Report of Thematic Centre 3: Urban Adaptation and Health

Case Studies: Vulnerability Assessment in the Hungarian Urban Settlements – city of Veszprem and 13th District of Budapest

DELIVERABLE INFORMATION	
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Chapter 1: Introduction

This activities under the Thematic Center 3: Urban Adaptation and Health (TC 3) focus on the key challenges that urban areas are facing with regards to adaptation to climate change. The special emphasis is made on the adaptation to the negative impacts of climate change on the public health sector in the urban environment. The TC 3 addresses these challenges though assessing the vulnerability of two pilot municipalities in Hungary with the consequent discussion about the potential solutions on how to increase climate resilience of these municipalities. An international workshop "Adaptation to Climate Change: Nexus between Urban Areas and Health Sector" to be hold on 12-13 November 2014 draws the final conclusions of the case studies, examines the international experience in urban adaptation, and represents dissemination activities under the TC 3.

1.1. Key problems related to climate change adaptation in urban areas

Over half of the world's population live in urban environments. Urban heat island, high population and density rates features the urban areas which face a variety of specific climate change challenges. A study *"Urban Spatial Planning in the Context of Adaptation to the Impacts of Climate Change"* carried out under the TC3 reviewing the global experience of urban adaptation has shown that all the urban systems are vulnerable to the impacts of climate change. Under different climatic conditions different systems are sensitive at the different rates and the urban environment serves as a multiplier of the impacts of climate change on a number of urban economic sectors and ecosystems. This includes public health, energy production, energy transmission, energy consumption, transportation, drinking water supply, technical water supply, sewage, housing sector, recreational areas, parks, historical monuments, urban agriculture, and urban biodiversity.

The primary concern in Europe is linked to heat-related morbidity and mortality, due to the increases in annual temperature and extremes of heat, although these issues are also influenced by socio-economic changes due to population growth and the ageing of the population (EU Adaptation Strategy, 2013). The growing urbanisation rates (e.g. between 2006 and 2010, Hungary had an annual urbanisation rate of 5 percent) and the increasing complexity of the urban systems providing energy, water, waste management, food and other crucial services demand the assessment of predicted health and socioeconomic impacts of climate change.

The practice shows that spatial and urban planning usually do not meet the challenges of the harmonization of different ecosystem services with other policy measures related to, for example, urban development, transport, recreation and climate change adaptation. There is a need to develop existing planning practices and analyse the mutual interferences of the different ecosystem services which can contribute to adapt to climate change effects, and the socioeconomic approaches of the different urban areas.

1.2. Objectives of the Thematic Centre 3: Urban Adaptation and Health

To address the above mentioned challenges, cities and municipalities need to develop effective, locally driven adaptation programmatic documents such as adaptation strategies or at least the lists of potential adaptation measures. This in its turn requires vulnerability assessment and the selection of effective adaptation measures.

The main objective of the TC 3 is to enhance the understanding and knowledge of the staff of municipalities on climate change adaptation aspects, acquaint them with the global good practices in urban adaptation, encourage them to assess the vulnerabilities of their urban systems against current and future (projected) climate conditions, and to encourage urban settlements in SEE region to assess the feasibility of implementing adaptation policies and measures already developed for use on a larger scale (regional, national and ecosystem level).

These objectives are achieved through conducting a vulnerability assessment of two pilot areas in Hungary under the TC 3 with consequent dissemination of the results acquired in these two areas. These are the 13th district of Budapest and Veszprem municipalities. All the urban systems of these municipalities are assessed, and special emphasis is placed on the linkages between the impacts of climate change and public health. A special study led by the national expert "*Impacts of Climate Change and Adaptation Measures of Public Health Sector of the city of Veszprem and District 13 of Budapest*" was carried out under the TC3 towards the completion of the case studies.

One of the reasons is the fact that the health sector in Hungary is one of the areas most affected by the impacts of climate change. Increasing numbers of elderly people, the large proportion of poorly insulated residential buildings constructed between 1960 and 1990, a low level of awareness, and a lack of adaptive capacities all contribute to the vulnerability of both the population and health system. The

study considers a number of options for utilising all available adaptive capacities, creating extra capacities, and boosting public health resilience.

Another important objective of the TC 3 is enhancement of exchange of good practices in urban adaptation. An overview of the global urban adaptation experience and lessons learnt was done under the Orientate project towards completion of the case studies. The results of this overview were disseminated among the stakeholders and discussed with them. On the other hand, the good adaptation practices and measures applicable in the two pilot municipalities are also highlighted, and can be replicated in the other settlements of South-East Europe.

Chapter 2: Strategic framework and knowledge base

This chapter presents the key strategic documents in Hungary that address adaptation to climate change. It also gives an overview of the available scientific knowledge on the topic of adaptation to climate change in urban areas.

2.1. Strategic framework

The most important strategic document for climate change adaptation (and mitigation) in Hungary is the **National Climate Change Strategy (NCCS) (2008-2025).** The strategy was prepared in the framework for the implementation of the UN Framework Convention on Climate Change (UNFCCC), and based on the 2007 Climate Change Act. The document), approved by the Hungarian Parliament in 2008, contains extensive chapters both on mitigation and adaptation, however objectives and main strategic directions of actions for the period of 2008-2025 in Hungary were identified only for mitigation. The adaptation part is less focused and combined with mitigation issues. The strategy deals with the adaptation issue mostly on a theoretical level, offers an introduction to the general impacts of climate change in Hungary, and lists priorities and tasks in the following areas of climate adaptation: nature conservation, natural flora and fauna, human health, water management, agriculture and forestry, regional development, regional planning, settlement development, settlement planning and built environment[1]

Concerning the adaptation to climate change the strategy underlines the importance of ecosystem services. A subchapter deals with the issue of the impact of climate change on public health. It says that the extreme weather conditions (heat waves, higher average temperature, UVB radiation etc.) will

[1] http://climate-adapt.eea.europa.eu/countries/hungary

negatively influence the health of the residents in the settlements more often and more intensive in the near future (mortality rate because of heat waves, more viruses, chronic diseases etc.).

The first revision of the NCCS mandated by the Climate Change Act 2007 took place and completed in 2013 waiting for approval by the Hungarian Parliament. The revised version extended the timeframe of the strategy to 2030 with a 2050 outlook. It treats mitigation and adaptation as of equal importance. The two parts, namely National Roadmap for De-carbonization and the National Adaptation Strategy (NAS) had been drafted providing with proper inter-linkage and coherence. The third important pillar of the revised strategy is related to education and awareness raising.

The NAS will provide further information on climate change science, observations and sectoral impact assessments. It will be based on a robust metadata base, called the National Adaptation Geographical Information System (NAGIS), currently in progress. This system will be the first comprehensive, countrywide tool to provide high-resolution results of quantified expected trends and the associated uncertainty of local and regional exposure, sensitivity and adaptive capacity for different hazards. It will also to provide input data for spatial and sectoral vulnerability studies.

The **third National Environmental Action Programme** was adopted by the Parliament in 2009 for the period of 2009-2014 and it includes a thematic (sub)programme dedicated to the problems and tasks related to climate change. It specifically deals with both mitigation and adaptation issues.

The **fourth National Environmental Action Programme** has been developed by the end of 2013 and is waiting for the adoption by/approval of the Parliament.

The **National Development and Spatial Development Concept** contains the main national development priorities for Hungary until 2030. It recognizes that there is a huge difference among the different regions concerning the adaptive capacity and vulnerability due to the territorial differentiation of the effect of climate change. In those regions where the economic system depends more on climate conditions (e.g. agriculture, tourism) there is a need to plan with more risks and develop more and diverse adaptation measures. The document also says that the impact of climate change can increase the economic, social and lifestyle differences among the different areas. The concept formulates the objective to create “climate safety” in the settlements and public buildings, and to develop adaptation measures to climate change, primary in the urban areas.

Main regulations of buildings are particularly covered in OTÉK for the whole country, but considered adaptation strategies are still missing. However environmental awareness appears in many territorial development strategies both at national and spatial level, the real measures concerning climate change adaptation in the development strategies are still missing at spatial level at this moment. There are only a few cities that have e.g. Energy Strategy or Environmental Program at spatial level but the adaptation measures have not been considered or developed yet.

2.2. Scientific knowledge available on the topic

Scientific knowledge available on the topic includes:

- The results of observations on climate essential variables since 1961;
- Statistical data on daily death rates since mid-XX century in Hungary;
- Statistical data on socio-economic factors across Budapest (example: unemployment level, illiteracy rate; distribution of illnesses, etc.):
- Statistical data on the adaptive capacities of the hospitals, kinder gardens, and senior care centres (so-called, retirement houses) in the city of Veszprem and 13th District of Budapest. These data were collected in the course of the case studies;
- Projections of climate essential variables derived from running of the two regional climate high-resolution models in Hungary. These data were acquired by the Hungarian Meteorological Service for the case studies;
- Experts' opinions collected through the stakeholder consultations;
- Experts' opinions collected through the interviews with the representatives of the urban systems identified by the stakeholders as the priority areas.

The methodology of vulnerability assessment of the annualized urban systems was devised on the basis of the 4th IPCC Assessment Report definition of Vulnerability as a function of Exposure, Sensitivity, and Adaptive Capacities. The 4th IPCC AR was chosen since at the time it was the most updated version of the IPCC continuous work.

To prioritize the urban systems which are the most important for the smooth functioning of the settlements the participatory approach has been adopted. The stakeholders identified:

- Prioritization of the urban systems;

- Current vulnerability of the systems against so-called adaptation challenges, e.g. climate change related hazards, such as heat waves, urban droughts, increased temperature variability, river floods, flash rain floods, icing conditions due to increased climate variability, and strong winds. This was based on the personal observations of the experts and stakeholders involved;
- Future vulnerability of the same systems against the projected changes of the essential climate variables. This was based on the experts' points of view on both projections and perception of climate dynamics in their respective regions over the past years.

The overall vulnerability of two municipalities is described in qualitative terms. At the same time, the basis for qualitative assessment constitute figures and statistical data.

Chapter 3: Pilot studies

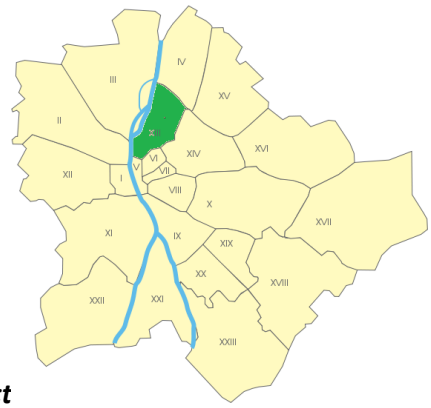
This chapter presents the outcome of pilot studies carried out for two Hungarian settlements. The Pilot studies were carried out for assessing the current and future vulnerability of the present urban systems against future exposure as a consequence of projected climate change. Special attention is paid on drawing conclusion, summarizing lessons learned and making suggestions for wider use of results of the pilot studies for authorities and policy makers at regional, national and international level.

3.1. Objective of the study and description of the study area

The pilot study assesses the vulnerability to climate change of two Hungarian municipalities – 13th District of Budapest and city of Veszprém. The study also aims to analyze the biophysical, social and economic vulnerability of urban systems in these municipalities. One specific goal is to demonstrate the applicability of adaptation measures and policies in the various administrative and governance contexts. Another goal focuses on the integration of adaptation polices and measures in existing and future long-term development plans. Good practices and lessons learnt gathered from climate change adaptation experience worldwide is carefully examined, and a list of feasible adaptation measures for the main urban economic sectors and/or ecosystems is compiled and offered to stakeholders for consideration.

The **13th District of Budapest** is one of the most intensively developing areas in the Hungarian capital, located on the north Pest side alongside the river Danube. Despite the small size of area (13.44 km2), the population of the district is relatively high, and intensively growing. The district is a densely built

residential, business and commercial area, with a constantly increasing volume of traffic. The most challenging characteristic of the district in terms of adaptation planning is the fact that the range of feasible adaptation measures is limited by the existing governance system.



Graph 1: Budapest with indicated 13th District

Veszprém is a medium-sized city (126,90 km²) situated in the western part of Hungary, about 110 km from Budapest and 15 km north of Lake Balaton, in a hilly area. Veszprém already has a strong mitigation policy which is included in the Energy Strategy of Veszprém. The main challenge facing adaptation decision makers in this case is the coherent integration of adaptation considerations into already existing climate policies.

Graph 2: Map of Hungary indicating Veszprem and Budapest

3.2. Methodology

Vulnerability assessment of the pilot areas

The focus of the pilot study is on conducting a vulnerability assessment of the crucial urban systems of the pilot areas, including an analyses of exposure, sensitivity and adaptive capacity. The exposure induced by future climate was identified by running regional climate models using the A1B climate

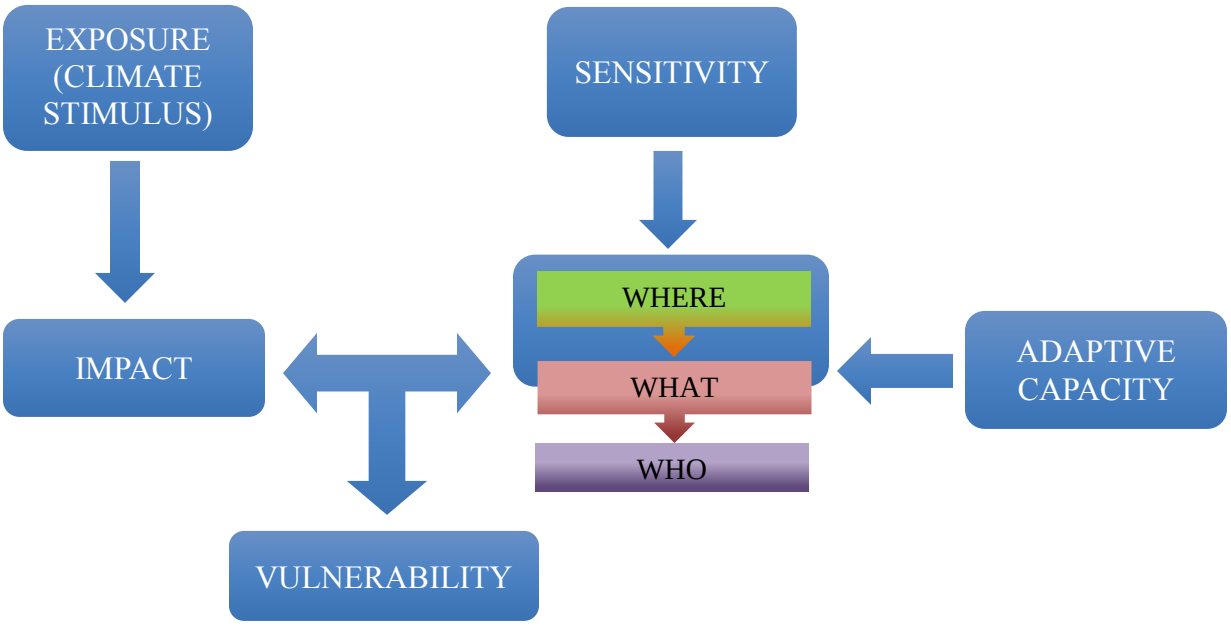
scenario developed under 4th AR of IPCC. The general circulation models (GCM) used for receiving information on future climate models are not able to provide projected climate data with satisfactory detailed geographical distribution. The regional climate models run by the Hungarian Meteorological Service for the pilot areas are operating using a resolution of 10km x 10 km, which can provide data on future climate (temperature and precipitation) with the required details for the whole area of Hungary and having local relevance.

In the framework of the present study, two future periods were examined in detail: 2021–2050 and 2071–2100, with reference of 1961–1990. The input data was provided by two regional climate models (RCMs) adapted and used at the Hungarian Meteorological Service: **ALADIN-Climate and REMO models.** The investigation of the results of two RCMs is necessary to quantify the projection uncertainties. The simulations of the two models are covering the Carpathian Basin with 10–25 km horizontal resolution. For describing the future anthropogenic activity, the medium A1B scenario was used. The results of the projections will be described under the sub-chapter 3.4. of the present study.

Sensitivity was characterized by identified specific indicators, which could be quantatively described by the assistance of statistical parameters. The adaptive capacity of the two settlements was analyzed by survey and personal interviews with responsible persons of the different urban systems.

The urban system vulnerability assessment's methodology follows a framework[2] which has various components being a logical interconnection among them. The baseline when assessing the vulnerability of a given urban system is to identify the type of natural hazards it is exposed to the most. As a second step, the sensitivity of the urban system has to be mapped from a social, physical/structural and economic point of view. The sensitivity of the system can be decreased introducing adaptation solutions both from a technical, structural (hard) and regulatory, organization (soft) side. The impact assessment looks at the consequences of the identified climate hazard taking into the urban system's level of sensitivity and its capacity to adapt. The vulnerability assessment combines all of the components of the logical framework and puts it into the context of the analyzed pilot areas.

[2] Urban Regions: Vulnerabilities, Vulnerability Assessments by Indicators and Adaptation Options for Climate Change Impacts, ETC/ACC Technical Paper 2010/12 December 2010.



Graph 3: Scheme of Vulnerability Assessment Methodology of the Case Studies

3.3. Stakeholder involvement and needs assessment

One of the important aspects of Thematic Center 3 is to develop the pilot study in close cooperation with both beneficiaries. The involvement of the relevant stakeholders from the two Hungarian local municipalities (Veszprem and 13th District of Budapest) in the process is essential for enhancing their understanding of the global and local adaptation challenges related to climate change and necessary local measures to reduce the impacts.

The project staff involved in the TC 3 activities has built up good relationship with both municipalities which were actively participating in the regular consultations related to the pilot study development. The key contact persons from the two municipalities serve as a liaison between the REC project team and the wider stakeholder communities such as businesses, bodies governing the urban systems, civil organizations working in the fields of public health, social care, daycare, the environment and planning departments within the two municipalities.

Municipalities and stakeholders were involved to the project activities in several ways:

A/ Surveys for identifying level of adaptation both from health point of view and other urban systems points of view. The municipalities contributed substantially to the data collection process by sending

official letters to heads of public institutions and urban system governing bodies which filled in questionnaires with specific data and went through the interviews. The data collected was used in several ways:

- Assessing the adaptive capacities of the health care system of the municipalities. Three types of the public institutions' (hospitals, kindergartens and social home for elderly people) adaptive capacities against the heat waves were examined;
- Assessing the vulnerability of the present urban systems of the municipalities against current and projected climate conditions which can represent the threats to the safety margins of the urban systems.

B/ Stakeholders consultations: two separate events were held in each settlement in the beginning and in the end of the case studies.

During the first round of stakeholder consultations (on 29 August 2013 and 20 October 2013 respectively) the discussions were focusing on the following topics:

- Personal impressions whether climate change is really happening
- Which elements of the urban system seem to be most affected by climate change? What is most vulnerable?
- Are the pillars of the urban system is prepared for coping with problems caused by climate change? Is the municipality prepared for guiding the process?
- Are public people aware of climate change and its potential impacts?
- What are the gaps and need from public point of view?

Based on the discussion it was concluded that knowledge and awareness among public is quite limited on climate change, more information and awareness raising would be needed. From governance point of view there are much to do at municipal level including more detailed information on impacts and vulnerability, potential measures to reduce the harmful effects of climate change and assistance is needed to elaborate proper adaptation strategy at municipal level.

During the second round of the stakeholder consultations (23 May 2014 in Veszprem and 17 September 2014 in 13th District of Budapest) the results of the case studies were discussed. The participants were informed about the "hot spots' of the crucial urban systems they have selected during the previous

round of consultations. The good practices in urban adaptation were presented to the participants as well as the legal framework of the adaptation process in Hungary. The discussion concentrated on what types of adaptation measures are feasible in Hungary from legal, administrative, and financial points of view. Also the discussions concentrated on how to involve more businesses in the public-private partnership schemes to implement adaptation measures effectively.

3.4. Results from the pilot study

Results from climate projections

The parameters selected for the vulnerability study are as follows for both target municipalities and future periods:

- Change of daily mean temperature (in ^{o}C/30 years, averaged for 30-year periods) in every gridpoint;
- Linear trend coefficients of monthly mean temperature (in ^{o}C/30 years) in every gridpoint within the actual future periods;
- Change of daily precipitation amount (in mm/day, averaged for 30-year periods) in every gridpoint;
- Linear trend coefficients of seasonal mean precipitation (in percentage/30 years) in every gridpoint within the actual future periods.

Investigating figures of daily mean 2-meter temperature change for Budapest the two models project warming for almost the whole year both in the near- and far-future periods. Regarding daily mean 2-meter temperature changes, results obtained for Veszprém county and Budapest are almost identical due to their small (100 km) distance and similar altitude in the models. Therefore the conclusions related to Budapest are also valid for Veszprém county as well. Monthly mean 2-meter temperature trends indicate warming in most months within 2021–2050, especially in winter and summer.

Regarding precipitation in Budapest, the daily mean changes are showing large day-to-day fluctuations; therefore, it is hard to find any significant conclusions. The range of the daily changes covers the interval

of -3–3 mm/day for 2021–2050, with smaller changes in winter, larger ones in summer and autumn. *Similarly to* Budapest, the daily mean precipitation changes for 2021–2050 indicate large variability for Veszprém, as well . The range of the daily changes covers the interval of -4–4 mm/day for, with smaller changes in winter, larger ones in summer and autumn. Large uncertainty can be concluded between the RCMs in September: one of them provides the greatest increase, while the other one provides the largest decrease throughout the year.

In the 21st century both in Budapest and Veszprém county temperature increase is expected throughout the year, especially in summer. This does not mean year-by-year warming, cooler periods can occur, as negative monthly intra-decadal trends show it. Though, daily changes should be handled with care since large day-by-day variability is possible, changes for 2071–2100 are more robust and clear for both Veszprém and Budapest than for the 2021–2050. Seasonal precipitation trends are similar for the near-future period for Veszprém and Budapest, but smaller trend values are most likely for Budapest for the far-future period. While the model results are clear only in the slight increasing spring trend for 2021–2050, they are in a good agreement in spring–summer decreasing and autumn increasing trend.

As it could be seen for the region of Budapest, the 10 and 25 km spatial resolutions are not sufficient for the detailed investigations. Even the 10 km resolution does not allow to correctly describe the surface characteristics and processes, especially the urban processes. Therefore, these results provide only limited opportunity to make hints for the vulnerability of the urbanized regions. In the future, finer (km-) scale simulations are needed for further investigations and making more sophisticated conclusions.

Results from the Vulnerability Assessment of Budapest 13th District Municipality

Adaptation problems and challenges have been identified in the 13th District of Budapest through desk research of literature and significant number of interviews with the municipal officials and representatives of the companies to which certain services have been outsourced. These stakeholders shared voluntarily their environmental concerns, not only on climate and adaptation buy also on other environmental topics. It became clear that a climate impacts can aggravate any of the mentioned problems, and any adaptation measure implemented has huge potential for co-benefits solving not only the climate but also social, economic, environmental, and demographic problems.

The experts selected among the major adaptation challenges faced by the district authorities and residents the following: extreme high temperatures, river floods on the river Danube and a small creek Rakos flowing into the Danube, excessive precipitation both in cold and warm seasons, and strong winds. According to the experts' opinion, the listed adaptation challenges affect to the biggest extend the following sectors:

- Electricity transmission: Interrupted electricity supply can start a chain reaction of unpredictable consequences. Modern civilization is very much dependent on stable electricity supply. The electricity transmission systems are vulnerable to high temperatures, strong winds and hurricanes, and excessive precipitation in the cold seasons (snow),
- Parks, green squares, and other green spots of n the 13th District. The 13th District area is 13.44 km$^{2.}$ It features 3 km^2 of parks and green spots. The famous Margaret Island, one of the major touristic sightseeing spots and important recreational area of the whole Budapest, is under the governance of 13th District. Heat waves combined with urban droughts, floods, strong winds and hurricanes adversely affect biodiversity of the green spots and significantly reduce a number of ecosystem services the green spots provide for the urban residents.

Within the case study special attention has been focused on public health and adaptation capacities in the facilities for the young children, senior citizens, and people with health problems, e.g. kindergartens, residences of seniors, and hospitals. There are 12 social care institutions on the territory of the district. As the analysis shows the majority of the facilities are not prepared not only for the future climate conditions but also for the current climate variability. The current vulnerability of the mentioned groups is assessed as very high.

Among the barriers on the way of adaptation measures implementations the main one is the discrepancy between vulnerability and decision taking power. The most vulnerable groups usually do not possess the decision making power. Another barrier is the lack of communication between the vulnerable groups and the decision makers and takers. One more barrier is the governance. Usually at the district level the feasible adaptation options are the soft options. For more substantial "hard" adaptation measures the district stakeholders have to wait the actions on the city level, or even on the national level.

Several other sectors vital for the day-to-day functioning of the 13th District have been listed by the experts as vulnerable to the impacts of climate change:

- Transport: transportation in the 13th District is both a vulnerable sector and sector exacerbating current adaptation problems. The District roads are altogether 170 km long. They are covered with asphalt. During the heat waves asphalt absorbs heat, and releases it during night time. As a result the District suffers so called “tropical night” harming human health because of inability to cool down during the night time. On the other hand the sector is vulnerable to heat ways (interruption of tram services because of rail buckling and wire sagging), climate variability destroying the asphalt coverage of the District, and floods destroying the underground pedestrian passages. Interestingly enough, the XIII District takes part in the renovation of the tram line number 1 in cooperation with the whole city. This renovation is supposed to make the tram line more heat resistant.
- Waste management, sewage system, water supply: 13th District possesses the well-established selective waste collection system, sewage system, and system of water supply to the citizens. The District also has a bubble of underground water placed beneath the surface. While sewage system, waste collection system, and centralized supply of drinking water are climate resilient, and feature thorough protection against impacts of climate change both observed and predicted ones, the ground waters can threatened by such hazards as river floods and excessive precipitation (rain and snow). Another threat to the underground water reserves can be overexploitation during urban droughts. Currently these reserves are used for watering the green spots of the District when natural precipitation is not sufficient.
- Spatial planning;
- Social Sector: Population of the 13th District grows rapidly due to the inflow of new residents. It includes major vulnerable groups, e.g. young children, senior citizens, homeless people, and also a number of migrants from the other countries. These groups are vulnerable to extreme temperatures, urban droughts, extreme precipitation, and strong winds. The latter group being exposed to all the adaptation challenges might not benefit to the fullest extent from the adaptation measures such as early warning systems and information campaigns because of their poor knowledge of national language. One more vulnerable group is a group of people with

health issues. All mentioned adaptation challenges can either worsen their health conditions or hinder the recovery process;

- Air quality

Vulnerability Assessment: current vulnerability of 13th District of Budapest can be assessed as "medium" Several sectors such as waste management, water management, sewage management are currently resilient to the adverse impacts of climate change. The other sectors such as public health, social sector, transportation, management of parks and green spots, and electricity supply are highly vulnerable. The observed climate impacts in the form of both accumulated effects and extreme events frequently surpass the safety margins of the systems. Current vulnerability against the future climate impacts as described above can be even assessed as "high".

Simultaneously, the 13th District authorities, experts, and advanced representatives of the local community are aware of the lack of resilience of the urban systems vital for the district. They already take steps towards improving the adaptive capacities. Several adaptation activities take form of acquiring compliance with the national regulations (example: spatial planning legislation on the ventilation corridors; building regulations on standards of newly built houses). Renovation of the rail tracks of the tram N 1 can also be considered to a certain extent as an adaptation measure. This is a big project, and several Budapest districts benefits from it. On the district level a number of 'soft' and/or low-cost adaptation options are carried out including information campaigns, provision of information (example: about upcoming weather conditions), and maintenance of the green spots and parks of the District. Further recommendations are in the Section 5 of the present Thematic Center Report.

Results from the Vulnerability Assessment of Veszprem Municipality

Vulnerability assessment in Veszprem Municipality was carried out in two directions. Under the first direction vulnerability assessment addressed the utility sectors and urban systems of the city, e.g. electricity and gas supply, drinking water supply, storm drainage, and sewage. In other words, at the first stage the vulnerability of urban systems providing framework for healthy and quality living has been assessed. Under the second direction economic and social vulnerability of the city was assessed.

Among the adaptation challenges the experts have chosen: extreme temperature events, extreme precipitation events (rain and snow), icing, floods on the creek Sed, and strong winds.

As in the 13th District of Budapest, special attention has been paid for the vulnerability of public health sector. From demographic point of view, almost 30% of Veszprem population belong to the age vulnerable groups – young children and senior citizens. There are XX (check!) social institutions including hospitals, kindergartens, residences for seniors, days cares, etc.

As the interviews with utilities' experts revealed, Veszprem urban utility systems feature high resilience against current impacts of climate change. The experts indicated that electricity supply system is more vulnerable than others since it operates under open sky and is exposed more to the climate hazards. The experts were positive that such adaptation challenges as extreme temperatures, icing, thunderstorms resulting in fallen trees cannot presently interrupt electricity or gas supply for more than 3 hours. The time period of 3 hours is pronounced even taking into consideration the labor code stipulations prohibiting for the outdoor workers to work for 1 hour in a row under harsh temperature conditions without taking substantial breaks. Vulnerability under future climate might increase though the utility experts assured that regular maintenance and technological upgrades will allow to cope even with the future climate stress.

The most vulnerable sector in Veszprem is tourism. Veszprem is an old and beautiful city featuring rich cultural, and especially architectural, heritage. It is also famous for its gardens and cloisters, for which Veszprem was even rewarded with a Climate Star of Hungary. Extreme weather events, their increasing frequency negatively affect these valuable sites. Moreover, the weather extremes prevent people to take trips to Veszprem and its vicinities. More than 10,000 households are employed or self-employed in the services related to tourism.

The vulnerability if Veszprem can be assessed as "Medium" though it might be misleading. One can say that Veszprem's vulnerability in terms of necessary utilities provision is low. At the same time, economic and social vulnerability of the city is high because of the tourist sector playing an important role in Veszprem's economic life.

3.5. Financing Adaptation Measures

Climate change adaptation is included in the proposals for all relevant EU finance programmes for 2014-2020, including the European Structural and Investment funds[3], Horizon 2020, that will promote

[3] The Cohesion Fund, the European Regional Development Fund (ERDF), the European Social Fund (ESF), the European Agricultural Fund for Rural Development (EAFRD) and the European Maritime and Fisheries Fund (EMFF)

research and development on climate change adaptation, the LIFE instrument which finances a wide range of projects related to environment and climate mitigation and adaptation, or the EU Solidarity Fund for natural disasters. With regards to Hungary the draft 2014-2020 Multi-annual Financial Framework (MFF) includes a proposal for increasing climate-related expenditure[4] to at least 20 % of the EU budget. It is strategically important for such investment to be climate-resilient.

Financing of adaptation measures in Hungary is strongly determined by the strategic framework for adaptation actions, which mainly aims to comply with international and European requirements. based on the 2007 Climate Change Act. A large part of the financing of the actions within the National Climate Change Strategy (2008-2025 has been provided through European funding, from the Structural Funds.

Funding for local level adaptation actions mostly comes from EU funds and the national level sources. The Hungarian Government set up financial incentives to support the adaptation measures envisaged in the National Climate Change Strategy (NCCS). Within the New Széchenyi Plan (NSRF 2011-2013) sources were allocated to climate adaptation actions mainly in the framework of the Environment and Energy Operational Program (KEOP). For the agriculture and forestry sector the main funding was provided by the New Hungary Rural Development Programme (NHRDP).

With regards to insurance the currently available private funding that supports adaptation actions is focused on the provision of insurance services, in different sectors. Insurance can be a valuable tool for adaptation in three main ways: helping to manage climate change risks; providing incentives for risk prevention; and providing information on risk (Courbage and Stahel, 2012). The insurance sector is arguably the most advanced in evaluating risks and opportunities. Major adaptation initiatives in the insurance sector, to date, have focused around building institutional networks that address the common risks to the industry through collaboration. It is likely that the insurance sector leads in this area due to its vulnerability, but also because of its historical experience in risk management and climate-related risks.

Operating the agricultural risk and crisis management system in Hungary has always been characterized by its division between the state (and its authorities) and insurance companies whose proprietary structure and the surrounding market competition have changed in the course of time. The state has

[4] referring to both climate change mitigation and adaptation

always had a significant role in the organization and financing the protection against agricultural crises caused by both natural disasters and economic turmoil.[5]

The 2012 act on the risk management of weather and other natural hazards affecting agricultural production entered created new conditions for agricultural risk management system. The act expanded the risk management community to all micro, small and medium enterprises. The scope of eligible damages were expanded to drought, inland inundation, hail, spring and winter frost, storm, rainstorm and flood (with specific case approval of European Commission).[6]

3.6. Integrating pilot study results in policies

The final study results have been disseminated among the stakeholders in both municipalities through the series of stakeholder consultations with the elements of trainings. The consultations emphasized that the methodological approach adopted in the case study can become a useful tool in future. Vulnerability assessment in the case study is based on the current available information. In future any components of vulnerability can change. The new bordering conditions (example: new scientific evidence will be collected: climate modeling in the urban areas will become more accurate) can change exposure component. New adaptive capacities can be introduced increasing the overall climate resilience of the systems. Also sensitivity of the urban systems might change due to either effective renovation or further deterioration. At any point of time the climate adaptation stakeholders in both municipality can re-assess vulnerability of the urban systems. The results can be used for internal purposes (example: assessment of economic and social vulnerability with further identification of hot-spots) or external purposes (example: application for adaptation related funding). This methodology also provides opportunities to find synergies between climate and other environment concerns, or even non-environmental concerns of the stakeholders.

The intermediate results of the case study raised awareness on adaptation tp climate change. Beforehand the municipalities were mostly aware about mitigation through energy efficiency. The case study under ORIENTGATE introduced new challenges to the stakeholders. They become aware that the impacts of climate change have been observed in their own country and threaten the wellbeing of their fellow citizens. Simultaneously, adaptation measures can be a powerful vehicle to introduce new technologies, safeguard and even create new employment, and bring investment into the municipality. For instance, Veszprem municipality has engaged into a new climate project, e.g IMPRESSIONS, looking for effective synergies between adaptation and mitigation under extreme climate scenarios.

[5] http://ec.europa.eu/agriculture/analysis/external/insurance/annex11_en.pdf
[6] http://www.mvh.gov.hu/portal/MVHPortal/default/mainmenu/hirek/tajekoztato_a_mezogazdasagi_te_20120126_1027118

http://www.kormany.hu/download/6/15/70000/T_2011_168_%28CLXVIII_2011_12_9%29_torveny.pdf

Chapter 4: Conclusions and lessons learned

4.1. Key constraints and limiting factors with regards to adaptation to climate change in urban areas and health

Adaptation process on the sphere of public health in the urban areas faces the barriers common for any sector:

- Psychology of denial: some decision makers and takers deny the incident of climate change attributing the evident impacts to "normal" climate variability. Though irrational, this type of perception of climate change can be met at non-negligible number of occasions;
- Lack of political will: the expenses associated with environmental issues and/or public health are classified as "social expenditures". Unfortunately, the common practice is that these expenditures are not on the top of the agenda;
- Lack of information on adaptation challenges regarding public health: the stakeholders either might not be aware about a challenge, or underestimate its frequency and severity (example: heat wave in Europe in 2003). To the same point one can attribute lack of methodologies of calculations of extra morbidity and mortality caused by an adaptation challenge;
- Lack of information on good practices and low-cost no-regret adaptation measures.
- Lack of financial resources as well as lack of information about the available financial opportunities;
- Low level of cooperation within communities: individuals tend to choose to maximize their own utility rather than public utility. Example: destroying green and blue areas for parking lots.

In the area of public health there is a specific barrier on the way towards successful adaptation, e.g. self-perception of individual's own vulnerability. This factor has been identified when assessing the vulnerability of the senior citizens in the Scandinavian countries. If an individual tends to underestimate its own vulnerability due to a number of reasons, she wouldn't undertake adaptation actions. Within vulnerable groups such as senior citizens, people with health problems, outdoor workers this phenomenon can become a tendency with obvious sad consequences. Example: a senior citizen disregards an early warning about slippery conditions occurring because of climate variability, falls on the ground, and stays without help for hours during night time. Example: an outdoor worker disregards the labor code requirements not to exceed 1 hour under the extreme heat conditions. In both examples the interviewed patients answered that they consider themselves "very resilient" and "not vulnerable".

4.2. Future challenges and opportunities with regards to adaptation to climate change in urban areas and health

Climate change is unequivocal, and the impacts of climate change on human health will necessarily grow stringer. The main challenge in the health sector is to raise stakeholders' awareness about the expected impacts of various adaptation challenges on human health. The effects might have direct effect (example: heat waves cause extra morbidity) and indirect (example: increased climate variability cause slippery conditions more frequently, as a results the number of injures increases).

The other challenge is to draw stakeholders' attention to the fact that main focus should be on preventive adaptation measures. The economic, social, human costs of preventive adaptation are always lower than those of reactive adaptation. Special emphasis should be put on the fact that unsophisticated low cost preventive adaptation measures can be very efficient. Example: information campaign in London during the heat waves calling for drinking sufficient amount of water.

When carrying out adaptation in the health sector mal-adaptation or inefficient adaptation should be avoided. Example; extensive use of air-conditioning during the heat season, adaptation measures should concentrate on natural ways of cooling.

4.3. Possible solutions to these challenges and areas for further improvements in terms of raising the adaptive capacity urban areas and health:

The study helped to identify the most vulnerable urban systems in the two municipalities and a number of appropriate adaptation options for small and medium-sized cities were suggested. These can serve as a starting point for shaping a local adaptation strategy either at municipality level or for an individual sector. Vulnerability assessments and the identification of potential measures can also connect climate adaptation aspects with short- and long-term urban planning.

Suggested climate adaptation measures for urban areas include:

- Introduction of innovative climate-resilient spatial planning;
- Expansion of green areas; the planting of drought-resistance plants;
- Adoption of new construction codes that minimize demand for air conditioning and promote the use of natural cooling for existing buildings;
- Upgrading of sewerage and drainage systems;

- Improved sealing of urban surfaces to cope with extreme precipitation.

The study recommends a number of soft measures such as:

- Legal framework stipulating urban authorities, especially, in the metropolitan areas, to prepare and implement public health adaptation strategy taking into view current and forecasted adaptation challenges;
- Encouragement of authorities, businesses, project implementers to study the accumulated experience of health adaptation (example: web platform weADAPT):
- Information campaigns for local residents and general climate awareness raising;
- Regular dissemination of information on extreme weather events and advices on the most efficient behavior;
- Support for instruments and methodologies translating adverse effects of climate change on public health into figures;
- Development of medical statistics;
- Synergies between adaptation to climate change and other environmental health issues (example: air pollution).

Chapter 5: Recommendations

This chapter includes key messages and recommendations for authorities and policy makers at EU, national and local level based on the results from the pilot study.

On strategic planning for climate change adaptation

- Staff in municipalities is often insufficiently informed about the opportunities to invest in adaptation measures, and is poorly trained or unable to partner with other institutions or associations. Therefore there is a need for strengthening the institutional and technical capacity for designing adaptation related measures and managing and complex project implementation.

Considering that in a situation of economic crisis the employment nearly always takes priority over climate change there is a need to highlight the potential of adaptation measures to provide opportunities for economic growth and job creation. Making this a case at municipal level is especially relevant.

On financing adaptation measures

- Municipalities need to dedicate more resources on assessment of risks and vulnerabilities in their territories and start planning for adaptation actions. External funding can be used to carry out strategic planning for climate change, particularly when research and assessment is required as a basis for decision making. For example, the LIFE climate sub-programme is expected to dedicate funds for this. Other EU funds, including the Cohesion Policy and rural development programmes also offer potential support for regional and local authorities to support their efforts on strategic planning and planning support work on climate change. This needs to be taken into account in the programming of EU funds.
- Aligning and mainstreaming activities on municipal level into national development or sector plans can help to identify and procure funding for adaptation measures, especially through national funds.
- Although efforts to improve strategic planning for adaptation need to continue in many municipalities, it is also important to dedicate financing resources on implementation. Carrying out demonstration projects and especially such with innovative character can stimulate locally driven, complex projects in addition to the conventional top-down projects.
- Both public and private financing measures are important for achieving climate-related objectives. However, the application of the first seems more widespread than the latter and municipalities should encourage private sector to invest in adaptation-related measures or initiate public-private schemes. To encourage private investors and foster their greater responsiveness there is a need to raise awareness about the essence of adaptation and the opportunities that such investments bring. Particular opportunities for private sector involvement exist in the health sector, water management, agriculture, etc. Improvement of

infrastructure resilience to climate change is another area with potential for private investments.

The last stakeholder meeting in Veszprem served also as a platform for meeting of the local farmers and city authorities. They discussed the possibility of using the local products in the catering of health and social institutions. This measure can be considered as a mitigation as well as adaptation one. Shortening the food supply chains can be considered as a mitigation measure since it reduces significantly the carbon emissions from transportation. On the other hand, food supply chains are vulnerable to the impacts of climate change, and local food can be a solution. Also this measure increases the social integration of the local farmers and promotion of health life style

Annex I

GLOSSARY

Adaptation	Adjustment in natural or *human systems* to a new or changing environment. Adaptation to *climate change* refers to 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 and reactive adaptation, private and public adaptation, and autonomous and planned adaptation (IPCC, 2007)
Adaptation measure	A single action in any of the sectors (infrastructure, finance, legal, etc.) leading to the increased resilience of the natural or human systems against climate change stimuli
Adaptation option	A group of adaptation measures carried out simultaneously to increase resilience of the natural or human systems.
Adaptation situation	A set of biophysical, administrative, legal, economic, and social conditions and adaptation challenges framing a situation under which a decision maker has to take a decision on adaptation
Climate- ADAPT	Information system Climate-ADAPT is one of the key, basic components of European adaptation knowledge. The system is managed by the European Environment Agency (EEA). It is available through http://climate-adapt.eea.europa.eu/web/guest/project/mediation)

Hazard	The temporal probability that an event of a given intensity involves a certain area during a specific time interval. Hazard includes latent conditions representing a future threat for man and the environment and is generally expressed in terms of annual probability.
Impact Attribution	The process of establishing the most likely causes for the detected change with some defined level of confidence.
Impact Assessment	Methodology which projects physical impacts and welfare costs from climate model outputs using impact functions, plus costs and benefits of adaptation options
MEDIATION Adaptation Platform	Online decision support tool representing in the electronic format the integrated methodology developed under MEDIATION. It assists to specify the tasks that have to be performed to address climate hazards effectively. The MAP is intended to be used by experts – i.e. scientists, policy advisors, and practitioners with technical or scientific backgrounds. It features such elements as the Adaptation Pathfinder, Toolbox, and Case Study Navigator.
Risk	Probability multiplied by consequence; with consequence being an impact such as economic, social or environmental damage / improvement that may result from a natural hazard. Theoretically, the consequence can be both positive and negative.
Risk Assessment	Comprises understanding, evaluating and interpreting the perceptions of risk and societal tolerances of risk as a basis for informing decisions and actions in the risk management process.

Vulnerability	Vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change. 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. (IPCC, 2007))
weADAPT	Online 'open space' devoted to climate adaptation issues (including synergies with mitigation) that allows practitioners, researchers and policy makers to access credible, high-quality information and to share experiences and lessons learnt. It is available at (http://weadapt.org)

Annex II

List of Indicators

Although the two pilot studies aimed at assessing the vulnerability of the urban system as a whole, indicators were suggested only for the health sector as the most crucial area which has been studied in a more detailed way and where statistic data are available.

Exposure related indicators are related to future climate stimuli, namely figures in connection with future temperature and precipitation, as follows:

- Daily mean temperature
- Projected maximum temperature
- Hot days: Number of days exceeding daily average temperature of 25C, 27C and 30C
- Number of hot days in intervals of at least 6 days with 5°C higher then mean calculated for each calendar day (on basis of 1961-1990) using running 5 day window
- consecutive hot days: maximum number of consecutive hot days
- Change(deviation from long term average) in seasonal precipitation amount
- Frequency of extreme events

Sensitivity related indicators related to socio-economic conditions, living conditions, education etc:

- The ageing index represents the ratio of the elderly (65-x) and children population (0-14 years old).
- SOCIO-ECONOMIC STATUS INDEX, based on the combination of some selected factors reflecting the settlement-level social situation (settlement level indicators incluse unemployment rate, low educational level, income conditions, number of passenger cars, rate of large families, rate of incomplete families, population density)
- Living environment/conditions: density of housing (person per room), proportion of dwellings lacking basic amenities, rate of one parent families, rate of one person households, rate of lonely pensioner households, rate of green areas per person, Large families (Parents with three or more children, in proportion of families)
- Education level: settlement level educational situation, rate of population with basic education, rate of population with secondary education, rate of population with high education
- Economic conditions: proportion of population of productive age, gross income serving basis for income tax, number of passenger cars per 100 inhabitants

Adaptive capacity, as ability to adjust to heat excess, characterized by the physical parameters and conditions of the buildings, awareness and knowledge, communication, measures and healthcare related indicators:

- Adaptive capacity complex index determined by factors as per capita income, inequalities, availability of healthcare services, access to information.
- Building features (material, insulation, shade, etc.)
- Adaptive tools (e.g. outer shade, special menu, etc.)
- Rules, measures (e.g. Heat wave plans, alerts)
- Per capita income

Vulnerability (function of exposure, sensitivity and adaptive capacity) indicators:

- Excess mortality, number of cases or % (causes of death, mapping the territorial distribution of mortality by settlements by age groups and by sex)
- Excess number of emergency calls, or number of cases or %

Risk related indicators:

- Health state of population characterized by territorial distribution of major diseases per 100000 population (spatial distribution of selected diseases)

Indicators are suggested to determine in spatial distribution stressing that impacts and consequently vulnerability to climate change are highly local dependent. Indicators can be used for identifying adaptation measures and policies only in that case, if the indicators are presented in proper geographic distribution.

Annex III

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