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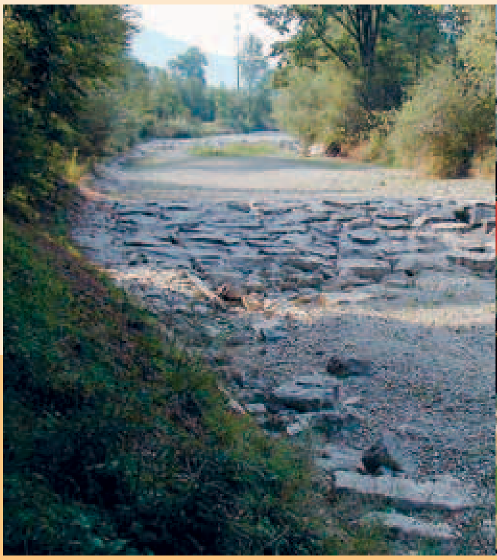

Adaptation and Mitigation

an integrated climate policy approach

CLIMATE ALLIANCE
KLIMA-BÜNDNIS
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AMICA

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North East South West
INTERREG IIIC

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1. Integration of mitigation and adaptation as a response to the problem of climate change

For more than 15 years, member municipalities of Climate Alliance across Europe have engaged in climate protection activities at local level, committing themselves to voluntary greenhouse gas emission targets and setting up action programmes to combat climate change.

However, the world's climate system has such long response times that experts now agree that climate change can no longer be halted completely. Hence the adverse experiences with weather extremes – floods, storms, extreme heat and drought – 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.
If we do not stop increasing the amount of carbon dioxide in the atmosphere we run the risk of changing the climate in unforeseen ways that we will be unable to adapt to.

Addressing climate change and its effects presents a twofold challenge: firstly, "mitigation", that is limiting further climate change by reducing the production of greenhouse gases and secondly "adaptation", which means preparing for the impacts of inevitable climate change.

It is essential that climate change be tackled in an integrated way. Choosing between mitigation and adaptation is comparable with choosing between mending a broken brake on a bicycle or buying a cycle helmet instead. Functioning brakes help to prevent accidents (mitigation), whereas the helmet is intended to avert disaster if an accident does occur (adaptation).

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.

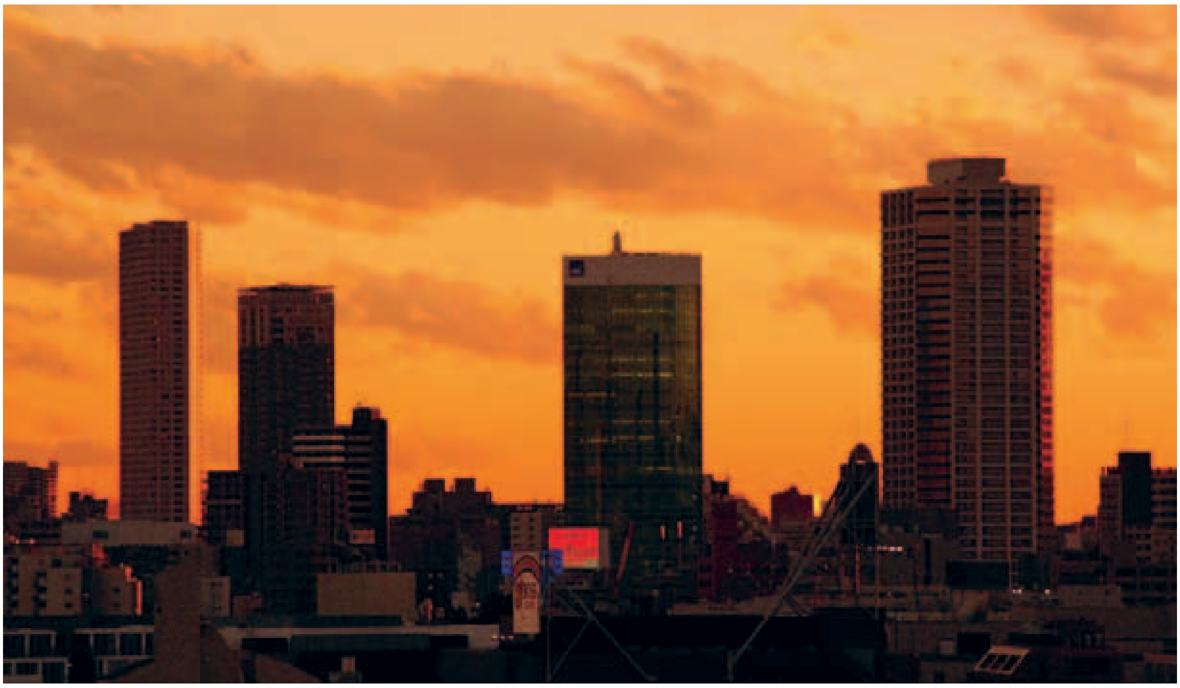


Photo: Head island (sxc.hu)

2. Is it all pure chance?

The average global temperature is rising. Current studies claim a 0.74 °C increase in global average temperatures over the last 100 years. Furthermore, eleven of the last twelve years rank among the twelve warmest years since 1850. The winter of 2006/2007 was the warmest winter in Europe since the start of weather data records in 1901.
For the future, experts foresee an increase in temperature of between 1.4 and 5.8 °C by the end of the century. The main causes are use of fossil fuels, industrial expansion and changes in land use.

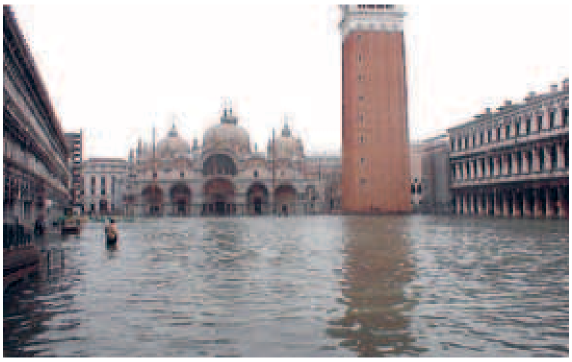


Photo: Flood in Venice (City of Venice)

Heat wave 2003

The heat wave in Europe in 2003 was during one of the hottest summers on record in Europe.
The heat wave led to health crises in several countries and combined with drought to create a crop shortfall in southern Europe. 35,000 people died as a result of the heat wave.

Photo: Dry river

Flooding 2002

In August of 2002 a once in a 100 year flood, caused by over a week of continuous heavy rains, caused severe damage across Europe. Dozens of people died, thousands were dispossessed, and it caused damage running to billions of euros in the Czech Republic, Austria, Germany and Poland. The floods started with heavy rainfall in the Eastern Alps which moved north-east to the Bohemian Forest and to the sources of the Elbe and neighbouring rivers, bringing disaster in their wake. Some villages in East Germany were almost completely destroyed by rivers that unexpectedly changed their course. Bridges were flooded or washed away, whole villages had to be evacuated, and energy and water supplies were cut off.
In Dresden and Prague large parts of the old town were under water and numerous historic buildings were damaged.

3. Climate Change is happening now

Climate change is a global issue, which is probably already affecting your local authority. The impacts of climate change are many and various. They include extreme events such as severe gales and hailstorms, flooding, heat waves and drought, all of which dramatically symbolise ongoing climate change. These extreme weather events often destroy infrastructure within a short space of time, lead to many injuries and deaths and disrupt the ecological balance.

Many European municipalities and regions are already being hit by natural disasters and this will continue in future. These extreme weather events affect buildings and infrastructure, cultural heritage, business, ecosystems and agriculture, and as a consequence lead to high economic losses and financial burdens.

There are also massive impacts in the form of long-lasting changes caused by a rise in temperature, such as retreating glaciers, longer growing seasons, shift of species ranges, and health impacts due to heat waves of unprecedented severity. The heat wave of 2003 caused damage totalling 17 billion euros. In France especially, it demonstrated the need for a health system that can quickly react to major emergencies and always has enough staff available. The previous year, 2002, a once in a 100 year flood caused severe damage across Europe. Thousands of people were dispossessed, dozens died and damage running to billions of Euro was caused.

4. Impacts of climate change in Europe

A. Flooding of rivers

Flooding of rivers has affected cities and regions for centuries. In the past, rivers had more space for runoff whenever there was prolonged and heavy rainfall.

However, recent advances in climate modelling suggest that global warming will intensify the hydrological cycle and increase the severity and frequency of precipitation in most parts of Europe, especially in the central and northern parts. The number of days with more than 20mm/day of rain will increase significantly. This is likely to contribute to an increase in flooding triggered by heavy rain, particularly flash floods.

Flooding may also increase during wetter and warmer winters, with increasingly frequent rainfall and less frequent snowfall.

An increase in extreme weather events is likely to become more widespread, meaning that regions relatively unaffected up until now will also experience problems.

There are some indications that the so-called Genoa Cyclogenesis (a weather event) which affects many regions could also increase. If that happens, the warm Mediterranean Sea in summertime will cause heavy rainfall north of the Alps, for example the floods of August 2002 in Upper Austria and Saxony.

Photo: Flood in Dresden 2003 (City of Dresden)

B. Flooding of coastal areas

Not surprisingly, cities near the coast always have to deal with changing sea levels. The variation depends on the
weather conditions. Storms have always been the main cause of high sea levels and flooding in coastal areas. In many cases different phenomena occur at the same time, for example storms and high tides that increase the problems. In some cases rivers can contribute too.
Coasts are projected to be at increasing risk, including the risk of coastal erosion, as a result of climate change and a rise in sea-levels. The effect will be exacerbated by increasing man-made pressures on coastal areas. Higher temperatures are expected to further raise sea levels by expansion of ocean water, melting mountain glaciers and ice caps, and causing parts of Greenland and the Antarctic ice sheets to melt.

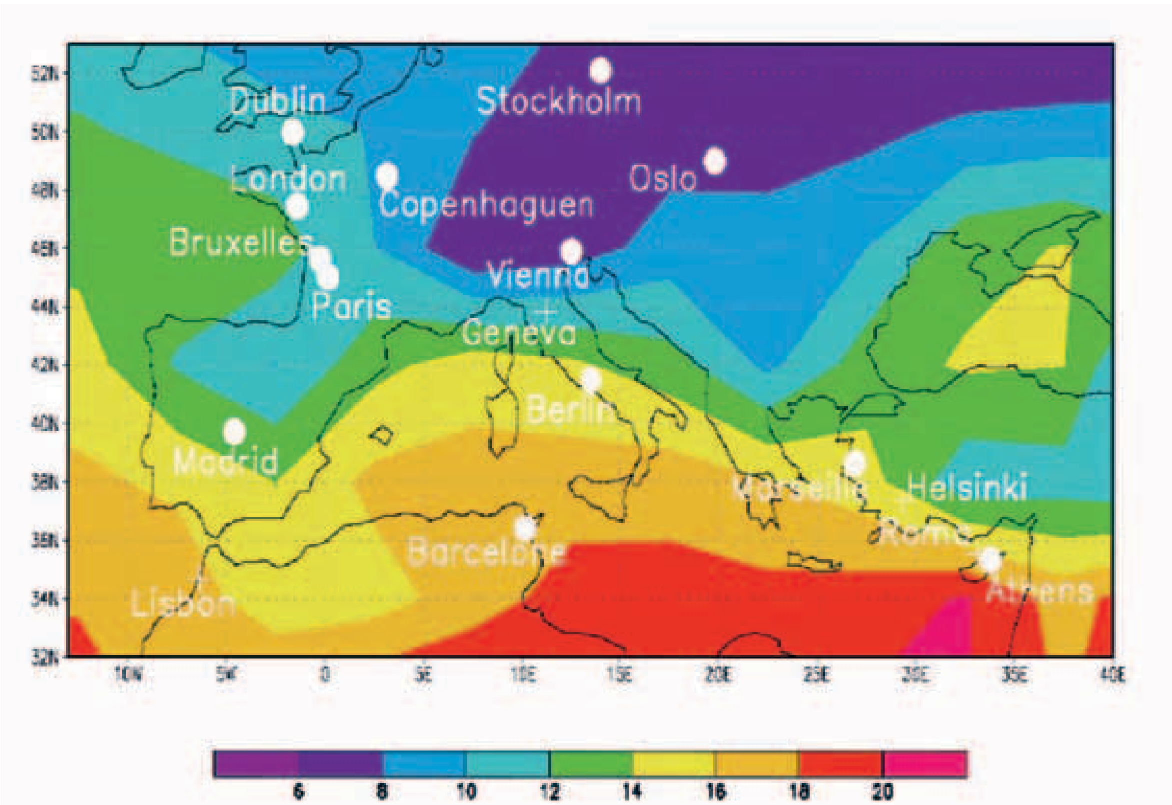
Rising sea levels in Europe have already had significant impacts, and these impacts are expected to accelerate as a result of the warming effect of climate change.

The rise in sea levels may vary greatly in the future, depending on success in mitigation of greenhouse gas emissions.
Current models calculate a rise of about half a metre this century if things continue as at present (IPCC 2007).
If the Greenland icecap melts over the long term, the consequence would be a rise of up to 7 meters, which would not give us sufficient time to adapt.

Photo: Coastel area (pixelio.de; Hans-Jürgen Steglich)

C. Overheating of urban areas

Climate change is increasingly exposing urban areas to the urban heat island effect. Overheating of urban areas can have serious repercussions for human beings, causing a rise in the number of excess deaths for particularly vulnerable groups of people and a reduction in the comfort of urban residents, affecting their productivity and the urban economy.
Architecture, buildings and building materials used in some regions are always an indicator of adaptation to certain climate conditions. Thick walls made of stone, architectural features that create shade and close proximity between buildings are typical of the Mediterranean regions, for example Venice or Ferrara. Climate change increases the likelihood of hot weather conditions in northern regions that are not well adapted, but new extreme weather events may also increasingly affect southern regions.
During the heat wave in the summer of 2003, almost 50,000 additional deaths were recorded in Europe.
The Lyon region was severely affected. During heat waves, increased use of air conditioners leads to an increase in energy requirements and further exacerbates climate change.
Experiences in Dresden and Lyon also demonstrated impacts on urban vegetation. Urban forest managers therefore need to address the problem of changes in ecological conditions in urban forest management.



Map: The Climate Relocation (Météo-France ARPEGE Model from Hallegatte et al. 2006)

D. Drought and flooding in rural areas

In rural areas natural disasters such as droughts and floods pose special problems for local and regional authorities because of the wide areas affected and the problems experienced by the agricultural and forestry sectors.

There is extensive historical data on droughts because of their effect on food production and the forest fires they cause. Droughts can destroy large areas of forest directly or through fires, and both droughts and floods destabilise food supplies as they can destroy a whole year's crops.
Their increasing effect on society today includes a lack of water for cooling processes (industry, power stations) or restrictions on shipping on rivers. The water balance also depends on the level of precipitation within a certain period.

Severe rainfall over a short period results in more runoff, thus decreasing the amount of water available in soils for agriculture.

Photo: Drought (sxc.hu)

Photo: Flood in agricultural area (pixelio.de)

Experts believe that agricultural production will be mainly affected by the severity and pace of climate change, and not so much by gradual climate change. Rapid climate change could harm agriculture, especially in those regions that are already suffering from poor soil and climate conditions, because there is no time for optimum natural selection and adaptation.

2003 demonstrated the high vulnerability of many regions in Europe. Agriculture based on grasslands is especially vulnerable, while horticulture can react more rapidly to dryer climate conditions by changing to more resistant plants.
During the spring of 2007 there was not enough water in the river Po for agriculture and power stations and decisions had to be taken over where to use the water.

5. Regional and local vulnerability

Every region is affected in a different way by climate change.
As already mentioned, there are differences in current and future impacts of extreme weather events, depending on geographical location and topography. The main problem is the effect of these impacts on society and vulnerable natural systems.
Adaptation has the potential to limit vulnerability.

Stakeholder discussions were held in the AMICA partner regions to give a comprehensive picture of the different situations in European regions now and in the future.
Tables showing current and future vulnerability with and without adaptation measures were created. The forecasts show that mountainous regions, especially the Alps, coastal zones, and the Mediterranean region, are particularly vulnerable to climate change.

"**Vulnerability** is the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.

Adaptive capacity is the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences."
(IPCC 2007)

	Basic informations				Actual climate (1961-1990), warming during 20th century, extreme weather events since 1945				Climate projections 2071-2100 per degree global warming for EU countries (PRUDENCE; http://prudence.dmi.dk/)
Region/ city/ country	**Area-region (km²)**	**Altitude range (m)**	**Inhabitants region (million)**	**Inhabitants city (million)**	**Mean annual temperature - city (C)**	**Mean annual precipitation - city (mm)**	**Temperature raise 20th century (C)**	**Extreme weather events since 1945**	**Trend weather extremes**
Schleswig-Holstein/ **Lübeck**/ Germany	15763 (Lübeck: 214)	0 – 168 (Lübeck: 0 – 37)	2,8	0,214	8,1	634	Ca. 0,85	Water: 1953, 1978, 2002 Temperature: 1959, 1963, 1995, 2003	Increase in intensity, frequency and duration of heat waves. Increase in heavy winter precipitation in central and northern Europe, decrease in the south. Heavy summer precipitation increases in north-eastern Europe and decrease in the south. Earlier and longer droughts in the Mediterranean. Intensive rain events - like those leading to the flooding in the Moldova, Danube, Elbe and Rhone in 2002 - will become more frequent and even more intensive. Extreme wind speeds increase between 45°N and 55°N, except over and south of the Alps, and become more north-westerly. These changes generate more North Sea storms, leading to increases in storm surge along the North Sea coast, especially in Holland, Germany and Denmark.
Saxony/ **Dresden**/ Germany	18.415 (Dresden: 328)	80 - 900	4,3	0,5	8,9	660	1,1	flooding 1954, 1958, 2002; drought 2003	
Region Stuttgard/ **Stuttgard**/ Germany	3.650	200-550	2,7	0,59	10,5	670	2	hailevent 1972; heat wave summer 2003	
Upper Austria/ Linz/ Austria	12.000	200-3.000	1,4	0,2	9,1	773	1,2	flooding 1954, 2002 heat wave summer 2003	

Figure: Extract of the AMICA Vulnerability Matrix

6. Integrated measures to mitigate climate change and to alleviate adverse impacts

Factors such as land-use patterns, coverage of urban trees and vegetation, integration of transport modes and systems, as well as the materials and heating systems used in building construction can be directly affected by decision makers. This is where integrated policies and programmes to mitigate climate change and to alleviate adverse impacts of climate change can be most effective. Hence, AMICA has identified three fields with synergies for adaptation and mitigation: These three aspects – urban planning, construction and decentralised energy production – are of their nature very local or regional. Therefore municipalities and regions should take a leading role in adaptation to climate change, and developing integrated mitigation and adaptation strategies. Examples of advanced 'beacon' local governments exist, but further awareness raising among local and regional decision makers is still needed.

Photo: Biomass district heating station (City of Altötting)

A. Energy

In the energy sector, mitigation benefits such as improving energy efficiency, enhancing CO_2-neutral energy consumption and O_2 fixation in vegetation can be merged with adaptation benefits such as risk prevention and energy supply security during extreme weather events, for example storms and droughts, comfort in buildings during heat waves and reduction of environmental damage in flooded areas (e.g. water pollution). For example, thermal power stations can only produce electricity if there is enough water for cooling the process. During heat waves and droughts, energy efficiency and electricity supplies will be reduced.
During the drought in the summer of 2006, power stations – producing both nuclear and fossil fuels – could not
deliver full energy supplies, especially in France, Germany, Spain and Italy.

Severe storms and flooding can also create problems for energy supplies as a result of interruptions to the electricity grid. A decentralized energy supply based on renewable energies is more adapted to climate extremes and black-outs than large centralised power plants. At the same time it contributes to mitigation to climate change. On a consumer level, using renewable energy sources for cooling and saving energy as well as the corresponding reduction in internal heat sources is a way to prevent low energy buildings from overheating (adaptation). In flood-risk areas, exchanging oil-fired heating for some form of biomass heating can help to reduce greenhouse gases and also to minimize damage caused when heating oil seeps into and contaminates floodwater.

For example, in Upper Austria more than two-thirds of homes are now heated with biomass fuel, heat pumps, and local and central district heating, after floods caused inundation of heating fuel tanks and contaminated the water.

B. Construction

In Europe, optimisation of the energy consumption of buildings offers the largest potential for long term CO_2-reduction strategies. Buildings are also important for adaptation measures against climate extremes such as floods, storms and overheating in summer. Risk prevention for buildings and cooling comfort during heatwaves are two areas in which synergy effects for climate change mitigation can be achieved.

For example, buildings with high standards of thermal insulation in walls and windows reduce energy demand during winter. Reduction rates of 80 to 90 percent in relation to current average heating demand of existing buildings are possible.
In addition energy-efficient buildings are more adapted to heat waves. CO_2 neutral energy solutions, for example using green roofs for photovoltaic installations or shading steep roofs with solar panels contributes to further cooling comfort during heat waves.

In order to prevent risks to buildings during flooding, wood from sustainable management can be used as flood-resistant material for constructions (adaptation), since wood is durable and will normally be structurally sound after severe water exposure during a flood. It can replace construction materials that require more fossil fuel input such as steel, plastic etc. (mitigation).


Photo: Thermal insulation with plants

C. Land Use Planning

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. However, understanding of both mitigation and
adaptation is essential: for example,
higher housing 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 help restrict the amount of land used for building 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, is likely to lead to a reduction in greenhouse gases and most probably contribute to adaptation.
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 heat waves. Innovative cooling systems contribute to limitation of emissions. Orientation and arrangement of buildings and built-over areas makes it possible to ensure that conventional air conditioning be replaced and solar cooling, district heating systems or geothermal energy be used for cooling comfort. Planting trees around buildings to shade urban surfaces, and green roofs to reduce their temperature, leads to substantial reductions in energy consumption for air-conditioning and the trees also absorb carbon while growing.

Trees to shade roads and parking lots reduce emissions of precursors of urban ozone. Biomass from urban trees and shrubs can be used as wood energy to replace fossil fuels, thus contributing to climate protection. On a regional level, more intensive afforestation and ecologically-adapted silviculture near river sources can help stabilize the local and regional water budget and can be combined with climate protection measures such as more intensive use of biomass fuels and the closing of regional economic cycles.

Photo: Green roof (Prof. Baumüller, City of Stuttgart)

7. Description of examples

Integration of mitigation and adaptation within passive houses

The passive house unites a high potential of energy saving with the advantages of adapting to upcoming temperature extremes. It is a building that maintains a comfortable interior climate without active heating or cooling systems. Its need for heating energy is only 10% of a conventional building.
This high potential for energy saving is the result of mainly two factors: the insulation, featuring 3-pane-glazing, that prevents loss of warmth in winter, and the use of renewable heat sources such as solar heat and body heat. In summer, the passive house is cool enough because of its standard cooling system that provides fresh air without draughts.

Schools and kindergartens are especially suited to the passive house standard because heat emission from the children's bodies already provides a substantial proportion of the heating requirements, so that 25 pupils can keep a class room warm enough even if the external temperature is -12°C.
Even in apartment blocks, the temperature on the top floor never exceeds 26°C in summer, when there is an outside temperature of 35°C.

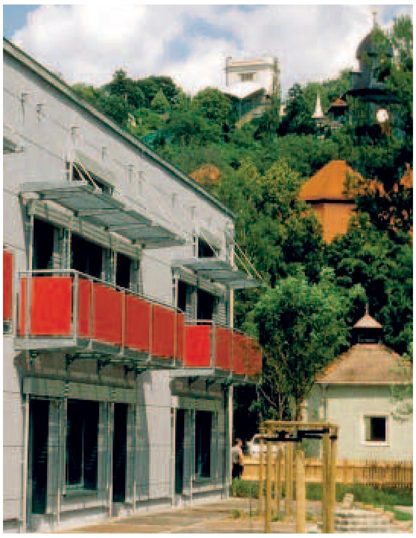


Photo: Passive house (City of Dresden)

Integration of mitigation and adaptation by the construction of ecological skyscrapers

The second highest building in Europe, the Commerzbank Tower in Frankfurt am Main, has been designed as an ecological skyscraper. Whilst the use of ‚sky-gardens' reduces the need for artificial light, even more important is the fact that environmental-friendly technologies were employed to reduce the amount of energy required for heating and cooling.

Photo: Commerzbank Tower (www.pixelio.de)

The façade of the tower consists of two layers, of which the outer layer can be opened. Whilst the external sheet of glass keeps rain and wind away from the openable windows, a system of chilled ceilings stabilizes the temperature. Every employee can open the windows him or herself to let fresh air flow into the office. The tower can therefore be ventilated naturally for about 9 out of 12 months, which reduces the need for air-conditioning to a minimum. Additionally, the used cooling water from the air conditioning system is reused for flushing the toilets.

8. Example of an energy saving measure

Cooling with district heat

District heating systems produce more than enough thermal energy during the summer, if the energy source is cogeneration of heat and power.
This waste heat can be used for cooling of private and public buildings. Possible overheating in buildings can be prevented in this way. This adaptive factor brings great advantages in mitigation, because the technique of cooling with district heat is energy efficient and leads to a reduction in CO_2 emissions.

Dresden is one of the pilot cities for this system: since 1993 more than 20 technical installations have been built here – mostly in prestigious buildings like the Saxon parliament – with a cooling power of about 13 MW.

For the future, it is planned to connect these smaller installations to a complete cooling network in the inner city, so that this cost-efficient technique along with its advantages for adaptation and mitigation will be spread even further.

Photo: Cooling network in Dresden (City of Dresden)

AMICA partners:

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KLIMA-BÜNDNIS
ALIANZA DEL CLIMA e.V.

STUTTGART

Landeshauptstadt
Dresden

KLIMABÜNDNIS
ÖSTERREICH

OÖ. AKADEMIE FÜR UMWELT UND NATUR

GRANDLYON

ALE
Agence Locale de l'Energie
de l'Agglomération Lyonnaise

Agence d'urbanisme
pour le développement
de l'agglomération
lyonnaise

ALLEANZA PER IL CLIMA
ITALIA ONLUS

Provinzia de Ferrara

CITTA' DI
VENEZIA

VERENIGING
KLIMAATVERBOND
NEDERLAND



Amica is a completely new approach to environmental policy designed to combine long-term climate protection with short- and midterm adaptation measures on the local level as a means to improve coherence of decisions and allocation of financial means.

The world's climate system has such long response times that experts now agree that, to some extent, climate change can no longer be halted completely. The impacts of climate change are already being felt around the world. In Europe, recent experiences with climatic extremes are a clear signal of the severe impacts of climate change, making it only too apparent that there is a substantial need for mitigation and adaptation measures.

AMICA is an integrated climate policy approach which combines the measures necessary to protect the environment by working to halt further climate change while promoting adaptation to the changes already occurring.