STATE OF THE ENVIRONMENT

IN HUNGARY

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*The flower is the protected greater pasque flower (*Pulsatilla grandis*), a species included in WildWatcher Programme.*

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MINISTRY OF AGRICULTURE

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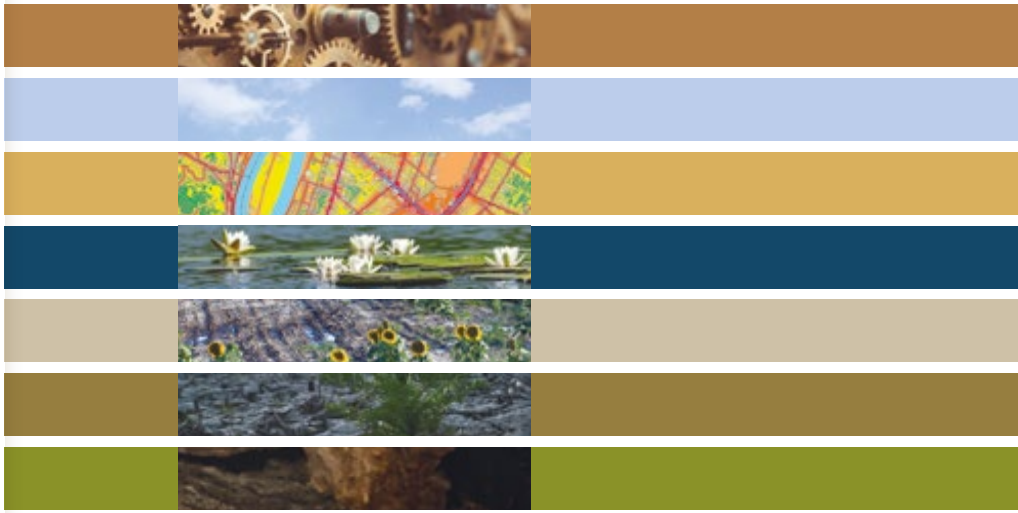


TO THE READER

Dr. István Nagy
Minister of Agriculture

A healthy environment is one of the essential conditions for a good quality of life. The state of the environment is determined to a great extent by the sustainable use of our natural resources, which has a substantial impact on the economic structure. In Hungary the use of raw material has been increasing steadily, which places a huge responsibility upon us. We must use our natural resources more efficiently.
It is a legitimate societal expectation to protect and preserve our natural values and to take responsibility for our historical heritage. These societal demands are the main drivers for symbiosis with industry, based on the mutual benefits of establishing a circular economy. Agricultural production also needs to adopt a Green Growth Strategy, which would require strategic investments in R&D and infrastructure to promote sustainable best practices. The role of agricultural environment management (including the promotion of organic farming and the enhancement of farm competitiveness) is particularly important to the Ministry of Agriculture. Effective environmental education is a crucial element in achieving strategic Green Growth objectives.
Environment consciousness requires a complex mental education, so children should be made aware of environmental issues at the earliest opportunities. The renewed agriculture technical vocational education system (integrated into regional management centres from September 2020), the support institutions of the Ministry of Agriculture and the Hungarian National Parks (through their environment education activities) are heavily involved in creating environmental awareness among children.

Hungary has a natural heritage which is unique in Europe. During the period of 2014-2020, 40.000 hectares of wetland were restored by state nature conservation specialists at a cost of more than 20 billion HUF. The third national river basin management plan and assessment of the ecological status of domestic waters are being prepared. This work includes summarising the pressures and impacts and making proposals to address them.
In the field of soil conservation, the issues of negative impacts on land and soil, halting urban sprawl, removing agricultural land from cultivation, reusing contaminated industrial sites, and effects of climate change must be addressed urgently. There is a huge progress in the management of contaminated sites in Europe, but in Hungary there are still many sites waiting for remedial work.
Earth's atmosphere is an invisible, but essential element of our environment. To emphasise the global importance of clean air, the United Nations designates 7 September as the "International Day of Clean Air for blue skies". Given that emissions are linked to air quality and climate change, combined policies for better tackling of climate change and air pollution is necessary to become climate-neutral by 2050.
Significant efforts and measures must be taken to achieve our common goals, and international cooperation on climate change is crucial to preserving the natural values of the Earth for the future generations!

FOREWORDS FROM THE DIRECTOR

Preparing and publishing the national report titled 'The state of the Hungarian environment' has been an important project for the Herman Otto Institute Nonprofit Ltd. In this report, we present the current status of the environment and underline the changes that have occurred in the environment to help explain many of the environmental trends that have been observed. Well-founded data sets and new, scientific results were used for monitoring and evaluating. We highlight the indispensable role of circular economy in fighting climate change and preserving our natural capital. Since EU environmental policy targets and objectives and Hungary's national commitments are considered, the report also gives a European comparison.

At EU level, significant achievements have been made in environmental protection and nature conservation last year. One of them is the European Green Deal, which strengthen the EU's commitment to tackling climate change and transitioning to a circular economy. In Hungary, various strategies and measures on climate protection, air quality and waste management have recently been implemented as well. The Hungarian National Air Pollution Control Programme as a main governance measure to improve air quality was introduced in 2020, and Herman Otto Institute Nonprofit Ltd. had main role of creating the program.

In the field of solid waste management, a positive trend is that municipal waste has decreased in volume, while recycling rate has increased.

Noise pollution is also a significant environmental issue in the EU. At least 20% of the EU's population lives in areas where noise levels are considered to be harmful to health. Noise pollution data cannot be measured by on-site monitoring, because of the impossibility to check the measurements, therefore noise pollution levels are represented on noise maps, produced by data modelling. The data is generated by mapping the long-term average sound levels of a given area. These data can be used to develop effective long-term environmental noise management. As a result of noise action plans being produced for large cities, the proportion of the population exposed to unhealthy noise levels should decrease significantly in the coming years.

Invasive alien species represent now one of the primary threats to natural habitats. Due to their fast spreading in a new environment, they can displace native and useful species and cause serious biodiversity loss. As invasive alien species do not respect borders, EU Regulation on IAS was adopted in 2015, establishing a coordinated EU-wide framework for action to prevent, minimise and mitigate the adverse impacts of IAS on biodiversity.

In an ever changing environment, we are committed to the Green Growth Strategy. We believe that the exchange of professional knowledge and experience, in a clear and concise manner, is crucial in enabling our action to protect biodiversity.

Péter Bozzay
Executive Director

CIRCULAR ECONOMY

1. CIRCULAR ECONOMY

1.1. THE WAY TO A CIRCULAR ECONOMY: THE CURRENT SITUATION AND PROSPECTS

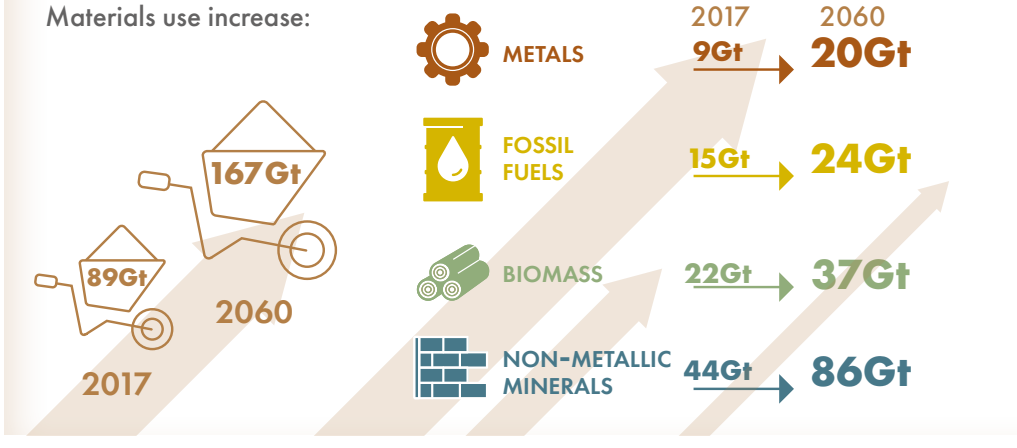
The use of resources – the current situation

According to an EU Commission working document, titled "Leading the way to a global circular economy: state of play and outlook", the world's annual global extraction of materials grew from 27 billion tonnes to 92 billion tonnes between 1970 and 2017, tripling in that time, and the growth in extraction rates have accelerated to 3.2 per cent per annum since 2000. The major drivers of the growth in extraction of materials are higher material living standards and major investments in infrastructure in developing and transitioning countries, especially in Asia.[1]

The global use of resources now exceeds the planet's carrying capacity by more than 1.7 times.

The extraction of resources, the processing of materials and food, or the use of fuels contribute to half of the total global greenhouse gas emissions and over 90 percent of biodiversity loss and water scarcity.
A study by the Ellen MacArthur Foundation & ARUP (2019) estimated that more than one third of global resources extracted every year is directly linked to building materials and constructions. The energy requirement for the production of these materials – within global material manufacturing – is responsible for more than 40 per cent of annual global greenhouse gas emissions. The rate of raw material consumption is forecasted to increase faster than the urban population, and will grow from 40 billion tonnes in 2010 to 90 billion tonnes by 2050.[1]

Figure 1.1.: Material use in the world economy
Source: OECD, 2018



The use of resources – prospects

Based on the estimation of OECD, the global use of materials is projected to double from 2017 to 2060 (Figure 1.1), while the world's population is expected to increase from 7.5 billion in 2017 to 10.2 billion in 2060. Living standards will rise all over the world, the emerging and developing countries are expected to reach the current level of the OECD members.
The unbroken growth of consumption in the world points out that the income level of 1.8 billion people will reach the level of the middle class between 2010 and 2025. It is a 75 per cent increase compared to the 2006-2015 period.[1]
Based on the latest risk assessment by the World Economic Forum, according to the interviewed economic and political decision makers and researchers the most important long-term risks are related to the environment, both in terms of probability of occurrence and highest risk potential.[2]

The linear economy: the past and the present

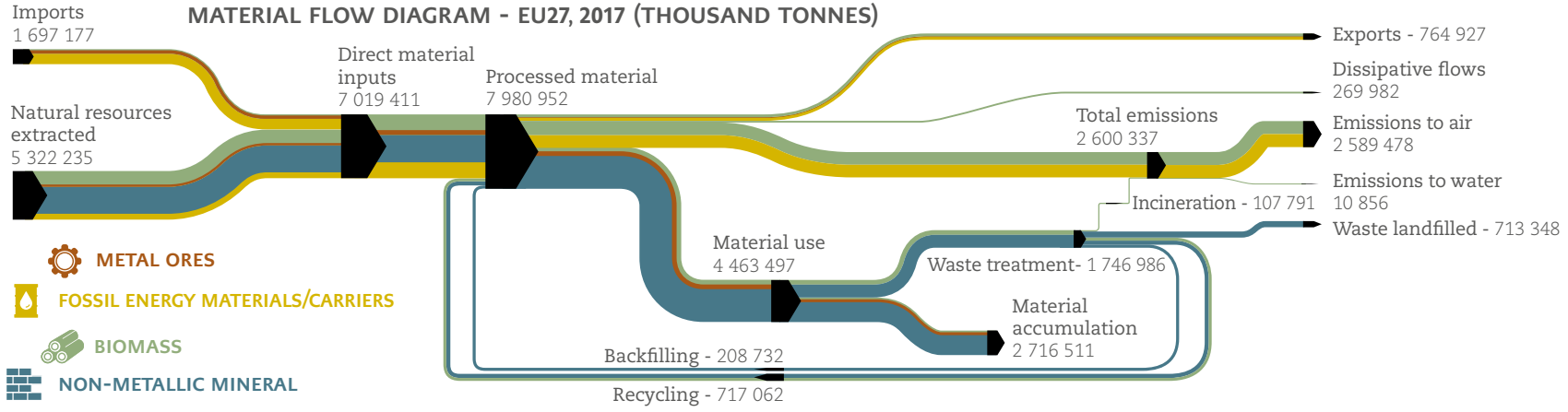
Current economies are still predominantly based on a linear model characterized by converting natural resources into waste via production. In this traditional model resources are extracted, traded, used for manufacturing goods, and then discarded as waste or emission. (Figure 1.2.)

Based on 2017 data, the Stankey diagram in which the width of the bands is proportional to the flow quantity, shows the flow of materials from left to right as they pass through the EU economy, entering as natural resources extracted from the environment or being imported, then they are transformed into products and assets or used as a source of energy, and accumulate in societal stocks, finally they are discarded as waste. Width of the closed loop illustrates the 0.7 billion tonnes of material – 9 per cent share of the total 7.98 billion tonnes of input material – eventually returning to the economy. From the 1.7 billion tonnes of total waste treatment, only 0.7 billion tonnes (41per cent) is recycled, which is 16 per cent of the total EU material use, and almost equal to the amount of material sent to the landfill. Further characteristics of the linear system is the high rate of material used for energy production, which is reflected in the high rate of fossil fuels consumption, also shown clearly in the diagram above.

After purchasing – in the case of the EU mainly acquiring from import – **fossil fuels are almost entirely used as a source of energy and eventually discharged into the environment.** Only a few percent of the total input is returned into the industry for example for the purpose of plastics production or used in road construction, where the recycling can be solved at all. The high level of coal usage in the energy system reflects that the development of a circular economy is essential to combat climate change. Another characteristic of the system is the high level of non-metallic materials – mineral resources – usage which is demonstrated by their high accumulation rate in the societal stocks, also illustrated well in the diagram above. As long as globally the material use rate and material accumulation related to construction will remain at the current level, the linear economy can no longer work as a system.[4]

With the operation of the current linear structure regarding the overuse of resources and the finite nature of material stock, it is no longer possible to cater to so many people at a satisfactory level on the current extensive use of materials. The increase in the raw material price and the difficulties in purchasing scarce material resources will overshadow the vision of the multinational companies operating along global supply chains.

Figure 1.2.: Material flow diagram for EU with 2017 data
Source: Eurostat, 2020 [3]



1.2. CIRCULAR ECONOMY, THE FUTURE

The European Union as the world's largest single market, has already begun the transition to a more carbon-neutral circular economy with a more moderate use of resources and has begun the decoupling of finite natural source use and environmental impacts from economic growth. **Circular economy** *is an economic system aimed at preserving and maintaining the value of the products, materials, resources for as long as possible, minimising waste generation, including through the application of waste hierarchy.* [5] This economy is carbon-neutral, instead of discharging the used products (discarding as waste) favours activities that preserve value in the form of energy, labour, and materials, and focuses on conserving the embodied energy and other valuable resources used to manufacture to keep products, materials and components circulating in the economy for as long as possible. This means to design products and materials for durability, ensure the same service with less material use. It has been carried out through establishing and operating value-maintaining, value-restoring, recycling and reusing systems: it shall facilitate repairing, resale, product upgrading, modularity, remanufacturing, reusing of components, and recycling of used products. All economic actors, from the designer through the manufacturer to the final consumer are involved in the process. With using these tools, the aim is to keep materials and products in use in the economy by prolonging their lifespan for as long as possible. The major goal of the system is to transform our world into a more moderate use of material and resources.

> „This economy [...] focuses on conserving the embodied energy and other valuable resources used to manufacture to keep products, materials and components circulating in the economy for as long as possible. ”

Figure 1.3.: Circular economy
Source: SOER 2020 [20]

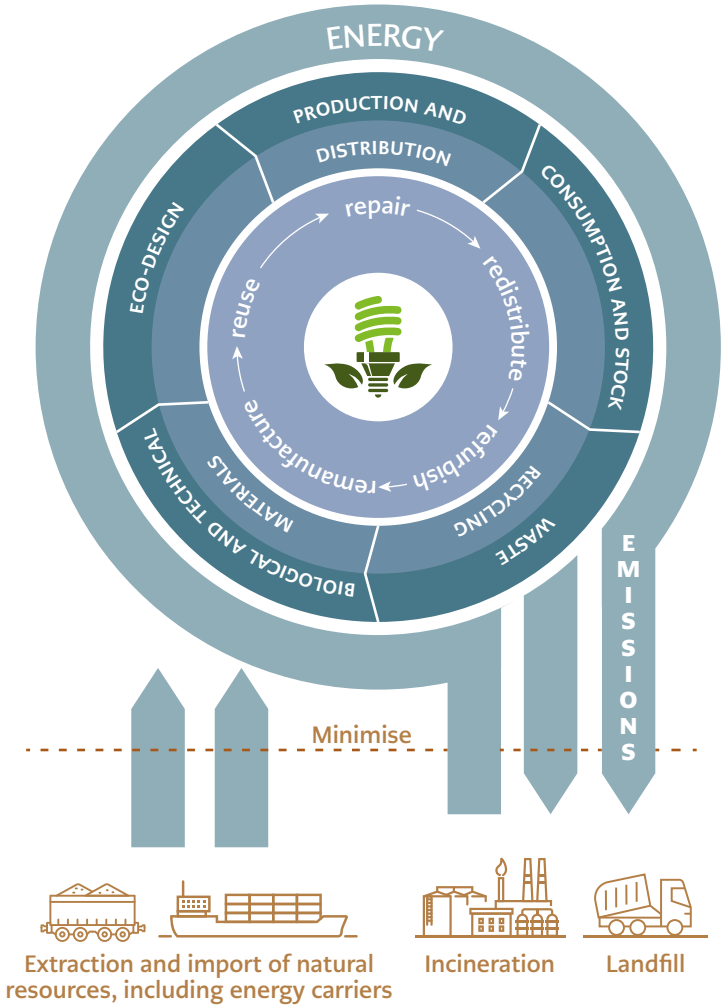


Figure 1.4.: The RESOLVE framework structure
Source: Horváth B. SZIE, 2019 [6]

ACTIVITY	DESCRIPTION
Regenerate	Shift to renewable energy and resources
	Reclaim, retain, and restore health of the ecosystem
	Return recovered biological resources to the biosphere
Share	Improve utility of by sharing use, access, or ownership
	Prolong lifespan trough reuse, maintenance (e.g. repairing, renovating) or designing for durability
Optimize	Optimize resources use by increasing performance of the product or outsourcing certain activities
	Remove waste in production and supply chain
Loop	Close the loop by remanufacturing of products or components, re-use, recycling or recovery of materials
Virtualize	Dematerialize products or services by using digital tools
Exchange	Apply new technologies, materials or processes

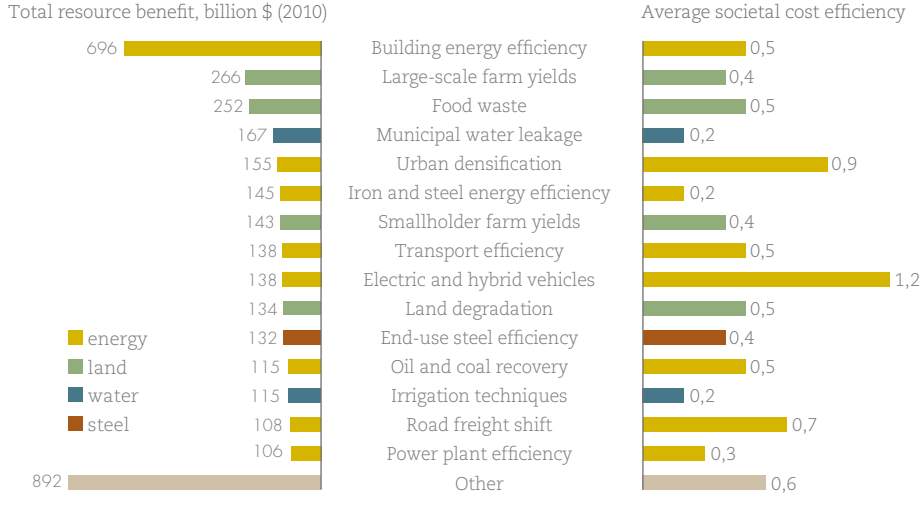
The application of the circular economy's principles in business practice is presented by the "ReSOLVE" framework (Figure 1.4) (Letters of the acronym are given by the initials of the names of the activities supported by circular economy). The indispensable role of the framework is that it can be used directly for setting economic and business policy targets contributing to convergence towards circular direction and for evaluating and establishing circular business models.[6]

Based on Figure 1.2, material flow data for the EU economy shows that the speed of transformation is still too slow, the current system is still very "linear", it depends and relies crucially on the amount of the primary resources that are extracted, traded, transformed into goods and energy, and ultimately leave the economy as waste or emission. The world's economy is only 9% circular, which offers great unexploited potential.[7]

1.3. TRENDS, CHALLENGES AND OPPORTUNITIES IN THE EU AND HUNGARY

Figure 1.5 shows the 15 target areas of the economy, where the greatest progress, about 75% resource savings can be achieved until 2030 with managing resources in an economically beneficial way. As the largest energy consumer in the EU, construction infrastructure sector consumes half of all the resources extracted from nature, and one-third of all waste is generated here. Building stock has represented 50% of total final energy consumption of the EU, while the current annual rate of modernization of the building stock in the Member States is between 0.4% and 1.2%.[8] The construction sector is followed by large-scale farming and the related food sector. Chemically intensive agriculture and planting of monocultures put enormous pressure on the environment, while in the EU, an estimated 20% of total food produced is wasted and more than half of the adult population is overweight.[9]

Figure 1.5.: The top 15 categories of resource efficiency potential
Source: European Commission Work Paper, 2020[1]



The European Green Deal

Along with the European Green Direction announced by the new President of the European Commission, on 11 December 2019 the EU launched the „European Green Deal"[7] to respond to the above mentioned environmental-related challenges. One of the aims of this comprehensive economic strategy is to move to a climate-neutral and circular economy within one generation (within 25 years) by decoupling economic growth from resource consumption, and ensuring that all EU policies contribute to the climate neutrality objective. Further information on the European Green Deal can be found in Chapter 5.

Certain measures will be adopted on the path set by the European Green Deal:

On 14 January 2020 the European Commission presented the European Green Deal Investment Plan, which will mobilize € 1 trillion provided by the European Union budget and public and private investments to increase funding for transition over the next decade. This is complemented by the "Just Transition Mechanism" financial instrument, which provides targeted support to help mobilize at least EUR 100 billion over 2021-2027 period, in the most affected regions in order to relieve the social-economic impact of the transition.

The proposed modification of the European Climate Act to provide necessary measures to achieve the objective of climate neutrality, was published on 4 March 2020.

On 10 March 2020, the European Commission adopted a new EU Industrial Strategy with three drivers: digital transition, competitiveness at global stage, green transition (achieving climate neutrality by 2050) by transition to circular economy.
On 11 March 2020, the European Commission adopted a new Circular Economy Action Plan[7] for sustainable growth based upon efficient resource use and transition to circular economy, the roadmap with certain target values will be structured around the following main chapters: sustainable product policy framework, key product value chains, waste prevention, more value, more crosscutting actions, monitoring progress.
On 20 May 2020 "Farm to Fork Strategy" was presented to create a sustainable food system and a new biodiversity strategy was adopted with measures to address the main drivers of biodiversity loss. These new labelling rules signifiacntly affect the agrifood sector because of their high resource consumption level.

Hungary and the European Green Deal Strategy

Governmental and government - related organizations

In Hungary, the coordination of industry, climate protection and waste management are the responsibility of the Ministry of Innovation and Technology. In the course of its activities, the Ministry has so far compiled several packages of measures related to climate protection and waste management, containing important government plans in terms of waste management and circular economy. These documents inter alia the Hungarian Energy and Climate Plan (NEKT in Hungarian); Climate Protection Action Plan (I. ÉCsT); Hungarian Clean Development Strategy (NTFS)[10] (for the time being in draft form); the 2020 Climate and Nature Action Plan (2020 KTA)[11], which can be found in Chapter 5 for more information.

1st Climate Protection Action Plan (by the end of 2020)

Upon the review and amendment of the national waste management, enforcement of mitigation aspects is required for the transposition of the EU circular economy package entered into force on 14 June 2018.
This means:

- Transposition of the new EU Waste Framework Directive[12] (hereinafter: WFD) into national law (the relevant deadline is 5 July 2020).
- Preparation of the Hungarian Waste Management Plan (OHT in Hungarian) for the period 2021-2027 related to the entire field of waste management. The adoption of the Plan is also important because it is one of the conditions for the disbursement of EU budget resources. To meet these conditions, it is necessary to overview the OHT currently in force until the end of 2020, and submit the new one to the government.

Hungarian Clean Development Strategy

In describing the external legal framework, the document mentions the WFD and Directive 2019/904/EU of the European Parliament and of the Council, as well as the creation of a national circular economy: *An important national economical and the environmental target is to move toward a 'circular economy'*. To facilitate the transition, European Circular Economy Stakeholder Platform was launched in 2018 with the signature of 65 member organizations. The professional work is organized by the Coordination Group. The research and innovation actions needed to change the national economy transformation are carried out by Bay Zoltán Nonprofit for Applied Research Ltd.
During the assessment of the national situation, those key statements of the Second Climate Change Strategy of Hungary (NÉS2 in Hungarian) will be used, which brings together under one roof the battle against climate change and the creation of a circular economy.

„Basically, therefore, a significant emission reduction can be achieved by decreasing the use of primary raw materials with the implementation of circular economy, by using carbon free raw materials, and changing consumption patterns. With these changes not only emissions produced during the process (process emissions) can be reduced, but the emissions linking to energy consumption as well."

In relation to the SUP Directive, the tasks are the following: 77% separate collection target for plastic bottles by 2025 (90% by 2029), with the ultimate goal of creating a more effective recycling system. According to the regulation PET bottles should contain at least 25% of recycled plastics in their manufacture by 2025, and 30% by 2030. To achieve these targets, deposit-refund systems and extended producer responsibility are necessary to develop.

The European Commission adopted a new Circular Economy Package on 2 December 2015, in terms of waste management highlights the following: *The basis of future waste management is to put sustainability and cooperation of other industrial actors at the forefront by developing a more material and energy efficient economy system.*

By the industrial transformation, the new WFD also appears as the basic document leading the way to a circular economy, but measures formulated in the WFD have derived from the Second Climate Change Strategy of Hungary which was adopted in 2018.

It is included in the plans for agriculture:

- Maintaining a gross nutrient balance by reducing nutrient depletion in soil and replenishing organic matter levels of soils;
- using plant by-products on a circular basis in forest management and in biomass-based agriculture;
- producing renewable energies by using agricultural by-products.

2020 Climate and Nature Protection Action Plan

Which includes among others the following:

- In 2020, a new waste management authority is planned to be set up to oversee waste management operations, to combat illegal waste disposal, deter and punish illegal dumping, and force property owners to remove waste in cooperation with local governments;
- From 2021, banning distribution of single-use plastic products, in particular plastic cups, cutlery, plates, straws and carrier bags. In this regard the Law XCI of 2020 was published on 15 July 2020 and will enter into force on 1 July 2021, which already contains specific initiatives:
  - With the amendment of the Law LIII of 1995 on environment protection, the government has been empowered to introduce bans centrally by regulations on manufacturing, trading, consuming of single-use products and products that can be replaced with eco-friendly items;
  - The environmental product fee has been incorporated into the law: related to plastic packaging, the definitions of biodegradable, lightweight and very lightweight plastic carrier bags have been defined;
  - in addition, the previous exemption for biodegradable plastic bags from the payment of the environmental product fee for has been removed, a mandatory environmental fee of HUF 500/kg is set, and for other carrier bags a fee of HUF 1,900/kg was established;
  - the plastic carrier bag has been taken out from the small quantities group with a ceiling value at 300 kg/year and put into the group with a ceiling value at 75 kg/year.
- introduction of a return system for glass and plastic bottles and for metal cans;
- cleaning our rivers (especially the Tisza and Danube) of plastic waste;
- by 2025, replacement of lignite-fired technology by waste-to-energy and natural gas-fired technology in the Mátra Power Plant.

The Hungarian Council for Sustainable Development (Nemzeti Fenntartható Fejlődési Tanács in Hungarian, hereinafter: NFFT in Hungarian) is an advisory body to the Hungarian Parliament, an independent national institution. The institution is involved in setting principles, objectives and comprehensive tasks to move our country into a sustainable economy.
The Hungarian Framework Strategy for Sustainable Development (NFFS in Hungarian) compiled by the NFFT and adopted by the Parliament in 2013, is defined every 2 years, and in its last revision (third progress report)[13] sustainable practices in the process and consumption phase of products and services are poorly adopted (below-average), but showing an improving tendency:

> "Resource efficiency shows a downward trend compared to the previous monitoring report. The use of material has increased (DCM), it means that increased material usage has gone along with economic development. The development of waste management, especially a developing trend towards a circular and sharing economy, and the strengthening of the tertiary (service) and quaternary sectors (K+F+I) could give a new impetus to improve resource efficiency. An upward trend has been observed in the society, sustainability is becoming increasingly important in Hungary since the previous monitoring report – and both the government ant civil society has been paying greater attention in recent years."

Subsequently, "Action Plan for the Protection of our Natural Heritage and the Sustainable Use of Natural Resources" as a proposal was presented by the NFFT in May 2019 [14]. According to the NFFT, a rapid, systematic change at system level is needed in the national economy policy to move into an environmental sustainability direction. The new policy shall focus on bringing together three major sectors:

- **Land-use reform:** by improving biological activity in soils, turning brownfields into greenfields, improving soil water holding capacity (water retention by rehabilitation of wetlands), and reducing agriculture's impact on the environment.
- **Achieving the appropriate social use of materials in the circular economy:** by reducing per capita material use, particularly in construction, transport, and agriculture sectors.
- **Building a low-carbon economy:** by reducing greenhouse gas emissions, improving energy efficiency, preparing for and adapting to climate change.

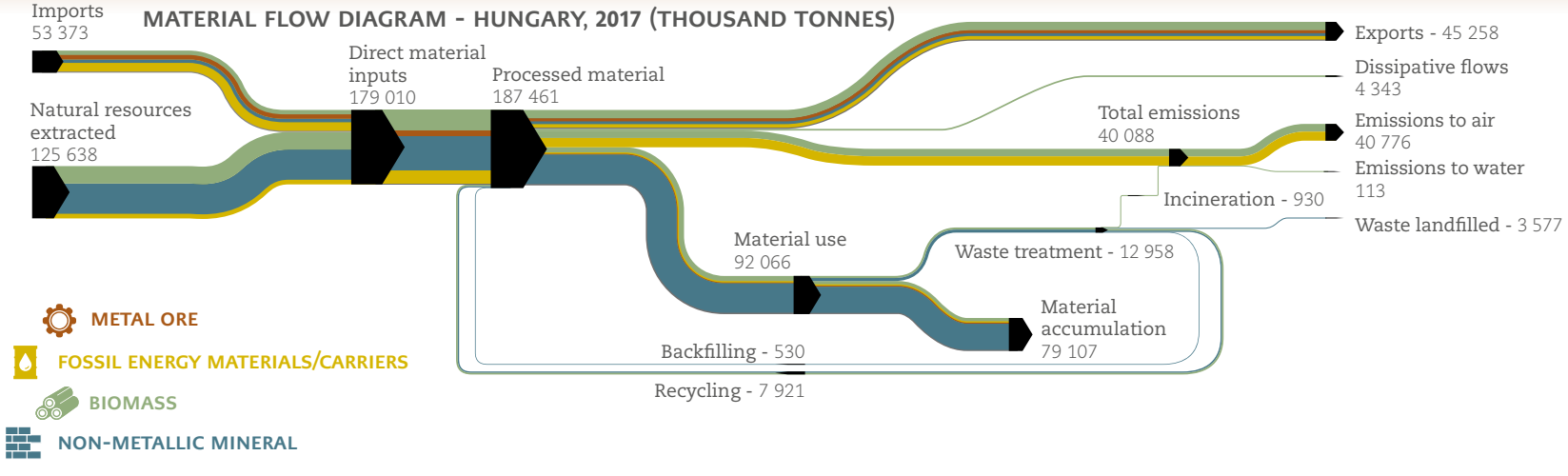
Transforming the linear economy is not possible without the financial sector: as other central banks in the EU, the Hungarian Central Bank has decided to support sustainability by financial intermediation. The "Green Program"[2] of the National Central Bank launched in February 2019, has concentrated on economic, financial and social issues.

1.4. The role of waste management in the circular economy

The economic development concept of the circular economy extends far beyond issues related to waste management: it combines the sustainability elements of the economy, society and environment. At the same time, waste management plays an important role in achieving the defined objectives during the transition to a circular economy (monitoring progress, improving resource efficiency, putting the economy and society on a circular path in accordance with the waste management hierarchy). On the other hand the fact that the waste prevention gets top priority in the waste hierarchy and the goal of transforming back all waste into natural resources has already predicted that the ultimate aim of the circular economy with the transition to a sustainable material management is to eliminate waste and waste management. The national circular economy strategy of the Member States is controlled by the EU through setting binding emission targets and developing and publishing binding monitoring and evaluation methodologies and indicators[15]. These new complex Eurostat material flow diagrams and indicators for measuring the progress of the transition towards a circular economy have already differed from the previous model which exclusively focused on GDP as it would be the single measure of social development. These new diagrams and indicators give information not just about the input and output side of the material flows, but about the entire material flow, strategies for closing material loops, and the efficiency of material use[6]:

- Sankey diagram
- Domestic material consumption per capita (hereinafter: DMC)
- Resource productivity
- Waste/domestic raw material consumption
- Waste/gross domestic product
- Recycling rate
- Circular material use (share of material recovered and fed back into the economy/ overall material use; hereinafter: CMU)[16]

Figure 1.6.: Material flows in Hungary with 2017 data
Source: Eurostat, 2020[17]



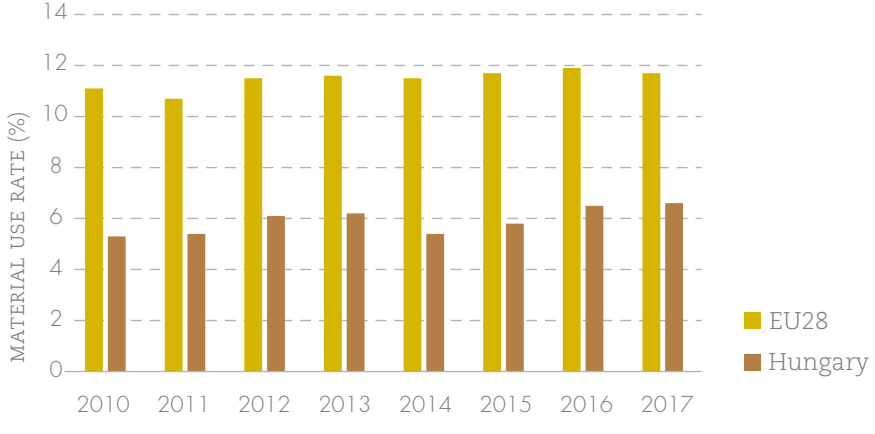
The Stankey diagram of Hungary's material flow (Figure 1.6) also shows the same linear characteristics which were identified above by the material flows in the EU: large-scale use of fossil fuels in the energy system, and increasing level of non-metallic materials accumulated in built infrastructure as societal stock. 0.007 billion tonnes of material recovered and fed back into the economy in Hungary, which is 4% of the 0.18 billion tons of total amount of material input (this value in the EU: 9%). From the total 0.012 billion tons of waste treated, 0.007 billion tons, 61% (EU 41%) is recycled, which is 9% (EU 16%) of the 0,092 billion tons of total amount of domestic material use. From the total waste treated, 0.003 billion tons, 28% (EU 41%) ends up in landfills.

Significantly, about one third less material is fed back into the economy than in the EU. The 9% efficiency of material use is lagging behind the 16% of the EU, in Hungary 26% of the total material use ends up as waste or emissions. On the other hand, the rate of waste treated is much better here than the EU average, while 28% of total material use ends up in landfills (EU 41%), and 61% (EU 44%) is recovered.
After the presentation of Stankey diagram, material use indicators CMU, DMC and resource efficiency are described below:

Circular material use (share of material recovered and fed back into the economy (circular use of materials) / overall material use - %, CMU). Higher amount of materials re-fed into the economy means that more secondary material is used to create products than primary raw materials. In this context, it assumes that the environmental pressures associated with the extraction of primary raw materials in the country has been decreased, and it indicates the development of waste management, how efficient is the waste collection and waste recovery for producing secondary raw materials. Waste imports (collected in other countries) are excluded from the indicator.

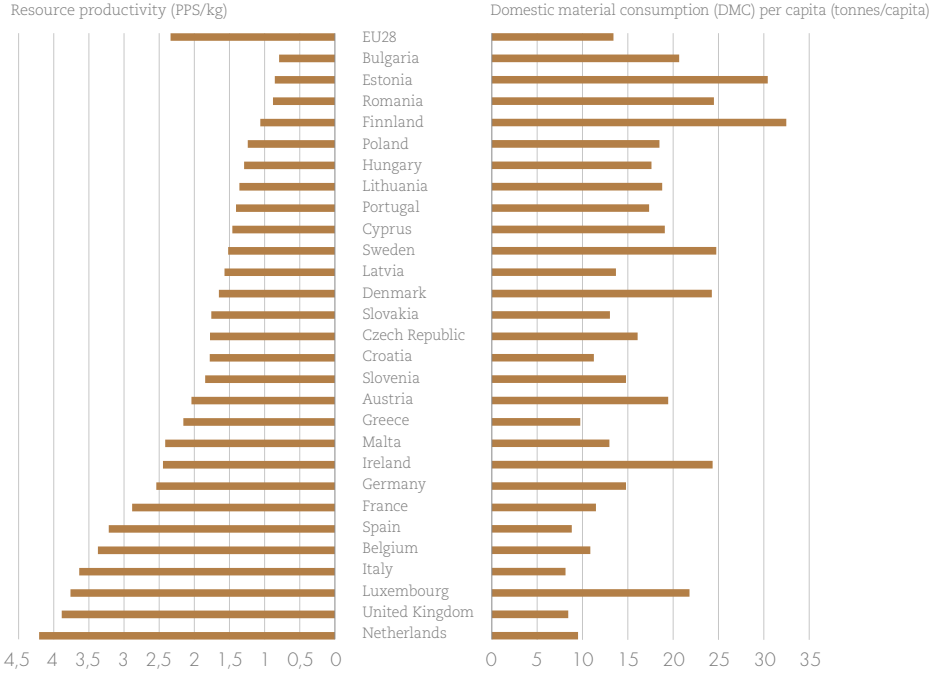
As outlined in Figure 1.7, in Hungary the CMU indicator remains below the EU average (at the same extent as already identified by the re-fed material flows), but in recent years the increase in value has indicated a catching-up path. With the intensive waste re-fed less primary raw materials shall be used, more jobs and businesses can be created which helps to improve the productivity of the economy. However, upon the use of materials the indicator does not take into account the total quantity of available resources. In other words, a developed economy with excessive use of natural resources combined with an effective waste management can provide a good value, therefore we can wrongly declare the functioning of its economy adequate, but looking at its ecological footprint, it is much larger than those of a less-developed economies using fewer primary resources but with lower CMP value.[6]

Figure 1.7: The EU and Hungary circular material use rate between 2010 and 2017
Source: Eurostat, 2020



In Figure 1.8, **the domestic material consumption per capita** (hereinafter: **DMC**) and **resource productivity** are presented. DMC is defined as the annual quantity of raw materials extracted from the domestic territory of the local economy, plus all physical imports minus all physical exports (tonnes/capita). The growth in the rate indicates an increase in the use of input materials, and this material intensity is one indication of the pressures placed on the environment to support economic growth. Opposite tendencies can be read from the figure: the indicator decreased slightly in the EU, while in Hungary it increased more strongly.

Figure 1.8.: Domestic material consumption per capita and resource productivity in the 28 Member States of the EU in 2019
Source: Eurostat, 2020 [18]



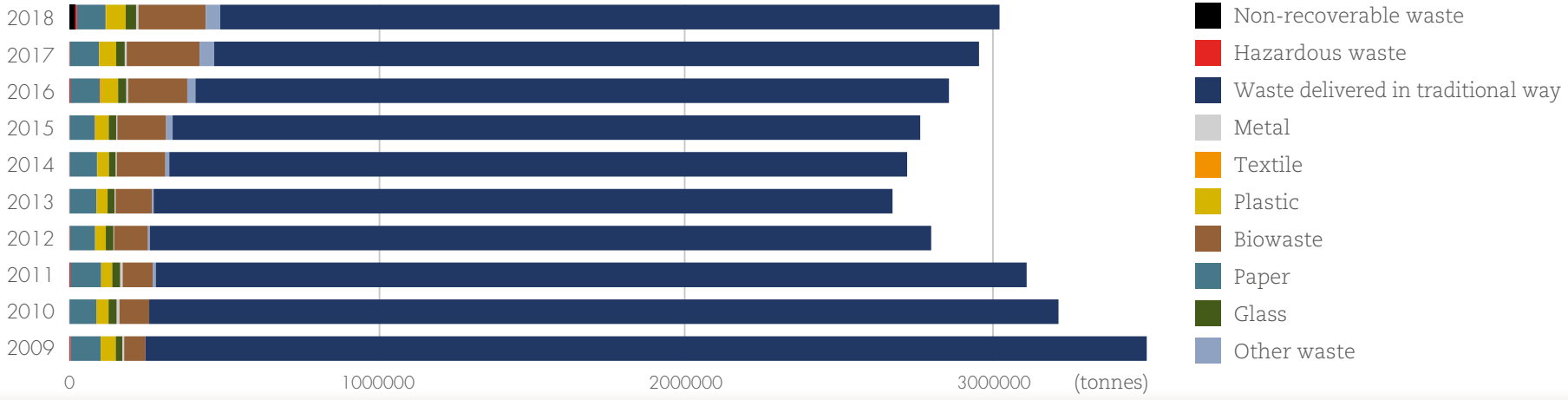
If we divide the GDP (in Purchasing Power Standards (PPS)) by the DMC (GDP (PPS)/DMC) we get the resource productivity index (in PPS/kg),, which measures the efficiency of the economy in terms of overall natural resource use to create wealth and consumption. The trends are also different here: the indicator increased at the EU level, but in Hungary there is a decrease. Another relevant factor is the fact that due to the level of economic development the purchasing power is limited in Hungary, at the same time improving the value of the indicator and ensuring economic development with less use of resources is even a real challenge for the most advanced Member States as well.
Due to the complexities of treatment of municipal waste and the special relationship of waste management to the population, it has a decisive influence on the whole economy of the EU and its waste management, furthermore on the societal progress towards a circular economy.

Figure 1.9 presents the changes in the amount of municipal waste between 2017 and 2018. The chart also shows a **positive trend, the total generation of municipal waste has decreased in the examined period. It is also good that the material recycled waste has increased.** However a negative development that the disposal of waste to landfills wasn't reduced at domestic level, the amount of municipal waste ended up in landfills increased in 2018.

Figure 1.9.: Data refer to the amount of domestic municipal waste generated in 2017 and 2018
Source: Hungarian Central Statistical Office 2020 (Központi Statisztikai Hivatal in Hungarian, hereinafter: KSH)

Municipal waste	2017 (thousand tonnes)	2018 (thousand tonnes)
Generated in total	3 752	3 746 ▼
Material recycling	1 319	1 394 ▲
Waste-to-energy	608	501 ▼
Disposal to landfills	1 825	1 851 ▲

Figure 1.10.: Municipal waste collected within the framework of the domestic public service (tonnes)
Source: KSH, 2020



From 2015 municipal waste collection as a public service with separate waste collection using a door-to-door system is mandatory by law in Hungary. Nevertheless, according to Figure 1.10, the amount of waste from separate collection hasn't increased significantly, from 468921.1 tons in 2017 increased to 488893.7 tons in 2018. In both years 16% of the total municipal waste collected within the framework of public service was collected separately. The waste collected unsorted can't be recycled at all, or only with very poor efficiency and particularly costly. On the basis of the growth rate in the collection of certain types of waste, the growth rate of hazardous waste is the highest: it increased from 2235.8 tons in 2017 to 6169.3 tons in 2018, about 2.7% more than the previous year. The growth rate of the other types of waste hasn't changed significantly over the last two years, generating only a 1.2% difference.

The Commission's proposed measures for sectoral development are highlighted in the following paragraphs.
The development of Hungary's municipal waste management is not fast enough compared at EU level: although the amount of waste generated per capita has a favourable decreasing trend, the amount of municipal waste sent to landfills shows an increasing trend. The amount of waste collected selectively is stagnant, the amount of waste recycled is not rising sufficiently. In the Commission's view the development of the separate collection system could be accelerated by focusing on household interests and involving additional economic instruments.

Therefore the Commission proposes the followings as development actions for efficiency improvements in the short terms:

- In order to improve separate waste collection, it should be mandatory as a mandatory requirements defined by the national waste management service plan for municipal waste collection providers to implement a separate waste collection using a door-to-door system at least every two weeks in all urban and suburban areas, for all street-level properties.
- To improve the efficiency of municipal waste recovery, the current frequency of residual waste should be reduced, and should link to the reduction of the existing capacity for sorting out the collected residual waste.
- In order to make cost-effective use of funds allocated for information and raising public awareness, the expenditures should be concentrated on already relatively well performing areas with the intention of encouraging them to perform even better.
- Investments in waste management should focus on areas with good waste collection and treatment results.
- The Commission suggests to review funding sources allocated for information and raising public awareness and increase the funding rates both at local and nation level.

In a more long term perspective the Commission proposes [19]:

- Reforming the economic instruments for encouraging waste recycling, in which the tariff of public service should be increased, and combined with a higher level of performance. This would make it possible to move away from the current stalemate and ensure a higher performance of the public waste management service.
- Developing the current knowledge base of the waste collection providers to improve cost efficiency with collecting and sharing good practices.
- Applying performance data that promotes the unification of domestic waste management systems, using up to five to six technical options for the provision of services nationwide.
- Developing a system at national level to provide technical support for local governments in the selection of the most appropriate collection service system, the procurement of services, the management of services, and conducting information campaigns.

AIR QUALITY

2. IMPROVING AND PRESERVATION OF AIR QUALITY

Air pollution is getting increased daily attention in the media. Air quality has shown improvement in the long run, but there are areas where air quality limit values for certain air pollutants, such as small aerosol particles (PM_{10}, particulate matter), nitrogen dioxide and ozone concentrations are still exceeded in Hungary.

In the case of air pollution caused by human activities, the role of industrial emissions has been relegated to the background in recent decades, nowadays residential combustion activities (burning of fossil fuels), transport, and agriculture sector are the main sources of air pollutants. In the EU countries the emissions of the main air pollutants decreased between 2000 and 2017, but the rate of progress is not the same in all countries, regions and sectors. At EU scale, emissions of nitrogen oxides (NO_x) decreased by near 40%, non-methane volatile organic pollutants (NMVOCs) and ammonia (NH_3) by nearly 15%, sulphur dioxide (SO_2) by 15% and small particulate matters ($PM_{2.5}$) by over 30% during that period. Due to air pollution, there is an urgent need the current energy, food processing and mobility systems performing a system-wide transformations.

By achieving the ambitious emission reduction targets, the desired levels of air quality in line with the WHO recommendations can be reached by 2030. As a result, more than 400.000 annual premature deaths related to air pollution is expected to reduce more than half in the Member States by 2030.[20]

For more details, visit www.levegominoseg.hu

2.1. AIR QUALITY TRENDS

In Hungary, the Hungarian Air Quality Network (Országos Légszennyezettségi Mérőhálózat, OLM in Hungarian) carries out measure of wide range of air pollutants in ambient air. Continuous monitoring is used in more than 30 settlements at more than 50 automatic monitoring stations and 3 background stations, and in the manual air quality network there are sampling sites in nearly 100 settlements. From the measurement data the concentrations of two pollutants can be highlighted as the major challenge for health and regulatory policy.

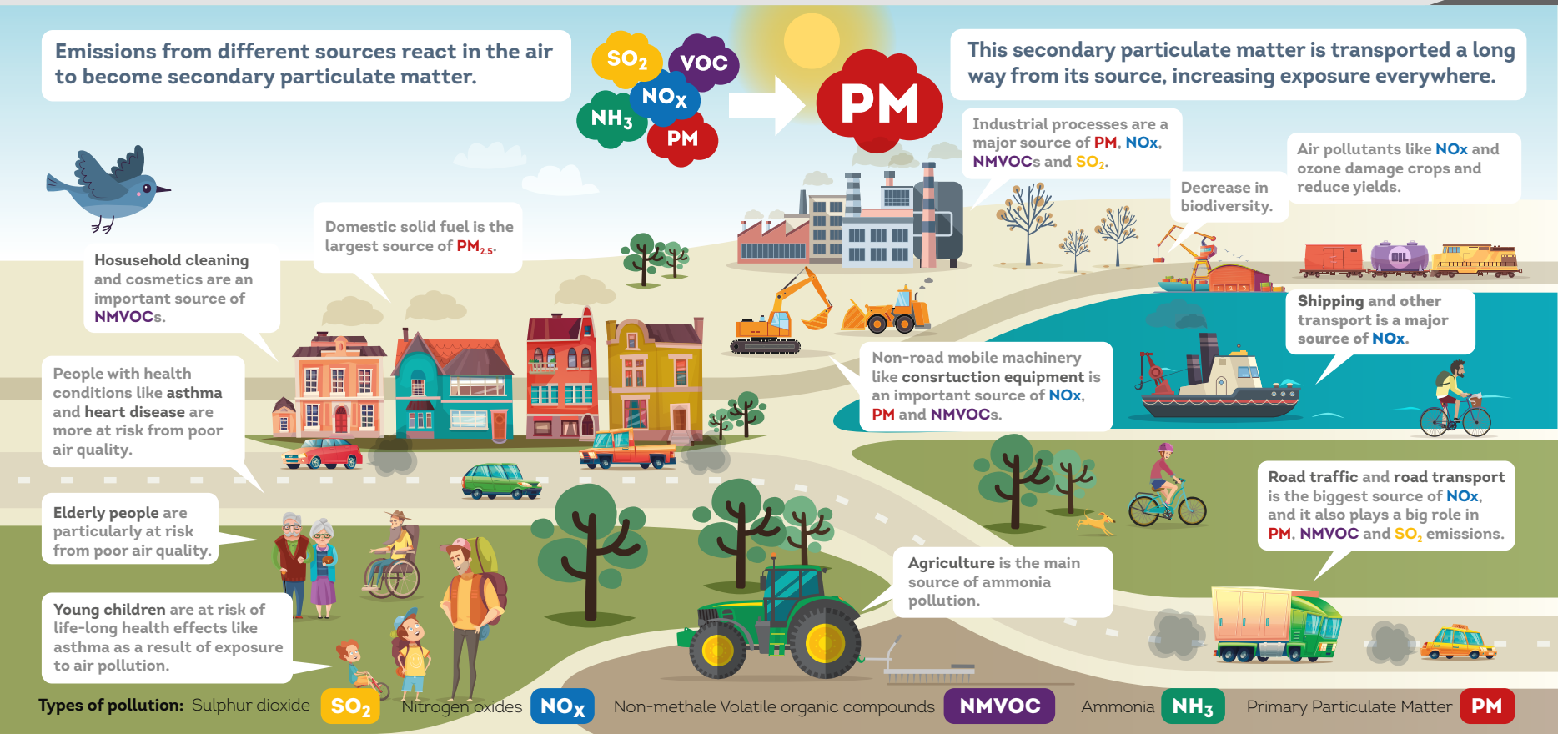
In the longer term, the concentrations of nitrogen dioxide in ambient air have exceeded the annual air quality limit value at two points of the country measured at "Széna tér" station in Budapest and "Szabadság út" station in Pécs in the longer term, but there seems to be a slight tendency towards decreasing concentration at a national scale. However the presence of small particles (PM_{10}) poses problems in a larger area of the country, and although all measurement stations meet with the annual average emission ceilings, one third of the stations is still exceeding the daily emission limit values more than allowed. In order to improve air quality, it is essential to reduce air pollutant emissions, identify the location of the emission sources and control the emissions. These are detailed below in the next section.

2.2. EUROPEAN UNION COMMITMENTS AND DOMESTIC TARGETS TO REDUCE AIR POLLUTION

Although cleaner air is in all our interests, due to the transboundary nature of the pollution only a coordinated transnational action can produce any appreciable improvement. The European Commission has recognised this, and launched a directive on the reduction of emissions of certain air pollutants[21] (NEC Directive). The Directive sets objectives for emission reduction for five air pollutants for each Member State as percentages of reduction to be reached in 2030 compared to the emission levels into 2005. Further, the Directive requires that the Member States draw up National Air Pollution Control Programmes

and implement air quality plans on a scheduled basis. The emission reduction targets can be achieved based on the implementation of the comprehensive measures set in the program. The Hungarian National Air Pollution Control Programme (Országos Levegőterhelés-csökkentési Program - hereinafter: OLP) has also been drawn up in Hungary, which was adopted by the Government by Regulation 1231/2020. (V.15.).[22] According to the NEC Directive, by 2030 reductions of 73% are required for sulphur dioxide, 55 % for PM, 32% for ammonia, 66% for NO_x and 58% for NVMOC compared to 2005.[23] The OLP has been drawn up with the involvement of authorities, relevant ministries, research institutes, ministry background institutes, professional and non-governmental organizations and general public. Based on environmental impact assessments, the implemented OLP measures are expected to reduce the environmental and health risks of air pollution by more than 50 percent in Hungary.

Figure 2.1.: The sources of air pollutants set out in NEC Directive and their effects
Source: OLP 2020-2030 [24]



Air quality is determined by emissions of six main sectors: transport, industry, energy, agriculture, waste management and residential activity (as a separated sector mainly due to the heating which can lead to high particulate matter emissions). The OLP contains a total of 28 measures for these sectors. Figure 2.1 presents principal air pollutants and their potential emission sources. Air pollutants can accumulate in significant amounts in the nearby areas of the emissions (such as close to busy roads, industrial facilities or intensive agricultural activities) that are harmful for our health and the environment as well. However, their common feature is that they can travel long distances, even across national borders and even continents.

Some components of different air pollutants can appear together, react with each other or with other components of the atmosphere, this is the way how secondary pollutants, such as ozone or aerosol particles are generated. Polluted air has adverse health effects in the short and long term, therefore it is important to reduce personal exposure to air pollution on all areas of our life: in our homes, during traveling, in schools and at workplaces.

Already in childhood, in the kindergartens and at schools, there is an increasing emphasis on learning about the environment and adopting an environmentally friendly, protective lifestyle. On famous days related to environmental protection, and at various events information about our environment and its current status is available for the general public in different way, for children and young people through games, tasks and publications, while for adults through informative leaflets and tests. In addition to the events, various government programs, tenders and civil society initiatives promote the protection of air quality, the prevention of air pollution and the reduction of emissions.

2.3. AIR POLLUTANT EMISSION' TRENDS IN HUNGARY

The development of air pollution emissions in Hungary is illustrated by the data provided between 2008 and 2018.
Transport is the main source of nitrogen dioxides. According to the data of the Hungarian Meteorological Service (Országos Meteorológiai Szolgálat, hereinafter: OMSZ) on the examined 10 years period (Figure 2.2.), the emission have decreased compared to the 2008 level, but the amount of emitted air pollutants has stagnated in recent years. In 2018, nearly 50 percent of emissions came from transport, ~ 20 percent from agriculture, and 13 percent from other sectors. (Figure 2.3.) As the result of the implementation of the measures included in the OLP and other national programs, national NO_x emissions are expected to decrease again.

One of the OLP's measures is to raise awareness for environmentally conscious transport (for example eco-driving), develop alternative fuels infrastructure (for example electric filling stations), to promote the use of low or zero emissions vehicles with the help of tax incentives or subsidies (for instance green bus program) and use traffic management tools for environmental purposes (for example revision of the environmental classification system for motor vehicles). In the HungAIRy project presented at the end of the chapter transport-related measures are implemented at local level in the framework of a mini-project in each participating settlement which are planned to be expanded to the regional level after successful implementation.
PM_{10} emissions have shown a slight declining trend since 2015 (Figure 2.4). In 2018, 55% of PM_{10} emissions was released by the residential sector, 20% by the industrial sector, and 15% by the agricultural sector, and less than 10% by the other sectors (Figure 2.5.) There is no decreasing trend in $PM_{2.5}$ emissions, and its source structure also differs from PM_{10} emissions, 81% of all $PM_{2.5}$ emissions were generated by the residential sector. Responding to these challenges requires a significant amount of effort to meet the emission reduction commitment by 2030.

Figure 2.2.: Emission of nitrogen oxides by sector between 2008 and 2018
Source: OMSZ

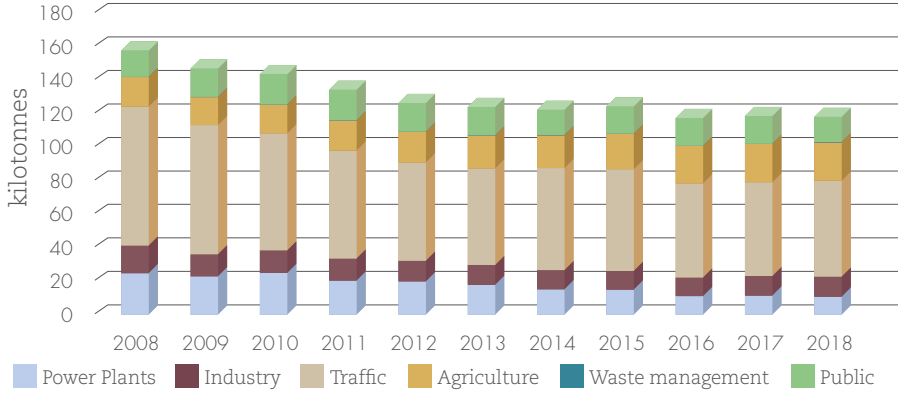


Figure 2.3.: Emission of nitrogen oxides by sector in 2018
Source: OMSZ

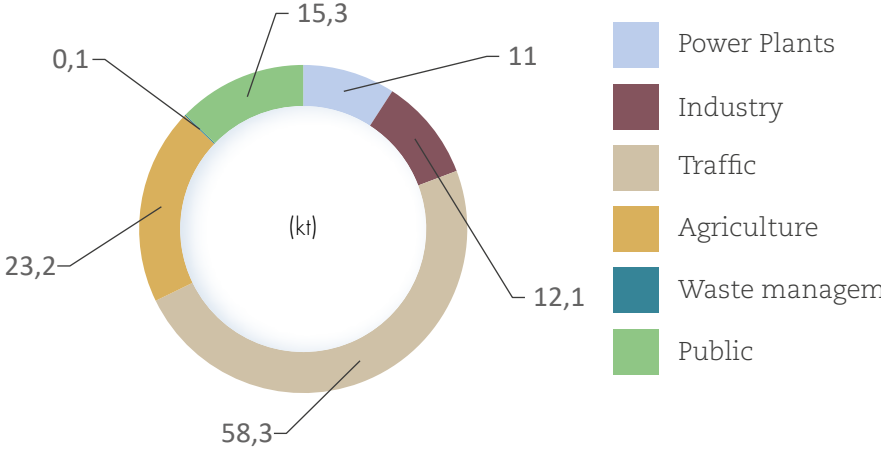


Figure 2.4.: The emissions of particulate matter (PM_{10}) by sector between 2008-2018
Source: OMSZ

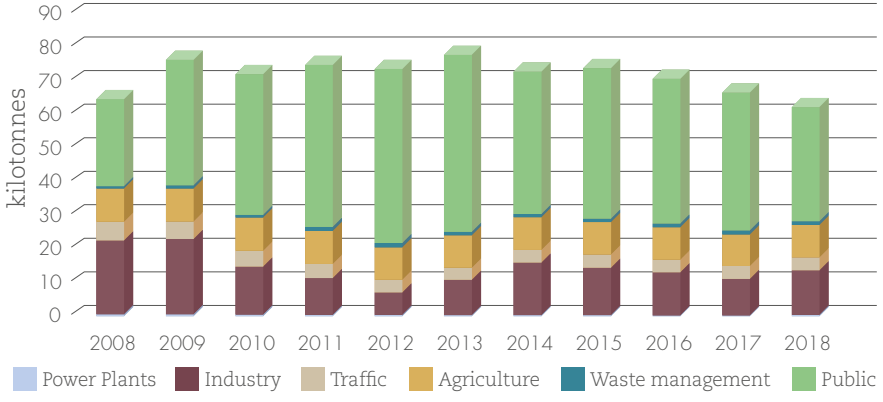
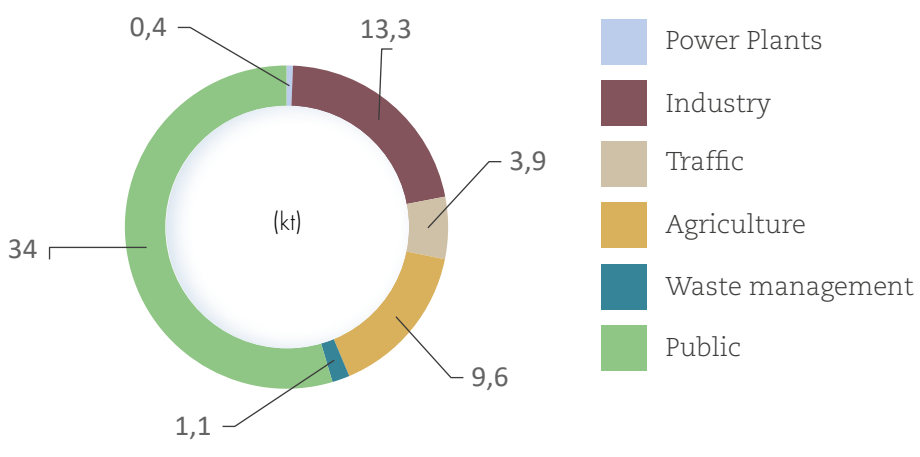


Figure 2.5.: The emissions of particulate matter (PM_{10}) by sector in 2018
Source: OMSZ



In order to reduce the particulate matter emissions, the incineration of yard leaves and other organic garden waste will be prohibited in the entire territory of the country from 2021. The amendment to the Environmental Protection Act adopted in the spring of 2020 abolished the authority of local governments to regulate the incineration of leaves and other garden waste, therefore the ban in the Government Decree on Air Protection has become the general rule.
Ammonia generated by the agricultural sector poses another challenge for air quality protection. Since 2009 an increasing tendency or stagnation has been noticed. Based on 2018 data, the main source of ammonia emissions is the agricultural sector, with more than the 92% of total emission is generated by there, the other sectors is responsible for only 8%. The implementation of agricultural measures of OLP and the agricultural sub-program containing their detailed explanation is intended to ensure that the emission reduction goals outlined in the Directive are reached. Amongst measures, the measures for urea-based fertilizers, promoting the use of organic fertilizers and laying down the conditions for their application to land, covering storage for slurry, and using technological development standards for reducing ammonia emissions by livestock farms have outstanding importance.

OLP
ORSZÁGOS LEVEGŐTERHELÉS-CSÖKKENTÉSI PROGRAM
2020-2030

The HungAIRy LIFE integrated project, launched in 2019, promotes the implementation of air quality plans in 8 regions, in 10 settlements, and thereby the improvement of air quality in Hungary.[25] This 8-year project is coordinated by Herman Otto Institute Nonprofit Ltd., the Institute is collaborating with 19 partners to achieve the goals of the project. As part of the project, a detailed emission database for settlements will be established, a comprehensive, awareness-raising and information activity will take place, a national network of experts and consultants will be set up with the following measures:

- Installing a new air quality measurement stations,
- Establishing an eco-manager network,
- Developing a community cycling,
- Developing a decision support and air quality modeling tools,
- Awareness-raising,
- Reducing the emissions of the residential sector, and using environmentally friendly agricultural technologies.

If the measures aimed at improving air quality at local levels are successfully implemented, it is possible to extend them at regional or even national level as well, providing a high level of air quality on a larger scale in Hungary.
We need to address air quality, because it is essential for all living beings on the Earth. The importance of air quality was highlighted by the UN as well, when a Decision was adopted by the UN General Assembly in December 2019, in which it declared 7th September to be the "International Day of Clean Air for blue skies" from 2020.

Let's do it to protect
our environment and our health!

NOISE PROTECTION

3. PROTECTION AGAINST ENVIRONMENTAL NOISE

Nowadays noise is a leading source of dissatisfaction for city residents.

Noise is an invisible pollution that we may not even notice, as it leaves no tangible trace, no garbage hills, no polluted areas, but it has adverse effects on health, detrimental impact on the entire body and its functioning.

3.1. ASSESSMENT AND MANAGEMENT OF ENVIRONMENTAL NOISE IN THE EU

Environmental noise is still a significant environmental issue in the EU, as at least 20% of the Community population live in areas where the levels of noise are considered harmful to health.
The number of people being exposed to high noise levels has remained almost stable since 2012, but due to the urban growth and the increasing demand for mobility, the size of the affected population is expected to increase.
The assessment and management of environmental noise underwent a significant change at the turn of the Millennium. The Commission of the European Union reviewed the environment status of noise in the Community at that time, and concluded that a new environmental noise policy was needed.
As a result of the new noise policy, strategic noise maps and action plans for large cities and major transport facilities were designed. These first noise maps and action plans were prepared in Hungary in 2007 and 2008.
The management of environmental noise is based on longer term systematic planned performance with the help of implementation plans based on strategic noise maps being renewed every 5 years.
Noise management means not only reducing noise in "noisy" areas, but also protecting the tranquillity of the quiet areas. We need to pay more and more attention to this.

Figure 3.1.: Our major cities for which strategic noise maps were made in 2018
Source: lazarus.elte.hu

From 2017, the Herman Otto Institute Nonprofit Ltd. is obliged to prepare strategic noise maps showing the environmental noise exposure of settlements with a population of more than 100,000.
Noise maps with current data for the major cities can be found on the following website: *www.zajterkepek.hu*.
Among the main high-traffic transport facilities, the noise maps of public roads and railway lines are included in the Electronic Air and Noise Protection Database (ELZA), prepared and operated by the Institute of Transport Science Nonprofit Ltd.[26]
The noise map of Budapest Liszt Ferenc International Airport is available on the website of the Ministry of Agriculture.
From the noise maps and the data obtained from it, we can get detailed information about the noise exposure of about 3 million Hungarians.

3.2. THE ENVIRONMENTAL NOISE SITUATION IN HUNGARY

Strategic noise maps have been created for Hungarian cities with a total population of about 3 million, which means that reliable and precise information is available to 30% of the Hungarian population, namely for the people most exposed to environmental noise. Thanks to planned and cyclical updates our information is almost up-to—date and also helps to monitor the trends. This is also a condition for taking the necessary measures in response to change.

Transport (especially road traffic) is the main source of noise pollution in urban areas. As a result, the population of large cities is most affected by noise pollution.

Current situation

Not the noise exposure data, but rather the proportion of the dwellers in a given area (city, settlement) exposed to noise levels above threshold shows the real intensity and severity of the noise situation, as seen in Figure 3.2. Figure 3.3 shows the proportion of the population exposure to noise emitted by road traffic.

It can be seen from the diagram that the population in the capital city exposure to noise– as expected – is proportionally higher than in other Hungarian settlements. The data obtained from the strategical noise map help in the decision-making processes.

Figure 3.2.: Population exposed to noise from given sources
Source: Budapest, capital city, 2018

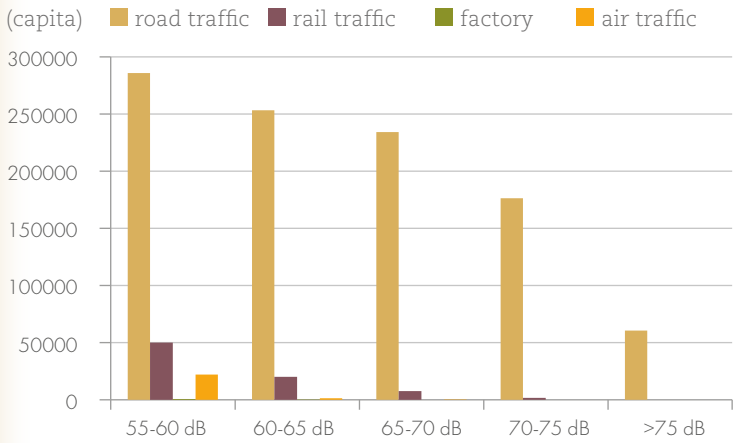
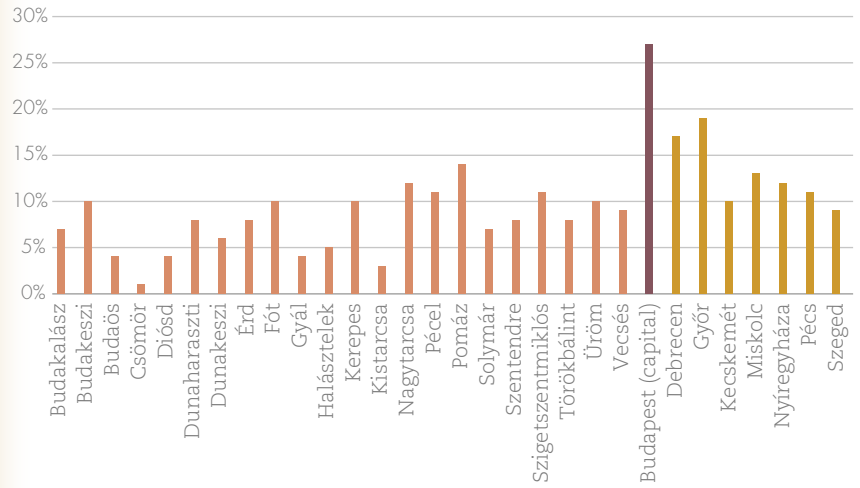


Figure 3.3.: The proportion of the population to be exposed to noise levels above threshold (L_{den} > 63dB)
Source: Herman Otto Institute Nonprofit Ltd.



Tendencies

The Community legislation on the assessment and management of environmental noise requires continuous monitoring of the noise situation, which provides opportunity to monitoring trends, which facilities the continuous improvement in noise management.
The following chapters analyse such typical changes - illustrating the changes between 2012 and 2017.

The changes in the noise situation (regarding road traffic) in Budapest and its agglomeration are shown in Figure 3.4. It is visible the tendency is more or less the same in the two area. It is an unfavourable phenomenon that the number of dwellers exposed to noise level higher than 75 dB has increased.

The change in the noise exposure in greater cites can be followed in Figure 3.5. The number of people exposed to higher noise levels hasn't increased to such an extent than in Budapest and its agglomeration. It is a positive phenomenon that we can also observe a decrease in some cities (Pécs, Szeged).

Figure 3.4.: Change in the number of people exposed to noise (L_{den}) from road traffic between 2012-2017 in Budapest and its agglomeration
Source: Herman Otto Institute Nonprofit Ltd.

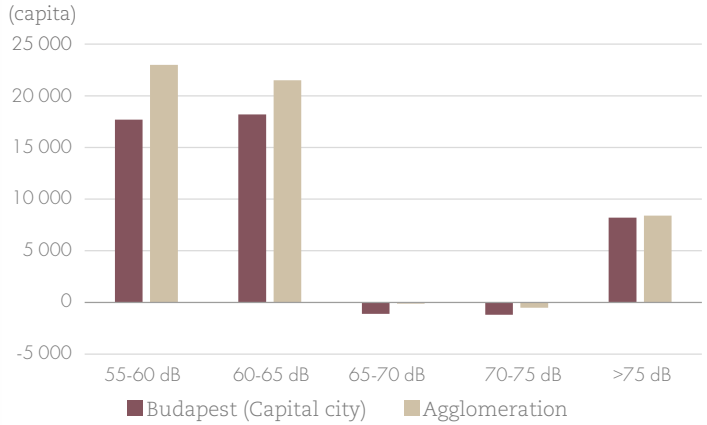
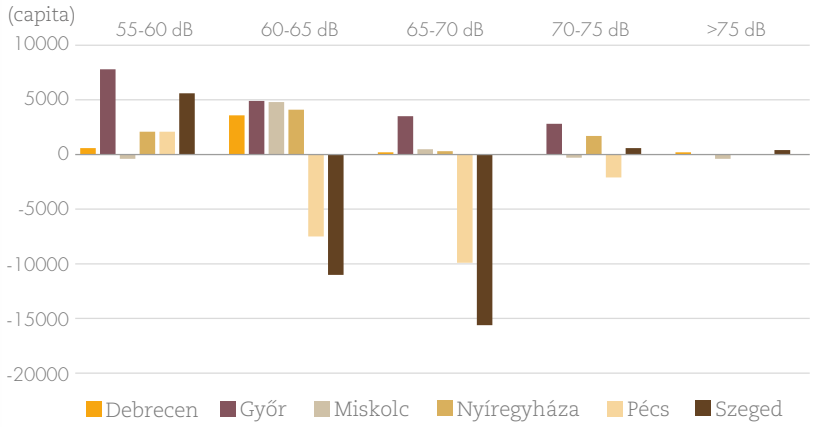
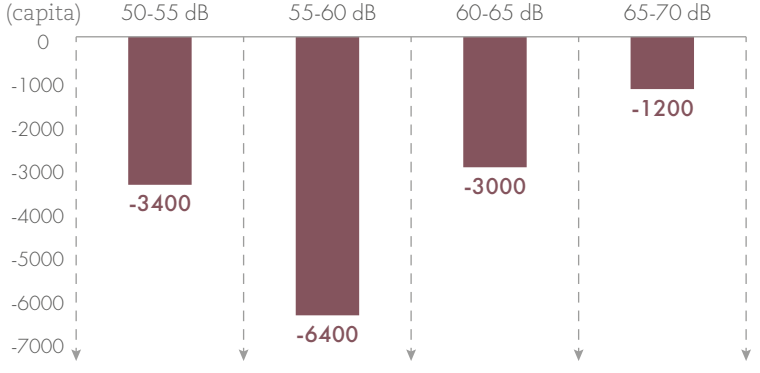


Figure 3.5.: Change in the number of people exposed to noise level (L_{den}) from road traffic between 2012-2017 in greater cities of Hungary
Source: Herman Otto Institute Nonprofit Ltd.



However, the rail noise exposure in Budapest has decreased, shown in the chart below in Figure 3.6.

Figure 3.6.: Change in the number of people exposed to rail noise (L_{night}) from 2012 to 2017 in Budapest



Our situation in the EU

After a brief overview of the Hungarian noise situation based on the basis of strategical noise maps, it is important to compare the Hungarian exposure to noise with the situation in the other Member States.

Before Community legislation (2004), it was not possible to make a comparison with Europe in terms of exposure to noise, because there wasn't a uniform indicator-system, and uniform analytical methods. Nowadays, this comparison can be done thanks to structural noise maps prepared by common methodology.

In Figure 3.7 below, the Hungarian situation is compared with the data of neighbouring Member States, the Eastern European and the so-called "Visegrád countries", and some Western European countries.

It is also worth taking a look at the European capitals, as even today there is the misconception that Budapest is one of the 3 capitals with the worst noise pollution.

Following the approach of the previous comparison, we compare the noise status of the capitals of the Member States given earlier.

The diagram in Figure 3.8 shows the real data.

Figure 3.7.: The percentage of urban people exposure to road noise (L_{den}) in some Member States of the EU
Source: Environmental noise in Europe 2020[27]

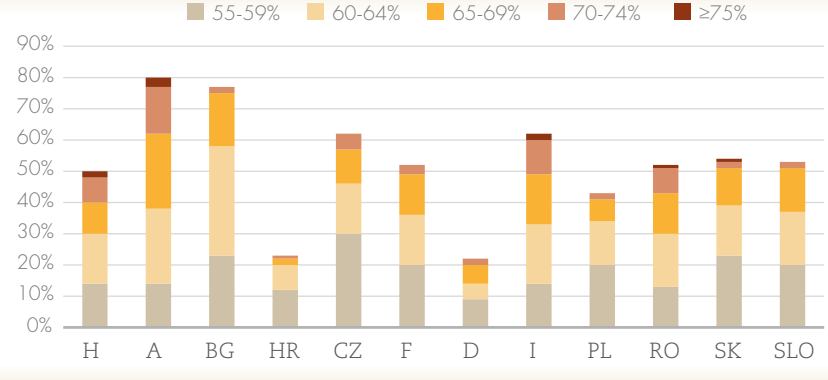
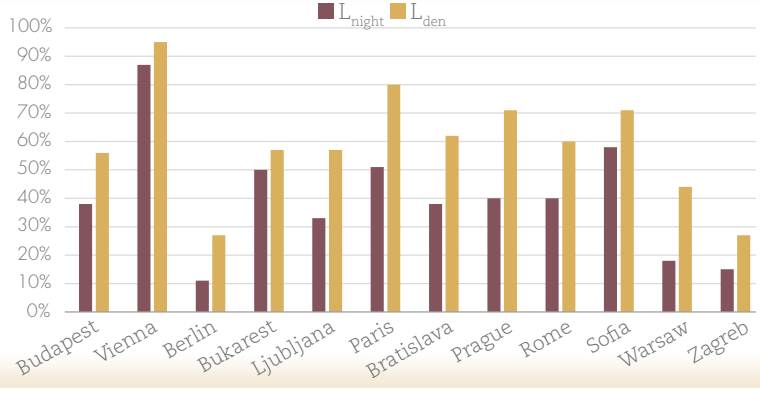


Figure 3.8.: The percentage of urban people exposure to road noise (L_{night}≥50 dB, L_{den} ≥ 55 dB) in the capitals of given Member States of the EU
Source: Environmental noise in Europe 2020



It can be observed from both diagrams that the environmental noise situation in Hungary roughly corresponds to the European average and Budapest is not one of the capitals with the worst noise pollution in Europe. The diagram clearly shows that steps should have been taken to control noise pollution in all countries.

Noise management

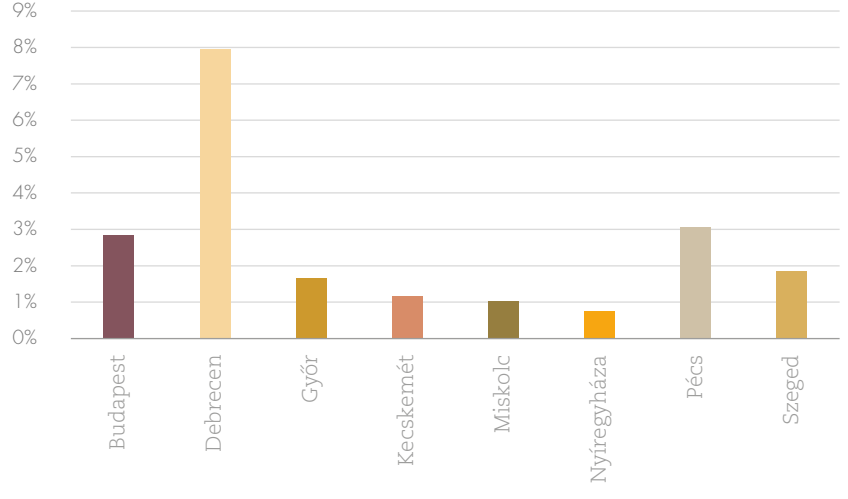
Managing environmental noise means not only reducing noise exposure, but also favorably changings in the distribution of noise exposure (for instance less affected dwellers), and protecting the quiet areas.
The assemblies of greater cities obliged for preparing noise abatement plans, have adopted these following general measures:

- Interventions to reduce traffic emissions (downtown traffic calming, "tempo30" zones, use of green wave system, limitation of heavy duty vehicles, construction of bypass)
- Developing a cycling network
- Increasing, renewing, and developing green spaces areas
- Improving the attractiveness of public transport system (with developing vehicle fleet, establishing combined modes of urban transport and promoting to use in urban traffic)
- Construction of noise barriers
- Maintaining road surfaces, road rehabilitation works
- Revision of settlement structure plans according to noise protection aspects
- Developing the parking system
- Passive protection (acoustic reinforcement of protected buildings and replacing doors and windows)
- Raising of environmental awareness (trainings, education-teaching, brochures)
- Establishing and maintaining a noise monitoring network, informing the public)
- Designating quiet (specially protected) areas

Detailed noise abatement plans on the official website of the obliged municipalities, and on the website of the Ministry of Agriculture.
As a result of the effective implementation of the above mentioned measures contained in the action plans, a positive change will be experienced in the proportion of the dwellers affected by noise pollution in greater cities.
Based on the data contained in the action plans of the greater cities, the following diagram in Figure 3.9 shows the positive impact of the measures regarding the proportion of the population affected by noise pollution.

We all have a responsibility and a duty to manage environmental noise. Let's take an active part in the process of preparing the noise abatement plan of our settlement!

Figure 3.9.: Percentage of the population positively affected by the implementation of the action plans in the greater cities
Source: Action Plans adopted by the municipalities of the cities between 2018-2019



WATER MANAGEMENT

4. WATER MANAGEMENT

4.1. PROTECTION OF WATER RESOURCES IN THE EU, THE EFFECTS OF THE WATER FRAMEWORK DIRECTIVE ON WATER QUALITY

Implementation of the Water Framework Directive in Hungary

The Water Framework Directive (2000/60/EC, hereinafter: WFD), the water policy of the European Union has entered into force on 22nd December 2000. As Hungary became a member of the European Union, the WFD and the associated guidelines were implemented into the domestic water management and water protection legislation.

The major goal of the WFD is to improve the quality of groundwater, surface water and protected areas associated with water bodies. Waters are considered to be in good condition, if the quality of water used for drinking or other purposes (recreation, irrigation) meets the requirements of intended uses, and the natural habitats depending on water are not disturbed by human activities. The aim is to achieve good ecological and chemical status or potential in the case of rivers and lakes and good chemical and quantitative status in the case of groundwater. The measures connected to the realisation of the above mentioned goals are summarized in the river basin management plan and are reviewed every six years.

Considering that the whole territory of Hungary is situated in the Danube Basin, the country is obliged to prepare a River Basin Management Plan (hereinafter: RBMP) for the domestic territory of the Danube River Basin District. The RBMP for the entire Danube River Basin is prepared in close cooperation with the other EU member countries concerned.

The fist river basin management plan (RBMP1) of Hungary was created in 2009, which was followed by the second one (RBMP2) in 2015. The RBMP3 for the third cycle 2022-2027 is currently under preparation, which should be completed by 22 December 2021 as a result of a careful, extensive and transparent strategic planning process. The preparation of the Significant Water Management Issues Discussion Paper at the end of 2019 was a crucial milestone in the process, which focused on identifying and analysing those stalemate issues that hinder the effective achievement of the intended goals according to the Water Framework Directive in the third cycle. To get more information about the planning process and the status of the surface and groundwater, please visit the following website: *www.vizeink.hu*

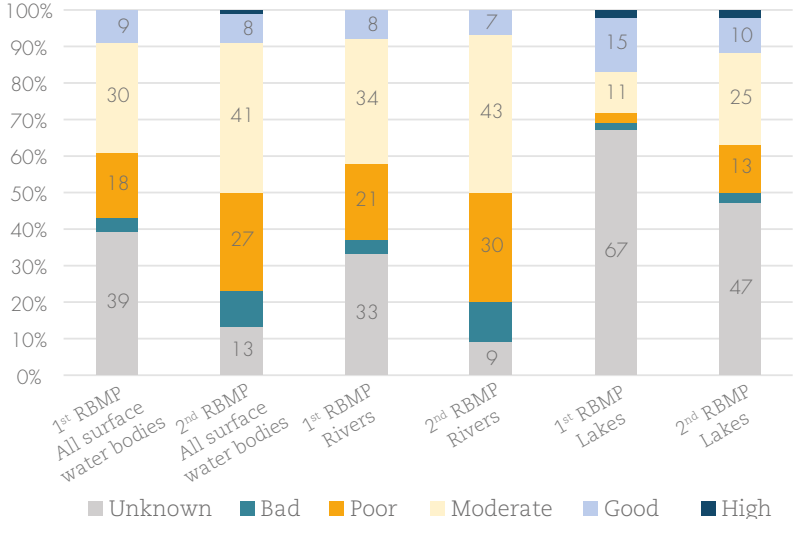
Picture 4.1.: Reservoir in Komravölgy
Photo: Zsuzsanna Barabás

The river basin management plan provides all the information available on the water bodies: loads on waters and their effects, the results of the status assessments, the problems arising in the planning area and their causes, as well as targets that can be set, and the technical, regulatory and other measures, financial support and incentives needed to achieve the intended goals.

Changes in the status of our waters

According to the conclusions of RBMP2, the status of the surface waters has not improved or shown only a slight recovery compared to the previous period. 9% of our surface waters have shown excellent or good ecological status, and 77% require some type of measures to achieve it. Some water bodies have not been classified due to lack of data or the intermittent nature of the watercourse. At the same time the number of surface water bodies with unknown ecological status has significantly decreased (Figure 4.1.). 85.4% of our assessed surface waters (511 rivers and 66 lakes) reflected good and 14.6% poor chemical status.

Figure 4.1.: Ecological status of surface water bodies in Hungary in the 1st and 2nd river basin management plans
Source: www.eea.europa.eu



The overall classification of groundwater bodies is determined by the worse of the results of the quantitative and chemical assessment. They are in a much better status than the surface water bodies: more than 50% of the 185 groundwater bodies are in good status, one third are in poor status and more than 10% are qualified as "good but risk of poor".
33 measure packages, including 135 measure elements were determined by the action plan of RBMP2. The assessment of the water status and the impact of the completed measures is in progress under the third river basin management plan currently being developed.
In Hungary, the objectives set out in the river basin management plans have not been completely accomplished. One of the main reasons is that the impact of the climate change has fundamentally altered the water management system and the natural, social and economic environment as well. In addition, most of the effects of the action plan – considering their natural processes – can only be observed in the long term.

Pressures on waters

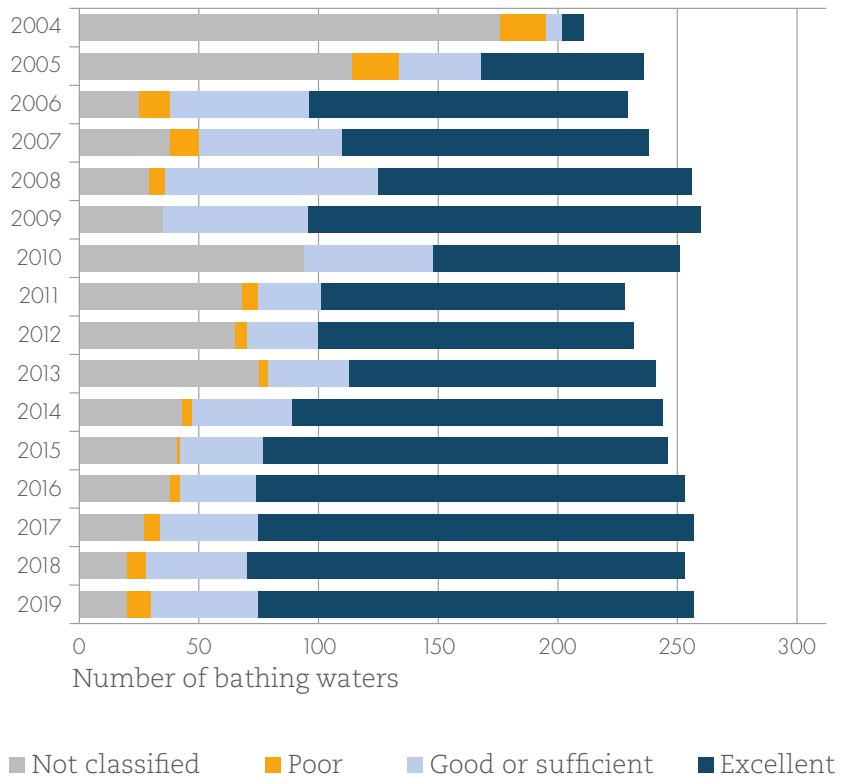
Human activities result in multiple pressures on the quality of our waters. The major elements of significant pressures from point sources of pollution are residential communal discharges of waste water, industrial discharges, urban rainwater drainage, and polluted areas. Diffuse water pollutants arrive to the waters from a larger, indistinct area. Among the several routes of contamination, the leachates from agricultural land and livestock farms (fertilizers, pesticides, etc.), the pollutants from rain and inland water, inadequate sewage disposal in settlements without drainage system and the deposition of atmospheric pollutants are the most significant. The extent of diffuse pollution depends not only on the factors connected to human activity but also on natural factors, e.g. climate, flow and soil conditions.
According to the interim report prepared in 2018 under Article 15 of WFD, about half of the diffuse nitrogen emissions get into the surface water through groundwater, which is considered to be nitrate contaminated and/or contains significant amount of natural ammonia in some parts of the country.

The second most significant sources are agricultural erosion and surface runoff. Other significant pressures come from atmospheric deposition (especially in the case of large surface waters) and urban rainwater runoff. Considering diffuse phosphorus load, the pressure by soil losses from erosion plays a dominant role: on a national average, diffuse emissions are clearly dominated by phosphorus load from the erosion of agricultural and natural vegetation areas, accounting for almost two-thirds of the total amount. For the rest, the urban load is predominant, caused mainly by the combined sewage networks of greater cities.
Hazardous substances are present in the public sewerage water in smaller amounts than nutrients. Apart from some direct industrial emitters, the industrial waste water discharged into the public sewer by industrial plants also appears in the urban waste water. Urban rainwater also contains hazardous substances (oil, heavy metals), to which for instance atmospheric deposition and transportation can contribute.

The status of domestic bathing waters

In accordance with the assessment system of the Bathing Water Directive 2006/7/EC, bathing waters of the European Union are classified on the basis of water quality monitoring by providing at least four samples a year. In 2019, 88.3% of the 257 Hungarian bathing waters were classified at least as sufficient, 70.8% of these sites as excellent. 10 bathing waters fell into the category of poor, most of them were river bathing sites. Compared to previous years, the number of bathing waters with poor quality has increased modestly mainly due to erratic weather conditions in the last season. Most of the 20 non-classified bathing water sites have been established in the past four years, hence do not have the complete dataset for the assessment period to assess the water quality (Figure 4.2.).

Figure 4.2.: Trend in inland bathing water quality in Hungary between 2004 and 2019
Source: Hungarian bathing water quality in 2019, Country report, EEA, 2020



4.2. WATER MANAGEMENT IN HUNGARY

Surface waters

The entire territory of Hungary is located in the river basin district of the Danube as one of the most closed basins on Earth, in the mainly lowland area of the Carpathian Basin. The hydrography of the country is fundamentally determined by the nature of the basin. More than 95% of the discharge of the 9800 registered watercourses in Hungary are provided by 24 large and medium-sized rivers arriving from foreign countries. As a result, the vulnerability of the country due to its downstream nature is very high in terms of quantity and quality.

The rivers arriving from the mountains surrounding the Carpathian Basin slow down and congest when they reach the plain, and mainly because of this, about two thirds of the country's territory are threatened by floods. Inland excess water causes damage in areas without runoff, which make up 45% of the territory of Hungary. Drought mainly affects the Great Plain and the Tisza River region, where evaporation can be higher than the average rainfall. Damages caused by drought can reach or even exceed the damages caused by flood. The occurrence of these water-related extreme situations is a legitimate consequence of our natural geographical features.

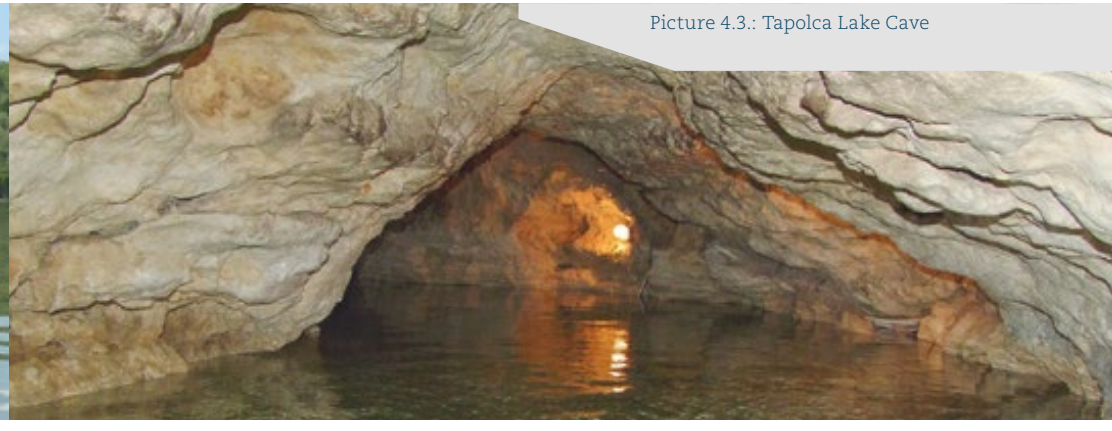
To prepare for the more frequently occurring extreme events as the impact of climate change and to increase the protection of our water resources, instead of rapid drainage of flood, new measures should be focused on storing water in a natural way and manage water resources at river basin level. To achieve these goals, cooperation with neighboring countries is necessary. Transboundary pollution shows a decreasing trend, however an exception to this is the communal (PET bottle) pollution in the Upper Tisza region. Preserving the water quantity and water quality of our large lakes (Lake Balaton, Lake Velence, Lake Tisza and Lake Fertő) is a significant water management task.

Groundwater

Due to its basin nature and geological structure, Hungary is rich in groundwater. In terms of amount, environmental and utility value, our groundwater resources have an outstanding importance in Europe. 95% of our drinking water supply is provided from groundwater resources, but the extraction of groundwater is also significant for industrial, agricultural, mining, energy and tourism purposes. Hungary has a significant supply of thermal water, which also contributes to the development of tourism.

Picture 4.2.: Tisza River
Photo: Dr. Anna Timár-Geng

Picture 4.3.: Tapolca Lake Cave



At the same time, groundwater resources are finite in both quantitative and qualitative terms, and only have a limited capacity to recover from adverse impacts from human activities. The use of groundwater can be maintained to the extent which does not lead to its overuse. In the past the water extraction related to mining activities in the Transdanubian Mountains caused an average of 40 meter and locally up to 200 meter drop in the karstic water level, and led to the depletion of several springs and the drying up of wetlands. As a result of the abandonment of water extraction, the recharge (rise in karstic water level) has significantly developed since 1990. Thanks to the restoration of resources towards baseline, prior bauxite mining conditions and the quantitative rehabilitation of karstic springs, the reconsideration of water use is necessary.

Authorizing the construction of water wells in Hungary dates back many centuries, hence the authority can monitor to what extent the water use can be permitted without endangering the water supply. In addition to the quantitative status of water, the improper construction and operation of the water well can also cause significant deterioration in the water quality of deeper aquifers by providing a direct path for the pollutants from the surface or from shallow aquifers.

Picture 4.4.: Lake Kolon
Photo: Dr. András Attila Takács

National Water Strategy (Kvassay Jenő Plan)

The Kvassay Jenő Plan – the National Water Strategy – adopted in 2017 is the framework strategy of the national water management for the period up to 2030 and the medium-term action plan for the period up to 2020. The Plan is required to establish objectives related to water management and water quality, identify the measures and tasks crucial to achieve them, and determine the conditions and methods of implementation in order to

- **avoid the water crisis threatening the world, and react efficiently against its already visible signs in time by adequate measures;**
- **protect the water for future generations, because it is an irreplaceable condition of life and a resource for the economy;**
- **use water for our advantage effectively and economic friendly;**
- **keep us safe from its imminent damages.**

The strategy includes several long-term headline targets to be met by 2030. It is of particular importance to improve water retention, increase water retention capacity in order to store inland waters and floods and utilize them during dry, droughty periods. Related to flood and inland water management, the reactive defense to events should be gradually replaced with prevention methods reducing water damage risks. A further priority is to gradually improve the quality of surface and groundwater, until reaching and maintaining good status and potential. Quality water utility service and rainwater management must be implemented with a tolerable consumer burden-sharing. The strategy lays down the conditions for the implementation of the tasks, which focus on the improvement of the relationship between society and water (at individual, economic and decision-making levels), the renewal of water planning and management, as well as the financial regulatory system of water management.[28]

CLIMATE PROTECTION

5. CLIMATE PROTECTION

The medium- and long-term concerns and challenges related to climate change have been known for a long time, but at the same time climate change together with climate protection have only become core determining factors recently. Less and less explanation is required for the notion, as the impact of more frequent extreme weather events in the form of heavy rains, lightning, heat waves has been experienced by all of us, and the public media has increasingly addressed the issue as well. Throughout the history of our Earth, the climate has changed several times, so the process of climate change is a natural phenomenon. The problem is caused by the fact that it is not known exactly to what extent this natural process is being influenced, accelerated by human activities, hence the climate change is one of the biggest global challenges we face this century. Environmental changes - to a different extent in a geographical sense - have an impact on health, economy and society.

On the basis of the Special Report of the Intergovernmental Panel on Climate Change (IPCC)[29] published in October 2018, if no major emission reduction measures are established, the rate of change in global average temperature can't be kept below 1.5 °C (compared to pre-industrial levels). This would have serious consequences, as, among many other problems, coastal and lower lying areas could be flooded, extreme weather conditions could intensify, and some natural habitats could disappear.

Based on the data of the OMSZ (Hungarian Meteorological Service, 2020)[30], according to data from five global climate databases, the year 2019 was the second warmest year on Earth in terms of temperature (1. 2016; 2. 2019; 3. 2017, 2015). In Hungary, the annual mean temperature in 2019 exceeded the average of 1981-2010 by 1.87 °C and was at a record mean temperature of 12.19 °C. Based on a linear trend estimate, the change in the national average of the annual temperature during the last 119 years (1901-2019) was on average +1.32 °C, with a variation rate between +1.14 °C and +1.52 °C within the country. The major sign for accelerated warming is the fact that eight of the ten warmest years have occurred in Hungary since the turn of the decade (Figure 5.1.). In our relatively small country, warming is not uniform neither in space nor in time, in the period between 1981 and 2019 the rate of change in the annual mean temperature in the north-eastern parts of the country was above 2 °C.

Figure 5.1.: Changes in the annual mean temperature in Hungary between 1901 and 2019 based on homogenized, interpolated data
Source: OMSZ, 2020

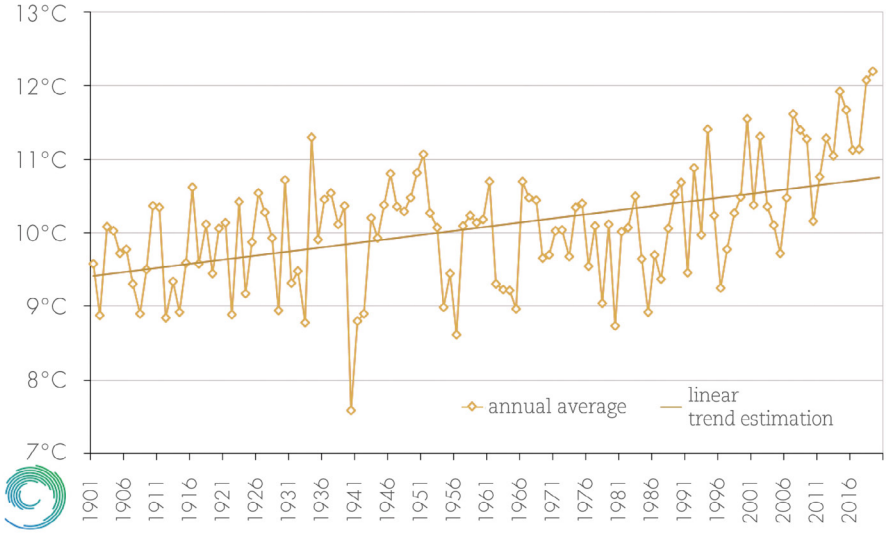
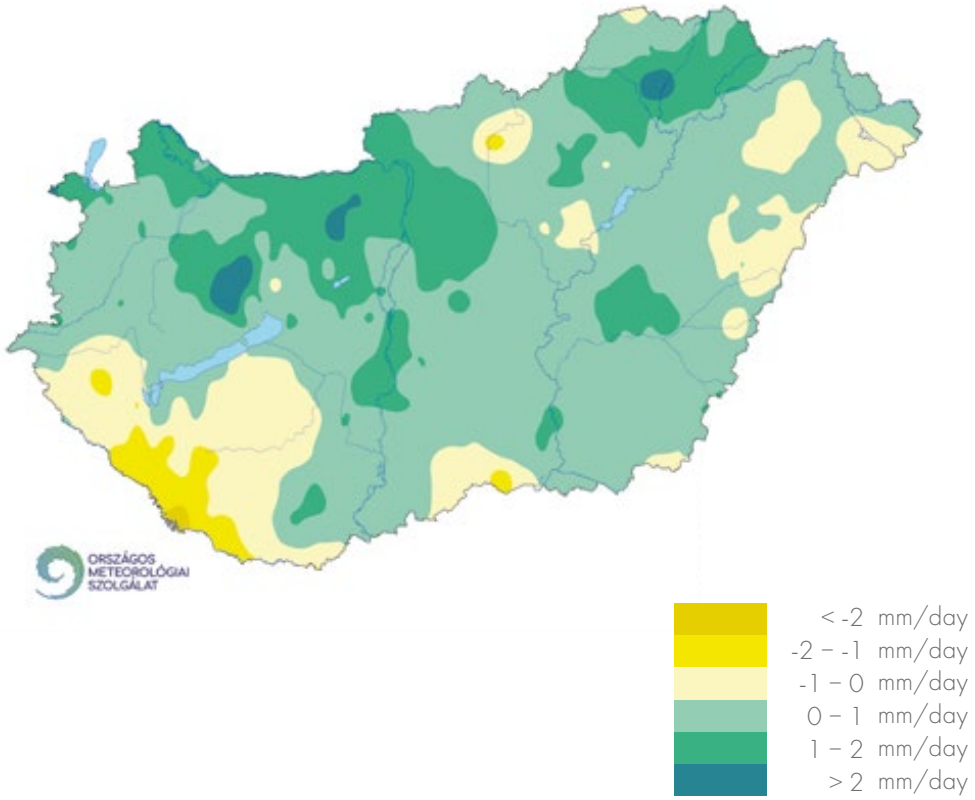


Figure 5.2.: Change in the daily mean precipitation intensity in the summer months (average precipitation) in the period 1961–2019 (based on grid point trend estimation).
Source: OMSZ, 2020



A clear change in temperature is also reflected in changes in other climatic indicators: the number of frosty days is declining significantly, while the number of heatwave days is increasing and severe weather events causing damage are becoming more frequent.

The amount of annual precipitation has reduced by 3%, fitting a trend line to the data of the last 119 years. The annual precipitation amount has shown a significant volatility in consecutive years. Although the annual precipitation amount has been average in recent years, distribution of precipitation has shown interannual variability within a year. Typically, longer precipitation-free, sometimes long dry periods, have been interrupted by short-term but intense situations with torrential rains. Daily mean precipitation in summer months increased mainly in our mountains in the period of 1960 and 1919. (Figure 5.2.)

One of the most serious consequences of climate change in Hungary is that rapid increase in average temperatures pose a significant risk for human health. The most vulnerable groups impacted by heatwaves are with chronic circulatory, metabolic, respiratory and mental illnesses, the elderly and children. The rate of daily mean mortality on hot day has increased by 15%.[31]

5.1. THE DEVELOPMENT OF THE EU CLIMATE POLICY

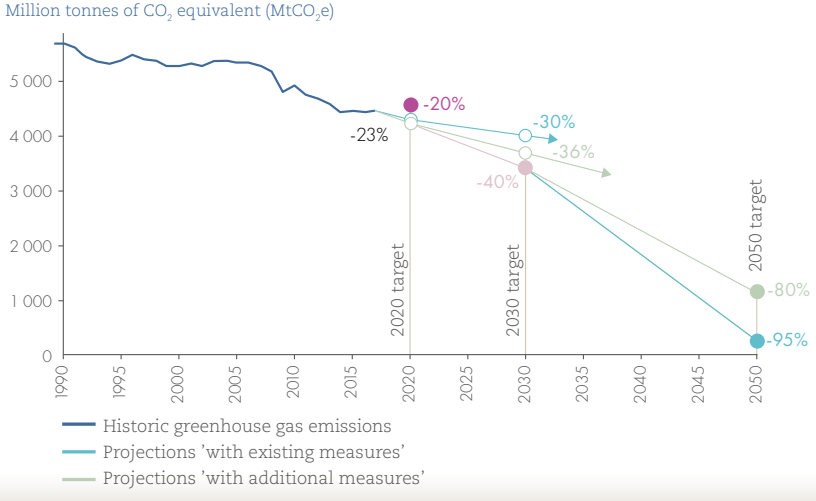
The global policy framework for the European Union's action is provided by the United Nations Framework Convention on Climate Change (UNFCCC) (1992). The Paris Agreement (entered into force in November 2016) to the Framework Convention has become one of the most significant international climate policy agreements in recent years. This is the first global legally binding agreement on climate with the long-term goal of reducing greenhouse gas emissions and keeping the increase in global average temperature to well below 2 °C (preferably not more than 1.5 °C) above pre-industrial levels.

Adaption to climate change has highlighted more often during establishing of EU policies, strategies, programs and projects, most Member States joined to the European Environment Agency have already developed a strategy on adaptation to climate change. There are a wide range of measures in the field of adaptation to climate change [32]. Therefore the EU has accepted binding objectives for the achievement of greenhouse gas emissions reductions by adopting measures to mitigate the effects of climate change, and transform Member States into a resource efficient, low carbon and climate resilient economy.

Over the last nearly 30 years (1990-2018), the European Union's greenhouse gas (GHG) emissions have were reduced by 23% (Figure 5.3), due to climate change mitigation measures, energy efficiency improvements, raising the share of renewable energy sources, improvement in building insulation, structural-economic changes and economic downturn.[31]

The EU climate and energy package[33] sets objectives for reduction in GHG emissions reduction, promotion of the use of energy from renewable energy sources, and improvement in energy efficiency for 2020 and 2030 (Figure 5.4.). The EU has set itself targets for reducing its greenhouse gas emissions progressively up, by 20% to 2020 and by 40% to 2030 (from 1990 levels). Positive projections indicate that the target will be met to 2020. However, to meet the GHG target of 40% reduction to 2030 significant efforts are needed, and the European Parliament has just adopted its new position on the EU 2030 climate target, calling for a further increase to at least 50% but preferably 55% emission cuts.

Figure 5.3.: GHG emission trends and projections and targets in the EU28 1990-2050
Source: EEA, SOER2020



Note: The indicator does not include greenhouse gas emissions and removals related to land use, land use change and forestry (LULUCF)

Figure 5.4.: Targets of the EU Climate and Energy Package

	2020	2030
Reducing of greenhouse gas emissions	↓ -20% compared to 1990 levels	↓ -40% compared to 1990 levels
Increasing the share of renewable energy	↑ -20% in final energy consumption	↑ -32% in final energy consumption
Increasing energy efficiency	↑ -20% compared to the estimated growth in 2007	↑ -32,5% compared to the estimated growth in 2007

One of the keys targets is to increase the share of renewable energy in the EU's final energy consumption to 20% and 32% by 2020 and 2030. EU is well on track to achieve its 2020 targets for renewable energy, however, the 10% renewable share target for transport may not be reached by 2020. The package has originally included a 20% energy efficiency target for 2020, while the target has increased at least to 32.5% for 2030 (compared to 2007 projections). Final electricity consumption has been raising again since 2014, which means that enhanced measures shall be required to reach its 2030 targets, furthermore fast and effective action and large-scale developments are essential. The EU ambitious aim is to be climate-neutral, achieve net-zero greenhouse gas emissions by 2050 (a balance between greenhouse gas emissions and their removals). It means that a faster emission reduction is needed, at least 80-95% cut in greenhouse gas emissions to reach the 2050 climate-neutral targets. The 2030 climate target is also the centrepieces of the Commission's Green Deal[34].

The new growth strategy, launched on 11 December 2019 aims to make Europe the world's first climate neutral continent by 2050, by decoupling economic growth from resource use, and allocating all EU measures and policies to achieve the goals of the Green Agreement. The Green Transformation has several "milestones", including the European industrial strategy, the circular economy action plan, the farm to fork strategy or the biodiversity strategy (for the period up to 2030). On 4 March 2020, the European Commission adopted a legislative proposal for a European climate law, which includes a framework for achieving climate-neutral objectives (Figure 5.5).

Figure 5.5.: European Green Deal's target system
Source: European Green Deal

5.2. DEVELOPMENT OF THE HUNGARIAN CLIMATE POLICY

The foundations of the domestic climate policy are contained in the Second Climate Change Strategy of Hungary (hereinafter: NÉS-2 in Hungarian), adopted by the Parliament in October 2018, which includes strategy for the period 2018-2030, but provides also an outlook for the period up to 2050 as well. The strategy was developed in accordance with the provisions of the Paris Agreement with the aims of decarbonisation (Decarbonisation Roadmap), sustainable development, studying the vulnerability caused by the climate change, adaptation (Hungarian Adaptation Strategy) and "Partnership for the Climate" as an awareness-raising plan.
At the beginning of 2020, 5 new climate policy documents[35] were adopted, all of which are in line with the Paris Agreement and EU climate policy targets:

- The document entitled Hungarian Energy Strategy 2030 with a look forward for the period up to 2040, has been renewed due to technological and market structural changes in recent years based on the EU frameworks and objectives.

- To meet the EU's energy and climate targets for 2030, Hungarian Energy and Climate Plan was established (hereinafter: NEKT in Hungarian)[36], which is closely linked to the new Energy Strategy, the main goals of these documents are to strengthen energy sovereignty and energy security, decarbonise the electricity sector, develop heating/cooling solutions based on renewable energy sources, implement renewable energy sources in district heating (Green District Heating Program), execute electromobility, fulfil the Green Bus program, and support the popularity of using smart meters.

- The First Climate Change Action Plan adopted for the period up to the end 2020, was developed with the major aim of translating the NÉS-2 targets into actual measures, i.e. putting the goals of the strategy into practice.

- The document called "Report on the scientific assessment of the possible effects of climate change on the Carpathian Basin" aims to give a comprehensive overview of the potential impacts of the climate change.

- The Hungarian Clean Development Strategy (draft)[37] has being developed for the end of this year as a long-term, comprehensive strategy to achieve climate neutrality by 2050.

Act XLIV of 2020 on Climate Protection[38] entered into force on June 2020, in which concrete targets were designed aligned with the EU's climate and energy package. The act has the same objectives as the NEKT:

- At least 40% cut in greenhouse gas emissions (from 1990 levels) for the year 2030;
- Reaching a 21% share of renewables in gross final energy consumption by 2030; increasing of the solar power capacity will be the key tool for achieving this target;
- After 2030, if final energy consumption exceeded the 2005 level, the surplus amount can only be provided from carbon-neutral energy source in Hungary;
- Being climate neutral by 2050.

Enshrining the climate and energy targets in Hungarian law can be stressed as a positive action, it is important to consider that current trend projections show that 7% deduction in greenhouse gas emissions is needed for reaching our 2030 target, since Hungary has reduced its GHG emissions by 33% for the year 2018 compared with 1990 level based on the National Inventory Report[39] submitted to the UN Framework Convention on Climate Change in April 2020 (Figure 5.6. and 5.7). Although this result gives us a prominent place in the EU, it does not mean that we can sit back and relax.

It is necessary to reduce our emissions as much as possible, because the final goal is to be climate neutral by 2050, and significant efforts and measures will be required for achieving this target in the future.

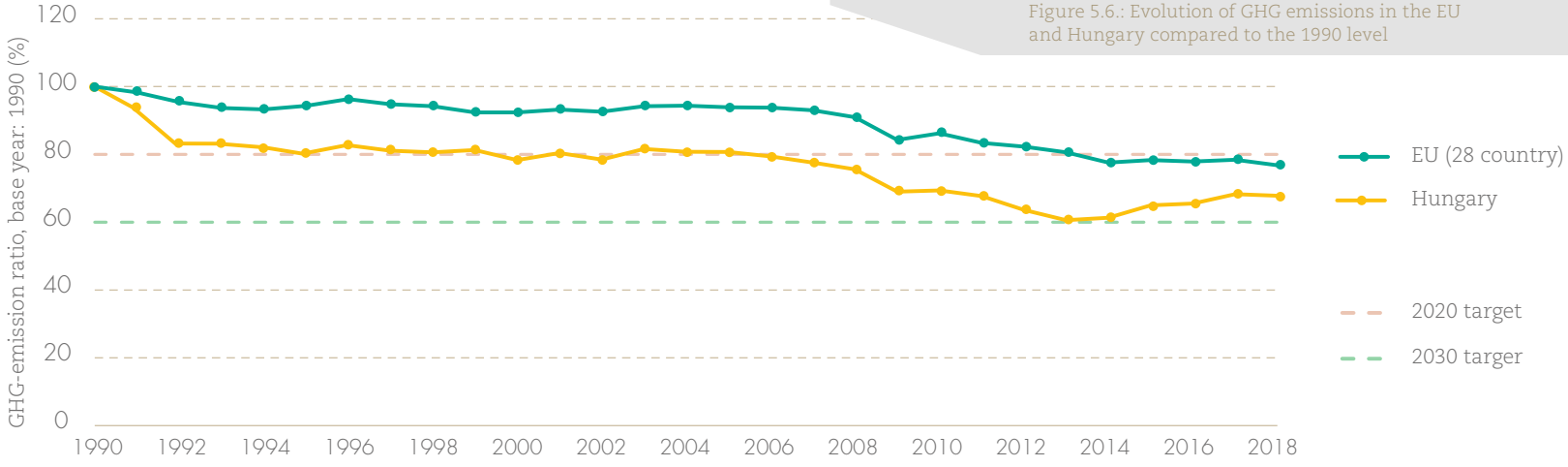


Figure 5.6.: Evolution of GHG emissions in the EU and Hungary compared to the 1990 level

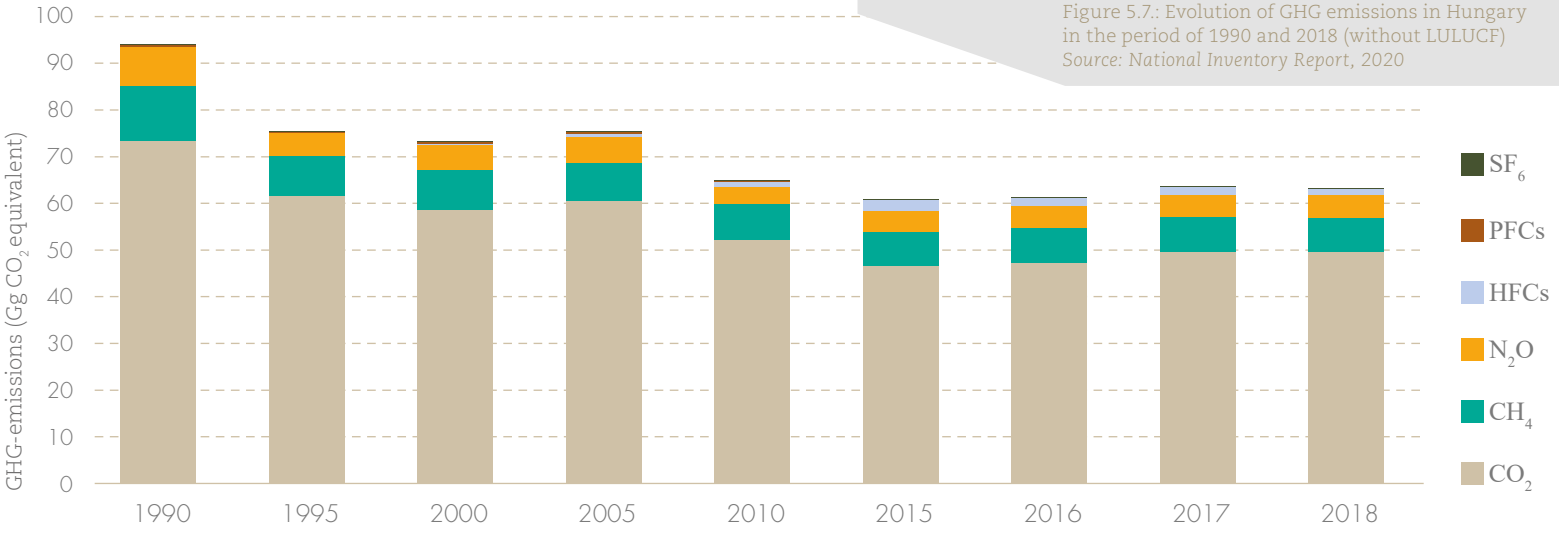


Figure 5.7.: Evolution of GHG emissions in Hungary in the period of 1990 and 2018 (without LULUCF)
Source: National Inventory Report, 2020

SOIL STATUS

6. SOIL STATUS AND ENVIRONMENTAL REMEDIATION

6.1. LAND AND SOIL MANAGEMENT, LAND COVER AND REHABILITATION OF REMEDIATION SITES IN EUROPE

The definition of land generally means the area of the planet that is not covered by seas, lakes or rivers, which involves the entire land area, including continents and islands. Agricultural land, arable land are part of our shared natural capital. We can't leave without healthy land and soil, because we produce most of our foods on land and built our home on them.

The soil is the essential element of the land, made up of layers of rock, sand, and clay as well as organic matter (such as plant residues) in addition to water and air accumulating in the pores of the soil, as well as the soil-dwelling animals and other organisms (such as bacteria and fungi).
The land is vital for all species, in which life is bustling, but it is often undervalued. Responsible management has pivotal importance for the purpose of the sustainable using of resources and provisioning of ecosystem services. Unfortunately, however, the way we currently use land and soil worldwide, including in Europe, is unsustainable and has a significant impact on ecosystems.

Europe's landscape has been changing, due to many impacts on its lands and soils; including urban sprawl, agricultural and industrial pollution, land sealing, landscape fragmentation, low diversity of cultivated crops, soil erosion and extreme weather events related to climate change.[40]
Green Cities with more environmentally sustainable energy and transport system, where green spaces are connected to each other by green infrastructure, furthermore the less intensive, sustainable agricultural practises can contribute to a more sustainable land use and to a better and healthier soil condition in Europe.

Both the 7 th Environment Action Programme (7th EAP) and the EU Roadmap to a Resource Efficient Europe outline the structural and technological changes needed by 2050, promote land recycling, sustainable land policy based on the prioritisation of renewal with the aim of mitigating urban expansion[41] and slowing down the increase in artificial surface areas (sealed soils, covered by buildings and concrete).
One clear way to limit the expansion of urban areas to make better use of existing urban space. Today the land recycling and densification of functions (for example, using an old industrial site for infrastructure and urban expansion) account only for a fraction - 13% - of new developments, and the pace and trend of land take continue to be a problem.
Europe's land cover has remained relatively stable since 2000, with about 25 % covered by arable land and permanent crops, 17% by pastures and 34% by forests.[42]
On the basis of a detailed analysis by the European Environment Agency (EEA) of land cover, Figure 6.1. shows the distribution of land cover types in the European Union and Hungary. Due to the geographical features of Hungary, the proportion of agricultural land is almost two thirds of the country's territory, which is well above the EU28 average of 45.2%. Forests and green urban areas are of exceptional value, account for 25.9% of land cover, but it is below the EU28 average of 44.4%. Unfortunately the Hungarian artificial surfaces cover 6.5% which is above the EU average of 5%. It is also typical for Hungarian's cities like for most of Europe's cities that they were built on and surrounded by arable land, it is often productive agricultural land that gets taken and covered by artificial surfaces during the expansion of the outer industrial area surrounding the city.

Figure 6.1.: Distribution of land cover types (percent) of total area in EU and Hungary (2018)[43]

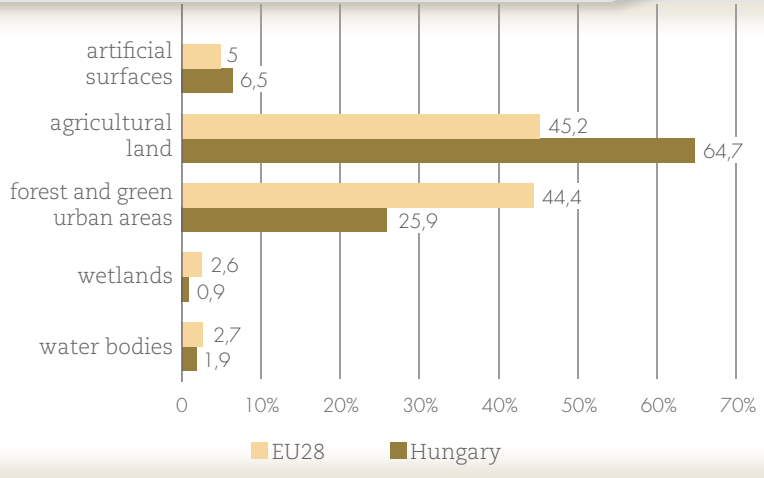
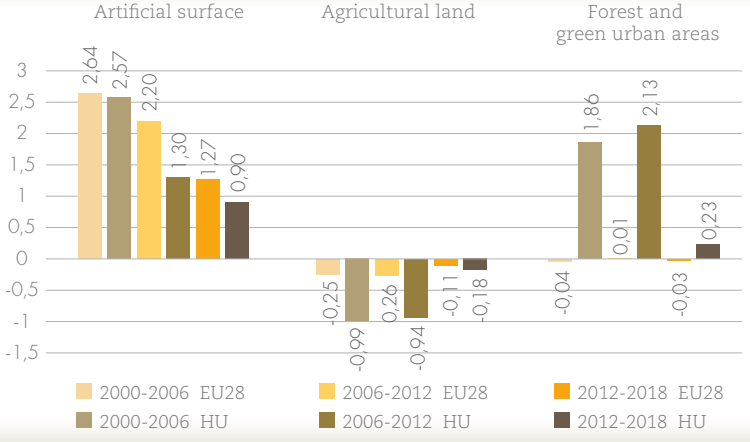


Figure 6.2.: Change in the distribution of land-cover types is measured in % of total area in the EU and Hungary (2000-2018)[42]



Copernicus program, the European Union's Earth Observation Program, also known as the Europe's Eyes on Earth has revolutionised the way can we get a picture about the Earth and manage the sustainable use of the valuable land and soil resources. The idea for the Copernicus Land Monitoring Service was initiated in the late 1990s and the first satellite was launched in 2014.[44] Based on a detailed analysis by the EEA of land cover, Figure 6.2. presents the changes in the artificial surfaces, agricultural lands, forests and urban areas in the European Union and Hungary (expressed in percentage of the total surface areas).

The increase in artificial surface areas was experienced in the examined period, the change was 12796 km^2 (6.11%) in the European Union and 275 km^2 (4.77%) in Hungary. The good news is that the rate of increase has slowed down, the most positive trend was observed in the period 2012 and 2018. The utilised agricultural area in the EU has continued to decline by a total of 12352 km^2 (0.62%), in Hungary by 1299 km^2, with an average shrinking rate of 2.11% during the examined 18 years, however the loss of agricultural land appears to have slowed down in the period 2012-2018. The land cover of forest and urban green area has decreased by 1274 km^2 (0.07%) during the entire period under examination in the European Union, but in Hungary an increase by 979 km^2 (4.22%) was experienced

Europe is one of the most intensively used continents on the globe, with the greatest fragmentation of the landscape as a result of urban and transport infrastructure such as roads and railways.

The way we use land has a significant impact on the species, ecosystems and habitats. Europe's arable land has recently come under increasing pressure caused by the harmful effects of climate change, such as increasing frequency of extreme weather events, forest fires, droughts and floods. A dynamic changes in land use as a result of urbanization and industrialization can be experienced, polluted industrial and commercial sites (also known as brownfields), low yield areas have been created. Environmental rehabilitation of brownfield sites is the important part of the effort to ensure circular economy in land use and the land management strategy, which respond to the needs of the society. In addition to exploiting the territory potential, brownfield redevelopment provides also solution for the existing environmental problems of the area. In the brownfield areas, heavy contamination (mainly unassessed) and unsolved ownership are also the problems to be addressed.
The environmental issue of the soil contamination is closely related to due to the economic transformation and structural change concentrated in recent decades common past, and part of the process in which Europe first became an industrial pioneer and later a pioneer of the environmental protection in the world.

We have made huge progress in cleaning up soils in Europe but we still have a problem, but several contaminated areas have been still waiting for cleaning up. In the end, the key question is what level of risk we are prepared to accept, and where those risks are exceeded what we will do about it.
Based on experience from the United Kingdom, the European Union and the United States, brownfield-to-green-space redevelopment offer significant potential for the production of renewable energy. In addition, it can also be a source of entertainment and recreation in residential areas. Better access to urban green spaces can be beneficial for social inclusion and health, in addition, more broadly, provide economic advantages with the contribution of an increase in the prices in the area due to the higher demand for property and land. Not only simply building up development, but gentle rehabilitation of the areas are essential that all the above mentioned services can be provided, therefore the brownfield-to-green-space redevelopment can also be interpreted as an excellent opportunity for garnering social, environmental, and economic benefits.[45]

6.2. ENVIRONMENTAL REMEDIATION AND BROWNFIELD INVESTMENTS WITHIN THE FRAMEWORK OF HUNGARIAN PRACTICE

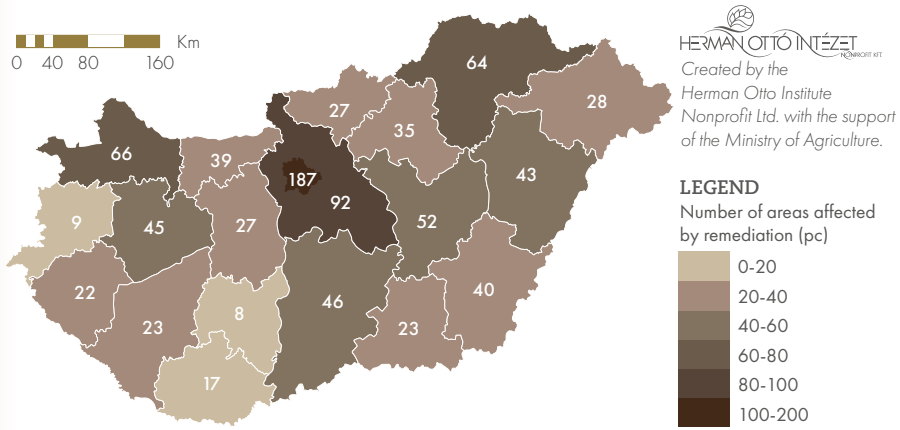
Due to the fact that the economic transformation and restructuring in Hungary have been concentrated in recent decades, the proportion of brownfield sites is significantly higher here than in Western Europe. Due to the infrastructure extensions, and the land take by other sectors of the economy, the process of building up and the rate of artificial surface areas (covered by concrete and asphalt) have increased rapidly, hence the sustainable use of soil is hindered. Appropriate measures should be taken to restrict the process of becoming more area sealed for example through the rehabilitation of abandoned contaminated sites, thus reducing the tendency to build upon greenfield sites and increase in area of artificial surfaces.

Different contaminants have different sources but probably the most important sources are former industrial activities. Another important source is military activity, defence industry, including on training grounds. The two main objectives of eliminating soil pollution are to reduce risks to human health and to the quality of surface and groundwater. The two big drivers for cleaning up soil contamination are the risks to human health and to surface water and groundwater quality. The third driver is agricultural contamination free production, increasing food safety by risk-free crop and livestock production. It is hard to remove soil contamination, in most cases groundwater also needs to be treated, and the cost of this is often very high. It is therefore a great burden for the current generation to address pollution problems accumulated by the previous generations.

Regulations and standards have been increasingly successful over the past 30-40 years in preventing soil contamination. Meanwhile, many heavily contaminated sites have been brought to safer conditions, although many remain that have not been dealt with. A very wide range of technologies can be used to reduce the risk of soil contamination, either by removing the contaminant or by containing it. The critical issue is the level of residual risk we are prepared to accept in the context of the cost of remediation. A lot depends on the end use of the land and the availability of funding from developers. In cities with a long industrial past, soil contamination in very-high-value areas, such as business districts or big developments near water, has now largely been dealt with, so risks are contained. This is good progress, but for areas without a high current economic importance, it is often not possible to secure funding for remediation.

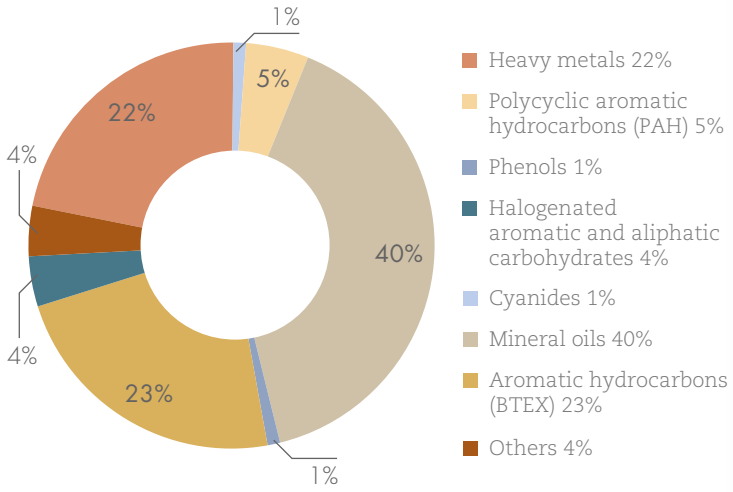
The FAVI-KÁRINFO Remediation Information Subsystem of the Hungarian Environmental Information System (OKIR) provides data on contaminated sites, sources of contaminants and remediation for the Hungarian contamination sites inventory.

Figure 6.3.: Number of areas affected by remediation by counties[42]
Source: OKIR-FAVI-KÁRINFO - 2020 july



The treatment of the contamination and the rehabilitation of contaminated sites have already been finished in many places, but still hundreds of areas have been waiting for remediation. The Figure 6.3. illustrates the total number of objects and sites by county where data sheet of FAVI-KÁRINFO INFO-B1 (pre-assessment data) or FAVI-KÁRINFO INFO-B2 (post-assessment data) or OKIR-FAVI-KÁRINFO data-B3 (post-technical intervention data) to the FAVI-KÁRINFO Remediation Information Subsystem was submitted and that allowed them to trigger the official attention of the authorities.

Figure 6.4.: Most frequently occurring contaminants in the geological medium[46]

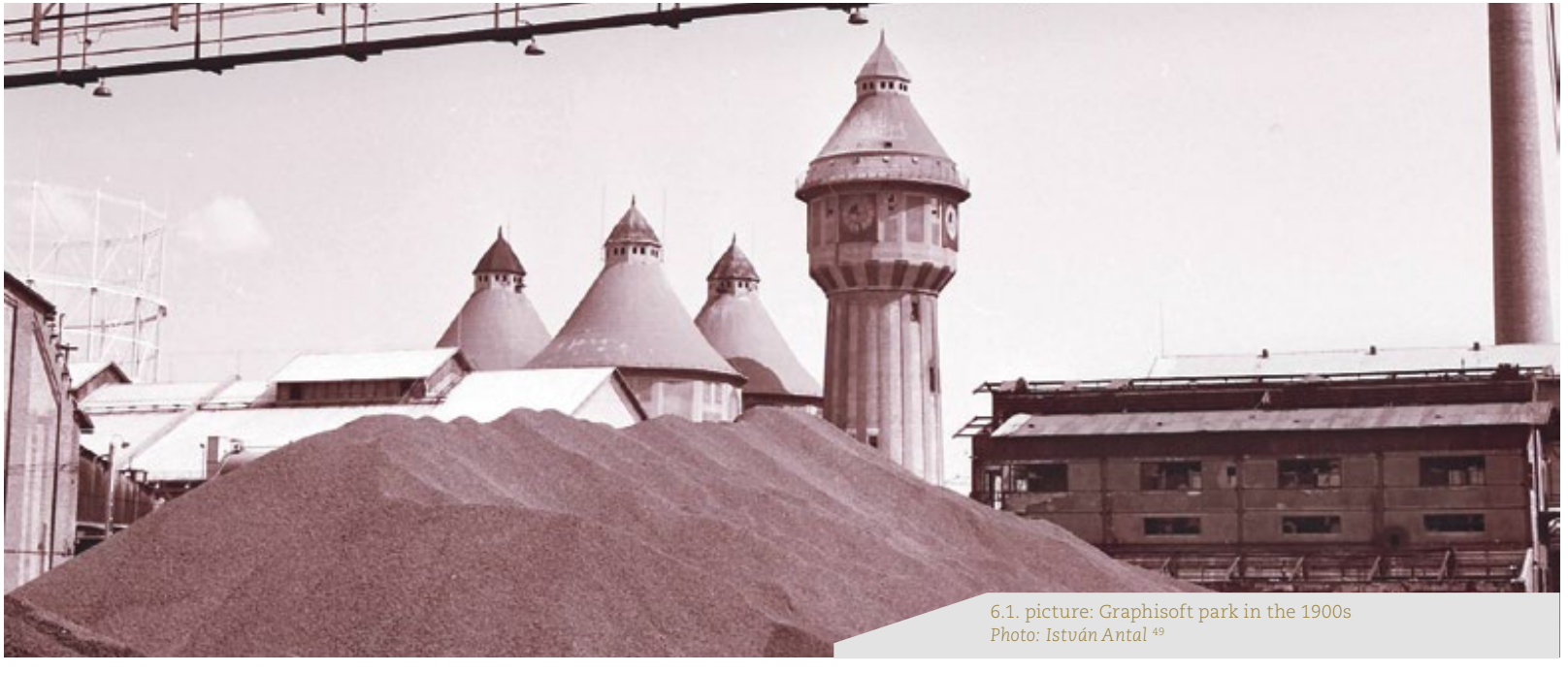


Currently, about 900 sites have technical data sheets which records the status of the sites before the assessment or after the technical intervention. The largest number of registered sites has occurred in Budapest and Pest county, but significant number of reports has arrived from Borsod-Abaúj-Zemplén and Győr-Moson-Sopron counties as well. In many areas detailed assessment has not yet taken place, hence the data on the risk of contamination, the need for remediation, the level of intervention can only be estimated.
The distribution of contaminants in the contaminated geological medium areas is shown in Figure 6.4. In Hungary mineral oil and BTEX are the most frequent geological medium contaminants. The occurrence of PAHs and halogenated aliphatic and aromatic hydrocarbons as contaminants is less significant, but deserves increased attention due to their carcinogenic properties. It can also be observed that nearly one quarter of the contaminated sites are contaminated with heavy metals.

To link GIS data on soil information, we can get a much clearer picture of where contaminants sites are located. For example, brownfield sites are scattered throughout Budapest. The development of the capital within existing boundaries and the rehabilitation of brownfield sites are the core objectives for the sustainable spatial planning policies and compact city development. The new urban development document on Coordinated Brownfields Development under thematic programme has drawn up with the participation of the district municipalities coordinated by the Municipality of Budapest over the past few years. The aim is to promote urban space utilisation by preferring mixed land uses in order to foster sustainable growth and promote temporary use of waiting spaces in urban (re)development.[47]

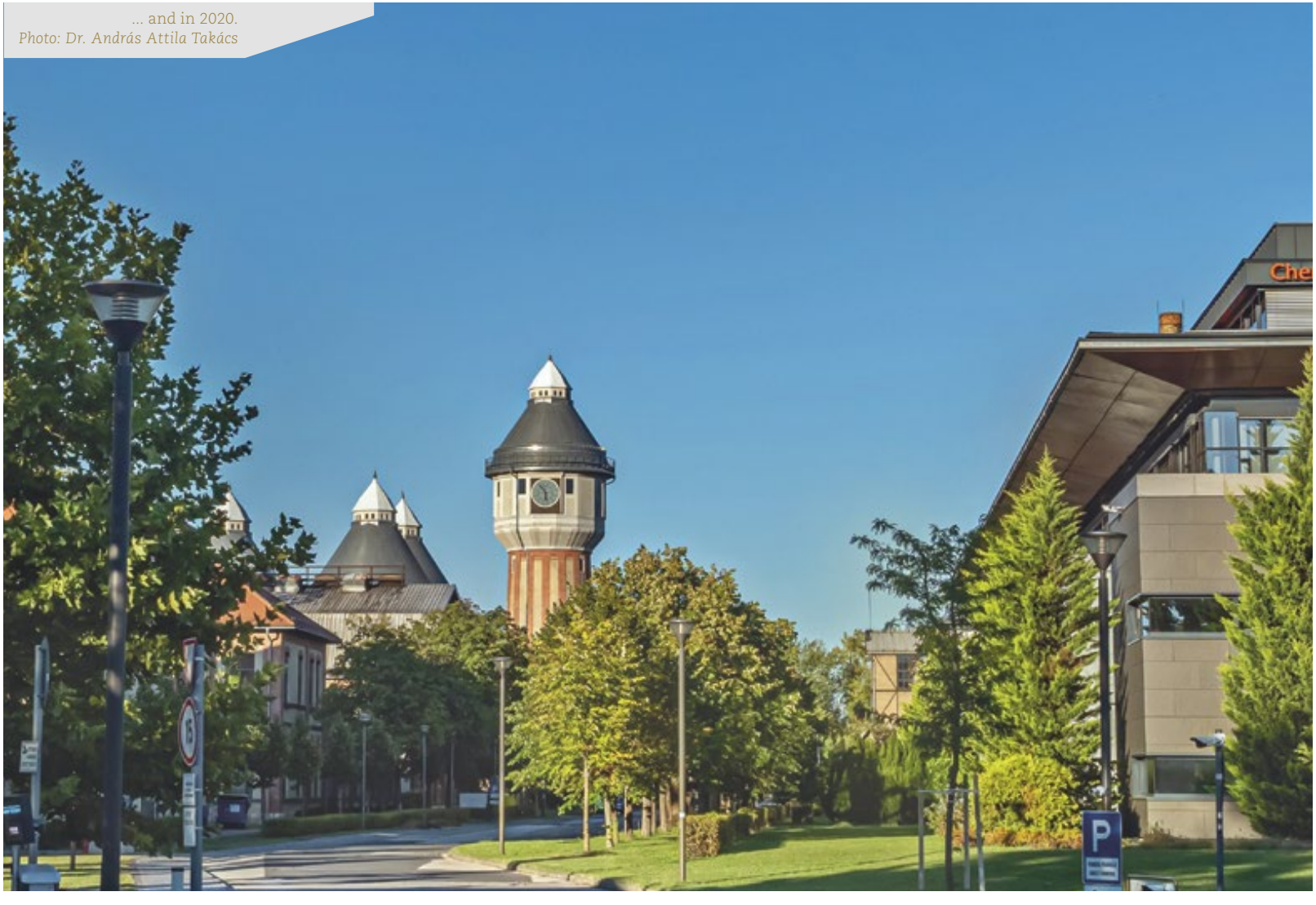
The success of brownfield investments can be visibly experienced in the reviving beauty and value of the abandoned sites, such in the case of Graphisoft Park, where the development began in 1997 on the abandoned site of the former Óbuda Gas Plant. Gas had been produced from 1918 over 70 years in the area and vast land contamination had been resulted. Prior to purchasing the area, contamination risk assessment was carried out by the investor. On the basis of the results of the assessment, the risk was acceptable, the expenditure of the remediation could fit into the development plan. The area was taken over in 1997, the buildings and utilities were demolished and the first buildings were built in the following year. The Park has been continuously developed over the last twenty years, and recently the area has provided offices, laboratories and areas for educational purposes with total useful space area over 82,000 m2 for rent. The area offers job for more than five thousand people and nearly one thousand students study there. By this modern, sustainable investment of the twenty-first century, and the creation of new jobs, the brownfield site was successfully reintegrated into the spatial and economic structure.[48]

The main expectation from these interventions is to ensure a sustainable, healthy and clean city attractive for entrepreneurs, investors, and residents. In addition to the development results, the long-term collaboration between the local governments and local enterprises, and between the public and private sectors is also necessary for the renewal of urban environment, and stimulating the economy and employment.



6.1. picture: Graphisoft park in the 1900s
Photo: István Antal [49]

... and in 2020.
Photo: Dr. András Attila Takács



NATURE CONSERVATION

7. NATURE CONSERVATION

7.1. European Union efforts on nature conservation

The backbone of the European Union's policy for nature conservation is the Natura 2000, a network of protected areas designated under two Directives on nature conservation (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora [50] and Directive 2009/147/EC on the conservation of wild birds [51]). The main purposes of the Natura 2000 network are to protect Europe's biodiversity, to ensure the long-term survival of Europe's most valuable and threatened species and habitats, contributing to the maintenance and restoration of favourable conservation status of these habitat types and species. The establishment of the network provides a regulatory framework that helps the EU Member States to meet their obligations under the International Convention on Biological Diversity. [52] By protecting our natural heritage, we can preserve Europe's wild flora and fauna and their habitats for future generations.

There are 525 Natura 2000 sites in Hungary, covering a total area of 19,950 km^2, which is 21.4% of the total area of Hungary. Natura 2000 sites overlap with designated areas of national nature conservation legislation (e.g. national parks).

With Hungary's accession to the EU, the Pannonian region, dominantly located in Hungary was added to the six biogeographical regions of the European Union. In the Pannonian biogeographical region, several species and habitat types are listed that are naturally not occurring in other European territories. In case of species and habitat types found only in Hungary, the so-called "pannonics", we have a particularly great responsibility to ensure the adequate size for these designated areas regarding the given habitat type and the population of the species, because their survival within the EU depends primarily on Hungary. Such Pannonian habitat types are: the Sub-Pannonic steppic grassland, the Pannonic loess steppic grasslands and Pannonic sand steppes, and among the woody habitats the Pannonic woods with *Quercus petraea* and *Carpinus betulus* and the Pannonic inland sand dune thicket (Junipero-Populetum-albae). Hungary's endemic plant and animal species or subspecies of special importance, listed in the Annex of the Habitats Directive are for example: the Hungarian pasque flower (*Pulsatilla flavescens*), dolomite flax (*Linum dolomiticum*), the Sadler's fennel (*Ferula sadleriana*), the Hungarian blind snail (*Bythiospeum hungaricum*) and the Hungarian meadow viper (*Vipera ursinii rakosiensis*).

Under the Habitats Directive,[50] all Member States shall submit a comprehensive and detailed report to the European Commission every six year about the conservation status of all habitats and species listed in the Annexes of the Habitats Directive (habitat types and species of Community interest) and the nationally implemented measures related to their conservation. Under the Habitats Directive, all the Member States, including Hungary submitted a national report for the first time in 2007.
The conservation status of natural habitat types of Community interest is derived from the assessment of four components: range, the area covered by the habitat within its range, structure and functions (species composition, fragmentation, presence of invasive species, vulnerability and success of conservation management) and future prospects considering the main pressures and threats.
The assessment of the conservation status of species of Community interest consists of analysing the following components: distribution, population size, suitable habitat area, future prospects including main pressures and threats and nature conservation measures.

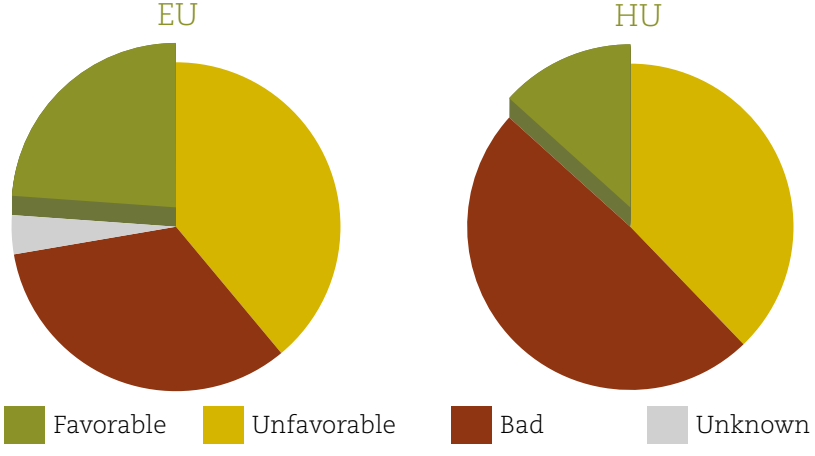
Felis silvestris, which is strictly protected in Hungary
Photo: Dr. András Attila Takács

Based on the analysis of the above components, the overall conservation status of a given species or habitat type of Community interest may be "favourable" (FV), "unfavourable – inadequate" (U1), "unfavourable – bad" (U2) or "unknown" (XX).

The conservation status of habitat types of Community interest determines the conservation status of the associated wild flora and fauna, thus also the condition of the ecosystem in the given region. Habitats ensure the survival of population of animal species living in a region, by providing sheltering, nesting places and food. In case of plants, the nutrient content of the soil, access to light or ensuring non-disturbance also depend on the conservation status of the habitats. Therefore, it is of crucial importance to maintain the favourable conservation status of habitat types or restore areas by appropriate conservation management, reducing the effects of main pressures (e.g. the spread of invasive alien species, inappropriate forestry or agricultural activities).

Since the vast majority of habitats have an unfavourable conservation status both on Hungarian national and EU level, their current condition does not ensure their long-term existence, nor does the survival of the living organisms associated with them. According to the latest national report in 2019, habitat types in Hungary are in a less favourable status than the European Union average (Figure 7.1), which refers to the high degree of sensitivity of Hungary's unique habitats. Many of the habitat types of the European Union occur only in Hungary, such as the Pannonic inland sand dune thickets (Junipero Populetum-albea) at Bugac, Pannonic salt steppes and salt marches, unique Rupicolous pannonic grasslands, the Sub-pannonic steppic grasslands with swaying feather grass reminiscent of ancient times, the Pannonic loess steppic grasslands, and among the woody habitats the Pannonic woods with *Quercus petraea* and *Carpinus betulus*, hence it is the duty and responsibility of all of us to preserve them.

Figure 7.1.: Conservation status of habitat types of Community interest in the European Union (EU) and in Hungary (HU) based on the national reports submitted in 2019 [53]



The 45 habitat types of Community interest occurring in Hungary, can be classified into four major groups: forest habitats with woody vegetation, grassland habitats with herbaceous vegetation or forming mosaics with woody vegetation, habitats related to water (e.g. bogs, lakes, watercourses, fens) and rocky habitats and caves.

Assessing the conservation status of each group separately (Figure 7.2), grasslands are the most vulnerable habitat types due to inadequate land use (under-grazing or over-grazing), or the lack of appropriate management (complete abandonment of traditional cultivation, such as lack of grazing or mowing). Invasive non-native plant species also pose a serious threat to grasslands in Hungary, by spreading rapidly they can alter the landscape quickly and displace the native species of a given habitat type. Our grasslands are also threatened by conversion into arable lands, or contamination of pesticides percolating from neighbouring farm fields, as well as by human disturbance (for example motocross, downhill cycling, large-scale mass events that cause trampling damage, increasing degradation and the chance for invasive non-native plant species to appear).

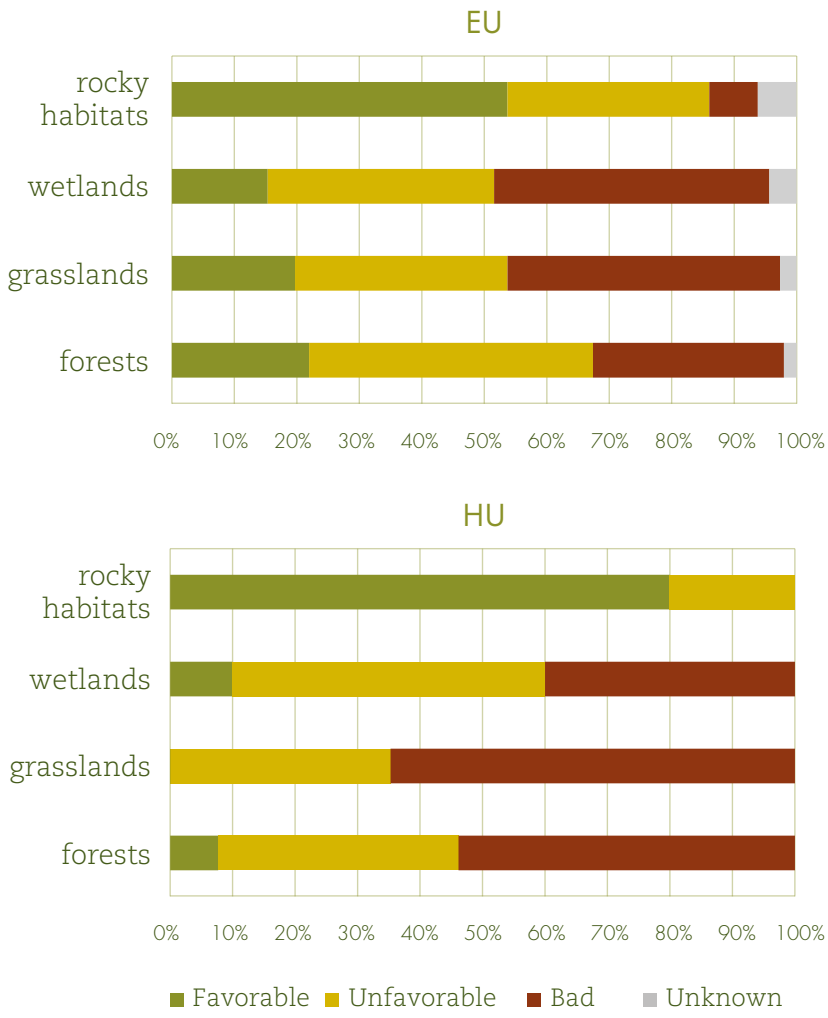
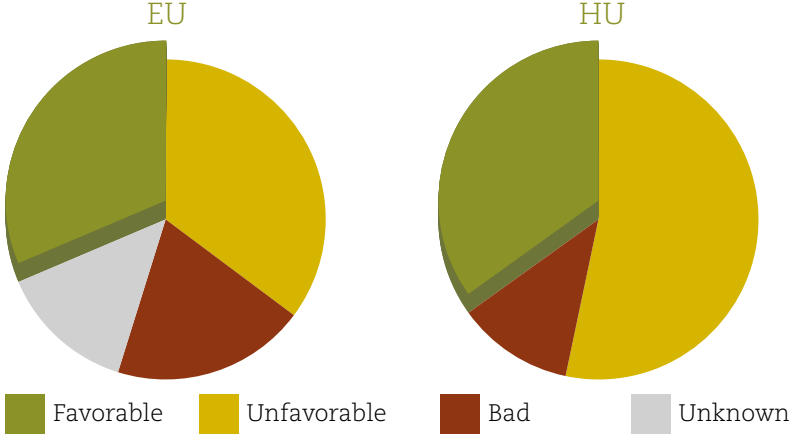


Figure 7.2.: Conservation status of habitat type groups of Community interest in the European Union (EU) and in Hungary (HU) based on the national reports submitted in 2019 [53]

Rocky habitats are the habitat type category with the highest proportion of favourable conservation status in Hungary, their extent seems sufficient thanks to the fact that their conversion into arable land, just as their accessibility for individuals is very difficult. Although some pressures still remain, e.g. trampling associated with animal activities (for example trampling of non-native mouflons on rocky grasslands) and human activities (related to excessive hiking tourism and using runways for paragliding) is considered to be the major pressure for rocky habitats. The Hungarian woodland and wetland habitat assessments frequently show an unfavourable or bad conservation status, below the EU average. Unfavourable overall conservation status of forests is more frequently due to excessive destructive human intervention (for example deforestation, removal of dead trees which provide food and shelter for forest-dependent insects, mosses) and introduction of invasive non-native species associated with forest degradation process, ultimately displacing native species, thereby completely altering the original forest landscape.

The wetland habitat types are among the most vulnerable habitats. They are directly related to our water regimes and they are heavily affected by drought, which is an increasingly common phenomenon in Hungary and one of the main water-related pressures. The effects of former drainage activities and today's water management policy are also responsible for the unfavourable conservation status of wetlands, due to these activities, the extent of wetlands have been constantly decreasing and they have been physically isolated from each other. The more fragmented the expanse of a habitat type is and the smaller the size of the patches are, the more vulnerable the habitat type is and less able to adapt to the changes of the environmental factors. Hungary is particularly rich in hot springs and thermal waters, but invasive non-native freshwater plant species from the tropics can be easily introduced in these waters by human mediation, which after a while can be able to adapt to cooler waters (for example Carolina fanwort - *Cabomba caroliniana*) and block entire sections of watercourses, thereby blocking oxygen from the water, slowing down the movement of water and either causing the perish of aquatic animals and plants.

Figure 7.3.: Conservation status of species of Community interest in the European Union (EU) and in Hungary (HU) based on the national reports submitted in 2019 [53]



Regarding the conservation status of animal and plant species of Community interest, in Hungary most species are classified as unfavourable, and although the proportion of favourable conservation status is lower than the EU average, smaller proportion was defined as bad at the same time (Figure 7.3). Compared to the data of EU's regional assessments, our knowledge regarding the status of species is more profound, because there's no animal or plant species in Hungary with non-evaluated status, while the evaluation of status of species caused difficulty for the other Member States, which is reflected by the 16% unknown conservation status at EU level.

We can get a more detailed picture, if we analyse the conservation status of the taxonomic categories separately (Figure 7.4). The proportion of favourable conservation status of fish is remarkably higher in Hungary than in the EU, and although to a lesser extent, it is generally true for mollusc species (snails, mussels), amphibians and reptiles (apart from a few endangered reptile species) as well. The conservation status of arthropods is similar to the EU average, while in the case of plants and mammals the proportion of species of favourable conservation status is lower than the EU average, but fewer were classified as bad.

Based on the above, it is apparent that more effective conservation measures are required in Hungary to reach improvement in the conservation status of many habitat types and species. Maintaining or restoring the current conservation status of habitats is essential to ensure the long-term viability of species. At the same time, it is to be concluded that in many cases more species and habitats have favourable conservation status in Hungary than the EU average, and these positive results are also helping us to focus on pressures addressed.

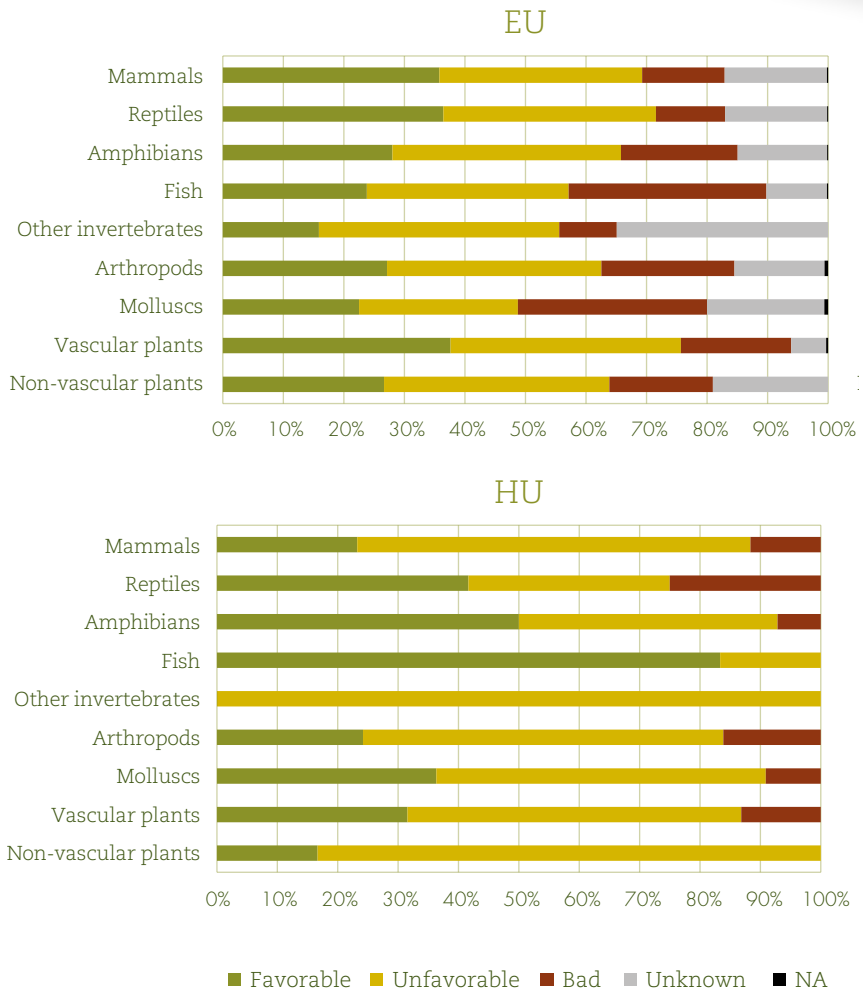


Figure 7.4.: Conservation status of taxonomic groups of species of Community interest in the European Union (EU) and in Hungary (HU) based on the national reports submitted in 2019 [53]

RATIOS IN PERCENTAGE OF PRESSURES AFFECTING HABITAT TYPES

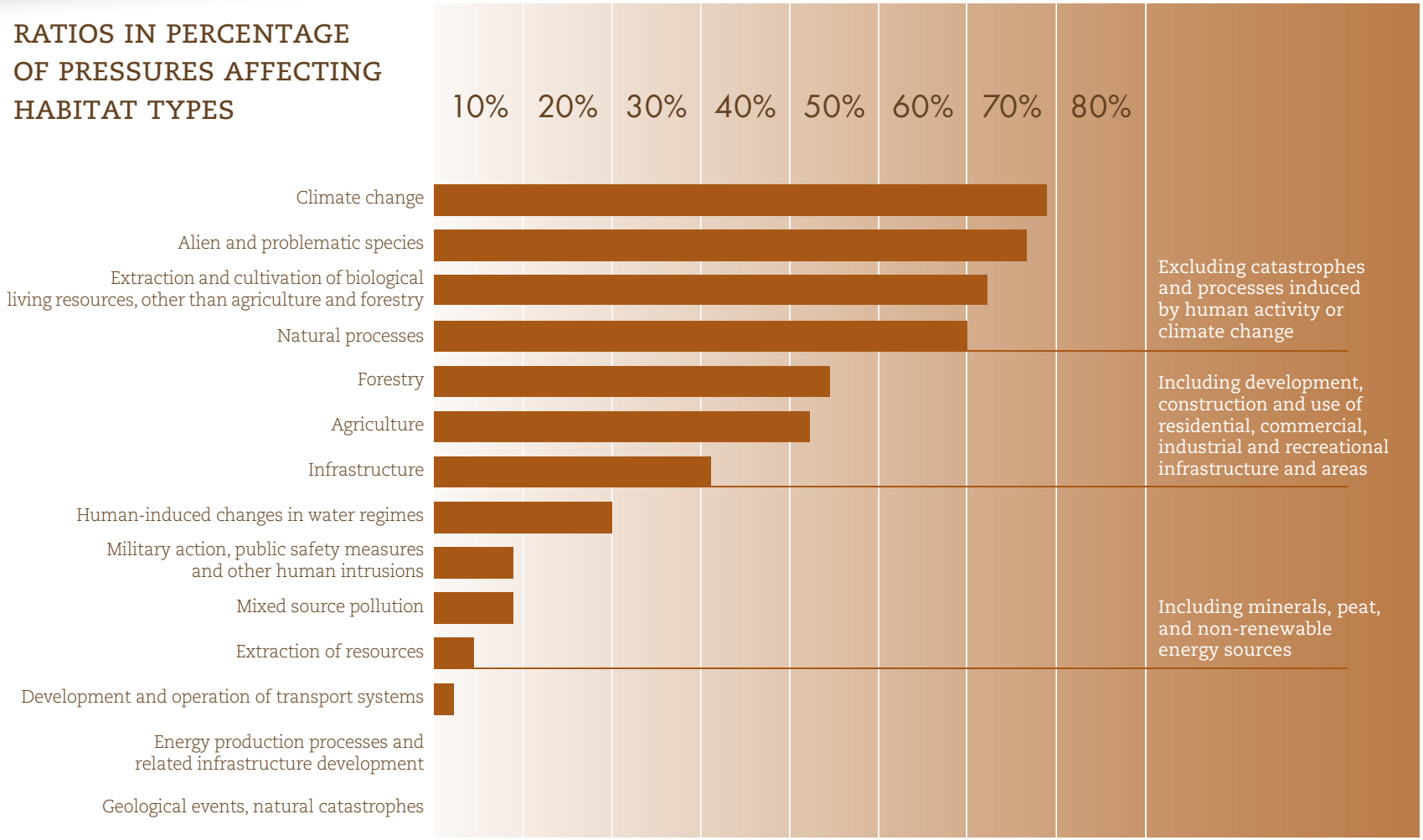


Figure 7.5/a: Ratios in percentage of main categories of pressures affecting the habitat types of Community interest in Hungary based on the national report submitted in 2019 [53]

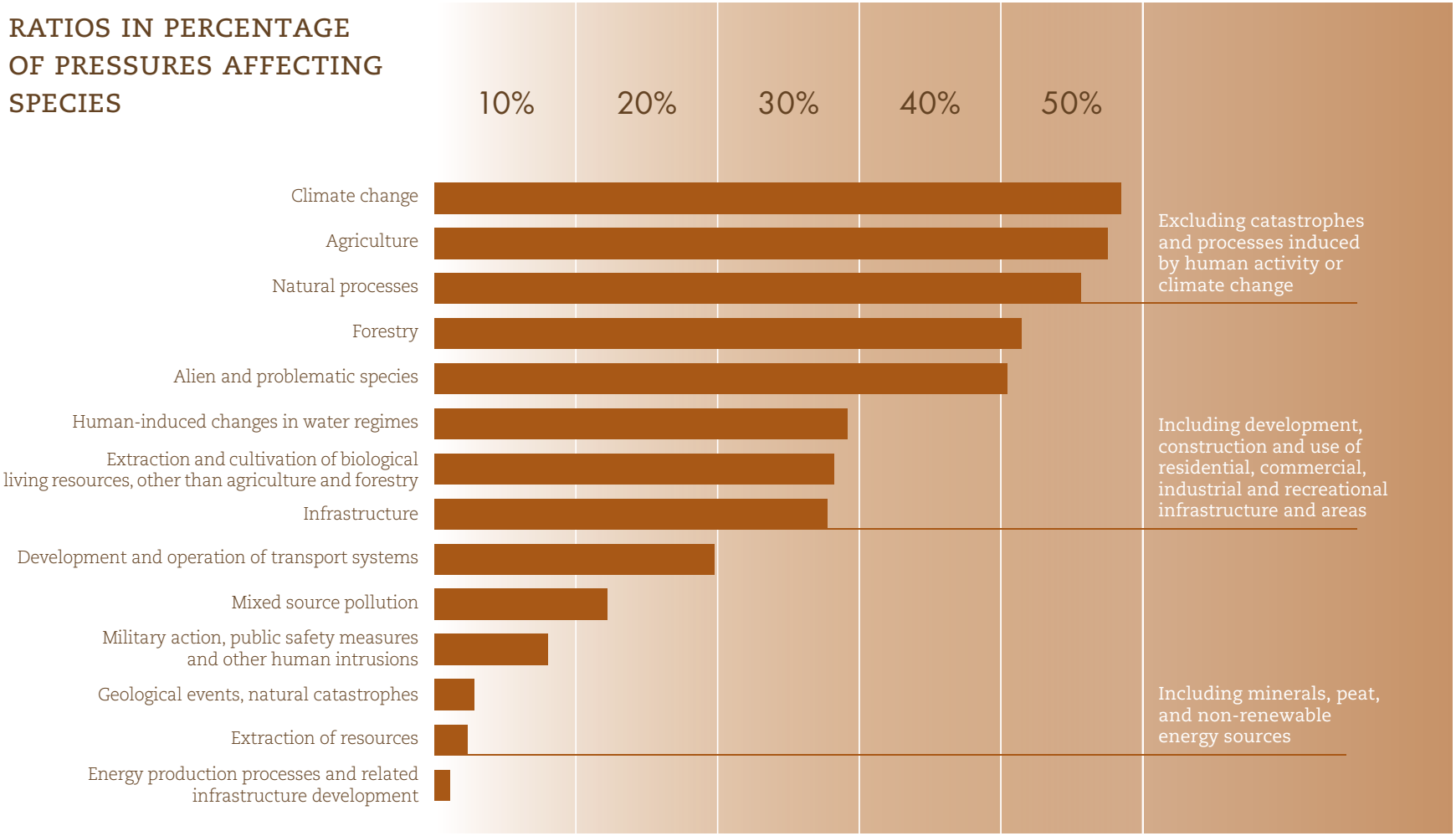


Figure 7.5/b: Ratios in percentage of main categories of pressures affecting the species of Community interest in Hungary based on the national report submitted in 2019 [53]

In course of discussing the conservation status of the habitat types, several pressures were mentioned. Figure 7.5/a presents the proportions of these factors affecting the habitat types of Community interest in Hungary based on the national report submitted in 2019. Due to the page constraints, only main pressure categories are displayed on the chart. It is to be concluded that approximately 70% of the habitat types are affected by climate change and the presence and expansion of invasive non-native species is not far behind from this value (68%). Furthermore, natural processes like changes of abiotic factors (e.g. erosion), accumulation of organic material, eutrophication or acidification, furthermore natural succession (progressive changing of the composition of plant communities, resulting the decrease of biodiversity) resulting in the change of species composition is to be reckoned among these factors. Under the main category of living biological resources, main threat is the damage caused by herbivores (including game species) resulted by the overpopulation of these organisms. This threat includes trampling and grazing too, and its proportion is high even in terms of the ratio of habitat types affected (62%). Threats originating from development, construction and use of residential, commercial, industrial and recreational infrastructure and areas need no further explanation because the growth of the area occupied by these infrastructure results in the decrease of the proportion of natural areas, thus its effect is undoubtedly negative. The category human-induced changes in water regimes consists of abstractions of surface and groundwater and modifications of waterflow. Fortunately, the magnitude of effects caused by these processes reducing continuously similarly to the impact of energy production processes (primarily mining) on habitat types of Community interest.

Ratios of the pressures affecting species of Community interest in Hungary are very similar to the ones discussed above, in case of the habitat types (Figure 7.5/b). Climate change is in the first place, which worsens the chances of survival of native species through loss of habitats or changing of habitat-structure. Improperly designed and performed commercial activities, development of infrastructure and road network are challenging the survival of native species living in grasslands, forests or even in aquatic habitats and wetlands. This category includes the acceleration of successive processes resulted by the inappropriate management of habitats e.g. the scrubbing and afforestation of grasslands or the filling up of eutrophic waterbodies. These processes resulting that the habitat structure becomes unsuitable for the survival of the original inhabiting species. The uncontrolled expansion of invasive non-native species results drastic transformation in the structure of habitats displacing the native species. Direct pollution and the perish of organisms are not to be considered as major threats, which is a favourable condition.

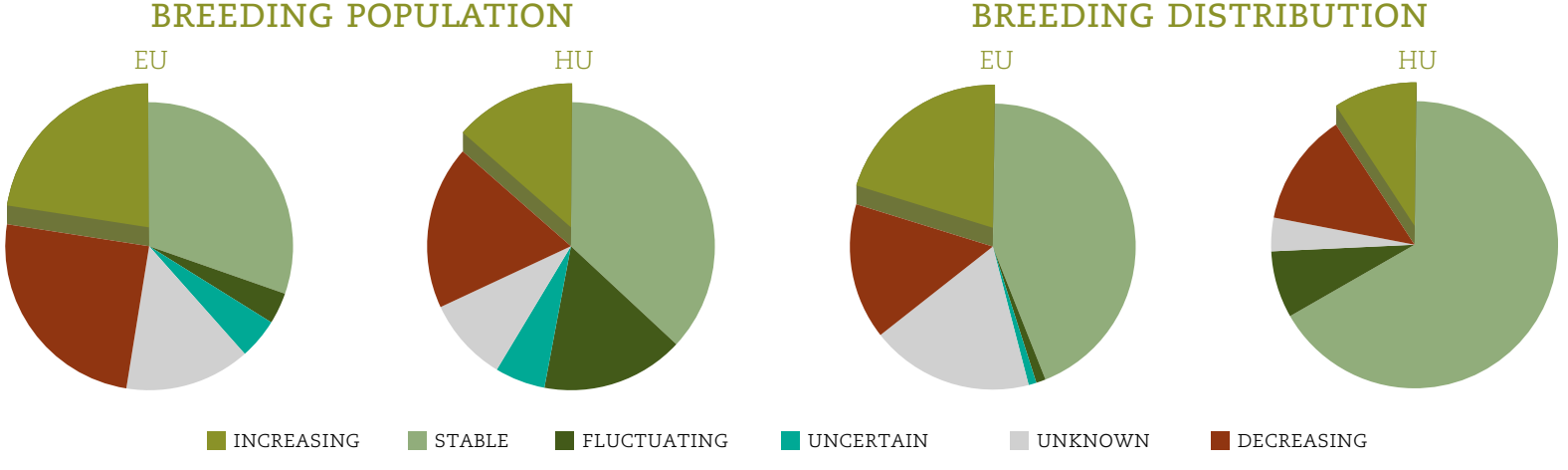
Summarizing, it is to be concluded that there is a broad scale of pressures and threats affecting the wildlife and natural habitats in Hungary. These factors are directly or indirectly linked to anthropogenic activities; thus, the proper conservation management of these sites has to be emphasized in order to ensure the long-term preserving of the special and unique wildlife of the country.

The aim of the Birds Directive [51] is to protect naturally occurring breeding and migrating bird species in EU territories. Its primary means is the designation of special protection areas (SPA). Annex I. of the Directive lists 181 bird species that should be protected through the designation of special protection areas. The Member States – including Hungary – submitting a report every six year according to the guidelines of the Directive. In case of species falling within the scope of the Birds Directive the status of the bird populations are characterized based on two aspects: short-term changes in population size and distribution.

The results of the Hungarian national report submitted in 2019 (Figure 7.6, 7.7) conclude that the populations of breeding species are stable. Although the proportion of species with growing population size or expanding distribution is below the EU average, the low ratio of species with declining values and the high proportion of species with stable state should be considered as positive state. Furthermore, according to the graphs the knowledge on the size and distribution of populations of the species of interest is outstanding compared to the EU average. Summarizing, it is to be concluded that the majority of the population of breeding bird species falling within the scope of the Birds Directive can be characterized with a relatively good state, however worrying declines are to be detected as well.

Figure 7.6.: Short-term population trend of breeding species in the European Union (EU) and in Hungary (HU) based on the national reports submitted in 2019 [53]

Figure 7.7.: Short-term trend in distribution of breeding species in European Union (EU) and in Hungary (HU) based on the national reports submitted in 2019 [53]



Management of invasive non-native species

Nowadays, besides the loss, decline and degradation of natural habitats the expansion of invasive non-native species poses the most serious threat to the native flora and fauna. Invasive non-native species can be characterized as organisms occurring outside of their original distribution range as result of human mediated introduction and threatening the communities of indigenous plant and animal species with their establishment and expansion. In Hungary most of these species are introduced from regions with similar climatic condition e.g. the temperate regions of North-America and Asia.[54, 55] Once these species are established in a region, they begin to spread causing the displacement of the native flora and fauna, thus completely transforming the communities and their environment. Invasive non-native plant species starting to spread intensively under new circumstances and influencing negatively the development of the native species through shading, abstraction of nutrients or emission of inhibitors, either causing their displacement. Among the invasive non-native animal species there are those causing harm though predation of native species or being competitors, spreading dangerous infections or hybridizing with related native species (leading to the genetic degradation of populations).[54]

Non-native species not necessarily become invasive. Out of thousand introduced species about hundred are viable to enter the new ecosystem, only ten out of hundred will be able to become established and only one will show an invasive character and become widely spread. However, as result of many of such introduction events there are several hundred invasive non-native plant and animal species capable to spread more or less intensively in the Carpathian Basin. These undesirable newcomers arrive on various routes to us. The maximum possible control over these routes, the early detection and prevention of spread of invasive non-native species shall be considered as common interest and duty.[54, 55]

Recognizing the importance of invasive non-native species and the damage caused by them, an EU level regulation was created, operative since the 1st of January 2015 [Regulation (EU) No. 1143/2014 of the European Parliament and of the Council on the prevention and management of the introduction and spread of invasive alien species[56]], which regulates and standardizes the effective common action on EU level against these dangerous species without borders. The regulation focuses primarily on the prevention and early detection of the threat, thus prohibiting those activities which possibly result the invasive non-native species entering local ecosystems and their spread. It specifies the synchronized action in order to preserve the biological diversity and the ecosystem services it provides. According to the prescriptions of regulation the actual situation of invasive non-native species should be reported in every six years by each and every Member State.

Figure 7.8.: Ratio of invasive alien species in Hungary by occurrence; based on the list of species posing threat to the EU [55]

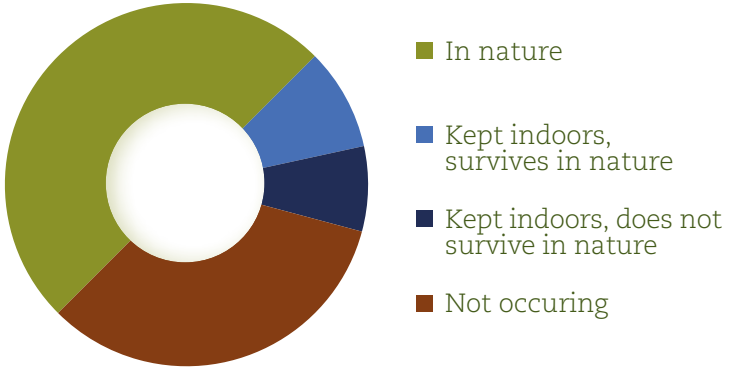


Figure 7.9.: Taxonomic proportions of the 33 invasive alien species detected in Hungary under natural circumstances [55]

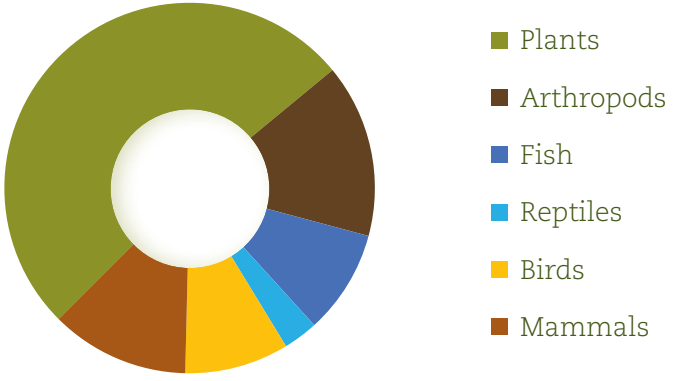
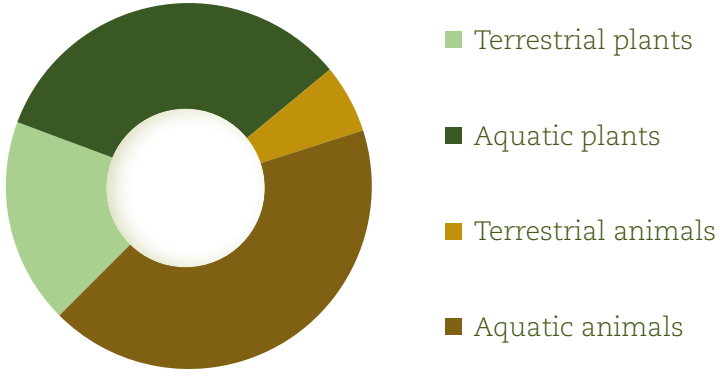


Figure 7.10.: Ratio of terrestrial and aquatic invasive alien plant- and animal species in Hungary [55]



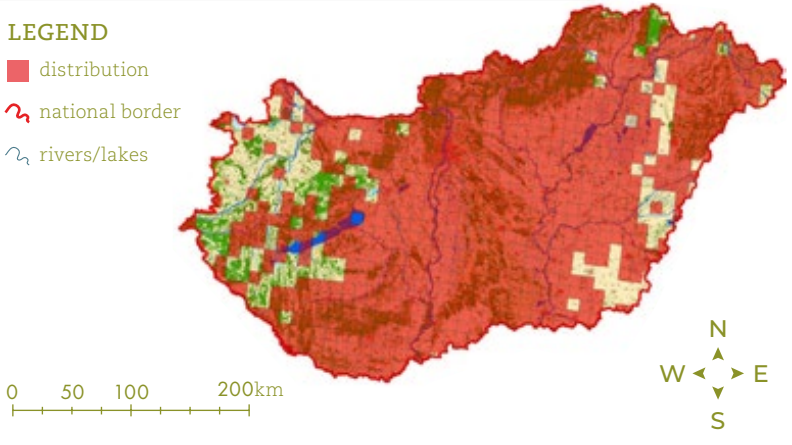
The implementation legislation contains the list of those species that are considered to pose a great threat for the EU and which are falling under a strict ruling e.g. the prohibition of their import, keeping or transport. This list currently consists of 66 species from which 44 can be found in Hungary. 33 of these species occur in natural environment and 11 more known to be present in captivity (e.g. zoos, aquariums or terrariums - Figure 7.8). [55]

In terms of proportions of different taxonomic categories of invasive alien species in Hungary (Figure 7.9) it is to be concluded that half of these species are plants. Furthermore, some of them are so widely distributed or has propagative strategy, which makes impossible to take appropriate actions against them.

An especially complicated case is when authorities have to face aquatic invasive alien species. The difficulty is resulted by the limited possibilities of selective control because the currently available chemicals are non-selective, thus eradicating both native and alien species in the waterbodies. The more problematic aspect of this phenomenon is the conspicuously high proportion of aquatic invasive alien species (Figure 7.10).

The North-American, aggressively expanding **common milkweed** (*Asclepias syriaca L.* – Picture 7.1) is one of the plant species listed in the annex of EU regulation. The species was introduced in Hungary for textile industrial purposes and its expansion was supported by the intensive cultivation between 1870-1950. However, it was only proven to be useful as bee pasture, thus the plantations were abandoned. These abandoned plantations were the main source of the expansion which was helped by its long-surviving seeds carried far by the wind, strong competitive ability, drought resistance and vegetative propagation by rootstock (Figure 7.11). The expansion of common milkweed is the most intensive on loose soils and disturbed habitats ranging between sand steppes to meadows on floodplains. More recently notable populations on loess and denser soils were established. Common milkweed transforms its environment where the extended rhizome-colonies displacing native elements of flora. The glade of this plant was obligatory before enlistment of the species in the annex of the EU regulation. However, to avoid the worsening of present situation it is required to imply a persistent, long-term management.[55]

Figure 7.11.: Distribution of common milkweed in Hungary, visualised in 10x10 km sized ETRS quadrats[55]

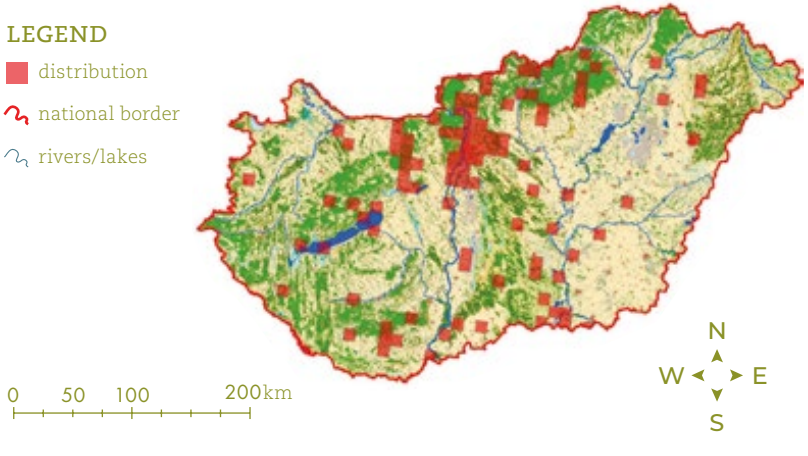


Picture 7.1.: Common milkweed
Photo: Dr. András Attila Takács

The **pond slider** (*Trachemys scripta* – Picture 7.2.) is also listed in the annex of the EU regulation. The species is originally native to North-America and was introduced due to hobbyists who released their bored pets. These individuals became established in Hungary and now widely distributed throughout the country (Figure 7.12). The species occurs frequently in ponds near human settlements, but can be found in more remote areas too. The pond slider can reproduce under local circumstances and there are suggestions on the over-wintering of younglings. This species is listed within the 100 most dangerous invasive non-native species of the EU. Pond slider is strong competitor of the native European pond turtle (*Emys orbicularis*).[55, 57]

Picture 7.2.: Red-eared slider
Photo: Dr. András Attila Takács

Figure 7.12.: Distribution of pond slider in Hungary, visualised in 10x10 km sized ETRS quadrats [55]



7.2. HUNGARIAN NATURE CONSERVATION PROGRAMMES

Hungarian Biodiversity-monitoring System

To assess the status and to track long-term changes of biodiversity in our country the Hungarian Biodiversity-monitoring System (HBMS) is operating for 20 years by the Department of Nature Conservation of the ministry responsible for nature conservation issues. The monitoring system is in correspondence with international treaties, EU and national legislation. The main purpose of HBMS is to track the status of native protected and endangered species, to observe the indicators of Hungary's wildlife and its communities and to assess the direct and indirect impact of human activities and environmental factors. The data collected provide basis for the conservation management, legislative and planning tasks and help to fulfil the EU and international reporting obligations.

Biodiversity monitoring means the long-term assessment of certain characteristics of selected organisms and communities. The aim of monitoring can be the observation of natural conditions for the purpose of comparison or the studying of known or forecasted environmental changes affecting wildlife e.g. decline of groundwater-level, river regulation or climate change. Considering that the number of species and habitats is enormous, monitoring everything and everywhere is not possible and superfluous. In order to achieve the goals set, more than a hundred carefully selected components are monitored under HBMS on more than a hundred permanent and variable sampling sites. These components are the following: habitat types; plant associations; protected and invasive plant species; bryophytes; mushrooms; mammals (small mammals - included separately, via analysis of owl pellet; root vole, bats, European ground squirrel, mound-building mouse, dormice); highly protected and mass-nesting birds (31 rare species with stable population and 28 mass-nesting bird species); amphibians; reptiles; fish; aquatic macroscopic invertebrates; dragonflies; diurnal lepidoptera; nocturnal macrolepidoptera; geophilous arthropods; orthopteran insects. Different regional monitoring programmes include further groups of organisms (e.g. birds, molluscans, spiders, caddisflies, algae, zooplankton), considering the characteristics of the locality.

In order to standardize the observations detailed guidance (i.e. protocols) were made with the involvement of researchers specialized in the target groups. These practical guides contain the location of sampling sites, the parameters to assess, detailed description of methods, frequency of sampling and criteria of data processing. Most groups of organisms are monitored with the involvement of specialists, though the involvement of non-governmental organisations, volunteers from schools is necessary in case of tasks which does not require special knowledge. Besides performing professional tasks awareness raising should be considered as priority too. The conservation of Hungarian wildlife which is rich even compared to European conditions requires social cooperation, to fulfil the tasks the support of governmental branches and residents is needful. [58, 59, 60]

Twenty years of operation of a biodiversity monitoring programme is an appreciable period and even compared to European or international conditions experiences of programmes similar to HBMS are to be considered as rarity in terms of complexity and scale. Nowadays, HBMS which has scientific value is indispensable for the knowledge-based nature conservation work. This fact is proven by the wide-range applicability of results which is demonstrated on the following three examples.

The **marsh gladiolus** (*Gladiolus palustris* – Picture 7.3) is an endangered plant species with Alpine-Illyrian distribution which has few isolated populations in Hungary (in the operative area of Bükk, Balaton-Uplands and Kiskunság National Parks). In correspondence with its name, the marsh gladiolus is to found primarily in fens, but also occurs in sand steppes, mountain meadows, woodlands, steppic oak forests, woodlands with *Quercus cerris*. Earlier its populations were threatened by the disappearing, transformation and inadequate management of the suitable habitats.

Based on the data of the national report of 2019 which was prepared in accordance with article 17 of the Habitats Directive, it is to be concluded that populations of the species have grown five times compared to the year 2007. The growth was largely increased by the habitat management implemented by the Kiskunság National Park Directorate e.g. melioration water retention, furthermore artificial propagation programme was carried out by the Bükk National Park Directorate.

Picture 7.3.: Marsh gladiolus
Photo: Kinga Bata

The Hungarian populations of the **wolf** (*Canis lupus* – Picture 7.4), a species assessed by HBMS, have remarkably declined by the end of 19th century, the species has become extinct in most parts of the country. There were sporadic sightings of the species for longer or shorter periods during the 20th century. These occurrences were mostly limited to the area of two major regions, the Dunántúl (West-Hungary), southern part of Duna-Tisza köze (middle of Hungary), and to the Northern Medium Mountains and Szabolcs-Szatmár-Bereg county (Northeast Hungary). These sightings suggest that wolves were continuously attempting to repopulate Hungary. The expansion of the species may have originated from two source population, the Dinaric and the Carpathian one.

Based on the available data the Hungarian population size of wolves was fluctuating, but showed a growing tendency in the past three decades. The individual sightings mostly reported one to four wolves moving together. The greatest estimated number of individuals countrywide was 20-25, though there were at most 2-5 families settled and the size of the new generations often remained unknown. However, there were years when only one individual was detected.

In the last 5-6 years the repopulation of wolves in Hungary accelerated. The centre of the process is concentrated in the Bükk Mountains where even the settlement and persistency of families were detected. The possible reasons of the growth can be the increase of food sources, better public perception of the species, increased extent of suitable habitats, furthermore positive and negative changes of source populations.

The wolf was considered to be extinct in Hungary by the early 1990's. The species was not included on the list of protected species; thus, its hunting could be allowed with the ad hoc authorization of the hunting and nature conservation authorities. After the spontaneous repopulation of the species, it became protected in 1993 and shortly after that strictly protected in 2001. Currently its conservation value expressed in money is 250 000 HUF.

Picture 7.4.: Wolf
Photo: Dr. András Attila Takács

Monitoring small mammalians via the analysis of owl pellet contents

The primarily nocturnal small mammals are determinative elements of food webs. The direct observation of these species has a great energy- and time-cost; thus, we are monitoring the food composition of owl species distributed countrywide (Picture 7.5), which represents the changes in composition of small mammal communities. The owls gagging back the remnants like bone and fur which cannot be digested in form of pellets; these pellets can be collected and with their analysis information on the food composition of the owl can be acquired; from this information the community conditions of small mammals of a specific area can be derived.

Picture 7.5.: Little owl (*Athene noctua*) with prey
Photo: Bence Máté

As part of the HBMS primarily the food composition of barn owl (*Tyto alba*) is assessed. In course of the 19-years, country wide survey a sum of 84 711 owl pellets were collected, 307 323 prey animals were identified from which 304 323 were identified as small mammals i.e. 98.81% of the food sources of barn owl was coming from small mammals. The small mammal species can be usually linked to a major habitat-type category; thus, we can characterize the long-term changes in small mammal communities of the open areas of forests and wetlands, or anthropogenic communities based on the data.
The results of the monitoring i.e. the measurable proportional changes in composition of owl pellets show that remarkable changes characterizing the small mammal communities related to human presence; the communities of forest are less affected (Figure 7.13). In case of the small mammal communities of open, treeless areas (meadows, arable fields, etc.) a stagnation, while in case of wetlands stagnation or slight decreasing tendencies can be observed. The increase in population size of organisms accustomed to anthropogenic presence is a constantly observable phenomenon which is spectacular evidence of adaptability of wildlife. As it can be observed in case of other groups of organisms, wetlands and associated species are the most endangered by anthropogenic impacts, while the species of forests tolerate these changes more than the wildlife of open areas e.g. agricultural landscapes.

Figure 7.13.: Long-term changes in composition of small mammal communities associated with different habitat-type categories based on the results of HBMS
Source: Dr. Győző Horváth, University of Pécs

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Citizens for nature, citizen science programmes

The development of environmentally conscious thinking of society and the gradual shift in attitude are playing key roles in stopping the decline of biodiversity. One of its most effective tools is getting the civilians involved in nature conservation activities which has an increasing importance on both national and EU relations. The planning, performing and evaluation of results of such activities has become an individual scientific approach, referred as "citizen science" in the literature. Opportunities of involvement in Hungary are offered by voluntary data collection programmes described in the following chapter.

WildWatcher Programme

The WildWatcher Programme was launched in 2009 with a twofold purpose: gathering nature conservation data through the controlled survey of carefully selected animal and plant species, furthermore dissemination of knowledge and awareness raising through the involvement of wide strata of society in nature conservation practices.
Currently 18 animal and plant species (or group) can be recorded in the programme which are easy to identify, cannot be confused with related taxa, protected or highly protected and are of Community interest. The tool of reporting is an online surface where the recorded data immediately expands the distribution map and data of the species detected. The data of the species can be used and analysed besides the scientific data acquired, in different ways which contribute to the nature conservation planning, work of authorities and fulfilment of national, EU and international obligations. [61]

During 11 years of the programme more than 12 000 observations were recorded and the page has 35-40 000 regular visitors, users. It is open to everyone and every information required to identify the species and record data is available.

Based on the data recorded, the northern white-breasted hedgehog (*Erinaceus roumanicus*) is the most popular among species surveyed (Figure 7.14). The participants report useful data regarding the circumstances of the sighting besides the distribution data. In case of the hedgehog it became evident that traffic poses a great threat to the species.[62] Fewer distribution data is recorded in case of the insects and plants which are present in shorter periods of the year. The number of records show that among the surveyed plant species spring pheasant's eye (*Adonis vernalis*) is the most popular catching sight of the hiker with its yellow flower.

Coordinating organisations:
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Herman Otto Institute Nonprofit Ltd.
Hungarian National History Museum

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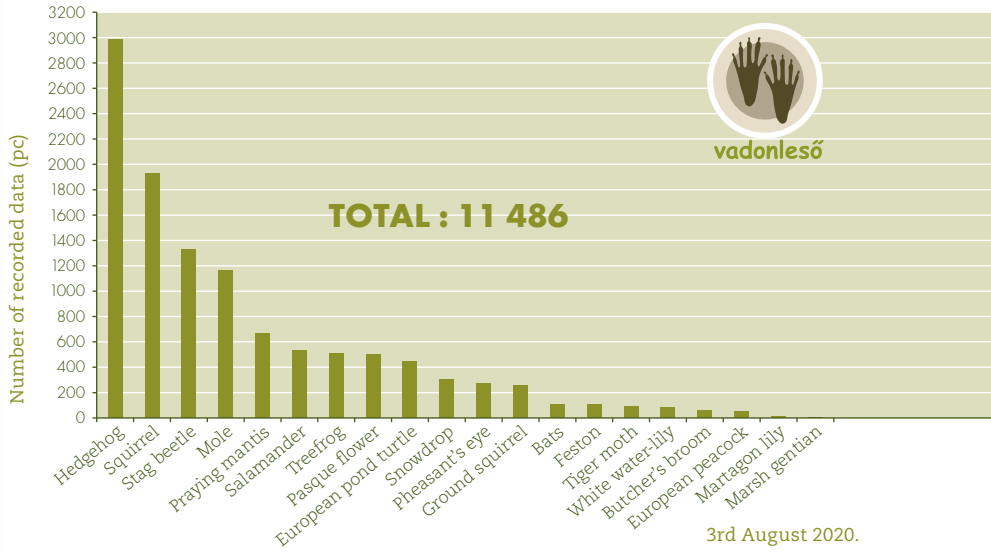
Website: *www.vadonleső.hu*

vadonleső

Figure 7.14.: Number of distribution data recorded by species in WildWathcer Programme



Monitoring of Everyday Birds

The Monitoring Centre of MME BirdLife Hungary launched a survey in 1998 on the long-term population changes of common nesting birds which are easy to identify. The antecedent of the programme is suggestion of the European Bird Census Council (EBCC) on launching of a standardized surveying programme which can effectively monitor the changes in major habitat-types through the nesting bird populations. The directorate of EBCC invited Hungary to elaborate the methodology and in the first years RSPB (Royal Society for the Protection of Birds) funded the monitoring which was considered as model in Europe. The programme offers good opportunity, inter alia, to assess the effects of joining the EU on environment and wildlife with the help of birds and to draw attention in time on undesirable changes.

The volunteer members of MME BirdLife Hungary spend two days of field work on surveying and knowledge on common bird species which can be seen everyday is enough to carry out the census. As part of the programme a randomly chosen area is surveyed by the volunteer in the preferred region of the country. This method gives a representative outline on the major habitat-types of the country because not only the "best" and "most popular" sites are monitored.

Up to now 1265 sample sites were surveyed repeatedly as part of the programme. As result of the data acquired outlines the long-term change of bird populations as it is shown of Figure 7.15. [63]

The analysis of the data acquired in the 21-years period between 1999-2019 concludes that values of biodiversity indicators of the agroecosystems, which show a considerable decline in the EU was stable in Hungary until the time of joining. Two years after joining the EU these indicators began to decrease. Unfortunately, the values of forest habitats which were stable and increasing until 2017, took a turn in 2018-2019 and the favourable tendencies seemingly cease to continue.

Based on the comprehensive analysis of the datasets of more than two decades it is to be concluded that the favourable tendencies in population changes of short-distance (Euro-Mediterranean region) migrant bird species inverted recently. These unfavourable tendencies were observable from the beginning of the programme in case of the long-distance (South of Sahara) migrant species.

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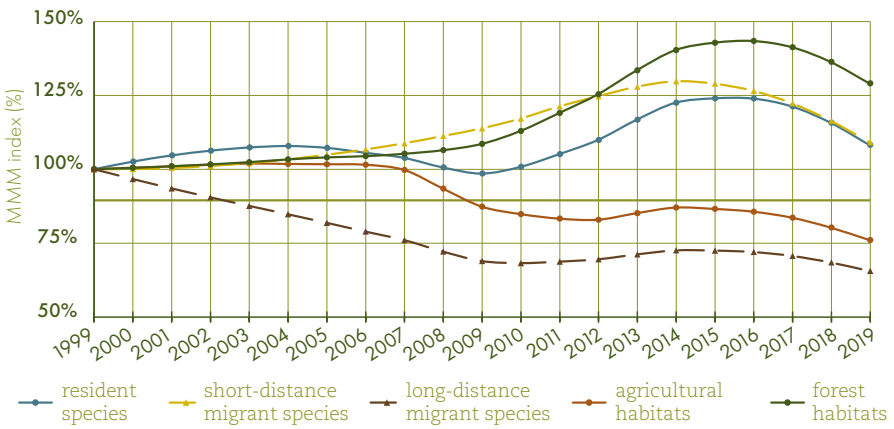
Figure 7.15.: Population changes of birds in Hungary, in nesting period based on the indices of MMM [63]



National Amphibian and Reptile Mapping

In 2011 Amphibian and Reptile Conservation Group of MME BirdLife Hungary launched a programme on the mapping and surveying of amphibian and reptile species for nature conservation purpose. Not only experts, but everybody is welcome to participate in the programme by submitting and sharing observations made even during a hike or gardening via the online surface. With the help of the programme we can get a more precise outline on the distribution of amphibians and reptiles of Hungary like ever before and assess the long-term changes of their population; these results can be incorporated in national reports submitted to the EU (reports made respectively to Habitats Directive or on invasive alien species) or in species conservation plans (e.g. viviparous lizard or Caspian whipsnake).

On the website of National Amphibian and Reptile Mapping anybody can upload the exact place of observation (either with the use of GPS-coordinates or marking it on satellite map), the description of habitat, characterization of the observed individuals and photos as proof can also be attached. The site currently contains a sum of 40 418 amphibians and 24 865 reptiles observed. In order to help the identification of the species the site contains illustrated descriptions. The interactive map visualizes the observations of the last three months by default (earlier ones can be displayed too) and the hits can be filtered by species. The obseravations belonging to specific taxa are indicated with unique icons. On species description pages a distribution map built from the received data so far. These maps are also included in MME Birdlife Hungary's knowledge base. HerpMap application for Android smartphones is also available; with its use observations can be submitted almost immediately.[64]

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Hungarian Butterfly Monitoring Network

The Hungarian Butterfly Monitoring Network was founded in 2015 as country-wide civil organisation comprising volunteers under the coordination of József Szalkay Hungarian Lepidopterist Society. The Network contributes to the work of European Butterfly Monitring System (eBMS) and the EU Pollinators Initiative, furthermore partner of Butterfly Conservtion Europe (BCE).
The goal of the programme is on the one hand the cultivation and promotion of citizen science, the drawing of attention to the importance of butterflies and other pollinators, on the other hand the programme studies and monitors the population size, diversity and spatial distribution of butterflies. The results not only serving the conservation of species, but the direction and temporality of changes provides information on the condition of environment and habitats. Furthermore, through the support of the transects managed by the national park directorates, performing fundamental assessments and backing up monitoring methods the programme helps the work of the institutional nature conservation.
In course of the programme diurnal butterflies are surveyed via transect census, during which the surveyors record the observed species along a specified route. The network of transects consists of sites managed partly by national park directorates and partly by voluteers. In 2019, there were 29 transects in the country from which 17 were surveyed by voluntary participants. On an individual sampling site monitoring is scheduled weekly which means a minimum of 30-35 occasions yearly when butterflies are observed and recorded. The programme is open for everyone who feels commitment and wants to contribute to the conservation of both butterflies and nature.[65]

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The largest Hungarian entomological community data recording site is an outstanding example on the bottom-up organized citizen science activities. The idea of the platform came from the activity of the Hungarian Facebook-group, "Rovarok, pókok" ("Insects, spiders") and went under further development. The site itself started its public operation in 2016 after a test period when it was limitedly accessible.
After the completion of registration data of observations can be recorded (e.g. number of individuals observed, GPS-coordinates, site of observation, comments) with the opportunity of uploading photos. The more precise identification of recorded taxa is performed by amateur and professional entomologists; thus, the data quality of the site is proper. According to the real-time refreshed data of the opening page, by October 2020 a sum of 153 031 observations of 12 976 arthropod taxa were recorded along with 254 029 uploaded pictures. Among the records there are valuable, protected and invasive species too. The database is completely open to everyone; thus, it can be used by experts to track long-term distribution of species e.g. observations of the invasive brown marmorated stinkbug (*Halyomorpha halys*) which occurs frequently in great masses was incorporated in a study on the expansion of the species.[66]
The page which was launched exclusively to data recording and sharing has been expanded later with further contents. Besides the data recording platform educational essays, literature to help identification and checklists of protected arthropods and species of Community interest are available too.[67]

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