Chapter 13
Pilot Action in Budapest

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Abstract Pilot area chosen for evaluation is one of the biggest green investments of the latest 30 years: the area of this public park is 3.5 ha cost 500 million HUF. 2000 m^2 water surface is 1.2 m deep. Rehabilitation of Millenáris Park including reconstructions of main building and establishment of a public park costs 15 billions HUF. This is one of the intervention areas of local government (District II) in Budapest. Municipality has determined boarders of pilot area. Pilot area contains brownfield area, street canyon, public park, which were rehabilitated in the past and there is a big building, which will be destroyed in the future. Surface of the area is 0.48 km^2. Local meteorological measurements are continuously available to characterize changing in microclimate of pilot action. Urban planners, experts of green roof planning were involved in choosing pilot area for the UHI assessment.

Keywords Pilot action • ENVI-MET simulation • Human comfort • Mitigation and adaptation strategies • Green roofs • Green facades • Single row of street trees • Double row of street trees • Planters • Heat waves alert system

13.1 Planning Framework

13.1.1 Legal Foundations of Urban Planning

In urban planning even the smallest municipalities (local government) have wide discretionary powers. Their planning decisions may be annulled only in cases of breaking the law (central state act or a government statute). Legal control of local plans is performed by the State Government Offices in each of the 19 Counties. The control in specific professional fields is exercised by 9 State Chief Architects with regional competencies. In cases of disputes the final authority is the Constitutional Court. Therefore, Hungarian urban planning is deeply embedded in codified law.

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The base of urban planning law (Act on the Formation and Protection of the Built Environment) was adopted by the Hungarian Parliament in 1997, after a 7 year period of preparatory work. It was modelled on the German law (Baugesetzbuch). The Act was supplemented in the same year by a central government statute, the National Building Code (OTÉK). Besides the National Building Code some other governmental edicts give orders regarding the detailed contents of the particular plans. The Code is binding on all local planning decisions, but municipalities are permitted to render its maximum/minimum standards more "rigorous". The 1997 Act introduced four planning tools, namely:

- Urban-planning development strategy
- Urban Development Concept
- Structure Plan (preparatory land use plan)
- Regulatory Plan (binding land use plan)
- Local Building Code.
- the Action plan is though not part of the edict, but it is used quite often, if needed. (The action plan is a mide-term operational plan concerning to a particular part of a given territory.

The first two tools are adopted by the local authorities through a local government decision (e.g. they are "only" binding on the local government and it's organisations), the other two are adopted through a local government statute (i.e. they are binding for all concerned – e.g. property owners and developers).

Planning decisions are enforced by the Building Authorities functioning as departments of local government offices in cities and bigger villages. For some building affairs (i.e. heritage buildings, heritage areas, Natura 2000 districts) other state agencies function as first level building authorities and their full consent is needed for the issuing a building permit. As in the case of planning legislation, none of these authorities and agencies has discretionary powers, but operate in terms of the platform of law administered and enforced by them. The second level building authority – the place for appeals against decisions – operates within the State Government Offices in each County.

13.1.2 Growing Environmental Complexity of Urban Planning in Hungary

While the permitted regulatory content of urban physical building plans in Hungary is rather limited, another important trend facilitates their complexity. Most state agencies, representing specific professional fields look at local physical plans as "omnipotent" tools for the assertion of their interests. That is why a great – and growing – number of so called "supporting studies" should be worked out as part of a local plan.

These include:

- the protection of local historic and architectural heritage (including archaeology),
- environmental protection and control

– landscape and nature protection (including Natura 2000 areas)
– generation and management of local traffic
– development of public utilities
– rain water management.

These studies should be part of the non-binding Structure Plan, thus enhancing the complexity, specifically the environmental foundations of local planning. However, the 27 State agencies find it rather problematic to formulate clear-cut and legally sound regulations in these fields in Regulatory plans and in local building codes. It is also noteworthy that no social or housing studies are prescribed by law as "supporting studies". Social planning has never been strong in Hungary while environmentalists are gaining ground here as everywhere in the world.

13.2 The UHI Project and the Planning of the Pilot Area

Climate-conscious urban planning, especially that of public spaces, has little history in Hungary. Although Hungary's Environmental Law requires that each settlement prepare a program for the protection of the environment, these documents tend to be either overly theoretical studies or summaries of the initiatives of local non-governmental organisations. In urban planning documents, climate consciousness manifests itself mostly in the parroting of well-known slogans, without any concrete practical suggestions.

This situation – found not only in Hungary – is what the UHI Project wished to remedy: Relying on several years' worth of research identifying and evaluating factors that influence climate, and inviting the contribution of external partners, we tested the effects that climate-related factors of urban development had on a pilot area. Background support for the experiment was provided by a computer program called ENVI-MET, which, based on knowledge of the existing situation, is able to use several dozen climatic variables to calculate changes that would occur if the plans were realised.

13.3 Description of the Pilot Area

The Budapest pilot area lies on the Buda side of the city: an area of approximately 50 ha, bordered by Margit körút – Retek utca – Fillér utca – Garas utca – Alvinci út – Kapor utca – Felvinci út – Ribáry utca – Bimbó út – Keleti Károly utca. The pilot area fits the nature of the experiment rather well, from several points of view, since it is a rather multifaceted area. In terms of neighbourhood character, it is located at the meeting point of traditional high-density urban cores characteristic of the end of the nineteenth century; rather dense, quasi-urban areas along Margit körút, built in the 1930s and 1940s, with larger, green yards; and a high-prestige

green belt with villas. The area is centred around a brownfield regeneration project, which used to be the site of an earlier turbine factory but which in the early 2000s gave way, with a complete change of its functions, to a recreational and cultural centre, retaining and utilising some of the earlier industrial structures and incorporating them into a public park. Another characteristic example of green space in the area is a park called Mechwart liget, which was renewed during the last few years, keeping intact its proportion of green space. The area also comprises several streets, such as Retek utca and Kis Rókus utca, which, along with Keleti Károly utca, provide typical examples of city canyons, with practically no trees.

Thus climate-conscious replanning of the area will offer, on the one hand, an opportunity for computer modelling that can project climatic conditions for a relatively diverse set of spaces, and, on the other hand, a potential starting point for the examination and analysis of many other modelling regions.

In addition, both the method of analysing data from the modelling regions and the content of the action plan can help to provide a framework for elected representatives in the local government of the targeted Budapest district to conduct informed discussions on the subject. The material may also provide ideas for the climate-conscious construction of projects for the new EU planning period.

13.4 Methodology – The Tools

The methods applied within the UHI Project are not new to public space planning: it is well known both in and outside professional circles that vegetation, for example, cools the environment through evapotranspiration; and these methods represent the primary tools employed in the redevelopment of outdoor public spaces in general. The novelty of the project – which is hopefully of revolutionary significance – lies in its ability to predict and calculate reliably the climatic effects of the tools employed, as well as the possibility to distribute these tools widely. Unfortunately, in Hungary – as in several other European countries – with the increase of solid paved surfaces, the currently fashionable trends in planning open public spaces often not only fail to improve but actually contribute to the deterioration of climatic conditions in the redeveloped areas, yet this effect is difficult to estimate in practice without reliable quantifiable methods. The methods tested within the UHI Project, designed to be made readily available for wide circulation, are expected to help specialists in organisations responsible for the regeneration of public spaces in accepting only commissioned plans that improve, rather than deteriorate, climatic conditions; otherwise visitors using public spaces will have a less comforTab. experience in the summer, and even though there might be temporary stop-gap measures taken, such as the installation of mist cooling gates, the new public spaces will be used less often than the old ones were.

Within the pilot area, the planners of the Budapest modelling regions used the following tools provided by the climate specialists of UHI:

- Single Row of Street Trees
- Double Row of Street Trees

- Planters
- Green Spaces
- Permeable Pavement
- Green Walls – Vertical Gardens
- Green Roofs

13.5 Suggestions for Application of the Tools

13.5.1 Open Space Characteristics of the Pilot Area

Rows of street trees appear only sporadically within the area (for example, in Lövőház utca, Bimbó út, Marczibányi tér, Fillér utca, Felvinci út, Kapor utca, Kitaibel Pál utca, Tizedes utca, Ribáry utca), and public green spaces or vegetation are present only to a minimal extent (Fillér utca).

The rows often have trees missing; there are single and double rows of street trees in the area (featuring Fraxinus, Koelreuteria, Acer, Robinia ssp.); and there are two areas of significant dimensions which also include water surfaces: Millenáris Park (3.5 ha) and Mechwart liget (1.8 ha).

Examples of permeable surfaces in the area are negligible; apart from isolated examples (such as Lövőház utca, Káplár utca, or Keleti Károly utca), the dominant surface is asphalt, on both the roads and the sidewalks.

13.5.2 Action Plan and the Tools Employed

Rows of Street Trees in Public Spaces

Main effects: shading; reducing the air and surface temperature; evapotranspiration; windbreaks; protection from UV rays; and reducing air pollution and greenhouse gas emission.

Street trees may be planted depending on the types of buildings, the forms of facades and streets, and the cross-section of the street; in many cases the dimensions of the sidewalk and parking lane will not allow for any green spaces other than rows of trees. Single or double rows may be planned (Figs. 13.1 and 13.2).

Street trees recommended for the area: a single row of Tilia x euchlora (15–20 m) in Keleti Károly utca; a single row of Fraxinus excelsior ‘Jaspidea’ (10–15 m, yellow-leaf variety) in Mechwart tér and Fillér utca and a double row in Fény utca (Fig. 13.3); a single row of Gleditsia triacanthos ‘Sunburst’ (10–15 m, yellow-leaf variety) in Buday László utca; a single row of Fraxinus excelsior ‘Westhof’s Glorie’ (20–25 m) in Garas utca; a single row of Koelreuteria paniculata (5–8 m) in Ezredes utca and Pengő utca (Fig. 13.4); and a single row of Acer platanoides ‘Emerald Queen’ (10–15 m, yellow-leaf variety) in Retek utca.

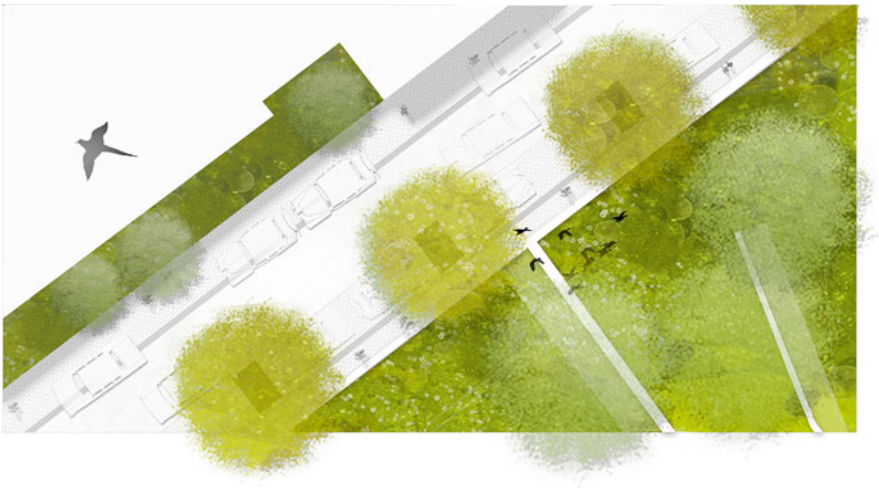

Fig. 13.1 Single row of trees on the pilot area

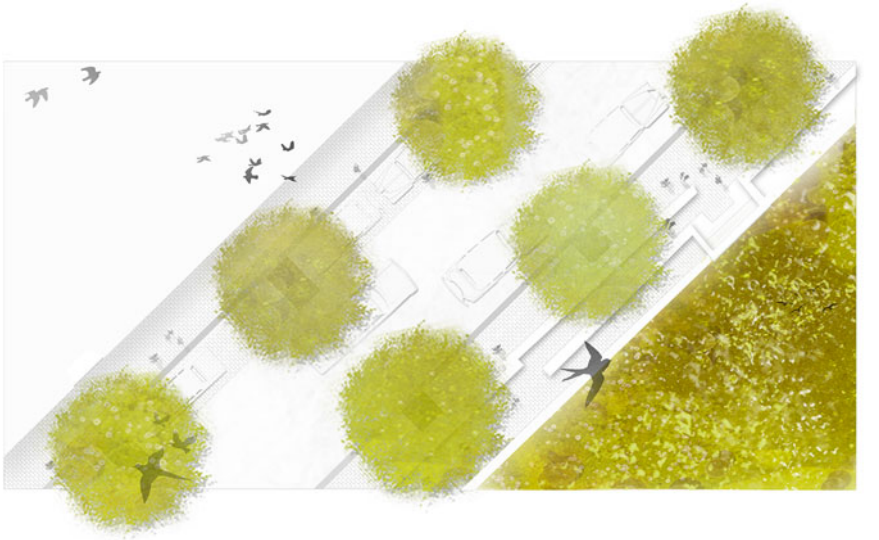

Fig. 13.2 Double row of trees

On occasion, rows of street trees will be planted in combination with parking, at an appropriate distance from the building facades, taking into account the relatively narrow cross-section of the street – 10–11 m between facades – and the expected growth of the canopy. Based on these considerations, we recommend planting individual trees every 11.5 m, replacing every other parking space.

Fig. 13.3 Double row of trees in Fény utca

Fig. 13.4 Single row of trees in Pengő utca with permeable pavement and tree protection

To protect each individual tree, a Corten Steel tree hole is provided, with a base of at least 1.5 m×1.5 m (when combined with parking, the base will be of 1.5 m×2.3 m) and with a fully accessible finished surface. The species and types recommended are drought-tolerant, pollution-tolerant and at least relatively quick-growth. For planting in streets with more shade, the high-tolerance species of Koelreuteria paniculata is recommended.

Fig. 13.5 Planters combined with rows of street trees

Planters
Planters may bring green spaces to streets that cannot accommodate trees.

In combination with rows of street trees, planters produce multi-zone vegetation (Fig. 13.5), but this solution is recommended only if the width of the sidewalk is at least 1.5–2 m – green surfaces that are too narrow can cause maintenance problems – and if parking allows enough space (that is, the parking lane is at least 2.5 m wide).

It is necessary to raise the level of the planters 50–60 cm from the surface of the sidewalk, because of their use within the city – litter, snow shovelling in the winter, salt, pedestrian traffic, dog walking, etc. – in order to ensure a longer lifetime for the vegetation.

Recommended locations: in the middle section of Fény utca, on both sides, with widths of 2.3 m and 2 m, respectively; in the southern section of Fillér utca, on one side, with a width of 1 m; and in the middle section of Bimbó út, on one side, with a width of 1.5 m (Fig. 13.6).

In terms of species and types to plant, low shrubs, perennials and grasses are preferable.

Species and types recommended for planting in full/partial sun: Helictotrichon ssp., Panicum ssp., Carex ssp., Calemagrostis ssp., Yucca ssp., Lavandula ssp., Rosmarinus ssp. For containers interspersed with rows of street trees, shade tolerant species and types are recommended: Carex ssp. (C. morrowii, C. sylvatica, C. oshimensis etc.), Deschampsia ssp., Hakonechloa ssp., Phalaris ssp., Vinca ssp.

Contiguous green spaces greatly contribute to decreased storm water runoff within inner city areas, and, due to the significant presence of ligneous plants, have advantages similar to those of planting rows of street trees. The plan recommends

Fig. 13.6 Planters in Bimbó street

the installation of new green spaces: a public park in the area bordered by Margit-körút – Kis Rókus utca – Fény utca, adjacent to Millenáris, which is to be called "Széllkapu Park" – a pun on the neighbouring public transport hub called Széll Kálmán tér and the Hungarian words szél ('wind') and kapu ('gate'); at the corner of Fillér utca and Garas utca (see Fig. 13.7); and in the inside courtyards of buildings Fillér utca 9–11 and Lövőház utca 24, 22, 20 and 16b.

These planned green spaces are characterised by multi-zone vegetation; the species and types recommended for planting in the Széllkapu area are similar to those planted in Millenáris (Fig. 13.8). Within green spaces, permeable pavement may be applied in areas paved for foot and service traffic: gravel, concrete tiles and light natural stone, such as limestone.

Permeable pavement is applied to decrease storm water runoff and desiccated soil in the city, thereby increasing evaporation even on paved surfaces.

Recommended locations: replacing older pavement on sidewalks (except for Lövőház utca, Káplár utca and Keleti Károly utca), and in parking lanes. As for the choice of materials, an important consideration is the use of light colours for a higher albedo, instead of dark, waterproof asphalt. For sidewalks, mostly used for foot traffic, the use of concrete tiles is recommended, while for areas of heavy use (surfaces in new green spaces) natural stone – limestone – is suggested.

For the installation, permeable pointing and foundation work must be applied.

Green Walls – Vertical Gardens

The use of green walls or vertical gardens contributes to the shading of walls, thereby lowering the surface temperature of wall facades, reducing heat gain and lowering energy use inside buildings, as well as cooling through evapotranspiration.

Green walls or vertical gardens are best used in locations where the width of the street does not allow for the placement of any other vegetation. Recommended locations: Kis Rókus utca 35, 18 (Fig. 13.9); Fény utca 21 (on the facade of the Melegpörgető building). Species and types of plants recommended: Parthenocissus ssp., Vitis ssp., Hedera ssp., Reynourtia ssp.

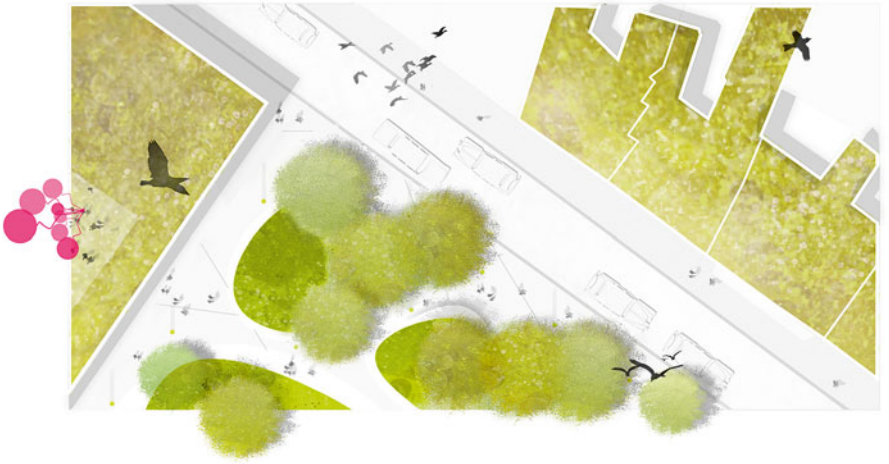

Fig. 13.7 Green spaces in Széllkapu Park

Fig. 13.8 View of Széllkapu Park

Using green roofs (Fig. 13.10) helps in retaining water and shading roofs; via evaporation, in reducing the surface temperature of roofs; in reducing air temperatures and cooling the city; in reducing heat gain and lowering energy use inside buildings; and in storing storm water within the substrate as well as evaporating it to the atmosphere.

Extensive green roofs – with a 5–10 cm soil bed – do not require watering and are low maintenance in general.

In the effort to encourage the installation of extensive green roofs, local authorities have a range of possibilities to intervene, depending on the ownership of the property: for buildings belonging to the local government, the local authorities themselves have full control over modifications, while in the case of buildings

Fig. 13.9 Green wall in Kis Rókus utca

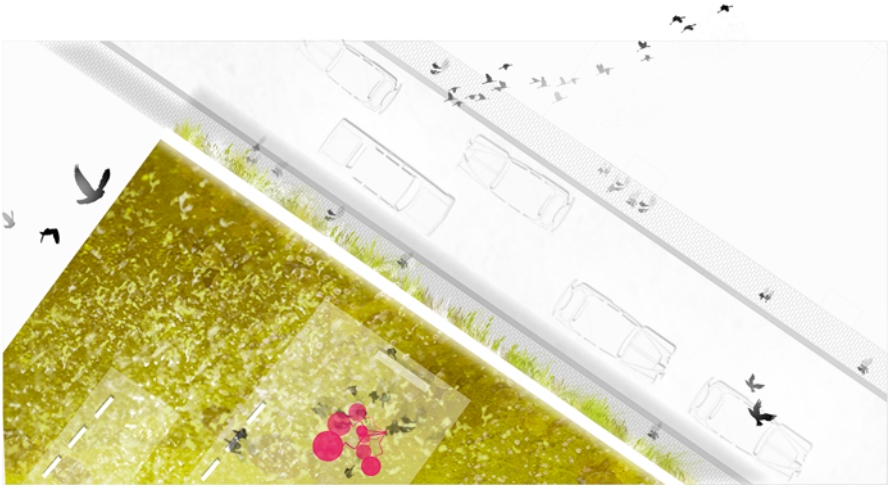

Fig. 13.10 Green roof within the pilot area

owned by other legal entities – such as the state government or private companies – the local authorities may initiate the process or, in the case of buildings owned by private citizens (condominiums, for example), may offer financial support as part of the preferred solution. Recommended locations:

Green roofs on buildings owned by local government: Marczibányi tér 5a, 13, etc.;
Green roofs on buildings owned by other legal entities: Tulipán utca 24, Marczibányi tér 3, Kis Rókus utca 18, 16, 14, 12, 2, 4, 6, Lövőház utca 1–6, 12, 14, Fényes Elek utca 7–13, 14–18, etc.;

Green roofs on buildings with multiple private owners: Kis Rókus utca 33–31 (Fig. 13.10), 1-1a-3-5-7, etc.

Species and types of plants recommended: Sedum ssp., Euphorbia ssp., Delosperma ssp., Thymus ssp.

13.6 Effects of Interventions on the Local Climate

13.6.1 Characteristics of the Local Climate

The microclimate of the pilot area is influenced by several factors. On the one hand, the prevailing north by north-westerly winds arrive from the direction of Hűvösvölgy, while on the other hand the terrain plays a significant role in the formation of the microclimate of the area, which lies on the south-western slopes of Rózsadomb, reaching down to Margit körút. In addition, larger buildings have a significant impact, especially in narrow streets with high facades, such as Lövőház utca, which, moreover, runs parallel to the prevailing winds, making it the most significant city canyon of the area. It is also important to mention that, as is true for District II as a whole, the pilot area is also quite well endowed with urban trees. Yet the state of the trees and, on occasion, run-down conditions in general offer sufficient justification for the regeneration of the area.

13.6.2 Description of the ENVI-MET model

In order to examine the effects on the microclimate created by the most important interventions planned in the area, a microclimate-modelling project was undertaken using ENVI-MET modelling software. Since the entire area would have been too extensive to model, three representative regions were selected, as shown by the map in Fig. 13.11.

For modelling microclimates, 4 m×4 m cells were used throughout. The direction of the wind was defined as north-westerly; wind speed at the elevation of 10 m was defined as 3 m/s. Simulations were started on a typical summer day at 9 p.m.; the period of simulation was 24 h. Initial air temperature was set to 23 °C; relative humidity at the elevation of 2 m was set to 70 %. For each selected region the model was projected in two versions: the first one represented the original situation, while the second one represented the planned situation.

Fig. 13.11 Layout of modelling regions within the pilot area

13.6.3 Evaluation of the Simulation Results

Below, the effects of the intervention tools described in the previous section will be summarised briefly.

Rows of Street Trees: Planting single and double rows of street trees results in decreases local to each tree, both in terms of mean radiant temperature (MRT) and in terms of predicted mean vote (PMV). With expansion of the canopy of the trees, or by planting trees closer together, the distribution of these decreases tends to become more linear.

As is shown by Figs. 13.12, 13.13, 13.14, and 13.15, rows of street trees typically reduce predicted mean vote (PMV) value by 2, occasionally by 3. In our case this means that while in the initial situation 80 % of pedestrians on the sidewalk feel uncomforTab., after trees are planted this ratio is reduced to 10–30 %.

Planters In isolation, planters have little effect on the microclimate; however, they exercise an undeniably positive effect on the streetscape and on the psychological well-being of the population. In Bimbó út, planters appear in combination with rows of street trees; here their effects cannot be clearly distinguished from the microcli-

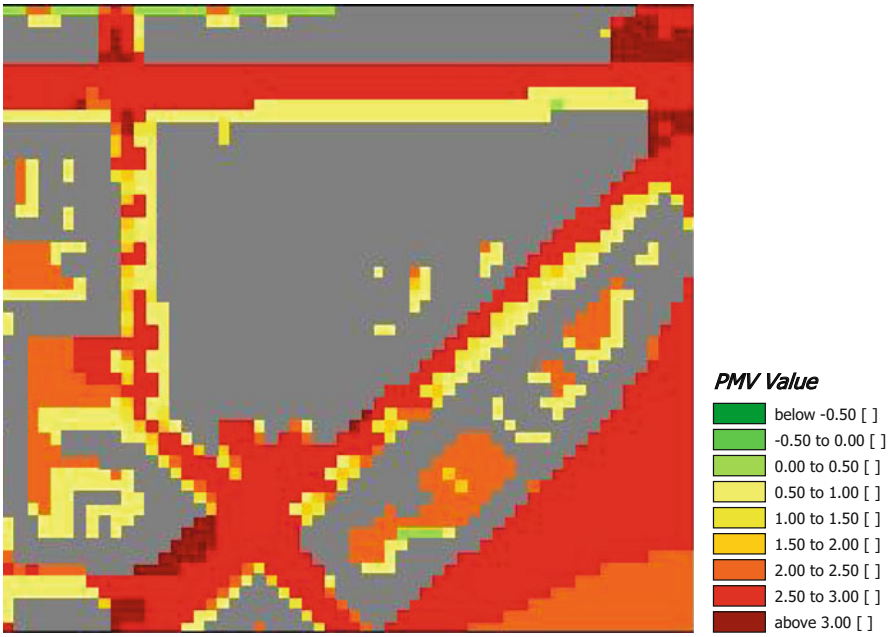

Fig. 13.12–13.13 Effects of single and double rows of street trees on predicted mean vote (PMV) in Fény utca and Retek utca (summer status, 12:00 p.m., 1.6 m)

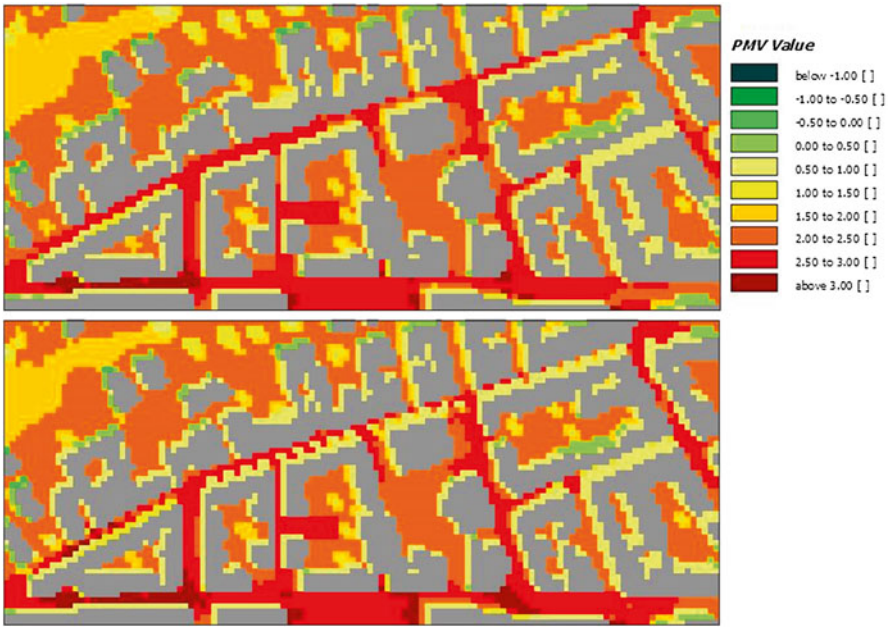

Fig. 13.14–13.15 Effects of rows of street trees on predicted mean vote (PMV) in Keleti Károly utca (summer status, 12:00 p.m., 1.6 m)

matic effects of the trees, and, therefore, far-reaching conclusions cannot be drawn concerning their effectiveness.

Permeable Pavement Permeable pavement cannot be modelled using the ENVI-MET program, thus its effects can only be estimated based on descriptive studies. It is well known, however, that, depending on the base layer, permeable pavement is typically able to retain 35-60 % of the water. This has several advantages. Due to its porosity and absorbance, it warms more slowly and cools more quickly than traditional pavement surfaces and, therefore, has a positive effect on the microclimate. It decreases storm water runoff, thus allowing water to reach the trees along the street, and helps replenish the water Tab.. Using permeable pavement therefore addresses two important problems of urban heat islands: it improves the radiation and water balances.

Green Walls – Vertical Gardens For the scale of the modelling regions, the planned green walls and vertical gardens could not be modelled; earlier research shows, however, that green walls – vertical gardens that are nearly parallel to the direction of the prevailing winds significantly decrease mean radiant temperature (MRT) and predicted mean vote (PMV) values in their immediate surroundings.

Green Roofs The effects of the planned green roofs are rather complex, and, therefore, difficult to model. Green roofs not only decrease the intensity of urban heat islands but also decrease storm water runoff, thus also reducing the amount of grey-water to be treated. They also play a significant role in improving the quality of life for people working or living in the buildings by offering a natural area for relaxation and recreation.

Green Spaces Within the pilot area, there are two significant public green spaces, Millenáris Park and Mechwart liget, where no changes were recommended. The model did, however, examine the effect of a new green space: the new park, to be created at the site of a soon-to-be-demolished ministry building, which will significantly increase the green spaces of Millenáris Park. The disappearance of the ministry block and the creation of the new green space will decrease air temperatures by 1.5–2.5 °C, according to the microclimate modelling results (Figs. 13.16 and 13.17).

In summary, it can be stated that within the modelled regions the microclimate – following the localised nature of the intervention – improves in discrete areas due to the proportionate increase of green spaces: cross-ventilation improves, relative humidity increases, mean radiant temperature (MRT) significantly decreases and, in cases of drastic intervention, air temperatures also show significant decreases.

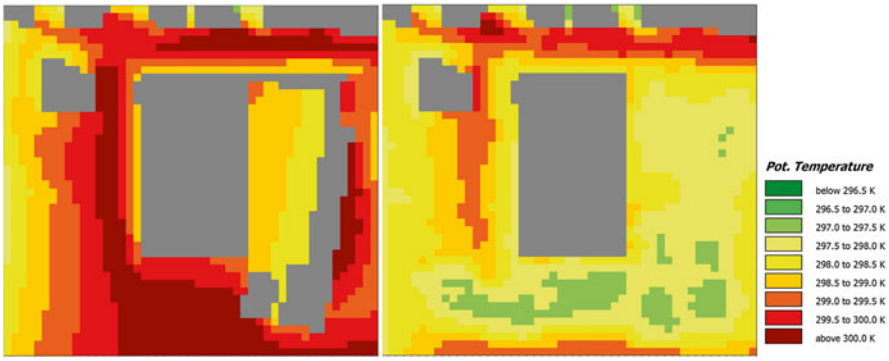

Fig. 13.16–13.17 Area of Széllkapu Park: status before (*left*) and after (*right*) the demolition of the ministry building and the installation of the planned park (air temperature, summer status, 12:00 p.m., 1.6 m)

13.6.4 Suggestions Concerning Organisation and Logistics

For the realisation of climate-conscious development of the area, the suggested solutions are similar to traditional solutions, undertaken in such a way that the role of the local government is in harmony with existing tools on the one hand and with the ownership relations of the properties to be developed or regenerated on the other, with special attention to properties owned by the local government.

Due to the diversity in ownership, interests and abilities, it cannot be hoped that the suggested plans could be realised in their entirety in one, well organised initiative, in a short period of time – yet most elements of the plan could indeed be carried out in such fashion, while a smaller proportion of the plans could be realised as – preferably coordinated – individual actions carried out by the other parties but initiated, and on occasion supported, by the local authorities.

For the preparation and organisation of tasks, especially those to be carried out by the local authorities, the relevant local government body responsible for urban development and planning should be appointed as coordinator – who will, then, invite the contributions of other parties, such as planners and constructors, as necessary.

As for the timing of individual tasks, priority should be given to properties owned by the local authorities, to tasks that can be carried out within the jurisdiction of the local authorities, primarily to public spaces that could serve as direct examples, such as green roofs on buildings of institutions controlled by the local authorities. An equally important recommendation is the simultaneous commencement of negotiations with the property managers of national institutions, to invite them to participate in the program and to help realise climate-conscious redevelopment for

elements of their buildings. The installation of a green wall or vertical garden on the Kis Rókus utca facade of the buildings in Millenáris Park may have a special position in this respect, as the soil in which the vegetation is planted is in a public space owned by the local authorities, while the vegetation climbs on the walls of a building under national ownership. Here a special agreement will be necessary between parties concerning maintenance, the recommended solution being that the local government take responsibility for planting and watering the plants.

The inclusion of local businesses and condominiums in the program requires yet another set of solutions. In both cases the recommended procedure would be for the local government to invite owners to participate in the program, and to explain in the course of preparatory negotiations how advantages and savings will accrue as a result. In addition, for businesses, PR-based incentives might be introduced (such as the establishment of the title 'Climate-Conscious Business of the Year'), while for condominiums a system of financial support might be successful.

13.6.5 Cost Estimate and Suggestions for Financing

Costs and sources of funds for realising the climate-conscious urban development action plan are estimated below. The sums presented are to be viewed as an order-of-magnitude estimate and relate primarily to the establishment of cost ratios, intended to help make decisions about subsequent steps and actions.

Individual trees

Keleti Károly utca: Tilia x euchlora (15–20 m) single row
45 @ 50,000 HUF, total: 2,250,000 HUF
Mechwart tér: Fraxinus excelsior 'Jaspidea' (10–15 m, yellow-leaf variety) single row
22 @ 25,000 HUF, total: 550,000 HUF
Fillér utca: Fraxinus excelsior 'Jaspidea' (10–15 m, yellow-leaf variety) single row
38 @ 25,000 HUF, total: 950,000 HUF
Fény utca: Fraxinus excelsior 'Jaspidea' (10–15 m, yellow-leaf variety) double row
28 @ 25,000 HUF, total: 700,000 HUF
Buday László utca: Gleditsia triacanthos 'Sunburst' (10–15 m, yellow-leaf variety) single row
10 @ 20,000 HUF, total: 200,000 HUF
Garas utca: Fraxinus excelsior 'Westhof's Glorie' (20–25 m) single row
17 @ 50,000 HUF, total: 850,000 HUF
Ezredes utca: Koelreuteria paniculata (5–8 m) single row
14 @ 20,000 HUF, total: 280,000 HUF
Pengő utca: Koelreuteria paniculata (5–8 m) single row

14 @ 20,000 HUF, total: 280,000 HUF
Retek utca: Acer platanoides ‘Emerald Queen’ (10–15 m, yellow-leaf variety) single row
14 @ 20,000 HUF, total: 280,000 HUF

Trees total: 6,340,000 HUF + 27 % VAT = 8,000,000 HUF

Tree hole grilles
202 @ 200,000 HUF, total: 40,400,000 HUF

Rows of street trees, total: 48,400,000 HUF

Planters
Fény utca: 2 m wide, on both sides
200 m^2 @ 20,000 HUF, total: 4,000,000 HUF
Fillér utca: 1 m wide, on one side
70 m^2 @ 20,000 HUF, total: 1,400,000 HUF
Bimbó út, 1.5 m wide, on one side
270 m^2 @ 20,000 HUF, total: 5,400,000 HUF
Plants, planters, total: 10,800,000 HUF
Green Spaces
SzéllKapu area
12,000 m^2 @ 20,000 HUF, total: 240,000,000 HUF
Green spaces, total: 240,000,000 HUF
Permeable Pavement
Total of 5 km pavement, on average 3.5 m wide
5000 lm @ 50,000 HUF, total: 250,000,000 HUF
Permeable pavement, total: 250,000,000 HUF
Green Walls – Vertical Gardens
Trellises
1100 m^2 @ 5,000,000 HUF, total: 5,500,000 HUF
Plants
110 lm @ 5000 HUF, total: 550,000 HUF
Green walls – vertical gardens, total: 6,050,000 HUF
Green Roofs
On buildings owned by local government
3900 m^2 @ 15,000 HUF, total: 58,500,000 HUF
On buildings owned by other legal entities
26,000 m^2 @ 15,000 HUF, total: 390,000,000 HUF
On buildings with multiple private owners
21,000 m^2 @ 15,000 HUF, total: 315,000,000 HUF
Green roofs, total: 763,500,000 HUF
Reconstruction of Public Utilities
In streets with rows of trees, organised in tandem with the introduction of district heating, in cooperation with FŐTÁV, the Budapest district heating agency
5 km @ 400,000,000 HUF, total: 2,000,000,000 HUF
Complete reconstruction of public utilities in affected streets, total: 2,000,000,000 HUF

Climate-conscious regeneration of complete area, sum total: 3,318,750,000 HUF
Costs to be paid directly by local government: 613,750,000 HUF
Costs to be paid by local government without the relatively low-benefit yet high-cost permeable pavement: 363,750,000 HUF

Costs of climatically most efficient and also most spectacular investment (street trees and planters), which are within the jurisdiction of local authorities: 59,200,000 HUF

A fundamental prerequisite for planting rows of street trees, however, is coming to a satisfactory arrangement with public utilities. Planting may be coordinated with complete upgrades carried out by the utility companies, or with the installation of a significant new type of utility – such as district heating – which necessitates the relocation of underground utility installations. It is therefore recommended that preliminary negotiations be conducted with utility companies, primarily with the representatives of FŐTÁV Zrt, the Budapest district heating agency, concerning the submission of an EU pilot project, such as Horizont 2020.

13.7 Action Plan for Local Governments in Heatwave Alert Situations

The following legal regulations apply, and should be considered, before raising a heat alert:

Act LXXII of 2012 on the Amendment of Act CXXVIII of 2011 Concerning Disaster Management and Amending Certain Related Acts;
Decree of the Minister of the Interior No. 61/2012. (XII. 11.) on the Disaster Management Categorisation of Municipalities, and on the Amendment of the Decree of the Minister of the Interior No. 62/2011. (XII. 29.) on Certain Rules of Disaster Management.
Act LXXXII of 1995 on the Promulgation of the UN Framework Convention on Climate Change;
Act CXXIX of 2000 on the Amendment of Act LIII of 1995 on the General Rules of Environmental Protection;
Act XV of 2005 on Greenhouse Gas Emission Allowance Trading; and 213/2006 (X. 27.) Governmental Decree Implementing Act XV of 2005 on Greenhouse Gas Emission Allowance Trading;
Act LX of 2007 on the implementation framework of the UN Framework Convention on Climate Change and the Kyoto Protocol thereof; and The National Climate Change Strategy (NCCS), which was based on the act on the implementation framework of the Kyoto Protocol;
"Adapting to Climate Change in Europe" European Commission Green Paper, June 2007;
Act XXXVII of 1996 on Civil Protection;

Act LXXIV of 1999 on Disaster Management (direction and structure of protection against disasters and the protection against major accidents involving hazardous materials);

Within the system of civil protection planning, the 'Decree of the Minister of the Interior No. 20/1998. (IV. 10.) on the System and Requirements of Civil Protection Planning' classifies the types of hazards that necessitate planning;

Due to climate change caused by global warming, extreme weather incidents have occurred in Hungary with increasing frequency; summer heatwaves, lasting for several weeks, are particularly stressful for the population. In Hungary, disaster management is conducted within a strict legal framework; the tasks of local authorities are specified in Act CXXVIII of 2011 on Disaster Management and Amending Certain Related Acts.

The steps for preparing for longer heatwaves, along with special points for consideration, will be detailed below. The European Commission Green Paper, June 2007, draws attention to, among other things, the dangers posed by heat to human health; thus, it is extremely important to prepare an action plan to protect the population during heat alerts.

There are several groups within the population of Hungary that are especially at risk. The age distribution of the population categorizes Hungary as an ageing society. A significant proportion of people performing manual labour are outdoors in the summer during heatwaves, for extended periods of time or all of the time. Summer is also the period for open air events, with cultural and sports events attracting large numbers of participants. Special attention must be paid to minimizing health risks for participants in these programs. Employers must seek to protect the health of employees working outdoors; during heatwaves, they must provide for their employees ample drinking water, periods of rest in shady areas, appropriate working clothes and protective gear.

From the point of view of the environment and of environmental health, special consideration must be given to those utilities and public services that influence positively or negatively the quality of life of the population, as well as the quality of the environment, during heatwaves.

Special protection must be provided for the drinking water infrastructure, particularly strategic reservoirs and water mains, which are maintained by water utilities to provide high-quality drinking water for the population.

In the event of disruptions to electricity service during heatwaves, all customers can be provided with electricity with blackouts averaging 2–3 h. During longer heatwaves, energy demands may increase, which might require the imposition of limitations on consumption.

Since Hungary is a country along major transit routes, dangers affecting branches of transportation during heatwaves must also be taken into account. A relatively minor disruption in railway services might cause serious delays. In extensive heat, rail lines can be deformed; overhead wires and pylons can be damaged. During a temporary suspension of railway services, railway stations must offer shelter for railway passengers until such time as they can continue their journeys. While these passengers remain stranded, their basic needs must be addressed.

Settlements are often situated near motorways and major transit routes. During periods of continuously high daily average temperatures, the number of accidents may increase in the affected stretches. When congestion builds up following an accident, people sitting in cars will need to be supplied with liquids.

Transit lines run by public transportation companies work continuously on days of high average temperatures as well. Newer vehicles have been equipped with air conditioning, which must be used. On older vehicles, cross ventilation and the use of ventilators must be applied continuously to offer heat protection for the passengers.

During periods of high daily average temperatures, communal waste must be collected more frequently in order to prevent epidemics.

13.7.1 Communicating with the Public

Heatwaves are usually possible to predict, and, therefore, the public must be informed about preventive measures they can take to protect their health. If the local authorities are to issue a warning, attention must be paid to the following considerations: Communication may be effected in writing or as a personal announcement. It may take the form of a press release, a public announcement, a briefing or interactive communication, during which attention must be called to the negative effects of heatwaves on health; the necessity of remaining hydrated; the need to seek shelter in shady places; and the dangers of leaving one's place of residence.

The public must be informed that they should take along some drinking water if they leave their homes. Warnings must be issued about the need to be extra careful and circumspect in traffic. The information issued must always be authenticated; creating a sense of panic must be avoided.

The tasks of the preparatory phase are as follows:

The forecasts and news bulletins of the Hungarian Meteorological Service and the National Public Health and Medical Officer Service (NPHMOS) must be followed.

The public must be informed.

People with severe medical conditions and others at special risk must be identified.

Reserves of drinking water must be prepared.

Vehicles delivering drinking water must be arranged.

Any available street watering trucks must be pressed into service.

Local institutions with air conditioned buildings that may accommodate large numbers of people must be identified.

The tasks of the protection phase are as follows:

Local authorities must remain in contact with the local offices of NPHMOS and with disaster management authorities.

Communication with the public must be continuous.
Access to public buildings with air conditioning must be arranged.
Shelters must be opened, if necessary.
Drinking water distribution in the busiest centres of the community must be organised.
Major routes and public spaces must be watered down several times a day.
Logistical support, with special attention to the availability of equipment and manpower, must be established and operated continuously.

Stages of heatwave alerts, action items, and the raising of alerts

Level One (Heatwave Advisory)

Criteria: according to forecasts, the daily median temperatures exceed 25 °C for at least 1 day
Actions required: Within its own internal system, NPHMOS provides information to its regional and micro-regional institutions. Local authorities will decide whether to inform the public through local media.

Level Two (Stage 1 Alert)

Criteria: according to forecasts, the daily median temperatures exceed 25 °C for at least 3 days
Actions required: The Chief Medical Officer will use the institutional network of NPHMOS to inform public health institutions, emergency services, doctors' offices and nurses' stations within the primary healthcare network and local authorities concerning the duration and degree of the heat alert. The task of the local authorities is to inform their own institutions (primarily those providing social services) to warn members of the public to take preparatory measures to protect their health.

Level Three (Stage 2 Alert)

Criteria: according to forecasts, the daily median temperatures exceed 27 °C for at least 3 days
Actions required: The responsible authorities must verify that actions taken at Level Two for the Stage 1 Alert are maintained. The public must be informed of the Stage 2 Alert through the media and via the local authorities. Protective measures must be initiated by health care institutions, nursing homes, chariTab. institutions, crèches, nursery schools, day care centres, and summer camps.

Rapid alert system for heatwave alerts

The first step is to set up a list of officials authorised to raise, and call off, a heatwave or UV alert. The appropriate level of heatwave or UV alert will be raised, and called off, by the Mayor, based on the alert issued by NPHMOS, the UV index values published by the Red Cross, or both. Based on the weather forecasts made by the Hungarian Meteorological Service, the Chief Medical Officer and NPHMOS will issue a warning. They will send a letter to inform the doctors' offices and nurses' stations of the primary healthcare network and the micro-regional local authorities concerning the duration and stage of the heatwave alert, asking for their cooperation

in abiding with the orders issued. The Mayor's Office will issue a warning to the institutions of the rapid alert system, as well as the general public, to take preventive action to protect their health (Table 13.1). The Mayor's Office must notify without delay the following institutions concerning the situation that has developed:

Civil Protection Office
Municipal Police Headquarters, Department of Public Order and Safety
Hospitals
National Ambulance Service
Social care institutions and sanatoriums
Local water works
Local energy providers
The Hungarian Labour Inspectorate
Local crèches
Preschools in operation at the time
Day camps and summer camps
The affected population, institutions and organisations, through the local media

Advice for various age demographic groups in the event of heatwave alerts is presented below in Tables 13.2, 13.3, and 13.4 in an easily understandable form, which can be converted to flyers. The colourful, printed flyers with illustrations can help draw attention to the information and reinforce the message (Tables 13.2–13.4).

Useful advice during heatwaves for the prevention and treatment of heat strokes for the elderly (Table 13.2).

Table 13.1 Advice for the general public

Suggestions and important messages for the general public in the event of heatwave alerts	
How to avoid heat	Important comments
Cool your home	Monitor room temperatures
Keep the windows closed during the day; use curtains, shutters, or other means of keeping the room dark. Open the windows to air the room at night, if possible. Switch off non-essential electric appliances (even including lights). If you have air conditioning, keep windows and doors closed	During heatwaves, when external temperatures reach 35–39 °C, the ideal indoor temperature is about 28 °C. Very cold settings for the air conditioner should be avoided. Electric fans should be used only for short periods of time
If these measures cannot be taken, spend at least 2–3 h in air conditioned places	People can be directed to the list of air conditioned places open to the public, as arranged during the protection phase
Avoid heavy physical work and stay in the shade during the hottest hours	
For the next summer, consider cooling your home ("cool" paint, humidifier, green plants)	
Keep your body temperature low and drink plenty of liquids to prevent dehydration	
Take frequent showers or baths in lukewarm water	Showers may increase the risk of falling for the elderly

(continued)

Table 13.1 (continued)

Suggestions and important messages for the general public in the event of heatwave alerts	
Use wet bandages and cool your feet in lukewarm water	
Wear loose garments of light colour and natural materials. If you go out in the sun, wear a large-brimmed hat and sunglasses	
Drink liquids regularly. Do not drink beverages with alcohol or high sugar content	During hydration, it is important to replenish lost salt and to avoid water intoxication. Caffeine acts as a diuretic
If you take medications regularly, ask your doctor about the effect of your medications on your internal fluid balance	People with elevated body temperatures require special attention
Monitor your body temperature	It is important to realise that body temperatures above 38 °C are detrimental to one's health. Heat strokes can occur at body temperatures exceeding 39 °C. Body temperatures above 40 °C present a life-threatening situation
Keep your medications at the appropriate temperature	If room temperature exceeds 25 °C, medications should be kept refrigerated, even if their boxes do not say so
Contact your doctor if you suffer from a chronic illness or if you take several different medications. If you experience unusual symptoms, contact your doctor immediately	
Inform yourself about the forms of assistance available	

Table 13.2 Brief, easily understandable advice for the elderly

Useful advice during heatwaves for the prevention and treatment of heat strokes for young mothers and small children (Table 13.3).

Those above 68, the disabled, or, especially, those with heart problems or high blood pressure should seek medical help immediately if their symptoms become worse in the heat	If you have an electric fan, use it in hot weather. During heatwaves, stay home in a darkened room, in a relatively cool place, for the hottest hours of the day, especially around noon or in the early afternoon
In very hot weather, take frequent showers or baths in lukewarm water	In hot summer days, do not go to the market during the hottest hours
WHAT TO DRINK	WHAT NOT TO DRINK
Water, mineral water, tea	Coffee, alcoholic beverages
Non-carbonated soft drinks	
Tomato juice, curd, kefir, yoghurt	Carbonated beverages with high caffeine and sugar content
Soups	
If you are taking medication for a heart condition, consume sufficient amounts of liquid while taking diuretics, that is, 1 l per day more on hot days than the usual amount.	

Table 13.3 Brief, easily understandable advice for young mothers and small children

Useful advice during heatwaves for the young (Table 13.4)

Babies and small children should be taken out for air only in shady places. Do not take babies for walks in extreme heat	If you have an electric fan, use it in hot weather. If possible, leave windows open at night for ventilation
Never leave children or animals (dogs) in locked, unventilated, parked cars	Protect yourself and your child by wearing wide-brimmed hats and sunglasses
WHAT TO DRINK	WHAT NOT TO DRINK
Water, mineral water, tea	Coffee, alcoholic beverages
Non-carbonated soft drinks	
Tomato juice, curd, kefir, yoghurt	Carbonated beverages with high caffeine and sugar content
Soups	
Babies in particular need a lot more liquid, even in addition to breast milk. Always offer them water or some tea with lemon and a little salt after breastfeeding.	

Table 13.4 Brief, easily understandable advice for the young

Protect yourself from the heat of the sun by wearing wide-brimmed hats and sunglasses. Wear light, loose cotton garments of light colour on hot days.	Apply sun protection lotion appropriate for your skin type several times a day. If you have very light skin and blue eyes, use sun lotion with a sun protection factor (SPF) above 10.
In very hot weather, take frequent showers or baths in lukewarm or cold water. Spend 1–2 h in air conditioned spaces.	If you are doing sports outdoors during heatwaves, cool yourself frequently and drink at least 4 l of liquids. It is also important to replenish lost salt.
WHAT TO DRINK	WHAT NOT TO DRINK
Water, mineral water, tea	Coffee, alcoholic beverages
Non-carbonated soft drinks	
Tomato juice, curd, kefir, yoghurt	Carbonated beverages with high caffeine and sugar content
Soups	

13.7.2 The Latest Tools for Communicating with the Public

Along with the public media (television, radio), web applications can also help in communicating with the public. In 2013, the National Directorate General for Disaster Management (NDGDM) developed and launched a disaster alert information application that can be downloaded on smart phones and Tab.ts free of charge. The mobile application makes it possible for people to be notified immediately about local weather anomalies or other dangers relevant to their homes or current locations. Through these devices, users with an Internet connection can conFig. the application to receive alert information relevant to the whole country or to a specific county, depending on their personal preferences. If the device has a GPS, that is, a unit able to define their position using a space-based satellite system, users can receive information for actual locations, for a planned route, or even for great distances.

In conjunction with its weather forecast and alert system, the Hungarian Meteorological Service (OMSZ) developed an application called Meteora, which can be downloaded from http://meteora.met.hu/meteora.html. The Meteora application is a clock that runs on mobile devices and also provides weather information. The program uses the positioning and Internet data access capabilities of the mobile device. Based on cell information, Meteora defines the position of the user and, using the data connection, automatically downloads local alerts and forecasts from the computers of the Hungarian Meteorological Service. Meteora is a widget developed for Android devices; after downloading, the version designed for the device screen size must be installed (Fig. 13.18). Installing the clock automatically activates the alert function.

Updates calling off alerts are passed on via the same rapid alert system.

The tasks for resuming normal life are as follows:
Establish responsibility.
Draw conclusions.

Fig. 13.18 Alert system application developed by the Hungarian Meteorological Service, displaying a clock on the mobile device

Evaluate efficacy and efficiency.
Provide relief as long as needed.
Resume the operation of institutions.
Reconcile costs incurred during disaster management.

Earlier experience indicates that the negative effects of extreme heat can affect extended areas and large segments of the population. It is therefore of paramount importance to be prepared for extended heatwaves and to utilize the protective powers of local governments to their full extent. Special attention must always be given to the protection of human life and property, as well as to the execution of any reconstruction work immediately required. Local authorities have a significant role in disaster management; they must devote special attention to the careful preparation of protective measures against the detrimental effects of extreme weather phenomena, because these preparations are crucial for developing an effective adaptation strategy.