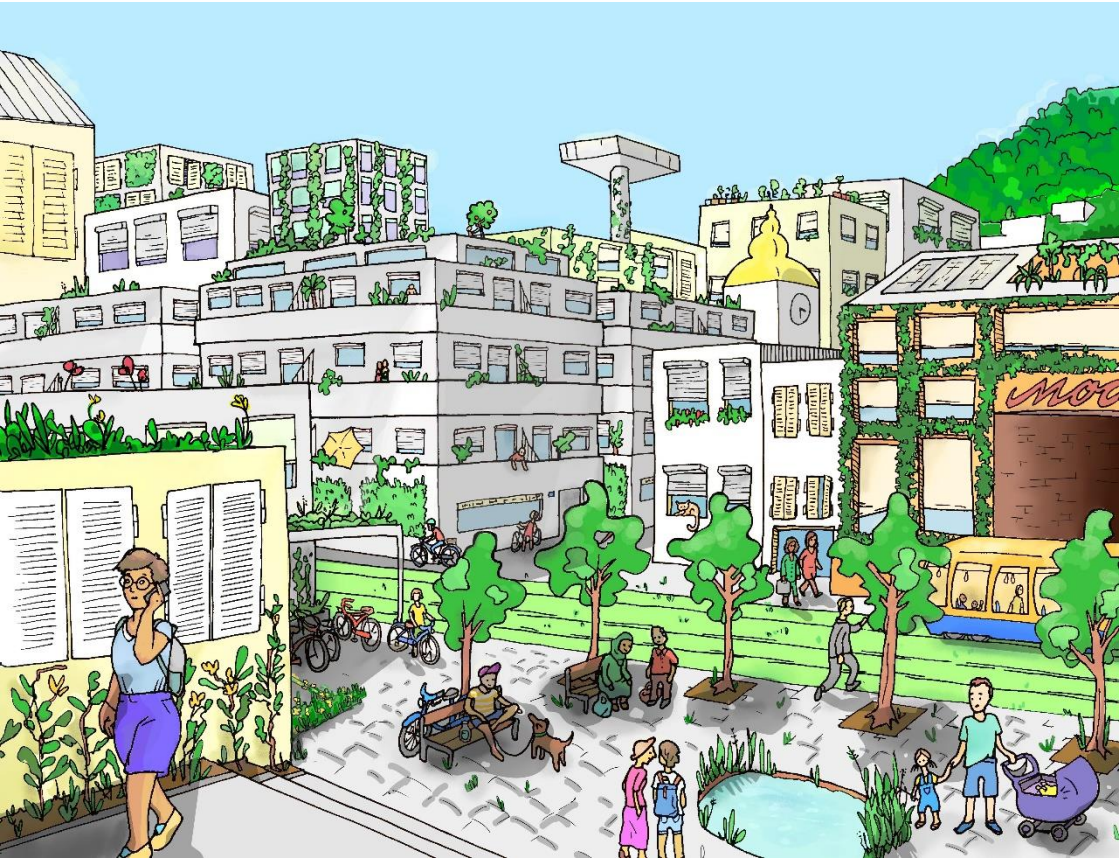
ADAPT
URBAN HEAT ISLANDS

Climate Change and Urban Heat Islands

Adaptation Measures for Urban Planning



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Impressum

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This brochure is a product of the research project ADAPT-UHI (KR17AC0K13693), which was funded by the Climate and Energy Fund of the Austrian Climate Research Programme (ACRP) from April 2018 to March 2020. Using three pilot cities as an example - Mödling and the surrounding area, Salzburg, and Klagenfurt - the ADAPT-UHI project developed tools to minimize the effects of urban heat islands in the future. The aim of the project was to provide city planners with the right tools to help them make decisions on climate change adaptation. All project results can be obtained from the project website: adapt-uhi.org

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Urban Heat Islands

Cities are particularly affected by climate change and rising temperatures. Large, impermeable surfaces, lack of vegetation and concentrated buildings drive up the temperatures in cities. This effect is called the Urban Heat Island (UHI).

Extreme heat affects human health and well-being. Heat waves in urban areas have already claimed many human lives. For example, the 2003 heat wave resulted in 30,000 deaths across Europe.

Large cities such as Vienna have already examined the UHI effect and developed climate protection and adaptation strategies. Less work has been done in small to medium-sized Austrian cities, which are also affected by heat waves during the summer. In addition, with increasing urbanization, urban planners need solutions to mitigate the impact of the UHI since cities will continue to grow in the future.

In the ADAPT-UHI project, both the future heat load and potential adaptation measures were modelled in the pilot cities of Mödling, Salzburg and Klagenfurt. In a further step, both the effects and the costs of these measures were compared.

This brochure is aimed at urban planners and provides information on:

- ✓ General urban planning measures to reduce the UHI effect
- ✓ Costs and benefits of the various measures

Website

https://adapt-uhi.org/

Overview

Using three pilot cities as an example - Mödling and the surrounding area, Salzburg, and Klagenfurt - the ADAPT-UHI project has developed tools to minimize the effects of urban heat islands in the future.

The aim of the project was to provide city planners with suitable tools when making decisions on climate change adaptation. The following products have been generated and can be obtained from the project website:

- Urban Heat Island Risk Index for all of Austria. This map shows the potential risk from Urban Heat Islands at a resolution of 100m x 100m.
- Modelling of three different adaptation scenarios for all three pilot cities at a resolution of 100m x 100m, including a cost-benefit calculation.
- Urban Climate Quality Monitoring. For all three pilot cities, the quality of the existing green and blue infrastructure (parks, lawns, city trees, water bodies) was evaluated and rated.

General recommendations for urban planning were developed based on the project results.

ADAPT-UHI Research Team

The Climate and Energy Fund of the Austrian Climate Research Program (ACRP) funded the ADAPT-UHI project from April 2018 to March 2020 for a total of € 250,000.

IIASA coordinated the project, created a UHI visualization tool and was responsible for knowledge transfer and dissemination.

The Zentralanstalt für Meteorologie und Geodynamik (ZAMG) modelled future urban heat islands for all three pilot cities taking different measures into account.

The Austrian Environment Agency (UBA) developed the Urban Climate Quality Maps and the UHI Risk Index.

The International Project Management Agency Klagenfurt (IPAK) supported climate modelling and adaptation measures for Klagenfurt.

Daniel Johnson from the ESCP Business School Berlin undertook the cost-benefit calculations for all three pilot cities.


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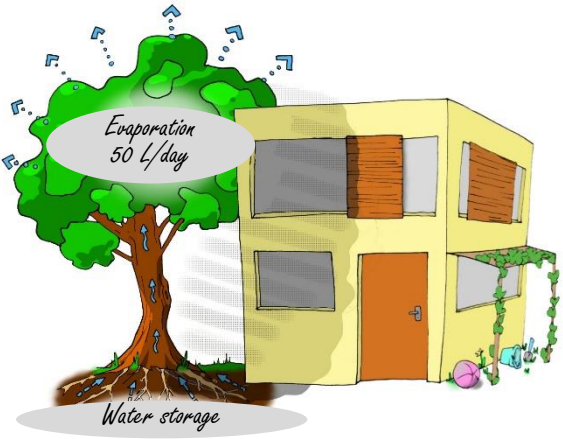
One Tree per Resident

Cities should plan for one tree per resident over the entire built-up area, or the equivalent in terms of green or blue infrastructure.

Both private and public spaces should be considered. The planting of new trees, the maintenance of existing trees and any replacement measures should be put into place within the next 20 years. Replacement measures should have the same cooling effect as an average healthy city tree with an age of 30 years, after 30 consecutive days of more than 30°C and no rainfall.

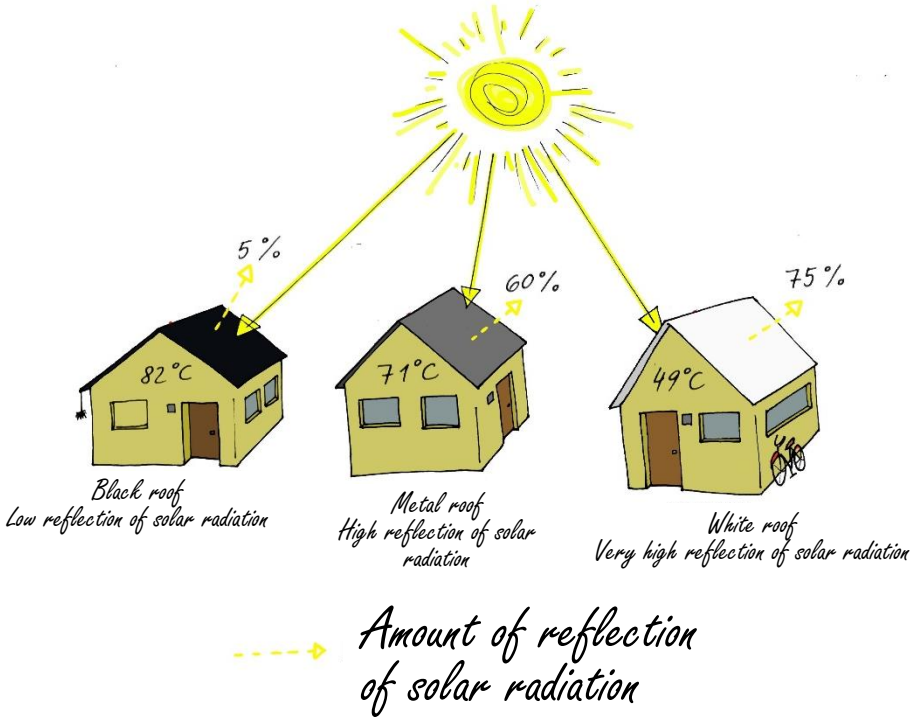
City trees provide cooling in two ways. First, through shading, and secondly, through the evaporation of water.



Increase the Reflection from Roofs

The reflectivity (or albedo) of roof surfaces should be increased continuously over time. An increase of 0.5 percentage points per year over the next 40 years is recommended. This corresponds to an increase in the reflectivity by a total of 20%.

"Cool roofs" are still largely unknown in Austria. In California, bright roofs are part of their climate strategy. So-called "cool roofs" should be placed on all new buildings - roofs whose materials are as reflective as possible, e.g., through bright colors.



Unsealing Surfaces

The aim should be to continuously unseal public and privately asphalted surfaces over time. An annual reduction in the sealed area of 1.25% of the total over a period of 40 years is recommended. This can be achieved by changing the sealed surface to a green area or by installing different surfaces that have at least 50% water permeability (see below).

Green tram tracks
(Example from Mulhouse, Frankreich)

Partially unsealed parking lot
(Example from Munich, Germany)

Examples of surfaces with different infiltration capabilities

(1) Macadam or water-bound surfaces
Permeability 50%, for parking spaces with light to medium-weight vehicles

(2) Gravel lawn
70% - 90% permeability, for parking spaces with light to medium-weight vehicles

(3) Lawn joint pavement
50% - 60% permeability, for parking spaces with light to medium-weight vehicles

(4) Grass and lawn pavers
60% permeability, also suitable for heavy vehicles

Shading from Buildings and Vegetation

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Effective shading of buildings and open spaces - for example by trees, green facades, arbors or solar panels - should be used wherever possible. In addition, other sustainable cooling measures should also be used, with priority given to passive measures in urban planning, architecture and building technology.

Everyday walks in public spaces should not be a burden for pedestrians and cyclists, even on hot days. For those who do not have a garden, the quality of the time spent in public spaces is particularly important. A bench in the shade serves as a place to relax and as a meeting point.

Shading of a public space in Bittburg, Germany (© Solana)

Shading of a public square in Benicassim, Spain (© urbadis)

Shaded courtyard (© Bruno Klomfar / proHolz Austria)

Protect Cool Spaces

Existing green areas and water bodies should be protected from obstruction, and new green areas and water bodies should be created where possible. It is also important to maintain and set up corridors that help to generate urban cooling.

Identify cooling corridors and protect them from obstruction. Austria's cities are particularly affected by increasing urban sprawl. Here there is a risk that important cooling corridors will be lost. These are often located in neighboring municipalities and thus, are also outside of a city's planning area. In this case, long-term protection can only be achieved through good regional cooperation.

Wherever possible, attention should be paid to the selection of building materials with regard to their thermal properties, and classic concrete construction should be avoided (e.g., the thermal conductivity of concrete is 16 times higher than that of wood).

Above: Wohnhausanlage Mühlweg, Vienna
Below left: Kindergarten Schukowitzgasse, Vienna
Below right: Wohnbau Wagramerstraße , Vienna
All photographs by © Bruno Klomfar / proHolz Austria

Include Private Gardens

Private gardens can make a major contribution to the city's climate and local biodiversity. City planning can achieve a great deal through awareness raising and incentive systems. Trees on private property should be protected against removal by legal means such as an ordinance.

- Improvement of public relations between the city and relevant target groups (private and institutional forest and garden owners, companies in industrial and commercial areas, farmers, forestry companies). The "Nature in the Garden" campaign (www.naturimgarten.at) is a great example of how garden knowledge can be conveyed in a manner that is easy to understand.

- Establishment of a tree protection regulation for the sustainable protection of the tree population - similar to the Vienna Tree Protection Act (LGBL 71/2018: Gesetz zum Schutze des Baumbestandes in Wien).

- Tree support program for new trees in gardens - similar to the Graz model (Richtl. für die Förderung einer urbanen Begrünung, 2019).

Regional Cooperation

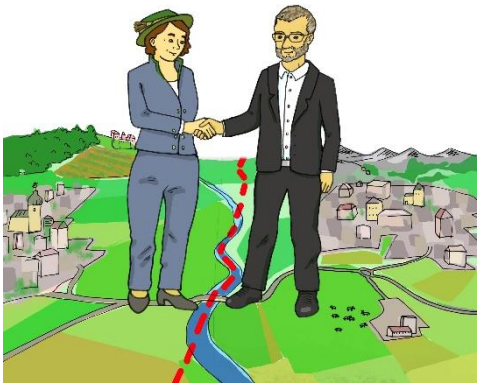
Through regional cooperation between neighboring municipalities, both costs and benefits can be optimized when applying climate change adaptation measures.

Typical areas of cooperation in this context are: the protection of forest areas (from construction on one side to prevention of fires on the other), the development and design of industrial and commercial areas, large construction projects, regional planning programs, and common data sets that can be shared.

Advantages of regional cooperation

In the ADAPT-UHI project, climate change adaptation measures for the city of Mödling (urban area only) and the Mödling region (the core city and 13 surrounding municipalities) were modelled until 2050.

- If the measures are only applied to the core city, the number of hot days can be reduced by 25%.
- If the measures are applied simultaneously in all surrounding communities, the number of hot days can be reduced by 36% in the entire region.



As part of the ADAPT-UHI project, the costs and benefits of the measures for reducing urban heat islands were assessed. Every measure for reducing urban heat islands has an associated investment and maintenance cost. In order to understand whether the benefits of the measures outweigh the costs, the measures for three pilot cities were assessed in monetary terms.

On the cost side of the equation are the investment costs for all measures, which include, for example, the planting and maintenance of city trees, the installation and maintenance of green roofs, the unsealing of asphalt surfaces, the installation and maintenance of white roofs, etc.

The benefits of ecosystem services were then evaluated, where the advantages are obtained by using “green measures”. It was shown that the benefits from ecosystem services outweigh the costs in the long term.

- Green roofs reduce the outflow of rainwater to sewage treatment plants.
- Trees reduce urban air pollution.
- The increase in green areas contributes to the storage of carbon and improves regional biodiversity.
- Green walls and green roofs increase the thermal insulation of buildings and thus increase property values.
- The reduction of hot days leads to positive health effects: there is less absenteeism, fewer hospital stays and a lower heat-related death rate.

	Mödling	Klagenfurt	Salzburg
Investment	372 mio €	1,848 mio €	2,232 mio €
Savings in operating and maintenance costs	70 mio €	396 mio €	391 mio €
Reduced mortality	398 mio €	2,546 mio €	6,108 mio €
Reduced hospital stays	2 mio €	11 mio €	29 mio €
Reduced productivity loss	15 mio €	24 mio €	50 mio €
Runoff reduction	16 mio €	130 mio €	180 mio €
Roof longevity increase	13 mio €	47 mio €	62 mio €
Property value increase	65 mio €	146 mio €	411 mio €
Habitat creation	5.5 mio €	20 mio €	27 mio €
Pollution removal and CO_2	17 mio €	13 mio €	19 mio €
Heating and cooling cost savings	28 mio €	115 mio €	139 mio €

The table shows the monetary valuation of ecosystem services versus investment and maintenance costs. In all cities, the benefits achieved are greater than the costs. The greatest benefit is achieved by reducing heat-related mortality. The second largest benefit is achieved through an increase in property values.

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