Inclusive Green for Tackling the UHI-Effect in Athens

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Introduction

The city of Athens is characterised by urbanisation and migratory waves. In relation to the changing climate with an overall increasing temperature and a significantly higher amount of extreme events, the city is especially vulnerable to the urban heat island effect. Spacing and orientation of buildings as well as outdoor spaces influence the microclimate of cities in a strong way (Kleerekoper et al. 2012, 30). The city of Athens is challenged by high temperatures within central city districts, because the high rate of dense construction is dominating and leaves little space for free and green areas. The urban heat island effect represents a serious danger for inhabitant's health and well-being (Kleerekoper et al. 2012, 31). Thus, the need for new solid solutions to develop the city in a more resilient and climate-proof way arises. A major challenge is to create policies and measures that meet the demand for more green 'lungs' in the city.

Within this research project, strategic solutions to tackle urban heat were developed on a small scale. Therefore, a central part of Athens was analysed to create a concept with detailed measures to mitigate and adapt to urban heat. With the help of further research and observations, the concept of 'Inclusive Green' was developed based on the conditions and problems in the study area. Different measures are proposed in order to deal with the grave situation of urban heat with which architects, planners, environmentalists, and civilians are confronted.

Background: Green Cities to Tackle Urban Heat

Urban heat islands are globally one of the most documented phenomenon of climate change (Santamouris 2012, 682) and can worsen social isolation as well as mental health issues and cause people's death (Australian Department of Infrastructure and Transport 2013, 189). Especially Mediterranean countries have the highest potential vulnerability to climate change in Europe but the lowest capacity to adapt to it (ESPON 2014). In July 2000, 10,000 people have been treated in hospital and at least 100 have died as a heatwave, which has seen temperatures of up to 48 °C, swept across the Mediterranean. Temperatures up to 44 °C have caused 31 deaths in Athens. More than 3,000 heat victims have been taken to hospital with breathing problems caused by dangerously high smog levels (Smith 2000). Apart from the social impact, heatwaves have significant impact on cities' productivity and liveability and more often affect the most vulnerable countries. When those also face a dramatic economic crisis like Greece, the capacity to adapt is very limited. With this increasingly severe heatwaves, caused by climate change, it has been widely understood that urban greenery has a growing importance for maintaining city's liveability as one of the most effective ways to address and reduce the urban heat island effect (Kleerekoper et al. 2012, 32). To understand those challenges in more detail and to develop 'green' solutions, a study area in Athens was the object of investigation.

The Study Area - Evidences for a High Vulnerability

The study area is located in the northern central part of the city, including the church of Ekklisia Agios Pantaleimona as well as the train and the bus station Stathmos Isap Attiki (see figure 1). The district is a residential area and characterised by pedestrian streets (see figure 1) and a comparable low traffic volume.

Many small streets are serving as parking areas for cars (see figure 4). The inhabitants are mainly immigrants (National Center for Social Research and Greek Statistical Authority 2017) and the income in the area is rather low. Over 30% of inhabitants have an annual income of less than 8,804 Euro. In the year 2008, the district was one of the poorest in the city (Bloomberg Associates and Athens Office of Resilience and Sustainability 2008). The microclimate is high in the part of the city, not only due to the high density of buildings but also because of the low amount of open spaces.

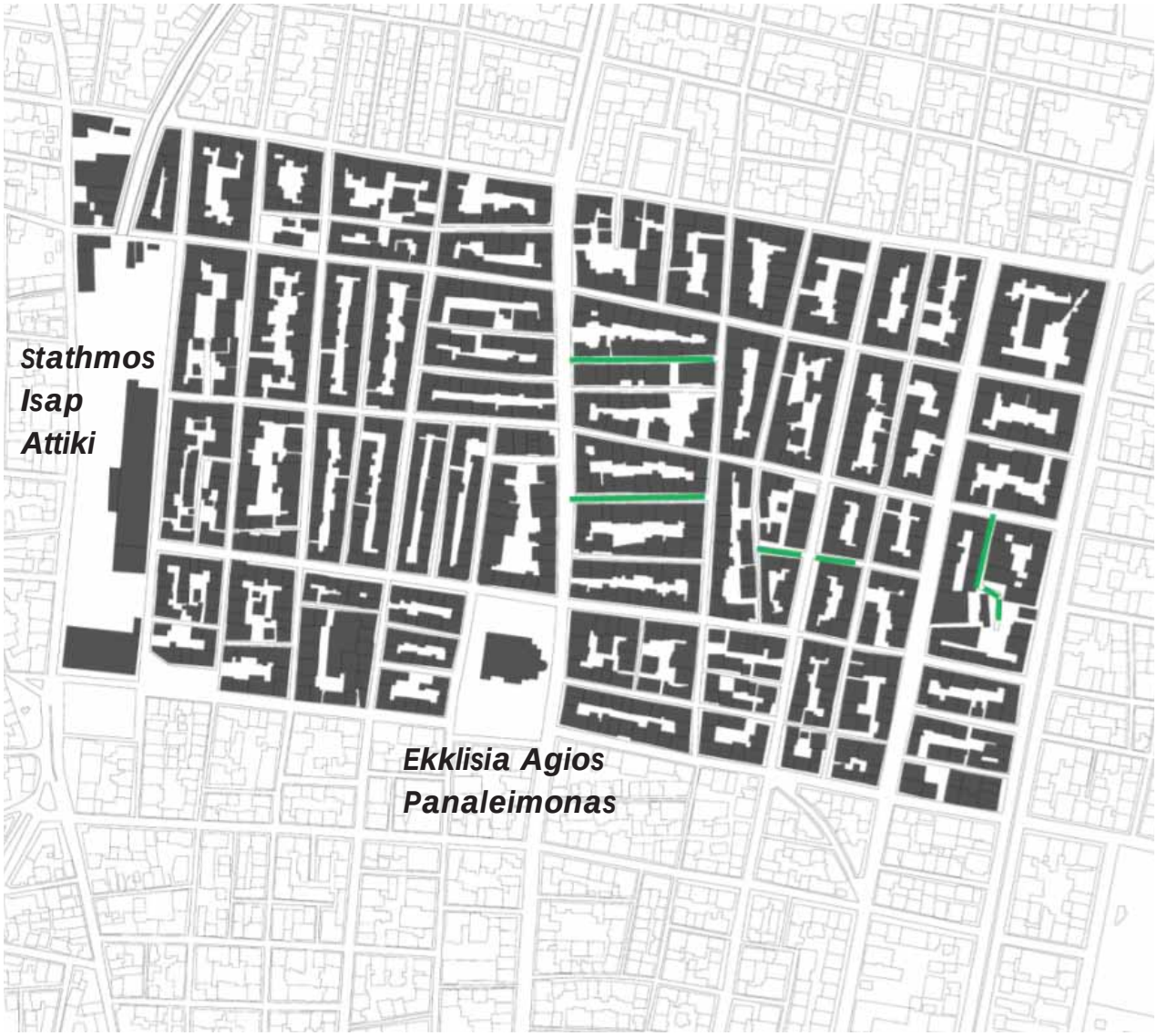

Figure 1: Study area with pedestrian streets (marked in green) (Source: Own Depiction)

Areas around larger green spaces show significant lower temperatures than the study area during heat waves (Bloomberg Associates and Athens Office of Resilience and Sustainability 2016). These statistical evidences underline the vulnerability to the heat island effect of the population in the district. Consequently, the danger for the health and well-being of residents is high.

Due to low-income in the study area, buildings lacking insulation measures, like double glazing or external walls (National Center for Social Research and Greek Statistical Authority 2017). Some buildings are still existing from the construction period before 1946 (National Center for Social Research and Greek Statistical Authority 2017) and were not restored. Those structural conditions are even decreasing the low resilience to urban heat of the area.

Figure 2: Green balconies (Source: Own Photography)

Figure 3: Unused spaces (Source: Own Photography)

In general it seems like buildings are often in a poor condition or only partly inhabited. Some shops at the ground floors of building blocks are operated by residents even though the majority seems to be vacant for a long time. Moreover, buildings were removed at some places but have not been reconstructed. These empty and unused spaces are fenced and not accessible (see figure 3). An essential factor for that development might be the economic crisis in Greece which began in 2010 (BBC News Services 2017) and has influenced politics in a strong way until today.

Residents in the study area cover balconies with greenery by the use of different kinds of potted plants and also roof tops are often green (see figure 2). People seem to be willing to cover their city with greenery and thus, favour to live in a green environment. Additionally, many small streets are planted with trees on both sides, affording a lot of shade (see figure 4) when walking under the trees. In those streets, the temperature is constantly cooler. The church of the area is placed at a public square where some palm trees are planted and a public playground is implemented. However, the majority of the floor is sealed or covered by sand and stones. Grass grows around trees but is also fenced, so that it is not possible to access the greenery. The square is busy even during the day for people to meet and to do some sports, for example football, due to the fact that no other open place exists nearby.

Figure 4: Small streets (Source: Own Photography)

Cooling centres are mostly more than 400 metres away and recreation opportunities for residents can only be found in neighbouring parts of the city (Bloomberg Associates and Athens Office of Resilience and Sustainability 2011). Consequently, there is a strong need for mitigation and adaptation measures that help to cool down the temperature in the area.

The Concept of Inclusive Green

"A climate adaptation plan can only be successful when it is also addressing social, economical and spatial aspects." (Kleerekoper et al. 2012, 37). Based on this approach and on the theoretical evidence about the potential of urban greenery to tackle heat, the concept of 'Inclusive Green' was developed. The aim is to provide better access to open green spaces with fresh air and water as well as cooling centres. Eco-friendly transport opportunities including pedestrian and cycling infrastructure for inhabitants need to be implemented to promote a low-carbon economy.

The social approach of the concept considers not only improvements of the area but also aims at involving residents in greening policies. Many different people "have a stake in what happens in a place" (Healey 2010, 13) and thus, inclusive governance cultures are needed (Healey 2012, 18) to create 'better'

places. This can be reached by collaboration between planning competencies and local residents. Following that, it is ensured that implemented measures are accepted by locals and that innovations are used for the purpose they were implemented for. Moreover, one important goal of the strategy is to make greenery open and accessible for everyone. The concept aims at raising the well-being, health and social cohesion of residents to strengthen liveability (Bush et al. 2015, 1) in the area. The term of 'Inclusiveness' therefore conects the idea of people's participation in greening policies with the creation of accessible green.

When considering the economic situation in Greece, measures to achieve impact at low costs are needed. It was agreed on selecting a concept that is likely to be economically the easiest to develop in terms of implementation and maintenance costs. Therefore, spatial characteristics of the area need to be used in their existing form and redesigned in a way that supports social and economic activities. The increase of greenery in the district leads to sustainable adaptation and mitigation to climate change in an affordable way. The different benefits of urban greenery will be explained in more detail in the following.

Benefits of the Inclusive Green Concept

A city's vegetation, its urban green space, provides a wide range of benefits for the city's residents and workers, in terms of mitigating and adapting to the urban heat island effect. The growing pressure on cities caused by climate change is affecting many dimensions such as human well-being, economy, society, and environment (Fryd et al. 2011). Research has identified and quantified many of the benefits provided by urban green space. These include:

Mental and physical health benefits: especially because the residents of the case study district are mainly immigrants with limited income and health access disadvantages. Therefore, they are more vulnerable to heatwave consequences. Greenery has a positive impact on human's psyche and can even prevent depressions (Kleerekoper et al. 2012, 37). Moreover, a green network of streets shaded by trees would cool down the temperature and offers, for example, more comfortable conditions and incentives for employees to get to work.

Economic benefits: including increased economic activity at a local level. The attractiveness of the area (associated with a cooler climate and shade) could be increased which would lead to an overall improvement of image (Kleerekoper et al. 2012, 37). It has been shown, previously, in the analysis that the income of the area is very low. Consequently, raised attractiveness would lead to more economic activity.

Social benefits: because open green spaces serve as recreation opportunities for residents and become consequently areas of social interaction and leisure activities. The analysis of the case study district showed that recreational areas are barely existing, relatively social isolation was evident.

Environmental benefits: including reduction of air pollution and improvement of urban air quality. Green produces oxygen and filters ozone out of the air (Kleerekoper et al. 2012, 37). Furthermore, green routes would promote the use of carbon-low transport like bicycles.

Actions and Measures for Inclusive Green

Heat Islands are a consequence of climate change but also of insufficient city planning. Therefore, actions and measures were identified to improve liveability within the city district. The concept of 'Inclusive Green' is based on three intervention levels which connect the social and environmental benefits of green. Different actors were identified to participate in the measures.

Residential Intervention Level – Atriums as Miniature Parks
The first case of the concept refers to the transformation of open spaces that appear inside the housing blocks in order to function as atriums. Those are a characteristic of the morphology of the Greek region of Attica. These spaces are normally either empty or used as parking lots. The atriums' floor consist of sealed soil and is not greened in any kind. Due to the cooling effects of vegetation these spaces could be developed as private inside gardens for the block tenants (see figure 5). One may say that those could be transformed into miniature central parks. Those would be accessible on a short distance at any time and support community-building.

Street trees, green roofs, green facades, and vegetation can help to reduce urban heat island effects by shading building surfaces, deflecting radiation from the sun, and releasing moisture into the micro-atmosphere as well as offering an ambient cooling effect (KLEEREKOPER et al. 2012, 31). Overall, vegetation can have a cooling effect of up to 4.7 °C (SCHMIDT 2006) and is consequently a good option to decrease the temperature at low costs in buildings without insulation.

The actors involved in that action are the residents of the district. First and foremost, it is essential to encourage, inform, and sensitise inhabitants of buildings who live in the district to take action in order to green these spaces. As those are private spaces that can only be changed by their owners, inhabitants need to become active themselves. An evidence that such an approach could have a high acceptance among citizens is the shown willingness to green the city as explained in the analysis. In this context, the research group believes that the first step to take is to unify atriums instead of keeping them as separate lots. This could be done by removing fences and making atriums more accessible as well as more attractive for recreation. The second step is to cover the area with more green and make it accessible for other uses, like urban agriculture. In this way a network of green private spaces, connecting to the public streets, would be created (see figure 5). Utopic as it may sound, the ground floors often host commerce stores that could very much profit by those new attractive spaces. Considering the prospected increase of visitors, a greater local economic activity will, relatively, acquire. In addition, the residents of the area who are predominantly immigrants and low income families will get a free access to recreational facilities that promote social interaction and foster inclusive and vibrant communities. The green spaces could work together for the better maintenance of the project, for instance there could be an annual rotation of products cultivated in the gardens. As a very high percentage of families live in the area, these open but still private spaces could be used for amusement and recreation, by addressing children as well as adults. For the completion of this project a low budget is required. The estimated time is five to eight years, but for spreading motivation across citizens to participate, pilot projects with an exemplary function should be started as soon as possible. By

implementing one green space after another the creation of an urban green network within the district would be the result.

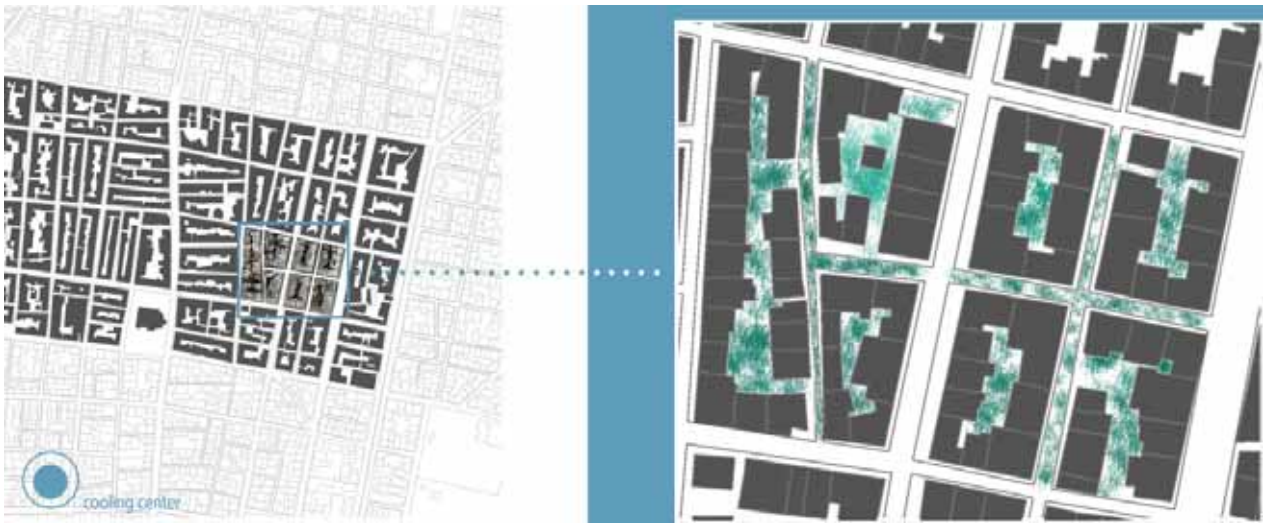

Figure 5: Transformation of atriums to miniature parks (Source: Own Depiction)

District Intervention Level - Awareness-Raising Campaigns

A collaborative joint effort between the district authority and engaged residents is required at this level to ensure sustainable effective actions. A high level of awareness among the local population about the dangerous impacts of heat islands, not only on the urban infrastructure but also for the well-being, is necessary to increase participation in actions and to support a selfprotective behaviour during heat waves. The creation of joint responsibility towards climate change is important to create win-win solutions for everybody (Gram et al. 2016, 312). Therefore, at the district level, measures could include: Planting trees and other vegetation, even though space in the urban district might be limited. Small green practices could easily be integrated into barren vacant and abandoned lots between the buildings which are clearly spread almost everywhere in the district. This measure covers two dimensions, on the one hand, it will offer a meeting area for the residents and will subsequently minimise the impact of social isolation caused by heat islands. Especially if the residents are involved themselves in implementing necessary actions and in taking in charge the future required maintenances, such measures are more likely a concept of public participation. Allowing public participation will give incentive for changing the area by residential engagement.

Examples for awareness-raising projects could be information and communication events about the urban heat island effect but also long-term projects like urban gardens shared by diverse users on open plots. Those projects could serve as pilots and should be started in the short-term as soon as possible to pave the way towards the acceptance and awareness for other planned measures.

City Intervention Level – Open up Public Spaces
Athens' municipal authorities can initiate several actions to minimise the city's vulnerability to the effect of urban heat islands. Measures should seek to retain the existing green cover and to identify opportunities to increase green cover along public roads which are denuded from trees. Fortunately, in the case study district, only one, but major road, with a high traffic of economic activities in comparison to the rest of the district, has no vegetation. This road is adjacent to the train and bus station. Subsequently, it is more likely to be a subject of congestion, traffic and of a high carbon emission and pollution. Thus, the measure required is to increase the area's total vegetation rate, mainly by planting trees along the road. For that cooperation with shop owners might be important to find the right distances between trees without blocking the view on window displays. To deal with this kind of perils, it would be the best to use planting compatible to the Attican microclimate. This kind of planting would be consisted of deciduous trees that allow the light to enter the houses in the winter and at the same time protect them from intense sunlight during the summer season.

Furthermore, the redesign of barren public properties, mainly the square in front of the church which is located in the heart of the district, is important to open up public places for recreation. The square represents a meeting place for social interaction for the local residents and does not look to be offering any recreational urban infrastructure or shade to be esteemed or attended by the neighbours, with fences around each parcel of ground endowed with a couple of trees (see figure 6). Increasingly, the effectiveness of urban greenery interventions on the square will depend on incorporating consistent sources of water, including urban design elements such as fountains. To implement water infrastructure might be difficult due to the high costs, but fountains represent a good cost-benefit

option and a high use, especially in busy places (Kleerekoper et al. 2012, 32). The average cooling effect is 1-3 °C and has an extent of 30-35 m (Kleerekoper et al. 2012, 32). Greening the square with trees and vegetation along with building incorporating fountains will help to boost cooling and shading inside the square as well as in the surrounding areas. To reduce the social isolation caused by heat islands, the supply with urban equipment will motivate the residents to attend the square, subsequently it will reinforce the social aspect.

To build green infrastructure improvements into regular streets, such as integrating pedestrian areas along the secondary roads surrounding the central church, is useful for recreation. Especially due to the fact that streets mostly serve as parking areas and have a comparable low traffic volume, this approach seems to be feasible. Moreover, by implementing more pedestrian roads, the use of bicycles would be encouraged and the possibility would be given to offer bicycle sharing, for example located on the public square.

Figure 6: Public square (Source: Own Photography)

When giving more space to pedestrian's recreation and social life, the effect can only be a positive one.

Another strategic point is to build pilot projects to ensure continued investments in heat-reducing practices and to test new approaches for a resistant green infrastructure in the district. The research group developed a concept to transform the bus/train station into an open central park, especially because it appears to be a sealed reservoir of heat waves and pollution emitted by buses. The project will be explained in the next chapter.

Pilot Project – The Public Park-Station

As a last and most costly action in the long-term, the demolition of the old bus and train terminal station is suggested to turn it into an eco-friendly station. The station is three blocks wide and currently serves very little purpose as a high wall (see figure 7). The construction blocks the connection between the areas of every side and also reduces the whole ventilation of the streets that are adjacent to the wall. The area lacks a cooling center as well as green pathways that lead to the existing cooling center, located further away. It is safe to say that the location is of a strategic importance to the goal of reducing the effect of urban heat islands. Therefore, the research group suggests the conduction of an architectural competition where the redesign of the bus/train station is asked. The new station should be open to the public and a hybrid construction that balances an effective amount of green with the urban infrastructure needed. This new creation will allow better ventilation of neighbouring streets and residences. As a result the microclimate of the whole area will improve. Water elements could be added, such as fountains. This will help to reduce the local temperature and to provide cooling sources. Tall trees should be planted in order to provide natural shade to pedestrians. Turned into this hybrid construction, the station will resume the role of a cooling center and of a green pathway connecting to other recreation opportunities. The timeframe for this project is estimated from eight to ten years.

Figure 7: Bus/Train station (Source: Own Photography)

Conclusion

To conclude, the research group developed a strategy for the study area to raise resilience, considering economic, environmental as well as social values. Referring those values the measures of the total open green space of squares with surrounding pedestrian areas, the public park-station, the access to greening projects, open for everyone willing to engage, and the green atriums used by building inhabitants, were explained. The plan of all actions is shown in figure 8.

The concept of 'Inclusive Green' has an integrative approach by including private as well as public spaces for an overall turn of the district in terms of resilience. The overlapping time frames of the different measures are important to increase acceptance among citizens and to underline an integrative approach. The actions will strengthen a further exchange between neighbours and communities and as an effect high potential for the creation of a more flexible and social – and with that a more resilient – neighbourhood is given.

Nevertheless, for some suggested measures, full participation of the citizens is required. If the residents do not act as a unit to achieve a better function of their community, less to nothing will be achieved. Thus, it is of vital importance that individuals are informed about the grave situation in which the city is as well as about the steps they should take to prevent and improve it. The collaboration between citizens and the authorities is urgent to implement measures to their full extent on different levels of administration. The city of Athens needs to start actions immediately from which awareness of citizens will raise and redesign important public places in a sustainable and resilient way. A multi-level governance approach regarding adaptation and mitigation is important to implement measures on all scales. Even though, planting of streets is really common in the area of study, it is not enough to fortify the city against extreme heat. Through this proposal, the city´s chances for resilience in case of a heat wave shock multiplies.

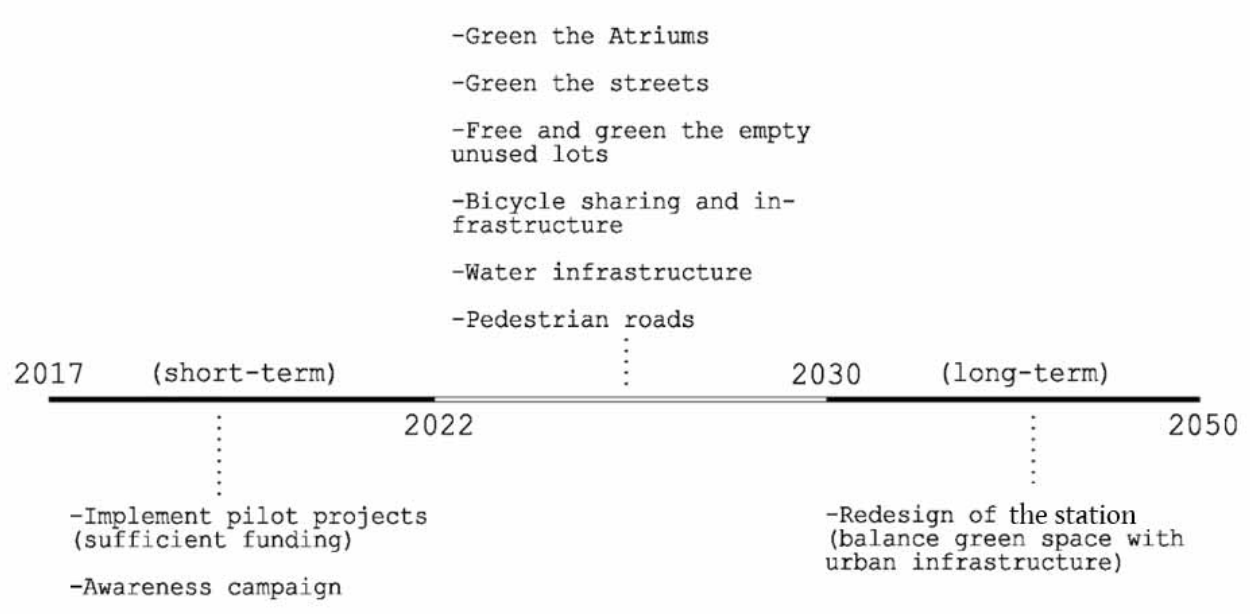

Figure 8: Action Plan of the concept (Source: Own Depiction)

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