Green areas

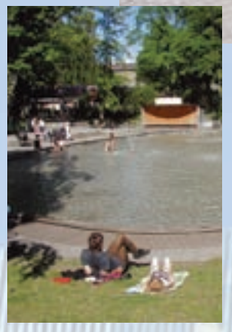
Green areas in urban settlements start playing a specific role in relation to global warming and climate change, especially with expected:

- temperature increase (especially extremely hot summers)
- decrease of relative air humidity

Moreover, the green areas play other important roles:

Micro-climate role is understood as a capability of green areas to affect by its transpiration the air humidity, provide shade, reduce temperature fluctuation, etc. e.g., a grown birch (*Betula pendula*) can evaporate up to 7,000 litres of water during a vegetation period, city parks reduce temperature roughly by 1°C when compared to the temperature on streets. Green areas increase air humidity (by 5 to 7% on average).

Insulation role is understood as a capability of vegetation to reduce noise influence, catch dust, absorb xenobiotic substances from the air, etc. e.g. a 50 year-old maple (*Acer platanoides*) absorbs during a vegetation period 0.0295 kg of sulphur, 0.0860 kg of chlorine and 0.0039 kg of fluorine. Filtration effects of vegetation are well known. Trees and bushes have positive impacts on air quality and serve as a filter for particulate matter (20 g of dust particles per 1 m^2 of leaf area). The role of reducing noise in the urban environment and wind speed is also important.



By measuring in terrain in 2006 it was confirmed that vegetation cover with various structure has a considerable micro-climate effect. Differences in measured values of temperature of air and relative humidity show that use of various vegetation formations in order to improve micro-climate in the urban environment is reasonable. Considerable differences were detected in measuring selected indicators – e.g. maximum temperature difference was up to 14.6 oC between the temperature on grass and under a solitaire tree (on the ground level). Cooling effect was manifested on all surfaces with wooden vegetation. Air temperature on grass was surprisingly high as it was in some cases comparable with the air temperature on asphalt surfaces (road and parking).

Even larger difference in temperature displays itself, following the ratio of impermeable built-up areas to the green areas with high share of trees where maximum temperature difference was 17 °C (temperature of 48 °C measured in areas of technical and transport facilities compare to 27 °C measured in park areas with prevailing trees and shrubs) even till 22 °C difference in temperature measurement in the surroundings of the water-course and on the parking lot without wegetation.

Conclusions:

- Increasing the share of vegetation in urban areas, in particular in built-up city centres (*including use of green roofs, climbing plants, planting trees on streets, parking areas with green pavement, etc.*)
- In green spaces, the ratio of wooden vegetation (trees) to grass should be more than 60%
- Taking into consideration shift of vegetation zones during the tree planting
- Increasing use of water component – *fountains, water courses, rain water retention*
- Looking after sufficient thermal insulation of buildings
- Shading of transparent parts of buildings. *Parts of buildings providing shade are a simple but very important element to maintain optimal internal temperature in a building*
- Bright colours and glittering surfaces should be used on facades which reflect radiation better than dark colours

The leaflet was published in the framework of the LIFE III project „URBECO – Sustainable Urban Development and Mitigating Impacts of Climate Change on Quality of Life and the Environment in Cities" which was implemented by the Regional Environmental Center for Central and Eastern Europe (REC Slovakia) in 2005 – 2007 with financial support provided by the European Commission LIFE Programme and Slovak Ministry of the Environment.

Contact:
REC Slovakia,
Vladimir Hudek, Country Office Director
Zuzana Hudekova, Project Manager
Vysoká 18
811 06 Bratislava
Slovak Republic
Tel.: +421 2 5263 2942
rec@changenet.sk
www.rec.sk

THE REGIONAL ENVIRONMENTAL CENTER
for Central and Eastern Europe
REC Slovakia

Presentation of possibilities to mitigate negative impacts of climate change in cities

Climate Change and Cities

THE REGIONAL ENVIRONMENTAL CENTER
for Central and Eastern Europe
REC Slovakia

PROJECT LIFE III - URBECO

Introduction

In accordance with the latest estimate by scientists, the warming and related climate changes proceed more rapidly than generally expected before. The Fourth Summary Report on Climate Change, prepared by a group of more than 600 scientists of the world, is unambiguous in its outcomes. It anticipates a considerable increase of temperature in the course of this century and the growth will continue in much longer perspective.
The scientists expect that the **average global temperature** of the Earth surface **could increase by 1.8 – 4.5 °C by 2100**.
The warming will lead to **increased evaporation and subsequently to increasing average global precipitation.** Soil humidity will decrease in many regions and intensive rainy storms will probably become more frequent. Along with long periods of drought, melting of glaciers, frequent floods and shortage of drinking water the scientists point out at further adverse impacts – millions of climate refugees, tornados and hurricanes.

Climate changes and cities

At present, more than 75% of Europeans live in urban areas (56.5% in Slovakia). The urban environment differs from the neighbouring landscape in a number of characteristics (temperature, humidity and air quality and others). It can be expected that due to climate change these adverse trends will even strengthen.
Air temperature is the most important characteristic of climate. In urban settlements there is high concentration of surfaces with large thermal capacity which are strongly warmed up. This causes considerable heat accumulation in cities. Temperature growth is also affected by the heat released from industrial processes, combusting engines in transport and the heating of residential houses. Common influence of these factors leads to creation of so called „**heat islands**". Literature describes a lot of data on temperature deviations in cities from surrounding landscape reaching up to 2.5 to 3°C.
Increased friction on uneven surface of cities makes movement of air more difficult up to the altitude of 1,000 metres over the city. Temperature of air layers over the city increases and together with condensation nuclei (dust and aerosol) help **increase amount of clouds** over the cities, when compared to surrounding landscape. As far as annual average is concerned, this difference is 5 to 10%.
Due to increasing amount of clouds the amount of rainfall is increased too, but **impermeable urban surfaces and sewerage system drain water from the territory.**

Consequences of climate change in cities

Some negative impacts of climate change, described above, will be more apparent in cities. The most visible problems related to climate change in cities will involve:

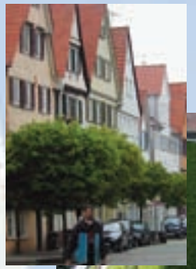
- Increased temperature (in case of heat waves the heat in cities will be multiplied by heat island effect. According to the study worked out by the British and American universities the temperature in cities can grow by 6 – 7 degrees when compared to surrounding landscape
- Considerable decrease of relative air humidity
- Rainfall decrease – aridisation (gradual drying, in particular due to increased potential evaporation and decreased soil humidity)
- Rainfall of storm nature – potential local floods

Possibilities to mitigate impacts – preparing to climate change

The time gap between reduction of greenhouse gas emissions and reduction of their real concentration is large. It is likely that, if we do not manage to reduce emissions to acceptable level, we will not avoid a certain degree of climate change, which will occur due to greenhouse gases incorporated already in the atmosphere. Therefore we need to identify and implement measures to adapt to the climate change consequences.

The studies bring a number of areas where measures are necessary
a) in planning cities and new construction activities,
- considering climate conditions in cities and supporting creation of new parks, green areas (including green roofs)
- using building materials allowing to reduce temperatures in cities,
- proposing constructions ensuring proper thermal conditions both in winters and summers,

b) in existing urban structure
- to re-construct buildings, energy and transport systems and infrastructure, to renew and extend green areas in cities so that they are well adapted to extreme weather phenomena;



The most important factors affecting urban climate:
- size and structure of the city
- thermal and hydrological properties of surfaces
- manner and nature of construction

Architecture

Based on comparison of heat persistence of various areas of a city it is apparent that more intensively built-up areas are cooled much more slowly than surrounding landscape. This is affected mainly by large heat persistence of building materials, less green areas and slow movement of air due to dense and high buildings. The situation in peripheral areas with more green areas and less dense construction is better.
Water constitutes a potential for improvement of micro-climate. Fountains and water bodies have always been a part of historic squares and parks. Through drops of aerosol and natural evaporation they increase air humidity and decrease its temperature. Due to high accumulation capacity the water temperature increases more slowly than surrounding surfaces and gradually evaporates. Special rain water retention system could influence in positive way also the temperature.
The architecture will have to gradually adapt to increased temperatures in cities. Air condition used so far is not a good solution for warmed-up buildings! Traditional air-conditioning leads to electricity consumption and greenhouse gas emissions which finally mean global warming.
Sufficient heat insulation constitutes a great contribution to ensure optimal climate. It protects buildings both in winters and summers. Buildings with massive inner constructions with accumulation capacities, which are therefore resistant to strong temperature fluctuation, hold an advantage.

Measures oriented to shading transparent parts of buildings are also important. Shading parts of buildings (marquises, lamellas, jalousie, roller-blinds, curtains) are simple but very important and effective components to maintain optimal temperature of a building.
In London in 2020 summer temperatures are expected to reach those of the southern France. Results of studies have shown that buildings with sufficient accumulation surface and passive solar and ventilation systems can better resist to climate change, while the current large-glassed buildings begin to suffer from heating.

Building materials

Temperature increase in cities is affected mainly by building materials, lining and paving, which are warmed-up to various extent depending on colour, structure and orientation. Large fixed areas can be on a direct sun radiation warmed up to 50 degrees and radiate for many hours, which depends in particular on volume. These areas contribute in this way to warming up the air during nights.

Bright colours and glittering surfaces should be used on facades as they reflect radiation generally better than dark colours. In case of dark colours there is larger absorption and radiation in infrared spectrum which is perceived as heat. Heat is strongly absorbed mainly by dark asphalt surfaces under which there is often concrete and after warming it has a capacity to radiate for a long time. Speed of heat transfer depends on temperature difference between the heat source and the area where the heat is being released.
Using green roofs constitutes a great potential. These roofs retain rain water and release it in form of water vapour. Retained water does not constitute a burden for sewerage and reduces the flood risk. Climbing plants can also play a positive role.