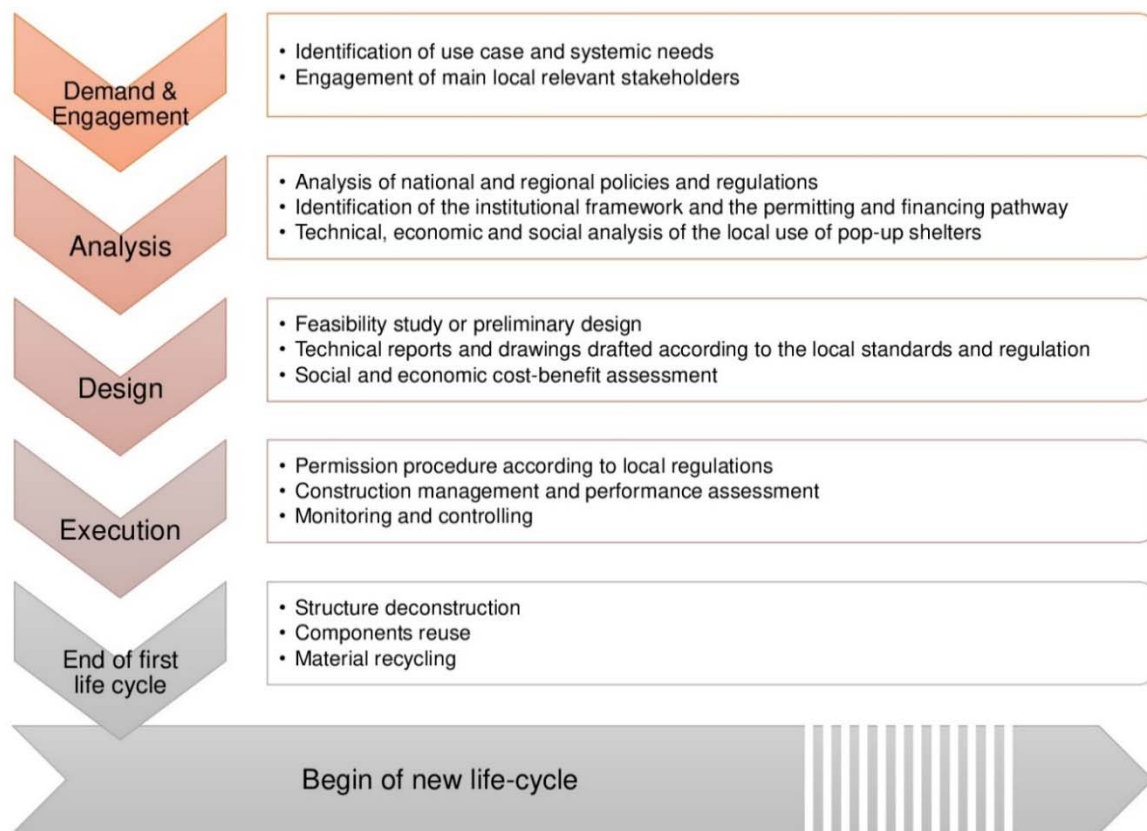
Figure 5: Phases of the transferability process

However, the data and outcome of the questionnaires provide a first insight and should be regarded as a starter for broader discussion about the implementation of the Viennese scenarios in an international context. Future steps would include the collection of feedback from a greater number of experts, especially from regions outside of Europe, and consequently a quantifiable approach. This would allow to refine the methodology and evaluate drivers and barriers with comparable parameters.

4 REFERENCES

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5 FIGURES AND TABLES