BUDAPEST

SUSTAINABLE ENERGY AND CLIMATE ACTION PLAN OF BUDAPEST

2030

Client

The Municipality of Budapest

Coordination on behalf of the Client

Department for Climate and Environmental Affairs

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EXECUTIVE SUMMARY

The Municipality of Budapest joined the European Covenant of Mayors in 2008, with Budapest undertaking to reduce its CO_2 emission by 21% as a minimum by 2020 compared to the base year of 2005. The Municipality summarized the measures and action programs necessary to attain this target in a Sustainable Energy Action Plan (SEAP) and submitted it to the Covenant of Mayors. (We will be able to examine to what extent the target has been attained this year when the statistical data for 2020 are available.)

The General Assembly of Budapest called upon the Mayor based on Resolution No. 950/2019 (11.05.) of the Municipality of Budapest to put forward the Sustainable Energy and Climate Action Plan (SECAP) of Budapest to the General Assembly of Budapest, which is the updated version of the SEAP adopted earlier, supplemented with a section on adaptation and extended to target year 2030 and in which the Municipality fixed the target of cut its emission by 40% as a minimum.

Budapest Climate Strategy was adopted by the General Assembly in 2018. As the scope of the measures included in the Climate Strategy and the subjects and themes of SECAP overlap each other completely, we also updated the Climate Strategy at the same time to synchronize the contents of the two documents. This affected the values of the target year, of the initial i.e. the benchmark year, as well as of the CO_2 emission mitigation target. Therefore, this document comprises both Budapest Climate Strategy and the Sustainable Energy and Climate Action Plan. (SECAP may only be entered into the online system of the Covenant of Mayors once it has been adopted by the General Assembly.

The first step of the Climate Strategy / SECAP was the analysis of the situation, which relied greatly on the data and trends presented in the relevant chapters of the document titled "Environmental Status Assessment of Budapest" (Budapest Környezeti Állapotértékelése). A key pillar of the situation analysis was drawing up the greenhouse gas inventory of Budapest, primarily based on the data of the Central Statistical Office and the Municipality of Budapest and expert estimates. According to the inventory, the total volume of energy used was 27,928,557 MWh and the volume of related CO_2 emission was 6,109,183 tons in Budapest in 2015, the base year of the climate strategy / SECAP. The largest portion of CO_2 emission was related to the energy consumption of buildings, transport being the second largest emission factor.

In addition to the presentation of emissions in numerical terms, the situation analysis also extended to the examination of problems and impacts of the climate change which are most relevant to Budapest. These included in particular:

- Extreme heat, heat waves
- Heavy rainfalls
- Flash floods, inundations
- Floods
- Drought and water shortage
- Storm-wind
- Landslide, land subsidence
- Diseases spread by disease transmitters
- Diseases spreading through air (droplet infection)
- Spread of allergens
- Rise in UV-B radiation
- Infestation or mycosis of vegetation
- Proliferation of invasive, non-indigenous species.

In the interest of reducing the problems disclosed by situation analysis, measures were determined in the action plan part which allow the cutting of the emissions of gas house gases causing climate change in Budapest on the

one hand and enhance the adaptability of the residents and other parties to the effects which have become inevitable. The document formulated the following actions:

Emission reduction

Má-1 Improving the energy efficiency of buildings, industrial production and facilities of the tertiary sector and increasing the ratio of renewables:

M1 – Energetic refurbishment and energy conscious operation of the buildings of the Municipality of Budapest and business associations providing public services

M2 – Energy efficient reconstruction of the public lighting system

M3 – Energetic refurbishment of residential buildings

M4 – Facilitation of photovoltaic development

M5 – Development of the district heating system and making it more environmentally friendly (reconstruction, increasing the use of renewables, etc)

M6 – Conducting surveys and researches on sustainable energy management and circular economy

M7 – Promotion of the mitigation and decarbonisation activities of the industry and service sector

Má-2 Improving the energy efficiency of transport infrastructures, supporting and developing environmentally friendly forms of transport

M8 – Development of public transport with attractive vehicles and services and better infrastructure

M9 – Development of the cycling and pedestrian infrastructure

M10 – Facilitation of the use of electric driven or low emission motor vehicles

M11 – Promotion of the use of car-sharing and car-pooling systems

M12 – Traffic control to reduce emission, designation of low-emission zones and construction of the related infrastructure (P+R parking areas)

Má-3 Increasing the size of the green areas and improving their quality to enhance their carbon absorption capacity

(The measures belonging here are the same as the measures belonging to Aá-1 "Development of the green – blue infrastructure".)

Adaptation

Aá0 – Climate modelling and related detailed vulnerability examination

Aá-1 Development of the green – blue infrastructure

A1 – Increasing the ratio of green areas and water surfaces

A2 – Improving the ratio of green area and forest area

A3 – Blue infrastructure development (revitalization of small watercourses)

A4 – Elaboration of a plan for planting trees in public spaces

A5 – Amendment of legal rules to protect trees

A6 – Establishing and operation of a uniform, up-to-date green space cadastre

A7 – Promotion of the revitalization of brown-field areas

Aá-2 Mitigation of the heat island effect in the built environment

A8 – Protection of ventilation corridors, ensuring sufficient airspace ratio in streets

A9 – Promotion of the application of climate friendly construction materials and technologies

Aá-3 Development of the flood control system

A10 – Construction and development of flood control structures

Aá-4 Adaptive rainwater management

A11 – Surface runoff regulation and the system required for its safety

A12 – Supporting the utilization and retention of rainwater

Aá-5 Preparation for extreme weather conditions and the health impacts of climate change

A13 – Preparation of the transport system for extreme weather phenomena

A14 – Controlling hazards caused by extreme weather phenomena

A15 – Examination of the climate vulnerability of water bases and drinking water supply and their climate-adaptive development and operation

A16 – Preparation for extreme weather conditions during the preservation and renovation of buildings

Aá-6 Mitigation of the vulnerability of natural and landscape values

A17 – Preparation of the detailed climate change risk and vulnerability assessment for natural values

A18 – Continuing the expansion and extension of protected natural sites of local importance

A19 – Environmental protection management, confinement of invasive plant and animal species

Awareness raising, climate consciousness

SZ-1 Climate conscious city management: cooperative city management taking the lead in climate protection

SZ1 Climate conscious workplaces, climate conscious colleagues

SZ2 Enforcement of horizontal climate protection principles in urban development, sectoral and urban planning, the creation of the relevant legal rules, and municipal tenders and in investments

SZ3 Operation of the Budapest Climate Change Platform and a dedicated online platform to share best practices and to improve partnerships

SZ4 Establishing cooperation with the corporate sector (companies, chambers, professional associations) to support the climate objectives of Budapest

SZ-2 Climate conscious city dwellers: reinforcement of the environmental culture and responsibility among the population and economic operators

SZ5 Thematic awareness-raising campaigns and informational activities through the Mayor's Office and the business organisations of Budapest, with special regard to reducing the volume of household energy consumption

SZ6 Development of the adaptation knowledge and ability of the population, particularly in respect of heat waves, rainwater management, property protection and green infrastructure

SZ7 Promotion of the climate protection aspects in the ordering of public services and public procurement processes

According to calculations, emissions could be cut in the capital city most effectively by the refurbishment of residential buildings, and there is also significant potential in reducing the emissions from traffic, by the development of public transport and cycling as a means of transport.

It is to be reviewed every 2 years to what extent the measures and objectives of SECAP have been realized. It is recommended for the relevant departments to report on the progress achieved regarding the measures every six months to the Chief Clerk as part of this review, who will then report to the Mayor directly.

In case all of the measures comprised in the document are fulfilled, the total emission of Budapest will be reduced by 40% by 2030, which is in line with the reduction target required by the Covenant of Mayors. The financing and investment demand of all the measures can be estimated to be around 2500 billion forint. It is important to emphasize that this would burden the budget of the Municipality of Budapest only in part, as many of the measures (e.g. the refurbishment of residential buildings) could only be realized with the joint commitment of the various parties (the residents, the districts, financial institutions, the government), by the involvement of various means of financing.

It is obvious that the climate strategy can be successfully realized only with the joint action and contribution of the various parties. Without action, by just following the regular course of business of the last decade, we cannot expect in Budapest any substantial reduction of emissions causing climate change.

1. ANALYSIS AND EVALUATION OF THE SITUATION

1.1. STRATEGIC REFERENCES

Numerous climate policy conventions and documents had to be taken into regard during the preparation of the action plan, the hierarchy and system of which are meant to be presented in the non-exhaustive chart below. On the one hand, the related documents provide a basis for the analysis of the situation (e.g. legal environment, development ideas). On the other hand, they can be used as legal, financial and social means to realize the objectives determined in the concept.

The action plan has to be adapted to the objectives and principles of the international and local climate policy, as well as the objectives of the local sectoral strategies. The supreme decision-making body of the United Nations Framework Convention on Climate Change signed in 1992 is the Conference of the Parties (COP) held on an annual basis. The 3rd Conference adopted the protocol supplementing the Convention in 1997 in Kyoto, in which Hungary undertook to reduce its emissions by 6% compared to its average emissions in the period of 1985–1987. At the COP21 held in 2015 in Paris, a new global climate protection agreement was concluded (the Paris Agreement), which included the following major elements:

- The signatories adopted the long-term plan to keep the rise in global average annual temperature well below 2 °C compared to the level before industrialization and to make efforts to reduce temperature rise to no more than 1.5 °C,
- The current mandatory and non-mandatory commitments shall be included in a new, comprehensive system;
- It would replace the second commitment period (2013-2020) of the Kyoto Protocol,
- All of the Parties to the new convention could participate in the global collaboration to combat climate change (including those who are not parties to the Kyoto Protocol).

The highest level Hungarian policy document on climate change is the Second National Climate Change Strategy, which formulates two major objectives: "Survival and sustainable development in a changing world" and "Getting to know our abilities, possibilities and limitations". Within these two comprehensive objectives, four thematic subgoals have been defined:

- decarbonization (promotion of low CO_2-emission economy, GHG emission mitigation and carbon sinks);
- examination of climate vulnerability (geographical information data system to facilitate decision-making and planning);
- adaptation and preparation (preservation of resources, flexible responding to problems);
- climate partnership (wide-scale partnership, awareness, setting an example).

Budapest contributes to these global and national objectives as described below.

The Municipality of Budapest joined the Covenant of Mayors in 2008 and prepared the Sustainable Energy Action Plan of Budapest (SEAP), in which Budapest set the target of cutting its CO_2 emissions by 21% as a minimum by 2020.

In December, 2015, Budapest also joined the Under 2 Coalition, the goal of which is to keep the rate of global warming below 2 °C and to reduce greenhouse gas emissions to or below 2 tons/person/year by 2050. By signing the Memorandum of Understanding (MOU), Budapest agreed to reduce its GHG emission by no less than 80% compared to the values in the 1990s or the local volume of GHG emission below the level of 2 tons/person/year.

Budapest joined the Compact of Mayors in January of 2016. In October, 2015, the European Commission established the Covenant of Mayors for Climate & Energy by renewing the Covenant of Mayors. This organisation added adaptation to the climate change and safe and sustainable energy management to its initial objective concerning the reduction of CO_2 emissions. The signatories undertook to submit their Sustainable Energy and Climate Action Plans (SECAP) including both emissions mitigation and adaptation in two years, following the official date of signature. The goals of the organisation are as follows:

- Reducing the emission of CO_2 and, as far as possible, also of other gases by 40% as a minimum by 2030 compared to the level in 1990 through measures to improve energy efficiency and the use of renewable energy resources;
- Improving resistance to climate change and strengthening the ability to adapt to climate change;
- Promoting cooperation with associated local and regional municipalities within and beyond the EU to improve access to safe, sustainable and available energy by improving energy efficiency and enhancing the use of renewables.

It is contemporaneously with the submission of the Sustainable Energy and Climate Action Plan (SECAP), that meeting the additional climate-related obligations of Budapest (Compact of Mayors and Under2 Coalition) can be ensured as well.

For more detailed information on the major international and national covenants and documents, see the Chapter titled *"I.5 Klimatikus viszonyok"* (Climate conditions) in the document titled *"Budapest Környezeti Állapotértékelése 2020"* (Assessment of the Environmental Status of Budapest in 2020) *(hereinafter: "BKÁÉ 2020).*

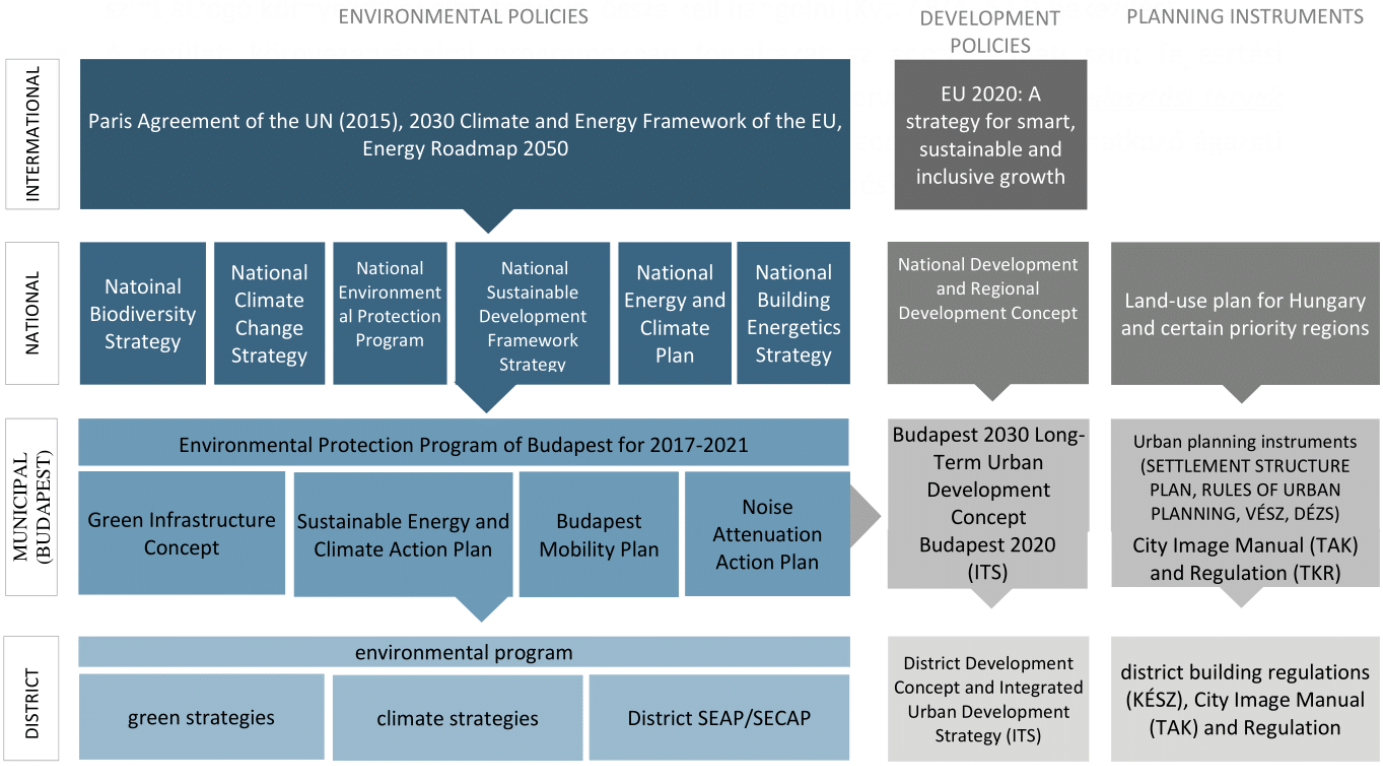


Figure 1: Examination of strategic points of connection

1.2. GENERAL OVERVIEW

Population

Budapest is the settlement of Hungary with the highest population number and density. The number of the population grew by 45665 persons between 2007 and 2020, primarily in the outskirts. Budapest is the centre of the country in terms of education, research and development and healthcare, which is a favourable condition for adaptation. At the same time, it is also a transport and economic centre, which has significant impacts on the environment. Although the inhabitants of Budapest are less vulnerable compared to the national average as they are in a more advantageous situation in respect of their education and income, the most vulnerable groups, such as the elderly, unemployed or homeless people are also present in high numbers. In the "residential belt of Pest", as well as on the Buda side of the downtown area, the system providing services to the elderly is deficient and the capacity of the system providing services to the homeless is quite low. The unregulated system of rented dwellings in Budapest also reduces adaptability and mobility. *(Detailed information: BKÁÉ 2020, Introduction)*

Water management

The drinking water supply of Budapest is based on the River Danube. Water is basically cleaned by the so-called bank filtration method, by which the water of the Danube leaks into the water aquifers along the river (from which water is then extracted) through the residuum made up of pebbles and sand that comprises the riverbed.

Bank filtration is fundamentally determined by the quantity and quality of the surface water leaking in, with special regard to its temperature, which influence viscosity and thus the extractable volume. Second, there is the surface water level, as its fluctuation (high and low tides) determines the direction of flow into and out of the aquifer depending on the water level of background waters (groundwater). In addition to the foregoing, water extraction based on bank filtration is determined by many other factors. In periods of high tide, some of the wells have to be excluded from production, whereas in periods of low tide, some wells can produce only a minimum amount of water. The long periods of low tide on Danube can cause problems concerning both quality and quantity: on the one hand, the excess burdening of the wells may cause so-called "sanding", which may damage the structure of the well (the filtering layer), and, on the other hand, microbiological objections may become more frequent and severe; in such cases, the proper quality of the water supplied can be ensured by the temporary removal of certain wells or series of wells from production.

Although since 2013, the flood elevation of the Danube has not come close to the highest ice-free flood elevation recorded by then, flood protection structures have insufficient crest height or are in need of development on several places. Small watercourses tend to be artificially modified, therefore their beneficial effects cannot be felt. The valuable karst areas and water reserves of Budapest are jeopardized by climate change. As a result of the drainage of water, a significant part of the city is getting dry, while groundwater is in connection with the water of the Danube in other areas, which may cause inundation in the lower lying areas.

In addition, the Danube also provides for the ventilation of Budapest.

The unfavourable features of the rainwater drainage system of the city, heavy rainfall may cause flash floods. Rainwater is usually drained, which impairs both the water management of the soil and the city climate.

(Detailed information: BKÁÉ 2020, I.4. Vizek állapota, II.5. Árvízvédelem, ivóvízellátás, szennyvízkezelés és csapadékvíz-gazdálkodás)

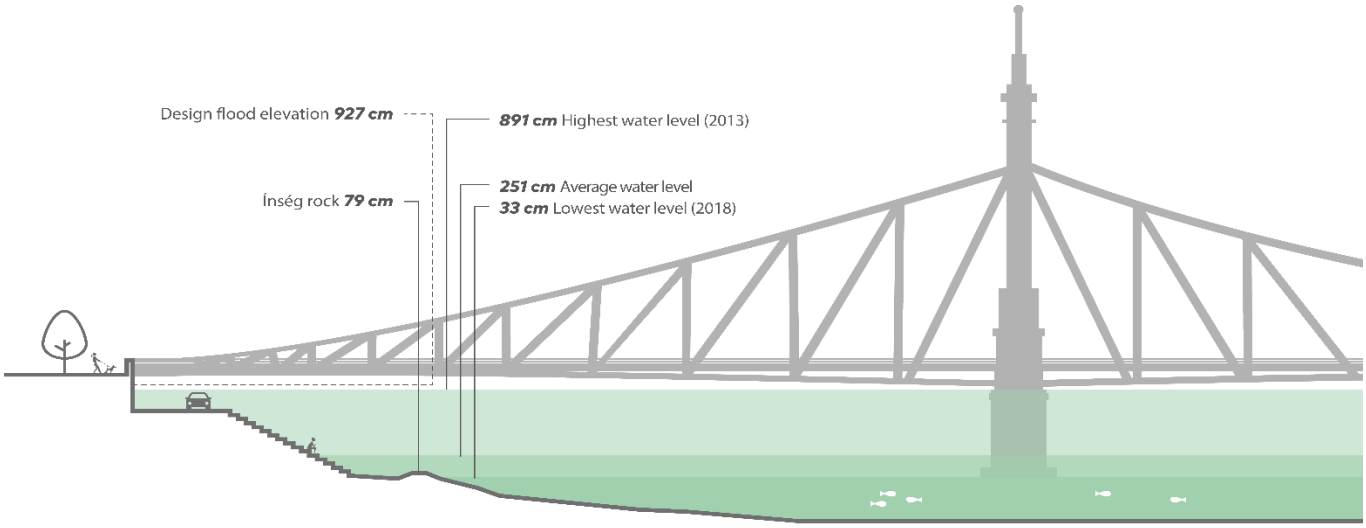


Figure 2: Significant water levels on the Budapest section of the Danube

Transport

Budapest is one of the major transport hubs of the country. It is the centre of the radial railway and road systems and the international airport of the country is also located here. The space demanded by traffic and parking cars and the high proportion of paved areas diminishes adaptation possibilities. The number of vehicles is growing continuously both in Budapest and its agglomeration. Traffic load has slightly increased in recent years, but the aging of vehicles contributes to emissions significantly. Modal split, i.e. the proportion of public transport, cycling, pedestrian traffic and car traffic has changed significantly in recent years, as the ratio of the use of passenger cars has grown and that of other environmentally friendly modes of transport has diminished. In 2020, the share of public transport continued its diminishing trend due to the COVID-19 pandemics. *(Detailed information: BKÁÉ 2018, II.3. Közlekedés- és szállításszervezés)*

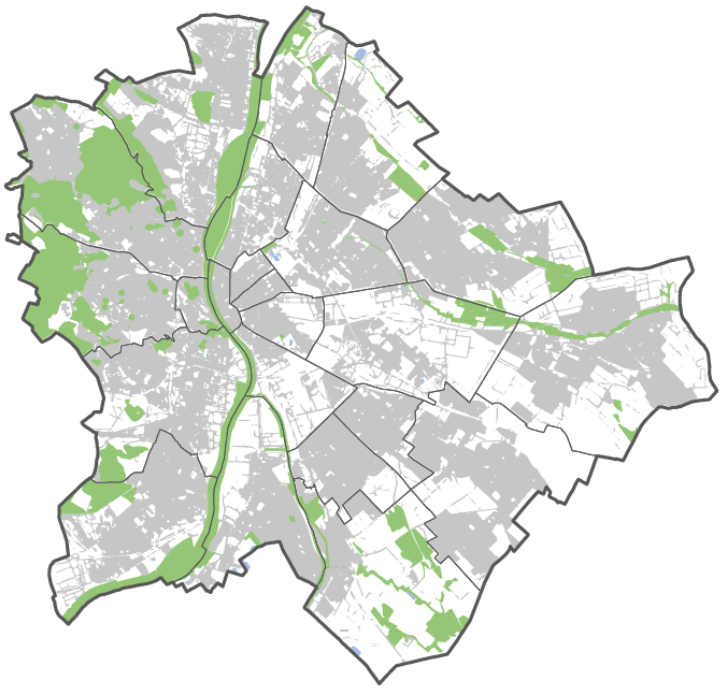


Figure 3: Protected natural sites in Budapest

Natural environment

Flash floods and inundations cause problems on both sides, but the Buda side is even more endangered because of the hazard of erosion. Thanks to the diverse relief of the city, there are mountainous as well as flatland-like areas, forest, meadow and water habitats, caves, fountains, rocks, swamps, marshes and lakes as well, some of which several are placed under protection. Budapest has rich birdlife and flora and it is the habitat of numerous rare inspect species. Budapest is the last habitat of several plant and animal species in Hungary. The natural areas preserved are placed under multi-level legal protection. 7% of the territory of Budapest is subject to national or local level protection (e.g. Gellért-hegy, Sas-hegy, Füvészkert, Tamariska-domb in Csepel, etc.). Natural vegetation cover plays a major role in the adaptation of the city, but it is endangered from several aspects not only due to the growing ratio of improved lands and pollution, but also

because of the multilateral effects of climate change. *(Detailed information: BKÁÉ 2020, I.1. Természeti környezet állapota)*

Green areas

The size and location of green areas has an impact on urban climate. In Budapest, the per capita area of public gardens and public parks is 6 m^2, but it is less than 1 m^2 in some parts of the downtown area. According to the WHO recommendation, the per capita size of green areas should be 9 m^2 as a minimum, which would require Budapest to establish ca. 500 hectares of new public parks. Currently, the total area of the large parks in Budapest is less than this and they were created over a period of more than 200 years. Green areas are insufficient and in a deteriorated condition, therefore they cannot adequately play their recreational and conditioning role. The size of the improved land in the city have tripled in half a century, which has reduced the ratio of green areas and increased the heat island effect significantly.

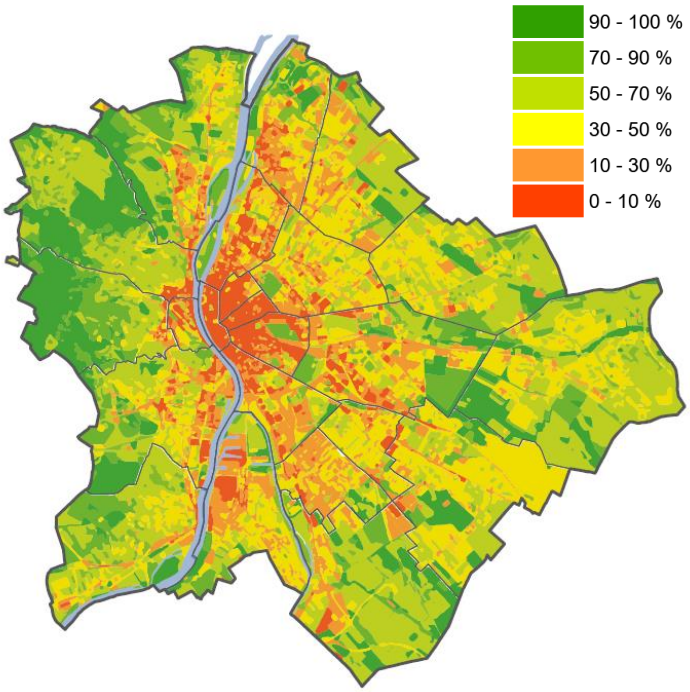


Figure 4: Green area intensity in Budapest, 2015. (Source: Greescope Kft.)

Forests cover 6173 hectares in Budapest, whereas the size of green areas in the city is estimated to be 27965 hectares. The CO_2 absorption capacity of these carbon sinks is 32125 CO_{2e}, i.e. they can absorb no more than 0,4% of the GHG emission of Budapest. *(Detailed information: BKÁÉ 2020, I.2. Épített zöldfelületek állapota, II.7. Zöldfelület-gazdálkodás)*

Climate

The changes in the climate data of Budapest demonstrates the impact of climate change and the heat island effect. The average annual temperature of the capital city has grown by more than 1 °C since 1901, and the annual amount of sunlight has also grown in parallel. Extreme weather events are more and more frequent: the frequency of heatwaves has sharply increased in recent decades and heavy rainstorms also occur more often. In addition to climate change, urban climate impacts, with special regard to heat island effect, aggravate summer heatwaves: the surface temperature of densely built-up areas can be by even 7 °C higher than in the green areas around the city. The change of the weather affects the natural environment and has a detrimental impact on several sectors. These effects are dealt with in detail in the Chapter titled *"Risk and vulnerability assessment"*.

According to the joint research of ELTE and OMSZ[1], the annual average temperature in Hungary is expected to rise by 1-2 °C in the near future (2021-2050) compared to the reference period of 1961-1990. Temperature rise will be most typical in the summer: the number of warm and extremely warm (summer, heat, hot and heat alert) days will increase by 12 days in the near future, while the number of frosty days (with the minimum temperature remaining under freezing point) can also be expected to fall. Temperature changes extend the vegetation period of plants. The volume of precipitation will decrease, primarily in the summer period, however, the frequency of extreme precipitation events will increase. *(Detailed information: BKÁÉ 2020, I.5. Klimatikus viszonyok)*

[1] Bartholy J., Bozó L., Haszpra L. (ed.): Klímaváltozás – 2011, Klímaszcenáriók a Kárpát-medence térségére. Budapest, 2011.

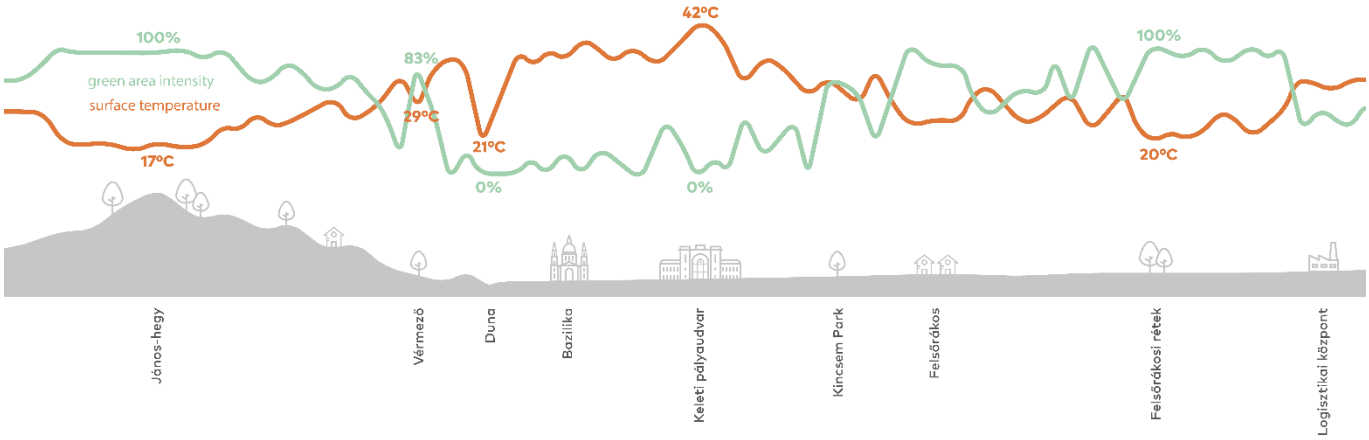


Figure 5: Correlation between surface temperature and green area intensity in Budapest measured at a given section of green area intensity maps

1.3. GREENHOUSE GAS EMISSIONS INVENTORY

RESULTS

The total volume of energy used was 27,928,557 MWh and the volume of related CO_2 emission was 6,109,183 tons in Budapest in the base year of 2015. The figures of the emissions inventory are presented in Annex 1, whereas sectoral distribution is illustrated by the diagrams below.

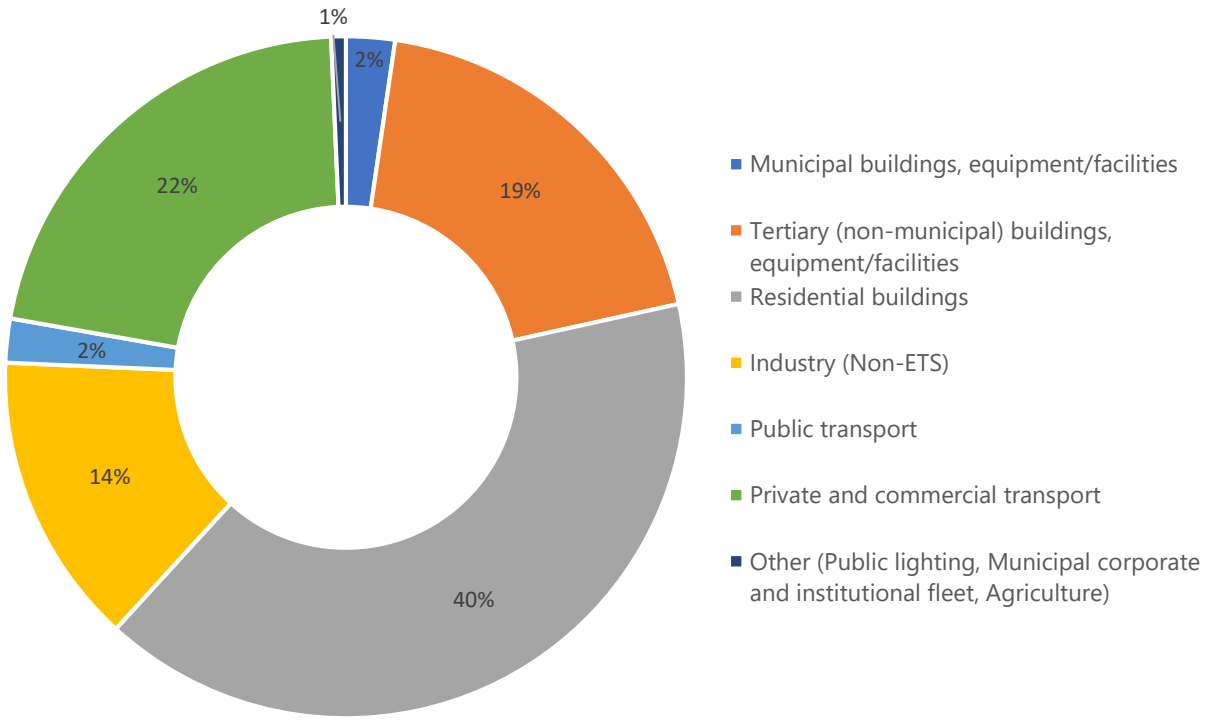


Figure 6: Sectoral distribution of final energy consumption (2015)

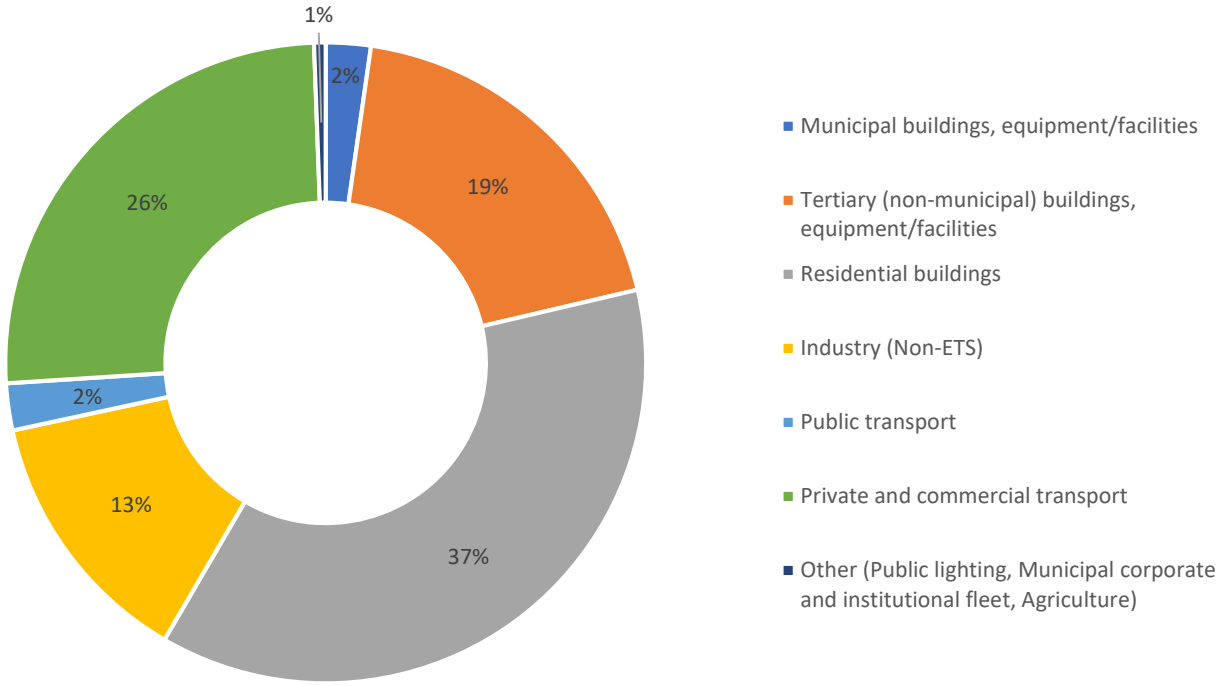


Figure 7: Sectoral distribution of CO_2 emission (2015)

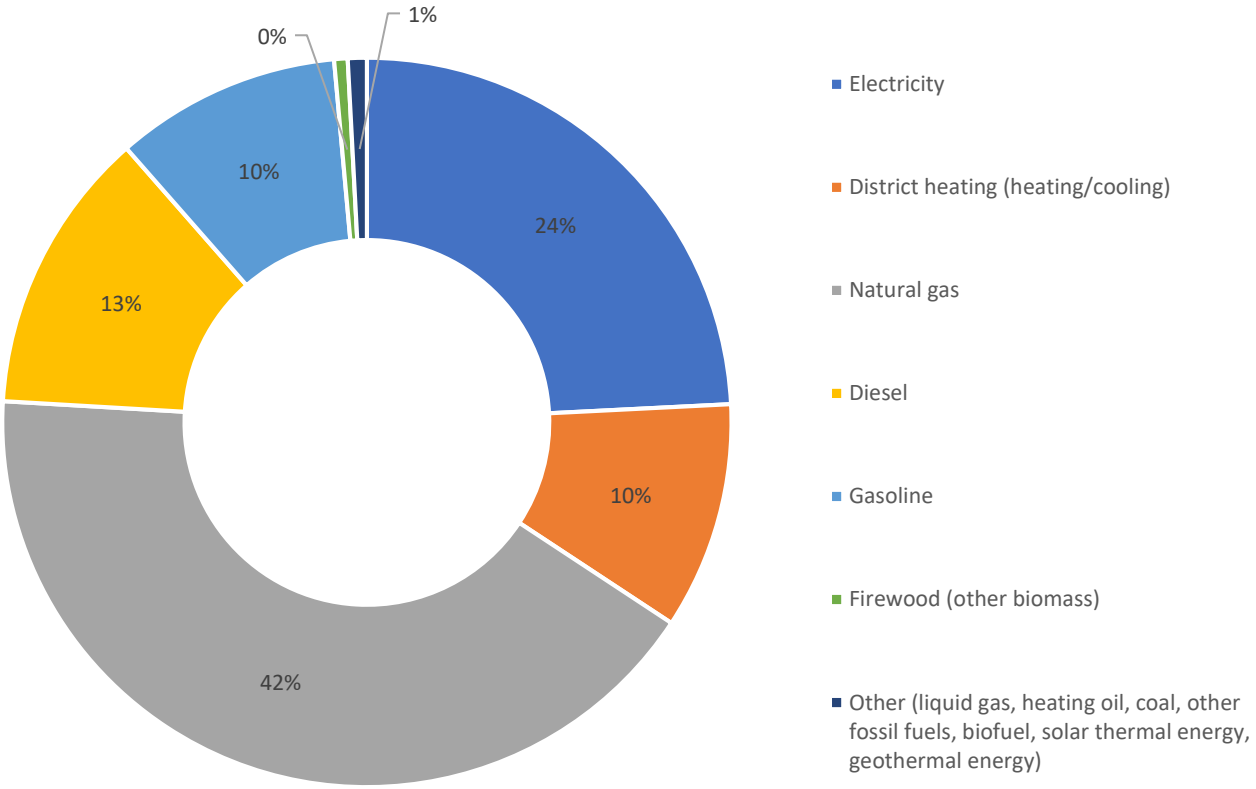


Figure 8: Distribution of final energy consumption by energy resources (2015)

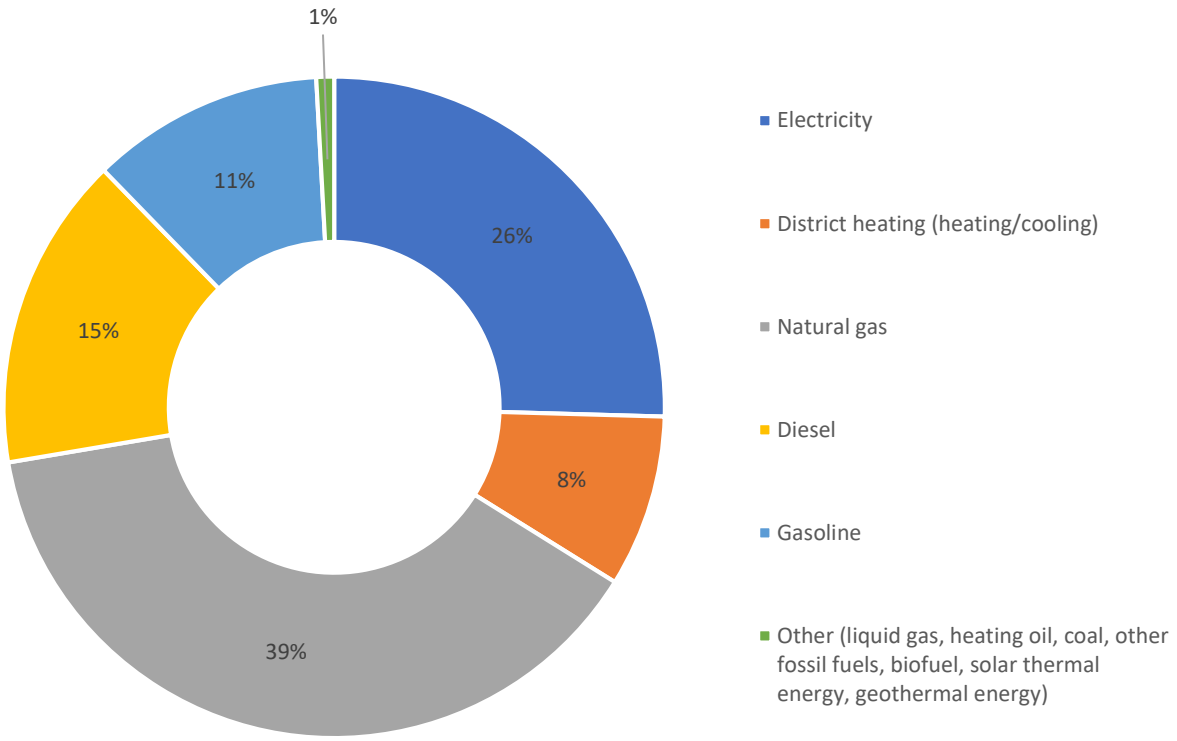


Figure 9: Distribution of CO_2 emission by energy resources (2015)

Based on the inventory, the largest portion of CO_2 emission can be connected to the energy consumption of buildings and facilities (industrial, tertiary, municipal, state and residential sector), representing 72% of the total volume of emission. Within buildings, the consumption of residential buildings is responsible for the largest portion of emissions. This can also be explained by the low energy condition of buildings. The second largest emitter is transport, which is responsible for 28% of the total emission. Energy consumption is influenced by several economic, social and natural factors as well, such as the average temperature in the heating season.

The diagram below presents changes to final energy consumption and CO_2 emission in Budapest between 2005 and 2019. We will be able to evaluate to what extent earlier SEAP and climate strategy objectives have been achieved when the statistical data for 2020 are available.

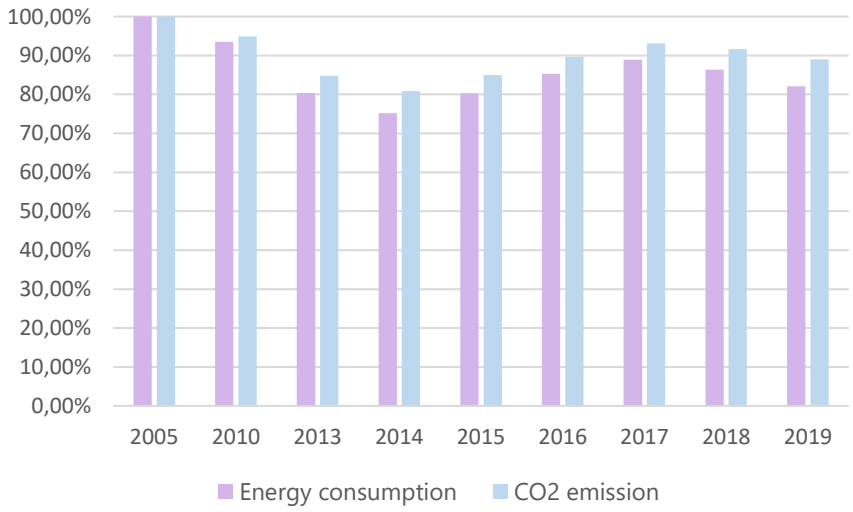


Figure 10: Change to annual energy consumption and related CO_2 emission compared to 2005 (100%)

METHODOLOGY

The greenhouse gas emission inventory was prepared for 2015 as base year (Baseline Emission Inventory – BEI) according to the methodology of the Sustainable Energy and Climate Action Plan (SECAP) compiled by the European Covenant of Mayors.

The emission inventory was drawn up based on the available data collected from the institutions and companies of the Municipality of Budapest, and the data provided by energy companies. Some data were derived from the census conducted by the Central Statistical Office (KSH) in 2011: these are primarily the estimated data of the consumption of firewood and coal. CO_2 emission was demonstrated by the application of the values determined in the SECAP guidelines for Hungary for 2015 as emission factors (CO_2 emission factors).

The present emission inventory differs from the earlier SEAP inventory in respect of the base year selected (2005 vs. 2015). The national energy mix in the base year 2015 is different from that of 2005, primarily in respect of the electricity generation mix, therefore it cannot be directly compared to earlier SEAP inventories. The most significant difference was caused by the change of the emission factor related to electricity consumption. This is 0.230 tCO_2/MWh for 2015 as base year, whereas it was 0.575 for 2005, the base year of the SEAP inventories, i.e. the Covenant of Mayors modified the emission factor significantly in the ten years' period between the two years. As we changed the earlier SEAP base year of 2005 to 2015 in line with the Climate Strategy, we took this updated value into regard for the emission factor applied as well, according to the directions in the methodological guide. It is important to emphasize regarding the (internationally adopted) methodology that electricity used in Hungary is generated partly in the neighbouring countries, therefore, a part of the emissions is not attributed to Hungary, and is not calculated to the national emission factor.

The inventory was drawn up for the purpose of determining the major emitter sectors in emissions, monitoring trends in time and substantiating mitigation targets.

According to the SECAP methodology, **final energy consumption and related CO_2 emission** is broken down to the following categories:

- buildings, equipment/facilities:
    - municipal
    - tertiary (non-municipal)
    - residential buildings
    - public lighting
    - industrial (non-ETS) facilities
- transport:
    - municipal vehicles
    - public transport
    - private and commercial transport
- other:
    - agriculture, forestry, fishery

Sources of emission not related to energy use (e.g. waste or sewage treatment) are not included in the inventory. The volume of methane generated at landfill sites are negligible compared to the overall GHG emission of Budapest and has a low CO_2 equivalent (va. 230t CO_{2e}). The CO_2 emission of the Municipal Waste Recovery Plant (Fővárosi Hulladékhasznosító Mű – HUHA) is contained by the industrial sector's emissions. Most of the methane emitted by sewage sludge is recovered energetically (but the disposal of sewage sludge is an important issue). At the Central Wastewater Treatment Plant operated by Budapest Waterworks (Fővárosi Vízművek) and at the wastewater treatment plants operated by Budapest Sewage Works Ltd. (Fővárosi Csatornázási Művek), the methane generated during the decomposition (putrefaction) of the sewage sludge is also used to produce electricity and thermal energy used on site.

Energy consumption of municipal buildings

The inventory contains the cumulated data of the institutions and companies of the Municipality of Budapest, and the data of district municipalities are demonstrated in the tertiary sector. The primary source of data was the annual energy statistics of the institutions and companies of the Municipality of Budapest and the data provided by energy companies.

The Municipality of Budapest maintains numerous institutions and companies and, therefore, a significant number of buildings and facilities. In 2015, the base year of the climate strategy / SECAP, energy used in these buildings was around 647 thousand MWh. The public transportation company, waterworks and thermal spas were the major energy consumers. It has to be emphasized that we are speaking here about energy consumption related to the buildings, while the consumption of vehicles and other facilities or equipment run by the institutions (e.g. public lighting) is not included in this data.

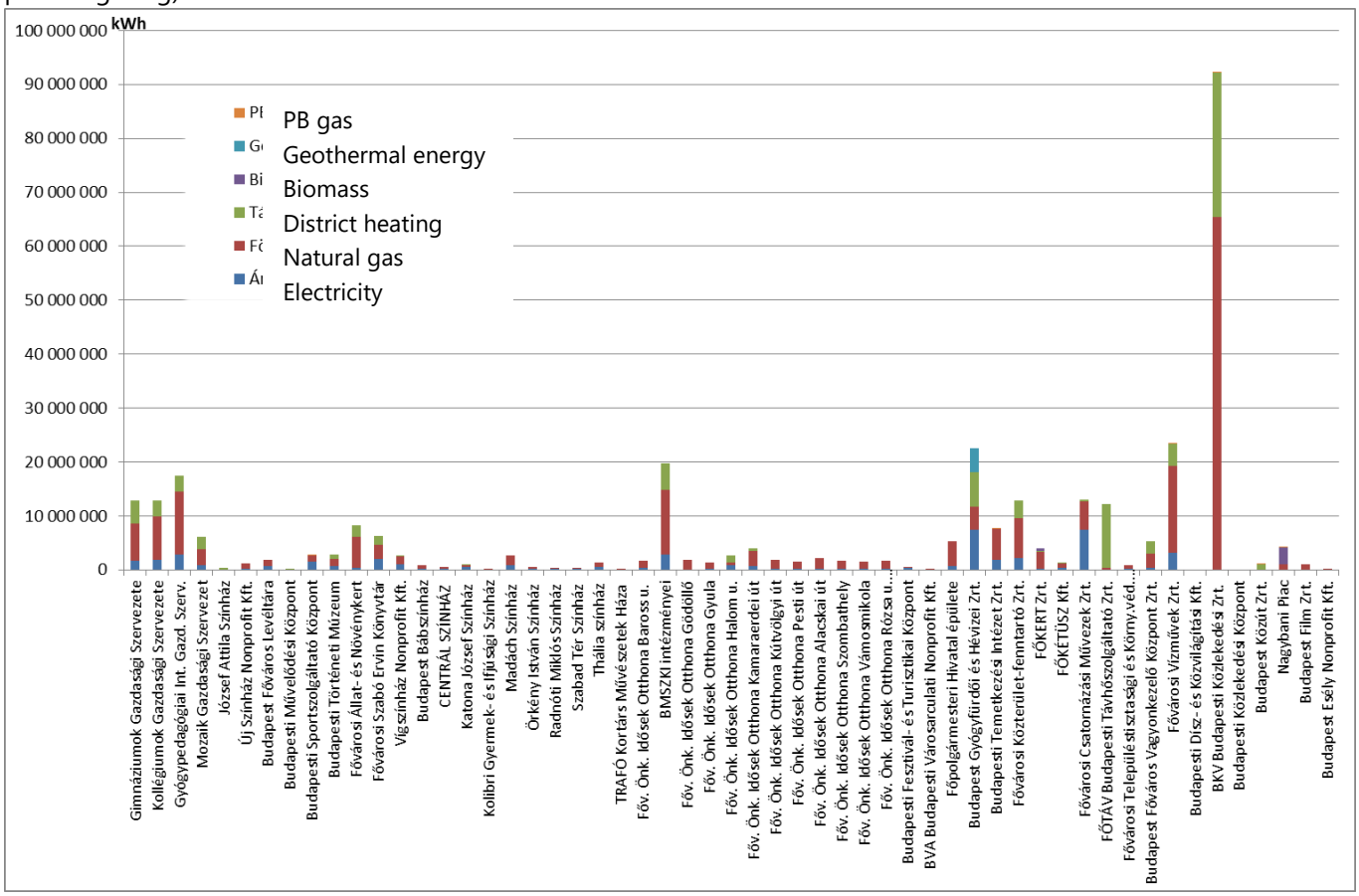


Figure 11: Energy consumed by the institutions and companies of the Municipality of Budapest in connection with buildings, 2015

Buildings and equipment/facilities of the tertiary sector (not operated by the Municipality of Budapest)

The consumers belonging to this key sector were responsible for 19% of the final energy consumption in the base year, and the related CO_2 emission also represented 19%. In provider buildings, 60% and 40% of the CO_2 emission comprised electricity consumption and heating, respectively.

Energy consumption of residential buildings

The energy consumption of the residential buildings in Budapest (911 thousand apartments, KSH, 2015) amounted to 11.2 MWh in 2015, which was 40% of the total energy consumption of the capital city. This meant 1.2 tons of related annual CO_2 emission, representing 37% of the total emission of Budapest in 2015. Within that, the CO_2 emission related to the heating of residential buildings was 78%. The share of residential electricity consumption displays a slowly, but continuously growing tendency.

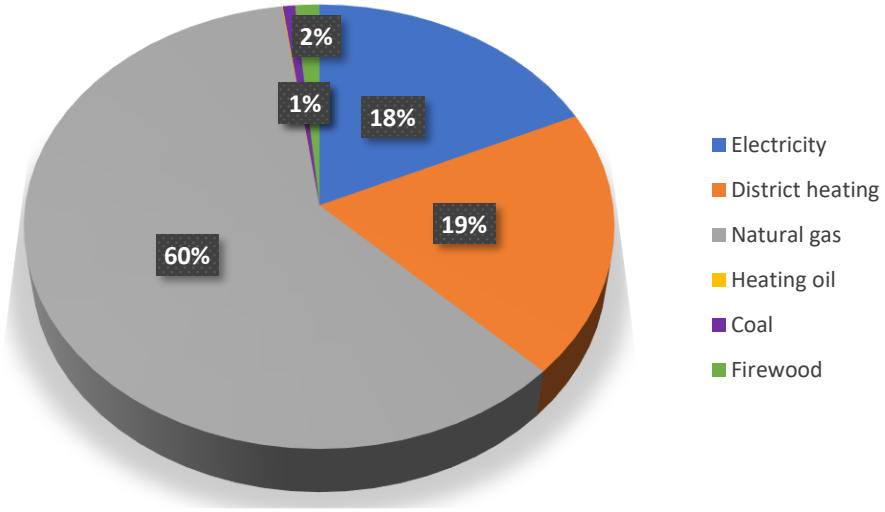


Figure 12: The distribution of final energy consumption of residential buildings in Budapest

It is to be noted that there are no precise and reliable data available regarding the residential use of coal and firewood. The related CO_2 emission was calculated based on the estimated data of the 2011 census of the Central Statistical Office (KSH). According to statistical data, 7192, 363 and 2919 apartments were heated with firewood, with coal and with both firewood and coal, respectively. They represent only 0.5% within the CO_2 emission related to the overall energy consumption. (It is to be noted, however, that heating with firewood results in the emission of not only carbon-dioxide, but of other pollutants as well, which contribute to air pollution significantly in Budapest as well. However, the climate strategy discusses the effects related to climate change, whereas the issue of air pollution is dealt with in the Budapest Environmental Protection Program.)

The rate of use of residential solar thermal collectors is also unknown, however, there is no CO_2 emission attached to them. Regarding the use of solar panels, there has been a steady growth in the recent years. According to the data of the system operator, a total installed capacity of 9.3 MW was connected to the distribution system in 2015, which produced electricity of 3.824 MWh. In 2019, the installed capacity amounted to 40 MW, whereas solar energy fed into the distribution system grew to 16,000 MWh per annum. Three quarters of the excess generation is related to residential installations. The ratio of renewables continues being low, but we can witness at the same time a significant mitigation potential and receptiveness among the population.

Public lighting

According to the data supplied by BDK Kft, the installed power of public lighting amounts to 20 MW, whereas decorative lighting demands 1.5 MW in addition. The annual energy consumption by lighting is about 88 thousand MWh, which represents 1.3% of the electricity consumption of Budapest. Public lighting contributed to an extent of 0.3% to CO_2 emission related to the energy consumption of Budapest in 2015.

Transport

Emissions generated by the transport sector totalled to 1.7 million CO_2 in 2015.

The volumes of CO_2 emitted by the vehicles of municipal institutions and companies, by public transport and by private and commercial traffic were determined separately according to the SECAP methodology. The data related to public transport only contains the emissions of public transportation vehicles operated by the Municipality of Budapest (BKK Zrt), i.e. the emissions related to companies like MÁV Zrt, Budapest Airport Zrt, VOLÁNBUSZ Zrt, MÁV-HÉV Zrt and ArrivaBus Kft are not included in it.

The fuel consumption related to transport was determined based on the data supplied by BKK Zrt in respect of public transport and it was estimated in respect of private and commercial traffic, based on the volume of fuel sold

in Budapest as published by the National Tax and Customs Administration. It is to mention that this does not provide a precise picture of consumption, as fuels filled in the tanks in Budapest are not necessarily used in Budapest and vice versa.

Based on the data thus derived, 91% of the CO_2 emitted by transport can be attributed to private and commercial road transport. The share of public transport represents 8.5% and the vehicles owned by the Municipality of Budapest have a share of 0.6% within the CO_2 emission generated by transport.

Vehicles with green licence plates appeared in the autumn of 2015 in road traffic and there were 8205 of them in the capital city at the end of 2019 (source: Ministry of the Interior). Based on the estimated annual run (km) and estimated average consumption, their electricity consumption is less than 0.2% of the total amount distributed.

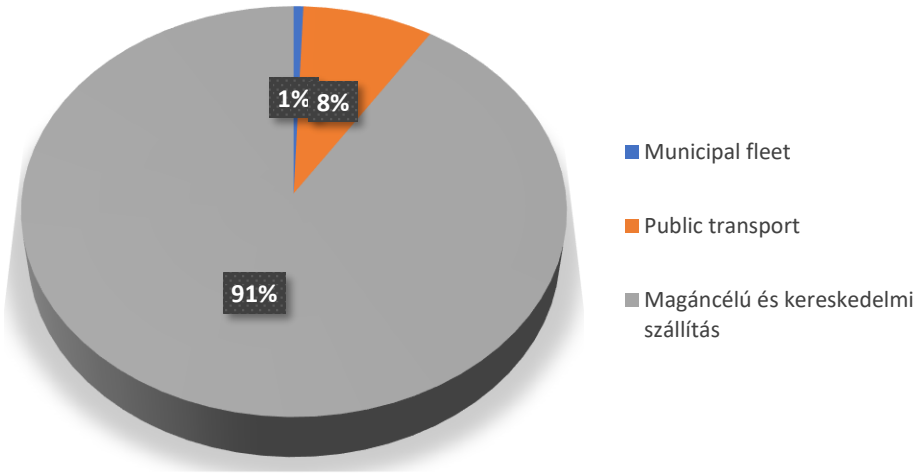


Figure 13: Distribution of the CO_2 emission of traffic

1.4. RISK AND VULNERABILITY ASSESSMENT

This Chapter presents the problem areas related to climate change which are of key relevance for Budapest. These were determined according to the methodological guidelines of the SECAP, based on the relevant literature (including but not limited to NÉS-2, the professional materials of NATéR, the Environmental Status Assessment of Budapest, etc.), the geographical information system of NATéR and the findings of the Settlement Adaptation Barometer (TAB).

Extreme heat, heat waves

Heat waves present a danger primarily to people suffering from chronic illnesses, with special regard to vascular diseases, the elderly and people working outdoors. As the proportion of people aged +65 is high in the capital city as well (19% of the population according to the data of the 2011 census), it is of primary importance to improve their adaptation capacity.

The health effects of heat waves may increase mortality rates, as well as the number of patients in need of hospitalization and that of road and workplace accidents.

Now, residents of Budapest protect themselves during heat waves mostly by using ventilators and air conditioners, drinking more water and visiting watersides, shady public parks and cooled public buildings.

The mitigation of the health impacts of heat waves is hindered by the typically low ratio of green areas and the high ratio of paved surfaces in the inner city, which gives rise to excess warming in these areas.

Heavy rainfalls

Although it is raining more and more rarely in Budapest, the amount of annual rainfall has not changed significantly. This means that extreme precipitation events, when a large volume of rain falls with high intensity and in a short time, are becoming more and more frequent.

Heavy rainfalls cause hindrances in traffic, damage buildings and overburden rainwater drainage systems.
It has become more and more frequent in recent years that the sewerage system could not collect the large volume of stormwater which then flooded the streets and caused serious problems in traffic as well.

The problem is caused by the lack of appropriate rainwater management.

Flash floods, inundations

Some of the buildings, roads and public places in Budapest are exposed to the risk of flash floods or inundations. The amount of damage caused by flash floods and inundations may increase significantly in the future because of extreme weather conditions becoming more frequent, the conditions and insufficient capacities of the rainwater drainage infrastructure and in part also because of the low ratio of green areas. Social and economic needs often contradict to the aspects of protection against flash floods and inundations. Drainage infrastructures (ditches, channels, reservoirs) are not properly maintained, and rainwater is not kept, reserved and utilized on site.

In Budapest, where sewerage networks comprise a unified system and rainwater channels were constructed in a separated system, the water level in the channels may be expected to rise temporarily in rainy weather or in the event of a temporary malfunction of the public sewage system. Rising water levels may cause inundation through low-lying structures not protected against reverse flow.

In case of a unified sewerage system, the volume of wastewater mixed with rainwater entering the system may cause a problem at wastewater treatment plants as well at times of flash floods or extended rainy periods, because, due to the lack of sufficient storm basin capacities, a part of the wastewater diluted by rainwater is cleaned only mechanically in such cases, as biological cleaning capacities are much more limited than mechanical cleaning capacities. The microorganisms performing biological cleaning react to the quality of wastewater very sensitively, and wastewater diluted by a large amount of rainwater may scour activated sludge, largely deteriorating the effectiveness of biological cleaning.

The sizing of the drainage system is a technical, as well as an economic issue –increasing the capacity of channels, ditches and other works has its physical as well as economic limitations. Therefore, efficient rainwater management needs to be realized in the first place: using rainwater for watering plants, or for cleaning paved surfaces will not only reduce the burden on the drainage system, but also the volume of drinking water consumption. The damage caused by high-intensity precipitation events may be mitigated by the retention (temporary reservation), delayed drainage, the promotion of the utilisation (infiltration into the soil) or on-site utilisation of rainwater or a combination of these solutions.

Floods

Because of the Danube and its tributaries, 6% of the buildings and 3% of the agricultural areas in Budapest are located on a floodplain. With respect to human life, 7.7% of the areas exposed to the hazard of flooding in Budapest are to be regarded as high-risk areas. As for property damage, the total size of high-risk areas requiring priority attention in Budapest 660 ha.[2]

If the planned developments in flood protection are not carried out, flood risk can be expected to increase and endanger drinking water bases, the traffic

[2] Source: VIZITERV Environ Kft.: Árvízi kockázati térképezés és stratégiai kockázatkezelési terv készítése (FCSM megbízás, 2016)

infrastructure, the built environment and the public utility network, and have in this form implications concerning the safety of life and property, as well as health, while also affecting tourism.

Currently, the major obstacles to mitigating flood damage are that, in certain places, the flood protection infrastructure is not properly built (e.g. insufficient crest height, poor condition etc.) and that in certain areas, many real properties were built on the floodplain, typically without a building permit. The development of the flood protection infrastructure in the downtown area may cause conflicts concerning the protection of the historical urban landscape.

Drought and water shortage

According to climate models, the amount of rainfall can be expected to decrease, whereas the length of the periods without precipitation will continuously grow in the summers (Bartholy-Bozó-Haszpra[3]). Although the period of July and August cannot be regarded as the driest periods, these months are affected by drought because of the high rate of evaporation loss arising from the high average temperature. There are long periods without precipitation in the water catchment area of the Danube as well, as a result of which the water level of the Danube in Budapest also decreases and extremely low water levels become more and more frequent. If we examine the water level of the Danube, we can establish that the number of days with a water level below 2 meters shows a significantly increasing trend. The differences between the individual years vary widely, but in contrast to the period until 1941, when there were 13 years having less than 10 days of a low (below 2 meters) water level, from 1981 on, we can a reverse trend. The number of such days was the lowest in 2003 (26 days), the next was 1989 with 77 days and from 2004, the smallest number was 120 days.[4] Low water levels endanger drinking water bases, the risk of overburdening the wells increases, capacities shrink and it becomes necessary to maintain a larger capacity reserve. Permanently low water level may also entail increased risk concerning water quality, with special regard to microbiological risk, therefore background waters become more significant. For all these reasons, prevention plays an important role in operation. Droughts also make the natural environment more vulnerable and may decrease crop yields as well. Preparation for the drought periods may require the compilation of an action plan and a manual for low water levels.

Storm-wind

Storms in Budapest tend to cause the most damage to the built environment and the transport infrastructure. Gusts of wind tear up roofs, break off branches or cause trees to fall, as there are many sick trees in the capital city, which may cause hazardous injuries, as well as damage to property. Wind storms and thunderstrokes can also damage public utility systems, such as public lighting. With wind storms becoming more and more frequent and as a result of thunderstrokes (overvoltage), the number of loss events and operational breakdowns may increase significantly.

The elimination and mitigation of storm damage are

[3] Bartholy J., Bozó L., Haszpra L. (ed.): Klímaváltozás – 2011, Klímaszcenáriók a Kárpát-medence térségére. Budapest, 2011.

[4] Source: Fővárosi Vízművek Zrt-: Budapest ivóvízellátó hálózatának fejlesztése

hindered by the fact that there is no sufficient information available to buildings owners and operators concerning the conditions of the buildings, their capability to withstand storms and the possibilities of reinforcing them.

The amount of damage to buildings and in areas with trees is expected to increase in the future.

Landslide, land subsidence

There are 23 abandoned areas in Budapest which used to function as excavation site or landfill (e.g. the landfill "Dunapart II", the landfills in Kőbánya, the Cséry-telep and its spoil area) and there is a potential hazard of surface movement in these areas.

Diseases spread by pathogen transmitters

As a consequence of climate change, certain pathogens and the arthropods transmitting pathogens (mosquitos, ticks, etc.) and rodents are spreading. These animals spread pathogens which have not been known before or have newly appeared. Climate change facilitates the spread of certain insect species.

As a result of these, infection by pathogens which have already appeared in the region and in Southern Europe (such as Western Nile fever, Dengue fever, Chikungunya infection, Leishmaniasis or Lyme disease) has also become a possibility. Malaria may also appear in the long term, and is occasionally being brought into the country from abroad. In addition, pathogens causing disease in animals need to be mentioned here as well.

Diseases spreading through air (droplet infection)

Energy consumption (transport, heating, etc.) does not only involve the emission of greenhouse gases, but other pollutants as well (e.g. small particulate matter, nitrogen oxides, etc.). Air pollution affects the immune system of the population adversely and starts (and maintains) inflammation processes in the respiratory system, which makes people more susceptive to infections caused by viruses and bacteria as well. Polluted air and the increasing heat due to climate change aggravate the health damaging impact even further.

According to the National Disaster Risk Assessment[5], the potential impact of a mass infection spread through the air is quite substantial, however, the probability of its occurrence is low. Despite this low probability of occurrence, we can now witness social and financial effects (e.g. catering industry, tourism) of the coronavirus pandemic. According to scientific research, polluted air makes the spread of coronavirus (and other viruses) easier and the course of the disease more severe.

Spread of allergens

The number of people suffering from allergy is expected to slightly increase in the future because of pollen generation seasons being extended as a result of the climate change. At the moment, combating allergens is hindered by the wide expansion of affected areas and the resulting high cost of weeding. It is the owners of the real properties who are primarily responsible for controlling the expansion, in cooperation with the local authorities, i.e. the district municipalities. It is also important to note, however, that 80% of the allergens arrive to Budapest from areas outside the municipal boundaries of the capital city. In the future, allergens can be expected to cause health damage, diminishing sense of comfort of the population, as well as financial effects (increase in the spending on medicines). Air pollution may aggravate the symptoms of allergy.

[5] https://www.katasztrofavedelem.hu/application/uploads/documents/2019-09/64097.pdf

Rise in UV-B radiation

In parallel with the rising amount of sunlight and the diminishing of clouds, UV-B radiation is increasing in the capital city as well. As a result, the number of cases of melanoma and other types of skin cancer and of eye diseases has been increasing.

Infestation or mycosis of vegetation

Climate change diminishes the resistance of the vegetation and increases the number of pests. The combination of these two effects can be expected to cause severe infections damaging the vegetation.

Proliferation of invasive, non-indigenous species

It is not only that animal species harmful to human health or vegetation are spreading, but biodiversity is also changing, which makes indigenous species being supplanted. Similarly, new invasive and allergen species are appearing, and the vegetation period of plants is also changing. Changed climatic conditions generate changes in the populations, currently present species may be supplanted and replaced by new, in many cases non-indigenous, invasive and allergen species. The change to the population may reduce biodiversity and make valuable species disappear, challenging green area management. Therefore it is important to plant adaptive, indigenous species.

Table 1: Evaluation of climatic hazards

Climatic hazards	Level of risk	Expected change to its intensity	Expected change to its frequency	Major effects, primary consequences	Major impact bearers
Extreme heat, heat waves	high	increase	increase	cardio-vascular symptoms, heat stroke, dehydration, respiratory and metabolic disorders, kidney failure, drying out and diminishing resistance of plants, damage to the energy system, growing demand for water	population, natural environment, energy systems, agriculture and forestry, water management
Heavy rainfalls	high	increase	increase	overloading of the drainage system, flooding of transport surfaces, damage to roads, traffic disturbances, roof damage	buildings, traffic roads, property damage, energy systems
Flash floods, flooding	high	increase	increase	overfilling of the drainage system and small watercourses overflowing due a large amount of local rainfall in a short time0}	population of areas exposed to the hazard of flash floods (settlements of high flash flood risk), primarily the inhabitants of the Buda side of the city, the owner and operator of wastewater treatment plants and the population living along the recipient water course
Floods	medium	increase	increase	recurrent flooding along the Danube	population living on a floodplain or near flood protection structures of insufficient crest height
Drought and water shortage	high	increase	increase	drought damage to and drying out of green areas, higher cost of maintenance of green areas, increased demand for irrigation and plant replacement, drinking water quality problems, loss of agricultural crops	natural environment, green areas, population, agricultural activities (arable land, family gardens, orchards, vineyards)
Storm-wind	medium	increase	increase	damage to façades and roofs, damage to trees	buildings, monuments, trees and, indirectly, accident hazard, property damage
Landslide	low	unknown	unknown	property damage, risk of accident	buildings, vegetation, transport
Land subsidence	low	unknown	unknown	property damage, risk of accident	buildings, vegetation, transport
Diseases spread by pathogen transmitters	medium	unknown	increase	increase in the frequency of diseases	population
Diseases spreading through air (droplet infection)	high	unknown	increase	increase in the frequency of diseases, outbreak of epidemics	population
Spread of allergens	medium	increase	increase	increase in the frequency of allergic diseases	the entire population, with special regard to people suffering from allergy
Rise in UV-B radiation	medium	increase	increase	increased risk of skin cancer and eye damage	population
Infestation or mycosis of vegetation	medium	unknown	increase	dying of vegetation, decreasing biodiversity	green areas, natural environment

Climatic hazards	Level of risk	Expected change to its intensity	Expected change to its frequency	Major effects, primary consequences	Major impact bearers
Spread of invasive, non-indigenous animal species	high	unknown	increase	change to the composition of the fauna, decreasing biodiversity, extinction of animal species	natural environment
Spread of invasive, non-indigenous plant species	high	unknown	increase	decreasing biodiversity	green areas, natural environment

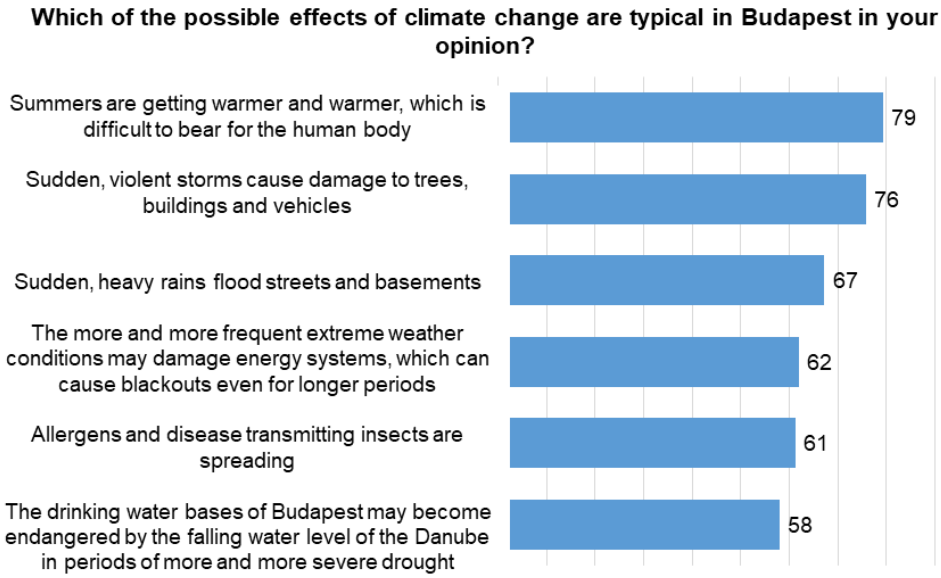
1.5. CITIZENS' INVOLVEMENT, PARTICIPATION

An important aim of the leaders of Budapest is to include citizens in the decision making and planning processes more than ever before. For this reason, the Municipality of Budapest has asked the inhabitants in several ways about what should be done to mitigate climate change and to adapt to its impacts in the capital city. *(Detailed information: BKÁÉ 2020, I.5. Klimatikus viszonyok, II.9. Környezeti nevelés, tájékoztatás, szemléletformálás)*

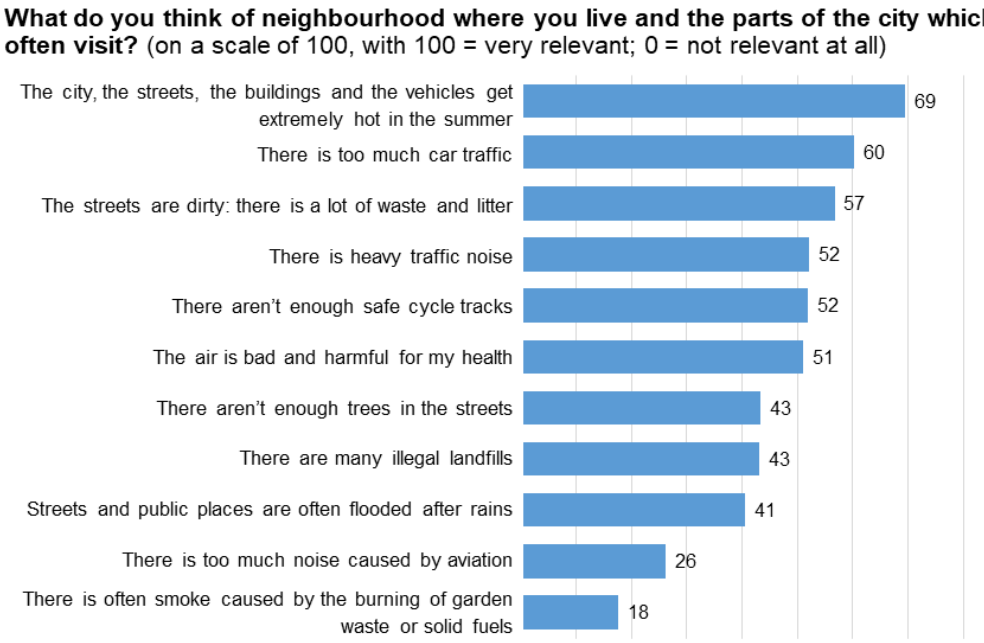
Data collected by surveys

The Municipality collected data by questionnaire survey in both July and October 2020 to provide a foundation for the strategic plans under preparation and to get to know the priorities and opinion of the public, both of them in cooperation with Medián. The samples represent the composition of the adult population of Budapest in terms of sex, age and education precisely.

On the average, people living in Budapest ranked their concern regarding climate change 61 on a scale from 0 to 100 (0 meaning not afraid at all and 100 meaning very afraid). They expressed their opinion about some specific imacts of climate change which can already be felt, as follows:

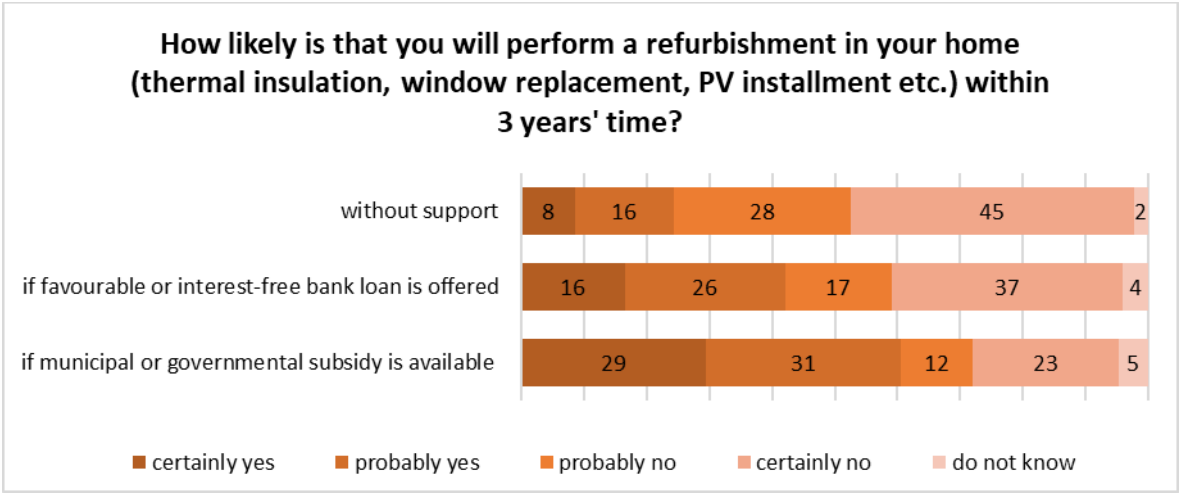


Summer heat (urban heat island effect) is outstanding among the several problems related to the respondents' living environment:

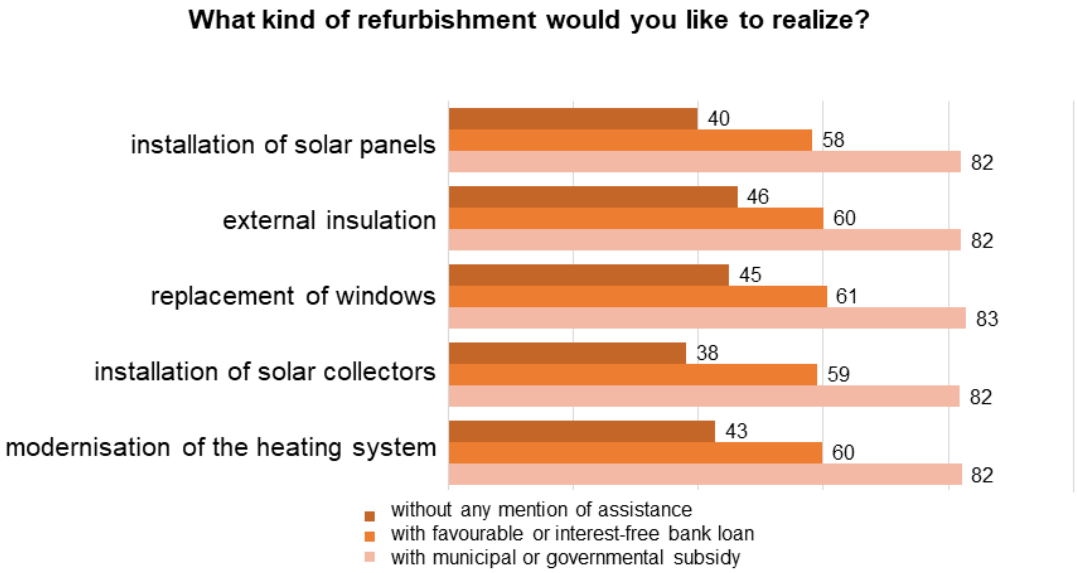


The elements of how the environment is judged are organised in accordance with the characteristics of the places of living: the number of people finding the last four answers (illegal landfills, flooding, aviation noise, smoke due to burning) relevant is significantly higher in the outskirts and suburbs. The remaining problems are more prevailing in the downtown areas, except for cycle tracks in the case of which there is no difference between residential zones.

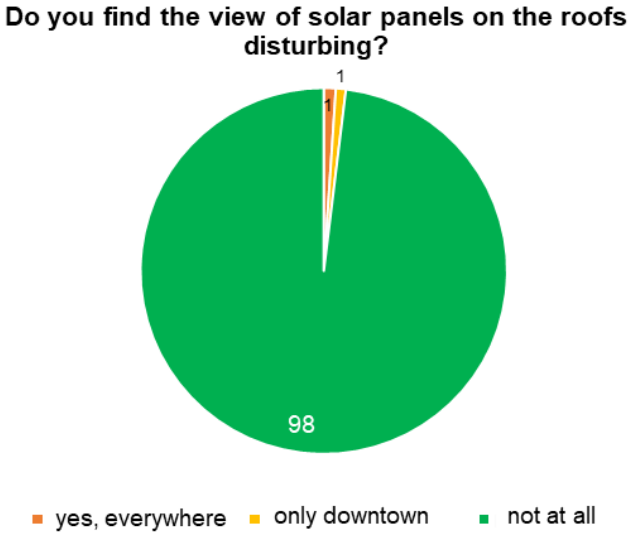
Only 8% of the population stated that they would implement some energy refurbishment in their home in three years' time. The proportion of those planning renovation would grow to 16% if some favourable or interest-free loan was offered, and to 29% if municipal or governmental subsidy was available.



The majority of those with at least a probable intention to renovate determined the installation of solar panels as their objective. The proportion of people wishing to have solar panels installed was higher among those living in housing estates or the suburbs (72-74%) than in the downtown area, but it was as high as 55% there as well.

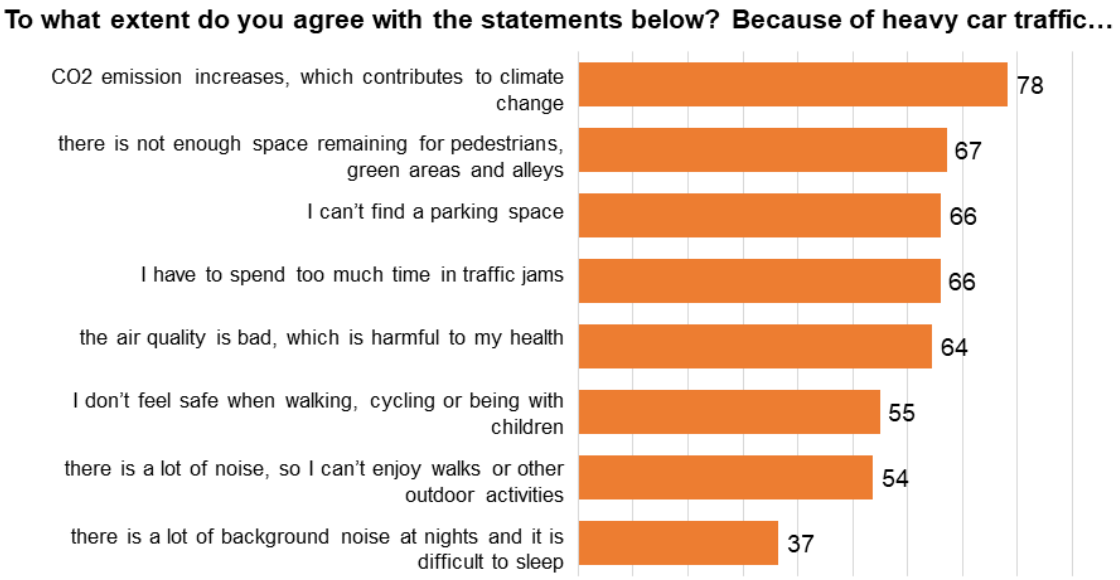


The answers revealed that the solar panels installed on the roofs do not disturb the people in Budapest at all in terms of the city view.



On a scale of 100, respondents rated the level of their satisfaction with green areas (public parks) in their neighbourhood at 67 points on the average (100: totally satisfied; 0: totally dissatisfied). The questionnaire also included a question concerning green areas at the city level: again on a scale of 100, respondents on the average agreed a bit more than to a medium extent (58) with the statement that Budapest is a city rich in green areas (0: does not agree at all; 100: agrees totally).

Car traffic is seen by the inhabitants of Budapest as a problem of a more than medium extent (60 points on a scale of 100, where 0: it is not a problem at all; 100: it is a big problem). According to the chart below, those who see the volume of car traffic as a problem, think as follows:



Before the pandemic, most of the people living in Budapest (6 of 10) had used public transport as their primary means of transport. This was followed by the use of car (30%), walking (6%) and cycling (3%). Seven of ten people travelling by car said that they would switch for public transport if the vehicles were cleaner and less crowded. Nearly 60% of them claimed that they would switch if there was free P+R service offered with public transport, if there was a special ticket for car users and if it was cheaper to park near public transport than in the city. Six of them would ride the bike, if at least one of the following conditions was filled: if they could store their bikes safely, if there were more cycle tracks, if cycling was safer, if there were more MOL Bubi stations or if MOL Bubi bicycles were better.

Online mini questionnaires

When compiling the Integrated Urban Development Strategy, the Municipality of Budapest asked the population in the form of online mini questionnaires as well to formulate their opinion on various topics (https://its2027.budapest.hu), including environmental protection and climate change. However, by their very nature, these questionnaires were not suitable for representative sampling, therefore the findings are only informative and provided some guidance for the planning of the large-sample data collection mentioned above.

Citizens' Assembly

"There is climate emergency! What should Budapest do?" - these were the issues regarding which the participants of the citizens' assembly organized by the Municipality of Budapest and Demnet in September 2020 were asked to present their suggestions. Citizens' assembly or citizens' jury is an internationally applied technique supplementing representative democracy in which the "jury" consisting of average people representing the population give their opinion on an issue regarding which usually only a circle of politicians and experts voice their position.

The nearly 50 Budapest citizens who finally attended the citizens' assembly of Budapest were randomly selected from ten thousand citizens addressed. The participants portrayed the composition of the population in terms of sex, education and age. The applicants undertook to listen to various positions in an open-minded manner, talk about them and formulate opinions and suggestions concerning the implications of climate change for Budapest on two weekends in September 2020.

At the first weekend, experts held presentations to participants about climate emergency, then the participants could ask questions and discussed what they had heard around tables with the help of facilitators. At the second

weekend of the citizens' assembly, attendants formulated recommendations as to what the Municipality should do to mitigate climate change.

The attendants selected between the possible suggestions in three rounds and then refined their selections in detail. Finally, they highlighted eight subjects regarding which the citizens of Budapest would expect the Municipality of Budapest to take measures the most. We are summarizing their recommendations below[6], while the related measures of the climate strategy/SECAP are indicated in brackets. (It is to be noted, however, that not all of the recommendations fall within the authority of the Municipality.)

1. The Municipality of Budapest should support the refurbishment of residential buildings. On the one hand, the Municipality should provide financial assistance in the form of non-refundable subsidy of 30% as a minimum and a loan of a preferential rate of 0%. On the other hand, it should set up an advisory office to provide free consultancy regarding the planned upgrading.
2. The Municipality should reduce downtown traffic by restricting the use of cars, reorganising traffic, developing bus lanes and cycle tracks, restructuring parking, creating special zones and providing community vehicles. This would not only serve the purpose of climate protection, but also mitigate air pollution, noise and congestion. (M8, M10, M11)
3. The Municipality should develop public transport in the agglomeration by creating a uniform season ticket system, car-pooling, bus lanes, the harmonisation of traffic lines and P+R and B+R parking spaces. (M11)
4. The Municipality should launch a media and informational campaign about climate change and the steps people can take against climate change individually and as a community. The promotional campaign should help people understand climate change, what is at stake, what changes they can expect and how they can prepare for them (SZ3)
5. The Municipality should increase the size of green areas by planting trees or sowing grass in the strips or areas next to roads, even by reducing parking spaces (and compensating for them). This could include the greening of noise attenuation walls, inner yards and tram rails, the creation of green walls, and making bus stops covered by creepers. (A1, A2)
6. The Municipality should provide incentives for the utilization and retention of rainwater by providing expert support, by announcing municipality tenders and by implementing pilot projects. This would not

[6] For more details, see https://kozossegigyules.budapest.hu/hirek/kozreadjuk-az-elso-fovarosi-kozossegi-gyules-reszletes-ajanlasait

only improve the local micro-climate, but also reduce the load on the sewage system and also help with saving drinking water. (A11, A12)

7. The city of the future could be introduced by the creation of climate-friendly experimental streets. By creating various types of streets, the Municipality could make the citizens acquainted with and understand the desirable lifestyle, environmental, energy consumption and traffic conditions and the possible urban architecture and traffic solutions could also be tested at the same time. (SZ3)
8. The Municipality should stop climate damaging projects and issue permits for projects by enforcing the criteria of climate protection. (SZ2)

Thematic working groups: Green urban development

In the course of the elaboration of the Integrated Urban Development Strategy, the Municipality organized working group sessions with the representatives of NGO-s on three different topics, one of which was green urban development. In July-October, 2020, the attendants worked together on three occasions on what a liveable, green city would be like in their opinion and which steps would lead there. The members of the working group discussed the current situation, the possibilities and challenges and the most important issues and needs. Then they also formulated the basics for the specific projects related to the specific issues.

https://its2027.budapest.hu/hirek/2020/08/11/milyen-az-elheto-varos-es-mik-az-ehhez-vezeto-elso-lepesek
https://its2027.budapest.hu/sites/bp/files/attachment/2020/TMCS_2_zold_varos.pdf

Participatory budgeting

In 2020, the Municipality of Budapest provided the citizens for the first time with an opportunity to brain storm jointly with the City Hall about the spending of 1 billion forint. Participatory budgeting means that the city management decides on the spending of a specific portion of the city budget based on the ideas and in continuous cooperation with the citizens. A total of 684 ideas were submitted in the period from October 1 to December 31, 2020, many of which addressed environmental protection and climate change. Following the first "test" year, participatory budgeting will be offered to the citizens on an annual basis.

The involvement of NGOs and experts

Climate Change Platform

The Climate Change Platform comprises of climate change experts of several sectors: universities, municipalities of settlements and districts, social organisations, companies, etc., and is coordinated by the Municipality of Budapest. By joining the platform, the members committed to cooperate and to share experiences and information with each other on a regular basis. The platform facilitates continuous communication with target groups on a wide scale, the collection and sharing of target group specific and thematic contents and best practices, the comprehensive follow-up of climate protection measures taken in the capital city and the creation of a database.

Advising

The preparation of the Climate Strategy / SECAP included the phase of public advising, which provided an opportunity between January 19 and February 19 of 2021 to the public to get to know the data and measures presented in the document and to formulate their recommendations and ideas.

The advisors included local residents, district municipalities, national and local NGO-s, public utility companies in Budapest and other organisations and experts working on the issue of climate change, such as: Greenpeace Hungary, HuGBC, Klímabarát Települések Szövetsége, Levegő Munkacsoport, Magyar Energiahatékonysági Intézet, Magyar Madártani Egyesület, Magyar Természetvédők Szövetsége, Budapest Esély Nonprofit Kft., City Consult Bt., BME Egyesült Innovációs és Tudásközpontja, Átalakuló Közösségek Magyarországi HUB, Civil Kollégium Alapítvány, Civil Zöldítők Egyesülete, Jószomszédok Egyesület, Energiahatékony Wekerle Civil Társaság, Zöld XVII Környezetvédelmi, Természetvédelmi és Városfejlesztési Egyesület, Kiserdővédők, KörTér, StadiOFF groups. From the public service provider companies of Budapest, BDK, BKK, BTI, Budapest Közút, FCSM and Fővárosi Vízművek

have expressed their opinion on the action plan. The General Assembly of Pest County, the municipalities of districts III, VII, XIV and XVIII and the Department of Environmental Protection, Nature Conservation and Mining Inspection of the Government Office of Pest County have also advised on the document. The opinions received, which presented various points of views, all contributed to the development of the document.

2. SWOT ANALYSIS

The SWOT analysis is based on the statements made in the Environmental Status Assessment of Budapest and the earlier climate strategy and helps with the evaluation of the characteristics of the capital city which are relevant in terms of the climate change, as well as the definition of a vision for the future and the objectives.

Reduction of greenhouse gas emission (mitigation)

Strengths	Weaknesses
• Methane emission is relatively low, because emissions by agriculture and waste treatment is less significant. • Several projects have been realized in recent years in respect of both the development of the transport infrastructure and the fleet of vehicles. • Cycling infrastructure has seen significant development and the number of people riding the bike has increased. The length of the system of major cycle tracks in the capital city has grown by more than 30% in the last 10 years and is ca. 325 km at the moment. • Thanks to technological upgrading, the energy consumption of public and decorative lighting has been reduced. • The biogas generated at the wastewater treatment plants in Budapest is energetically utilized. • The structure of the industry has changed since the 1990s and heavy industry generating a lot of GHG emission has declined. • The number of plants with substantial GHG emission has not grown for years. • The CO_{2e} emission of the industry (except for ETS participants) has not changed significantly in recent years. • International green rating systems have become widespread in real property developments. • The openness of the citizens to renewables, with special regard to solar panels. • As its owner, the Municipality of Budapest can affect the development of the district heating system directly.	• A significant portion of the buildings in Budapest is technologically obsolete and of low energy efficiency, with special regard to the buildings built before 1990. • There are no detailed, up-to-date and real data available concerning the energy performance of buildings or the use of renewables. • 83% of the energy used in Budapest is generated from fossil fuels, and the ratio of renewables is very low (4%). • Heating of residential buildings by using mixed fuels (including solid fuels or burning waste despite prohibition) generates particulate matter (PM10) emission. • Sustainable, environmentally conscious company management culture (e.g. the introduction of EMAS or other authentication and rating systems) is not wide-spread. Budapest is the centre of the road network of the country, and the emission of road traffic crossing the boundary of the city is 2.5 times higher than the emission of traffic within the city. • The continuous growth of the number of cars • Road traffic increased by 1 – 1.5% on the average between 2014 and 2019. • The average age of vehicles in Budapest increased by 2.7 years between 2009 and 2019. • There is a substantial volume of traffic arriving from the agglomeration; despite its continuous expansion, the capacity of the P+R and B+R network is still insufficient. • Due to the lack of green area developments and of green area utilization in brown-field areas, the level of CO_2 absorption capacity is low.
Opportunities	**Threats**
• The energy refurbishment of residential buildings presents a substantial opportunity to reduce emissions. • Emissions could be cut significantly by the development of public transport and cycling. • The application of more stringent energy requirements to buildings affect the energy consumption of buildings positively. • Renewable energy potential (e.g. solar energy, further utilization of thermal heat utilized in baths, establishing of geothermal heat generation capacities, increasing the ratio of waste based heat generation). • Environmental protection requirements becoming more stringent and, in parallel to this, the development of technology. • Growing popularity of cycling to and from work in Budapest. • Railways could be even more integrated with urban and suburban transport. • Continuing spread of and demand for electric and hybrid vehicles. • Young people are open to new services appearing in community economy (car pooling, car renting, car sharing). • The spread of active and micro-mobility. • The capital city plays a significant role in education and research	• Decreasing tendency of using public transport. • Energy efficient projects are not carried out due to economic recession. • Growth in consumption demands increase energy consumption. • Increasing suburbanisation and the uncoordinated sprawling of the city (urban sprawl) drive further spreading of individual motorisation and continuing growth of the transport GHG emission. • Heating with waste or poor-quality wood (pollutants). • Because of artificially lowered retail energy prices, energy efficiency improvement and the use of renewables are not sufficiently attractive prospects financially. • The regulatory environment does not support the use of renewables or the spread of practices to use locally generated energy. • Professional organisations are not properly involved in the decisions-making process before the amendment of legal rules governing building energetics. • The central, governmental funds offered to the population for energy upgrading purposes to encourage energy savings are not sufficient. • Governmental measures contrary to the interests of municipalities.

and development as well, which may promote climate protection research and measures. • The positive impact of business potentials in green economy on the elaboration and spreading the use of new, innovative technologies and solutions. • EU funds can facilitate mitigation efforts in the governmental, municipal and corporate sectors. In the new financing cycle, funds might become available for the refurbishment of residential buildings as well. • Enhanced cooperation and communication between the districts and settlements in the agglomeration on environmental protection issues.	

Adaptation

Strengths	Weaknesses
• The flood protection infrastructure is mostly established/completed. The rate of availability of the sewage system is nearly 100%. • There is a significant number of natural habitats, which are supervised by the Hungarian Park Rangers (Természetvédelmi Őrszolgálat). • The population can use medicines and vaccines to protect against allergens and disease spreading insects. • During heatwaves, information is provided and public service provider companies distribute water to the citizens. • The forests covering large areas on the Buda side favourably affect urban climate. • Increasing urban biodiversity. • The openness of the population to adaptation measures.	• Flood protection infrastructure has insufficient crest height and is in bad condition in certain places. • A part of the rainwater drainage system lacks sufficient capacity or is improperly maintained. • The proportion of paved surfaces is too high, which hinders water from leaking into the soil. • Rainwater tends to be drained and there are no solutions for keeping and utilizing it on site or draining it in a delayed manner. • In the areas where there is a unified drainage system, the rainwater intake capacity of the sewage system is limited. • Some of the buildings are threatened by floods, flash floods or flooding. • Extreme water levels pose a risk to drinking water supply and karst areas. • Some of the buildings, public places and roads in Budapest are exposed to the risk of flash floods or flooding, which indirectly jeopardizes the citizens as well. • The large number of monuments are more sensitive to the effects of climate change, such as storms. • Living creatures are vulnerable to changing climate, extreme weather conditions and the spread of invasive species and pests. • Green areas are few and of poor quality, whereas the ratio of paved areas is high, which increases the intensity of heatwaves. • Due to the structure of the city, there is little possibility for ventilation. • The green area ratio is low. • The majority of rust belts are privately held, which makes it difficult to utilize them as green areas. • The healthcare and the social care system is underfinanced and of low efficiency. • There is little shade in public places. • Wastewater treatment plants are not prepared for receiving and storing large volumes of rainwater falling suddenly in a short time, therefore a portion of mixed and dilute wastewaters is only subjected to mechanical cleaning. • As the issue of rainwater management is not resolved, rainfalls and flash floods may continue causing flooding and problems.
Opportunities	**Threats**
• EU funds facilitate adaptation efforts. • Participation in international tenders and co-operations (e.g. LIFE, Interreg, H2020, Horizon Europe).	• Biodiversity is diminishing due to the utilization of areas which used to be wilderness, the sprawling of settlements, the fragmentation of habitats due to infrastructure development and the spread of invasive species. • The spread of allergens, disease transmitter insects and viruses and bacteria present a risk to human health and there isn't a vaccine available for every infectious disease, moreover, the detection of

	diseases is problematic in many cases. • Building regulations are often created without regard to flood protection aspects. • 80% of the allergenic pollens in the air of Budapest arrive from outside the city, therefore controlling this problem goes beyond the capacity of the capital city; at the same time, allergenic species can be found in a substantial amount within Budapest as well. • New infectious diseases can spread as a result of the climate change (malaria, leishmaniasis, Western Nile fever, Dengue fever) and the hazard of epidemics increases. • Attempts at raising the awareness of the endangered population fail, and the trends of degrading social relationships and loneliness further reduce the possibility of timely interventions. • The number of households using air conditioners to mitigate the effects of heatwaves increases, which reinforces the heat island effect even further. • Real property developments further increase density and the volume of traffic. • Due to the cutting of public utility charges, the reconstruction and development of existing public utility systems may not be performed. • Governmental measures contrary to the interests of municipalities.

Awareness, attitude and behaviour of people

Strengths	Weaknesses
• There is a strong system of relations between non-governmental actors playing a central role in awareness-raising (they know and acknowledge each other's work). • The Municipality of Budapest has an Environmental Protection Fund to improve and develop the condition of the environment. • There is an Environmental Status Assessment prepared for the capital city each year, providing a picture of the climatic conditions of the city, as well as the achievements, on a regular basis. • The Department for Climate and Environmental Affairs examines every proposal concerning the environment or climate.	• It is the groups of a lower status and most vulnerable who lack information the most and they are difficult to reach and inform. • People lack sufficient information on the possibilities of adapting to the effects of climate change. • The lack of support and financing for grass-root initiatives in awareness-raising.
Opportunities	**Threats**
• There is a growing commitment in the society to nature conservation and environmental protection. • In parallel with growing health-consciousness, the demand of the society for outdoor recreation is becoming stronger, resulting in an increased demand for green areas and cycling infrastructure. • Increasing volunteerism, opportunities inherent in cooperation between organisations, appearance of the responsibility of business associations in financing. • The -18 age group can be reached with awareness-raising in a relatively active manner in the institutions. • Financial institutions start to create investment portfolios based on environmental responsibility. • A system of Eco-schools and Green Kindergartens help raising the awareness of children.	• The wasteful lifestyle of consumer society. • Imprecise, misleading or even denying information appearing in the media concerning climate change and the negative impact of such information on behaviours and attitudes. • Governmental measures contrary to the interests of municipalities.

3. CITY VISION 2030

A vision must include the recognition of joint responsibility. There is a need for responsible, active city dwellers, cooperating companies, as well as a city management taking the lead in climate protection.

To this end and in line with the Environmental Program of Budapest for 2021-2026, the Municipality of Budapest is committed to

- effectively protect the local values jeopardized by climate change;
- continuously examine and analyse local climatic, natural and environmental processes and phenomena, and publish regularly updated data on the local environmental conditions and the related conclusions, with consideration to the authenticity and verifiability of data;
- review its budgetary expenditures regularly, considering their impact on the environment, with special regard to the reduction (mitigation) of the emission of greenhouse gases, as well as in correlation with the objectives to facilitate energy efficiency and climate adaptation;
- order public services by striving at the provision of the most energy efficient and environmentally friendly public services at the highest possible, permanent technical standard;
- consider in public procurement processes that the environmental impact of the production, transportation, use and operation of the product or service purchased should be as little as possible.

The Municipality of Budapest undertakes to examine while planning development projects that the version to be implemented should be the one which not only meets the requirements of a high standard technical content, safe operation in the long term and cost efficiency, but is also more energy saving and energy efficient, supports adaptation and causes the smallest possible burden for the environment.

THE VISION

By 2030, Budapest is prepared to manage the adverse effects of climate change, ensures the protection of its natural and built values, provides a healthy, green, liveable and attractive environment to people living or working in or visiting Budapest by improving energy efficiency and sets an example for the country as a whole regarding sustainable use of energy and its innovative and climate conscious attitude.

The cornerstones of this vision:

- - major energy refurbishment is realized in 1/3 of the apartments in Budapest,
- - the total photovoltaic capacity in Budapest increases to 1,500 MW,
- - district heating uses at least 50% renewable energy, 50% waste heat, 75% cogenerated heat or 50% of a combination of such energy and heat,
- - the proportion of car users is reduced at least to 30%,
- - the per capita size of green areas grows by $1m^2$,
- - the size of protected natural areas of local importance grows by 350 ha.

Budapest as the capital of Hungary sets an example for the other towns in the country in respect of energy savings, energy efficiency, adaptation, the protection of vulnerable areas and awareness raising.

Both the citizens of Budapest and decision-makers live their everyday lives in a climate conscious manner. Climate consciousness appears not only in campaigns, but it is also part of the decisions made in numerous fields indirectly related to the topics of healthy environment, healthy living, cost reduction and sustainability (healthcare, workplace environment, elderly care, SME development, trade, food supply, water consumption).

The capital city is prepared to face the negative effects of climate change and has taken the necessary steps to prevent harmful effects and protect the population. In the city planning processes and the renovation of existing buildings and the construction of new buildings, priority attention is paid to decreasing the intensity of the heat island effect. As the flood protection infrastructure has been fully constructed and is in good condition, the amount of flood damage is not increasing. Budapest values its water reserves more than ever, strives at the efficient use of

drinking water and introduced adaptive rainwater and grey water management. The citizens and the transport and public utility infrastructure are also prepared against extreme weather events. Budapest manages its natural, landscape and architectural values with special consideration to the values sensitive to the impacts of climate change. The development of the green area system successfully contributed to the mitigation climate change (urban heat island effect, extreme precipitation) and the enhanced absorption of carbon.

The energy efficiency of public and residential buildings and industrial production and service provider facilities has also been improved. The ratio of renewables compared to fossil fuels has grown both in the energy consumption of buildings and in district heating. As a result of its energy efficiency, the district heating system has been integrated: with the connection of island-like systems and the improvement of its competitiveness, the area covered by district heating is expanding. As for transport, the ratio of the use of private cars has diminished, whereas a growing proportion of the citizens decides for public transport and cycling or walking. The system of electric charging stations has been established and electric and low emission vehicles have become wide-spread both in individual and public transport. The proportion and/or the distance covered by commuters crossing the city boundary has decreased thanks to the development of the local centres of settlements in the agglomeration and of the districts in the outskirts. Infrastructure for quick and comfortable public transport is also established in the agglomeration, and the growing number of P+R car parks and B+R bike stations have encouraged the majority of commuters to choose public transport within the city boundaries. Cars may drive into the downtown area with restrictions. Energy efficiency, transport and green area development projects contribute not only to the reducing of emissions in Budapest, but also to the improvement of air quality, the mitigation of smog and of the intensity of the heat island effect and, through all these, they promote the health of the citizens and the preservation of the natural environment. The volume of waste generated in the capital city has decreased, selective waste collection has been introduced everywhere, waste is efficiently recovered, and this has also resulted in significant decrease in methane and nitrous emissions.

4. CLIMATE STRATEGY OBJECTIVES

Emission reduction (mitigation)	Adaptation and preparation	Awareness raising, climate consciousness
Má-1 Improving the energy efficiency of buildings, industrial production and facilities of the tertiary sector and increasing the ratio of renewables Má-2 Improving the energy efficiency of transport infrastructures, supporting and developing environmentally friendly forms of transport Má-3 Increasing the size of the green areas and improving their quality to enhance their carbon absorption capacity	Aá-1 Development of the green – blue infrastructure Aá-2 Mitigation of the heat island effect in the built environment Aá-3 Development of the flood control system Aá-4 Adaptive rainwater management Aá-5 Preparation for extreme weather conditions and the health impacts of climate change Aá-6 Mitigation of the vulnerability of natural and landscape values	SZ-1 Climate conscious city management: cooperative city management taking the lead in climate protection SZ-2 Climate conscious city dwellers: reinforcement of the environmental culture and responsibility among the population and economic actors

Figure 15: The climate strategy objectives of Budapest

Objectives and actions were determined with priority focus on responsibility for their implementation, i.e. the action plan focuses on areas which the Municipality of Budapest can realize in its own authority.

4.1. REDUCTION OF THE EMISSION OF GREENHOUSE GASES (MITIGATION)

In the spirit of the vision for 2030, the strategy determines the objectives necessary for the vision to become reality. Decarbonisation and mitigation include activities reducing greenhouse gas emission, which can be realized by the mitigation of material and energy consumption and by the lowering of demands. The decarbonisation and mitigation targets of Budapest have been determined based on the Hungarian Decarbonisation Roadmap of the second National Climate Change Strategy.

The climate and energy policy framework of the European Union valid until 2030[7] proposes that Member States should commit to further reduce their greenhouse gas emissions, i.e. by 40% by 2030 compared to the level of 1990. The members of the European Covenant of Mayors (including Budapest) are also required to realize GHG savings at a minimum rate of 40% by 2030 compared to a base year selected by the members in their own discretion.

Accordingly, the Municipality of Budapest has set the target to reduce its emissions by 40% by 2030 compared to the base year of 2015.

Chart 2: The decarbonisation target of Budapest

2015	2030
6.11 million t CO_2	**-40%**

[7] COM(2014) 15 final: Éghajlat- és energiapolitikai keret a 2020–2030-as időszakra

In addition to the foregoing, the Municipality of Budapest has also assumed a long-term commitment by joining the Under 2 Coalition[8]. By joining the Coalition, the parties undertake to reduce their emission of greenhouse gases by 80% as a minimum by 2050 compared to the values in 1990 and/or reduce their annual per capita emission below 2 metric tons.

The figure below shows the change to emission so far based on SECAP data and the decrease in emission expected to result in the future from the measures of this climate strategy.

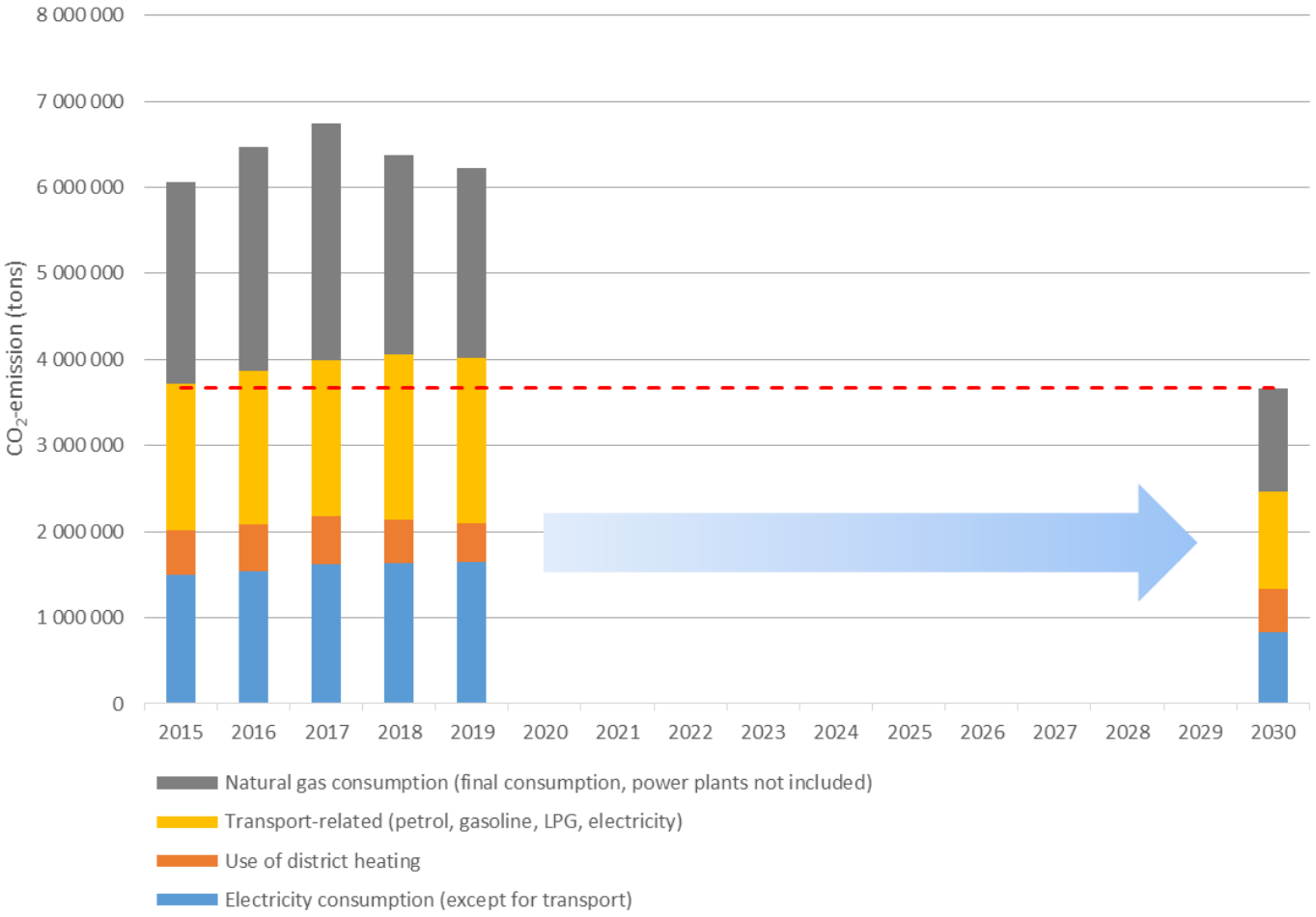


Figure 16: Change to GHG emission in recent years and the expected impact of the climate strategy measures on GHG emission

[8] Budapest joined the Under 2 Coalition in December of 2015 aimed, as implied by its name, at keeping the rate of global warming under 2 °C.

Chart 3: The GHG emission reduction (mitigation) objectives of the strategy

Code of the objective	Description of the objective
Objective Má-1	Improving the energy efficiency of buildings, industrial production and facilities of the tertiary sector and increasing the ratio of renewables
Objective Má-2	Improving the energy efficiency of transport infrastructures, supporting and developing environmentally friendly forms of transport
Objective Má-3	Increasing the size of the green areas and improving their quality to enhance their carbon absorption capacity

Má-1 Improving the energy efficiency of buildings, industrial production and facilities of the tertiary sector and increasing the ratio of renewables

The energy consumption of buildings is primarily responsible for the CO2 emission of Budapest. The majority of the energy used is generated from fossil resources, whereas the ratio of renewables still remains low. More specifically, the emission of residential buildings is most significant. That's why GHG emission reduction (mitigation) objective Má-1 is aimed, besides the use of renewable energy resources, at the improvement of the energy efficiency of buildings and of industrial production and service provider facilities in the first place. This can be achieved primarily by means of the renovation of the building structures and heating systems and, in the case of institutions, by the installation of building monitoring and automation systems. The establishing of energy communities means a new opportunity for Budapest as well, whether in the field of electricity generation, storage and consumption or the operation of electric charging stations.

Má-2 Improving the energy efficiency of transport infrastructures, supporting and developing environmentally friendly forms of transport

The energy consumption of transport is responsible for ca. 28% of all greenhouse gas emissions in Budapest. Accordingly, the reduction (mitigation) of the GHG emission of traffic is the second most important comprehensive objective. This requires change in respect of each of the three factors directly affecting traffic: tracks, vehicles and people (which cannot be sharply separated). In general, developments aimed at a more efficient and compact city form, using local opportunities and services and the application of telecommunication in travel organisation may effectively mitigate demands for mobility.

It is preferable to increase the ratio of public transport, cycling and pedestrian traffic, to encourage the application and use of low or zero emission (electric) vehicles and means of micro-mobility, which can be promoted by traffic regulation and the designation of climate protection zones as well. In order to realize all these things, the financial background for establishing the infrastructure (e.g. cycle track network, P+R and B+R parking spaces) and the targeted renewing of public transport (including taxi service) and the municipal vehicle fleet needs to be ensured. Then, in addition to raising the awareness of and providing support to the public, there is also a need for traffic regulation measures (e.g. entry restrictions, designation of low emission zones).

Má-3 Increasing the size of green areas and improving their quality to enhance their carbon absorption capacity

The ratio of green areas is quite low in Budapest, therefore their carbon absorption capacity is weak as well, although green areas would have an important role in the absorption of CO_2. This requires not only the increasing of the proportion of green areas or the number of trees, but also the improvement of the quality of green areas, as the carbon absorption capacity of the plants grows in direct proportion to their vitality. This objective is not only important in respect of carbon absorption but of adaptation as well, because it contributes to the mitigation of the heat island effect, and it also plays a major role in water management.

4.2. ADAPTATION AND PREPARATION OBJECTIVES

The objectives related to adaptation and preparation determine, in accordance with the climate protection vision of Budapest, the goals necessary for preparation for climate change, which promote the welfare and health of the citizens and protect local values as well. In respect of adaptation, the most important topics are as follows in Budapest:

- heatwaves,
- floods,
- flash floods, inundation,
- storm damage,
- damage to the infrastructure,
- spread of allergens and inspects transmitting diseases,
- shrinking of natural habitats,
- damage to forests.

Chart 4: The comprehensive adaptation objectives of the strategy

Code of the objective	Description of the objective
Objective Aá-1	Development of the green – blue infrastructure
Objective Aá-2	Mitigation of the heat island effect in the built environment
Objective Aá-3	Development of the flood control system
Objective Aá-4	Adaptive rainwater management
Objective Aá-5	Preparation for extreme weather conditions and the health impacts of climate change
Objective Aá-6	Mitigation of the vulnerability of natural and landscape values

Aá-1 Development of the green – blue infrastructure

The climate of the city is influenced by the ratio of inactive, paved surfaces and biologically active, green areas and water surfaces to a large extent. In order to attain favourable effects, it is not enough to increase the ratio of green areas, but their quality also needs to be developed.

The measures necessary for increasing the size and improving the quality of green areas and for ensuring the advanced level maintenance of the green areas following the developments are going to be included in the Budapest Green Infrastructure Development and Maintenance Action Plan, which is under preparation (Radó Dezső Plan).

Aá-2 Mitigation of the heat island effect in the built environment

Due to the characteristics of Budapest, the intensity of the heat island effect is high in the city, with special regard to the downtown area and the Pest side. Therefore, one of the most important adaptation objectives in the capital city is to protect against the effects of heatwaves. The mitigation of the effects of heatwaves can be promoted by means of urban planning, architecture and green and blue infrastructure.

Aá-3 Development of the flood control system

Because of increased flood hazard, there are large areas in the capital city at risk. Floods may not only cause damage to property and buildings, but may also threaten human lives. Therefore, the reinforcement and proper technical condition of flood protection lines are of prime importance.

Aá-4 Adaptive rainwater management

Besides flood hazard, short-term but high-intensity incidents of a large volume of precipitation and flash floods have also been causing more and more severe problems. One of the most important ways to tackle these problems may be the rainwater management plan to be prepared for the area of Budapest. It is intended, among others, to survey the current system and to prepare a model for the territory of the city which would examine the impacts of

various precipitation events, determine the critical points in terms of the drainage of rainwater and propose solutions. The plan would cover the regulation of surface runoff, as well as the encouraging of the retention and utilization of rainwater.

Aá-5 Preparation for extreme weather conditions and the health impacts of climate change

Extreme heat, strong UV radiation, gusts of wind, extreme precipitation events and other extreme weather conditions and the ensuing floods, flash floods, inundations and drought periods jeopardize human health, involve the risk of accidents and may cause material damage. It is important therefore to provide the population proper information and protection during heatwaves and to survey and properly manage municipal properties affected by storm damage (buildings, public service systems) to mitigate the damage. In addition, it is also necessary to examine the climate vulnerability of particularly sensitive areas, such as drinking water bases and drinking water supply.

Aá-6 Mitigation of the vulnerability of natural and landscape values

Natural elements are also exposed to high risk due to the effects of climate change. The preservation of natural values and biodiversity requires the expansion of protected areas and the reinforcement of current protection. Beyond the reconsideration of the bases of financing of nature conservation management, it is also highly important to settle the regulatory background and to support environmental education.

4.3. AWARENESS-RAISING AND CLIMATE-CONSCIOUSNESS OBJECTIVES

The awareness-raising objectives have been determined based on the attitude of the citizens, of previous awareness-raising projects of the capital city and the findings of the vulnerability test. Awareness-raising objectives are also in correlation with and facilitate the implementation of decarbonisation and adaptation objectives.

Chart 5: Awareness-raising objectives in the strategy

Code of the objective	Description of the objective
Objective SZ-1	Climate conscious city management: cooperative city management taking the lead in climate protection
Objective SZ-2	Climate conscious city dwellers: reinforcement of the environmental culture and responsibility among the population and economic actors

SZ-1 Climate conscious city management: cooperative city management taking the lead in climate protection

It is of priority importance to realize some kind of internal awareness-raising, i.e. to improve climate consciousness in the operation of the Mayor's Office and the public service providers as well, and to incorporate climate protection criteria as horizontal principles in various projects and everyday operation. This is how the Municipality of Budapest may become an authentic leader, capable of influencing the behaviours and decisions of the various target groups positively by operating in an exemplary manner. Leadership also involves the ability to cooperate with various stakeholders, what more, to initiate such co-operations, being open to innovative solutions and ready to experiment with and implement novelties.

SZ-2 Climate conscious city dwellers: strengthening of the environmental culture and responsibility among the population and economic actors

In addition to the influencing of the lifestyle, the consumption habits, the activities and the way of thinking of the population and the strengthening of responsibility and climate consciousness among citizens, it is the attitude and the decisions of the businesses in the capital city which will fundamentally determine the success of the climate strategy and to what extent the GHG emission reduction (mitigation) and adaptation objectives set can be achieved.

5. EMISSION REDUCTION ACTION PLAN

Má-1 Improving the energy efficiency of buildings, industrial production and service provider facilities and increasing the ratio of renewables

Refurbishment and energy conscious operation of the buildings and facilities of the Municipality of Budapest and public service providers	**M1**

The Municipality of Budapest maintains numerous institutions and companies, thus operates a large number of buildings and facilities (social institutions, theatres, educational institutions, public utility companies, etc.), and may directly influence their energy consumption and energy efficient renovation and operation.

Renovation of the City Hall

The building complex constructed in 1741, which is a protected historical monument, means a heated floorspace of more than 51 thousand m^2 in Városház street next to Deák square. According to the energy certificate issued in 2019, the building has an FF rating on the scale from AA++ to JJ. Due to the boiler modernisation carried out in 2015 at the City Hall, the Municipality managed to save 30% of the natural gas consumed. In 2020, the connection of the building of the City Hall to the district heating system started as part of the program announced by the DH provider under the title "Chimney-free City Centre".

Due to the protected status of the building, complex building energy refurbishment (e.g. the insulation of the external façades) is restricted by the law, but attic floors and flat roofs may be insulated, the lighting system may be modernised and windows may be replaced in the building (subject to certain restrictions) and thermal insulation works and solar panels (100 kWp) may also be performed and installed in the parts of the building facing the inner yard.

According to calculations, by the insulation of the ceilings and the electricity generated by solar PV panels, the total energy consumption of the building could be reduced by ca. 6%. More complex renovation works (the thermal insulation not only of the ceilings, but also of the façades of the parts of the building facing the yard and the installation of modern windows and solar panels together) could reduce the total energy demand of the City Hall by about 30%. In this way, the FF rating of the building could be improved to EE.

Such renovation would require substantial investment of several billions of forints, while the amount of energy saved would be limited due to regulations regarding the protection of historical monuments. For this reason, in the interest of efficiency and the responsible spending of public funds, the Municipality gave priority to the renovation of other municipal institutions (see below). Should, however, sufficient funds be available in the future, the modernisation of the City Hall could also continue.

Annual volume of energy saved, 2015-2020 (boiler): 1,306 MWh

Annual volume of energy to be saved, 2020-2030:

- solar PV panels - 120 MWh,
- window replacement and thermal insulation: 730 MWh

GHG mitigation: 440 tCO_2

Other institutions

Provisions have been made for the refurbishment of several, mainly cultural and social institutions maintained by the Municipality by 2023, such as:

- Libraries No. XVIII/3, XIX/1, XIII/8, III/5 of Metropolitan Ervin Szabó Library
- Budapest City Archives
- Old People's Homes of Alacskai road, Kamaraerdei road, Pesti road, Gödöllő, Baross street and Kútvölgyi road of the Municipality of Budapest
- BMSZKI Temporary Accomodation for Homeless People in Mester street, Táblás steet and Kálvária street
- BMSZKI Night Shelter in Kőbányai road and Night Shelter and Daytime Warming Shelter in Könyves Kálmán boulevard
- BMSZKI Temporary Home for Families in Rákosszeg park

Annual volume of energy to be saved: 10000 MWh

GHG mitigation: 2020 tCO_2

The Municipality of Budapest is making continuous efforts to raise funds to modernize the remaining municipal institutions as well.

Type of measure	Mitigation		
Timeframe	2030		
Owner	Municipality of Budapest, Department of Office Management and Institutional Development		
Necessary financing	HUF 15000 million		
Potential sources	EU funds and schemes, own contribution		
Related thematic programs, strategies, plans	Budapest 2030 Long-Term Urban Development Concept		
Indicator	Amount of energy saved (MWh/annum) CO_2 mitigation (tCO_2/annum)		
	Source of data: Municipality of Budapest		
	Base year: 2015	*Base year value: 0*	
	Target year: 2030	*Target year value: 12,156 MWh/annum 2,460 tCO_2/annum*	

Institutions of business associations providing public services

1. At the Central Wastewater Treatment Plant operated by Budapest Waterworks (Fővárosi Vízművek) and at the wastewater treatment plants operated by Budapest Sewage Works Ltd. (Fővárosi Csatornázási Művek) in North-Pest and South-Pest, the methane generated during the decomposition (putrefaction) of the sewage sludge is also used to produce electricity and thermal energy used, which can be used to fulfil the electricity and/or heat demand of wastewater treatment plants in the future as well, in part or as a whole. The volume of biogas generated may be increased by the decomposition of additional waste rich in organic matter. With the decomposition of organic materials, the volume and weight of wastes and sewage sludges can be reduced. The objective could be to achieve that the biogas or other renewables generated at the plants should satisfy, as a minimum, the total demand of the plants for electricity and heat.

In addition, the preliminary examination of the possibility of establishing a biogas plant is also necessary in the interest of the processing of biowaste by fermentation, in accordance with the principle of utilizing biologically degradable waste. (KEHOP 2.2.2 project titled: "Budapesti Központi Szennyvíztisztító Telep iszapelőkezelési technológiájának fejlesztése")

Estimated cost: HUF 2,500,000,000

2. In order to improve the energy efficiency and operational safety of Budapest Central Wastewater Treatment Plant (BKSZTT), the operational methods of the technological units of the plant which require the most energy need to be optimized. It is also necessary to clean biogas produced at BKSZTT sufficiently to enable its feeding into the natural gas system in accordance with the regulations, to provide for the addition of the necessary additives (propane) and for continuous quality control as required, as well as to create the conditions of connection to the natural gas system on the consumers' side.

Estimated cost: HUF 1,000,000,000

3. Budapest Waterworks intends to implement a solar panel-based power generation program and there are plans for other related energy efficiency investments as well. The implementation of phase II of the solar panel-based power generation program will reduce the volume of electricity purchased and result in the on-site utilization of the electricity generated. The total capacity of the solar panel systems to be commissioned may amount to 2.51 MWp. The solar panel capacity planned to be installed will be sufficient to generate nearly 3% of the electricity purchased.

Estimated cost: HUF 650,000,000

4. There are also plans for the commissioning of an additional solar panel system of a total capacity of 3.0 MWp at the premises of the Budapest Central Wastewater Treatment Plant, which will be sufficient to generate more than 3% of the electricity purchased annually.

Estimated cost: HUF 1,050,000,000

The implementation of the midterm reconstruction program meant to extend the lifetime of the waste recovery plant operated by FKF in Rákoskeresztúr. It is technically essential to treat hazardous waste, manage the outgoing waste stream and to replace the turbine. In the field of waste treatment, it is important to provide the facilities and technologies necessary to treat various material types, to reduce the exposure to subcontractors in the interest of effective and flexible adaptation to changing conditions on the market of secondary raw materials, as well as to enhance energy efficiency.

The development and reconstruction works of the Waste Treatment Plant in Rákospalota could be realized in the amount of ca. HUF 8,500,000,000, of which energy development would be ca. HUF 4,000,000,000, reconstruction tasks would be ca. HUF 4,000,000,000 and the purchasing of vehicles necessary for the removal of hazardous waste would be ca. HUF 500,000,000.

The energy development includes the replacement of the turbine generator unit, the mechanical system of the new district heating centre and the heat exchangers used to recover the heat from waste gases.

The amount to be spent on reconstruction contains the refurbishment of our current equipment necessary for continuing operation.

Works aimed at the replacement of windows and the modernisation of lighting systems, heating and ventilation systems and the solar panel system are planned to be realized by BKV Zrt on several sites (bus garages, remises, etc.).

The energy refurbishment projects of the district heating company are presented in more detail in measure M5.

Type of measure	Mitigation		
Timeframe	2030		
Owner	Municipality of Budapest, Department of City Management		
Necessary financing	HUF 15000 million		
Potential sources	EU funds and schemes, own contribution		
Related thematic programs, strategies, plans	-		
Indicator	Amount of energy saved (MWh/annum) CO2 mitigation (tCO_2/annum)		
	Source of data: Municipality of Budapest and business associations providing public services		
	Base year: 2020	*Base year value: 0*	
	Target year: 2030	*Target year value: 159,790 MWh/annum 36,750 tCO_2/annum*	

Reconstruction and energy upgrading of the public lighting system	**M2**

According to the data of BDK, of the 183 thousand luminaries used in Budapest for public lighting, about 110 thousand are worn-out and technically outdated and of high energy consumption and operating cost and will need to be replaced in the next 5 years. The effect of the total upgrading project has been estimated by assuming that they would be replaced by LED luminaries. (Note: The installation or extension of artificial lighting should be avoided in natural areas and areas close to nature to prevent any disturbance to wildlife.

Of the 110 thousand luminaries, BKD Kft can finance and implement on its own the replacement of 4,000 luminaries per annum, i.e. 20,000 in total; for any additional replacement, external funding and capacity need to be involved.

Considering the experience of the recent period and the composition of the current portfolio of 110,000 luminaries, the power per unit is expected to be reduced by 40 W/pcs on the average, based on which the target value of the savings on electricity can be 18,242 MWh/annum.

In years 2018 and 2019, the Municipality of Budapest installed 7,000 LED luminaries in public lighting to replace obsolete luminaries depreciated to nil. The volume of energy saved by this modernisation resulted in 1.952 MWh, calculated with the reduced installed capacity and the annual operating hours of 4,146 in 2019.

Type of measure	Mitigation		
Timeframe	2026		
Owner	Municipality of Budapest, Department of Office Management and Institutional Development (and Department of Urban Planning)		
Necessary financing	HUF 13,970 million		
Potential sources	EU funds and schemes		
Related thematic programs, strategies, plans	Lighting Master Plan for Budapest (Budapest Világítási Mesterterv)		

Indicator	Amount of energy saved (MWh/annum) CO_2 mitigation (tCO_2/annum)	
	Source of data: BDK Kft.	
	Base year: 2020	*Base year value: 0 MWh/annum; 0 tCO_2/annum*
	Target year: 2027	*Target year value: 18,242 MWh/annum 4,200 tCO_2/annum*

Refurbishment of residential buildings	**M3**

One of the most effective ways to mitigate GHG emissions in Budapest is to reduce the energy demand of residential buildings, resulting in the mitigation of the consumption of electricity, natural gas and other energy sources. The measure comprises the following elements: thermal insulation of external walls; modernisation of the heating system; installation of renewable energy technologies. It is advisable to implement these as part of a complex refurbishment project. The renovation of one third of the residential buildings in Budapest has a saving potential of 4,809,105 MWh energy and 981,977 t CO_2 per annum.

The special focal areas of the planned refurbishment program are listed below:

- suburban areas where the use of highly polluting fuels (including firewood, however, this is primarily an environmental, air quality and health issue, rather than climate change),
- assistance and consultancy for households in need, in poverty or energy poverty,
- supporting community energy production, prosumers and energy communities,
- designing, creation and testing of positive energy districts,
- possibilities of reducing the amount of energy used in or for the materials of buildings and in the course of construction works (life cycle analysis, circular construction materials),
- technologies and solutions that also support climate adaptation.

The launching of the building renovation program in Budapest requires the creation of a financing model of several components, involving both national and international funds. The data collected from the population as presented in the situational analysis clearly show that a substantial wave of major refurbishments may only be realized if there are financial supports available. It is also necessary to monitor and evaluate future results of the program.

At the citizens' climate assembly held in Budapest (see Chapter 1.5), the great majority of the participaants identified financial support for the energy renovation of buildings as the most important request and climate protection proposal. In addition, the need for setting up an advisory and consultancy office was also formulated, which could help the public with advice and calculations in connection with the refurbishment possibilities. Similar initiatives have been launched recently (e.g. RenoHub project), and the Municipality is examining the possibility of joining them.

The implementation of this measure requires the effective cooperation between the various stakeholders (the Municipality of Budapest, district municipalities, the state, financial institutions etc.).

Type of measure	Mitigation		Energy poverty
Timeframe	2030		
Owner	Municipality of Budapest, Department of Climate and Environment Issues		
Necessary financing	964 000 million HUF[9]		
Potential sources	national and EU funds and the contribution of businesses, districts, the Municipality of Budapest and the citizens		
Related thematic programs, strategies, plans	-		
Indicator	Amount of energy saved (MWh/annum) CO_2 mitigation (tCO_2/annum)		

[9] *The estimated amount of financing necessary for the measure is based on 2 methods of teh National Bulding Energy System, and calculates, depending on the type of the building, with a renovation ratio of 15-50% according to cost criteria. The amount includes the total cost of investment (state aid + own contribution).*

		Source of data: BKAE
	Target year: 2030	*Target year value: 4,809,105 MWh/annum 981,977 tCO_2/annum*

Facilitation of solar panel development projects	**M4**

The ratio of renewables can be currently promoted in Budapest in the simplest and most cost-efficient manner by the active utilisation of solar energy, which primarily means the application of photovoltaic panels. As part of the energy development of public transport, energy generation based on solar panels is planned to be realized at 100 stops.

The geographic and climatic conditions for utilizing solar energy are excellent in Budapest (the number of sunny hours and days is high), but there are also some regulations in place which hinder utilisation (sometimes differing from district to district), and it is high time they were examined and addressed.

According to the data available, the portion of the buildings and roofs in Budapest which are suitable for the installation of solar panels and the areas suitable for being used for this purpose are sufficient for the installation of solar panels of a total installed capacity of 1500 MW (1750 MWp). This would require a (roof) area of ca. 10 million m^2 (it is to be noted, that photovoltaic systems may be installed not only on roofs, but also on walls, on the ground, as well as on stands above parking spaces, etc.).

This measure has a CO_2 savings potential of 467 thousand tons, which corresponds to the CO_2 emission of the residential electricity use in 2015. This estimate is in accordance with the survey of the solar potential of Budapest published by Google in July, 2016. (Budapest - Rooftop solar potential - Google Environmental Insights Explorer - Make Informed Decisions)

The Municipality of Budapest intends to promote solar panel development through the means indicated under measure M3 and, in its own buildings and facilities, in the form of own investment and tender projects (measure M1).

The implementation of this measure requires the effective cooperation between the various stakeholders (the Municipality of Budapest, district municipalities, the state, economic operators).

Type of measure	Mitigation		
Timeframe	2030		
Owner	Municipality of Budapest, Department of Climate and Environment Issues		
Necessary financing	HUF 630,000 million		
Potential sources	national and EU tender funds, the own resources of businesses and the population, Urban Development Fund		
Related thematic programs, strategies, plans	-		
Indicator	Amount of energy saved (MWh/annum) CO_2 mitigation (t CO_2/annum)		
			Source of data: ELMŰ Hálózati Kft.
	Base year: 2019		*Base year value: 15,872 MWh/annum 3,651 t CO_2/annum*
	Target year: 2030		*Target year value: 2,031,409 MWh/annum 467,224 t CO_2/annum*

Development of the district heating system (reconstruction, increasing efficiency and the ratio of renewables, etc)	**M5**

The purpose of the district heating development program is to refurbish and develop the district heating system (own heat generators, pipelines, heat centres), and to increase the ratio of renewable energy resources as well as to realize "efficient district heating and cooling" in terms of Article 2, Section 41 of Directive 2012/27/EU. According to the Directive, "efficient district heating and cooling" means a district heating or cooling system using at least 50% renewable energy, 50% waste heat, 75% cogenerated heat or 50% of a combination of such energy and heat.

According to the data supplied by Főtáv (the district heating provider), the reconstruction or replacement of PTVM furnaces is needed to reduce NO_x emission – the emission must be reduced by the end of 2022 based on the obligation determined in the law on environmental protection. The purpose of the project is to mitigate the emission of NO_x gases by 70%, in addition to which annual primary energy savings by 6,022 MWh/annum and emission reduction by 1,471 tCO_2/annum are planned to be achieved by means of energy efficiency development.

The planned installation of geothermal capacities of 4-5 MW in Rákoskeresztúr and 20MW in Kispest would enable the generation of renewable district heat in the volume of 98,000 MWh/annum, which would in turn mitigate primary energy use by 115.294 MWh/annum and emissions by 27,534 tCO_2/annum.

According to plans, with the replacement of the steam turbine HuHa1 waste incinerator plant and the reconstruction of the furnaces to be realized as part of the thermal upgrading project, an additional installed capacity of 20 MW would be added to the system, 50% of which can be regarded as renewable energy in the meaning of TNM Decree 7/2006 (V.24.). By means of such development, primary energy could be saved in an amount of 108,009 MWh/annum and CO_2-emissions could be mitigated by 29,372t per annum.

The connection of the various district heating zones (connection of the heating zones of Kelenföld and Csepel, connection of the heating zones of Kispest and Csepel, the leading of the district heating pipeline over Galvani bridge with the installation of a pump shed, construction of the cooperating main pipe between "Csepel csillagpont" and Rákóczi bridge) could mitigate primary energy use by 240,206 MWh/annum and related emissions by 58,368 tCO_2/annum.

The energy efficiency reconstruction of the pipelines and the energy efficiency and control technology reconstruction of the district heating centre could result in additional primary energy saving by 87,359 MWh and emission mitigation by 21,071 tCO_2 on the district heating system.

As a result of the hydraulic capacity enhancement works to be performed to increase the heat emission of Újpest Power Plant and to improve the safety of supply, primary energy savings by 25,345 MWh/annum could be realized, whereas CO_2 emissions could be reduced by 6,160t CO_2/annum.

According to the calculations made and the data supplied by FŐTÁV, by the connection of new consumers to the district heating system, energy consumption and CO_2 emissions could be reduced by by 136,830 MWh/annum and 32,160 t respectively by 2030.

The said developments could be realized with European and national investment support funds, such as the Green Infrastructure and Climate Protection Operational Programme or the Modernisation Fund. Concerning development cycle 2014 – 2020, there are five tender projects being implemented as part of EEEOP 5.3.1 titled "Energetic modernisation of the district heating sector".

Type of measure	Mitigation		
Timeframe	2030		
Owner	Municipality of Budapest, Department of City Management		
Necessary financing	HUF 98,507 million		
Potential sources	Municipality of Budapest, Főtáv, EU funds, own funds of the population and economic operators		
Related thematic programs, strategies, plans	-		
Indicator	Amount of energy saved (MWh/annum) CO_2 mitigation (tCO_2/annum)		
	Source of data: FŐTÁV Zrt.		
	Base year: 2015	*Base year value: 0 tCO_2/annum / 0 MWh/annum*	
	Target year: 2030	*Target year value: 719,066 MWh/annum 176,135 tCO_2/annum*	

Conducting basic surveys and researches on the subject of the feasibility and application of sustainable energy management and circular economy	**M6**

Appropriate planning, emission reduction and increasing the ratio of renewables substantially necessitate a more precise presentation of the possibilities for the residential and non-residential application of renewable energy resources in Budapest (solar panel and geothermal potentials primarily). As part of this, it is important to survey and model the existing buildings in detail, to create a database (including their location in the city structure and other regional analyses), as well as to explore administrative requirements and restrictions.

Life-cycle analyses relevant to the emissions of building materials and equipment are also missing (in respect of manufacturing and operation alike), which would be necessary for example to realize zero emission construction works ("clean construction").

Type of measure	Mitigation		
Timeframe	2022		
Owner	Municipality of Budapest, Department of Climate and Environment Issues		
Necessary financing	HUF 30 million		
Potential sources	EU funds, municipal funds		
Related thematic programs, strategies, plans	-		

Enhancing mitigation and decarbonisation activities of industrial production and facilities of the tertiary sector	**M7**

The energy demand of premises and buildings of businesses is also quite substantial, the reduction of which could improve their competitiveness by means of the direct reduction of costs. The energy demand of production technologies is also quite high compared to the available standard of technology: the energy intensity of the Hungarian economy is nearly the double of the EU 28 average. The municipality plays a role in this respect primarily in providing information to businesses, making them acquainted with state-of-the-art technologies and providing assistance in finding the necessary financing for applying those technologies (see Measure SZ4).

Type of measure	Mitigation		
Timeframe	2030		
Owner	Municipality of Budapest, Department of Climate and Environment Issues		
Necessary financing	15-20 M HUF/annum.		
Potential sources	EU funds, own resources of businesses		
Related thematic programs, strategies, plans			
Indicator	Amount of energy saved (MWh/annum) CO_2 mitigation (tCO_2/annum)		
	Source of data: number of businesses reached with the information (to be determined in the course of further planning)		
	Base year:	*Base year value: 0*	
	Target year:	*Target year value: 390,000 MWh/annum* *78,780 tCO_2/annum*	

Má-2 Improving the energy efficiency of transport infrastructures and supporting and developing environmentally friendly forms of transport

Development of public transport with more attractive vehicles and services and better infrastructure	**M8**

The Municipality of Budapest can influence the energy use of transport in the capital city (responsible for 24% of total energy use and 25% of total CO_2 emission) through the operation and development of public transport in Budapest in the most direct, but significant manner. The energy used by public transport in Budapest is merely 2% of the total amount of energy used in the city. Based on Act CLXXXIX. of 2011 on the Local Governments of Hungary, the provision of local public transport constitutes the obligation of the Municipality of Budapest, performed through Budapesti Közlekedési Központ Zrt, which is responsible for transport organisation, and the major provider is Budapesti Közlekedési Zrt. (BKV), a company owned by the Municipality of Budapest.

According to the Budapest Mobility Plan (BMP), the share of public transport shall be increased to 50% by 2030 with consideration to the distances covered. (The recommended target values determined for other means of transport, again based on passenger km-s, are 15% for walking, 5% for cycling and 30% for passenger cars.) The equipment and infrastructure of public transport in Budapest have improved significantly, thanks to the investments in the recent years (e.g. ca. 1/3 of the buses have been newly purchased). The modernisation of the vehicle fleet needs to be continued. The target oriented development of the public transport vehicles is also a governmental requirement and the fleet of public transport vehicles needs to be expanded and replaced accordingly. As for buses and vessels, the latter of which play a marginal role, transition should be made from vehicles based on the use of hydrocarbon to electric, hydrogen driven and other vehicles. As for trams and trolleybuses, vehicles of a lower electricity consumption should be purchased. (The fleet of metro cars has been recently renewed and the suburban railways (HÉV) are now within the competence of the state.) The integration of railway transport with urban public transport may also generate savings in energy consumption.

The energy efficiency of public transport may be enhanced, which can result in reduced energy consumption, provided that the organisation of the system is further improved. This in turn can be facilitated by the creation of new connections, the safe and reliable development of existing elements, the running of modern, comfortable and clean vehicles precisely to schedule and reasonably utilized and affordable operation. The use of public transport for travelling within the city should be an enjoyable experience.

A related task is to ensure that public transport are given the right of way in traffic (the establishing of separate lanes, where possible; tuning traffic lights to public transport vehicles). Public transport can be made even more attractive through the creation of passenger-centred intermodal connections. The introduction of an electronic, time-based ticket system and a related tariff system in public transport and the establishing of the MaaS (Mobility as a Service) application framework can improve the standard of public transport considerably.

Type of measure	Mitigation		
Timeframe	2030		
Owner	Municipality of Budapest, Department of City Management (to be implemented by BKK)		
Necessary financing	HUF 500,000 million		
Potential sources	EU funds		
Related thematic programs, strategies, plans	Budapest Mobility Plan		
Indicator	Proportion of the users of public transport (based on distances covered)		
	Source of data: BKK		
	Base year: 2019	*Base year value: walking 9%, cycling 1% public transport 29% private cars 61%*	
	Target year: 2030	*Target year value: walking 15%, cycling 5% public transport 50%*	

		private cars 30%
Indicator	Amount of energy saved (MWh/annum) CO_2 emission mitigation (tCO_2/annum)	
		Source of data: BKK
	Base year: 2015	*Base year value: 0 MWh/annum* *0 tCO_2/annum*
	Target year: 2030	*Target year value:* *1,908,791 MWh/annum* *496,286 tCO_2/annum*

Development of the cycling and pedestrian infrastructure	**M9**

In recent years, in parallel to the development of the network of cycling racks, bicycle traffic has also increased dynamically and cyclists have become natural participants of traffic and users of public spaces.

According to the BMP, in order to make the city interoperable for cyclists, there is a need for a comprehensive core network of obvious, practical and safe cycle lanes within the Hungária ring road. In the outer districts, the development of the connections between local cycling connections and city centres is a priority. It is a fundamental criterion that it is not the length of cycle tracks which should be increased in the first place, but the size of the area adapted to cycling.

By means of the preferred development of cycling traffic, the share of cycling should be increased to 5% by 2030 based on the distances covered. The network of cycling lanes in Budapest is realized in the amount of HUF 8,390 million provided as part of the VEKOP tender in the EU financing period ending in 2020. The development of the cycling infrastructure includes the expansion of bicycle storage capacities in public spaces (the installation of bicycle stands) in connection with travel destinations and the installation of B+R facilities in connection with transfer hubs. It is also advisable to examine the possibilities for further extending the service area and service offer of MOL Bubi public bike system. Freight bike lending can be added as a new service.

In addition to developing the cycling infrastructure, giving priority to pedestrian traffic is also extremely important. The development in the recent period have created new architectural quality and gained social support for continuing public space reconstruction and traffic attenuation projects. In the course of the complex reallocation of public spaces, reducing the number of parking spaces offered may influence the choice of the means of transport significantly.

The goal is to continue constructing the central areas of the external parts of the city with preference to pedestrians and to integrate the pedestrian and cyclist friendly public spaces of the inner parts of the city in a uniform network, a liveable city functioning as an organism. The banks of river Danube play a key role in the development of pedestrian traffic in the city; as part of this, the complex renewal of the section of the river bank in the downtown area between Kossuth square and Fővám square, also called RAK-PARK, is already underway. It is also preferable to transform the “avenues” and boulevards in the city centre to become pedestrian friendly (e.g. Kossuth Lajos street – Rákóczi road, Üllői road, Bajcsy-Zsilinszky road, Nagykörút).

The municipality level regulation of the more and more widespread use of electric micro-mobility vehicles (bicycles, scooters, etc.) can only take place following the amendment of the relevant higher level legal rules. As these means of transport are spreading, it is to be examined in which direction and to what extent the modal split changes as a result of their application.

The comfort of bicycle and pedestrian traffic could be enhanced by the introduction and expansion of low emission zones (LEZ), primarily applied as a means of traffic attenuation in the city centre. The overall mitigation of the volume of car traffic contributes to increasing the sense of comfort and safety of people walking and cycling, which again influences the choice between the various means of transport favourably.

Type of measure	Mitigation		
Timeframe	2030		
Owner	Municipality of Budapest, Department of Urban Planning, Unit of Public Transport Infrastructure Development (to be implemented by BKK)		
Necessary financing	HUF 28,000 million		
Potential sources	EU funds, municipal funds		
Related thematic programs, strategies, plans	BMP, Active and micro-mobility strategy (under elaboration)		

Indicator	Ratio of pedestrians and cyclists Amount of energy saved (MWh/annum) CO_2 emission mitigation (tCO_2/annum)		
	Source of data: BKK		
	Base year: 2019	*Base year value: walking 9%, cycling 1% 0 MWh/annum; 0 tCO_2/annum*	
	Target year: 2030	*Target year value: walking 15%, cycling 5% 133,091 MWh/annum 34,604 tCO_2/annum*	

Facilitation of the use of electric driven or low emission motor vehicles	**M10**

Despite the continuously growing demand, the number of electric or low emission cars is still low in Budapest (in 2019, there were 8,205 cars registered in Budapest with green licence plate), therefore the development of e-mobility is a particularly important task.

This package of measures could be enforced through governmental regulatory bodies in the first place. The Municipality of Budapest can provide support as opposed to traditional vehicles by offering free parking in zones subject to limited waiting period on the one hand (which obviously cannot be maintained after the reaching of a certain ratio) and by establishing charging stations for private transport on the other hand. The system needs to be established with consideration to the infrastructure at home and in facilities attracting traffic, and the establishment and operation of charging stations in public places must be supported. As demand grows, charging stations can start operating on market terms. The system of incentives promoting the growth of the ratio of e-mobility cannot be maintained in itself on the long run, as, in addition to the financing of investment costs, the operating costs arising are also substantial, particularly due to the fact that charging is offered free of charge or at a preferential rate in the initial phase.

Type of measure	Mitigation		
Timeframe	2030		
Owner	Municipality of Budapest, Department of Urban Planning, Unit of Public Transport Infrastructure Development (to be implemented by BKK)		
Necessary financing	HUF 1,200 million		
Potential sources	EU funds		
Related thematic programs, strategies, plans	Budapest Mobility Plan, Active and micro mobility strategy (under elaboration)		
Indicator	Ratio of vehicles of environmental class 5 Amount of energy saved (MWh/annum) CO_2 emission mitigation (tCO_2/annum)		
	Source of data: Ministry of Innovation and Technology, Department of Vehicle Methodology Authority		
	Base year: 2018	*Base year value: 0.5% (5,024 pcs) 0 MWh/annum; 0 tCO_2/annum*	
	Target year: 2030	*Target year value: 30% (225,000 pcs) 19,843 MWh/annum; 8,733 tCO_2/annum*	

Promotion of the use of car-sharing and car-pooling systems	**M11**

The objective of the integrated transport organisation entity of Budapest is to establish the rules of a uniform, transparent, universally accessible and, last but not least, environmentally friendly, integrated community system of car rental or car sharing. The essence of the concept is that users can enjoy the benefits of an own vehicle without having to bear the operational costs and obligations.

The establishing and use of an electric fleet can also be supported in the case of the car rental or car sharing services already present in the capital city (eg. GreenGo, Mol-Limo, ShareNow) and passenger transport (taxi). Service providers need to be encouraged to gradually replace the vehicles using traditional fuels by electric vehicles.

To be able to provide a real alternative for having an own car, it would be necessary to have such public car systems as well which can be used for longer travels and offer vehicles of various sizes at stations established in public spaces and the opportunity to book them well in advance.

Besides public car services, it is also preferable to promote the use of car-pooling systems (transport not pursued as a regular business activity). Car-pooling systems are capable of increasing the number of passengers per cars (which is about 1.3 – 1.4 in Hungary) and thus reducing traffic jams and air pollution. This mode of transport can also be facilitated by the municipalities concerned establishing car-pooling meeting points where people wishing to travel from the agglomeration or the suburbs to the city centre (and back) can meet.

Type of measure	Mitigation		
Timeframe	2030		
Owner	Municipality of Budapest, Department of Urban Planning, Unit of Public Transport Infrastructure Development (to be implemented by BKK)		
Necessary financing	-		
Potential sources	-		
Related thematic programs, strategies, plans	Budapest Mobility Plan		
Indicator	Number of vehicles available in carsharing systems		
	Amount of energy saved (MWh/annum) CO_2 emission mitigation (tCO2/annum)		
	Base year: -	*Base year value: -*	
	Target year: 2030	*Target year value: 1,200 pcs 433 MWh/annum; 191 tCO_2/annum*	

Traffic control to reduce emission, designation of low-emission zones and construction of the related infrastructure	**M12**

The environmental burden arising from transport may be mitigated significantly by influencing the traffic crossing the city boundaries, as it is dominated by personal cars, the ratio of which is more than 50%. The share of the individual use of cars may be reduced basically by offering more favourable alternatives for transport, which can be created primarily by the development of suburban railway transport, including the modernisation of HÉV lines. The provision of transport between settlements, including the development of railway and HÉV lines, is the responsibility of the government, which, when successfully completed, would affect the environmental burden on Budapest favourably. As for the number of travels crossing the city boundary, the goal is to reduce the ratio of car use to 40% and to increase the ratio of public transport from 45% to 50% by 2030.

In the last decade, the modernisation of the railway vehicles (electric trains, double deck vehicles) and of the railway infrastructure (electrification, construction of second tracks, renovation of stations, construction of P+R car parks) was substantial, reconstruction is planned to continue in this decade as well, which is greatly facilitated by the availability of EU funds.

Connecting to the development of the railway and the suburban railway system, the Municipality of Budapest can play a role in influencing the traffic crossing the city boundaries by providing more favourable opportunities to transfer for urban public transport (M9).

In certain parts of the city, the entering of cars may be made dependant on certain conditions for the purpose of reducing traffic and mitigating the pollution of the environment. The designation of climate protection zones promotes changing to public transport or cycling and, within the use of cars, the use of electric driven vehicles. The designation of climate protection zones may be the "ante-room" to the banning of combustion engines in the farther future. The introduction of an emission-proportionate congestion charge may be an effective tool to achieving the traffic policy goals of the city, provided that it is realized as a result of proper legal, economic and infrastructural preparation. The congestion charge may also alleviate the financing problems of public transport. A prognosticated in the BMP, the congestion charge would be introduced for passenger traffic in the period of 2021-2025. Accordingly, driving into the area enclosed by Hungária ring road and the "Nagykörút" in Buda between 7.00 a.m. and 7.00 p.m. would be subject to the payment of a fee. Contemporaneously with the introduction of the congestion charge, it is necessary to reconsider the parking system and the related system of allowances. If it is realized in harmony with the project titled "Introduction of low-emission zones (LEZ)", the amount of the congestion charge can be influenced in part by the emission of the given car as well. In connection with the introduction of the congestion charge, tasks of prime importance include the creation of zones subject to traffic attenuation and traffic restrictions, the development of the so-called "inner zone" within Hungária boulevard in a differentiated manner, the conclusion of the restructuring process of the public transport system, the implementation of the normative, predictable financing of public transport and the support of environmentally friendly transport technologies. In the interest of the continuous maintenance of an operable transport system, it is necessary in connection with the foregoing to construct P+R car parks in Budapest and it would also be advisable to develop intermodal centres and the central areas of outer districts in an attempt to reduce the necessity of travelling.

Based on Act CLXXXIX. of 2011 on the Local Governments of Hungary, it is primarily the obligation of the Municipality of Budapest to provide the conditions of parking, including the creation of the network of P+R car parks, and the Municipality is discharging such obligation Budapesti Közlekedési Központ Zrt, which is responsible for transport organisation.

The number of P+R car parks was dynamically growing until 2017, then this process stopped in the subsequent period, and no new P+R car park of a substantial number of parking spaces has been newly established. The P+R car parks which lost their function due to their location close to the downtown area or otherwise became part of the limited waiting zone (paid parking). Currently, there are 5649 P+R parking spaces available at 30 premises in the capital city.

In addition to passenger cars, the traffic of freight vehicles also needs to be regulated. Through Budapest Freight Traffic Strategy, a system has been developed that keeps transit shipments away from the city, but provides access to the manufacturing and logistics sites.

Act CLXXXIX. of 2011 on the Local Governments of Hungary delegates traffic technology management and operation duties, as well as the obligation of traffic organisation to the Municipality of Budapest, which is performed by the Municipality through Budapesti Közlekedési Központ Zrt in charge of traffic organisation, whereas Budapest Közút Zrt is the organisation in charge of operative execution.

The establishing of a well-functioning city logistics system may also contribute to the reduction of the traffic of motor vehicles. Special attention must be paid to the IT based organisation and monitoring of urban transports and the optimisation of the use of loading sites in public spaces. There is a need for a comprehensive logistics concept to be formulated in the interest of the creation of the institutional and service background and the service connections in the city, as well as the territorial and time-based regulation of logistics supply. With the use of intelligent transport systems, delivery periods can become shorter, the volume of traffic may be reduced and, this way the emission of CO_2 and pollutants may be mitigated

Type of measure	Mitigation		
Timeframe	in phases: 2025; 2030; 2050		
Owner	Municipality of Budapest, Department of Urban Planning, Unit of Public Transport Infrastructure Development (to be implemented by BKK)		
Necessary financing	HUF 25,000 million		
Potential sources	*EU funds*		
Intervention area	Modal change to public transport Modal change to walking and cycling Development of logistics and urban freight transport		

Policy instrument	Regulation of the planning of transport / mobility Tolls	
Related thematic programs, strategies, plans	BMP	
Indicator	Modal split Amount of energy saved (MWh/annum) CO_2 emission mitigation (tCO_2/annum)	
	Source of data: BKK	
	Base year: 2017	*Base year value: 5,649 pcs; 0 MWh/annum; 0 tCO_2/annum*
	Target year: 2030	*Target year value: 22,000 pcs 117,280 MWh/annum 32,877 tCO_2/annum*

Má-3 Increasing the size of the green areas and improving their quality to enhance their carbon absorption capacity

See Part 6: Adaptation Action Plan, Chapter Aá-1: Measures of the objective of the development of the green – blue infrastructure

6. ADAPTATION ACTION PLAN

Climate modelling and vulnerability assessment	**Aá0**

Urbanisation fundamentally changes the adaptation features of a given area. The precise, model-based prediction of impacts related to climate change which are most critical in terms of adaptation (extreme heat, heat waves, heavy rainfalls, flash floods, inundations, etc.) is indispensable for the planning of the necessary technical and other interventions.

Special emphasis needs to be laid on the two most critical areas: i.e. the prediction of changed precipitation and temperature conditions. In the course of climate adaptation, efforts shall be made in the interest of shifting to the direction of the natural hydrological cycle (runoff mitigation, storage, transpiration), otherwise severe problems concerning the infrastructure and diminishing the quality of life will have to be faced.

Budapest is in a special situation, as the life of the city is influenced not only by river basins of local significance, but by the Danube as well, which, however, the city has almost no influence on, while we have to adapt to water level changes because of the variety of water uses and relations (flood control, drinking water supply, embankment use, shipping).

Because of the significant increase in the frequency of high-temperature periods and the heat island effect contributing to rising temperatures, people living in built-up areas have to cope with extremely serious challenges.

As part of this measure, forecasts need to be generated on a local level (cells of 1-5 km), based on a scientifically substantiated climate model (with the examination of GCM-RCM climate model pairs and taking into regard long-term historic weather data of high temporal resolution for local operations, e.g. statistical scaling). Forecasts need to contain sufficiently precise data to be interpreted technically, primarily regarding the quantity and frequency of extreme precipitation.

Following climate forecasts, it is also necessary to create a city-level rainwater runoff and sewage system model, with consideration to the parameters of the individual recipients (watercourses, wastewater treatment plants, etc.), in order to facilitate the identification of intervention sites and methods. The runoff model must be based on a topographical model of sufficient resolution.

It is also necessary to conduct a detailed vulnerability examination for the territory of Budapest based on these models, based on which we can determine and parameterise the necessary adaptation measures with the help of which the grey, green and blue infrastructure of the city can be made resistant to the effects of climate change.

Type of measure		Adaptation	
Timeframe	2022		
Responsible:	Municipality of Budapest, Department for Climate and Environmental Affairs		
Necessary financing	HUF 300 million		
Potential sources	-		
Related thematic programs, strategies			

Aá-1 Development of the green – blue infrastructure

Increasing the ratio of green areas and water surfaces	**A1**

Increasing the ratio of green areas and water surfaces means from the point of view of climate protection the enhancing of the carbon absorption capacity and the improving of adaptability to climate change at the same time. The protection of biologically active surfaces (water and green areas) is of particular importance, but it requires a legislative environment adjusted to the specifics of the capital city and the unique regulatory system.

The primary task is to increase the quantity and improve the quality of the areas owned and managed by the Municipality of Budapest by the implementation of programs and projects suited to the priority objectives determined in the Green Infrastructure Development and Maintenance Action Plan.

In the course of the renewal of public spaces in the inner zone lacking green sufficient green areas, the ratio of green areas needs to be increased (based on the review of paved surfaces) and alternative green area elements, e.g. green roofs and green façades can be established. Beyond the creation of the said regulation, the Municipality of Budapest can enforce

its objectives mainly by means of the urban planning instruments delegated to the Municipality. In addition to regulatory instruments, the range of support instruments also needs to be extended in this field. It is recommended to widen the scope and enhance the volume of tender funds which support the establishing of green community areas, green roofs, roof gardens, green walls (e.g. Environmental Protection Fund).

In addition, it is be important to create a regulation expanding the scope of biological activity by enforcing the principle of compensation not only upon the designation of new areas to be built up, but also upon reclassification in terms of the land use units to be built up or even between zones. This means that the regulation shall be extended not only to the modification of the Settlement Structure Plan to be approved by the Municipality of Budapest, but also to building regulations to be approved by district municipalities (and the Municipality of Budapest). Moreover, the biological activity values assigned to the land use units shall also be reviewed. It is advisable to specify indicators based on the green area intensity value determined based on satellite pictures. However, this is not directly within the authority of the Municipality of Budapest.

Type of measure	Mitigation	Adaptation	
Timeframe	2030		
Responsible:	Municipality of Budapest, Unit of Landscape Architecture		
Necessary financing	-		
Potential sources	-		
Related thematic programs, strategies	Dezső Radó Plan *(under elaboration)*		
Indicator	cumulated green area intensity value for the territory of Budapest, derived from satellite picture by the application of the NDVI vegetation index		
		Source of data: BFVT Kft.	
	Base year: 2015	*Base year value: 52.5%*	
	Target year: 2030	*Target year value:* 57%	

Improving the ratio of green area and forest area	**A2**

In the districts not supplied with green areas, and the city centre lacking sufficient green areas, new green areas of public purposes (city park, public park, public garden, square with trees, green promenades) need to be created in a manner facilitating the utilization and retention of rainwater. In addition to their recreational role, green areas have a significant conditioning effect on city climate. Currently, the per capita size of green area (public garden, public park) is only 6 m^2, in contrast to the internationally recommended (WHO) target value of 9 m^2/person. For the purpose of all-day recreation, new major city parks and forest areas well developed for recreational purposes need to be established primarily on the Pest side because of the large distance to good quality forests. Improving the green area supply not only necessitates territorial expansion, but quality improvement as well. To realize all these, however, appropriate financing background is required. The currently underfinanced management of Főkert Nonprofit Zrt does not enable optimal green area management. The specific interventions will be determined in the Dezső Radó Plan, the elaboration of which is still pending. By realizing the planned increase in the per capita green area supply by 1 m^2 by 2030, CO_2 absorption could be increased by 140 t CO_2/annum. The internationally recommended target value to be attained by 2050 is 9 m^2/person, which would correspond to additional CO_2 absorption of 240 t CO_2/annum. Besides the creation of green areas, carbon absorption capacity can be enhanced by afforestation as well. The planned Settlement Structure Plan designates planned forest areas on 3,400 ha, which would allow CO_2 absorption in the amount of 7,378 t CO_2/annum. However, as the afforestation of a substantial portion of the planned forest areas is impossible or would be difficult for being cultivated or other reasons (e.g. ownership structure), further examinations are needed to determine this more specifically.

Related projects in the Dezső Radó Plan by action areas:

"CITY PARKS IN PEST" action area:

- Regeneration of Népliget (key project)
- Continuing the regeneration of Margitsziget
- Regeneration of the park area in Városliget (advocacy project)
- Creation of a city park in Észak-Csepel (advocacy project)

"BUDAI PARKTENGELY" action area:

- Regeneration of the green areas of Gellért-hegy (key project)
- Regeneration of the green areas of Horváth-kert
- Regeneration of the green areas of Vérmező
- Regeneration of the green areas of Városmajor

"ALONG THE DANUBE" action area:

- Complex public space rehabilitation of the Danube bank in downtown Pest (key project)
- Complex public space rehabilitation of the Danube bank in downtown Buda
- Publc park and natural rehabilitation of Római-part and Gázgyári Danube Bank
- Háros-sziget and Hunyadi army base
- Development of the areas along Ráckevei (Soroksári) Danube, phase I
- Recreational and character preservation devleopment of Óbudai-sziget
- Ecological green area development in Pünkösdfürdő
- Recreational development of Népsziget and Újpesti-öböl (advocacy project)

"DOWNTOWN" action area:

- Creation of the City Hall park (key project)
- Rehabilitation of Blaha Lujza square
- Complex rehabilitation of Jókai square
- Bakáts project
- Creation of a new public park at underground stop Klinikák

"FORESTS" action area:

- Overall rehabilitation of Terebesi forest
- Nature conservation development of Farkaserdő
- Hármashatár-hegy – "Urban forests" project
- Renewal of the small forest at Cinkota as a semi-natural forest
- Community purpose rehabilitation of the environment of Kiscelli castle
- Forest development projects of Pilisi Parkerdő Zrt. (advocacy project)
- Recultivation of former mine areas in Óbuda (advocacy project)

HOUSING ESTATES action area:

- Development of the public park at Flórián square (key project)
- Programs for teh complex renewal of the green infrastructure of housing estates (advocacy project)

CEMETERIES action area:

- Budapest memorial forest, alternative cemetery

Type of measure	Mitigation	Adaptation	
Timeframe	2030(2050)		
Responsible:	Municipality of Budapest, Unit of Landscape Architecture		
Necessary financing	HUF 80,000 million		
Potential sources	municipal funds, investors' funds (in the case of compensation fund), EU funds		
Related thematic programs, strategies	Dezső Radó Plan (*under elaboration*)		
Indicator	Per capita green area supply		
		Source of data: BFVT Kft.	
	Base year: 2019	*Base year value:* 6 m^2/person	
	Target year: 2030	*Target year value:* 7 m^2/person	
	Target year: 2050	*Target year value:* 9 m^2/person	

Blue infrastructure development *(revitalization of small watercourses)*	**A3**

The purpose of the measure is to implement complex revitalisation programs which facilitate the environmental, ecological, functional (surface drainage, water habitat, recreation) and landscape architectural integration and improve the characteristics of small water courses.

Beyond the regulation of the bed and the bank and the recreational development of small water courses, revitalisation programs also need to restore habitats to increase biodiversity and to develop the connecting public utilities, roads and cycle tracks and green areas.

Rákos creek can be a suitable pilot project, as the master plan for the Budapest section of the creek has already been compiled and additional technical drawings for the implementation are being prepared at the moment. In the first step, the Rákos creek ecotourism corridor project will be implemented until 2024 with a total budget of HUF 2.3 billion, the major element of which will be the construction of a cycling track. The next step will be the revitalisation of the external section of the bed of the creek in districts X and XVII.

The development of the green corridor along Rákos creek as a flagship project will have to be followed by the other creek revitalisation programs in Budapest. The draft of the Budapest Green Infrastructure Development and Maintenance Action Plan contains the implementation of several model projects on certain points of intervention in the valley of the creek. Moreover, the thematic projects include the preparation of a study and master plan and the elaboration of revitalisation proposals for the complex development of Aranyhegyi, Hosszúréti and Gyáli creeks.

Besides the revitalisation of small watercourses, the conservation, maintenance or restoration of the semi-natural condition of other banks (of smaller lakes, water reservoirs) is also needed.

Related projects in the Dezső Radó Plan by action areas:

- Rákos creek: Nature conservation rehabilitation and management of the nature reserve areas of Felsőrákosi-rétek (key project)
- Rákos creek: Urban creek revitalisation and creation of a green promanade along the section between Madarász street and Béke street
- Rákos creek: Establishing of an ecotouristic and horticultural training and visistors' centre
- Ecological corridor along Rákos creek, creation of pedestrian and cycling tracks and the recreational devleopment of areas along the creek
- Rákos creek: Nyilas-tábla area (section between Ferihegyi út and Szabadság sugárút): creation of a lake, recreational development of the area
- Regulation of the bed of Szilas-patak on the section between Zúgó creek and Naplás lake (advocacy project)
- Hosszúréti creek: Review of the lake system, public park and public welfare forest development (advocacy project)
- Rákos creek: Establishing of a green promanade and recreational centre in Zugló (advocacy project)

Type of measure	Mitigation	Adaptation	
Timeframe	2030		
Responsible:	Municipality of Budapest, Unit of Landscape Architecture		
Necessary financing	HUF 5,000 million		
Potential sources	Municipality of Budapest, district municipalities, EU funds		
Related thematic programs, strategies, plans	Dezső Radó Plan (*under elaboration*)		
Indicator	Length of revitalised small watercourse sections		
		Source of data: .	
	Base year: 2020	*Base year value: 0km*	
	Target year: 2026	*Target year value: 10km*	

Elaboration of a plan for planting trees in public spaces	**A4**

It is necessary to elaborate a 10 years' plan for planting trees in public spaces, then to continue rolling planning, specifying an annual timetable including not only the venues and the numbers, but also data relevant to quality development, as well as the budgeted costs of modern and planned technical preparation.

The plan needs to be elaborated with a focus on quality development and state-of-the-art technical preparation rather than quantity aspects. The complex revitalisation of avenues is the goal, which requires the performance of all professionally justified felling and tending works in advance. New lines of trees may only be established with regard to the safe distance from public utility lines, if any, while providing sufficient living space to trees in the course of the revitalisation of public spaces. The species must be chosen with special consideration to planting trees with no or a smaller tendency of causing allergy and capable of adapting to the prognosticated climate.

The aging of the trees in the avenues of Budapest means increased environmental risk and weakening vitality, therefore replacements need to be scheduled as well. The damage caused to the root zone by the construction of public utilities also represents a risk factor in terms of the stability and viability of the avenue. In recent years, the lack of trust among the population has grown significantly due to the felling of trees in connection with investment projects, therefore the felling (and replacement) of trees often does not take place even if it was necessary for horticultural and accident prevention reasons. Therefore, responsibility in the management of avenues has to be emphasized, so that the felling of trees required to prevent accidents may not be dispensed with. There should be more emphasis on proper communication with the citizens. To this end, a communication protocol needs to be elaborated for the felling of trees. It is advisable to start providing accurate information to the public, in accordance with the national and foreign best practices. At least one month before the commencement of any planned horticultural intervention, information should be posted both on the website and locally, including the description of the tree, the reason for its felling or pruning or planned replacement.

The high quality and modern solutions of planting trees in cities should be introduced and disseminated. In the planning, establishing and maintenance of avenues and green belts, one should strive at the application of state-of-the-art technologies. The green infrastructure brochure titled "Relation of trees and public utilities in the city" could be used as a guide for the planning. The application of compromise solutions with public utility providers to introduce a "tree planting friendly" attitude and building technology, to declare green belts to be public utility free zones or to make the application of utility tunnels or corridors saving space (and thus facilitating the planting of trees along streets) mandatory at least in densely populated city centres in the case of complex reconstruction projects.

Co-operations may be formed with various business associations and/or non-governmental organisations (such as the *10 million trees* movement) in the interest of the implementation of the planting of trees in public spaces.

Related projects in the Dezső Radó Terv by action areas:

- Healthy streets program (key project)
- Revitalisation of the green promenade of Andrássy road
- Planting of trees in Üllői road
- Revitalisation of the Nagykörút
- Revitalisaiton of Kossuth Lajos street – Rákóczi road
- Creation of a green promanade between Western Railway Station (Nyugati pályaudvar) and Istvántelek, recreational development along Külső szilágyi road (advocacy project)

Type of measure	Mitigation	Adaptation	
Timeframe	2030		
Owner	Municipality of Budapest, Unit of Landscape Architecture		
Necessary financing	to be determined based on the plan for planting trees in public spaces (planting of new trees – ca. HUF 250 million per annum maintenance of existing avenues – ca. HUF 400 million per annum)		
Potential sources	Municipality of Budapest, district municipalities		
Related thematic programs, strategies	Dezső Radó Plan (*under elaboration*)		
Indicator	number and health condition of trees in public spaces managed		

	by the capital city (to be elaborated based on the Plan for tree planting in public spaces) *Source of data: FATÁR*	
	Base year: 2020	*Base year value: 107,000 pcs;*
	Target year: 2030	*Target year value: 130,000 pcs;*

Amendment of legal rules to protect trees	**A5**

It is necessary to initiate the amendment of higher-level legal rules to ensure the more effective protection of trees. Gov. Decree 346/2008 (XII.30.) on the protection of woody plants shall be supplemented with the provision that the Chief Clark may only make a decision in the proceeding for the felling and replacement of trees by involving an expert. By managing a legislative gap, it should also be added that in justified cases it is also allowed to make payment into the Environmental Fund instead of replacing a tree or to plant a tree in some other area of the capital city which is designated for green area development. The requirements of Gov. Decree 253/1997 (XII. 20.) ("OTÉK") needs to be specified in respect of the place of planting trees and the size of the required area. In addition, legal rules and standards related to public utilities and affecting the planting of trees need to be reviewed.

The relevant regulation of the Municipality of Budapest (Regulation No. 10/2005. (III. 8.) of the General Assembly) requires some update to include provisions concerning the planting and protection of avenues and individual trees, the minimum requirements regarding the space to be provided for a tree and the parameters of the tree to be planted, recommended and prohibited species of trees, as well as the monitoring of compliance with all these regulations and the applicable rules of procedure. In public procurement projects, the application of the standard "MSZ 12172" governing the Planting of decorative trees and bushes in public spaces of settlements and standard and "MSZ 12042" on the Protection of trees at construction site prepared by the Association of Landscape Contractors of Hungary shall be required.

Type of measure	Mitigation	Adaptation	
Timeframe	2022		
Owner	Municipality of Budapest, Unit of Landscape Architecture		
Necessary financing	-		
Potential sources	-		
Related thematic programs, strategies, plans	Dezső Radó Plan (*under elaboration*)		

Establishing and operation of a uniform, up-to-date green space cadastre	**A6**

The planning, protection and long-term management of green areas and the provision of related information require the application of up-to-date monitoring systems. It is necessary to create an up-to-date green space cadastre encompassing the entire public administrative area of Budapest based on a uniform methodology in cooperation with the district municipalities and organisations concerned, which shall take stock not only of trees, but of parks, forests, semi-natural areas and gardens as well. It is advisable to further develop the FATÁR application created by FŐKERT so that the green areas, avenues and other green area managed by district municipalities and other green area managers also appear in the database. The green space cadastre should meet the following requirements:

- elaborate a universally accepted methodology
- determine data supply obligations and access authorisations
- ensure publicity and social participation
  provide the possibility of integration.

Further recommendations concerning the green space cadastre will be determined in the Budapest Green Infrastructure Development and Maintenance Action Plan, the elaboration of which is still pending.

Type of measure		Adaptation	
Timeframe	2024		
Responsible:	Municipality of Budapest, Unit of Landscape Architecture		
Necessary financing	HUF 400 million		

Potential sources	Municipal funds, central budget
Related thematic programs, strategies	Dezső Radó Plan (*under elaboration*)

Promotion of the revitalisation of brown-field areas	**A7**

By the regular updating and publishing of the cadastre of brown-field areas and sites subject to remediation obligation, the Municipality of Budapest can promote the renewal of areas in need of rehabilitation and the information of the citizens living in the neighbourhood.

In the interest of increasing the green area intensity to offset emissions, urban planning instruments should be modified in the future by giving priority to the use of land as green areas, especially in the regions less supplied with green areas (public parks and public gardens) and forest areas. In addition, the developments should be diverted to brown-field areas instead of making greenfield investments. Accordingly, it is advisable not to designate any new areas to be built up in the Settlement Structure Plan, unless it is justified (with regard to public interest), as there remain significant potentials for development in the brown-field areas.

As brown-field areas are typically not municipal properties, it is necessary to incorporate such support schemes and funds in urban and green area development which promote the revitalisation of abandoned brown-field areas.

Before the recovery of brown-field areas and rust belts, green area developments realized with simple means could be aimed at, even as temporary utilisation, so that there is a usable plant stock available by the time of actual, future utilisation. The Municipality of Budapest can realize temporary utilisation primarily on properties managed by the Municipality of Budapest as property manager.

Type of measure	Mitigation	Adaptation	
Timeframe	2030		
Owner	Municipality of Budapest, Department of Urban Planning		
Necessary financing	-		
Potential sources	EU funds and schemes		
Indicator	Size of brown-field areas delivered for use as community garden or public park (ha)		
	Source of data: BFVT		
	Base year: 2021	*Base year value: 0*	
	Target year: 2030	*Target year value:* ⬆	
Related thematic programs, strategies, plans	SETTLEMENT STRUCTURE PLAN		

Aá-2 Mitigation of the heat island effect in the built environment

Protection of ventilation corridors, ensuring sufficient airspace ratio in streets	**A8**

The city has to face numerous tasks concerning the mitigation of the urban heat island effect, many of which can be performed through urban planning. The Municipality of Budapest can provide for the ventilation corridors of significance for the settlement structure in its Settlement Structure Plan (TSZT) and the Rules of Urban Planning (FRSZ). In these areas, the designation of new areas to be built up or the raising of the permitted building height may not be supported. Another FRSZ instrument also effective in terms of climate protection is the sill height calculated based on the air space ratio. In the major ventilation corridors of the city, it is essential to apply development methods, heights and street air-space ratio which allow better ventilation. This way, we can prevent the further deterioration of already unfavourable space ratios and the growth of height of the buildings in the densely built parts of the city, maintain the exposure to sunlight and the visibility of the sky, as a result of which there are better chances for the establishing and maintenance of green areas in public spaces and for more favourable living conditions.

The district municipalities are authorized to apply additional regulatory instruments through district zoning regulations and cityscape regulations. At the same time, the Municipality of Budapest may formulate recommendations for district municipalities. The goal is to compile a manual by the collection and presentation of good examples of the districts which can assist local governments and designers in the review of their urban planning instruments related to climate protection.

Type of measure		Adaptation	
Timeframe	continuous (2021-2030)		
Owner	Municipality of Budapest, Department of Urban Planning		
Necessary financing	-		
Potential sources	-		
Related thematic programs, strategies	SETTLEMENT STRUCTURE PLAN, Rules of Urban Planning		
Indicator	The size of areas in the ventilation corridor designated to be built up according to the Settlement Structure Plan		
	Source of data: SETTLEMENT STRUCTURE PLAN		
	Base year: 2019	*Base year value: 7208 ha according to TSZT2021*	
	Target year: 2030	*Target year value:* it should be reduced	

Promotion of climate friendly construction materials and technologies	**A9**

Climate protection has to be a priority criterion in the public procurement processes and the tender-based support schemes of the Municipality of Budapest (e.g. Environmental Protection Fund, Healthy Streets Program). The Green Infrastructure brochures (Permeable pavements; Green façades, Water-sensitive planning in open urban spaces, Relation of trees and public utilities in the city, Revitalisation of downtown inner yards) provide professional background for the application of climate-friendly construction materials and technologies. Additional recommendations need to be prepared for the use of construction materials.

From the point of view of improving urban climate, the diverse climatic effects of the various types of pavements should be highlighted. Instead of traditional asphalt, “cooler” and, if possible, permeable surfaces of higher albedo should be applied. In addition, the energy consumption of the individual buildings may be reduced considerably by the application of green roofs and green façades as well, and these green infrastructure tools could also facilitate the utilisation and retention of rainwater. In the case of municipal investments, it is advisable to introduce one of the environmentally friendly building rating schemes or an own scheme. But the rating schemes do not only deal with the use of materials and technologies, but many other environmentally friendly topics as well (such as efficiency per life cycle, the minimalization of waste generation, water retention, healthy working environment, the mitigation of adverse environmental effects, etc.), therefore they connect to several measures and objectives at the same time.

The foreseeable increase in the frequency of windstorms means a source of physical hazard for the building stock of the

Municipality of Budapest, affecting primarily the structural boundaries of buildings, i.e. structures on the façades and roofs. Floods, flash floods and inundations also have a significant effect on the building stock; to avoid these, proper rainwater management must be established in the first place. See the measure titled "Surface runoff regulation and the system required for its safety"

For all these reasons, the Municipality has to pay priority attention concerning its own building stock to the proper sizing of support structures, pavements, windows, sun shading (solar panels) and waterproofing sheets and to the optimal use of materials according to aspects relevant to the whole life cycle.

Type of measure		Adaptation	
Timeframe	continuous		
Owner	Municipality of Budapest, Department of Urban Planning		
Necessary financing	-		
Potential sources	-		

Aá-3 Development of the flood control system

Construction and development of flood control structures	**A10**

Extreme weather conditions are becoming more and more frequent due to climate change. As for the flow regime, the once usual spring and autumn flood phenomena have changed and the recent decades have been dominated by extremities, therefore we need to be prepared for sudden, substantial flood waves at the most unexpected times as well. Based on the experience gathered during the 2013 flooding of the Danube, the hydrological review of design flood elevations was carried out under the supervision of the General Directorate of Water Management, as a result of which Decree 11/2010. (IV.28.) of the Minister of Environment and Water on the Design flood elevation of Rivers was amended by Decree 41/2014. (VIII.5.) of the Minister of Interior Affairs and after that the new legal rule on the design flood elevation of rivers was also adopted by Decree 74/2014. (XII.23.) of the Minister of Interior Affairs.

In light of the amendments of legal rules, the flood control structures of Budapest conform to height requirements (design flood elevation or DFE + 1.3m) on no more than one third (ca. 30 km) of the entire length. On the Buda side, the security height requirement is met at Pünkösdfürdő, on Gellért rakpart, from the southern peak of Kopaszi-gát in the southern direction up to the city boundary (except for a smaller section) and on some smaller sections. On the Pest side: the section between Juta street and Paduc alley, the section between Vizafogó street and the southern bridgehead of Árpád bridge, the section between Havas street and Zsil street, the section from the southern part of Boráros square to Pápay István street, almost the entire section of the protection line in district XXI and some smaller sections. The technical condition and inappropriate construction of the flood control structures constitute a major problem in many cases. Cross-sectional dam deficiencies and problems related to the acceptability of the material, the suitability of built structures and the safety of the subsoil are also significant. Due to climate effects seen on the entire catchment area of the Danube, flood waves reaching or even exceeding a water level of 8 m by far may arise in the subsequent period as well just like in recent year, therefore the flood protection line needs to be developed urgently. The development and further construction of existing flood control structures can provide for the regulated propagation of flood waves and the prevention of various kinds of flood damage.

Fővárosi Csatornázási Művek Zrt. as the organisation in charge of flood protection tasks in the capital city prepared its proposal for flood control developments as part of the document titled "Water Management in Budapest, status survey examinations and recommendations for addressing deficiencies". According to the proposal of FCSM Zrt, the sections most crucial in terms of exposure to floods are the ones where significant intervention was necessary in the past in the course of flood prevention and there is an economic potential with significant population number and value in the floodplain protected by flood protection lines the protection capacity of which falls behind the required standard significantly or where the protected side is protected by dikes to a major extent. According to the recommendation of FCSM Zrt, priority should be given to the development of the flood protection sections of Buda-North, Pest-North and Buda-Central, in order to raise the height of the flood control structure required by the law to crown level and prevent seepage: on flood protection sections No. 5 and 6 named "Annahegyi brook, left and right side dike" (Buda-North) – length of the flood control structure concerned: 2.0 km; on flood protection section No. 4, named "Királyok road, Nánási road dike" (Buda-North) – length of the

<table>
<tr><td colspan="4">flood control structure concerned: 3.1 km; on flood protection section No. 8 named “Óbuda quay, HÉV line” (Buda-Central) – length of the flood protection structure concerned: 3.09 km; on flood protection sections from No. 27 named “road No. 2” to No. 34 named “Váci road” (Pest-North) – length of the flood control structure concerned: 11.8 km; on flood protection section No 35 named “Dike next to water plants” (Pest-North) – length of the flood control structure concerned: 1.68 km; on flood protection sections No. 37 named “Komp street wall and high bank”, No. 38 named “Control structure next to Váci road” and No. 101 named “North-Pest Wastewater Treatment Plant high bank” (Pest-North) – length of the flood control structure concerned: 2.82 km; on flood protection sections No. 39 named “Marina bank” and No. 40 named “Rákos brook, right-side bank (Pest-North) – length of the flood control structure concerned: 4.21 km.
As flood control development needs tend to determine the future and image of a given area for a long time (50-100 years) and many of them are located in territories with significant aesthetic value and subject to world heritage protection, they require thorough consideration, planning and social consensus, as well as the enforcement of ecological aspects.</td></tr>
<tr><td>Type of measure</td><td></td><td>Adaptation</td><td></td></tr>
<tr><td>Timeframe</td><td colspan="3">2030</td></tr>
<tr><td>Owner</td><td colspan="3">Municipality of Budapest, Department of City Management</td></tr>
<tr><td>Necessary financing</td><td colspan="2">HUF 32,500 million</td><td></td></tr>
<tr><td>Potential sources</td><td colspan="3">Own resources of local governments, national and EU funds and schemes</td></tr>
<tr><td>Related thematic programs, strategies, plans</td><td colspan="3">Riverbed Management Plan</td></tr>
<tr><td rowspan="3">Indicator</td><td colspan="3">length of flood protection line reaching the safety level of DFE + 1.3m (km)</td></tr>
<tr><td>Base year: 2019</td><td colspan="2">Base year value: 33.73 km</td></tr>
<tr><td>Target year: 2030</td><td colspan="2">Target year value: 69 km</td></tr>
</table>

Aá-4 Adaptive rainwater management

Surface runoff regulation and the system required for its safety	**A11**

Drainage regulation may be realized on the surface of the urban watershed or in the system of drainage ditches or pipelines or in both of them, with their effects complementing each other. Accordingly, we can talk about a traditional system, a grey system, green regulation methods and a hybrid system. In the case of Budapest, we could aim at the creation of a hybrid system, so that the regulation and drainage of rainwater could be the most effective and most economical in the individual subareas, in accordance with the given circumstances.

To reach this goal, it has become necessary to review general sewage plans, also with consideration to the aspects of rainwater drainage. As part of this review, it is necessary to check the existing rainwater drainage structures in Budapest, such as streams, storm basins, paved and infiltration trenches managed by FCSM Zrt, the combined sewer network and the separate sewer network, as well as other facilities. It is also necessary to lay the foundations for modelling the universal rainwater drainage and the provide the conditions for simulation testing in respect of the complete watershed and any part of it. One of the purposes of modelling might be to determine critical points and problematic places and areas in case of precipitation events of various intensity and duration (the expected location and severity of inundations). The complete mid- and long-term rainwater drainage concept for Budapest is to be created with regard to all of these factors. At the same time, the places hit by ad hoc flash floods can be identified precisely, so they can be managed immediately or in the short term. FCSM Zrt has been working on examinations with the subject of the "Water Management in Budapest, status survey examinations and recommendations for addressing deficiencies", the findings of which can be used in rainwater management as well.

General, short-term tasks include the application of catch basins of a better drainage capacity (double inlet drainage system, cross-direction grated slotted channel), the creation of proper inclination in closed basins, the mitigation of infiltration, the promotion of the modernisation of inner sewage systems, the provision of operating and hot standby power plant capacity of sufficient volume and operational safety and the establishing of cold standby.

Short-term development goals: development of rainwater drainage in subways (prevention of the gathering of surface waters to subways, installation of water grates of higher drainage capacity within the subway, with regard to the possibility of blockage or clogging, review of the capacity of rainwater transfer pumps), developments on small watercourses (many of the watercourses are problematic in terms of operability of performance, which may hinder the necessary developments in the long term: private properties, lack of proper regulation, bed maintenance problems, etc.), network developments (construction of relief reservoirs), performance of interventions enabling water flow regulation and connection between basins, establishing of new outlets along the Danube bank, construction of facilities enabling the separation of diluted rainwater within the city, development of transfer pumps and pumping stations.

In addition to the foregoing, it is important to plan and develop public parks with regard to efforts aimed at the retention and secondary use of rainwater (e.g. for irrigation, for street washing, etc.). To this end, the construction of storm basins of various sizes depending on the size of the given public park may also be supported.

Mid-term developments may include the integration of on-line water level sensors in the system and the establishing of a connection with pumping stations, the preparation of the system for water flow regulation, the automation of control and water flow regulation structures, the reconstruction of disadvantageous intersections or inverted siphons causing local bottlenecks to have sufficient hydraulic capacity, other network development opportunities (construction of relief reservoirs), continued construction of facilities enabling the separation of diluted rainwater within the city, separation of combined, mixed systems within the city, green technologies, improvement of above ground storage capacities.

The computer simulation of the existing sewage system has become an essential prerequisite for the foundation and definition of long-term developments. A smart, digital system needs to be established, the essence of which is that the on-line water level sensors are in connection with the locks and water flow regulation tools within the system. Moreover, the system operator keeps contacts with the meteorological forecasting service, which provides the operator short-term forecasts in due time. This in turn makes it possible to prepare the network for the receipt and effective drainage of the extra amount of rainwater expected to fall. In addition to the foregoing, it may also be necessary to construct a large size, horizontal, tunnel-like deep reservoir which, being designed to the right location, could catch the first waves of intensive showers. A reservoir capacity of this type could be established for example starting off from the territory of Népliget.

Type of measure		Adaptation	

Timeframe	continuous
Owner	Municipality of Budapest, Department for Climate and Environmental Affairs
Necessary financing	HUF 10,000 million
Potential sources	Own resources of local governments, regional, national and EU funds and schemes

Supporting the utilization and retention of rainwater	**A12**

Rainwater management should be realized in an adaptive manner, as close as possible to the catchment area, in line with the National Water Strategy (Jenő Kvassay Plan). Private water management will become more and more important in the future. The conscious use of rainwater and grey water may not only put an end to being wasteful with drinking water, but also reduce water consumption significantly. The need to retain and delay rainwater is the most justified in the suburbs with a separate sewer network, especially where there is no solution in place for the drainage of rainwater next to the operation of the separate sewer network. With the mitigation of the burden on the system by the retention and harvesting of rainwater, the structures to be constructed for the drainage of rainwater can be reduced to a major extent, which in turn can result in lower investment costs, and the retention of rainwater will also optimise the burden on recipient watercourses and wastewater treatment plants.

At the same time, it should also be considered, in the interest of the safe operation of the complex sewer systems in the inner districts, that periodical stormwaters continue provide for the flushing of the sewage system, which in turn reduces the frequency of settling and its consequences (bad odours, blocking).

Retained rainwater used for irrigation or drained into the soil improve the water balance of the soil, and being natural, soft waters, they are more beneficial for the vegetation as well, compared to drinking water cleaned with chemicals. In order to promote the application and spread of such systems, they need to be integrated in the planning of municipal or governmental investment projects and, for private investments, the appropriate regulatory instruments (e.g. building allowances (floor area, etc.)) and the related support system should be elaborated, which can take the form of a contribution to the cost of construction (e.g. non-refundable support could be requested or the establishing of above ground or underground rainwater reservoirs). At the same time, it is also necessary to determine the rights and obligations of the parties in charge of rain water management. There are two basic methods to manage rainwater on site. One of them is to facilitate the infiltration of the rainwater into the soil (in areas covered by grass or bushes, in open ditches, through permeable pavement, etc.), which can supplement groundwater and reduce the volume of rainwater to be drained. The other solution would be to retain waters in temporary reservoirs (above ground water tanks, storage in the sewage system, storm basins, etc.) or to direct waters into the recipient with delay to reduce the excess burden on the system and the recipient and the peak levels of flood waves. Interventions combined with green areas might be ideal: infiltration cells, green roofs, rain gardens, infiltration trenches, trenches and embankments covered with grass, temporary inundation areas, wetlands permanently covered with water, solid but permeable pavements, retention of water from roofs and paved surfaces.

In the case of major emitters (industry, shopping malls, office blocks), users should be made interested in applying or compelled to apply the delayed runoff, retention or secondary use of rainwater. Public initiatives to this end should also be supported.

In the case of the harvesting of rainwater as grey water, it is extremely important to ensure the proper quality of water, therefore the integration of pre-clarification facilities should be considered. This is particularly important if rainwaters are collected from paved road surface.

Recommendations for the harvesting of rainwaters by green infrastructure tools are formulated in the title “Water-sensitive planning in open urban spaces” issued in the series of the Green Infrastructure brochures of the Municipality. The retention and harvesting of rainwater should be a priority criterion in the public procurement processes and the tender-based support schemes (Environmental Protection Fund, Healthy Streets program) of the Municipality of Budapest (see Measure A9 titled “Promotion of the application of climate-friendly construction materials and technologies”).

Type of measure		Adaptation	
Timeframe	continuous		

Owner	Municipality of Budapest, Department of City Management
Necessary financing	n.a.
Potential sources	Own resources of local governments, EU funds and schemes
Related thematic programs, strategies, plans	-

Aá-5 Preparation for extreme weather conditions and the health impacts of climate change

Preparation of the transport system for extreme weather phenomena	**A13**

Transport systems and public utility networks should be designed with consideration to the prognostications that temperatures can be expected to increase and heatwaves, storms and flash floods will occur more frequently. In the summer months, we can expect asphalt damage to deteriorate and hot days will also bring about the deformation of rails, which may make the ordering of speed limitation and track obstruction necessary. This in turn may lead to delays, which reduce the competitiveness of public transport. These factors need to be considered in the planning process (e.g. the standard applied should be deviated from with regard to climate impacts, construction materials and technologies should be selected appropriately).

Moreover, it is advisable to make the pavement of sidewalks more resistant to heat and, wherever possible, alternative, possible permeable pavements shall be applied instead of asphalt (paving stones, concrete) with sufficient dilatation and the provision of proper maintenance to maintain its permeability. In addition, deformation caused by heat may be reduced by the planting of trees alongside tracks and the grassing of tracks. It is recommended to introduce any innovation and technology advances in order to find better solutions (higher quality and climate protection).

The aspects described above need to be enforced in the planning process, in public procurement process (despite the extra costs involved) and upon the issuing of owners' consents. Adaptation must be regarded as a priority criterion with the tender-based support schemes of the Municipality of Budapest as well (Environmental Protection Fund, "Tér_köz" program, Healthy Streets program).

It is recommended to elaborate an emergency scenario for the resolution of operating disruptions caused by extreme weather conditions (e.g. changing the route of services, commencing replacement services, providing information to travellers). It is recommended to assess the status of the public transport infrastructure, as the findings may affect the creation and prioritisation of the technical content of investments.

Type of measure		Adaptation	
Timeframe	continuous		
Responsible:	Municipality of Budapest, Unit of Transport		
Necessary financing	-		
Potential sources	Own resources of local governments, regional, national and EU funds and schemes		

Managing hazards caused by extreme weather phenomena	**A14**

The Mayor directs and organises the tasks of preparation and control in the area within his competence. As part of preparation, he provides for the preparation of the disaster management rating and of the hazard control plan of Budapest and presents them to the president of the Security Committee of Budapest for approval. The Mayor is responsible for providing the conditions of and directs preparations for control. He manages local disaster management in the city in reliance on the professional directions of the official disaster management body, organises and manages the protection, evacuation, rescue, accommodation and resettlement of the citizens, organises and manages the protection of material assets and provides for supplying the population with basic necessities.

Hazard control plans include elements, e.g. the order of actions and measures, which support the decision-maker and facilitate the effective and successful implementation of control measures in the interest of the prevention or mitigation of the consequences of natural, civilisational or other hazards. The plans also contain the places of risk identified, as well as the assignment of personal, material and technical means necessary for the implementation of disaster management tasks and

measures. Based on the hazard control plan of the city, the Mayor prepares a publication to make the citizens acquainted with hazards and the regulations to be followed and makes it accessible to the public with the locally available means. It is necessary to examine and ensure that emergency plans manage extreme events which may occur due to climate change (drought, flood, flash flood, damage to critical infrastructure, etc.), and to review the publication prepared to inform the citizens.

Based on Act LVII. of 1995 on Water Management, the governmental bodies and local governments are responsible for fighting against flood and inland water and protect against local water damage. On the structures maintained by settlements performing their control duties with their own organisation, the technical tasks related to combating flood and inland water control shall be performed within the city boundaries by the mayor (in Budapest the Mayor of Budapest) through the mayor's office, in reliance on the professional direction of the water management authority. It is the Mayor who orders evacuation, rescue and resettlement in connection with protection against flood, inland water and local water damage.

Pursuant to Article 23, Section (4), paragraph 12 of Act CLXXXIX. of 2011 on the Local Governments of Hungary, water management and water damage protection constitute the responsibility of the Municipality of Budapest.

In connection with the activity of the Municipality of Budapest related to flood and inland water protection, it is necessary to maintain and review flood control structures and equipment and the technical structures intended to drain inland water, to maintain junction locks along flood protection lines and to develop, maintain and keep records of small watercourses and ditches meant to lead off rainwaters, inland waters and mountain waters, namely in the phase before the period of alert, under the direction of the Chief Clerk. Flood fighting in Budapest has four degrees: I: standby (first degree), II: actual (second degree), III: increased (third degree), IV: extraordinary preparedness. Based on Decree No. 10/1997. (VII. 17.) of the Minister of Transport, Telecommunication and Water on Protection against Flood and Inland Water, flood protection preparedness may be ordered and abolished by the Mayor, except for extraordinary preparedness and a state of emergency. Extraordinary flood protection preparedness may be ordered and abolished by the minister in charge of the management of water management authorities. Based on Article 53, Section (1) of the Fundamental Law, the state of emergency may be announced by the government.

In the cases determined by the legal rule (Regulation No. 39/1997 (VII. 18.)), the Municipality of Budapest may restrict the use of water. In the event the amount of water which may be produced for public utility supply is reduced for any natural or other unavoidable cause, the use of drinking water quality water taken out from the public utility system may be limited without the obligation to indemnify any party, except for subsistence-level water consumption. Water-use restriction (of the necessary degree) may be ordered and lifted, after having been initiated by the water supplier, by the Mayor, based on the recommendation of the Chief Clark. The use of water may be limited by the issuing of a watering ban and/or water-use restriction.

The level of information and alert to be provided and applied at times of heat waves, cold waves or solar radiation of a level harmful to health, the scope and content of measures to be introduced in the event heat or cold waves reaching the level harmful to health and the detailed rules relevant to national level heat alerts may be determined by the Government in a Decree, whereas the powers of the Municipality of Budapest are limited in this respect.

Type of measure		Adaptation	
Timeframe	continuous		
Owner	Mayor		
Necessary financing	-		
Potential sources	-		

Examination of the climate vulnerability of water bases and drinking water supply and their climate-adaptive development and operation	**A15**

Water procurement by Budapest Waterworks is based on bank filtration completely. It can be established based on literature and operating experience as well that the climate vulnerability of this technology is significant. In the water production areas, the necessary amount of drinking water is supplied by a total of 760 bank filtration wells not only for Budapest, but certain settlements in the agglomeration as well.

Due to climate change affecting the catchment area of the Danube as well, extreme weather conditions are becoming more and more frequent: based on the weather trends experienced and evaluated in recent years, there is a justified demand for elaborating operational changes for periods hit by extreme drought. The extended low-water periods on the Danube cause not only quantitative, but qualitative problems as well. Considering also drinking water consumption data, we can establish that the current operation cannot be sustained in the long run without the advanced amortisation of the infrastructure, water quality complaints and water-use restrictions and without the development of water production capacities.

In 2018, the water level of the Danube decreased to such a low level that Budapest Waterworks had to enforce the so-called "low-water measures" determined in its policy on 3 occasions (30.07.2018-28.08.2018, 13.09.2018-27.10.2018, 05.11.2018-05.12.2018). During these periods, water supply could only be maintained with the temporary overburdening of the wells. The operation of several wells had to be limited due to low water level or high depression in the wells.

The water quality risks arising in low-water periods may be different: on the one hand, the excess load of the wells may cause sanding, which in turn may damage the well structure (the filter layer), grains of sand may abrade pumps and related engineering elements extremely and cause secondary water quality problems as well when they settle in the connected gravitational channel. During long periods of low-tide, especially if this occurs in the warm summer period, the frequency of occurrence and severity of microbiological complaints may increase. Because of the specifics of the system (the lack of water treatment works), the set of tools available to improve water quality (with effective disinfection) is limited. In such cases, the problem can only be managed by the exclusion of the wells producing low quality water from the production, which in turn reduces the available capacities.

When considering the capacity of wells, we need to differentiate between capacities available in the winter and in the summer period, as the change to the water temperature of the Danube affects the recharging of the water significantly, due to the changing viscosity of Danube water. Based on the capacity values relevant to various Danube water levels, we can say that the capacity available in extremely low water periods is no longer sufficient to meet consumption demands.

The document prepared by Budapest Waterworks under the title "Development of the drinking water system of Budapest" examined several suggestions to solve the above-mentioned problems and after having analysed the various versions, proposed the capacity enhancement of existing wells by the increasing of the specific filter area as a solution to the problem. With the replacement of the nodes in radial collector wells by bridge filter nodes, the specific node surface could be increased significantly. This influences the conditions of the water cleaning process from several aspects significantly, particularly during low-tides. It does not require the reconstruction or removal of the structure, so the extent of the intervention may be minimized in this way.

As nearly 50% of radial collector wells were built within a decade (1970-1980) and they have reached the age of 40-50 years by now, and as more than 20% of the total number of wells are even older than this, we can prognosticate that they will become totally worn off accordingly, which means that ca. 100-120 wells will be in need of reconstruction in the coming years. Budapest Waterworks has started the development of 60 water production wells as part of a project.

Type of measure		Adaptation	
Timeframe	2022		
Owner	Municipality of Budapest, Department of City Management		
Necessary financing	HUF 4,900 million		
Potential sources	Own resources of local governments, EU funds and schemes		
Related thematic programs, strategies, plans	Development of the drinking water system of Budapest		

Preparation for extreme weather conditions during the preservation and renovation of buildings	**A16**

The foreseeable increase in the frequency of windstorms means a source of physical hazard for the building stock of the Municipality of Budapest, affecting primarily the structural boundaries of buildings, i.e. structures on the façades and roofs. Floods, flash floods and inundations also have a significant effect on the building stock; to avoid these, proper rainwater management must be established in the first place. (see measures A11 and A12) For all these reasons, the Municipality has to pay priority attention concerning its own building stock to the proper sizing of support structures, basements, windows, sun shades and waterproofing sheets.

Type of measure		Adaptation	
Timeframe	2030		
Owner	Municipality of Budapest, Department of Urban Planning		
Necessary financing	n.a.		
Potential sources	Own resources of local governments, EU funds and schemes		

Aá-6 Mitigation of the vulnerability of natural and landscape values

Preparation of the detailed climate change risk and vulnerability assessment for natural values	**A17**

Effective nature conservation and the confining of invasive animal and plant species requires the examination of the sensitivity of natural values to climate change as part of regular status assessment, based on the forecasts of a precise climate model and the assessment and monitoring of risks and vulnerabilities. Climate change intensifies the external effects on natural areas. The appearance of invasive plant species and pests degrades valuable habitats, which finally results in decreasing biodiversity.

Type of measure		Adaptation	
Timeframe	2023		
Owner	The Municipality of Budapest		
Necessary financing	n.a.		
Potential sources	LIFE		

Continuing the expansion and extension of protected natural sites of local importance	**A18**

About 7% of the territory within the city boundaries of Budapest is protected area, where numerous protected plant and animal species can be found. The primary objective is to protect the botanical, zoological, geological and landscape values of protected areas, to preserve biodiversity, to reduce conflicts concerning nature and the achieve that new areas are declared to be protected sites on an estimated area of 800 ha based on preliminary surveys. The possibility of the extension of protection is being examined continuously. The values which may be recommended to enjoy local protection include areas which are valuable in terms of nature conservation and which have survived despite the increase in the improved areas of the capital city, preserving the biological diversity and landscape values once typical in the region. Placing the valuable natural areas currently not protected under protection is included as a thematic project in the draft of the Dezső Radó Plan.

Type of measure		Adaptation	
Timeframe	2030		
Owner	The Municipality of Budapest		
Necessary financing	-		
Potential sources	-		
Indicator	Size of protected natural sites of local importance		
			Source of data: BFVT Kft.
	Base year: 2019		*Base year value: 861 ha*
	Target year: 2026		*Target year value: 1200 ha*

Environmental protection management, confinement of invasive plant and animal species	**A19**

The Municipality of Budapest plays a priority role especially in the preservation and management of protected natural areas and monuments of local significance, but it also has to take responsibility indirectly for the preservation of other protected areas and landscape value (subject to national and international protection), through urban planning instruments in the first place. Nature conservation management shall be realized according to the management plans determined in the legal rule. One of the most important tasks of this management is to confine invasive species in the areas concerned, but nature conservation aspects need to be enforced not only in protected natural sites, but in the "urban ecosystem" as well. In the urban ecosystem, special emphasis must be laid on the confinement of plant species causing allergy as well.

The system of monitoring of the conditions of protected areas (naturality, degradation, infection by invasive species) has already been elaborated as part of the environmental status assessment to substantiate the necessary interventions. This requires the continuous collection of data by Hungarian Park Rangers (Természetvédelmi Őrszolgálat) and FŐKERT Nonprofit Zrt.

The preservation of natural habitats, the habitat management of natural habitats, the confinement of invasive plant species and the restoration of habitats are included as thematic projects in the draft of the Dezső Radó Plan.

Related projects in the Radó Dezső Plan by action areas:

- Nature conservation rehabilitation of Mocsárosdűlő (key project)
- Nature conservation rehabilitation of Tétényi-fennsík
- Nature conservation rehabilitation of Homoktövis, review of forest plans from the point of view of nature preservnation
- Rehabilitation of the salt meadow of Kőérberek
- Extension and nature conservation development of the protected area of Merzse-mocsár
- Nature conservation development of and green surface expansion on Ferenc-hegy

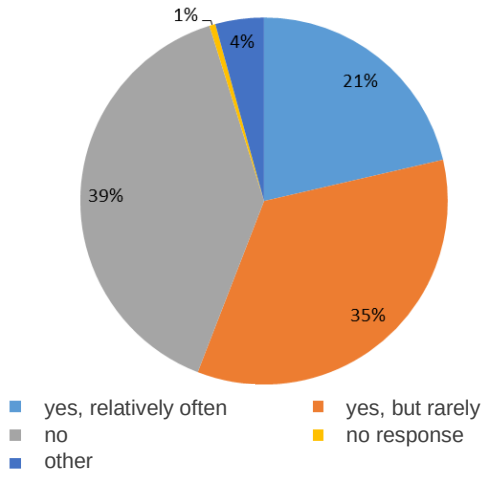
Type of measure		Adaptation	
Timeframe	continuous		
Owner	The Municipality of Budapest		
Necessary financing	HUF 2 billion		
Potential sources	LIFE, own resources of the Municipality of Budapest		
Indicator	The highest coverage ratio of invasive plant species in protected natural sites of local importance		
			Source of data: BFVT Kft.
	Base year: 2017		*Base year value: 18%*
	Target year: 2030		*Target year value: it should be reduced*

7. AWARENESS-RAISING AND CLIMATE-CONSCIOUSNESS ACTION PLAN

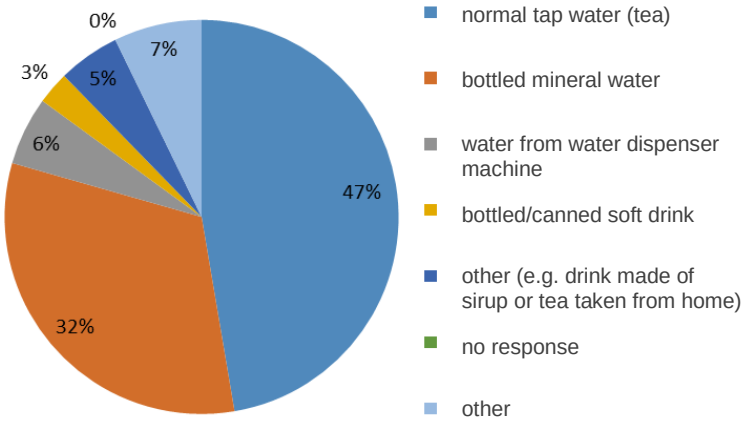
SZ-1 Climate conscious city management: cooperative city management taking the lead in climate protection

An important goal of the Municipality of Budapest is for the city management to set an example and operate the City Hall in an environmentally friendly manner, to the possible extent. The Municipality surveyed opinions and habits in an internal, office questionnaire to determine the possible measures which would be supported by the employees as well.

According to the 374 replies received, the majority, i.e. nearly two thirds of those working at the City Hall use public transport to get to work. The remaining 20%, 5%, 3% and 1% of the employees go to work by car, by bike, on foot and by scooter, respectively, in the highest numbers from district XI (10%) and the agglomeration (18%). More than 50% of the workers eat in the office canteen more or less frequently and nearly 50% of them drink tap water (according to a former test, lead was found in the water at several points in the building of the City Hall, however, this is not a climate but a health issue).



Do you eat in the canteen?



What do you most often drink in the office?

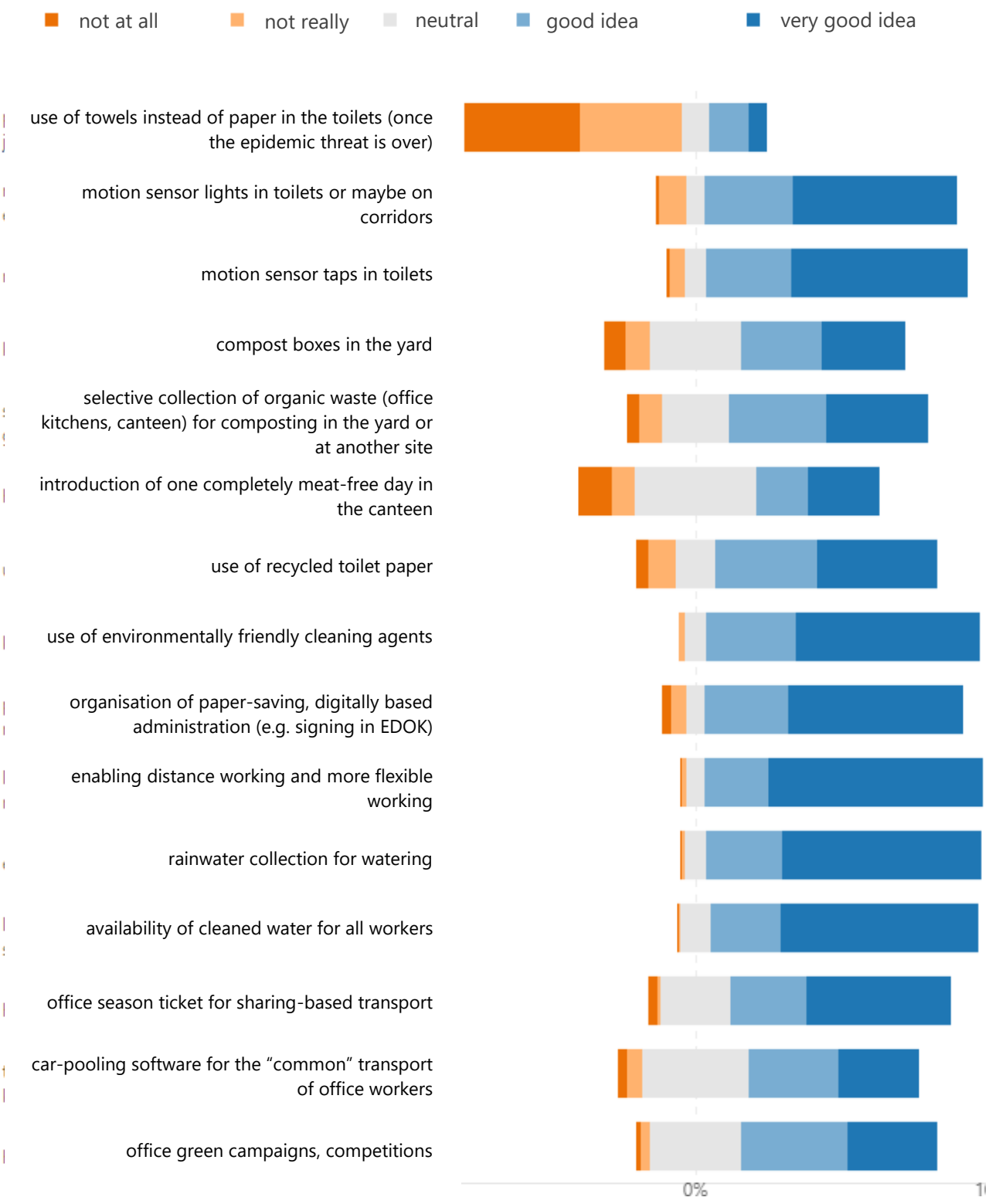
Climate conscious workplace, climate conscious colleagues	**SZ1**

The goal of the measure is to support and encourage initiatives promoting the climate-conscious operation of the Mayor's Office and its companies and to introduce climate protection measures.

In the office questionnaire mentioned above, City Hall workers could also express their opinion about pre-formulated measures and could propose other measures as well as deemed fit. The former can be seen in the diagram below, whereas among the actions suggested by the workers on their own, the subjects below were the most often mentioned or most relevant ideas:

- reconstruction of the inner parking spaces of the City Hall to a community space,
- flexitime working on hot summer days, introduction of core time,
- coordination within the house of the recycling or gifting of used, but good quality clothes, objects, technological devices (e.g. donation collection depots within the house),
- taking the lunch away from the canteen should be allowed only in reusable, own containers,
- there should be no cars except for those necessary for the performance of official duties and the cars of the senior managers, and only those should come to work by car who actually need it to perform their job responsibilities. The other workers should be allowed to request occasional allowance for parking on a limited number of days per month (e.g. 3 days),

- office workers should be provided charging stations to charge their electric cars, scooters or bikes,
- creation of covered, safely locked bicycle / scooter storage facilities,
- investment of the funds and savings of the Municipality of Budapest into green portfolios,
- covered parking slots with solar panels installed on their roofs.



Type of measure	Mitigation	Adaptation	

Timeframe	2030	
Owner	Municipality of Budapest, Department for Climate and Environmental Affairs	
Necessary financing	HUF 4 million per annum	
Potential sources	Municipality of Budapest, companies in Budapest, international and national tenders	
Indicator	Number of persons participating in training (person)	
	Source of data: FPH	
	Base year: 2020	Baase year value: n.a.
	Célév: 2030	*Target year value: 1,500 persons*

Enforcement of horizontal climate protection principles in urban development, sectoral and urban planning, the creation of the relevant legal rules, the issuing of municipal invitations to tender and in investments	**SZ2**

This measure is intended to integrate climate protection measures and/or horizontal climate protection principles during the preparation and review of urban development and thematic sectoral strategies, thus establish correlation of the documents with the Sustainable Energy and Climate Action Plan. It is also necessary to integrate climate-related aspects in the due diligence and detailed planning of major investments from the point of view of climate protection, as well as to check whether they are duly realized. It would be advisable to use the preparation and socialisation of the documents to present and widely communicate best practices and to raise awareness on professional grounds. It is also necessary to enforce climate protection principles and the 2021-2026 of Budapest Environmental Program objectives in the course of the creation of the relevant decrees related to the strategies and when the criteria for the tenders announced by the capital city are determined. The Department for Climate and Environmental Affairs set up in 2020 at the Mayor's Office advises on proposals related to climate and environmental protection and other relevant materials and initiatives continuously.

Type of measure	Mitigation	Adaptation	
Timeframe	continuous		
Owner	Municipality of Budapest, Department for Climate and Environmental Affairs		
Necessary financing	n.a.		
Potential sources	n.a.		

Operation of the Budapest Climate Change Program and a dedicated online platform to share best practices and to improve partnerships	**SZ3**

The purpose of the measure is to establish long-term cooperation with stakeholders playing a strategic role in the promotion of climate consciousness and the sharing of best practices. The platform facilitates continuous communication with target groups on a wide scale, the collection and sharing of target group specific and thematic contents and best practices, the comprehensive follow-up of climate protection measures taken in the capital city and the creation of a database. It is advisable to participate in co-operation projects related to climate protection, to support innovation workshops, to initiate national and international projects to be realized with the participation of the Municipality of Budapest, to build partnerships and connect to initiatives, as well as to attend national and international knowledge sharing and relationship building events.

One of the priority tasks of the Climate Change Platform is to realize cooperation with district municipalities, to promote district climate strategies and SECAPs and the division of labour and the synchronization of tasks in the interest of the achievement of the objectives. Another important goal is to strengthen cooperation with non-governmental organisations and the organisations of residential communities and to support these organisations (e.g. through the Environmental Protection Fund).

Type of measure	Mitigation	Adaptation	

Timeframe	continuous	
Owner	Municipality of Budapest, Department for Climate and Environmental Affairs	
Necessary financing	HUF 10 million per annum	
Potential sources	EU tenders	
Indicator	Number of meetings of the Platform, number of visitors of the online platform	
		Source of data: FPH
	Base year: 2021	*Base year value: 0*
	Target year: 2030	*Target year value: 20 sessions, 30,000 visitors*

Establishing cooperation with the corporate sector (companies, chambers, associations) to support the climate objectives of Budapest	**SZ4**

One third of the amount of energy used in one year in Budapest is consumed by the companies in the tertiary and industrial sectors to operate their buildings and facilities. For these reasons, the City Hall expects not only district municipalities and citizens, but the managers of companies as well to be allies in the climate and environmental protection efforts. The purpose of the measure is to establish cooperation between the Municipality of Budapest and companies and to involve companies in the implementation and financing of the mitigation, adaptation and awareness-raising measure of Budapest, e.g. in the field of the expansion and development of green areas, solar panel investments and communication campaigns.

The Municipality of Budapest also wishes to promote climate-conscious city management by organising and coordinating climate-friendly alliances with companies, voluntary commitments, awards and competitions. In many cases, the mere reorganisation of the processes and minor interventions are enough to make much progress. A few examples:

- The mitigation of the excess heating in the winter and cooling in the summer of shopping malls by a few degrees can result in substantial savings.
- The roofs of shopping centres and office blocks provide excellent, until now unutilised surfaces for the installation of solar panel systems, just as large, outdoor car parks, which could be covered by solar panels mounted on stands, which would also provide shade against strong sunshine. This is invaluable in a densely built city in lack of space.
- Rush hours and traffic jams in the city could be mitigated by the coordinated shifting of working hours, particularly for secondary schools and tertiary educational institutions, and also by the encouraging of the home office system.

In order to reduce climate risks and reinforce climate consciousness in the corporate sector, it is necessary to establish cooperation and enter into thematic agreements with the interest groups and professional organisations of the corporate sector. The purpose of the cooperation is to monitor the emission reduction and adaptation aimed investments of the economic sector and the related R&D and professional activities and to encourage and initiate the launching of knowledge sharing and expansion programs accordingly.

Type of measure	Mitigation	Adaptation	
Timeframe	continuous		
Owner	Municipality of Budapest, Department for Climate and Environmental Affairs		
Necessary financing	HUF 4.5 million per annum		
Potential sources	municipal budget, sponsorship		
Indicator	Number of partners		
			Source of data: FPH
	Base year: 2020		*Base year value: n.a.*
	Target year: 2030		*Target year value: growth*

SZ-2 Climate conscious citizens: strengthening the environmental awareness and responsibility among the population and economic actors

Thematic awareness-raising campaigns and informational activities through the Mayor's Office and the business organisations of Budapest, with special regard to reducing the volume of household energy consumption	**SZ5**

The purpose of the measure is to perform a complex awareness-raising activity reaching the population on a wide scale and matching the sectoral profile of the individual companies through the following core activities:

- appearance at events organised on the level of the capital city and the organisation of own company events
- development of visitors' centres, open days and marketing communication tools
- awareness-raising related to projects (targeted campaigns and activities).

Priority issues include the reduction of the energy consumption of households, the support of the building energy investments of the citizens, the promotion of public transport and cycling as opposed to the use of cars, the preparation of corporate mobility plans, the reduction of waste generation and the creation of conscious consumption and waste collection habits.

The participants of the Citizens' Assembly held in 2020 in Budapest suggested that the Municipality should launch a media and informational campaign about climate change and the steps people can take against climate change individually and as a community. The promotional campaign should help people understand climate change, what is at stake, what changes they can expect and how they can prepare for them. As a special action, they also proposed the creation of climate friendly experimental streets (streets of the future) so that people may become familiar with and get concrete ideas about the solutions for environmental protection, urban architecture, organisation, lifestyle and technology which may be desirable in the future.

As for the reduction of the energy use of buildings (whether of residential or workplace functions), the local mitigation of heating demand (by heating the buildings to a temperature lower by 1°C), the volume of thermal energy consumed can be reduced by 6% on the average.

Possible actions: photo competitions, educational programs in the awareness-raising centre of FKF, giving ideas to the citizens concerning the development of a climate-conscious household, holding of thematic days, family days and further training programs for nursery school teachers in the two kindergartens owned by the capital city, dissemination of awareness-raising and informational materials in the media with the help of influencers. It is important to start awareness-raising already in early childhood, therefore it is recommended to realize awareness-raising actions and further training programs to inform and train parents and teachers. It would be also advisable to involve non-governmental organisations and churches in awareness-raising activities.

Type of measure	Mitigation		
Timeframe	continuous		
Owner	Municipality of Budapest, Department for Climate and Environmental Affairs (and the Department of City Management)		
Necessary financing	HUF 100 million per annum		
Potential sources	Municipal budget, tenders, companies' budget, private sector		
Indicator	Amount of energy saved (MWh/annum) CO_2 emission mitigation (tCO_2/annum)		
			Source of indicator: FPH
	Base year: 2020		*Base year value: 0 MWh/annum; 0 tCO_2/annum*
	Target year: 2030		*Target year value: 432,496 MWh; 85,744 tCO_2/annum*

Developing the adaptation knowledge and ability of the population, particularly in respect of heat waves, rainwater management, property protection and green infrastructure	**SZ6**

The population must be made aware of the adverse effects of heatwaves on human health and the necessary and possible ways of protecting against them, with special regard to vulnerable groups of the society (the elderly). Because of heatwaves becoming more and more frequent and their environmental, health and economic effects, it would be reasonably necessary to provide for the legal regulation of heat alerts. In addition to regular planning on the proper levels, there is a need for the definition of the tasks performed by the municipality under such extraordinary circumstances on a voluntary basis at the moment and the regulation of the financing of such tasks. As for heat alerts, it is particularly important to inform the population about the possible ways of protection against heat and UV radiation: the proper application of the active (cooling, ventilation of buildings) and passive (shading, orientation, insulation) ways of adaptation and taking protection against heat into regard when planning and constructing buildings.

The Municipality of Budapest may appoint a person to be in charge of checking the effectiveness of reaching the population with information on heat waves. In addition, the Municipality of Budapest may also compile a heat plan document containing things to do concerning the provision of information, the communication panels which may be applied, as well as the tasks to be performed in connection with the events organised by the Municipality, such as the installation of shades, the provision of water supply points and the selection of the date of events under extreme weather conditions.

It is also necessary to make the citizens familiar with the actions they should take to prevent property damage and the importance of these actions (maintenance of drainage ditches and gutters, application of permeable pavements). The assessment of the vulnerability and the protection of the buildings against storm damage requires the addressing of condominium properties and non-governmental organisations. Besides the things to do after the occurrence of emergency events, the information provided should cover the issue of prevention and give advance warning as well. It is necessary to encourage the citizens to utilise rainwaters and grey waters, thus involving them in adaptive rainwater management. They should be informed of the available technologies and possibilities and the ways in which they can contribute to the reduction of the use of drinking water, the prevention of damage caused by rainwater and the conservation of the environment by the application of various methods.

Facilities built on low-lying locations exposed to inundation should be utilised in awareness of the risk of inundation. Property owners are obliged to manage the rainwater falling on their property. Moreover, it is also important inform the citizens in a campaign of the fact that prolonged heatwaves affect water supply significantly.

Type of measure		Adaptation	
Timeframe	continuous		
Owner	Municipality of Budapest, Department for Climate and Environmental Affairs (and the Department of Urban Planning)		
Necessary financing	n.a.		
Potential sources	municipal budget, district budget		
Indicator	Number of persons reached actively and passively		
			Source of indicator: FPH
	Base year: 2020		*Base year value: n.a.*
	Target year: 2030		*Target year value: 100 000*

Promoting climate protection aspects in the ordering of public services and public procurement processes	**SZ7**

The purpose of the objective is to enforce climate protection aspects in the public procurement practice of the Mayor's Office and the companies owned by the capital city. The Municipality of Budapest has been engaged in the "Global Lead Cities Network on Sustainable Public Procurement" since 2015. In 2018, the Municipality of Budapest joined the International Council for Local Environmental Initiatives (ICLEI) and PROCURA+, which is the thematic public procurement network of the former (European Sustainable Procurement Network). In addition, since 2019, Budapest has been an active member of the Big Buyers program created by European Commission DG Internal Market, Industry, Entrepreneurship and SMEs (DG GROW), the main focus of which is strategic procurement aimed at sustainability. The majority of the activities realized to achieve the horizontal or specific objectives formulated in the development plans are implemented by means of public procurement,

therefore public procurement should not be regarded as an objective, but as a means which can provide us with access to social, economic and environmental welfare and serves the implementation of strategic objectives. For this reason, the Municipality of Budapest wishes to create its sustainable, green and innovative procurement strategy as soon as possible.			
Type of measure	Mitigation	Adaptation	
Timeframe	2022		
Responsible:	Municipality of Budapest, Public Procurement Unit		
Necessary financing	n.a.		
Potential sources	EU funds, municipal funds		

8. MONITORING AND REVIEW

An important part of the action plan is the monitoring of the attaining and implementation of the objectives and measures determined. Monitoring makes it possible to determine the fields of action lagging behind and where resources should be reallocated. It also shows how effectively the individual measures serve the purposes of the action plan and what modifications might be possible in the course of the review of the action plan.

It is to be reviewed every 2 years to what extent the measures and objectives of the SECAP have been realized. It is recommended for the responsible departments of the Mayor's Office to report on the progress achieved regarding the measures every six months to the Chief Clerk, who will then report to the Mayor directly.

The biennial review provides an opportunity to modify or amend the measures as may be necessary or to add new measures depending on the changing social, economic, environmental and technological environment. The review shall be carried out with due regard to the objectives and measures of the relevant district and national strategies and action plans as well.

The follow-up of the implementation of the measures can take place with the help of the indicators specified in the chart relevant to the individual measures (see chapter 5 on the Emission mitigation action plan, chapter 6 on the Adaptation action plan and chapter 7 on the Awareness-raising and climate-consciousness action plan). The charts contain in respect of the given indicator the base year and the base year value, the target year and the target year value and the source of data necessary for the calculation. However, in some of the cases, the indicator cannot be determined precisely. In such cases, it is to be specified/elaborated in the course of the elaboration of the measure.

For the time being, it is impossible to prognosticate the economic or social impacts of the current corona virus epidemic or how these impacts can be managed or to calculate with these impacts, therefore this issue requires special attention in the first review of the action plan.

Summary chart of the final energy and CO_2 savings which may be achieved by emission reduction measures and the costs involved.

Measure		Energy saved (MWh/ annum)	CO_2 mitigation (tCO_2/ annum)	CO_2 mitigation within total CO_2 mitigation (%)	Cost (million HUF)
Má-1	**Má-1 Improving the energy efficiency of buildings, industrial production and facilities of the tertiary sector. Increasing the ratio of renewables**				
M1	Refurbishment and energy conscious operation of the buildings and facilities of the Municipality of Budapest and business associations providing public services	171 946	39210	1,6	30 000
M2	Reconstruction of the public lighting system	18 242	4 200	0,2	13 970
M3	Refurbishment of residential buildings	4 809 105	981 977	39,6	964 000
M4	Installation of solar panel developments	2 031 409	467 224	18,9	630 000
M5	Development of the district heating system and making it more environmentally friendly (reconstruction, increasing the ratio of renewables, etc)	719 066	176 135	7,1	98 507
M6	Conducting initial surveys and researches on the subject of the feasibility and application of sustainable energy management and circular economy	0	0	0	30
M7	Refurbishment and energy-conscious operation of the mitigation and decarbonisation activities of industrial production and facilities of the tertiary sector	747 178	150 930	6,1	115 478
Má-2	**Improving the energy efficiency of transport and supporting and developing environmentally friendly forms of transport**				
M8	Development of public transport with attractive vehicles and services and better infrastructure	1 908 791	496 286	20	500 000
M9	Development of the cycling and pedestrian infrastructure	133 091	34 604	1,4	28 000
M10	Facilitation of the use of electric driven or low emission motor vehicles	19 843	8 733	0,4	1 200
M11	Promotion of the use of car-sharing and car-pooling systems	433	191	0	0
M12	Traffic control to reduce emission, designation of low-emission zones and construction of the related infrastructure	117 280	32 877	1,3	25 000
SZ-2	**Climate conscious city dwellers: strengthening of the environmental culture and responsibility among the population and economic operators**				
SZ5	Thematic awareness-raising campaigns and informational activities through the Mayor's Office and the business organisations of Budapest, with special regard to reducing the volume of household energy consumption	432 496	85 744	3,5	1 000

Summary of mitigation measures by sectors

Sector	CO2 emission in 2015 (t)	Target value (tCO2)	CO2 mitigation (t)	Cost (million HUF)
Municipal buildings, equipment/facilities	138 432	92 107	46 325	32 888
Buildings, equipment/facilities of (non-municipal) service providers	1 164 660	848 849	315 811	335 695
Residential buildings	2 264 251	802 127	1 462 124	1 418 913
Public lighting	20 595	71 281	4 200	13 970
Industry (non-ETS)	807 626	713 518	94 108	51 719
Transport	1 709 130	1 136 438	572 692	554 200
Agriculture, forestry, fishery	4 413	4 413	0	0

Summary chart of the costs and indicators of all measures

Measure		Indicator	Source of data	Base year	Base year value	Target year	Target year value	Cost (million HUF)
Mitigation measures								
Má-1 Improving the energy efficiency of buildings, industrial production and service provider facilities and increasing the ratio of renewables								
M1	Energetic upgrading and energy conscious operation of the buildings and facilities of the Municipality of Budapest and business associations providing public services							
	City Hall and other institutions	Energy saved (MWh/annum)	Municipality of Budapest	2015	0	2030	12 156	15 000
		CO_2 mitigation (tCO_2/annum)	Municipality of Budapest	2015	0	2030	2 460	
	Institutions of business associations providing public services	Energy saved (MWh/annum)	The Municipality of Budapest, and business associations providing public services	2020	0	2030	159 790	15 000
		CO_2 mitigation (tCO_2/annum)	The Municipality of Budapest, and business associations providing public services	2020	0	2030	36 750	
M2	Reconstruction and energy upgrading of the public lighting system	Energy saved (MWh/annum)	BDK Kft.	2020	0	2027	18 242	13970
		CO_2 mitigation (tCO_2/annum)	BDK Kft.	2020	0	2027	4 200	
M3	Energy upgrading of residential buildings	Energy saved (MWh/annum)	BKAE			2030	4 809 105	964 000
		CO_2 mitigation (tCO_2/annum)	BKAE			2030	981 977	
M4	Installation of solar panels	Energy saved (MWh/annum)	ELMŰ Hálózati Kft.	2019	15 872	2030	2 031 409	630 000
		CO_2 mitigation (tCO_2/annum)	ELMŰ Hálózati Kft.	2019	3651	2030	467 224	
M5	Development of the district heating system and making it more environmentally friendly (reconstruction, increasing the ratio of renewables, etc)	Energy saved (MWh/annum)	FŐTÁV Zrt.	2015	0	2030	719 066	98 507
		CO_2 mitigation (tCO_2/annum)	FŐTÁV Zrt.	2015	0	2030	176 135	
M6	Conducting initial surveys and researches on the subject of the feasibility and application of sustainable energy management and circular economy	Energy saved (MWh/annum)					0	30
		CO_2 mitigation (tCO_2/annum)					0	
M7	Energy upgrading and energy-conscious operation of the mitigation and decarbonisation activities of industrial production and service provider facilities	Energy saved (MWh/annum)	number of businesses reached with the information (to be determined in the course of further planning)		0		747 178	15-20/annum
		CO_2 mitigation (tCO_2/annum)	number of businesses reached with the information (to be determined in the course of further planning)		0		150 930	

Má-2 Improving the energy efficiency of transport and supporting and developing environmentally friendly forms of transport								
M8	***Development of public transport with attractive vehicles and services and better infrastructure***	Energy saved (MWh/annum)	BKK	2015	0	230	1 908 791	500 000
		CO_2 mitigation (tCO_2/annum)	BKK	2015	0	2030	496 286	
		Proportion of the users of public transport (based on distances covered)	BKK	2017	walking 12%, cycling 2%, public transport 43%, passenger cars 43%	2030	walking 15%, cycling 5%, public transport 50%, passenger cars 30%	
M9	***Development of the cycling and pedestrian infrastructure***	Energy saved (MWh/annum)	BKK	2017	0	2030	133 091	28 000
		CO_2 mitigation (tCO_2/annum)	BKK	2017	0	2030	34 604	
		Ratio of pedestrians and cyclists (%)	BKK	2017	walking 12%, cycling 2%	2030	walking 15%, cycling 5%, public transport 50%, passenger cars 30%	
M10	***Facilitation of the use of electric driven or low emission motor vehicles***	Energy saved (MWh/annum)	Ministry of Innovation and Technology, Department of Vehicle Methodology Authority	2018	0	2030	19 843	1200
		CO_2 mitigation (tCO_2/annum)	Ministry of Innovation and Technology, Department of Vehicle Methodology Authority	2018	0	2030	8 733	
		Ratio of vehicles of environmental class 5 (%)	Ministry of Innovation and Technology, Department of Vehicle Methodology Authority	2018	0,50	2030	30	
M11	***Promotion of the use of car-sharing and car-pooling systems***	Energy saved (MWh/annum)				2030	433	-
		CO_2 mitigation (tCO_2/annum)				2030	191	
		Number of vehicles available in carsharing systems				2030	1 200	
M12	***Traffic control to reduce emission, designation of low-emission zones and construction of the related infrastructure (P+R car parks)***	Energy saved (MWh/annum)	BKK	2017	0	2030	117 280	25 000
		Number of P+R car parks	BKK	2017	5649	2030	22 000	
		CO_2 mitigation (tCO_2/annum)	BKK	2017	0	2030	32 877	
Adaptation measures								
Aá1	***Climate model and related detailed vulnerability examination***							300
Aá-1 Development of the green – blue infrastructure								
A1	***Increasing the ratio of green areas and water surfaces***	cumulated green area intensity value for the territory of Budapest, derived from satellite picture by the application of the NDVI vegetation index	BFVT Kft.	2015	0,525	2030	0,57	

A2	***Improving the ratio of green area and forest area***	Per capita green area supply (m^2/person)	BFVT Kft.	2019	6	2030 2050	7 9	15 000
A3	***Blue infrastructure development (revitalization of small watercourses)***	Length of revitalised small watercourse sections (km)		2020	0	2026	10	1500
A4	***Elaboration of a plan for planting trees in public spaces***	number and health condition of trees in public spaces managed by the capital city (to be elaborated based on the Plan for tree planting in public spaces)	FATÁR	2020	107 000	2030	130 000	to be determined based on the plan for planting trees in public spaces (the planning of new trees: ca. HUF 250 million per annum* the maintenance of existing avenues: ca. HUF 400 million per annum*)
A5	***Amendment of legal rules to protect trees***							-
A6	***Establishing and operation of a uniform, up-to-date green space cadastre***							400
A7	***Promotion of the revitalisation of brown-field areas***	Size of brown-field areas delivered for use as community garden or public park	BFVT Kft.	2021	0	2030	it should increase	-
Aá-2 Mitigation of the heat island effect in the built environment								
A8	***Protection of ventilation corridors, ensuring sufficient airspace ratio in streets***	The size of areas to be improved in the ventilation corridor; the areas to be improved according to the Settlement Structure Plan	SETTLEMENT STRUCTURE PLAN	2019		2030	it should decrease	-
A9	***Promotion of the application of climate friendly construction materials and technologies***							-
Aá-3 Development of the flood control system								
A10	***Construction and development of flood control structures***	length of flood protection line reaching the safety level of DFE + 1.3m (km)		2019	33,73	2030	69	32 500
Aá-4 Adaptive rainwater management								
A11	***Surface runoff regulation and the system required for its safety***							10 000
A12	***Supporting the utilization and retention of rainwater***							n.a.
Aá-5 Preparation for extreme weather conditions and the health impacts of climate change								
A13	***Preparation of the transport system for extreme weather phenomena***							-
A14	***Controlling hazards caused by extreme weather phenomena***							-

A15	***Examination of the climate vulnerability of water bases and drinking water supply and their climate-adaptive development and operation***							4 900
A16	***Preparation for extreme weather conditions during the preservation and renovation of buildings***							n.a.
Aá-6 Mitigation of the vulnerability of natural and landscape values								
A17	***Preparation of the detailed climate change risk and vulnerability assessment for natural values***							n.a.
A18	***Continuing the expansion and extension of protected natural sites of local importance***	Size of protected natural sites of local importance (ha)	BFVT Kft.	2019	861	2026	1200	-
A19	***Environmental protection management, confinement of invasive plant and animal species***	The highest coverage ratio of invasive plant species in protected natural sites of local importance (%)	BFVT Kft.	2017	18	2030	reduction	n.a.
Awareness-raising measures								
SZ-1 Climate conscious city management: cooperative city management taking the lead in climate protection								
SZ1	***Climate conscious workplaces, climate conscious colleagues***	Number of persons participating in training	FPH	2020	n.a.	2030	1500	4/annum
SZ2	***Enforcement of horizontal climate protection principles in urban development, sectoral and urban planning, the creation of the relevant legal rules, the issuing of municipal invitations to tender and in investments***							n.a.
SZ3	***Operation of the Budapest Climate Change Program and a dedicated online platform to share best practices and to improve partner relationships***	Number of meetings of the Platform, number of visitors of the online platform	FPH	2020	0	2030	20 sessions, 30,000 visitors	10/annum
SZ4	***Establishing cooperation with the corporate sector (companies, chambers, professional associations) to support the climate objectives of Budapest***	Number of partners	FPH	2020	n.a.	2030	increase	4.5/annum
SZ-2 Climate conscious city dwellers: reinforcement/promotion of the environmental culture and responsibility among the population and economic operators								
SZ5	***Thematic awareness-raising campaigns and informational activities through the Mayor's Office and the business organisations of Budapest, with special regard to reducing the volume of household energy consumption***	Energy saved (MWh/annum)	FPH	2020	0	2030	518 995	100/annum
		CO_2 mitigation (tCO_2/annum)	FPH	2020	0	2030	102 893	
SZ6	***Developing the adaptation knowledge and ability of the population, particularly in respect of heat waves, rainwater management, property protection and green infrastructure***	Number of persons reached actively and passively	FPH	2020	n.a.	2030	100 000	n.a.
SZ7	***Promoting climate protection aspects in the ordering of public services and public procurement processes***							n.a.

Emission Inventory

HOME

Baseline Emission Inventory

1) Inventory year: 2015

2) Population in the inventory year: 1759407

3) Emission factors
- [x] IPCC
- [ ] LCA (Life Cycle Assessment)

4) Emission reporting unit
- [x] tonnes CO_2
- [ ] tonnes CO_2 equivalent

5) Methodological note

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A. Final energy consumption

Please note that for separating decimals dot [.] is used. No thousand separators are allowed.

Sector	FINAL ENERGY CONSUMPTION [MWh]															
			Fossil fuels								Renewable energies					
	Electricity	District heating and cooling	Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal	Total
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES																
Municipal buildings, equipment/facilities	337 437	80 924	208 160	674	367	4 974	973	0	0	5 351	0	0	3 463	53	4 448	646 823
Tertiary (non municipal) buildings, equipment/facilities	2 976 225	185 796	2 209 108													5 371 130
Residential buildings	2 031 408	2 174 617	6 779 937	0	6 000	0	0		81960			0	163920	1 128		11 238 970
Public lighting	87 936	0	830	0	0	757	0	0	0	0	0	0	0	0	0	89 523
Industry – Non-ETS	1 060 934	370 949	2 407 024	41 485												3 880 392
Industry – ETS (not recommended)																0
Subtotal	6 493 940	2 812 286	11 605 059	42 159	6 367	5 731	973	0	81 960	5 351	0	0	167 383	1 181	4 448	21 226 838
TRANSPORT																
Municipal fleet	0	0	5 994	0	0	32 643	2 649	0	0	0	0	43 585	0	0	0	84 871
Public transport	246 450	0	23 187	0	0	312 180	0	0	0	0	0	0	0	0	0	581 817
Private and commercial transport	60	0	0	48 262	0	3 171 174	2 795 014	0	0	0	0	1 288	0	0	0	6 015 798
Subtotal	246 510	0	29 181	48 262	0	3 515 997	2 797 663	0	0	0	0	44 873	0	0	0	6 682 486
OTHER																
Agriculture, Forestry, Fisheries	18 861		372													19 233
TOTAL	6 759 311	2 812 286	11 634 612	90 421	6 367	3 521 728	2 798 636	0	81 960	5 351	0	44 873	167 383	1 181	4 448	27 928 557

Covenant Key Sectors

B. Energy supply

Hide sections or rows as appropriate to your emission inventory.

B1. Certified green electricity

Certified green electricity	Renewable electricity [MWh]	CO2 / CO2 eq. Emission factor [t/MWh]
Vásárolt hitelesített zöldáram	NE	

B2. Local/distributed electricity production (Renewable energy only)

Local renewable electricity plants	Renewable electricity produced [MWh]	Emission factor [t/MWh produced]	CO2 / CO2 eq. emissions [t]
Wind	10,259	0,000	0
Hydroelectric			0
Photovoltaics	3824,413	0,000	0
Geothermal	0		0
TOTAL	3834,672		0

B3. Local/distributed electricity production

Local electricity production plants	Electricity produced [MWh]		Energy carrier input [MWh]										CO2 / CO2 eq. emissions [t]	
			Fossil fuels					Waste	Plant oil	Other biomass	Other renewable	Other		
	from renewable sources	from non-renewable sources	Natural gas	Liquid gas	Heating oil	Lignite	Coal						Fossil sources	Renewable sources
Combined Heat and Power	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Other (ETS and large-scale plants > 20 MW not recomme	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0

B4. Local heat/cold production

Local heat/cold production plants	Heat/cold produced [MWh]		Energy carrier input [MWh]										CO2 / CO2 eq. emissions [t]	
			Fosszilis tüzelőanyagok					Waste	Plant oil	Other biomass	Other renewable	Other		
	from renewable sources	from non-renewable sources	Natural gas	Liquid gas	Heating oil	Lignite	Coal						Fossil sources	Renewable sources
Combined Heat and Power	94058									115662				
District heating (heat-only)	4 448										4 448			
Other														
TOTAL	98506,32022	0	0	0	0	0	0	0	0	115661,969	4448,333333	0	0	0

C. CO2 emissions

C1. Please insert the CO2 emission factors adopted [t/MWh]:

Click here to visualise fuel emission factors

electricity		Heat/cold	Fossil fuels								Renewable energies				
National	Local		Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil	Biofuel	Plant oil	Other biomass	Solar thermal	Geothermal
0,230	0,230	0,183	0,202	0,231	0,267	0,267	0,249	0,364	0,346	0,403	0,000	0,000	0,000	0,000	0,000

C2. Please complete in case non-energy related sectors are included:

Non-energy related sectors	CO2 eq. emissions [t]
Waste management	
Wastewater treatment and discharge	
Other non-energy related such as fugitive emissions	

Emission Inventory Summary

Sector		CO2 emissions [t]														
				Fossil fuels								Renewable energies					
		Electricity	District heating and cooling	Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal	Total
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES																	
Municipal buildings, equipment/facilities		77 610	14 793	42 048	156	98	1 328	242	0	0	2 156	0	0	0	0	0	**138 432**
Tertiary (non municipal) buildings, equipment/facilities		684 532	33 964	446 240	0	0	0	0	0	0	0	0	0	0	0	0	**1 164 735**
Residential buildings		467 224	397 520	1 369 547	0	1 602	0	0	0	28 358	0	0	0	0	0	0	**2 264 251**
Public lighting		20 225	0	168	0	0	202	0	0	0	0	0	0	0	0	0	**20 595**
Industry	non-ETS	244 015	67 809	486 219	9 583	0	0	0	0	0	0	0	0	0	0	0	**807 626**
	ETS (not recommended)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Subtotal		1 493 606	514 086	2 344 222	9 739	1 700	1 530	242	0	28 358	2 156	0	0	0	0	0	**4 395 640**
TRANSPORT																	
Municipal fleet		0	0	1 211	0	0	8 716	660	0	0	0	0	0	0	0	0	**10 586**
Public transport		56 684	0	4 684	0	0	83 352	0	0	0	0	0	0	0	0	0	**144 719**
Private and commercial transport		14	0	0	11 149	0	846 703	695 958	0	0	0	0	0	0	0	0	**1 553 824**
Subtotal		56 697	0	5 895	11 149	0	938 771	696 618	0	0	0	0	0	0	0	0	**1 709 130**
OTHER																	
Agriculture, Forestry, Fisheries		4 338	0	75	0	0	0	0	0	0	0	0	0	0	0	0	**4 413**
Non-energy related sectors																	
Waste management																	**0**
Wastewater treatment and discharge																	**0**
Other non-energy related such as fugitive emissions																	**0**
TOTAL		**1 554 642**	**514 086**	**2 350 192**	**20 887**	**1 700**	**940 301**	**696 860**	**0**	**28 358**	**2 156**	**0**	**0**	**0**	**0**	**0**	**6 109 183**

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