LIFE CRITICAL

Guidebook to Climate Resilience Through the Involvement of Local Citizens

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About this report

This guidance builds on the lessons learned in the municipality of Dordrecht, in the Netherlands, on how to build climate resilience through the involvement of local citizens in the design, planning, and monitoring of climate adaptation measures. The approach has been developed in Dordrecht within the project LIFE CRITICAL, funded by the EU Life Programme. Gemeente Dordrecht is the project coordinator and other project partners are the Bradford Metropolitan District Council as the main replication city and IMEC – OnePlanet Research Center as the technical partner. The project is followed by the replication cities Ghent in Belgium, and Bergen in Norway.

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LIFE CRITICAL's approach to climate resilience

The LIFE CRITICAL approach targets climate adaptation in urban areas where it has the greatest impact. The method focuses on three main principles to build climate resilience in older, densely populated, and lower-income residential areas:

- **Consciously planned blue and green infrastructure**
- **Involvement of the community in the process**
- **Monitor, evaluate, learn, and replicate**

Consciously planned blue and green infrastructure

Blue and green infrastructure (BGI) leverages natural features like water bodies and green spaces to provide sustainable solutions that enhance resilience, biodiversity, and overall environmental and human wellbeing. Consciously planned BGI means designing and implementing each intervention with multiple specific objectives in mind to achieve a holistic climate resilience response.

Image: Dordrecht's newly reconstructed Tomptuinen (2023), by the Drone Team of the Municipality of Dordrecht

Discovering the potentials: Where to intervene?

Green elements in cities can improve air quality, mitigate heat stress, prevent flooding, support mental and physical health, and more. Competition for space is high in European cities and the opportunities to create new large-scale green areas are limited. The urgent climate change impacts are even more pronounced in lower income neighbourhoods with densely placed older buildings, high traffic intensity, and extensive impermeable paving. This makes the residents of these neighbourhoods more exposed to climate effects such as heat waves and flooding. Existing urban green spaces offer an exciting opportunity to help climate-proof neighbourhoods, for instance:

Image: Wielwijk after heavy rainfall (March 2024), by Dr. Özlem Bozkurt

Existing parks and green areas

Climate adaptation measures in Wielwijk park include reconstruction with height differences, permeable surfaces and specific plant species to mitigate flooding issues and ensure the park is accessible all year round.

Redesign from grey infrastructure to green

Reallocation of a trafficked road to the outskirts of the neighbourhood and construction of the ‘garden road’ Tromptuinen creates new green space in the city.

Image: Wielwijk under construction (May 2022), by Caitlin Ball

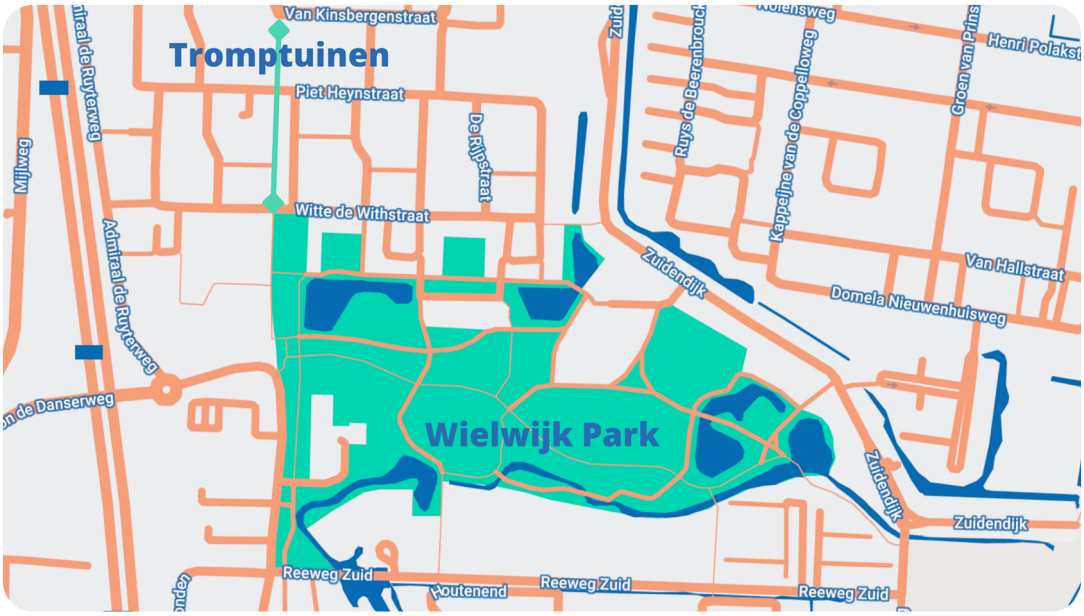
Image: Collaboration with homeowners in the Wielwijk area to connect green areas across public and private land (2023)

Private land and gardens

Supporting locals in setting up personal gardens makes private greening more accessible, connecting green spaces across the community and generating more ownership and awareness around climate topics.

Climate adaptation solutions: What to focus on?

The LIFE CRITICAL approach targets four priority climate change impacts in cities: flooding, heat waves, pollution, and biodiversity. To address each impact, specific adaptation measures are implemented.



Flood mitigation and adaptation

Harness topography: Negative effects of flooding can be reduced by optimising the use of space and selecting materials and species according to flooding risk. Plan for water storage and nature-related elements and vegetation that can coexist with occasional water issues in lower-lying areas, and place vulnerable functions, like recreational areas, in higher places.

Use nature-based solutions (NbS): Permeable surfaces and effective stormwater management are crucial to protect neighbourhoods during heavy rainfall. NbS are inspired and supported by nature to simultaneously provide environmental, social, and economic benefits and help build resilience. To address flooding issues, Bioblocks[1] that support biodiversity while promoting water infiltration, reducing runoff and supporting groundwater recharge, are a good option.

Reintroducing water: Water features help to protect against flooding by providing natural reservoirs to collect runoff. Reintroduce blue spaces by digging up canals, detaching drainpipes from the sewage, and leading them into the canal, as well as installing sloping pavements, essentially 'feeding' the canal with excess water.

[1] An innovative solution used in Tromptuinen where permeable blocks that promote plant growth are place along the canal to facilitate drainage and boost biodiversity.

Heat reduction

Increase green coverage: Green and grey surfaces can demonstrate up to 20ºC temperature differences on hot summer days, making green coverage essential. Consider all opportunities to convert grey pavement into green. For instance, greening private gardens, grass between traffic lanes, façade or rooftop gardens, or small gardens in public areas that citizens can make their own.

Safeguard and create shaded areas: With summers getting hotter, the need for shade becomes more pressing. Large trees are an effective way of creating shaded areas. In redevelopment projects, make sure to protect and recover old, large trees as they offer far more value than new trees in terms of immediate carbon capture, shade, and shelter.

Introduce water (canal or natural water playgrounds): Water features significantly help to cool areas, especially with rising summer temperatures. Reintroduce blue spaces strategically to help offset the urban heat island effect.

Improved air quality

Reduce pollution: Air quality issues lead to health problems such as respiratory diseases. In dense urban areas the main cause of poor air quality is traffic. Combine urban greening approaches with strategies to reduce traffic, such as redirecting cars and removing heavily trafficked roads from within neighbourhoods. Promote active modes of transport such as walking and cycling through urban planning and engagement activities with citizens.

Create green barriers and corridors: A barrier of bushes between a road and a pedestrian path can filter away pollutants like (PM, O_3, NO_2) and reduce noise. Strive for access to green areas right at people's doorsteps. This also enhances the appeal of outdoor activities like walking, cycling, sports or playing and improves mental health and wellbeing.

Protection and promotion of biodiversity

Select plants consciously: Diversity in species creates greater resistance against climate issues and plagues, while also increasing the performance of ecosystem services such as maintenance of nutrient cycles . Make sure that newly planted species support the local flora and fauna populations and are resistant to the local weather, wind, and rain conditions.

Careful maintenance: Natural processes of pollination and composting are important for maintenance and promotion of biodiversity. Through LIFE CRITICAL we have seen that longer grass offers shelter for insects and animals, while blooming flowers are crucial for regrowth. Customise the maintenance processes for different types of green spaces that serve multiple purposes. For instance, creating a range of grassy areas, from cleared grass for community activities to tall grass for animals and insects.

Involvement of the local community in the process

The involvement of the residents and other stakeholders in a targeted neighbourhood can have several purposes: it can directly contribute to the implementation of climate adaptation measures, and it can more generally contribute to strengthening the resilience of the neighbourhood.

Image: Wielwijk's Citizen Science day (23 September 2023) by the Drone Team of the Municipality of Dordrecht

Purposeful citizen engagement: Why involve the local citizens?

The LIFE CRITICAL approach is built on purposeful citizen engagement. This means that the activities to engage with the citizens of the neighbourhood are planned to meet certain goals.

Suitable design of public space and care for common green

By involving citizens in consultations and co-creation of redevelopments of their neighbourhood, the new urban areas can better meet their real needs. Engagement and dialogue increase the sense of ownership. Suitably designed spaces encourage use, and when these spaces are used, they are appreciated and more likely to be taken care of by the community.

Citizen science for increased climate awareness

Direct involvement of citizens in monitoring activities helps to show how greening actions contribute to tangible benefits for all. This helps increase awareness of general climate change related issues and it can create a better understanding of planned climate adaptation measures, resulting in higher commitment from the local community to contribute.

Community building

The benefits of engagement activities also go beyond the design of physical space. By bringing together the local stakeholders – including citizens, businesses, associations, schools, employees of the municipality – they get to meet and better understand each other and how they can contribute to creating a better neighbourhood together. This, in turn, builds a sense of ownership and belonging, moving the community spirit toward sharing and caring for one another.

Image: Wielwijk's Citizen Science day (23 September 2023) by the Drone Team of the Municipality of Dordrecht

Personalised involvement: How to achieve engagement?

The LIFE CRITICAL approach proposes three strategies to achieve a high involvement: customisation of activities, aiming for dialogue, and finding and involving facilitators in the process.

Customise the activities

If citizens are expected to dedicate their own time, the activities they participate in need to feel relevant to them. Customisation of involvement can be done through adjusting the formats and role of the contribution (such as consultations or citizen science) or through targeting specific themes like air quality, water, heat, or biodiversity.

Activate citizen scientists: This type of community engagement invites citizens to contribute to science by collecting data on specific issues. It is an effective strategy to increase awareness of a certain topic and it can generate new insights that can be used in decision-making (Lee et al. 2020). Customise the citizen science approach by allowing individuals to choose which parameters they monitor, based on what is relevant or interesting to them. For example, counting biodiversity (plants, insects, birds, or other animals) or measuring pollution in the air or water.

Image: Wielwijk's Citizen Science Day – a local alderman with citizen science intermediary PULSAQUA (left) and a local water creature (right), (23 September 2023)

Organise community events: Events in the local area can help to motivate people regarding chosen topics. The event can be anything from regular small-scale meetings with civil society representatives, to neighbourhood-wide festivals. Combining easily digestible knowledge about environmental issues that affect your daily life with fun activities is a way of sparking interest from broader citizen groups and increasing awareness about climate change, its causes, and its impacts.

Dialogue

Build relationships: For any type of citizen engagement activity, the most important success factor is to build trust and a relationship between the stakeholders involved. The information and communication throughout the process is crucial. Be clear from the start about the purpose and goals of the citizen involvement initiative and emphasise how it contributes to answering specific questions or addressing climate adaptation challenges. Managing expectations and being transparent about the project's intentions helps to build trust and avoid later disappointment (De Vries, 2023).

Image: Citizen Science intermediary Buurtbinders presents LIFE CRITICAL at the area information market in Wielwijk, (September 2022)

Involve facilitators: Citizen engagement is a process that requires understanding and communication that meet the target groups' needs. An intermediary partner in the process, such as a local NGO, can function as a neutral party that helps establish trust and create a more open and constructive dialogue between the citizens and the authorities. It allows for a fresh perspective and avoids getting caught up in discussions about other issues.

Monitor, evaluate, learn and replicate

Environmental impact monitoring is aimed at measuring how climate adaptation measures address an area's climate-related challenges, including air quality, heat stress, and flooding.

Image: A solar-powered remote sensor in Wielwijk (May 2022), by Caitlin Ball

Data driven adaptation strategies: Why monitor?

The urgent need to implement effective climate adaptation interventions calls for more evidence of what actually works. Thanks to new technologies, it is possible to collect data on specific climate-related challenges, including air quality, heat stress, and flooding, and use this to evaluate the effectiveness of adaptation measures.

Air quality monitoring

Targeted indicators for air quality monitoring may include CO_2, $PM_{2.5}$, PM_{10}, CO, NO_2, and NH_3. These measurements can demonstrate the effects of redirecting traffic or the impact of a green barrier separating roads for people. Fixed locations for low-cost sensors make them aptly suited to citizen science projects as measurements are low-maintenance and accessible. Connecting these measurements to an online platform allows citizens to see the impact of the efforts in real-time.

Microclimate monitoring

Measuring temperature and humidity will help to show impact from cooling strategies looking at shade vs sun or green vs asphalt. Measurements done at fixed locations are useful for comparability. Through citizen science, some mobile measurements can be taken with handheld temperature meters to boost measuring points and increase awareness.

Flooding (soil moisture)

Soil moisture is an important indicator of its permeability. By measuring this, it is possible to link data to weather conditions and extrapolate how permeable the ground is. This is also key for introducing green features, as it will guide decisions on plant species and placement depending on which flora can survive best in wetter or drier soil.

Biodiversity counting

Assessing the variety of plant or animal species in a certain area and observing the number of insects near a certain plant (e.g. by engaging schools in citizen science activities) creates awareness of biodiversity and demonstrates the impact of changes to different species.

Citizen behaviour and perceptions

Quantitative measurements of how many people use the park provide indicators of the social acceptance of new infrastructure. Qualitative collection of people's experiences and perceptions of different areas provide details on the needs and preferences of the park users. Measurements can be taken through automatic counting stations and user survey methods.

Effective monitoring: How to set up a monitoring approach?

Image: Heat sensor and image comparison (August 2023) by the Drone Team of the Municipality of Dordrecht.

Heat sensor drone images compared to real-life image demonstrating the temperature difference between green, blue, and grey spaces, 18 August 2023 between 12:00PM and 15:00PM. Highest measured temperature difference was approximately 21°C-23°C in green spaces compared to 43°C-45°C in grey spaces.

Define monitoring needs and develop a strategy

First, identify the measurable parameters linked to climate adaptation in the area, connected with the challenges and solutions in question. Then, evaluate the monitoring networks already in place - are the current metrics and monitors sufficient? Do additional monitors need to be installed at new sites? Do new metrics need to be introduced? The selection of sensors should be based on their relevance to climate resilience measures, the sensor unit requirements (e.g., power and connectivity), and the accuracy and long-term reliability they offer.

Deploy monitoring equipment and ensure accuracy

To accurately quantify impact, it is necessary to compare sensor data before and after urban transformation. Before executing climate adaptation measures, ensure your monitoring network is up and running to log the baseline data.

Key considerations for set up of extended sensor network (imec, 2021):

1. **Sensor metrics:** Focus on useful metrics, detectable in ambient air and where impacts by the urban transformation would be expected.
2. **Power:** Consider self-supportive systems (battery, solar panel) if continuous on-site power supply at the sites cannot be guaranteed.
3. **Connectivity:** Ensure sensors support IoT connectivity (LoRa, GPRS, NBIoT) to be able to provide real-time measurements.
4. **Sensor location:** Select meaningful locations with sensor mounts (lampposts, trees, poles) that wouldn't be relocated during reconstruction works.
5. **Calibration:** Sensors may need to be calibrated to optimise measurement accuracy, ensure that the calibration remains valid under conditions similar to those the sensors will encounter during their deployment.

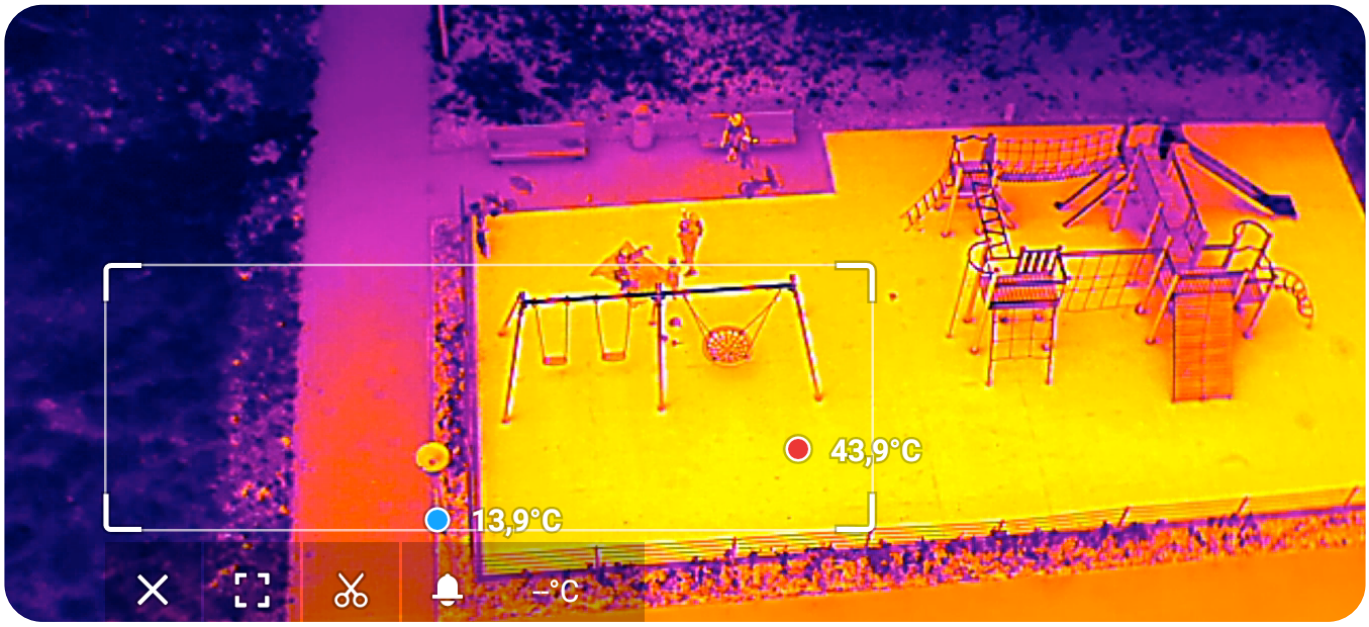


Image: Heat sensor drones demonstrating the temperature difference between green, blue, and grey spaces (18 August 2023 between 12PM and 15PM) by the Drone Team of the Municipality of Dordrecht

Turn the data into knowledge and action

Analyse the collected data in relation to your climate adaptation interventions, looking at results achieved over time (before and after interventions) and as a result of implementing specific blue and green infrastructure elements. The purpose of the data collection is to help evaluate the effectiveness of different solutions; the results of such an evaluation lead to more evidence-based decision-making. Open sharing of sensor data on a public platform establishes transparency and encourages citizens and other stakeholders to actively engage with the gathered data to enrich the analysis and aid in the interpretation and use of observed data.

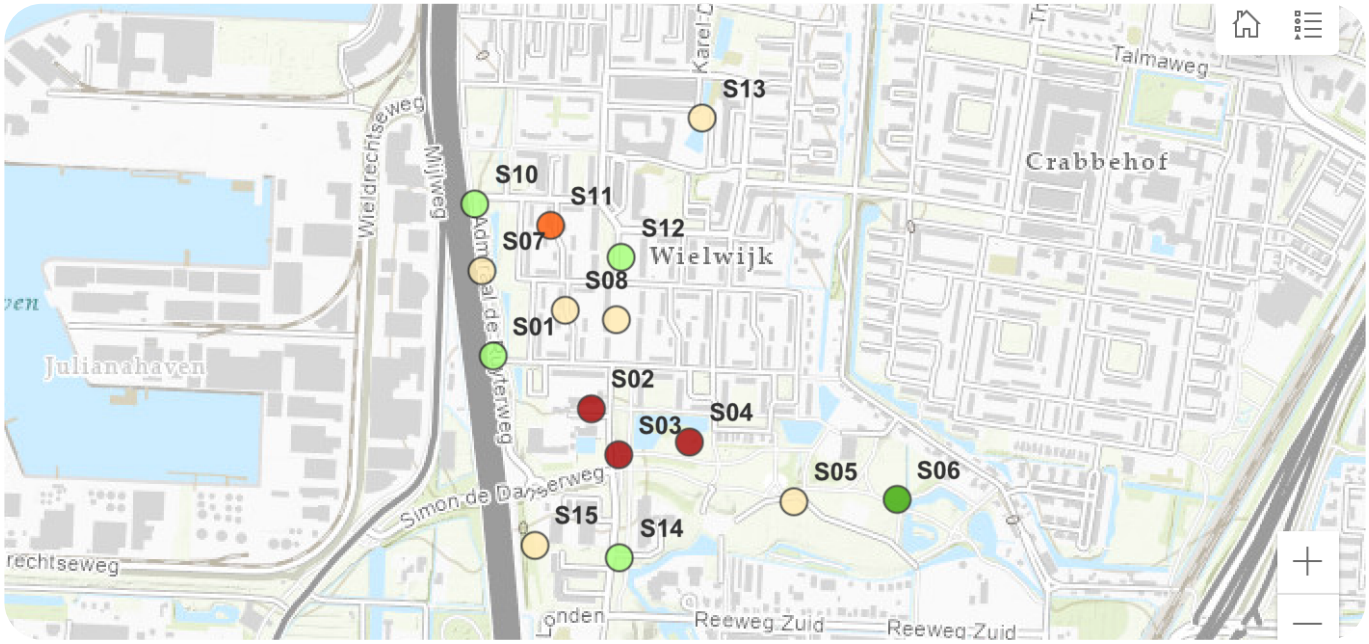


*Image: Screenshot from publicly available **real time monitoring** platform showing placement of sensor, to monitor temperature, humidity, and NO_2 in the neighbourhood (2024)*

More resources

This report was published as a part of the LIFE CRITICAL project. The project is ongoing until December 2025. New resources and insights are published on the project website regularly.

Do you want to know more about the experiences in the municipality of Dordrecht in the Netherlands with developing and testing the LIFE CRITICAL approach? See the full case study Climate Resilience Through the Involvement of Local Citizens.

This report is written based on the experiences in the municipality of Dordrecht. Content in the report is collected directly from the project team of the 'Green-blue city department'. Main sources of information are:

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