Climate change mitigation and adaptation to the impacts of heatwaves – an integrated urban planning approach

For more than 15 years, member municipalities of Climate Alliance across Europe have engaged in local level climate protection activities, committed themselves to voluntary greenhouse gas emission targets and set up action programmes to combat climate change. However, due to emissions in the past, adaptation to climate change shall be required to address impacts resulting from unavoidable warming. The adverse experiences with weather extremes - floods, storms, extreme heat and droughts - are a clear sign of the severe impacts of climate change. Even if we were to stop all green house gas emissions today, we would still feel the impacts of climate change for decades to come. At the same time if we do not stop increasing the amount of carbon dioxide in the atmosphere we run the risk of changing the climate so severely that we will be unable to adapt. The integration of climate change mitigation and of adaptation to the effects of heat islands through urban planning is a good example to illustrate the challenges.

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Adaptation and Mitigation through urban planning

Addressing climate change and its effects through urban planning presents a twofold challenge: On one hand *"mitigation"*, that is limiting further climate change by reducing the production of greenhouse gases; and, *"adaptation"* on the other hand, which is about preparing for the impacts of inevitable climate change.

The key impacts of climate change on urban areas and building infrastructure within Europe are related to extreme events such as heat, hail, storm, flooding rivers, as well as sea level rise in coastal areas. Urban planning could play a key role in minimizing climate related risks in the human environment. Moreover there are many opportunities for local councils to use the urban planning process to reduce greenhouse gas emissions.

See www.climate-compass.net.

It is essential that climate change be tackled in an integrated way. The objective of the AMICA Project is to motivate local governments to include climate protection and adaptation in their planning practices. Synergies are created when measures that control greenhouse gas concentrations also reduce adverse impacts of climate change, or vice versa.

Climate Change enforces urban heat islands

Due to climate change urban areas are increasingly exposed to the urban heat island effect. Overheating of urban areas can have serious repercussions for human beings such as a rising in the number of excess deaths for particularly vulnerable group of people, a reduction in the comfort of urban residents with further effects on their productiveness and the urban economy.

During heatwaves elevated demand for air conditioners leads to enhanced energy requirement and further exacerbates climate change. Experiences in Dresden and Lyon have also shown first impact on the urban vegetation urging urban forest managers to address the issue of coping with modified ecological conditions for urban forest management.

Contribution of urban sprawl to climate change

In Europe the area of sealed land used for settlements, roads and industrial estates etc. has dramatically expanded. Urban sprawl is synonymous to a re-distribution of housing, workplaces, retail and leisure facilities. This means as well loss of prime farmland, lengthens commute times and increase in CO_2 emissions. As a result of urban sprawl, road transportation has become the fastest growing source of greenhouse gases. Construction on the *"green field"* and bad energy balance of suburban detached housing contribute to further CO_2 emissions.

Mitigation of climate change through urban planning

Local governments can take a range of planning decisions related to urban development to reduce greenhouse gas emissions. They can be proactive in regulatory and educational measures and apply mandatory density and energy efficiency criteria. Cities can make a substantial long-term contribution to prevention of car traffic if they consider this aspect early in the planning process.

Urban development planning is a key determinant of demand for mobility: weather it is a compact city where the various functions - residential and commercial, services, education and recreation – are located and how they interconnect; weather public transport is available for newly developed areas, etc. Actually, the State of California is pioneering in what could be the next step against global warming: filing suit to hold cities accountable for greenhouse gas emissions caused by poorly planned suburban sprawl.

Adaptation to climate change through urban planning
Urban planning that is sensitive to climate change issues should consistently make decisions based upon local climate diagnostics and modelling, as well as vulnerability assessments. When restricted to a respective local area of application, planning can be carried out using the legal instruments like the guidelines of the land-use plan, the legally-binding parameters of the site plan and the process and realisation plans. The AMICA Adaptation Tool suggests a number of measures that communities can take to lessen the impacts of heat islands:

- *"Heat Wave Warning System"* – to inform and alerts citizens about current heat wave dangers – and *"Heat Wave Action Plan"* - an administrative crisis management plan for times of heat waves.
- *"Blue Roofs"*; water basins on top of buildings to store excess water and thus prevent flooding and, in addition, to use heat exchanger for solar heating and cooling.

Biologically related solutions use vegetation to reduce urban heat. Vegetation provides shading effects as well as cooling through evaporation:

- *"Green roofs"* – planting the roofs of buildings with grass and vegetation to improve the insulation and *"Green rails"* - planting new/existing rails with grass.
- Planting trees around individual buildings, roads and parking lots to shade urban surfaces and creation of green space such as parks.

The Cities of Dresden and Lyon have started to conduct studies on tree species that withstand the impacts of climate change. The most important questions to start with are: What is the current degree of vulnerability of trees to the climate-related events today? What kind of trees will be affected in future?

Integrated urban planning measures to reduce the impacts of heat islands and to mitigate climate change
Factors such as land-use patterns, the coverage of urban trees and vegetation, the integration of transport modes and systems as well as the materials used in building construction can be directly affected by decision makers. This is where policies and programs to reduce the impacts of heat islands – can be most effective - and achieve mitigation goals.
Understanding of both mitigation and adaptation is essential: Higher densities are a way of improving the overall energy efficiency of the urban area. General urban consolidation, and more intensive mixed use of local activity centres close to public transport nodes restrict soil consumption and are likely to reduce travel as well as emissions from transport. However, responding to climate change adaptation requires space within and around buildings. But if planned well, with the use of tree cover and landscaping, this can provide parallel opportunities to lower carbon emissions. Medium density housing including mixed-use and green areas are likely to provide greenhouse benefits and can contribute to adaptation.
The approach of integrating uses within existing urban areas brings further adaptation benefits – such as the reduction of direct heat from individual cars. The planning of housing areas can significantly affect living comfort during heatwaves. Innovative cooling systems contribute to limitation of emissions. Orientation and arrangement of buildings and areas makes it possible to ensure that conventional air condition be replaced and solar cooling, district heating systems or geothermal energy be utilised for cooling comfort.
Planting trees around buildings to shade urban surfaces and green roofs to reduce their temperature lead to substantial reductions in energy consumption for air-conditioning and sequester carbon while growing. Trees to shade roads and parking lots reduce evaporative emissions from gasoline, which contribute to increased levels of urban ozone. Biomass from urban trees and shrub can be used as wood energy to replace fossil fuels, thus contributing to climate protection. ■

Fig. 1: Urban density and movements in Lyon

Variables studied	City Centre	Suburbs	Urban Peripheries	Rural Peripheries
Cars per 100 households	89	110	129	136
% of diesel	24	26	31	36
Average age of cars in the year	6.6	6.7	7.5	ns
Av. commuting distance in km	8.5	12.2	15.7	16

Source: Communauté urbaine GRANLYON.

Links
- AMICA: www.amica-climate.net
- Klima-Bündnis: www.klimabuendnis.org
- Gran Lyon: http://ale-lyon.org/rubrique/references/progeuro/amica.html
- Landeshauptstadt Stuttgart: http://www.staedtebauliche-klimafibel.de/Climate_Booklet/index-1.htm
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