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How to Make Existing Urban Structures Climate-Resilient?

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1 ABSTRACT

We are currently faced with a variety of serious crisis: climate, health and migration, all of them deeply interwoven. And all of them particularly apparent within the dense city structures. Urban open space becomes - once more - crucial in facing the accompanying negative effects like rising heat, density and infection. Evidentially green and blue infrastructure provides a cooling effect, a qualitative life space and a healthy environment – considered in a holistic and large-scale view guaranteeing good living conditions throughout the city. Before the background of urban densification the streetscape holds a huge potential in this regard. The street system forms a stable network of open space defined by building structure. It is entirely publicly owned and thus more easily accessible to public authorities for the immediate development and implementation of necessary measures. Furthermore, a change in mobility patterns is to be expected, that will initiate a debate about new functions of the street system. Last but not least, a variety of studies indicate, that the desealing of surfaces and the integration of trees and other vegetation - including green facades - offer a particular climate adaptation potential especially within the streetscape.

Although within the scientific society and politics well-known, the implementation of green and blue infrastructure measures is confronted with a variety of barriers - starting with administrative, technical and legal frameworks but also to a great part through missing awareness of and acceptance by neighbours and local stakeholders. This paper focusses on the latter presenting supportive processes and actions which are needed for transforming existing urban structures towards climate resilience in this regard. The findings are based on lessons learned in the Smart Cities Demo project LiLa4Green (Accompanying Living Lab for the implementation of green-blue infrstructure measures in the Smart City Vienna, 2018-2021).

LiLa4Green focusses on the visibility and traceability of the additional value of potential green and blue interventions within the streetscape opening up the discussion and mutual learning with the diverse involved parties on site. Main goals set are a) to cooperatively highlight existing challenges and elaborate potentials of green and blue design measures on site; b) to literally show options of participatorial developed interventions within the streetscape by effectively implementing commonly accorded small-scale measures; and c) to visualize potentials and alternatives virtually by means of an AR tool to enable low-treshhold participation in an early planning stage and to raise awareness for the topic. Multifold methods such as potential analysis, design studios, climate measurements and simulations have been applied to accomplish these goals - accompanied by a continuous Living Lab process on site.

In the course of LiLa4Green several barriers and restrictions but also potentials for making existing urban structure more climate-resilient became evident. All in all, the project managed to start a transition towards climate resilience in one of the densly built areas of Vienna. Three key elements proved to be essential 1) find solutions which fit to the local setting and set concrete actions 2) raise awareness and involve local networks, stakeholder and neighbours and 3) embed measures and demonstrations into a continuous process.

Keywords: urban structure, climate adaptation, green-blue infrastructure, living lab, public space

2 INTRODUCTION

The Paris Agreement, which entered into force in November 2016 (UN, 2015), has been a milestone in global climate policy stressing protection and adaptation as equally important and strenghtening the efforts of countries world-wide to achieve their climate targets. Likewise, Austria committed itself to the agreement and even strives for climate neutrality by 2040, intended trough the preparation of an amendment to the Climate Protection Act. This will mean a great effort in all sectors and at all scales. Action is urgently needed as the impacts of climate change are already tangible, especially within the dense urban areas due to urban

structure and materiality. Natural surface has largely been replaced by sealed cover and building sites, that multiply the amount of heat storing materials in the third dimension.

Besides climate change, growing cities such as Vienna are currently faced with additional serious crisis such as health and migration, all of them particularly apparent within the dense city structures and deeply intervowen. Urban open space becomes - once more - crucial in facing the accompanying negative effects like rising heat, density and infection. Before the background of urban densification the streetscape holds a huge potential in this regard. The street system forms a stable network of open space defined by building structure. It is entirely publicly owned and thus more easily accessible to public authorities for the immediate development and implementation of necessary measures. Furthermore, a change in mobility patterns is to be expected, that will initiate a debate about new functions of the street system. Cities and settlements that are no longer designed to be "car-friendly" but "more human" and designed for active mobility improve social contacts, well-being and health (APCC 2018). Last but not least, reduced car traffic opens space for unsealing and greening. A variety of studies indicate, that the desealing of surfaces and the integration of trees and other vegetation - including green facades - offer a particular climate adaptation potential especially within the streetscape (Demuzere et al. 2014, Hagen et al. 2014, Stangl et al. 2019, Reinwald et al. 2019). Evidentially green and blue infrastructure plays a decisive role for the quality of life in cities by providing a healthy environment for recreation, a cooling effect reducing the heat island effect and by increasing the biodiversity (Reinwald et al. 2019).

Due to advancing climate change and the manifold benefits of green and blue infrastructure, many cities have already developed strategies and are setting measures for realizing climate resilient and green urban structures. The city of Vienna was one of the first which committed itself to a strategy for counteracting the UHI (e.g. MA22 2015). Vienna is also one of 15 European cities in the "Deep Demonstration" program (based on the EU initiative EIT Climate-KIC), which aims to network and support cities and regions in order to promote climate neutrality. But not only Vienna, also numerous medium-sized cities such as Graz and Linz, and even smaller cities such as Weiz, Kufstein, Perchtoldsdorf or Traiskirchen are actively committed to climate change adaptation and climate protection. The realization of green-blue infrastructure measures will be key for a successful realization.

However, the implementation of green and blue infrastructure measures is challenging as it addresses various urban issues (green and open space, traffic and pipeline infrastructure, water and sewage infrastructure, etc.) and stakeholders (Tötzer et al. 2019). Greening measures are confronted with a variety of barriers - starting with administrative, technical and legal frameworks but also to a great part through missing awareness of and acceptance by neighbours and local stakeholders.

The lessons learned from the Smart Cities demonstration project LiLa4Green[1] (Accompanying Living Lab for the implementation of green-blue infrastructure measures in the Smart City Vienna, 2018-2021) presented in this paper illustrate supportive processes and actions which are needed for transforming existing urban structures towards climate resilience. In the course of the project it became evident what it takes to realise green-blue infrastructure projects (urban green and urban water areas) in a densely built area of the city of Vienna (Tötzer et al., 2019). The project has been carried out by an interdisciplinary project consortium consisting of partners in the fields of planning, participation and communication, landscape architecture, climate modelling and software engineering. The central approach applied was a Living Lab, which has been set up throughout the entire project duration for involving citizens, stakeholders and decision makers in the implementation process. The Living Lab aimed at building a co-creative environment, raising awareness for the positive effects of green-blue infrastructure measures and increasing the acceptance and willingness to implement and invest.

[1] LiLa4Green is funded by the Climate and Energy Fund and implemented under the "SMART CITIES – FIT for SET" programme.

3 LILA4GREEN SET-UP – THE LIVING LAB PROCESS

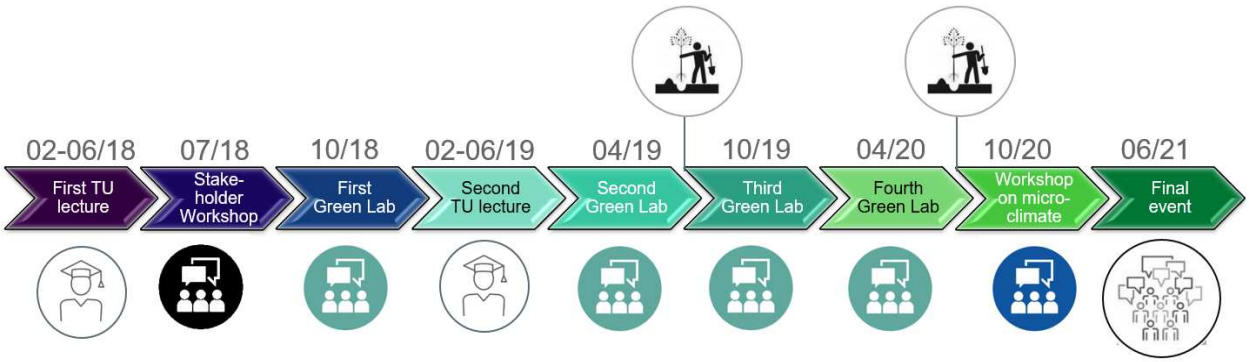

Fig. 1: Structure and timeline of the LiLa4Green project

The Living Lab (LL) structure worked as a framework for the entire project so that the basic structure of the LL had to be defined in the very beginning (Fig.1). Basic characteristics have been identified which are crucial for the success of the LL process: openness, realism, empowerment, spontaneity, sustainability and value as well as the local context. As the Living Lab aimed at the cooperative development of resilient solutions for the urban common ground (the streetscape) in a changing climate the involvement of local inhabitants and stakeholders at eye level was a key factor of success. Therefore the research team of LiLa4Green collectively formulated basic principles for its specific "Urban Living Lab" (ULL) to be concerted at the very beginning of all common events. One key basic principle was that the ULL should aim at a cocreative process involving urban Stakeholders and local Citizens to work out new products, services, technologies and social innovations in an experimental way (Fig. 2r.). The ULL therefore should aim at finding sustainable solutions for climate change adaptation measures in the urban open space by keeping the user in mind at the same time. The ULL should work as a eye level planning system and an alternative to top down city planning strategies.

After the defintion of the ULL characteristics a basic lay-out of the workshops had been designed. The core elements of the LiLa4Green ULL were the "Green Workshops" (GW) which were held on site and worked as different stages of envolvement. These workshops consisted of five steps towards a cocreative process of changing the local environment. The first step was taken hosting a "start-workshop" where local and city-wide stakeholders were invited to discuss the setup of the project and share their knowledge with the research-team and each other. Based on this interrogational setup the project also invited the participating stakeholders to involve themselves in the further steps (see below GW#1 to GW#4) as well as to formulate potential questions which could be answered throughout the LiLa4Green project. In this way the stakeholders where motivated to stay involved within the project also taking part within the following GWs. To find the right tool-set for the different workshops a screening of methods has been undertaken. 15 participatorial methods where collected and screened for their adaptiveness onto the layout of our ULL. This pool of methods was used for the design of the upcoming workshops each based on the respective foregoing event.

Preliminary to the GWs the neigbours had to be informed and their interest to involve themselves had to be raised. Therefore a set of methods was created to reach out on the public on different levels. Besides the classical communication strategies of posters, flyers and spreading these through multipliers, on-street campaigns were set up. Using transport-bikes and folding-chairs the passers-by were being informed and asked to interact (Fig. 2l.). As one interactive element they were asked to put flags on the perceived "hottest" and "coolest" spots within the research area. These spots were documented and continuously updated in a digital map on the project website (Fig. 4r.).

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Fig. 2: On-street activation in the case study area "Quellenstraße Ost" (l., ©PlanSinn_Brossmann) and co-creative design process within GW#3 held at Stadtraum in 2019 (r., ©PlanSinn_Meinharter).

Alltogether four "Green Workshops" where defined as linear events following a red line of interaction between the research team, the stakeholders and the neigbours. As it was planned in the setup of the framework to react on the outcomes of the GWs for the design of the oncoming workshops a basic flexibility in the structure and content of each meeting was taken into account.

The first "Green Workshop" (GW#1) was defined as an "exchange of knowledge" involving the participating neighbours as experts of their local district. The setup of the event was a "marketplace of ideas", in a first step presenting the topics of climate change, open space usage and adaptation strategies on the base of the potential analysis (see chap. 4) by the research team and in a second step collecting the neighbour's information on the surrounding urban open space and its interaction with everyday life in form of table discussions. The GW#1 concluded in a collective discussion highlighting amongst other findings the participating neighbours' demand for an exemplification as a first step to be done to visualize possible changes in the streetscape.

The second "Green Workshop" (GW#2) aimed at finding first steps. On the one hand this workshop worked as an intersection between the intended design studios at the TU Wien and the Living Lab by offering a collective decision process. The GW was therefore defined as collective jury where students presented and discussed their ideas for a green-blue design intervention and the participating citzens could vote for their favorite design to be actually realized within the streetscape on site (Fig.3). Crucial for the success of the collective decision was a high correspondance of elected design and realized implementation requiring a lot of effort by all people involved (see chap. 5). On the other hand the GW#2 used the collective knowledge for testing the AR tool to be developed within the LiLa4Green project. The participants could vote and comment on the usability and effect of the presented web-based AR tool giving valuable feedback for its further development e.g. in changing to an AR app (see chap. 6).

Fig. 3: Participants of the GW#2 with the elected favourite design (©PlanSinn_Schopper).

The third "Green Workshop" (GW#3) served for identifying potentials in the urban open space. Based on the design implementation a lot of trust was built up between the participants and the research-team opening way to the next step. The GW#3 aimed at a co-creative design process for the complete research area by means of a specifically tailored game in divided groups. In the first phase the participants could playfully decide on and create adaptation activities based on given information on climate simulations and all other data collected in the project beforehand. In a second phase the participants had to take decisions within their

range of collected ideas regarding a limited budget forcing them to focus. At the end each group presented a map of negotiated adaptation ideas. This "plan of action" builds the framework for all further implementations and activities in the case study area. In this workshop also the further developed AR app was tested and the results of the comments by the participants were compared to the first step of the development. Therefore, the participants themselves could identify the development of the tool related to their comments in the GW#2.

Finally, the fourth "Green Workshop" (GW#4) aimed at a collective implementation of specific adaptation ideas. Due to the Pandemic this workshop - planned as a collective realization workshop - had to be transferred into a digital format. A ZOOM Meeting was held with different breakout rooms related to the identified actions from GW#3. Despite of the complicated situation two of the commonly accorded adaptive actions could be implemented in summer 2020 (see chap. 5). All of these activities were accompanied by a frequent news mail to keep all participants of the GW informed. Furthermore, an Explain Video was created and put on the project website to activate citizens to take part and / or comment on the further steps.

The Green Workshops themselves were accompanied by a survey process which was set up before GW#1 consisting of a pre- and a post-survey. The participants answered an online questionnaire at their first attendance and were invited to fill out a second one after the GW#4. The final results are expected at the end of the project.

4 HIGHLIGHTING CHALLENGES AND POTENTIALS

At the beginning it was essential to get to know the overall frame conditions and the case study area itself in detail. Starting point of this process has been an extensive analysis concerning the need for and potentials of green-blue measures within our case study area as well as a specific analysis of existing strategies of the City of Vienna regarding climate adaptation within the streetscape. Following the co-creative approach, the early involvement of citizens and stakeholders was essential to pick up local knowledge and to raise awareness for and acceptance of the following process on site (see chap. 3).

As a case study served the area of "Quellenstraße Ost" within the Viennese district of Favoriten - representative for a dense city structure with very high impacts of urban climate on the one hand and an urgent need for public green and open space due to the prevailing demographic and ownership structure on the other hand. The current climatic conditions were mapped using objective microclimate simulations of a typical heat wave day with ENVImet. To evaluate the model results perceived data from interviews on the streets have been mapped in personal heat maps and discussed within the GW#1 (Fig. 4).

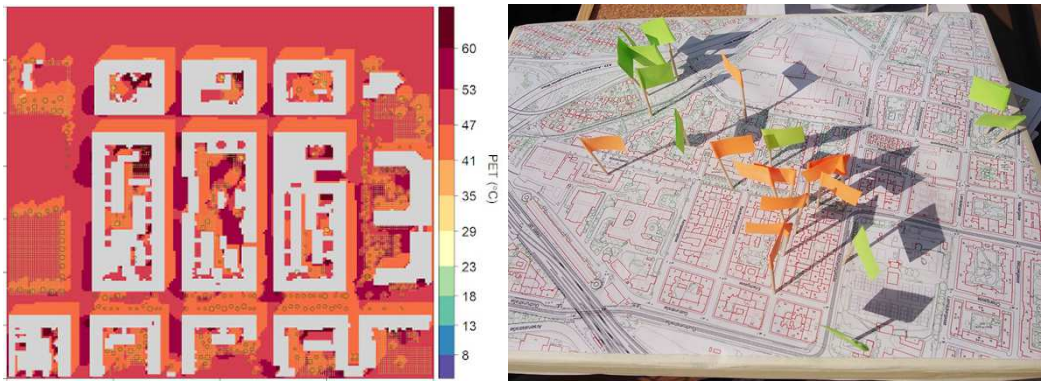

Fig. 4: ENVI-met simulation map on PET at 2pm (l., ©weatherpark) and personal heatmap of neighbours (r., ©PlanSinn_Matejka).

Previous to the potential analysis the intention was to analyse existing strategies of the City of Vienna to be able to tie in to concrete aims and measures already formulated within those papers. Main sources were the Urban Development Plan 2025 (MA18 2014) with its specifications "Green and open space" (MA18 2015), "Public space" (MA19 2017) and "Mobility" (MA18 2015) and the Urban Heat Island Strategy (MA22 2015). All strategy papers highlight the importance of urban green and open spaces in terms of ecology, urban climate and social relevance. The potential of street trees as well as the need for green links with a high quality of stay are explicitly mentioned. Through all strategy papers the streetscape as "urban and public open spaces that are accessible anytime for everyone and primarily in public ownership" (MA18 2017, p.6) stands out to hold the greatest potential for the transformation to green infrastructure within the urban

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structure. The strategy papers have been scanned regarding the statements about the intersection of streetscape, green infrastructure and urban climate leading to consensual planning principles serving as important basis for the specific potential analysis within the study area "Quellenstraße Ost". These consensual planning principles are: the greening of streetscapes with high quality of stay; creation of public and usable open spaces within the streetscape; creation of micro open spaces (Mikrofreiräume); upgrading of forecourts of public (education) buildings; completion of missing links within the urban green net; inclusion of semi-public and private green areas into the urban green net; inclusion of building related greenery such as facades and roofs; innovative temporary and multi-functional solutions; implementation of microclimatic design measures; awareness raising and involvement of citizens; rethinking and discussion of existing legal frameworks.

The consensual planning principles served as important basis for the subsequent analysis of potentials within the case study area "Quellenstraße Ost" (Fig. 5l.): The case study area is characterized by a very heterogenic city structure including large building complexes with generous greenery. Nevertheless, public green is limited to a single park in the very east. Green links are missing connecting with the recreation area in the east and the surrounding districts. The potential analysis highlighted potential green links inside (orange arrows) and outside (green arrows) the case study area regarding the future urban development and its consequences especially for the dense block structure in the north-west. It became apparent that this block structure (the so called "Kreta") with its high percentage of sealed surfaces and missing greenery stands out as an isolated area with urgent need for action and a high potential for green-blue measurements. Furthermore, this area adjoins to several education buildings (orange) with high potential to upgrade the forecourts on the streets (purple stripes) including a feasible reduction of moving and stationary traffic (purple).

Besides the involvement of citizens and stakeholders also the involvement of students from Architecture and Planning as future urban planners has been an important issue within the LiLa4Green project structure. The first of two design studios held at the TU Wien had been set up within the analysis phase. Within "Grün'o'polis – grüne Wege in der Stadt" (WS 2018) interdisciplinary teams of 3 students each worked on the analysis of a wider area surrounding the study area of "Quellenstraße Ost". Strategies and concepts had to be developed on a larger scale confirming to a great extent the potentials elaborated within the potential analysis. Further the students proposed first ideas of design measures on a block respectively street scale strengthening their concepts and giving an idea of how the streetscape could be developed in a greener and user-focused way. The results have been publicly presented on site followed by a poster exhibition that has been visited by neighbours, local initiatives, stakeholders and decision makers helping to raise the awareness, initiate a discussion and to foster acceptance for the topic and for green-blue design measures within the streetscape (Fig. 5r.).

Fig. 5: Potential analysis map of "Quellenstraße Ost" (l., ©TUWien) and poster exhibition of the design studio "Grün'o'polis" in the Ankerbrotfabrik in 2018 (r., ©Hagen).

5 IMPLEMENTING SMALL-SCALE MEASURE

An important result of the GW#1 had been the "demand for action" meaning the request of the participants to discuss based on an exemplification – is to say on a concrete implemented object instead of on mere theoretical aspects of potentials, visions and wishes in advance (see chapter 3).

The second design studio "Green up – cool down" held at the TU Wien tied in at this point. Master students from Architecture were to design ideas for a green-blue design element to be implemented within the streetscape of the dense block structure of "Kreta". Important aspects have been the transparent process on site, the involvement of neighbours and local initiatives at an early stage, a precise framework for the design and the collective decision of which idea would be effectively built and implemented. The design course was held during the whole process in the Stadtraum am Kempelenpark opened for the public and on its corresponding terrain. Several inputs and workshops have been held for the students involving also local initiatives such as the Materialnomaden dedicated to the reuse of construction material. The specific guidelines for the design included: the layout of a parklet on two parking-lots within the focus area regarding all legal constraints necessary for the approval of implementation; the integration of green-blue elements; a modular system enabling the construction, deconstruction, storage and reconstruction of the design element; consideration of social aspects resp. multifunctional use; proposal of location and adjacent cooperation partner for stewardship and irrigation; costs within the budget of the funding programme "Grätzloase" by the City of Vienna. The 9 final designs have been publicly pitched and put to the vote during the GW#2. The living lab decided on the project "Follow the water cycle" by Jana Faraj Allah and Mais Msto that has been further developed and effectively implemented in summer 2019 on the Randhartingergasse by the whole student collective (Fig.6l.). As local partners served the Stadtraum am Kempelenpark together with the Egyptian Culture and Music Association directly adjoining the parklet.

Fig. 6: Parklet "Green up – cool down: Follow the water cycle", Randhartingergasse in summer 2019 (l.: ©Grätzloase, r.: ©KLIEN).

The implementation process itself enabled further involvement of the neighbours and local partners in the set-up and maintenance of the design object. The parklet has been used by the direct neighbours and passers-by fostering its appropriation e.g. in form of gardening and gathering. A discourse has been initiated as well on additional benefit as on existing disapproval – the latter without any vandalism during the entire summer. Altogether the intervention can be considered as very successful resulting in concrete interests in "adopting" the parklet in 2020 and in the impulse for additional parklets within the district. Furthermore, the parklet has been recognized beyond the district by the Smart City Award 2018, as best practice for the Grätzloase and within the initiative Children`s University (Kinderuni, Fig. 6r.).

Subsequent to the implementation of the parklet the GW#3 aimed at an intense discourse on further potential green-blue design measures within the study area "Quellenstraße Ost" (see chapter 3). The Erlachgasse turned out to be an important starting point for implementation including a desired micro space at the entrance of the language school at the corner of the Absberggasse, an artistic green intervention at the crossing at Randhartingergasse and a temporary collective street-event. The choice of the Erlachgasse confirms the findings of the potential analysis highlighting the significance of this street as connecting pass and living space.

Despite of the unpredicted Corona situation - hindering the planned face-to-face exchange and cocreation with the neighbours – LiLa4Green achieved the implementation of the two desired design interventions in summer 2020. The parklet has been submitted and reconstructed by the language school Eurasya on two parking lots in front of their entrance in the Erlachgasse (Fig.7l.). In the meantime, they achieved a permanent permission guaranteeing a micro space during the entire year serving as common open space for the students and passers-by as well as for the children of the adjacent kindergarten. With respect to the artistic intervention the artist and landscape architect Hannes Gröblacher designed a temporary "magic

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carpet" of grass floating above two parking lots at the crossing Erlachgasse/Randhartingergasse (Fig.7r.). The magic carpet has been publicly inaugurated in September serving neighbours and passers-by as urban green lounge. Both interventions initiated again a discussion on benefit and disapproval continuing the desired process of discourse and awareness raising.

Fig. 7: Reconstructed parklet in front of the language school (l.) and the magic carpet (r.), Erlachgasse in summer 2020 (©Hagen).

After summer, the magic carpet has been moved within the study area to the courtyard of the primary school opposite of the Stadtraum at the crossing of Kempelengasse and Quellenstraße. In summer 2021 a further design intervention will be implemented in cooperation with the primary school – once more in cocreation with the artist and landscape architect Hannes Gröblacher. The dead-end street in front of the school's entrance will be temporarily redesigned giving the impulse for permanent change into a green forecourt and public open space. The potential analysis highlighted this street section as one of the hot-spots for the implementation of green-blue infrastructure measures - also regarding the Viennese strategy to improve the forecourts of education buildings.

6 ENABLING LOW-TRESHHOLD PARTICIPATION BY VISUALISATION

An additional ambition of the LiLa4Green project was the elaboration of an alternative and innovative form of participation tool to enable low-threshold participation in an early planning stage and to raise awareness for the topic. Different ideas for measures to increase awareness and participation of stake-holders and inhabitants were discussed and refined. A broad range of possible measures were identified, ranging from electronic tags for marking hot areas in a street, to a heat simulation tool for explaining effects of heat in cities and finally to an augmented reality (AR) app for visualizing greening and cooling measures in a realistic way. A selection process of the project team favoured the augmented reality app with the reasoning that an innovative technology would possibly raise more awareness than other lower technology approaches.

The basic idea of the augmented reality app is to project 3D modelled objects of a greening project (like trees, water ponds or built design interventions) at exactly the same position where the measures would be placed in the real world. Participants would be able to observe the measures and even walk around and interact with the objects using the AR tool. In advanced applications, the participants can be invited to vote and comment on alternative options for a greening project.

A first implementation of the augmented reality application was designed with the goal to have a very low technological barrier for installing and using the app. This resulted in a browser based augmented reality solution. A test with participants during the GW#1 proved the assumption correct that such an application raises awareness of the topic, however, it also showed that some participants were more concerned with issues of the app on their personal mobile phone than with the topic itself. Also, it became apparent that the selected technology was not sufficient to provide a gameful user experience since the users could not freely walk around the projected AR objects (Fig. 8l.).

Those observations together with the feedback of the participant lead to a new implementation with modified requirements. It was decided to use special hardware devices for the AR application (iPads with Lidar sensors) in order to provide a high level and playful AR experience. This increases the barrier of use, but it allows the participants to focus on the topic and not on installation issues on their mobile devices.

Fig. 8: Testing of the browser-based AR tool in GW#1 (l., ©PlanSinn_Schopper) and of the advanced iPad-based AR tool in GW#2 (r., ©GrünStattGrau_Formanek)

The new version of the AR application was made available in the Apple application store under the name L4G AR Viewer and was tested during two different events. Prepared iPads were given to the participants together with explanations of the planned greening measures, resulting in more vivid discussions and interactions between Living Lab staff and participants (Fig. 8r.).

During the finalization of the tool for the app store, a new functionality was added which allows the use of the application without any preparation of models and markers. In this basic mode, the app allows the planting of virtual trees in streets and on sidewalks. Screenshots of those planted trees can be shared with other persons. This mode can be used to raise basic awareness of the greening topic, especially with younger persons. First tests using this functionality are scheduled with school kids throughout the end of the Lila4Green project.

7 CONCLUSIONS

In the course of LiLa4Green several barriers and restrictions but also potentials for making existing urban structure more climate-resilient became evident. All in all, the project managed to start a transition towards climate resilience in one of the most densely built areas of Vienna. Three key elements proved to be essential 1) find solutions which fit to the local setting and set concrete actions 2) raise awareness and involve local networks, stakeholder and neighbours and 3) embed measures and demonstrations into a continuous process.

To accomplish the associated aims for building a co-creative environment, for raising awareness for the positive effects of green-blue infrastructure measures and for increasing the acceptance and willingness to implement and to invest the following aspects appeared to be crucial:

(a) transdisciplinarity: to build up a sound base for decisions and actions a comprehensive scientific background is necessary. In the case of LiLa4Green this involved various disciplines and methods such as the potential analysis and microclimate maps.

(b) interplay between external impulses and local involvement: every external impulse can only be successful when locally accepted. Local involvement at an early stage guarantees awareness for and identification with implemented measures. This link is facilitated by the living lab.

(c) experiments: interventions are useful and important, because they are visible and tangible. Above all they initiate controverse discussions constituting a crucial step for involvement and for awareness raising. It is necessary though to install an accompanying communication process e.g. within a living lab.

(d) continuity in the process: it is essential to let the participating and observing people know that the process is still ongoing. This can be achieved through different channels such as newsletters, on site visits, websites and activities on site.

(e) low threshold participation: to gain the confidence and engagement of the involved parties it is necessary to approach all participants at eye level and to appreciate local knowledge. Low threshold tools should therefore be selected when preparing the process to foster successful participation.

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(f) legacy of the LL: the living lab should be embedded into existing local networks in order to guarantee a continuity after the end of the research project. Within Lila4Green these have been the area renewal office, the Stadtraum on site, the collaboration with local partners such as the Egyptian Culture Association or the Materialnomaden, the language and primary schools and many more.

The Living Lab proved to be essential for framing the entire process and for embedding the various elements of the project (awareness raising, implementation of green measures, testing and co-development of AR tool, involvement&training of students and pupils, etc.). Making existing urban structures climate-resilient is a complex issue that requires the consideration of the specific local setting and the involvement of diverse stakeholders and actors. Thus, the process towards transformation is as crucial as the measures themselves.

The LiLa4Green project has been nominated as official IBA Candidate (International Building Exhibition Vienna 2022) and was part of the IBA interims-exhibition "How will we live tomorrow?" in October 2020.

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