PACINAS

Public Adaptation to Climate Change

klima+ energie fonds

WP2 - Adaptation need, costs and benefits

Policy case study "public adaptation at the municipal level"

Wolfgang Loibl[1]
Markus Leitner[2]
Romana Stollnberger[1]
Hans-Martin Neumann[1]

[1] AIT - Austrian Institute of Technology, Wien, Austria
[2] Environment Agency Austria (Umweltbundesamt, Wien)

PACINAS Working Paper #02

June 2017

http://anpassung.ccca.at/pacinas

Wegener Center | UNI GRAZ | IIASA | AIT AUSTRIAN INSTITUTE OF TECHNOLOGY TOMORROW TODAY | umweltbundesamt ENVIRONMENT AGENCY AUSTRIA

ADAPTATION NEED, COSTS AND BENEFITS – POLICY CASE STUDY "PUBLIC ADAPTATION AT THE MUNICIPAL LEVEL"

Wolfgang Loibl[1], Markus Leitner[2], Romana Stollnberger[1] & Hans-Martin Neumann[1]

[1] *AIT - Austrian Institute of Technology, Wien, Austria*

[2] *Environment Agency Austria (Umweltbundesamt, Wien)*

May 2017

Abstract

The goal of this PACINAS report is to review public adaptation measures and the associated costs at the municipal level by means of a case study. In the municipality case study, conducted by AIT and Environment Agency Austria (Umweltbundesamt), a sample of four Austrian cities was considered. Regarding short-term risks, municipal budget data from 2001 to 2014 was assessed to identify adaptation relevant costs. Here the main cost categories were costs of damage repair and adaptation after extreme events. While the focus of the budget analysis lied on short-term risks, long-term risks were addressed by a series of interviews with officers of the relevant municipal departments (finance department; and departments responsible for flood protection, building and road maintenance, urban green maintenance etc.).

Content

1. Introduction

1.1 Positioning of the case study in the project

Figure 1 shows the positioning of this case study in the overall PACINAS project.

WP1 served as an overarching work package by developing the overall methodological framework of the project and by ensuring exchange between all project partners and the international experts. WP2 contributed with policy case studies on adaptation both on the federal and provincial as well as on the municipal level (cities of various sizes). In WP3, the information gathered in WP2 was assessed regarding adaptation costs for the federal level of Austria. In WP4 the indirect costs of adaptation (i.e. spill over costs to other sectors, effects on unemployment, growth etc.) were assessed at the national scale via macro-economic analysis. WP5 provided stakeholder involvement as well as outreach and dissemination throughout the PACINAS project.

In WP2 task B) a case study on public adaptation at the municipal level (cities) was carried out. In this municipality case study conducted by AIT and Environment Agency Austria (Umweltbundesamt), a sample of four Austrian cities covering the size range of several 300.000 down to 10.000 inhabitants and a range of physical characteristics (regarding terrain, land use and climate) typical for Austria have been considered.

The case study is addressing short- and long-term risks and we concentrate on short-term risks. The numbers for adaptation related costs are based on investigations of municipal budget data from 2003 to 2014 and a series of interviews with city stakeholders.

The sample of cities shall allow gaining quantitative and qualitative information about the entire range of adaptation measures and related costs through municipality budget investigation and interviews with the cities' finance officers. In particular, the intention was to select two small to medium sized cities serving as district centres and two large(r) cities serving as provincial capitals.

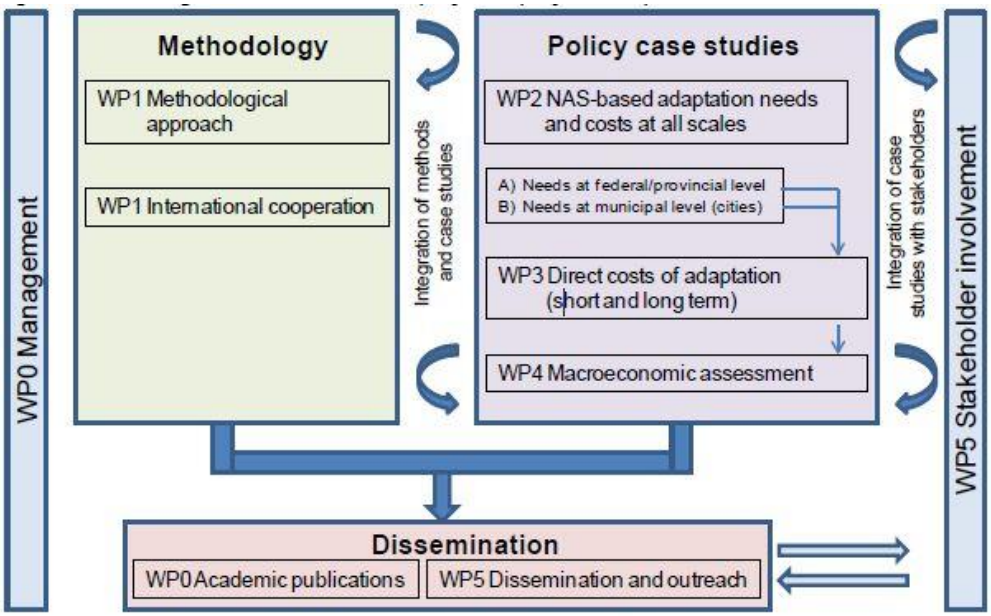


Figure 1: PACINAS project – project components and their interaction. Source: PACINAS Project Partners (2014)

Several municipalities were asked to cooperate in budget exploration, but not all municipalities were willing to cooperate. The reasons against refer to policy issues mentioning local elections as well as data provision obstacles due to necessary efforts for data retrieval and the decline to be involved in qualitative interviews.

The cities of Linz, Graz, Baden and Judenburg were selected as case study cities. These four cities do cover the size range down to 10.000 inhabitants and different physical characteristics (regarding terrain, land use and climate) typical for Austria. This was also a relevant criterion to gain quantitative and qualitative information about the entire range of adaptation measures and related costs through municipal budget investigation and interviews with the cities' stakeholders, regarding experiences with climate impacts, adaptation measures and requirements for future support. Support from the Austrian Association of Cities and Towns (Österreichischen Städtebund) was provided to the project team throughout the case study. Interim results of the city case study were presented at the Conference of the Committee of Environment Officers from the Austrian Association of Cities (Konferenz der Umweltbeauftragten des Österreichischen Städtebundes) in March 2016 in Klagenfurt. The discussion with environmental officers of other Austrian cities and municipalities allowed for a better understanding on how transferable the obtained case study results are for other Austrian municipalities.

1.2 Adaptation on climate change

Adaptation is a term, which needs a clear definition. Adaptation of ecological, physical, social or economic systems, activities – measures and processes aims at reducing potential consequences and impact of current climate variability (the adaptation deficit) and the future climate change (anticipatory (proactive) adaptation). It also aims to seizing any of the opportunities and advantages to exploit targets for adaptation are the modification of exposure, sensitivity and vulnerability of (environmental, social or economic) system.

Adaptation

Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation (IPCC, 2007).

In social systems, adaptation seeks to reduce or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.

- Incremental adaptation: Adaptation actions where the central aim is to maintain the essence and integrity of a system or process at a given scale.
- Transformational adaptation: Adaptation that changes the fundamental attributes of a system in response to climate and its effects.

A pragmatic approach to "early adaptation" in Austria is to focus on the "adaptation deficit", covering today's climate risks, which are triggered by existing climate variability and extremes. Any activity that addresses these risks is understood as "adaptation relevant" and the related financial expenses are called "adaptation relevant expenditures".

Although this definition of adaptation relevant expenditures may seem clear at first sight, there are often distinction problems in practice, especially at the municipal level. A number of (already implemented) measures are, even without the ability to reduce climate change induced impacts, meaningful and necessary. Some climate protection / climate change mitigation measures in the field of energy consumption and housing (increasing energy efficiency, thermal insulation, etc.) are directly related to climate adaptation or have a co-benefit. Some repair measures are combined with improvement steps turning out as incremental adaptation, which brings stepwise benefit. Thus, city representatives do not always clearly distinguish between adaptation activities and damage repair activities.

These adaptation co-benefit effects for mitigation are reasons why – in the media and public – adaptation is frequently confused with mitigation, although the differences are clear: while adaptation shall protect natural and social systems against climate-induced damage, mitigation refers to activities, which shall protect the climate system by reducing greenhouse gas emissions.

Table 1 provides an overview of public representatives involved in Disaster Risk Management. While the costs are largely covered by federal funding, 25 to 30 % of repair, protection and adaptation measures have to be paid by municipalities.

These public expenses from municipalities are covered additionally by federal funding, since a large share of taxes are collected by the federal state (Ministry of Finance) and redistributed to the municipalities via the fiscal transfer (Finanzausgleich). Municipalities receive direct revenues only via a few and little local taxes: property tax, employer tax, and infrastructure provision tax. Property tax ("Grundsteuer") is paid by property owners and can be passed on to the tenants. The property tax rate is 0.5 to 2 ‰ of the property tax value which is far below the market value of the property. Employer tax is 3% of the salary total ("Kommunalertragssteuer") to be paid by the local employers. The infrastructure provision tax is calculated based on the building and property size and covers a share of the local infrastructure provision and maintenance costs (e.g. for road network maintenance, street lighting, power-, gas-, water- and sewage-network provision, waste collection and treatment, waste water treatment etc.).

Table 1: Governance levels involved in the Austrian Disaster Risk Management practice

Public agency	Superordinate governance level	Description
Austrian Service for Torrent and Avalanche Control (i "Wildbach und Lawinenverbauung" (WLV))	Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW)	The WLV analyses and assesses hazards and risks, plans and conducts preventive and protective measures in Austrian Alpine regions. It is thereby focusing on different Alpine hazards such as floods, landslides, avalanches and rock fall.
Federal Water Engineering Administration" ("Bundeswasserbauverwaltung" (BWV))	Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW)	The implementation of the different actions according to "Wasserbautenförderungsgesetz 1985" is a domain of Austrian provinces. BWV is responsible for flood protection in Austrian river valleys, except torrents (where WLV is responsible), and the Danube (where viadonau is responsible). The BWV is fostering *active flood control*.
viadonau – Austrian waterway Ltd. („Österreichische Wasserstraßen-Gesellschaft mbH")	Federal Ministry for Transport, Innovation and Technology (bmvit)	viadonau is responsible for maintaining the Danube waterway as transport infrastructure. With respect to flood risk, viadonau constructs and operates flood control dykes and facilities to protect the residents of the areas concerned.
Federal Crisis and Catastrophe Protection Management ("Staatliches Krisen- und Katastrophenschutzmanagement" (SKKM))	Federal Ministry of the Interior (BMI)	The SKKM is handling the national disaster protection management, national crisis management and international disaster relief. The Federal Ministry of the Interior is responsible for managing catastrophes and crises.
Municipalities	Province	Municipalities are implementing repair as well as adaptation measures as far as they are not covered by national duties. These measures refer to infrastructure owned by municipalities or for infrastructure for which they are indirectly responsible for ("mittelbare" Bundes- or Landesverwaltung"). There is close cooperation with WLV as well as the BWV.

2. Methodology: Case study on public adaptation at the municipal level (cities)

In the municipal case study, a sample of four Austrian cities covering a range of city sizes and physical characteristics (regarding terrain, land use and climate) typical for Austria were considered. Based on the criteria, a well-defined set of cities was selected, allowing gaining quantitative and qualitative information about the entire range of adaptation measures and related costs through municipality budget investigation and interviews with the cities' finance officers.

Four cities were selected based on the following criteria:

- Population range from 10.000 to around 300.000
- Different physical and socioeconomic characteristics and climate exposure

Theoretical Assumptions:

To investigate climate change efforts and adaptation expenditures of municipalities, we concentrate on those frequent climate-related impacts affecting urban areas, which are expected to worsen in the future like exposure to extreme heat waves and heavy precipitation events and their related impacts.

Larger cities in Austria (> 50.000 residents) may care to some extent about heat island effects and thus about impact of future temperature increase, with negative effects not only on health and work efficiency but also on economic development: city tourism / festival tourism. Flooding is in those larger cities an issue, but to a smaller extent since past (adaptation) measures have already conducted to avoid or reduce frequent damages.

Smaller cities in Austria (10.000 – 50.000) are less affected by extreme heat exposure, because of smaller building volume and a smaller amount of paved surfaces, responsible for heat storage, and because of a larger share of green open space in the cities and in its surroundings. Heavy precipitation related effects – flooding, landslides – are partly a more relevant issue.

70% of Austria's population lives in cities, and the influx continues. Cities and urban areas are predominantly affected by climate change due to their large number of inhabitants, dense populations and the concentrations of assets and critical infrastructure. Graz, Linz, Baden and Judenburg were investigated as case studies for an initial assessment of adaptation expenditures in cities.

Table 2: Characterisation of Large Cities

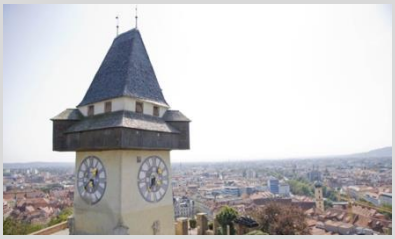
	Graz	**Linz**
	 © Stadt Graz/Fischer	 © Planung, Technik und Umwelt – Pertlwieser
Inhabitants	270 000	200 000
Province	Styria	Upper Austria
Physical characteristics	located in the Mur Basin, surrounded by hilly, forested terrain, arable land	located in the large Danube Basin, rather flat, only few hills inside the administration borders, peri-urban land use – commercial and industrial areas, transportation network arable land, forests
Climate	South-east Austrian "illyric" climate • Hot humid summers, certain precipitation peaks , air pollution due to little ventilation within basin • Heavy precipitation events occur: flooding more from remote events along Mur and confluences	Moderate continental climate • Hot dry summers, rather mild winters • Average precipitation regime – flooding from remote events along Danube and confluences
Economy	city and province administration services, schools, universities, retail, cultural infrastructure, technic-oriented /metal industry, car production	city and province administration services, schools, universities, hospitals, cultural infrastructure, retail, heavy industry
Tourism	day visits focusing on museums, theatre, avant-garde culture event in autumn, younger, more local audience, few overnight stays, growing importance	day visits focusing on museums, theatre, culture event in summer, few overnight stays, growing importance

Table 3: Characterisation of Smaller Cities

	Baden  © GG Tourismus/Ovidiu Dehelean	**Judenburg**  © Stadtamt Judenburg
Inhabitants	25 000	10 000
Province	Lower Austria	Styria
Physical characteristics	located in the Vienna Basin 25 km south of Vienna, rather flat settlement area, adjacent to the southern "Vienna Forest" slopes reaching elevations of a few 100 m, peri-urban land use – commercial and industrial areas, transportation network, little arable land, forests in the western hilly area	city centre located in the Mur valley, 20-30 meters above the valley floor, but further exposed by additional inflows and alpine creeks along the forested mountain slopes affecting further distributed small settlements located in the neighbouring hills and mountains of the "Seetaler Alpen" reaching elevations up to 3000m.
Climate	Continental climate • Hot very dry summers, mild winters • Average precipitation occurs – occasional flooding due to regional precipitation events	Moderate alpine climate • warm to hot summers, cold winters • Heavy precipitation during winter and spring – occasional flooding of the Mur and tributaries within small areas of the municipality due to regional precipitation events, torrent flooding and mud flows in limited areas along the forested slopes adjacent to the Judenburg settlement area affecting roads and the wastewater discharge network
Economy	services – city and district administration services, schools, hospital, and medical services, cultural infrastructure, retail centre, little industrial production, population commutes frequently to Vienna for work	city and district administration services, schools, dairy farming, forestry, important industrial production – iron and steel, engineering industry, hospital
Tourism	tourism is important business, well known thermal spa resort, many guests receiving health treatment, many hotels and additional day tourism from Vienna visiting spa, parks, forests, old city centre some points of interest (e.g. summer apartment of Ludwig van Beethoven)	Of growing importance, oldest city centre in the area, day visits to planetarium and museums and in connection with visits to Red Bull Ring, cycling and hiking tourism, cultural events

Budget Analysis:

Regarding **short-term risk management** to cope with impacts of recent events a budget analysis has been conducted.:

The communal budget is divided into budget groups, indicated through a system of unique codes. Each municipality must relate their expenditures to the some budget groups and subgroups indicated through the unique codes, to allow a comparison of expenditures (unfortunately the grouping of expenditures is not fully identical, thus some uncertainties must be accepted).

Communal budgets are further separated into *ordinary budget* and *extraordinary budget:*

- *ordinary budget* covers all regular annual expenditures,
- *extraordinary budget* covers singular (unexpected or planned), usually expensive activities which are financed by credit.

The budget analysis consisted of the following steps:

- Budgets from publicly accessible data (ordinary + extraordinary budget) for the cities of Graz, Linz, Baden, Judenburg as far as data available were analysed. (Salzburg data were investigated in a first step, but have not been considered in the final analysis).
- Budget review obtaining data from (ordinary + extraordinary budget covering singular activities) for the smaller cities of Baden and Judenburg, where no data are available to the public via Web-access.
- Analysis of budget-critical activities with respect to recent events and related catastrophe management as well as pro-active adaptation measures in different sectors like infrastructure/transport, green infrastructure, water-management and protective infrastructure, emergency services and rescue were performed.
- Interviews with responsible persons of the case study cities like heads/experts of departments and staff for municipal building management, road network and technical infrastructure, river management, green spaces maintenance, spatial planning, catastrophe and risk management, finance and budget management, climate and energy depending on sectoral responsibilities) were carried out in all four cities Linz, Graz and Baden and Judenburg.
- Further meetings reflecting and discussing the results took place with environmental commissioners of various Austrian municipalities during an environmental congress carried out by the Austrian Association of Cities in March 2016 in Klagenfurt.

Regarding **medium to long-term risk management** which comprise expenditures to reduce future impacts the following activities were conducted:

- Interviews with the persons responsible for the cities‘ budgets on future risk management. These questions were usually delegated to the same persons of the case study cities Linz, Graz, Baden and Judenburg. The arguments to select those persons were the following: long time experience with sectoral budgeting and are thus able to discuss future implications of climate change induced impacts on costs.
- Test survey of politicians experience and expectations with respect to climate change, adaptation needs and adaptation costs.
- Synthesis of current and expected future practice and identification of stakeholder needs regarding options and costs of public adaptation.

3. Results

3.1. Budget analysis

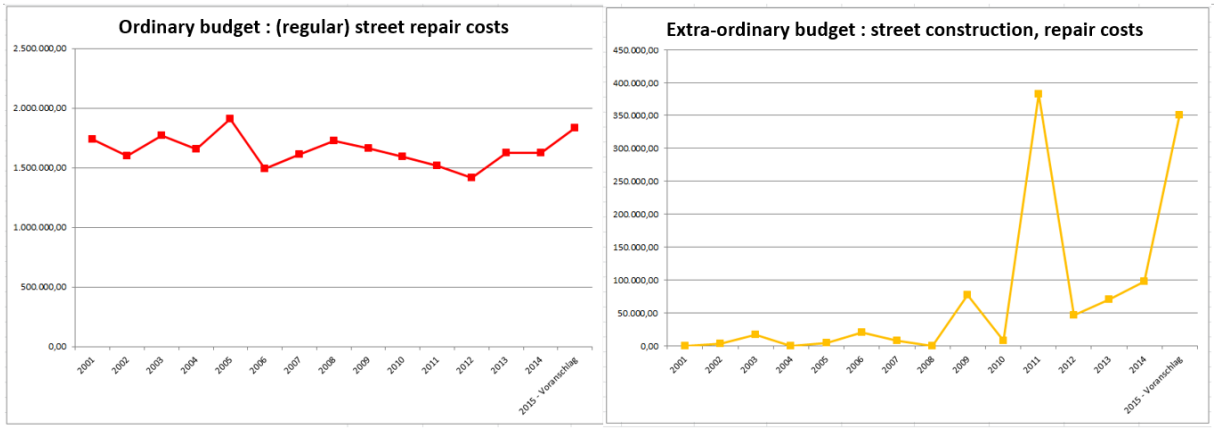
As a first step, an analysis of selected budgetary areas of relevance for adaptation related expenditures, including damage repair following extreme events, was carried out for the four selected cities for the period 2001-2015. Publicly accessible budgetary data (www.offenerhaushalt.at) was used for Graz, Linz and Baden, and the budgetary data for all cities were collected directly on site. Based on the clearance of accounts (Rechnungsabschluss), the expenditures on damage repair were identified for time periods after extreme weather events. As far as possible, expenditures for reactive adaptation (in response to events) and anticipatory adaptation (proactive adaptation that takes place before the impacts of climate change are observed) were also collected. More precisely, the ordinary and extraordinary budgets were considered to cover both the regular current expenditures and the individually planned and unforeseen, large and credit-financed expenditures.

3.1.1 Baden

In Baden, small flood events occurred in 1997, 2002, and 2006. Additional climate impacts are triggered by heavy rainfall, which occasionally causes backwater in sewer networks. Heat is not considered a climate-risk, but is considered as an issue of thermal comfort.

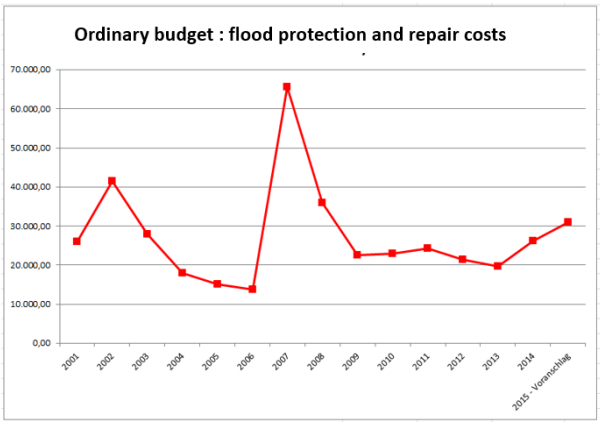
Costs for road maintenance

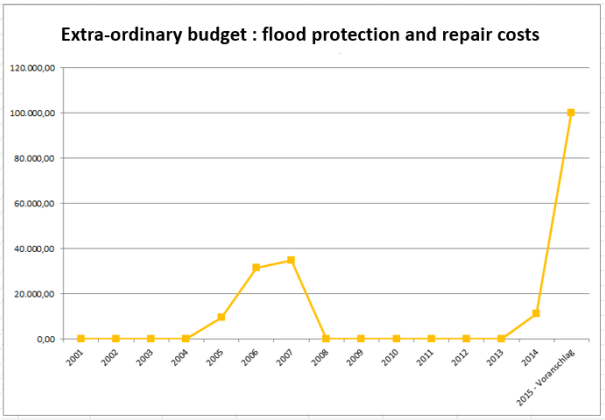
By comparing the years of flooding events to the expenditure patterns for the ordinary and ordinary budget, no significant relation between road repair and climate effects can be identified –while expenditures are highest for 2011 and 2015, flooding events occurred in 1997, 2002, and 2006.



Costs for flood damage repair, risk mitigation and adaptation

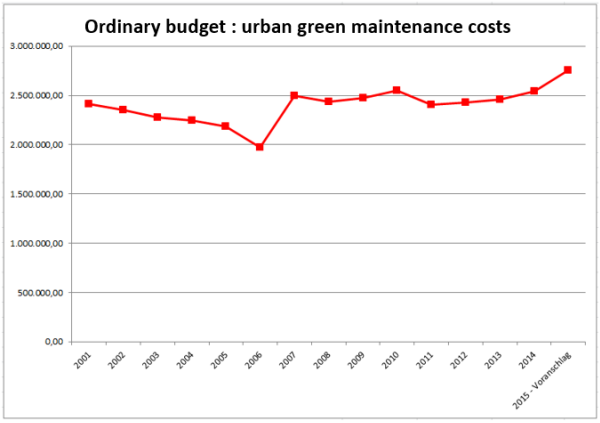
Higher expenditures on flood protection measures could be observed in Baden for 2 significant years – in 2002 and 2006 flood events occurred, where damage repair (and some adaptation measures) show high expenditures in the following years (2007 and 2008) covered by ordinary and extraordinary budgets. Further adaptation measures (renaturation of the river Mühlbach) reported for 2013 and 2014 have led to increased expenditures in the ordinary budget in 2014.

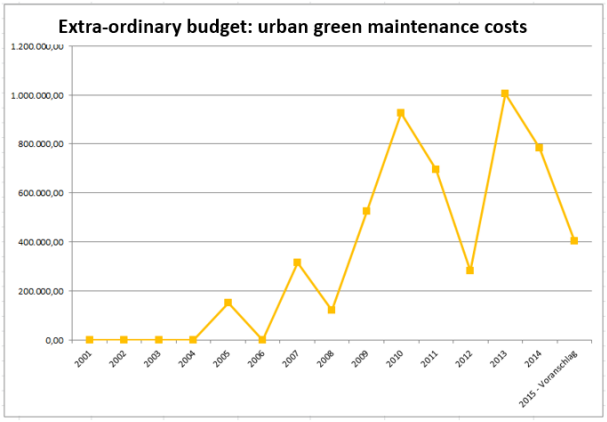




Costs for urban green maintenance

As for road maintenance, expenditures on the maintenance of parks and other urban green show no distinct relation with climate related events. The annual costs in the ordinary budget are steadily around 2.5 Million euro. The extraordinary expenditures show more fluctuations, but these costs are related to certain park improvement activities and not caused by climate related events.



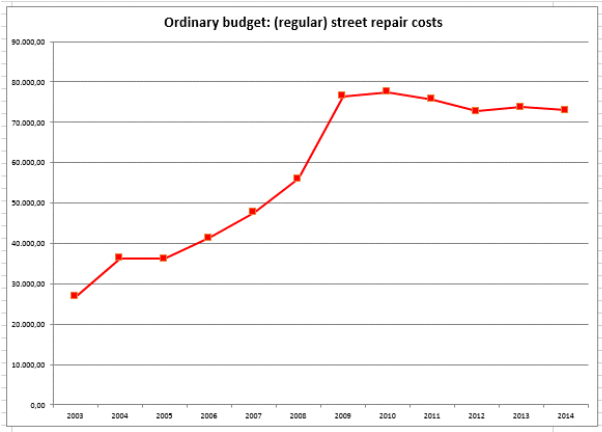


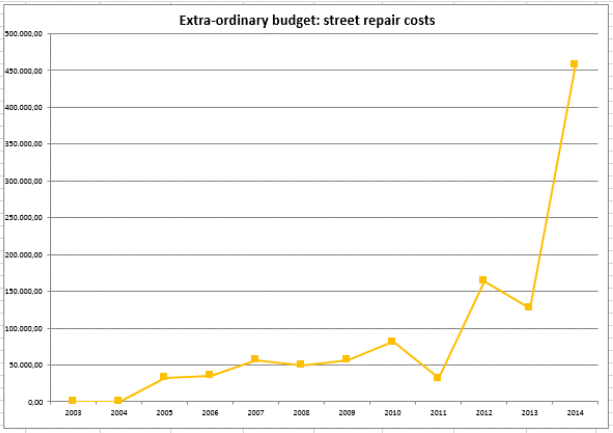
3.1.2 Judenburg

In Judenburg, local flood events were caused by torrents in 2005 and 2006. After heavy rainfall, local flood events occurred due to suddenly snow melting in 2012 and 201. In addition, storms caused forest damage in 2002, 2003, 2007 and 2008 (severe). Judenburg is also affected by, backwater in sewer networks, Heat is an issue of thermal comfort.

Costs for road maintenance

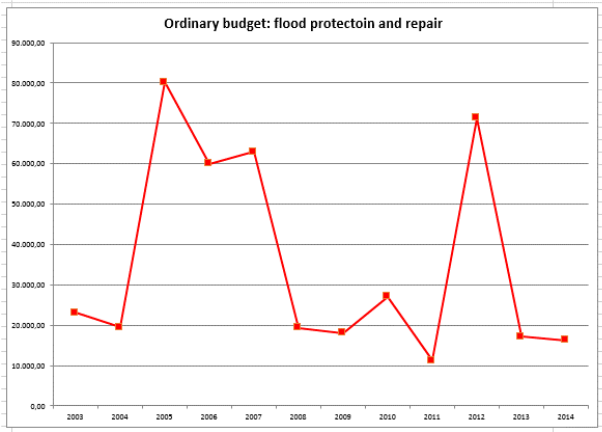
Similar as for Baden, no distinct climate related costs for road maintenance were identified. This can be explained by the fact that the main settlement area and road network is located 20-30 m above the river Mur valley floor, which is exposed to Mur-flooding only to a little extent. Peaks in extraordinary expenditures refer to individual road improvement activities, but not to climate related costs.

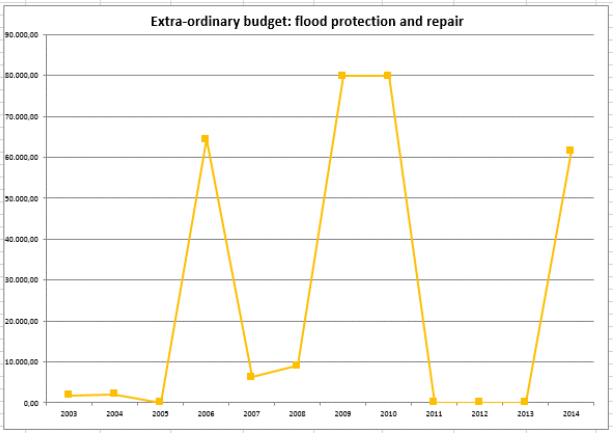




Costs for flood and land slide protection

Similar as for Baden, distinct climate related costs occur, in the form of damage repair as well as adaptation to protect against local creeks, which might release local torrents. The peaks 2005 and 2006 as well as 2014 are well documented and can be related to the local flood events.





Costs for urban green maintenance

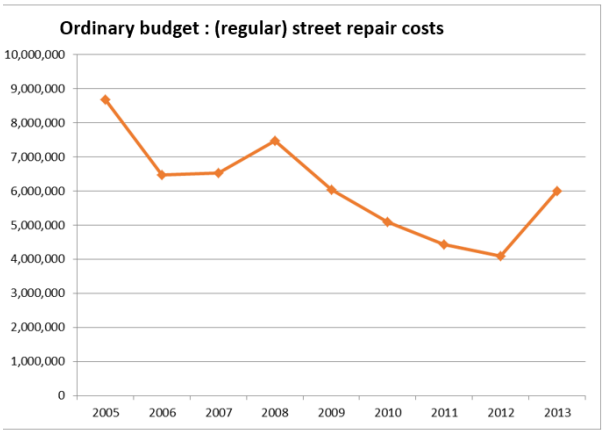
There are no significant costs for green maintenance to be related to climate change effects.

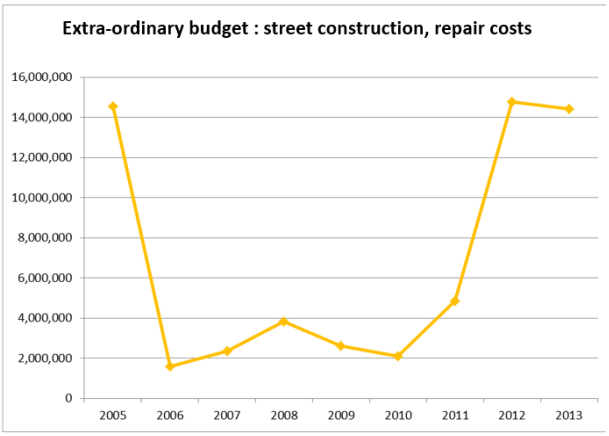
3.1.3 Linz

Climate induced extreme events in Linz occurred in the form of road damage due to heavy winter in 2005/06 and Danube flooding in 2002 and 2013 with severe damages to roads and buildings. Again, heat is an issue of thermal comfort.

Costs for road maintenance

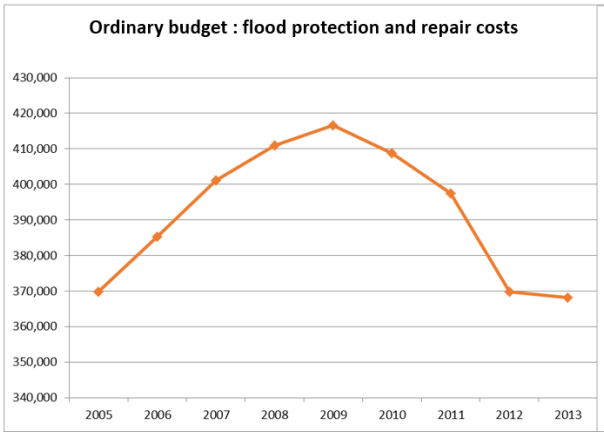
Here distinct climate related costs for road maintenance are identified due to flood events in the years 2005 as well as in 2014.

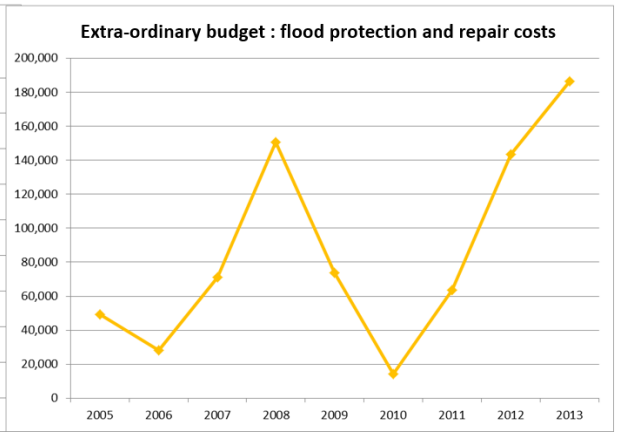




Costs for flood protection

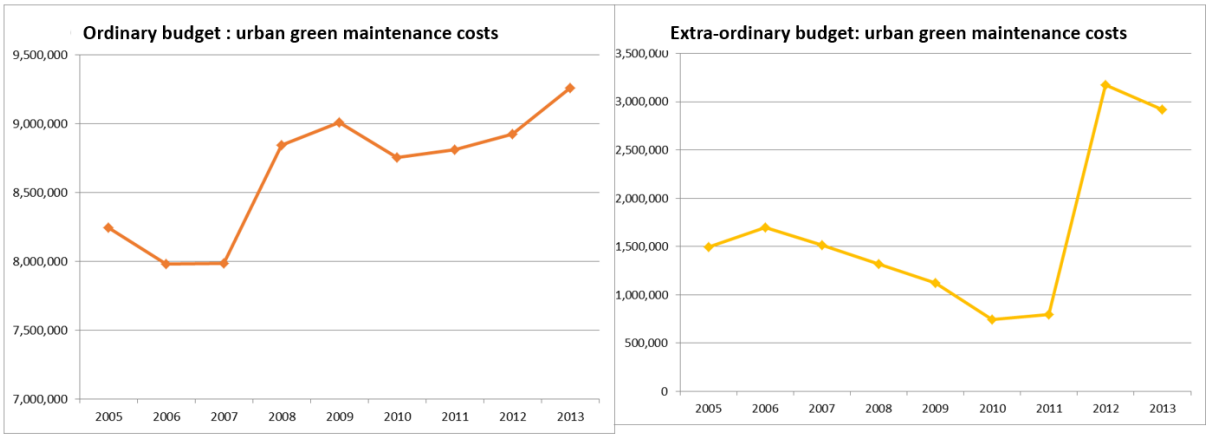
Here distinct costs can be identified for 2008 and 2009 as well as for 2013, where the latter year can be addressed as climate adaptation related costs.





Costs for urban green maintenance

Here the costs show a constant increase with no distinct relation to climate change induced costs. The large costing peak in the extraordinary budget is not related to climate-induced reaction.

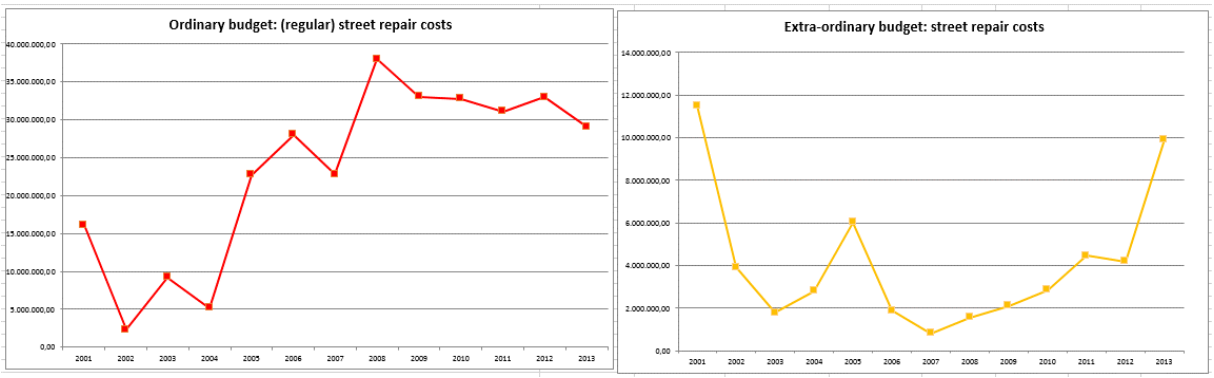


3.1.4 Graz

The key climate induced extreme events in Graz were caused by flood events in 2003 2005, and 2013, which caused road damage and damage to private buildings. Also for Graz, heat is an issue of thermal comfort.

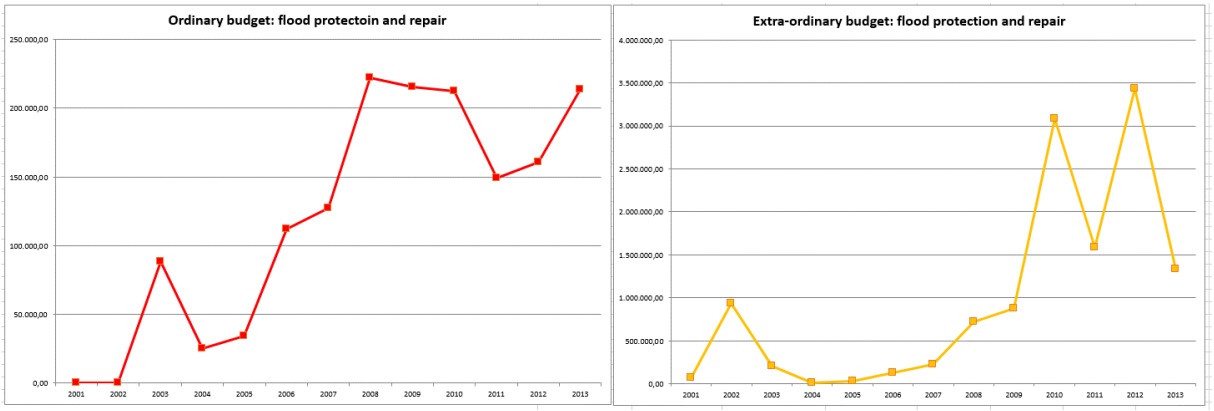
Costs for road construction and maintenance

For expenditures on road construction and maintenance, distinct climate related costs can be identified for the flooding year 2005 and the subsequent years assumed to be damage repair payed during 2005-2012, and in 2012 (extraordinary budget).



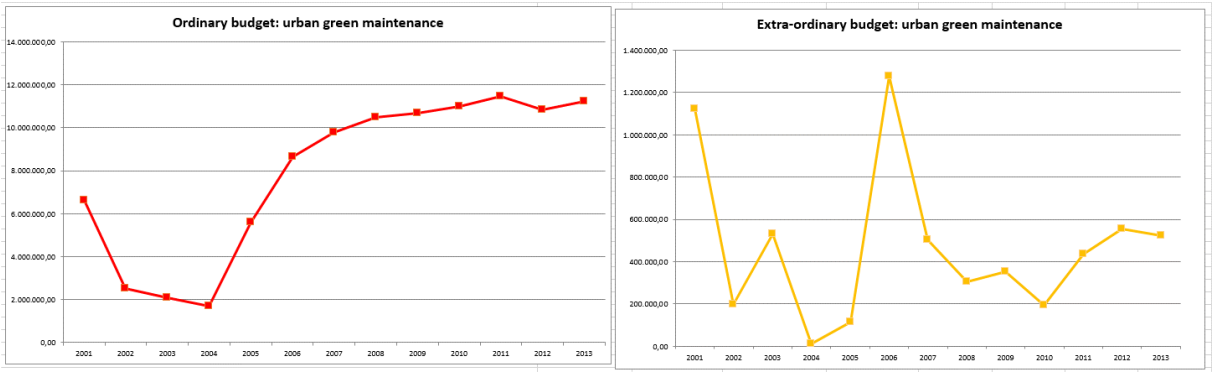
Costs for flood protection

Here the annual costs show again a steady increase with a peak in 2008-2010 related to damage repair costs. Distinct costs for adaptation can be identified in the extraordinary budget 2010 and 2012.



Costs for urban green maintenance

Here the annual costs show a steady increase which can be related to growing heat exposure. The large costing peak in the extraordinary budget in 2006 is not related to climate-induced reaction.



3.1.5 Costs – case study summary

In the annual accounts of Linz for "regular" years (without extreme events), the costs of road construction and repair measures were about 25 - 30 M euro or 4 – 6 % of the city budget. In years with or after extreme events (heavy rainfall, floods) these costs were significantly higher, reaching up to 60 M euro or 8 % of the city budget of the respective year. The expenditures for flood protection construction show a peak in the years with or after extreme events. In Linz, the annual expenditures on flood protection construction are usually less than 1 million euro or < 0.1 % of the city budget, while in peak years expenditures have reached 3 to 5 M euro or 0.1 to 0.8 % of city budget.

In Graz, the influence of extremes during the observation period was less serious. No pronounced peaks of expenditure in road construction and repair were observed, and while there was a continuous increase in expenditure over time, this cannot be tied to specific events. In the case of flood protection construction, expenditures in regular years were between 0.5 and 1 M euro or < 0.1 % of the city budget. During the peak years, expenditures of up to 3 M euro or 0.4 % of the city budget was observed. In smaller communities, the situation varies according to topography and climate.

In Baden, which is less affected by flooding, expenditure was around 25,000 euro or 0.02 % of municipal budget on flood protection construction during regular years: rising to 0.1 to 0.25 M euro (a 4 to 10 – fold increase) after years of heavy rainfall or flood events. While the proportion of the total budget is often low, the costs of unexpected damage repair are important, as they are a large proportion of the freely available funds of the total budget.

3.2. Expert interviews with city officers

Interviews were conducted in all four cities with various representatives/experts from public administration, which are responsible for the following topics (dealing with damage repair and climate change adaptation):

- environment, climate and energy
- municipal building management
- road infrastructure
- water wastewater management
- green areas maintenance
- spatial planning
- disaster and risk management
- financial and budget management

Interviews were carried out, addressing short-term risk management and long-term "future" risk management. The experts of the departments in the case study cities Linz, Graz, Baden and Judenburg answered these questions.

Arguments, why the experts were chosen refer to the following:

- Long-term experience with sectoral budgeting knowledge of past provides information about CC induced effects of the future and related costs.
- Test-interviews with responsible municipal policy makers (StadträtInnen/city councillors, geschäftsführende GemeinderätInnen/executive municipal councillor; UmweltgemeinderätInnen/municipal councillor for the Environment) about former experience and future expectations regarding climate change, adaptation needs and adjustment costs lead to no concrete answer, were justified with changing responsibilities and functions, being no longer or new in the office. Frequently they refer to their "competent officers" in the particular department of the city administration.

Error! Reference source not found. gives an overview of relevant adaptation measures in cities. These examples have also been used to discuss the topic of climate change impacts and adaptation with city representatives.

Table 4: Overview of relevant measures for adaptation in cities

Field of action	Examples of measures relevant for adaptation
Green and open space	• Control, maintenance and remediation (improvement of location conditions) of city trees • Use of " urban climate-robust " species and varieties (e.g., heat and dry tolerance, wind safety) • Urban green space concept with step-by-step implementation (networking of green areas, balancing existing deficits in green areas) • Planting of trees along treeless roads • Intensive green space planning for all urban development projects
Water and waste water management	• Establishment of a rainfall retention system • Construction of flood protection measures or flood retention basins • Monitoring of rainfall • Hydraulic check of the performance of the sewer network • Expansion of the sewer network to improve hydraulic performance • Analysis of the sewage treatment plant and flood risk • Precipitation water seepage in all construction measures • Rainwater storage through retention basins

Field of action	Examples of measures relevant for adaptation
Transport	• Preferred conversions of paved tramway-routes into unpaved, green routes • Restoration of road infrastructure • Targeted greening of slope areas near traffic routes with root-growing plants for soil protection in case of severe rain events • Rail and road drainage
Rescue and disaster control Organizations	• Recast and regular revision of alarm and catastrophe plans to better deal with risk and damage caused by extreme weather events • Renewal of technical equipment for disaster control • Catastrophe prevention training (with climate change scenario assumptions) • Awareness raising of the population for autonomous (private) adaptation
Health	• Establishment of heat warning systems (cooperation with the country and health authorities) • Consideration of thermal requirements, especially in new school and kindergarten buildings • Publicly accessible drinking water dispensers: also in public facilities (for example, the town hall) • Local control of newly immigrant pests

3.2.1 Expenditures on damage repair

During the expert interviews, the following climate damages and adaptation relevant measures were reported:

Damage in the lowlands and basins along large rivers (Linz, Graz)

- Floods by local or regional heavy rainfall
- Heatwaves – Damage to roads (rail network) – according to literature but not confirmed

Damage in the eastern hot continental summer lowlands (Baden)

- Occasional small local flooding events
- Overloaded sewer system or backpressure
- Restoration need of sidewalks in parks due to heavy rain events
- Heat damage on road network – according to literature, but not confirmed

Damage in intra-alpine valleys, along smaller rivers, near torrents (Judenburg)

- Floods – on local scale caused by heavy rainfalls, and after rapid snow-melting-phases
- small mud slides, obstructions of torrents
- no damage to public buildings (no settlement areas close to river shore and inundation area)
- hardly no damage to the road network
- damage to the sewer network
- large scale storm damages of forests

Reported damage repair (in municipalities surveyed) covers (Judenburg and partly all four cities):

- sludge removal – streets, public areas, green areas (recovery after heavy rainfall), public buildings
- clearing of torrent obstacles
- clearing of mudslides on roads and building land

- repair of community buildings (difficult with listed buildings)
- Rehabilitation of road routes (after rinsing)

Reported adaptation relevant measures (Judenburg and partly all four cities)

- flood control – dams (concepts and implementation provincial matter, about 80% of costs by disaster fund radical community.)
- retention plains (purchase, lease, compensation for usage reduction to land owners by municipalities, partly reimbursement by Disaster Fund)
- torrent control (Planning Federal matter, 60-80% of costs by covered Disaster Fund)
- discharge of small torrents through channels (60-80% of costs covered by Disaster Fund)
- road drainage: construction of separation instead of mixing duct systems
- sewer pipe network: diameter to better cope with heavy rainfall and flash floods

The results found that cities are already responding reactively to the changing climate, and even developing some anticipatory adaptation. Examples were found of adaptation expenditures in spatial planning, land use and building management (including thermal refurbishment), maintenance of (local) roads, water and sewage management (e.g. renovation and adaptation of the channel network) and, to a lesser extent, lawn care and open green maintenance.

3.2.2 Expenditures on adaptation

This section summarizes the interview results of all experts from all four cities.

Currently, the focus of expenditures is on damage repair after extreme events. However, depending on the financial situation, some additional adaptation measures are being taken to reduce the impact on future natural hazards, although these are mostly reactive adaptation measures and to a lesser extent anticipatory adaptation measures (investment in anticipatory adaptation is likely to be on research and early planning, so it will not involve large expenditures). The distinction between the categories of damage repair and adaptation is usually not made in the accounts, which makes a distinction difficult.

As adaptation measures are usually taken after extreme events, most measures are reactive, addressing current climate variability. The study identified these measures from the expenditure analysis, noting these include some early anticipatory adaptation examples as well.

The available **planning guidelines** are the local hazard zone plans, which outline the risk of torrents, avalanches and erosion as well as flood risk. These are based on hydrological and geological-morphological investigations, taking into account previously observed extreme event impacts. The analysis found that possible future climate change effects are currently not included in these hazard- or flood risk zones. In order to include future climate projections in these detailed risk assessments, additional studies and better understanding of how to cope with future climate challenges at both the regional and local level would be require. In some cases, cities have started to investigate this topic.

Spatial planning (all four cities)

The interview results show that spatial planning is considered as a key instrument for adaptation. But the definition and allocation of flood-risk zones and natural hazard zones is a sensitive issue in the municipalities. This is especially the case, if there is little potential for settlement expansion or if already built up residential areas shall be rededicated due to their flood-risk. Thus, these actions are not in the interests of the population willing to sell or purchase land or buildings.

Thus there is a high pressure to local policy makers to keep the current status of regulation, due to the risk of the decrease of land values and increase of insurance costs.

The focus of the municipalities is on issues like:

- land use zoning,
- municipal building management (incl. thermal remediation),
- local road maintenance (damage repair),
- water- and wastewater management (sewer system improvement, torrent control),
- green space maintenance (to a lesser extent) and partly irrigation (relevant in Baden).

Water / wastewater management (Judenburg, but partly all four cities)
is another major adaptation instrument:

- Dams will be erected as technical measures in the immediate danger zone:
  - either new constructed or
  - reinforced and increased.

In the long-term, further retention basins need to be established, due to more intensive and frequent heavy precipitation events. These are often expensive measures, requiring negotiations with farmers on lease or acquisition of the necessary land:

- Compensation for timeshare use rights,
- Partially active unsealing in settlement areas – creation of leakage areas.

The Rainwater sewer network requires (Baden)

- substitution of channel mixing systems ,
- creation of rainwater sewer system parallel to wastewater system,
- replacement of existing pipes by new pipes with larger diameters along the main strands,
- expansion of the capacity of sewage treatment plant.

Green area maintenance (Baden)
Partial recovery of paths in parks is required after heavy rainfalls.

A further topic is the replacement of existing roadside trees by other, more drought-resistant species. This is an issue due to increase of maintenance costs for irrigation of roadside trees in the city.

In addition, the replacement of current trees and plants in parks, green spaces and alleys is an issue. Irrigation starts to get more and more important, causing additional costs. Also certain pests and invasive plants requiring treatment become more relevant.

No or a very low focus is currently placed on (partly all four cities)

- Health issues and natural hazards management, since these issues are seen as a federal / provincial responsibility, with a minor field of responsibility for the municipality.
- Negotiations about cooperation and coordination between levels (municipal, district, province and federal) is improving, but is still rather neglected.

Health care (partly all four cities)
Health care is regarded as a responsibility of the federal or at least the provincial government, which is in charge of hospital services. Nevertheless, municipalities are frequently owners or at least administrators of nursing- and retirement homes being responsible for patients and staff.

3.2.3 Financing of adaptation and future costs

Financing of measures

The biggest financial challenges are that the cities have no way of providing reserves for future spending because of limited resources. Furthermore, the budget structure for assigning climate-relevant costs lacks transparency, and municipalities do not have a clear overview of the direct costs caused by climate variability or future climate change. Loans for major repairs and adjustments are covered in the extraordinary budget and are often assigned to the expenditure account "finance management", which makes it impossible to allocate annual expenditures to certain adaptation measures. Even if the annual loan repayments are allocated to the thematically correct expenditure account, it is difficult to differentiate the cost impacts of adaptation from the damage repair costs, due to the relatively low annual pay back amounts. The cost refunds from the disaster fund is, on the other side, allocated to the account "finance management" as income allocated to the ordinary budget. A key recommendation is that the disaggregation of these items in the budget, and their allocation to climate risks, would be useful. This would increase the transparency of climate related expenditures and would raise awareness of the potential importance of climate change in the budget.

Justification of measure implementation

Adaptation measures are carried out in order to mitigate possible consequences of extreme events on the basis of

- current climate variability and
- vague expectations of changes in the future.

Future challenges for cities

Some of the interviewed city officials, in all four of the cities, expect a further increase in the number of hot and very hot days, and longer heat waves, but also an increase in severe rainfall events and a correspondingly rising risk of flooding. Rising temperatures and longer hot periods will result in required changes in plant selection in urban green spaces. In addition, steadily rising temperatures cause an increase in cooling demand and the number of air-conditioning systems, increasing electricity consumption and potentially increasing greenhouse gas emissions depending on the kind of power generation. A greater number of severe rainfall events are expected, which could damage roads and walkways, and potentially exceed the capacity of the sewer systems.

When developing and implementing adaptation measures, construction time, the lifetime of the investment, and more severe future climate impacts must be taken into account. This is particularly the case for protective dams, retention areas, torrent control and the urban sewer network. The implementation of adaptation into these investment areas depends strongly on the potential risk, the current budgetary scope and the possibilities for external funding.

A further insight is that adaptation investments need to be seen in the context of other challenges. As an example, urban green spaces are considered to have a positive effect on urban climates, but the city officials responsible for urban green maintenance do not recognize the additional costs arising from climate change effects as such. Instead, they attribute larger cost burdens arising from the degradation of the environment (i.e. air pollution, sealing of the surface, deterioration of soil quality because of infrastructure installations).

At the moment, cities and their citizens focus primarily on climate mitigation measures (reducing greenhouse gas emissions). Long-term adaptation measures and therefore the costs of anticipatory adaptation are therefore of less priority. This is likely to reflect a greater focus on immediate reactive responses, but it could also infer that public authorities are increasingly appealing to citizens to take on the responsibility and implement autonomous (private) adaptation.

Finally the interviewees complain that signals indicating climate change are observed, but the statements on future impacts at the local scale are uncertain and the results regarding locations where damage will be expected remain frequently too fuzzy to justify placement of expensive adaptation measures. Here further research, regional climate modelling and impact assessment is necessary to provide results with higher spatial certainty to allow a scientifically sound justification for reasonable measures and a clearer definition of the scope.

4. Synthesis and **conclusions**

Cities and municipalities often focus on climate change adaptation to infrastructure (climate-proofing), in order to protect their built environment against potential consequences of current extreme events as well as of future extreme events expected to increase in frequency and magnitude due to future accelerated climate change.

Municipalities concentrate on those issues and areas where they are responsible and have a stake: on municipality buildings, transport infrastructure, water and wastewater management and green space maintenance. To safeguard the built environment, cities/municipalities see their role as public body/administration, providing infrastructure and services to their citizens. The cities see their main responsibility for climate change adaptation activities in the fields of municipal building management, road maintenance, water- as well as wastewater management and green spaces maintenance. In contrast, topics covered by other public bodies, such as health care, natural hazard management, federal and provincial infrastructure, are not or marginally addressed, but discussions on collaboration and coordination are held and partly take place.

Spatial planning could serve as major adaptation instrument by defining construction bans for selected areas. But this is not considered that much as relevant topic. The arguments against may be high political pressure from the population: first from the owners of vacant land of potential flood risk, second from the population interested in buying land and building new houses for themselves or for their children. A delicate argument is the area already zoned as building land, which – to a large extent – would lose value.

Cities do not clearly distinguish between adaptation expenditures and damage repair costs. Frequently both activities are merged – repairing damage and establishing some adaptation – turning out as incremental adaptation, which brings some co-benefit. The motivation here is that damage repair is often combined with "building back better" or that e.g. early warning systems are improved to deal with future risks.

Regarding proactive adaptation, the municipalities were asked whether they are able to implement large-scale measures to reduce the long-term climate risks, or to build reserves, to implement adaptation measures to better cope with climate risk in the long-run. Since the municipalities have no possibility to accumulate deposits for such adaptation measures today, proactive adaptation is currently not undertaken according to the interviews with city representative. This was also explained by the fact that the municipalities can hardly cover the running costs and repaying loans of earlier infrastructure expenditures, and therefore accumulating deposits seems even less feasible.

Costs are budget positions related to certain administrative entities responsible for certain sectoral issues. Interview results, show that costs are often not defined as adaptation relevant expenditures. While at the federal government levels the goals of budget positions (budget subdivisions) have to be stated in the Bundesvoranschlag (Federal Budget proposal), no similar regulation is in place for the municipal level. This implies that it is more difficult to identify adaptation relevant expenditures at the municipal level. In addition, there is some flexibility how municipalities account expenditures e.g. between ordinary and extraordinary budgets and therefore any comparison of expenditures between municipalities, especially when they are located in different provinces, is difficult.

Signals indicating climate change are observed by the local officers, but the expert statements on future impacts are uncertain at the local scale and the results regarding locations where damage will be expected remain frequently too fuzzy to justify placement of expensive adaptation measures. Here further research, regional climate modelling and impact assessment is necessary to provide results with higher spatial certainty to allow a scientifically sound justification for reasonable measures and a clearer definition of the scope.

The current PACINAS results for cities were presented at the Conference of the Committee of Environment Officers of the Austrian Association of Cities (Konferenz der Umweltbeauftragten des Österreichischen Städtebundes) in Klagenfurt in March 2016. After the presentation, the outcomes

were discussed and the general finding were supported by the city representatives. It was specified that detailed numbers of the cities shall not be published as they should not be compared between each other for the reasons listed above. Nevertheless, it was stressed that issues like adaptation measures and adaptation relevant costs and expenditures are very important for the cities and needs to be further examined.

5. References

APCC (2014) Österreichischer Sachstandsbericht Klimawandel 2014 (AAR14). Austrian Panel on Limane Change (APCC), Verlag der Österreichischen Akademie der Wissenschaften, Wien, Österreich, 1096 Seiten. ISBN 978-3-7001-7699-2.

Arrow, K. J., & Lind, R. C. (1970). Uncertainty and the evaluation of public investment decisions. The American Economic Review, 60, 364–378.

BMF (2012). Der Katastrophenfonds in Österreich. Federal Ministry of Finance. Vienna, Austria.

BMF (2014) Katastrophenfondsgesetz 1996. 10. Bericht des Bundesministeriums für Finanzen. Federal Ministry of Finance.

BMI (2014). Bericht der Republik Öterreich über die Verwendung der Finanzhilfe nach dem Hochwasser im Juni 2013. Federal Ministry of the Interior. http://www.bmi.gv.at/cms/BMI_Zivilschutz/schutz/files/Bericht_Solidarittsfonds_sterreich_2013_final_publik.pdf

BMLFUW (2014). Österreich wird sicherer. The Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management. http://www.naturgefahren.at/massnahmen/wlv2014-2019.html

BMLFUW (2015). 1. Nationaler Hochwasserrisikomanagementplan: Sicher Leben mit der Natur. The Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management. http://www.bmlfuw.gv.at/wasser/schutz_vor_naturgefahren/beratung_information/oeffentlbeteil_2.html

Brilly, M. (2012) Hydrologische Studie der Mur, Univ. Ljubljana

EEA (2014) National adaptation policy processes in European countries — 2014. European Environment Agency. EEA Report No 4/2014. Luxembourg. ISSN 1977-8449

Habersack, H., J. Bürgel, A. Petraschek (2004) Analyse der Hochwasserereignisse vom August 2002 – FloodRisk. Synthesebericht. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien.

Hochrainer-Stigler S, Lugeri N, Radziejewski M (2014) Up-scaling of Impact Dependent Loss Distributions: A Hybrid-Convolution Approach. *Natural Hazards* 70(2). DOI: 10.1007/s11069-013-0885-6

IPCC (2007) Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IPCC (2007) Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group // to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 976pp.

IPCC (2012) Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA, 582 pp.

IPCC (2013) Climate Change 2013: The Physical Science Basis (eds Stocker, T. et al.). Cambridge Univ. Press.

IPCC (2014) Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the

Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros , D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy , S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1132pp.

IPCC (2014) Annex II: Glossary [Agard, J., E.L.F. Schipper, J. Birkmann, M. Campos, C. Dubeux, Y. Nojiri, L. Olsson, B. Osman-Elasha, M. Pelling, M.J. Prather, M.G. Rivera-Ferre, O.C. Ruppel, A. Sallenger, K.R. Smith, A.L. St Clair, K.J. Mach, M.D. Mastrandrea, and T.E. Bilir (eds.)], in: Barros, V.R., Field, C.B., Dokken, D.J., Mastrandrea, M.D., Mach, K.J., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R., White, L.L. (Eds.), Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1757–1776.

König, M., Loibl W., Haas, W., Kranzl, L. (2015) Shared-Socio-Economic Pathways. in: Steininger, K., König, M., Bednar-Friedl, B., Kranzl, L., Loibl, W., Prettenthaler, F. (eds.), (2014) Economic Evaluation of Climate Change Impacts: Development of a Cross-Sectoral Framework and Results for Austria, Springer 2015

Kranzl, L., Hummel, M., Loibl, W., Müller A., Schicker I., Toleikyte, A., Bachner G., Birgit Bednar, F., (2015) Buildings: Heating and Cooling. In: Steininger, K., König, M., Bednar-Friedl, B., Kranzl, L., Loibl, W., Prettenthaler, F. (eds.), (2014) Economic Evaluation of Climate Change Impacts: Development of a Cross-Sectoral Framework and Results for Austria, Springer 2015

Loibl W., Tötzer, T., Köstl ,M.,Nabernegg S., Steininger, K. (2015) Cities and Urban Green. In: Steininger, K., König, M., Bednar-Friedl, B., Kranzl, L., Loibl, W., Prettenthaler, F. (eds.), (2015) Economic Evaluation of Climate Change Impacts: Development of a Cross-Sectoral Framework and Results for Austria, Springer 2015

Loibl, W., Stiles, R., Pauleit, S., Hagen, K., Gasienica, B., Tötzer, T., Trimmel, H., Köstl, M. (2014) Improving Open Space Design to Cope Better with Urban Heat Islands Effects. In: GAIA 23/1(2014): 64 – 66 doi: 10.14512/gaia.23.1.17

Mechler et al. (2014). Managing unnatural disaster risk from climate extremes. Nature Climate Change 4: 235-237.

Prettenthaler, F., Kortschak, D., Hochrainer-Stigler, S., Mechler, R., Urban, H., Steininger, K.W. (2015). Catastrophe Management, Chapter 18, in: Steininger et al. (eds.) (2015), Economic Evaluation of Climate Change Impacts: Development of a Cross-Sectoral Framework and Results for Austria, Springer Climate.

Schöner, W., Böhm, R., Haslinger, K., Blöschl, G., Merz, R. Blaschke, A. P., Viglione, A., Parajka, J., Kroiß, H., Kreuzinger, N. (2010). Anpassungsstrategien an den Klimawandel für Österreichs Wasserwirtschaft – Kurzfassung. Vienna, Austria.

Seebauer, S. & Babcicky, P. (2016). BürgerInnenbefragung zum Hochwasserschutz 2014/2015. Task of VOICE (Voluntary work in disaster management: Challenges for Adaptation to Climate Change), Wegener Center, Univ. Graz.

Steininger, K.W., König, M., Bednar-Friedl, B., Kranzl, L., Loibl, W., Prettenthaler, F. (eds.) (2015). Economic Evaluation of Climate Change Impacts: Development of a Cross-Sectoral Framework and Results for Austria. Springer Climate.

Steininger, K.W., Steinreiber, C., Ritz, C. (2015) Extreme Wetterereignisse und ihre wirtschaftlichen Folgen. Springer Climate.

Annex 1 – Interview Guideline

Fragen an VertreterInnen der Gemeinde: xxx/Datum xx.xx.2015

Vielen Dank für Ihre Bereitschaft zur Mitarbeit und ihre Zeit!

Nennen Sie bitte Ihren Namen, Ihre Funktion und Verantwortung (seit wann?)

Ereignisse, Maßnahmen und Kosten in der jüngeren Vergangenheit

- Welche klimabedingten (Extrem-)Ereignisse (z.B. Hitzewellen, Stürme, Starkniederschläge, Hochwasserereignisse und Überschwemmungen, Trockenheit, Dürre,) wurden in ihrer Gemeinde seit etwa 2000 beobachtet. (Ereignis: Jahr, Jahreszeit)
- Welche Reparaturmaßnahmen für Schäden (Auswirkungen der Ereignisse) an öffentlichem Gut waren in Ihrer Gemeinde (/Ihrem Ressort) notwendig? Wenn ja - nach welchen Ereignissen, wie hoch waren die Kosten, wer ist dafür aufgekommen? (Ereignis: Jahr, Maßnahme: Jahr, Kosten, Finanzierung (OH, AOH)?)
- Welche Risikominderungs-Maßnahmen bzw. Anpassungs-Maßnahmen sind in ihrer Gemeinde (/in ihrem Ressort) wegen vergangener Ereignisse umgesetzt worden. Wenn ja wann (nach welchen Ereignissen?) und wie hoch waren die Kosten? (Ereignis: Jahr, Maßnahme: Jahr, Kosten, Finanzierung (OH, AOH)?)
- Sind die Kosten für Reparatur von Schäden durch Katastrophenereignisse bzw. für Anpassungsmaßnahmen in den Budgets von uns richtig identifiziert worden (OH, AOH)? Wenn nein – korrigieren und Gründe nennen!
- Wie stellt sich der Aufteilungsschlüssel (Bund-Land-Gemeinde) für die Finanzierung von Maßnahmen (Reparatur & Prävention dar?
- Hat ihre Gemeinde Mittel aus dem Katastrophenfond? erhalten? Wenn ja für welche Ereignisse, für welche Maßnahmen und wieviel? (Ereignis: Jahr, Maßnahme, Höhe)
- Wie effektiv sind bereits implementierte Maßnahmen; d.h. haben bereits umgesetzte Maßnahmen zu einer höheren Widerstandsfähigkeit gegenüber Extremereignissen geführt? Wenn ja in welcher Form?

Erwartungen hinsichtlich Ereignissen, Maßnahmen und Kosten in der <u>Zukunft</u>

- Rechnen sie in Anbetracht von zu erwartenden Änderungen des Klimas mit Veränderungen von künftigen (Extrem-)Ereignissen in ihrer Gemeinde? – Wenn ja, welche Veränderung?
- Haben vergangene Extremereignisse und Naturkatastrophen ihre Budget(planungs)-praxis verändert? Wenn ja , wie (OH, AOH)?
- Glauben Sie, dass künftige Extremereignisse (Veränderung von z.B. häufiger und stärkere Ausprägung) mehr Auswirkung auf ihre (zukünftige) Budgetplanung haben? (Wenn ja, welche?)
- Rechnen Sie mit einer Erweiterung von Finanzierungsinstrumenten im Bereich des öffentlichen Katastrophenmanagements in Anbetracht der zu erwartenden Änderungen des Klimas?
- Welchen Einfluss haben Extremereignisse auf die Verstärkung der Risikovorsorge und Risikotransfermechanismen?
- Wie hoch ist das Bewusstsein in der Verwaltung / im Gemeinderat über die Notwendigkeit langfristiger, Klimawandel-bedingter Anpassungsmaßnahmen im öffentlichen Bereich und über die Zuständigkeit für deren Umsetzung?
- Wie hoch ist das Bewusstsein in der Bevölkerung über die Notwendigkeit langfristiger, Klimawandel-bedingter Anpassungsmaßnahmen im privaten Bereich?

Annex 2 – Interview Partners

City	Person	Field of responsibility
Baden bei Wien	Dr. Gerfried Koch	Leiter Klima- und Energiereferat
	DI Gerhard Weber	Stadtgärten und Umweltreferat
	Dr. Ferdinand Schütz	Finanzwirtschaft
Judenburg	Mag. Eva Volkar	Projektmanagement Umwelt und Klima
	Ing. Bernd Preininger	Bauamt
Linz	Mag. Christoph Arzt	Direktor des Geschäftsbereichs Gebäudemanagement und Tiefbau
	Ing. Hans Lindemann	Abteilungsleiter Technisches Gebäudemanagement
	Ing. Obernberger	
	Dipl.-Ing. Werner Münzker	Stadtgrün und Straßenbetreuung Nord
	Dipl.-Ing. Martin Stiedl	Logistik und Technik des Geschäftsbereichs Stadtgrün und Straßenbetreuung, zuständig für die Straßenerhaltung der gesamten
	DI Dr. Christian Puchner	Leiter der Berufsfeuerwehr Linz / Branddirektor des Geschäftsbereich Feuerwehr & Katastrophenschutz
Graz	MSc Dominik Piringer	Umweltamt/ Dr. Prutsch
	Dr. Werner Prutsch	Leiter Umweltamt
	DI Robert Wiener	Grünraum und Gewässer
	Ing. Dipl. WI (FH) Martin Nigitz	Grünraum der Holding Graz