

Stuttgart: combating the heat island effect and poor air quality with green ventilation corridors ^[1]

Stuttgart's location in a valley basin, its mild climate, low wind speeds, industrial activity and high volume of traffic has made it susceptible to poor air quality. Development on the valley slopes has prevented air from moving through the city, which worsens the air quality and contributes to the urban heat island effect. A Climate Atlas was developed for the Stuttgart region, presenting the distribution of temperature and cold air flows according to the city's topography and land use. Based on this information, a number of planning and zoning regulations are recommended that also aim to preserve and increase open space in densely built-up areas.

Case Study Description

Challenges:

The city's location has a significant influence on its local climate including implications for solar radiation, air temperature, humidity, precipitation and wind. Stuttgart sits in the wide Neckar basin formed by two river valleys, shielded by steep hill slopes. Stuttgart's centre is located at about 240m above sea level, while the surrounding hills rise to 500m a.s.l.

Stuttgart has a mild, temperate climate with warm summers. Wind speeds throughout the city are generally low, which along with the urban heat island effect, contributes to poor air quality. The future climate projections for 2071-2100 suggest a 2°C increase of mean annual temperature in Stuttgart. The projections for heat waves ($T > 30^{\circ}\text{C}$) suggest that the number of days with heat stress (when people's thermoregulation is impaired) will increase significantly. By 2100, 57% of the Greater Stuttgart region could have more than 30 days with heat stress (in the low lying areas over 60 days). Therefore, a significantly higher percentage of people are likely to be exposed to the risks associated with heat waves than at present.

Objectives:

The primary objective for the region of Stuttgart is to facilitate air exchange in the city, thereby enhancing the potential for cool air flow from the hills towards the urban areas on the valley floor.

Solutions:

The Climate Atlas for the region of Stuttgart was published in 2008, based on the previous work in this area carried out by the City of Stuttgart since the 1980s and the in-house urban climatology department (in existence in the City of Stuttgart since 1938). The Climate Atlas provides standardised climatic assessments for the 179 towns and municipalities in the Stuttgart region. The Atlas comprises maps which show regional wind patterns, flows of cold air, air pollution concentrations, and other relevant information required to inform planners on what to do for urban climatic optimization that could inform new projects and retrofits. A key element of the Atlas is an area classification based on the role that different locations play in air exchange and cool airflow in the Stuttgart region, based on topography, development density and character, and provision of green space. The Atlas distinguishes eight categories of areas in this manner, and for each of them different planning measures and recommendations are provided.

In addition to responding to local climate characteristics, the following principles form the basis for the planning recommendations included in the "Climate Booklet for Urban Development Online – Städtebauliche Klimafibel

Online”:

- Vegetation should be placed to surround developments and larger, connected green spaces should be created or maintained throughout developed areas to facilitate air exchange;
- Valleys serve as air delivery corridors and should not be developed;
- Hillsides should remain undeveloped, especially when development exists in valleys, since intensive cold- and fresh-air transport occurs here;
- Saddle-like topographies serve as air induction corridors and should not be developed;
- Urban sprawl is to be avoided;
- All trees growing in the urban core with a trunk circumference of more than 80 cm at height of 1m are protected with a tree preservation order.

The implementation of the recommendations in the Climate Atlas is carried out by the Office for Urban Planning and Urban Renewal, supported by the Office for Environmental Protection. The Section of Urban Climatology within the Office for Environmental Protection evaluates the climatic implications of intended development and larger buildings. As a result of the implementation of the recommendations included in the Climate Atlas and Climate Booklet, over 39% of Stuttgart's surface area has been put under the protection of nature conservation orders; a record in Germany. As a result of greening actions, greenery covers more than 60% of the city. Stuttgart contains 5,000 hectares of forests and woodland, 65,000 trees in parks and open spaces and 35,000 street trees. 300,000 square meters of rooftops have been greened and 40 out of 250 kilometres of tram tracks have been grassed (as of 2007). In line with the city development vision, 60 hectares of greenfield land previously earmarked for development has been cut from the 2010 land development plan to protect existing green space. Targeted interventions such as a building ban in the hills around the town, and prevention of building projects that might obstruct the ventilation effect of nocturnal cold-air flows have resulted in preservation and enhancement of air exchange and cool air flows in the city.

Importance and relevance of the adaptation:

Case mainly developed and implemented because of other policy objectives, but with significant consideration of CCA aspects.

Additional Details

Stakeholder engagement:

The Climate Atlas 2008 was developed in close collaboration between the Verband Region Stuttgart (the association of regional cities and municipalities) and the City of Stuttgart. The Section of Urban Climatology within the Office for Environmental Protection of the City of Stuttgart contributed with its specialist knowledge. The evaluation and processing of the data for drawing up of the basic material required to produce the maps were undertaken by an external specialist consultant.

The City of Stuttgart emphasises the importance of public participation in greening strategies aimed at improving air quality and mitigation of the heat island effect. This is achieved through different strategies:

- Since 1986, the City of Stuttgart has provided financial support to green about 60,000 square meters of roofs.
- Since 1992, a scheme has been in place for Stuttgart residents to adopt a tree. Today some 182 caretakers have adopted almost 500 trees. They are responsible for watering the tree, reporting pest attacks, removing the leaf litter and fallen branches, and protecting the tree from dog fouling.

The Mayor of the City of Stuttgart supports the city greening initiatives aimed at improving air quality and reducing temperatures. The land use plan 2010 for Stuttgart envisages urban development under the slogan “urban – compact – green”. Climate change adaptation and mitigation are both high on the political agenda locally. The city has had a climate change mitigation strategy since 1997 and a climate change adaptation strategy was developed in 2012.

Success and limiting factors:

The following factors are highlighted:

- Compilation of detailed information about the area's topography, climate and land use allows for precise planning for different areas, which together aim to improve air quality and mitigate the urban heat island effect.
- The case demonstrates the advantages to a municipality of having in-house climatic research capacity to provide concrete knowledge of local conditions and remedies, as opposed to relying on an understanding derived from general principles. Cumulatively, over several decades, the city has used its planning and landscaping powers to engineer an entire system of urban air circulation.
- Constructive use of existing regulations (e.g. the German Building Code) provides a mandate for the implementation of planning recommendations relating to local climate.
- Close collaboration between the Office for Environmental Protection (analysis of information, provision of recommendations) and the City Planning and Renewal team means that the recommended green infrastructure solutions are being implemented through spatial planning and development control.

Budget, funding and additional benefits:

The initiative was funded by the City of Stuttgart and the Verband Region Stuttgart. The funds were necessary to generate the climatic data around which the Climate Atlas is produced.

Legal aspects:

The preservation of natural environment in urban areas is principally guided by the Federal Nature Conservation Act (BNatSchG) and by the Nature Conservation Act of the Land of Baden-Württemberg (NatSchG). The Federal Nature Conservation Act prohibits the modification or impairment of protected green spaces, or changing land use in these protected areas. Protected green spaces comprise: green zones in settlement areas, parks, cemeteries, significant gardens, single trees, lines of trees, avenues or groves in settled or under developed areas; and some plantings and protective wooded areas outside forests. Preserving the history and culture of the region can also be a reason for protecting green spaces.

German Building Code from 1960 is an important influence over urban development. The regulations were revised in 2004, and now require precautionary environmental protection in urban zoning and planning practices. § 1 (5) states that urban development planning has to be sustainable, integrating social, economic and ecological demands, and also assuming responsibility for future generations. Urban development plans must contribute to the creation of an environment that is fit for human beings, that protects natural resources, that contributes to climate protection, as well as preserving and developing the urban pattern and appearance of the landscape of towns and cities. According to § 1 (6) the following aspects have to be taken into account (amongst others) when establishing urban development plans: the presentation of landscape plans and green open space structure plans, as well as other plans concerning issues such as water rights, waste rights and pollution control rights; and the conservation of the best possible air quality.

Implementation time:

None

Reference Information

Contact:

Ulrich Reuter

Municipality of Stuttgart

Office for Environmental Protection, Department of Urban Climatology

Gaisburgstraße 4, 70182 Stuttgart, Germany

Tel: +49 711 216 88625

E-mail: ulrich.reuter@stuttgart.de [2]

Websites:

http://www.stadtklima-stuttgart.de/index.php?start_e [3]

http://www.stadtklima-stuttgart.de/index.php?climate_climate_atlas_2008 [4]

Sources:

Green and Blue Space Adaptation for Urban Areas and Eco Towns (GRaBS)

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ventilation-corridors

Links

[1] <https://adaptecca.es/en/stuttgart-combating-heat-island-effect-and-poor-air-quality-green-ventilation-corridors>

[2] <mailto:ulrich.reuter@stuttgart.de>

[3] http://www.stadtklima-stuttgart.de/index.php?start_e

[4] http://www.stadtklima-stuttgart.de/index.php?climate_climate_atlas_2008