MINISTRY OF INNOVATION AND TECHNOLOGY

A comprehensive assessment of the potential for the application of high-efficiency cogeneration and efficient district heating and cooling pursuant to Article 14 of Directive 2012/27/EU on energy efficiency

ITM

FUTURE IS OUR MISSION

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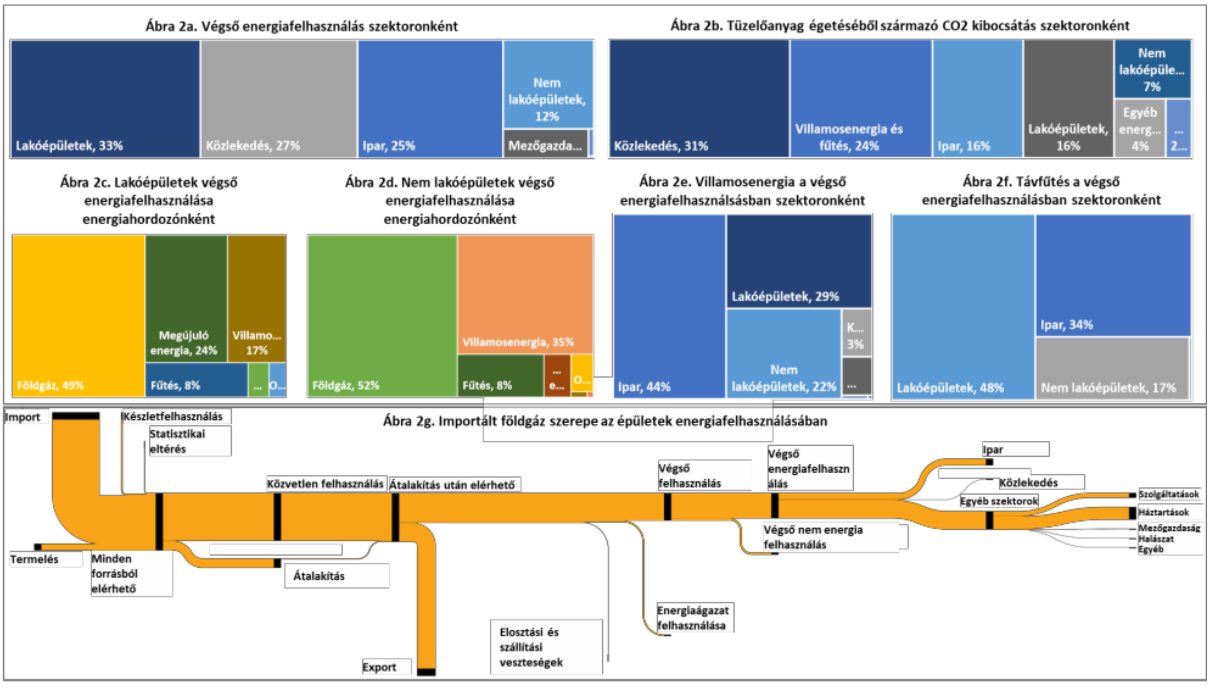
I. OVERVIEW OF HEATING AND COOLING

Buildings contributed 45% to final energy consumption and **23% to emissions of CO2 resulting from the combustion of fuels** in 2018. 50% of final electricity consumption and 65% of district heating were attributed to buildings (Figure I.1). The energy demand of buildings is largely covered by natural gas (Figures 2c and 2d), and the share used in households accounted for **41% (Figure 2g) of net gas import.** Thus, the refurbishment of buildings **decreases natural gas consumption and increases energy security and trade balance**, since the share of import of oil and natural gas was 15.2% in the 2019 marketing year (EUROSTAT).



Ábra 2a. Végső energiafelhasználás szektoronként	Figure 2a: Final energy consumption per sector
Lakóépületek, 33%	Residential buildings, 33%
Közlekedés, 27%	Transport, 27%
Ipar, 25%	Industry, 25%
Nem lakóépületek, 12%	Non-residential buildings, 12%
Mezőgazda…	Agricultural…
Ábra 2b. Tüzelőanyag égetéséből származó CO2 kibocsátás szektoronként	**Figure 2b: Emissions of CO2 resulting from the combustion of fuels per sector**
Közlekedés, 31%	Transport, 31%
Villamosenergia és fűtés, 24%	Electricity and heating, 24%
Ipar, 16%	Industry, 16%
Lakóépületek, 16%	Residential buildings, 16%
Nem lakóépületek, 7%	Non-residential buildings, 7%
Egyéb energia, 4%	Other energy, 4%
Ábra 2c. Lakóépületek végső energiafelhasználása energiahordozónként	**Figure 2c: Final energy consumption of residential buildings per energy commodity**
Földgáz, 49%	Natural gas, 49%
Megújuló energia, 24%	Renewable energy, 24%
Villamos… 17%	Electricity…, 17%
Fűtés, 8%	Heating, 8%
Ábra 2d. Nem lakóépületek végső energiafelhasználása energiahordozónként	**Figure 2d: Final energy consumption of non-residential buildings per energy commodity**
Földgáz, 52%	Natural gas, 52%
Villamosenergia, 35%	Electricity, 35%
Fűtés, 8%	Heating, 8%
Ábra 2e. Villamosenergia a végső energiafelhasználásban szektoronként	**Figure 2e: Electricity in the final energy consumption per sector**

Ipar, 44%	Industry, 44%
Lakóépületek, 29%	Residential buildings, 29%
Nem lakóépületek, 22%	Non-residential buildings, 22%
Ábra 2f. Távfűtés a végső energiafelhasználásban szektoronként	**Figure 2f: District heating in the final energy consumption per sector**
Lakóépületek, 48%	Residential buildings, 48%
Ipar, 34%	Industry, 34%
Nem lakóépületek, 17%	Non-residential buildings, 17%
Ábra 2g. Importált földgáz szerepe au épületek energiafelhasználásában	**Figure 2g: The role of imported natural gas in the energy consumption of buildings**
Import	Import
Készletfelhasználás	Stock draw
Statisztikai eltérés	Statistical discrepancy
Termelés	Generation
Minden forrásból elérhető	Available from all sources
Közvetlen felhasználás	Direct use
Átalakítás	Transformation
Átalakítás után elérhető	Available after transformation
Export	Export
Elosztási és szállítási veszteségek	Distribution and transport losses
Végső felhasználás	End use
Energiaágazat felhasználása	Use of the energy sector
Végső energiafelhasználás	Final energy consumption
Végső nem energia felhasználás	Final non-energy consumption
Ipar	Industry
Közlekedés	Transport
Egyéb szektorok	Other sectors
Szolgáltatások	Services
Háztartások	Households
Mezőgazdaság	Agriculture
Halászat	Fishing
Egyéb	Other

Figure I.1: The role of buildings in the energy transition of Hungary (according to the EBRD, EUROSTAT and IEA, 2020)

The National Energy and Climate Plan of Hungary published on 16 January 2020 establishes that the aggregate final energy savings objective must be achieved in the period between 2021 and 2030 in accordance with the requirements of Directive 2012/27/EU on energy efficiency ('EED Directive'). Reducing the heating and cooling energy demand of buildings essentially ensures the possibility of meeting that requirement. Given the low rate of construction and demolition (according to the statistics provided by the Hungarian Central Statistical Office (HCSO), the annual ratio of residential construction constitutes approximately 0.2% to 0.4% of the total building stock), **the comprehensive energy efficiency conversion of existing buildings is of key importance.**

According to our estimates, **the renovation of all the existing residential and public buildings** would reach the level of energy efficiency corresponding to the cost-optimal energy consumption calculated on the basis of Government Decree No 176/2008 of 26 May 2008 on the certification of energy characteristics of buildings, and allows for **a saving of 122 PJ or 16% of the total final energy consumption**. Regarding building categories, including public buildings (PB), multi-apartment buildings (MAB) and detached houses (DH), **detached houses offer the greatest potential** (82 PJ); thus, they constitute **a key target area** for the decarbonisation of the construction industry.

A comparison of the **specific energy consumption** of Hungarian residential buildings with the energy consumption measured in other Member States of the European Union indicates that, with a value of 234 kWh/m2/year, Hungary is approaching the upper bounds of the observed range. This is 20% higher than in Austria and 56% higher than in Slovakia, i.e. in neighbouring countries having a similar climate and sociodemographic profile.

According to the results of the cost-effectiveness analysis performed by the European Bank for Reconstruction and Development (EBRD), based on the cost of 1 kWh/a energy savings it is **recommended to give priority to buildings built before 1990**, while **buildings made of adobe must be de-prioritised** for renovation. The latter is also supported by a comparison of the 2011 census and the 2016 microcensus data, based on which it can be established that the number of adobe houses occupied is decreasing. In addition, despite the more favourable cost/savings ratio, buildings built before 1945 are also being vacated (Figure I.2).

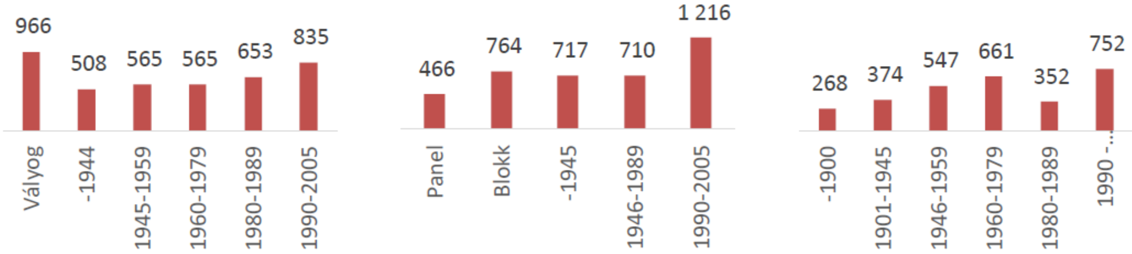
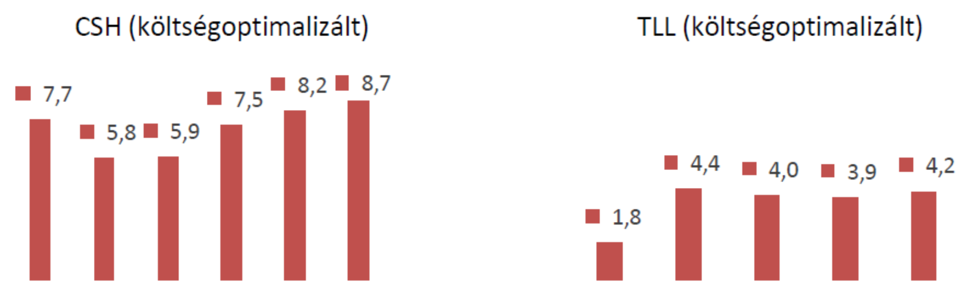


Figure I.2: The cost of saving 1 kWh/a energy (HUF/kWh/a)

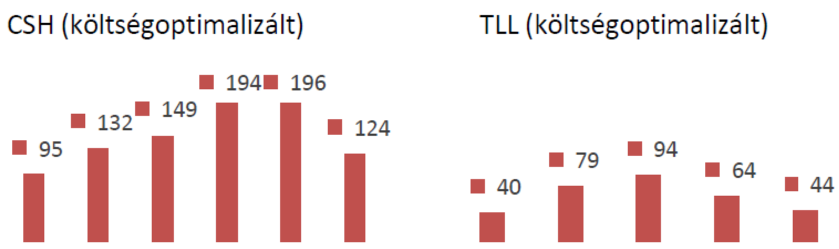
It is also important to note that, despite the fact that the typical renovation costs per unit of energy saved by detached houses are on average lower than the costs of multi-apartment blocks, **the total renovation cost of detached houses per apartment is higher**. This is due to their larger average floor area. The renovation of a 75 m2 detached house built between 1960 and 1979 to the cost-optimal level costs HUF 7.5 million, while the cost of renovating a 58 m2 apartment of a multi-apartment block built between 1945 and 1989 is only HUF 3.9 million (see Figure I.3).



CSH (költségoptimalizált)	DH (cost-optimal)
TLL (költségoptimalizált)	MAB (cost-optimal)

Figure I.3: Renovation cost per household (HUF million)

According to the HCSO, the average annual disposable income in 2018 was HUF 3.3 million per household. This has a positive correlation with the renovation costs of multi-apartment blocks, but the costs of renovating detached houses can be almost three times the average income for average-sized houses (see Figure I.4).



CSH (költségoptimalizált)	DH (cost-optimal)
TLL (költségoptimalizált)	MAB (cost-optimal)

Figure I.4: Annual cost savings per household (HUF thousand / year)

The average cost saving per household is the highest for detached houses, and, accordingly, payback time is shorter. In comparison with residential buildings, payback time for public buildings is more favourable (Figure I.5). Figure I.6 shows the total residential final energy consumption regarding heating, cooling and the production of domestic hot water.

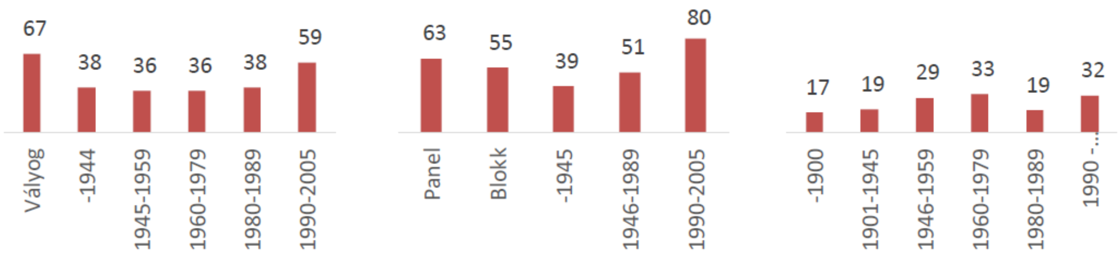
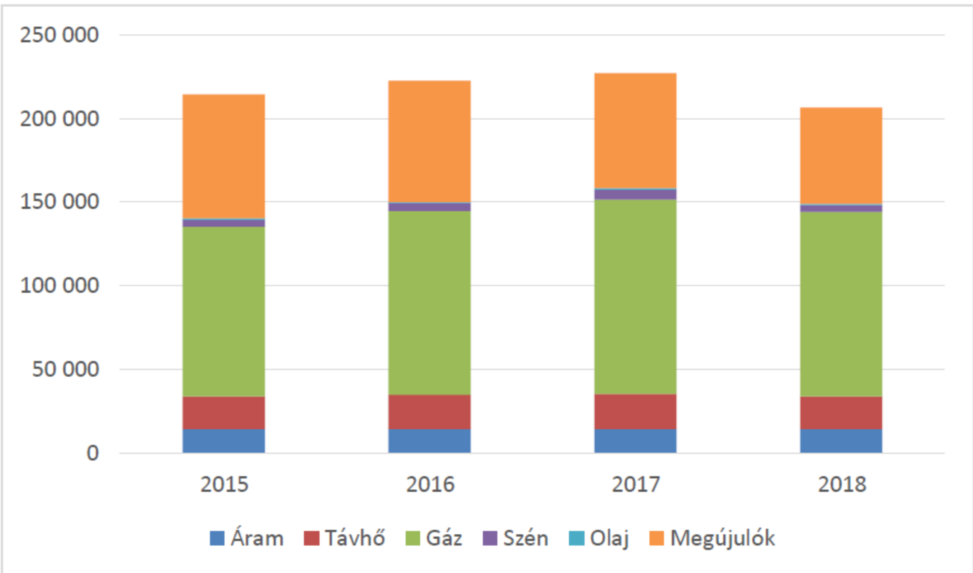


Figure I.5: Dynamic payback time of building energy improvements (year)



Áram	Electricity
Távhő	District heating
Gáz	Gas
Szén	Coal
Olaj	Oil

Megújulók	Renewables

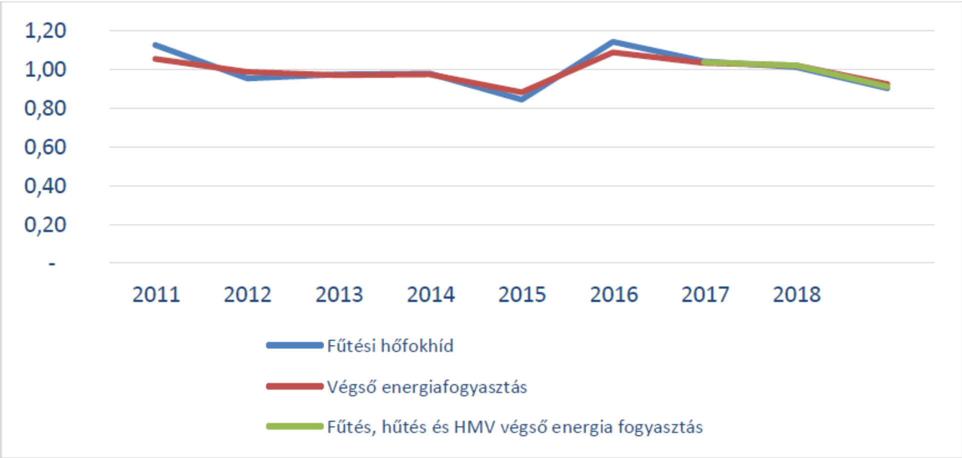
Figure I.6: ***Residential final energy consumption regarding heating, cooling and the production of domestic hot water (TJ/year), source: MEKH, annual energy consumption of households, 2019***

In the case of the residential building stock, the most commonly used fuel for cooling and heating purposes is natural gas, while the second most commonly used is renewable energy (Table I.1). It appears that direct demand for cooling in the residential sector is still small, while the demand for heating accounts for around 71–72% of residential final energy consumption depending on the outside temperature.

Table I.1: Final energy consumption of households in Hungary, data by MEKH per purpose of use, year 2019, TJ/year

Name	Heating	Cooling	Domestic hot water	Cooking	Lighting and electrical appliances	Total
Electricity	1,407	569	12 349	1 473	26 025	**41 825**
District heating	14 064		4 986	0		**19 050**
Natural gas	96 840		12 003	8 090		**116 933**
Coal and coal products	2 954		0	0		**2 954**
Petroleum products	394		438	2 260		**3 091**
Renewables	52 356		1 450	19		**53 825**
Total	**168 015**	**569**	**31 226**	**11 842**	**26 025**	**237 679**

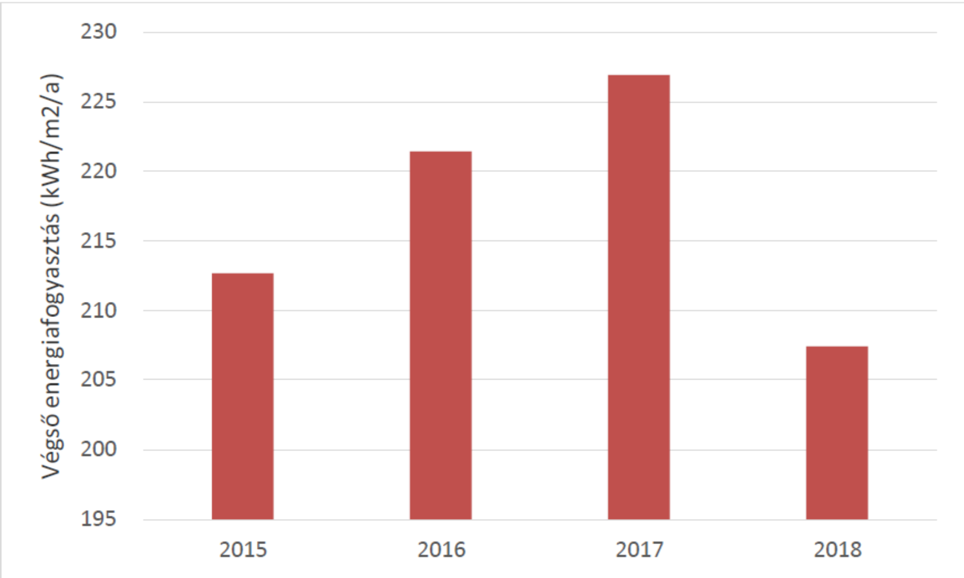
The final energy consumption of the residential sector increased slightly between 2015 and 2017, and then decreased between 2017 and 2019. These slight changes can be explained by the changes of heating degree days. However, according to the statistical data of the Hungarian Energy and Public Utility Regulatory Authority (Magyar Energetikai és Közmű-szabályozási Hivatal, MEKH), the residential renewable energy use decreased significantly from more than 74 PJ/year in 2015 (the year with milder heating demand) to around 54 PJ / year, which is partly explained by the increase in natural gas consumption by almost 7 PJ/year. The figure below shows the changes in heating degree days in the 2011–2018 period compared to the same period of the previous year, as well as the total residential final energy consumption, and the final energy consumption regarding heating, cooling and the production of hot water (Figure I.7).



Fűtési hőfokhíd	Heating degree day
Végső energiafogyasztás	Final energy consumption
Fűtés, hűtés és HMV végső energia fogyasztás	Energy consumption regarding heating, cooling and domestic hot water

Figure I.7: ***Changes in the heating degree days and residential energy consumption compared with the same period of the previous year, based on the data by Eurostat***

A similar trend can be observed when examining the estimated consumption values per square metre. It is important to note that the consumption per square metre is about 200 kWh/m2/a (Figure I.8).



Végső energiafogyasztás (kWh/m2/a)	Final energy consumption (kWh/m2/a)

Figure I.8: Residential final energy consumption regarding heating, cooling and the production of domestic hot water per square metre of occupied space, source: Estimate of the Adviser based on the data of MEKH, annual energy consumption of households of 2018, and the Adviser's own estimate regarding the dwellings occupied (see Annex VII)

Energy poverty

Based on our estimates of 2011, 380 000 (10%) households live in energy poverty, if we adopt a definition of energy poverty as a situation where energy cost consumes 25% of the income of the household in question. If the definition of energy poverty is modified to mean that, after paying the energy costs, the given household is considered poor, then the number of households affected is 800 000 (21%).

According to the energy union factsheet (SWD(2017) 397) prepared by the European Union in 2017 regarding Hungary, 24.7% of households are unable to heat their homes properly, based on an ad hoc survey made in 2015. This is a decrease compared to 33.9% in 2005.

In the case of public buildings, based on appropriate statistical data and according to the modelling assessment set up during the Structural Reform Support Programme (SRSP) study prepared by the EBRD in 2020, the typical final energy demand of technical building systems used for cooling, ventilation, the production of domestic hot water, integrated lighting, building automation and control, on-the-spot power generation or the combination thereof is ~32 PJ/year for buildings with a heated floor of more than 250 m2. The average consumption per square metre is about 200 kWh/m2/year, which is similar to that of residential buildings.

The most commonly used fuel in the buildings of the public sector is natural gas. In the database of the HCSO regarding municipalities, 8% of buildings with a floor area of more than 250 m2 are heated by district heating (HCSO, National Data Collection Programme, 1616 tables, 2018), while according to the National Building Energy Registry (Nemzeti Épületenergetikai Kataszter, NÉeR2) project and the 2015 report of Építésügyi Minőségellenőrző Innovációs Nonprofit Kft. (ÉMI) on public buildings, 10% of the buildings mentioned in the report use district heating. However, other types of fuel are not too common.

Examining the total consumption of the service sector compared to the same period of the previous year, and having regard to the changes in heating degree days, the correlation of energy consumption with the heating degree days is 0.52 based on the findings of the EBRD study. The most important conclusion of the EBRD was that, if we take a longer period as a basis, there is no significant decrease in the total energy consumption of the public sector.

II. OBJECTIVES, STRATEGIES AND POLICY MEASURES IN THE HEATING AND COOLING SECTOR (STRATEGIES)

II.1. The objectives and planned measures of the new National Energy Strategy in the heating and cooling sector

The vision of the National Energy Strategy

The changes taking place in the energy sector foresee a significant transformation of the European and thus, domestic energy markets. In order for the transition to an energy sector with low greenhouse gas emissions to take place in an effective way, by rationalising costs and in a way that guarantees security of energy supply to a maximum level, current incentives must be reviewed, the regulatory environment must be renewed, and the production and procurement portfolios must be restructured. Hungary considers the energy sector to be a strategic sector; therefore, due to the significant technological and market structure changes of the last decade it has become necessary to renew the **National Energy Strategy of 2011 in a way that it updates the sustainable and operable framework and objectives of the restructuring of the domestic energy sector** that keep in mind the interests of the public assets policy and comply with EU law.

The most important objective of the **new National Energy Strategy (the Strategy) adopted on 8 January 2021** is strengthening **energy sovereignty** and **energy security**, maintaining **the results of overhead cuts**, as well as **the decarbonisation of energy generation, which is only possible with the combined use of nuclear and renewable energy sources**. For countries poor in conventional energy carriers, such as Hungary, energy sovereignty is **a matter of prosperity, economy and national security.**

It is the clear interest of Hungary **to reduce its energy import demand** and, at the same time, to ensure an **ever wider connection to the regional electricity and gas networks**, which is the guarantee of both security of energy supply and effective import competition.

The cleanest energy is unused energy. Nevertheless, the objectives of the Strategy can be achieved by ensuring the principle of energy efficiency, by **using heating/cooling solutions based on renewable energy sources**, by implementing the Green District Heating Programme, and by reducing energy use **in public institutions, industry and transport.**

It is also to be noted that, due to the high efficiency of electric motors, clear end-user energy savings will be achieved **with the spread of electromobility**. As a result of the Green Bus Programme launched in 2019 concerning the greening of local transport, ecofriendly electric buses will run in bigger cities.

The **energy independence of families** may be facilitated by supporting **decentralised renewable energy generation for own use**, and by promoting the spread of **smart meters**.

The goal of Hungary is for most of Hungary's electricity generation to come from two sources: **nuclear energy and renewable energy**, primarily from solar power stations. These are not technologies which replace or exclude one another, but ones that support each other, and both can be considered clean energy sources. With the combined use of solar and nuclear energy, 90% of electricity generation in Hungary may become carbon-free already in the medium term, by 2030.

Nearly half of Hungary's electricity generation comes from carbon-neutral nuclear energy. With the Paks 2 investment, this ratio can continue to be maintained in the long run.

The goal of the European Union is that its Member States should have an overall climate-neutral economy by 2050.

The Hungarian National Clean Development Strategy (Nemzeti Tiszta Fejlődési Stratégia, NTFS) aims **to outline**

the long-term socio-economic and technological path towards meeting the 2050 climate neutrality objective as defined in Act XLIV of 2020 on climate protection[1]. This strategy **puts the prosperity, growth and well-being of Hungarian families in the focus** by integrating the necessary preventive measures against the negative effects of climate change and the measures preparing for the effects that are already unavoidable into the long-term development and welfare goals of the country.

In order to achieve climate neutrality by 2050, significant investments need to be made in the upcoming decades. **However, the potential medium- and long-term advantages resulting from the decarbonisation of the national economy outweigh these costs.** The achievement of climate neutrality by 2050 requires significant additional investments in all the emitting sectors. In order for Hungary to have carbon-neutral electricity generation, to completely replace the use of natural gas, and to put the transport sector on a fully electric footing, the costs **increase by about HUF 24 709 billion compared to the scenario of *'Sitting on our hands'* (*'ÖlbeTett Kéz'*), based on the NTFS.** This goal is achievable for our country, but it requires a significant financial contribution from the European Union.

The achievement of climate neutrality requires significant expenditure in each sector of the national economy. In order to reach our goals, the contribution of the climate-polluting industries and the private sector is essential. It is the firm position of the Hungarian Government that the biggest polluters should pay most of the costs, and the energy and food costs of families should not increase because of the energy transition. In addition to incurring significant costs, climate neutrality also **has a huge potential for prosperity by laying the foundations for sustainable economic growth over the next 30 years.**

Domestic energy supply of the future is:

1. Clean because it increases the weight of low or zero emission technologies within domestic energy use and encourages increased energy efficiency, thereby strengthening our energy independence. It supports energy efficient solutions at all levels of the value chain to minimize negative impacts on the environment, climate and consumers' energy costs.

2. Smart because it builds on the latest technological developments to ensure that high-level energy services are provided at the lowest possible cost. During the transformation of the energy sector, we aim to create new market opportunities for innovative domestic companies and strengthen research and development activities in the sector.

3. Affordable because we create a diversified supply portfolio and regulatory environment in which the **development of domestic energy prices sustainably supports the improvement of the competitiveness of the Hungarian economy and the increase of consumer prosperity.**

Programmes and projects of the National Energy Strategy

The two main pillars of strengthening our energy independence at the level of national economy are the reduction of our reliance on energy import and, for our remaining energy imports, diversification ensuring security of supply and effective import competition. The reduction in the import of energy carriers largely entails the decarbonisation of our energy sector. The application of innovative technological and business solutions contributes to achieving our goals of strengthening energy independence at the national and local levels, **increasing the freedom of consumer choice**, and greening the energy sector in a cost-effective way, while also supporting domestic industrial development efforts. Therefore, we build the Strategy along the following four defined directions of development:

[1] Act XLIV of 2020 on climate protection.
Available at: https://net.jogtar.hu/jogszabaly?docid=A2000044.TV&searchUrl=/gyorskereso

- **We put the Hungarian consumer in the focus of the Strategy.**
- **We strengthen the security of our energy supply.**
- **We implement the climate-friendly transformation of the energy sector.**
- **We take advantage of the economic development potential of energy innovation.**

The Strategy sets out the key objectives for the transformation of the domestic energy sector by 2030 and the key measures to achieve these objectives, but in order for it to establish a long-term vision focusing on the provision of 'clean, smart and affordable' energy, it also includes an outlook for the period up to 2040. The projects planned to be implemented under each programme are listed below:

Table II.1: Programmes of the new National Energy Strategy related to heating and cooling

Programme	Project
We keep consumers' energy overheads to a minimum in a sustainable way, still covering the costs of services	Strengthening competition on the wholesale markets of electricity and natural gas
	Introducing an energy efficiency obligation scheme promoting energy saving of consumers
	Modernising price regulations of authorities regarding electricity, natural gas and district heating
Supporting decentralised energy generation for own use	Promoting renewable energy investments of households
	Promoting the development of renewable energy communities
	Supporting municipal energy investments building on local renewable energy sources
Expanding the freedom of consumer choice by the smartening of measurement, digitised administration and the expansion of universal service packages	Measures supporting smart meters (programme) in the electricity and natural gas sector
	Making district heating controllable, equipping dwellings heated by district heating with heat cost allocators
	Programme for the digitalisation of the administration of service providers
	Promoting services based on demand side response (DSR); developing regulations to support the emergence of independent aggregators
	Creating differentiated universal service provider packages in the electricity and natural gas sector

The electrification of residential heating and the dissemination of renewable energy

The flagship project called *Energy-intelligent and modern Hungarian homes* (*Energiatudatos és modern magyar* *otthonok*) implementing the relevant strategic direction of the new National Energy Strategy promotes the installation of solar panel systems to partially or completely replace own electricity consumption. The strategic goal is that by 2035, at least 200 000 households should have roof-mounted solar panels with an average output of 4-5 kW.

Another goal is to increase the installed power of residential heat pumps to almost 400 MW by 2030 (from 62 MW in 2017 and 148 MW in 2019; the data from the latter year was produced by around 15 000 households). The reason for using heat pumps is that the technology itself is more efficient than that of gas boilers and biomass boilers in general (i.e. the amount of energy used can be reduced without further action).

These strategic objectives should also be facilitated by targeted support which promotes the electrification of heating systems in households at risk of energy poverty and the reduction of energy demand of buildings (the latter by replacing doors and windows), complemented by solar power generation. These means are also capable of reducing air pollution resulting from outdated heating solutions. The energy savings that can be achieved through the replacement of doors and windows and the modernisation of the heating system account for 15–30% of the final energy consumption, depending on the nature and technical condition of the doors and windows and the efficiency of the boiler to be replaced.

The investment is mainly based on the utilisation of solar energy, since in the case of existing buildings, this renewable energy source provides the most cost-effective implementation. A heating system based on another type of renewable energy source (especially geothermal energy) can also be eligible under the investment, if the investment cost does not exceed the cost of the solution based on solar energy.

II.2. Measures of the Climate Change Action Plan

The effects of climate change and the more frequent and intense weather extremes, the preparation for them and adaptation are the most important challenges in Hungary today. There are many international agreements, planning documents and strategies addressing these issues worldwide, in Europe and in Hungary, but the actual response requires specific interventions. The second National Climate Change Strategy (Nemzeti Éghajlatváltozási Stratégia, NÉS-2) adopted by the Hungarian Parliament in October 2018 sets long-, medium- and short-term goals and courses of action for Hungary as well; however, it is the action plans connected to the strategy that need to specify the actual response, the first of which is the First Climate Change Action Plan (I. Éghajlatváltozási Cselekvési Terv, I. ÉCsT) for the period up to the end of 2020.

The planning of the I. ÉCsT was carried out in parallel with the preparation of the National Energy and Climate Plan (NECP) to be prepared by the end of 2019 as an EU obligation, as well as the renewing of the National Energy Strategy. The planning of these two documents also identified the mitigation approaches of the ÉCsT: the tasks aimed at reducing the greenhouse gas (GHG) emissions specified in the Action Plan harmonise with the framework and principles of the aforementioned documents and the National Clean Development Strategy. The importance of the ÉCsT is also emphasised by the fact that, among the documents mentioned, adaptation and shaping attitude are given prominence within the strands of climate policy.

Based on the horizontal, multi-sectoral nature of climate change, and in line with the sectoral themes of the NÉS-2, the I. ÉCsT also affects many policy strands, but key areas are outlined among them in which significant progress can be achieved even in the short term. A number of interventions are underway to help reduce GHG emissions, prepare for the effects of climate change, and adapt to the effects of climate change.

In addition to the measures and developments in progress, among the new interventions to be carried out during the I. ÉCsT period, the following can be mentioned as further priority areas:

- Increasing corporate energy efficiency: it is of paramount importance also in Hungary to achieve economic growth in a way that reduces industrial GHG emissions. One way to do this is to improve the energy efficiency of companies, which is directly or indirectly targeted by a number of measures that can be implemented with relatively little financial input, involving advanced expertise. Within the framework of the I. ÉCsT, guidelines and instructions were developed for the system of corporate tax advantages connected to investment regarding energy efficiency. An information campaign and training for SMEs on the importance and benefits of voluntary energy audits will be launched at the bases of energy trade associations and professional bodies.

- Renewable energy use: One of the key elements to reduce GHG emissions is replacing fossil fuels with renewable energy sources. Firstly, the promotion of the use of the latter, and secondly, the placement of the existing supply systems on a renewable basis, and the replacement of fossil resources in construction and building renovations appear as solutions. In addition to the already realised and the ongoing interventions for energy efficiency and district heating development, the efficient, affordable, ecofriendly district heat generation policy programme, which is based on renewable energy sources and guarantees high level of supply security as per the EED Directive, as well as the development of the background brief examining the possibilities of decentralised renewable energy generation can be highlighted among the preparatory measures of the I. ÉCsT that lay the foundations for future developments.
- The ÉCsT gives priority to the expansion of forest areas and other wooded areas. Moreover, it aims to further develop the monitoring system ensuring the monitoring of the state of forests.

Current policies regarding adaptation and shaping attitude aim at protection against flash floods and water retention hillside water management, as well as the development of municipal rainwater management systems, the safe collection, retention and recovery of rainwater, taking into account climate change. Furthermore, within the framework of the scheme named KEHOP 1.2.0, support for the implementation of climate strategies and related climate protection programmes is ongoing. In addition to the complex habitat reconstruction investments of nature conservation, related calls for shaping attitude which are supported under the KEHOP (concerning water utilities, waste management, nature conservation, energy efficiency) may also be mentioned.

Beyond the ongoing interventions for adaptation, the following can be highlighted among the new interventions to be implemented during the period of the I. ÉCsT:

- Municipal and regional adaptation: Although climate change is a global problem, and international cooperation plays a key role in the reduction of GHG emissions, adapting to and preparing for specific effects can be done most effectively locally, in a given place and with the active participation of local players with the knowledge and ability to adapt to local conditions. Many adaptation measures of the I. ÉCsT fit into this list. For example: the review and development of systems warning of extreme weather events as a means of preparing for the adverse health effects of heat waves. A similar specific means of helping municipalities is to develop a planning methodology for the flexible adaptation of municipal land drainage to climate impacts.
- Recognising the importance of the adverse effects of climate change on human health, during **the infrastructure development of hospitals and social institutions,** the I. ÉCsT places emphasis on **the temperature control of critical rooms**, on measures ensuring their protection against UVR, and on the preparation of the monitoring system of allergenic plants.
- A significant part of the I. ÉCsT measures aims to strengthen the available information and knowledge base on the effects of climate change and the vulnerability of certain sectors, thereby contributing to effective preparation for change. Among the measures helping the preparation of critical infrastructure systems, we may mention the development and validation of the concept of an electricity transfer system that guarantees adequate security of supply even in the presence of increasingly extreme

climate parameters, as well as the assessment of the development of energy demand as a result of climate change. Strengthening the disaster risk assessment capacity of the relevant bodies will allow for regular and accurate forecasts and, through this, for mitigation of damage from catastrophic events.

- Among the priority measures supporting the sustainable utilisation of natural resources are interventions aimed at the prevention and mitigation of agricultural and forest management damages.

The preventive and adaptation measures listed – whether they are calls for proposals under Operational Programmes already under way or interventions specifically planned now by the I. ÉCsT – can only work and achieve their goals set if a truly effective framework helps to realise them. This framework is supported by the implementing measures of the I. ÉCsT as the pillars for the implementation of an effective climate policy. Among these, we can underline the establishment of a comprehensive climate policy monitoring and evaluation framework for measuring, continuously monitoring and evaluating the results of energy and climate policy measures. One of the key points of the group of implementing measures is also the supporting of the operation of the organisation responsible for the national climate change report. Based on the assessment reports on global climate change prepared by the Intergovernmental Panel on Climate Change (IPCC), the organisation initiates the preparation of a decision-supporting national report focusing on Hungary, involving chosen experts and organisations, thus laying the foundations for scientific networking on climate protection and adaptation. In the framework of permanent Hungarian participation in international climate financing, the I. ÉCsT includes the establishment, operation and publication of call for proposals of Nyugat-Balkáni Zöld Központ Nonprofit Kft. as the first phase of the Western Balkans Green Fund Project.

Last but not least, as a favourable development policy opportunity, while the planning of the NÉS-2 took place after the planning of the OP prior to 2014, the I. ÉCsT with its time horizon until 2020 provides for the preparation for the development and budgetary period of 2021–2027 of the European Union in addition to closing the relevant schemes for the current programming period. Thus, given that the time remaining until 2020, i.e. until the end of the implementation period of the I. ÉCsT, is rather short, the current I. ÉCsT – in addition to the climate policy interventions expiring by 2020 – puts emphasis on the preparation of subsequent major interventions and programmes, as well as the related planning tasks.

Set of measures on Energy Efficiency of the Climate Change Action Plan

M8 Preparation of the ESCO programme aiming at improving the energy efficiency of public and residential buildings

Justification: The building stock in Hungary accounts for 40% of total energy consumption. Two-thirds of this relate to heating and cooling. About 80% of the dwelling stock do not meet modern technical and energy requirements, and this ratio is similar in the case of public buildings. Components:

- Assessment of the technical and financing needs of the support schemes and making proposals to satisfy them. The activity includes the examination of different energy saving programmes (of the State, municipality, ESCO, etc.) with the involvement of individual public utility service providers in terms of energy efficiency, cost-effectiveness and sustainability.
- Identification of legislative gaps and obstacles in the case of residential and public buildings, and preparation of policy proposals to tackle them.

II.3. Key elements of the National Energy and Climate Plan

The dimension of energy efficiency

Our objective on energy efficiency is that the final energy consumption of the country in 2030 should not

exceed the value in the year of 2005 (785 PJ). In case final energy consumption exceeds the level of 2005, the increase must only come from carbon-neutral energy sources. Naturally, reducing energy consumption is a priority, but to this effect neither the energy consumption of the industry nor that of the logistics sector (transport) must be limited in case of economic growth. Our goal is for GDP growth to increasingly outpace energy consumption growth.

The cumulative end-use energy saving obligation regarding the period from 2014 to the end of 2020 was 167.5 PJ according to the calculation method specified in the National Energy Efficiency Action Plan. Eurostat has developed the indicator of final energy consumption for 2020–2030 in order to calculate energy efficiency targets of the Member States according to the same methodological basis and to make them comparable to the previous planning period. Based on the above, the cumulative end-use energy saving obligation for the period from 2021 to the end of 2030 may be achieved by setting an average of 7 PJ of new savings per year. Achieving the energy savings target laid down in the EED Directive poses a serious challenge in every area. The energy efficiency programmes and measures introduced in the period 2014–2020 will result in final energy savings of about 3–4 PJ per year for end-users, therefore an increase of about twice the current savings is necessary in the next period.

Milestones without commitments for the years 2030, 2040 and 2050, measurable result indicators developed at national level, and their contribution to the energy efficiency targets of the European Union, as set out in the roadmaps specified in the long-term strategies for the renovation of the national stock of privately and publicly owned residential and non-residential buildings, in line with Article 2a of Directive 2010/31/EU

According to the data of the MEKH on the energy consumption of households[2], a significant part (three fourths) of the energy consumption of Hungarian households is spent on heating, which is mainly provided on a natural gas basis (nearly half of the country's gas consumption is residential). The other two major areas of energy consumption are the production of domestic hot water, and lighting and the use of electric appliances (in a ratio of one tenth each). Therefore, in the case of residential buildings, most of the energy saving potential lies in the modernisation of buildings and heating systems. **With the modernisation aiming at improving the energy efficiency of the residential building stock, and through the advancement of switching to alternative heating methods, we estimate that up to a quarter of natural gas imports (~ 2 billion m^3 of natural gas consumption per year) could be replaced.** Residential modernisation will be realised on a market basis, within the framework of the energy efficiency obligation scheme; therefore, the costs thereof will not be borne by households or the State budget. **A 3% deep renovation per year of the floor area of the central government building stock** is an additional strategic goal.

Furthermore, maintaining climate-friendly energy management while maintaining and further expanding industrial performance is also a headline target. The key to the competitiveness of energy- and GHG-intensive industrial activities is for them to be able to produce at most at the level of specific energy and GHG emissions of European industrial competitors. In addition to maintaining the existing energy-intensive industries, it is a goal from an energy strategic point of view that further industrial investments should be realised in high-tech sectors with low energy and GHG intensity, thus supporting the development of the structure of the Hungarian economy in a sustainable and competitive direction.

The dimension of renewable energy

We increase the share of renewable energy sources at least to 21% by 2030 in proportion to gross final energy consumption.

By 2030, Hungary wishes to increase the share of renewable energy-based energy generation within electricity consumption to at least 21%. The central element of ‘greening’ is the expansion of solar capacities, which would

[2] http://mekh.hu/download/5/13/90000/8_1_Haztartasok_felhasznalasa_eves.xlsx

increase from less than 680 MW in 2016 to almost 6 500 MW by 2030, and it would significantly exceed 10 000 MW by 2040. In the perspective of the NECP (in 2030), wind power capacity will be close to current levels (~330 MW). In addition to maintaining existing hydroelectric power plants, it is also justified to expand the capacity of small hydroelectric plants.

Within the cooling and heating sector, we see great potential for the effective utilisation of biomass both in individual heaters and in the supply of district heating, as well as in the possibilities of using ambient heat through heat pumps. Currently, only 10–15% of Hungary's geothermal potential is being exploited, although the utilisation of geothermal energy – in case of creating proper incentives – may be a competitive alternative compared to other energy sources. **Given the geological conditions of Hungary, the goal is to exploit the geothermal energy potential** both in district heat generation and in agro-economic utilisation (e.g. in the heating of greenhouses). Furthermore, the involvement of biodegradable parts of municipal waste in useful heat generation is also a potential to be exploited. The following tables show the roadmap regarding the share of renewable energy:

Table II.2: Estimated national roadmaps for the share per sector of renewable energy in gross final energy consumption between 2021 and 2030

(%)	2017	2020	2 025	2030
Share of renewable energy in gross final energy consumption – in total	**13.3**	**13.2**	**16.4**	**21**
Share per sector:				
Electricity	7.5	10.8	16.4	21.3
Cooling and heating	**19.6**	**18.2**	**20.7**	**28.7**
Transport	6.8	6.6	16.8	16.9

Table II.3: Use of renewable energy sources in the individual sectors, 2020–2030

(ktoe)	2020	2021	2022	2023	2024	2 025	2026	2027	2028	2029	2030
RES-E	402	459	515	572	628	684	741	799	856	913	971
RES-H-C	1 946	1 966	1 986	2 005	2 025	2 045	2 181	2 316	2 451	2 586	2 722
RES-T	194	243	291	340	389	438	421	405	389	374	358

Table II.4: Use of renewable energy sources in cooling and heating

(ktoe)	2020	2021	2022	2023	2024	2 025	2026	2027	2028	2029	2030
Heat pump	2.4	4.6	6.4	7.9	9.0	13.6	13.6	13.6	13.6	13.6	13.6
Geothermal energy	84.6	106.9	128.8	150.3	171.5	114.0	134.6	155.2	175.8	196.4	116.6
Biomass and renewable waste	1 785.0	2 155.1	2 524.8	2 894.1	3 263.1	1 853.0	2 351.1	2 849.2	3 347.2	3 845.3	2 504.0

Solar	11.1	12.8	14.1	15.1	15.7	11.1	17.8	24.4	31.1	37.7	46.9

According to the NECP, the total use of biomass in 2016 was 2 361 ktoe, the majority of which, namely 73%, came from household use. Based on our calculations, the use of bioenergy will increase by about 30%, taking into account additional measures. Most of this increase will come from electricity and district heat generation, from the industrial sector and the service sector. On the contrary, residential biomass use will significantly decrease, namely by 46%, by 2030. The use of biomass will peak in the 2030s, after which it will enter a slightly declining path.

Table II.5: Bioenergy use

Bioenergy use (ktoe)	2020	2 025	2030
Electricity	200	243	286
Cooling and heating	1 911	1 959	2 584
Transport	194	227	111

In our country's forests, potential uses of the forests taking into account the sustainability criteria are determined within the framework of forest planning (except for forests under free disposal). The majority of state forests is under the property management of state-owned forestry public companies subject to the exercise of rights of ownership of the Ministry of Agriculture. Determining the logging volume per year of forestry public companies is an ecological issue. The planning of logging activities which are in accordance with the objectives of forest maintenance and silviculture, and which acquire the necessary resources therefore and ensure the sustainability of forest management takes place in multiple stages. The ten-year forest plans form the basis thereof, based on which three-year strategic plans and annual plans are developed.

In neighbouring countries, climate change has already caused unprecedented levels of forest damage, which upsets the planned course of forest management. Although the measures already being introduced in the management of deciduous tree stocks and forest management, as well as in forestry businesses, contribute to the prevention of greater forest damage, the occurrence of such damage cannot be ruled out, which (due to the necessary harvest of dead trees) may result in a temporary, sharp increase in the availability of wood biomass, and then a decrease in the availability thereof.

With the increased use of residential solar panels, more and more consumers are able to generate power for themselves, which – in addition to providing the possibility of even more active market participation in the conscious regulation of consumption – ensures the strengthening of energy independence at household level. **We wish to continue to promote energy generation by consumers and consumer communities for their own use, which is based on renewable energy sources and strengthens their energy independence.** In addition to satisfying the electricity demand of the consumer (including possibly the energy demand of electric vehicles) using solar panels, this also includes replacing the use of piped gas or inefficient district heating with the use of geothermal heat, ambient heat, electric heating or biomass. We will promote initiatives that aim to satisfy municipal heat use with local energy.

In parallel with energy generation based on decentralised, locally available renewable energy sources gaining ground, initiatives ensuring that electricity is used locally must be supported. This is expected to reduce energy supply costs and simplify the integration of renewable energy sources. **The most important task in this respect is to support and promote the establishment of renewable energy communities.** Concerning the **supply of**

district heating, our aim in the long run is to place the entire domestic district heating service in the 'efficient district heating and cooling' category as per the relevant EU directive, and in the medium term to place the district heating systems of those municipalities in the said category where the amount of district heat supplied to the network at the municipal level reaches the consumption of 100 000 GJ/year, and if this goal is realised, it may significantly increase the domestic and EU funds that can be used for development, as well as decrease energy consumption connected to buildings and GHG emissions. Under the Directive, efficiency presupposes a district heating and cooling system using at least 50% renewable energy, 50% waste heat, 75% cogenerated heat or 50% of a combination of such energy sources.

II.4. Key elements of the long-term renovation strategy (LTRS)

The aim of the Government is **to preserve the built heritage that enriches our national values, to contribute to the modernisation of existing buildings and, at the same time, to help Hungarian families to live in more liveable and cheaper-to-maintain buildings**.

Moreover, the Government also sets the goal to support the development of the Hungarian economy and construction companies, as well as families **through programmes supporting the protection and renovation of built environment.**

The Government pursues a realistic and responsible policy regarding climate protection, however, **implements measures designed to make the living conditions of people in Hungary easier and better**.

Concerning our built environment, the **Government of Hungary** establishes the following **vision (2050)**:

- **Liveable** because it provides families living in Hungarian cities and villages with a living space that contributes to an improved quality of life. A further goal is to increase the dwelling stock by the rehabilitation of brownfield sites.
- **Affordable** because the construction and renovation of a building happens in high quality and with sustainability in mind, the building utilises energy efficient renewable energy and operates with minimal overhead costs, with further support to residential constructions.
- **Clean** because it is eco-conscious regarding the environment, used materials and energy sources, and household waste. This also gives direction to the green transformation of the construction industry.
- **Accessible** because due to its design and technical solutions, everybody can use it in a comfortable and safe way, including those who need special devices or technical solutions to do so.
- **Modern** because it helps the everyday lives of building users and the operation of buildings with innovative and smart technologies.

During the development of the LTRS, in addition to compliance with the law and the obligations of the Member States, **special attention was devoted to the enforcement of those strategic goals of Hungary which base the renewal of the domestic building stock on deep renovations enabling renewable, energy- and cost-efficient operation, on the reduction of energy imports, and on the use of smart systems, while maintaining the reduction of final consumer prices of public services to the extent set by law.**

Furthermore, Hungary places great emphasis on the introduction of the Energy Efficiency Obligation Scheme (EEOS) and the operation thereof at high professional level. With the introduction of the EEOS, many measures promoting energy efficiency renovations can be implemented; said measures are described in detail in the LTRS.

An important aspect in the design of the measures is the significant reduction in the number of so-called (energy-poor) households to be supported, and the achievement of this goal would directly and indirectly

contribute to the improvement of energy efficiency, environmental protection, health, economic and sociodemographic indicators.

Starting point and situational picture

Buildings are among the largest emitters of carbon dioxide and energy consumers in Hungary. About 27% of the total final energy consumption takes place in residential buildings, while around 6% takes place in public buildings. The industrial sector accounts for nearly a quarter of consumption, the service sector (trade, public services, other services) for 12%, while agriculture accounts for 4% and transport for 27%. 40% of domestic energy consumption is for cooling and heating. There is a huge potential for savings in this type of energy consumption, as Hungary is one of the ten most consuming countries in the EU in terms of the amount of energy used per dwelling. **Natural gas is the primary fuel used for the energy supply of more than 3.7 million occupied dwellings in Hungary at the moment; nearly 75% of households use natural gas for heating. At the same time, about 80% of the natural gas used comes from imports, and this proportion can be significantly reduced by implementing the measured specified in this Strategy and by operating the EEOS.**

Although there is an increase, the ratio of renewal, i.e. renovation of the building stock is still low, as **the ratio of renovation in the case of residential buildings is only about 1% per year.**

The average primary energy consumption of residential buildings is approximately 215 kWh/m^2/year, while that of public buildings is about 214 kWh/m^2/year. Compared to other EU Member States, we can see that the numbers are similar in the case of Croatia, the Czech Republic and Poland, i.e. primary energy consumption exceeds 200 kWh/m^2. However, Germany and Austria have a building stock with an average primary energy consumption of under 200 kWh/m^2.

System of objectives

The **overall objective of the LTRS is to lay the foundation for achieving a sustainably operated, energy efficient and cost-effective domestic building stock by 2050** through energy efficiency-, value-, comfort- and health-improving measures, by utilising renewable energy and using smart technology, as a result of which primary energy consumption and emissions of CO2 decrease at the national level. This significantly contributes to the goal of greatly reducing Hungary's energy import dependence, and it indirectly strengthens the long-term sustainability of overhead cuts. Hungary sets it as a horizontal objective that the first one, namely the **principle of energy efficiency** should be a mandatory aspect in all construction interventions and investments, as well as in shaping attitude.

Operational goals and objectives

1. By 2030, 20% savings in the energy consumption of the domestic residential building stock,
2. By 2040, a 60% reduction in CO2 emissions related to the use of buildings for energy purposes from the average level in 2018–2020,
3. By 2050, the percentage of nearly-zero energy buildings must reach 90%.

Renovation targets

By implementing the measures set out in the LTRS, the goal of achieving a renovation rate of 3% per year for the entire residential building stock by 2030 can be realised. In this way, the total energy consumption of residential buildings and emissions of CO2 can be reduced by approximately 20%.

An additional goal is to strengthen the 5% renovation rate of the public building stock during this period. In case we gradually achieve this target, the total energy consumption of public buildings and emissions of CO2 can decrease by 18%.

Areas of intervention, necessary measures

The long-term realisation of the above objectives can only be achieved by deep renovation in case of the existing building stock. Since this requires significant costs on the part of the owner, it is also necessary to create the **possibility of staged renovations**. In order to facilitate that renovations reach, as a **primary aim**, the required level of deep renovation to the largest possible extent, the Strategy assesses the scope of financial incentives, measures and eligible activities, and the relevance thereof, in order for appropriate schemes to be developed.

For the efficient use of EU funds in the 2021–2027 programming period, **the combination of non-repayable and repayable support is justified**. Hungary plans potential financing programmes so that the forms of support do not crowd out market-based financing, but mobilise it, and they better align with segment-specific particularities and needs. Special attention must be given to households and vulnerable groups, as well as to users of residential buildings and apartments who face difficulties and should be supported, for which specific programmes will be developed and implemented.

The processes of recent years indicate that it is necessary to rethink the energy efficiency measures applied so far, to develop new incentives, and to introduce an Energy Efficiency Obligation Scheme under which programmes are introduced and measures are implemented resulting in proven energy savings on the end-user side. Based on the above, Hungary introduces an Energy Efficiency Obligation Scheme from 2021.

In addition to deep renovation, the preparation of the introduction of a smart readiness indicator (SRI) system is also an important goal. Article 8(10) and (11) of the Directive and Annex 1 specify the design of the SRI and the introduction of a trial period. The introduction of the SRI system is a Community policy pilot measure directly managed by the Commission.

Furthermore, Hungary pays special attention to the role of training and shaping attitude, with particular regard to building users. The scope of trainings available in second and tertiary level education regarding energy efficiency will be expanded.

Vision

Achieving the objectives of the LTRS and implementing the measures have a significant impact on economic development and employment. From the point of view of both the built environment and the sustainability of the construction industry, it is decisive what milestones are used for achieving the objectives, and how effectively these objectives are realised.

The LTRS specifies 35 measures. The implementation of the measures will be monitored by the so-called **Building Renovation Monitoring System** (Épületfelújítási Monitoring Rendszer, ÉMOR) to be designed. This makes it possible to continuously process the feedback and, if necessary, to define new intervention points.

The implementation of the Strategy gives rise to the following positive effects:

- maintaining **overhead cuts** in the long term,
- **decrease** in **natural gas consumption,**
- **decrease** in **energy imports** (natural gas, electricity),
- the **strengthening of energy independence**, increase in energy self-sufficiency and autonomy,
- renewable, sustainable, **smart public building stock,**
- the significant **job-creating effect** of energy efficient modernisations, interventions and measures,
- **increase in value** of modernised **buildings**,
- **the emergence of attractive, liveable (rural) municipalities,**
- **increase in the life expectancy of buildings,**
- **creating a competitive alternative for construction workers returning from abroad** due to the job-creating effect of energy efficient renovations,
- **significant decrease in the number of households that need support.**

The measures of the Strategy also contribute to the achievement of the following Sustainable Development Goals (SDG) set for 2030 by the United Nations:

- affordable and clean energy,
- doubling the improvement rate of energy efficiency worldwide,
- sustainable cities and communities,
- responsible consumption and production,
- taking action to combat climate change,
- promoting sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all,
- ensuring healthy lives and promote well-being for all at all ages.

The LTRS thereby supports and, at the same time, further strengthens Hungary's commitment to responsible and sustainable development.

Measures of the LTRS related to cooling and heating are as follows:

- creating an inventory of public buildings and keeping it up to date,
- establishing the Building Renovation Monitoring System (ÉMOR),
- Home Renovation Programme,
- examining the expandability of the scope of eligible activities,
- checking the availability of the required energy performance certificate,
- introducing energy performance contracting (EPC) for renovations, and the involvement of ESCO companies in the projects,
- education, raising consumer awareness,
- energy modernisation of healthcare institutions under ESCO-type energy efficiency service contracts,
- introducing mandatory energy efficiency audits for public institutions,
- preparation of standard integration related to smart technology,
- increasing policy coordination related to the developments of district heating services,
- policy support for demand-side regulation of utilities services using smart meters,
- obligation of installing smart meters,
- policy support for the establishment of decentralised community heating points,
- supporting specialised education in the energy sector,
- increasing the rationale of energy efficiency investments,
- supporting the establishment of renewable energy communities,
- fulfilling the inspection obligation scheme for heating and cooling systems,
- developing occupational guidance programmes and trainings in the energy engineering field,
- reviewing the evaluation criteria for aid schemes,
- Green District Heating Programme,
- examining the possibilities of support regarding the establishment of biomass heating,
- the development of smart and hygienic building technologies in educational, healthcare and social buildings,
- promoting by the State of the issuing of green bonds – programme development,
- Green Preferential Capital Requirement Programme for dwelling purposes,
- expanding the development tax advantage under the Economy Protection Action Plan,
- examining the expansion of 'Falusi CSOK' home-creation support scheme for families (Családi Otthonteremtési Kedvezmény, CSOK),

- improving the state of development of regions and counties,
- shaping the attitude of residents and the business sector, as well as improving their knowledge,
- Green Financial Product Finder Tool,
- one-stop government for users.

II.5. The planned key elements of the NTFS

Modern network capable of accommodating renewable energy and providing a high level of supply security

The tripling of the current domestic solar power station capacity in 10 years means the comprehensive reform of the country's electricity mix, which can only happen by providing adequate network access and the necessary network capacity, the preparation of the transmission and the distribution network (for the challenges of integrating weather-dependent renewable energy generators), and the development of the electricity system for flexibility.

Another reason for the support is that, in its absence, investment expenditure amounts for network development would be built in electricity prices, thereby reducing the international competitiveness of businesses.

According to the projections in the NTFS, the share of renewable energy in final energy consumption is expected to be between 21–27% in 2030 (depending on scenarios), between 30–33.7% in 2040, and at least 90% by 2050.

We respond to the presented challenges with the following investments:

Challenge	Objective	Reforms/investments
high proportion of biomass within renewable energy	securing a new basis for the legal and strategic environment facilitating renewable energy to gain ground, and the utilisation of renewable energy contributing to meeting the growing demand for electrification	transforming legislation on electricity, and supporting residential solar panel systems
reduction of environmental pollution from the heating of residential buildings	modernisation of residential heating, increasing energy efficiency by replacing doors and windows, and facilitating the spread of small-scale units of household size which utilise renewable energy	electrification of residential heating systems combined with solar panel systems and replacement of doors and windows
scarce capacity of the electricity network	modern network capable of accommodating renewable energy and providing a high level of supply security	classic and smart network developments of transmission system operator and distribution networks

The component contributes to the implementation of two country-specific recommendations:

	Country-specific recommendations of 2019	Related reforms/interventions
recommendati	a) Research and innovation, low carbon	• Classic and smart network developments of

on 3	economy and transport, waste management infrastructure, and energy and resource efficiency must be placed in the centre of investment-oriented economic policy, also taking into account regional differences.	transmission system operator and distribution networks • Facilitating residential renewable energy investments
	Country-specific recommendations of 2020	**Related reforms/interventions**
recommendation 3	c) Green and digital transition, but first and foremost, clean and efficient energy generation and energy use, sustainable transport, waste and water management, research and innovation, and the digital infrastructure of schools must be placed in the centre of investments.	• Classic and smart network developments of transmission system operator and distribution networks • Facilitating residential renewable energy investments

Social impacts

The most important social impact of the component is the reduction of GHG emissions to the extend previously indicated, and the replacing of the outdated heating systems of at least 11 600 households, thereby reducing the resulting air pollution (e.g. particulate matter, sulphur dioxide).

The component additionally increases energy efficiency through the use of more efficient heating technology and the upgrading of doors and windows.

Moreover, investments relating to the decarbonisation of the energy sector and the increasing of renewable energy generation capacity are able to create about 38 000 to 41 000 jobs by 2050, based on the calculations of the NTFS. The job-creating effect of the investments realised based on this component can be estimated at about 500 persons.

III. DEVELOPMENTS BASED ON COMMUNITY CO-FINANCING IN THE COOLING AND HEATING SECTOR

III.1. Planned measures of the Multiannual Financial Framework (MFF) 2021–2027

Hungary primarily contributes to the Renovation Wave Strategy of the European Commission through the priority axis of Renewable energy economy of the KEHOP Plusz operational programme and the building energy investments of the TOP Plusz programme. This component ensures a more efficient use of energy by replacing the doors and windows in the apartments and buildings of at least 11 600 households affected by the modernisation of the heating system, and by developing of more efficient heating systems, although the primary goal of the investment in the field of cooling and heating is to spread the use of renewable energy. The rate of available energy savings will be around 15–30% of the final energy consumption, depending on the efficiency of the heating system used before implementation, and the nature and technical condition of the doors and windows.

Due to its relatively high investment costs, the energy efficiency renovation of buildings will be financed from a variety of sources:

a) KEHOP Plusz supports the improvement of the energy efficiency of public buildings;
b) TOP Plusz complements the above by supporting public buildings maintained by local governments;
c) for the renovation of residential buildings, support programmes with a variety of financing forms are available until 2023 in addition to this component: for example, a soft loan financed from the GINOP 2014–2020, and the Home Renovation Programme supported from the national budget, which also provides non-repayable support for building energy activities with an intensity of 50%. Furthermore, a new soft loan facility financed from the KEHOP Plusz will become available from this year;
d) as of 2021, a support for the premises of businesses will be available under the KEHOP Plusz.

These support schemes provide enough financing to all sectors for the implementation of short- and medium-term energy efficiency developments. Moreover, attention must be paid on the capacity of the national economy: in case of further financing, capacity limits are estimated to be exceeded, which would definitely have the effect of raising prices, thereby crowding out the very target group of people from future developments regarding energy efficiency.

For the above reasons, no additional energy efficiency schemes can be provided from the energy component. However, in the case of investment affecting the public, the aim is to include the most cost-effective means of improving energy efficiency, namely the replacing of doors and windows of the building stock in question.

Facilitating energy efficiency measures and promoting activities for the shaping of attitude (KEHOP Plusz)

Modernising the existing domestic building stock, and especially residential buildings, has a great energy efficiency potential, but without support, modernisation will not move towards deep renovations that exploit the potential (insulation, replacing doors and windows, and the modernisation of cooling and heating, as well as domestic hot water systems). In the field of energy efficiency developments of buildings, green infrastructure solutions (green walls, green roofs) have been completely unused so far, although these solutions may result in significant energy savings with a relatively small investment (both in the field of heating and increasingly important cooling). The measure covers the energy efficiency renovations of residential buildings, central government buildings, the buildings of administrative bodies, the buildings of bodies with a public-service mission, the buildings kept by churches or civil societies, as well as the premises of businesses (SMEs and large companies). The energy efficiency intervention may be implemented by directly supporting the owners of the buildings and/or those keeping them, or through ESCO companies and energy efficiency obligated organisations. . Renovation must be at least medium deep.

The NECP established the introduction of the Energy Efficiency Obligation Scheme (EEOS) as of 2021, based on which the energy efficiency obligation to be achieved at the final consumer – as per the EED Directive – must be implemented through a defined group of obligated parties. This group and the annual obligation are defined by Act LVII of 2015 as amended on 1 January 2021, when it states that energy efficiency at the final consumer must be realised by the licence holders providing commercial and universal electricity and natural gas services and organisations selling transport fuel. The EEOS directs energy efficiency investments on a market basis to areas with the highest energy consumption and energy efficiency potential and the shortest payback time. It is the aim within the obligation scheme that the obligated parties also implement at the final consumer building energy renovations having longer payback time and higher investment needs, furthermore, the obligated parties may not pass their burden resulting from energy savings on to the consumers, and that the liquidity necessary for the investments must be ensured.

The improvement of energy saving and energy efficiency of the buildings of the central budgetary institution must primarily, but not exclusively, be realised under a so-called ESCO scheme, by directly or indirectly supporting the keeper/owner of the buildings. KEHOP Plusz also provides support for the energy developments of the renovations of public buildings kept or owned by other than local governments (social, healthcare and educational institutions), buildings of government bodies with a public-service mission (whether managed by the State, civil societies or churches), as well as residential buildings and buildings of businesses, either within the framework of the EEOS or, as an alternative measure, outside the framework of the EEOS. In Act LVII of 2015, Hungary made it mandatory that in the case of central government buildings, half of the annual renovation obligation must be implemented based on stricter rules than those specified in the Directive, i.e. in accordance with the obligations regarding nearly-zero energy buildings.

Within the EEOS, the obligated parties, and in the ESCO system, ESCO companies get non-repayable and repayable support from the KEHOP Plusz to implement the investments necessary for the fulfilment of their obligations at the final consumers, or the investments to be performed under the ESCO scheme. The obligated parties may use the support primarily for the investments of final consumers, namely for the energy investment implemented at the final consumer, thus the development is also realised primarily at the final consumer. Granting the support may promote the implementation of building energy investments within the obligation scheme, and an increase in the beneficiary's overhead costs can be avoided. The obligation and the ESCO scheme can be implemented in a combined way. Since these schemes can only be introduced gradually, traditional forms of support used in the period of 2014–2020 may also be applied, i.e. the owners, keepers or managers of the buildings may directly receive support. It is also possible to include energy efficiency developments which are not specifically targeted at building energy, but may achieve significant savings and a leap in quality. Shaping the attitude of consumers and sensitizing society may contribute to the effectiveness and success of building energy interventions.

Thus, the following are eligible in particular:

- the general energy efficiency investments and measures held in the registry used in the case of the EEOS,
- specific measures with demonstrable increase in energy efficiency, which may appear in lower energy consumption and/or lower GHG emissions,
- modernisation affecting the building envelope (insulation, replacing doors and windows),
- developments for technical systems in a building (modernisation of cooling and heating systems, as well as equipment and systems for producing domestic hot water), lighting modernisation, etc.
- installation of application-size small-scale units utilising renewable energy sources related to building

energy renovation, and generating electricity from said energy sources,

- activities related to the introduction and operation of the Energy Efficiency Obligation Scheme and the ESCO,
- construction of green roofs and green walls, preferring extensive solutions requiring minimal maintenance. Modification, reinforcement and waterproofing of building structures in order to make the green roof solution feasible, designing the supporting structure of the green wall, establishing growing medium, planting,
- shaping attitude, providing information and assistance for the preparation of investments, development of an information network for the public,
- soft and related investments; research, development and innovation up to a few percent of the core investment,
- elements and programmes for shaping attitude in cooperation with related policies.

Improving the efficiency of district heating and cooling systems (KEHOP Plusz)

The intervention covers the modernisation of district heating and cooling systems, the improvement of the efficiency of energy generation units, as well as the installation of new district heating systems, except for the placement of heat generation on a renewable basis. New district heating systems will be installed primarily where renewable-based operation and high heat demand density are ensured. At the level of consumers using district heating services, investments to facilitate energy efficiency may also be supported (thus, for example, the installation of cost-sharing and measuring equipment, modernisation of in-house systems).

Thus, the following are eligible in particular:

- energy efficiency interventions affecting the whole of the district heating system (including the elements at the consumers),
- connecting new consumers to the district heating system.

Promoting renewable energy sources in electricity generation and in the field of heating and cooling (KEHOP Plusz)

One of the keys to reducing import dependence and to decarbonisation is the greater exploitation of renewable resources. Therefore, promoting individual and community electricity generation based on renewable energy sources by granting non-repayable and repayable supports plays an important role. TOP Plusz provides support for the establishment and investments of energy communities with majority local government participation.

Promoting the establishment of decentralised individual heating and community heating points based on renewable energy sources is key for satisfying local heating and cooling demands. This measure also promotes the placement of heat-generating units of district heating and cooling on a renewable energy source basis (especially geothermal and biomass).

The individual heating modernisation of consumers having outdated heaters is of special importance at parts of municipalities where air pollution levels are high. Another essential activity is the promotion of heat generation of public buildings, buildings of government bodies with a public-service mission, residential buildings and buildings of businesses in an individual or energy community form. Support may be granted for facilities using biomass for energy purposes, both to meet local demand for heat and for further use in alternative fuels.

Thus, the following are eligible in particular:

- placing electricity generation on a renewable basis in an individual, energy community or other form,
- installing modern boilers or heat pump systems utilising renewable energy sources,

- investments of community heating points based on biomass and geothermal energy, and placing heat-generating units of district heating on a renewable basis,
- using biomass for energy purposes,
- installing systems based on renewable energy meeting electric heating demands,
- soft and related investments; research, development and innovation up to a few percent of the core investment,
- elements and programmes for shaping attitude in cooperation with related policies.

III.2. Planned measures of the Recovery and Resilience Facility (RRF)

The programme called ***Supporting residential solar panel systems and the electrification of heating systems combined with solar panel systems*** can be outlined among the planned measures.

Description:

According to the data of the HCSO, although the prices of solid fuels have materially increased in recent years, there has been no significant change in the share of households using such solutions: it might be because despite the relative rise in their prices, they can still be considered a cheap solution, on the other hand, high investment costs also make it more difficult to switch to other heating methods.[3]

In order to avoid the risk of getting stuck in an outdated and air-polluting heating method, it is reasonable to grant non-repayable support for the following activities to households with home ownership that are at higher than average risk of energy poverty (having an income below the national average) and have a low creditworthiness:

(1) Installation of a solar panel system on the roof, aimed at replacing own consumption

Eligible activities:

- fulfilment of basic legal requirements necessary for the establishment of a solar panel system (e.g. connection of three-phase power, standardisation of electricity meters),
- solar panel system installed on the roof, aimed at replacing own consumption (4–5 kW at most), with inverter, supporting structure, including the activity of designing, licencing and implementation.

(2) Installation of solar panel system, replacement of doors and windows, establishment of storage capacity, and the electrification of heating or domestic hot water systems

Activities eligible under the programme:

- fulfilment of basic legal requirements necessary for the establishment of a solar panel system (e.g. tying in three-phase power, standardisation of electricity meters),
- solar panel system installed on the roof, aimed at replacing own consumption (4–5 kW), with inverter, supporting structure, including the activity of designing, licencing and implementation,
- installation and putting into operation of a domestic battery-powered storage unit with a power of 5 kW, not providing premium services (for the temporary storage of the generated renewable-based electricity),
- having 2 energy performance certificates prepared (at the beginning and closing of the investment),
- replacement of doors and windows (with plastic frame, in accordance with the applicable building regulations and the characteristics of the building),
- implementing one of the below 2 technical solutions based on the design of the building owned by the beneficiary household:

[3] https://www.ksh.hu/mikrocenzus2016/kotet_6_haztartasok_es_csaladok_adatai

- installation of energy efficient and modern electric heating panels / infrared heating with a solar panel system capable of serving it, (5 kW max.) in buildings where no hydronic system is available. If necessary, air-to-air heat pumps may be used for the heating and cooling of larger spaces. In order to connect the solar panel system to the network, it is also necessary to ensure the construction of an electricity network specifically connected only to the new electrical consumer equipment for heating purposes.

OR

- purchasing and installation of an energy efficient and modern air-to-water heat pump, if the hydronic system with heat emitters is already in place. In order to connect the solar panel system to the network, it is also necessary to ensure the construction of an electricity network specifically connected only to the new electrical consumer equipment for heating purposes.

The above systems may be supplemented with a storage ensuring the production of domestic hot water and, if necessary, also with ceramic heating cartridge. In theory, geothermal heat and solar collector could also be used for heating purposes, if their investment costs and operating efficiency are not inferior to that of the above equipment.

As a result of the support schemes, about 175 MW installed solar panel capacity and 50 MW installed electric heating system capacity could be achieved by 2026.

The rate of available energy savings will be around 15–30% of the final energy consumption of the building, depending on the efficiency of the heating system used before implementation, and the nature and technical condition of the doors and windows. The Energy Efficiency First principle is implemented in case of complex modernisation of heating systems partly by using modern insulated doors and windows with a low thermal transmittance adapted to the technical conditions of the house, and partly by improving the efficiency of the new heating system. The technical solution involving only solar panels aims at a wider use of renewable energy sources.

To establish the energy savings achieved by the introduction of the technical solution regarding the complex modernisation of the heating system, an energy audit must be performed at the beginning and at the completion of the investment. This makes it possible to determine the extent of the savings in an objective way.

Under the tender, only equipment containing F-gases with a low global warming potential may be purchased. The aim is to use equipment with refrigerants that have a low global warming potential, are easy to neutralise, and whose efficiency is adequate.

Indicator of the investment:

Output indicator: number of households supplied with solar panel system and/or modernised heating system. Goal: 34 920 households (data source: managing body)

Table III.1: Schedule for the fulfilment of the indicator (aggregate values):

	2022 Q3	2024 Q3	2026 Q3
number of households supplied with solar panel system and/or modernised heating system, pcs	2 444	15 015	34 920

Target group

Households with property ownership that are at higher than average risk of energy poverty, i.e. have an income below the national average income and typically a low creditworthiness, and are physically eligible for the investment (the conditions of the building must make them eligible for the implementation of the investment).

The call for proposals identifies the target groups that are eligible to apply according to objective criteria. One aspect of defining these target groups is that the income of the beneficiaries should be below the national average income, while another important aspect is that the condition of the building should be eligible for receiving the investment. This investment contributes to the reduction of energy poverty by helping those households enjoy the benefits of renewable energy which would not be able to achieve this goal on their own.

During the tendering process, our aim is simplification and providing professional support to applicant households. The two-round qualification (prequalification according to eligibility criteria, then providing professional support for the preparation), the prequalification of the project developers, or the reduction of financial administration for the people serve this goal.

Other measures and impacts:

The intervention aiming to increase the spread of residential solar panel systems directly contributes to the achievement of climate goals and the goals concerning the increase in the share of renewable energy sources, and reduces the energy costs of the households affected.

Such a complex support scheme involving energy efficiency, renewable energy utilisation and energy storage elements has not yet been published in Hungary. As a result, this will serve as a reference point for the preparation of schemes published thereafter.

With the implementation of the **Support for residential use of solar panels and the modernisation of heating systems**, based on our calculations, **direct air pollution and GHG emissions from heating can be eliminated** in about 11 600 households. Since the investment will also take into account social aspects, the replacement of heating systems will speed up in geographical areas where particulate matter, nitrogen dioxide concentrations and ground-level ozone load are currently at levels above average. As a result, the investment has a positive impact on the public health situation in areas where the EU air quality limit values set out in Directive 2008/50/EC are exceeded or are at risk of being exceeded. Equipment containing F-gases with a low global warming potential will be purchased.

Up to 70% by weight of non-hazardous construction and demolition waste generated during the investment will be handled in accordance with the EU waste hierarchy and the EU construction and demolition waste protocol.

The solar panels to be used are regulated under Act LXXXV of 2011 on environmental protection product charges, according to which the State finances the recycling of obsolete solar panels at the end of their life cycle by paying the charge imposed on solar panels.

Planned schedule:

- applications may be submitted from August 2021, the application documents to be submitted will start to be developed from August 2021,
- start of the first implementation activities: continuously from December 2021,
- closing of the application phase: 2025 Q4,
- closing of schemes: 31 July 2026

During the implementation of the investment, we strive to apply the simplest possible procedure for both the application and the payments, as well as in the professional implementation. The tender will be overseen by an organisation that has experience in the field of organising public tenders.

When identifying the milestones of 2022–2026, we expected a gradual take-off, allowing for system self-learning and correction as needed.

Investment costs and the total financial framework:

The unit cost of small-scale units of household size is HUF 410 000/kW net based on market price analysis. The unit cost of a 5 kW domestic battery-powered storage unit is HUF 2 772 760 net including both installation and putting into operation. The cost of a heat pump system calculated for one household (heating system based on solar panel and heat pump) is HUF 4 270 000 net based on a market price analysis of 2020.

If a heat pump system cannot be installed, the total calculated cost per household using heating panels (heating system based on solar panel and heating panel) is HUF 2 545 000 net, also based on market price analysis.

The unit cost of cost-optimal replacement of doors and windows (U=1.1 Wm²K) is HUF 65 040/m² net. The total financial framework for support provided by the RRF is HUF 158 759 billion net.

The planned support intensity is 100% of the net cost.

IV. PROJECTING HEATING AND COOLING DEMANDS FOR THE NEXT 30 YEARS

IV.1. Projections

GDP and population changes are very important factors in terms of energy use and GHG emissions. In addition to oil prices, these factors are the ones that best determine the future performance of each sector.

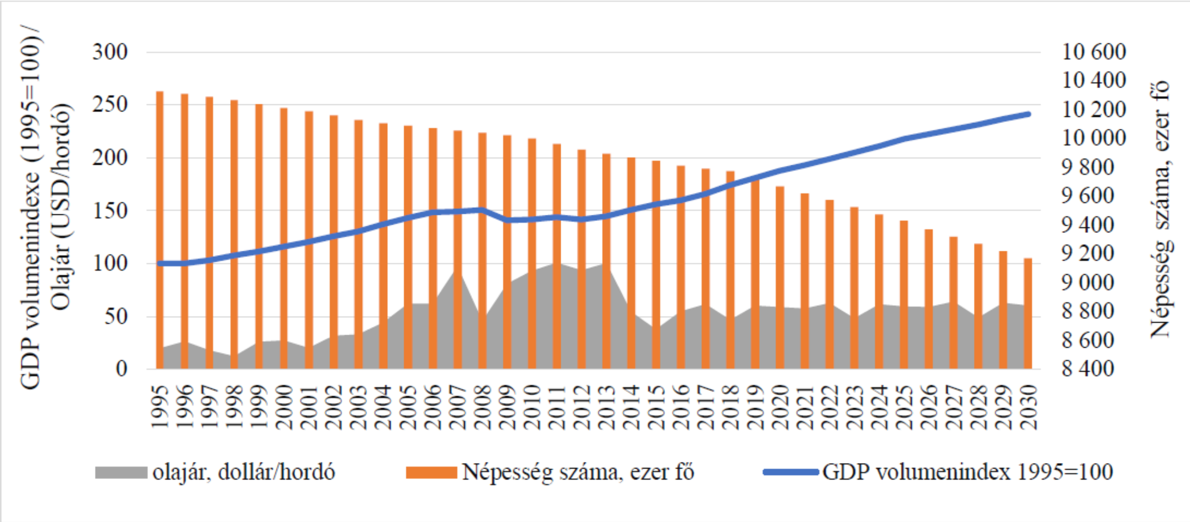
The initial population size and the expected population size are the basic influencing factors of the energy consumption model in the case of buildings, and they also have significant explanatory power in the case of many sectors. **The size of population in 2016** – based on the data of a 2016 microcensus – **was 9.55 million in terms of permanent population** and **9.8 million in terms of resident population**.

Currently, the latest official **population projection** is a calculation of the Demographic Research Institute (Népességtudományi Kutatóintézet, NKI) of the HCSO made in 2015, which examines three (basic, high, low) prospects until 2060. The UN also prepares country-specific population projections based on three scenarios, which figure on 8.9, 9.1 and 9.5 million persons by 2030. **Our calculations were based on the projections of the NKI**, which figure on 9.17 million persons by 2030 and 8.56 million persons by 2050.

The below table shows in summary the sources of the three most important variables used in the NECP.

Table IV.1: Variables used to project demand in each sector and their sources

Variable	Source
Explanatory variables	
GDP volume index historical data and projection until 2050 (1995=100%)	Source of factual data: National accounts of the HCSO, the projection is from the European Commission
Population size historical data and projection until 2050 (thousand persons)	Factual data is from the HCSO Demography, the projection is based on the modelling of the NKI
Oil price historical data and projection until 2050 (USD/barrel)	Factual data and projection from Reuters



GDP volumenindexe (1995=100)/Olajár (USD/hordó)	GDP volume index (1995=100) / Oil price (USD/barrel)
olajár, dollár/hordó	oil price, USD/barrel
Népesség száma, ezer fő	Population size, thousand persons
GDP volumenindex 1995=100	GDP volume index 1995=100
Népesség száma, ezer fő	Population size, thousand persons

Figure IV.1: GDP volume index, oil price time line (left-hand axis), population size (right-hand axis)[4] (HCSO, NKI, EC, Reuters)

Sectoral changes that are expected to affect the energy system and greenhouse gas emissions

In the following, the key factors that determine the performance of a given sector, and thus partly its energy consumption and GHG emissions, are summarised by sector.

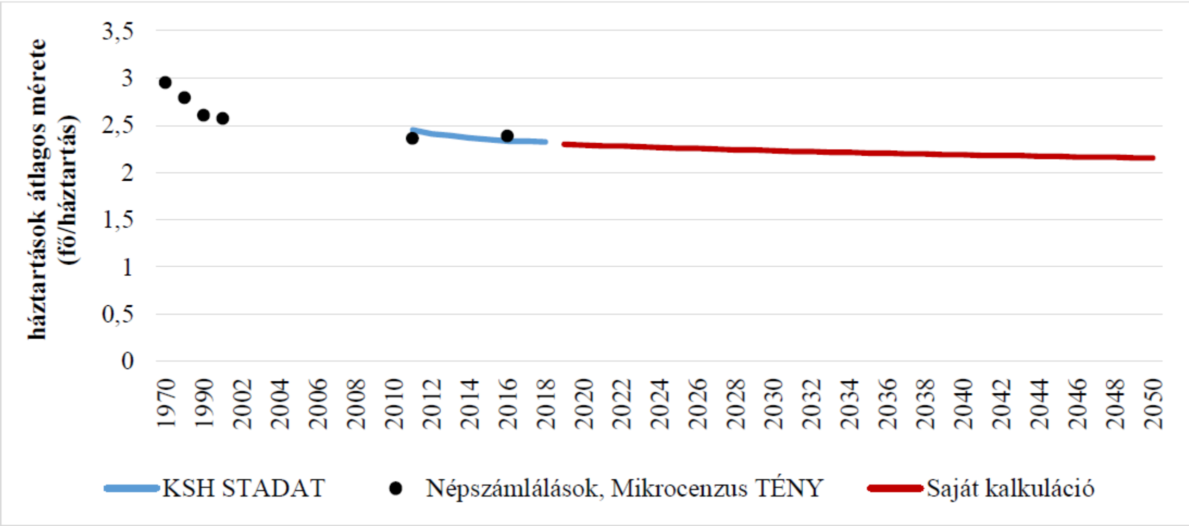
Households

The number of households is an important indicator for the future mainly due to the change in the number of household appliances, since typically all households have large appliances with significant energy consumption; therefore the change in the number of households has an impact on energy consumption as well. On the other hand, the number of households depends primarily on the size of the population and other cultural, social and economic factors.

Both Hungarian and European trends show that the number of single-person households has increased in recent years (HCSO 2015). An average household had almost three persons in Hungary in the 1970s, while based on the surveys of the 2010s, this figure was only around 2.4.

According to the population projection used in the model, which is based on a slightly slowing decline in the data of the STADAT summary tables of the HCSO, the size of an average household is expected to decrease to 2.14 persons by 2050.

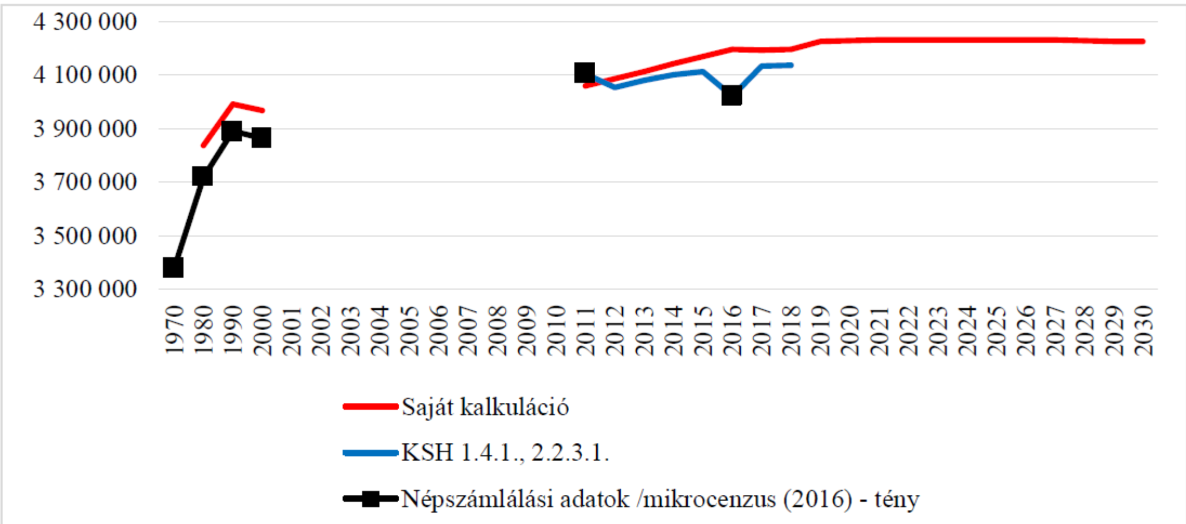
[4] factual data between 1995 and 2018, projections thereafter



Háztartások átlagos mérete (fő/háztartás)	Average size of households (person/household)
KSH STADAT	HCSO STADAT
Népszámlálások, Mikrocenzus TÉNY	Censuses, Microcensus FACT
Saját kalkuláció	Own calculation

Figure IV.2: Average number of people in a household (broken down by ten years until 2001, and then by one year) (HCSO 2018, ITM calculation)

The number of households in Hungary exceeded 4.1 million at the time of the 2011 census, while based on the 2016 microcensus, this number dropped to around 4 million.



Saját kalkuláció	Own calculation
KSH 1.4.1., 2.2.3.1.	HCSO 1.4.1., 2.2.3.1.
Népszámlálási adatok /mikrocenzus (2016) - tény	Census data / microcensus (2016) – fact

Figure IV.3: Measured and calculated household number data and projections broken down by ten years until 2001, and then by one year (HCSO (2011, 2017, 2018) and ITM's own calculation)

Based on the data published by HCSO STADAT, it can be concluded that, similarly to European trends, the **number of households in Hungary will continue to grow in the future.** The forecast presented here was made based on the population projection described above and the expected average number of people living in a household, with a slight increase in the number of households by 2024 (up to 4.24 million households) and a slight decrease by 2050 (4.13 million households).

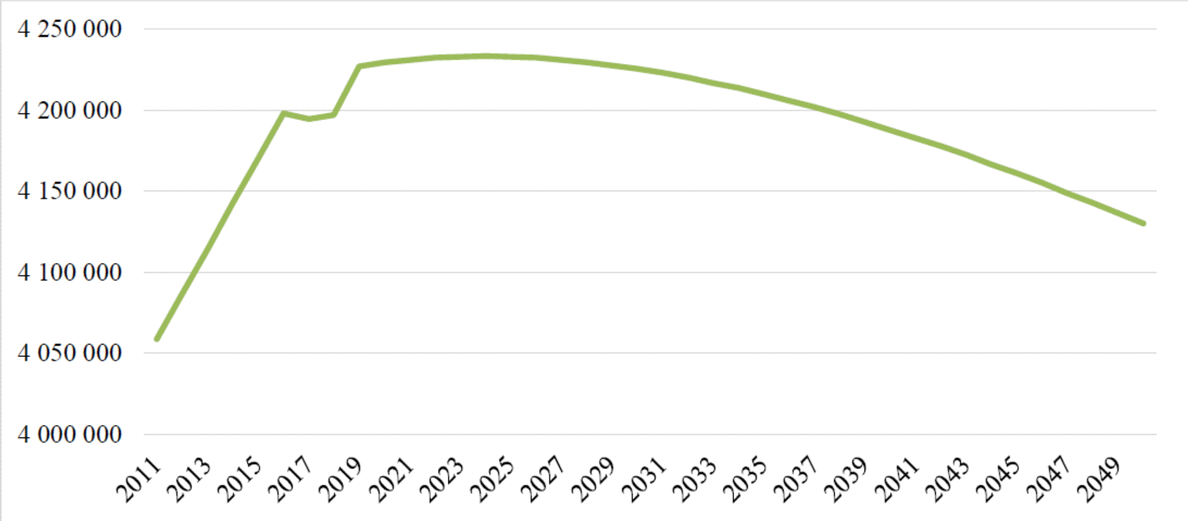


Figure IV.4: The number of households in Hungary until 2050 (HCSO 2018 and ITM's own calculation)

Residential building stock

We assumed during the modelling that the number of occupied dwellings follows the number of households. As a result of the reduction in the size of households, **the total number of households will decline by 2050 to a lesser extent than the population.** Instead of the 4 202 000 households in 2016, there will be 3 975 000 households in Hungary by 2050. At the same time, we also assumed that the number of dwellings per 100 households, which was approximately 92 in 2016, will reach100 by 2050, i.e. every household will have its own dwelling.

At the time of the latest census (2011), there were 2.73 million buildings in Hungary, **while according to the microcensus of 2016, there were slightly fewer, i.e. 2.68 million buildings.** The National Building Energy Strategy (Nemzeti Épületenergetikai Stratégia, NÉeS) estimated 2.7 million buildings (NFM 2015), the underlying study estimated 2.36 million buildings[5], and the TABULA- EPISCOPE[6] estimated 2.64 million buildings. According to the NEéS, 96% of the buildings are detached houses, 3% are traditional apartment blocks, and 1% are industrialised apartment blocks (Table IV.2).

In case of occupied dwellings, it is important to make a distinction between the total dwelling stock and, within this, the dwellings occupied. The NÉeS and its background studies perform their calculations based on the total dwelling stock, while this document calculates based on the dwellings occupied. This is because no one lives habitually in dwellings not occupied; therefore, we cannot talk about energy consumption in these cases. In addition, very little information is available on these buildings, and most statistics refer to occupied dwellings.

Table IV.2: The building stock of Hungary according to different sources

Source	Year	Building stock (pcs)
HCSO microcensus	2016	2 675 300

[5] A typology of buildings for modelling the energy performance of the domestic residential building stock (Épülettipológia a hazai lakóépület-állomány energetikai modellezéséhez) (Background Study for the National Building Energy Strategy, author: Dr Tamás Csoknyai, 2013)
[6] https://episcope.eu

HCSO census	2011	2 732 171
National Building Energy Strategy (2015)	2011–13	2 702 183
NÉeS background study (Csoknyai 2013)	2001-11	2 358 908
TABULA-EPISCOPE	2001-11	2 640 543

The dwelling stock was around 4.4 million according to the 2011 census, of which the number of occupied dwellings was 3.9 million, i.e. almost half a million dwellings were empty. The number of dwellings slightly increased between 2011 and 2017, by nearly 50 000, while the number of occupied dwellings decreased by almost 60 000 between 2011 and 2016. According to our assumption, based on which the share of households with self-contained dwellings is increasing, **the number of occupied dwellings will not decrease with the number of households**, **but will increase by around 2.5% by 2050 from the number in 2016** (3 854 000 occupied dwellings).

Table IV.3: Dwelling stock according to the data of HCSO

Source	Year	Number of dwellings (pcs)	Number of occupied dwellings (pcs)
HCSO census	2011	4 390 302	3 912 429
HCSO microcensus	2016	4 404 518	3 854 405
HCSO dwelling statistics (xstadat)	2017	4 427 805	

The dwelling stock was divided into building types, and further categories were established within the building types according to the heating method. For building types, we used the data of the 2011 census (which also forms the basis of the NÉeS) because the microcensus of 2016 is not representative in this regard. Within each building type, the data of the 2016 microcensus were taken into account for the heating method.

Based on our projections[7], the total building stock will reach 5 561 dwellings per year by 2026, then will decrease and stabilise at a level of 4 446 ceasing dwellings per year. Predicted dwelling cessations were allocated to each building type in such a way that the cessation rate of buildings built before 1945 was four times that of buildings built after 1980.

[7] http://www.trenecon.hu/[8] State Audit Office of Hungary (2018): Verification of the energy efficiency of public buildings (A középületek energiahatékonyságának ellenőrzése). Report. (https://asz.hu/storage/files/files/jelentes/2018/18144.pdf)

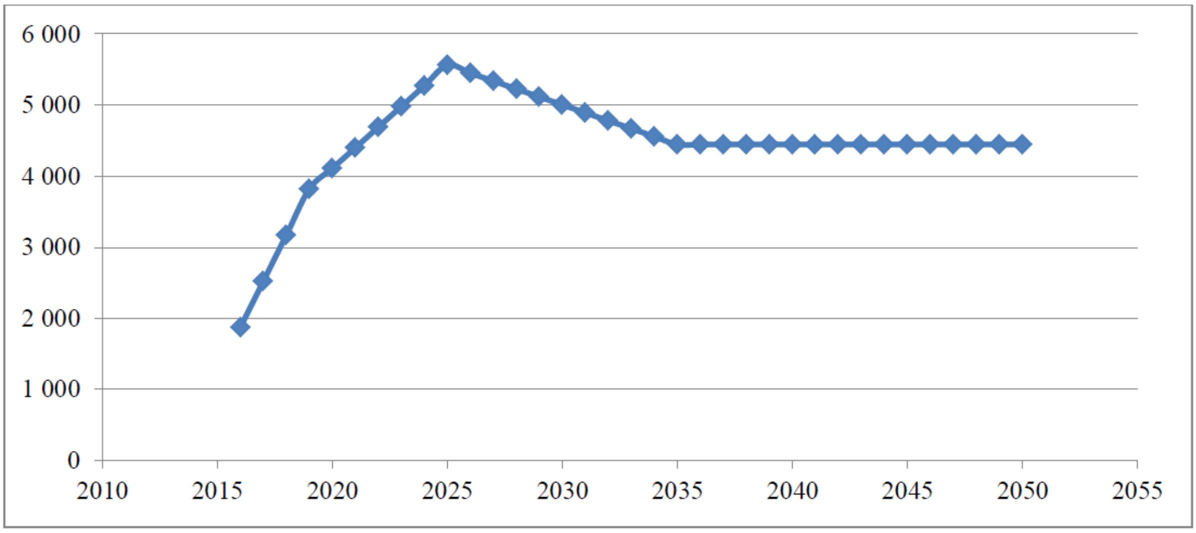


Figure IV.5: Number of dwelling cessations per year, pcs/year (TRENECON)

New dwelling constructions serve to meet the growing demand for dwellings on the one hand, and to replace ceasing dwellings on the other. Accordingly, dwelling constructions are as shown in the figure below. The projection also takes into account the target specified in the convergence programme until 2020, as a result of which **the number of dwelling constructions is high until 2020**, **then it becomes uneven**, but is lower on average than the level planned for the near future.

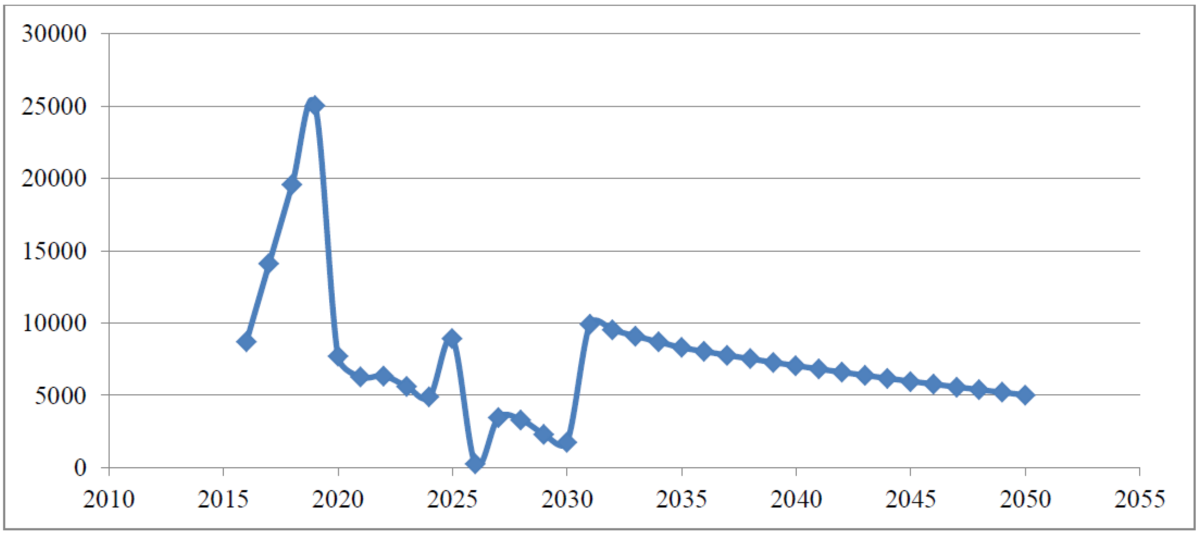


Figure IV.6: Number of new constructions per year, pcs/year (HCSO data)

The level of energy efficiency achieved in newly built dwellings is endogenously selected by the model depending on the additional costs of the buildings with higher energy efficiency, the cost of the energy saved and the supports.

No uniform, detailed and regularly updated database is available on the renovation investments of buildings; therefore, we can only refer to the results of ad hoc data recordings.

As a background study of the NÉeS, ÉMI conducted a nationwide survey of 20 842 buildings in which the level of renovation was examined by visually inspecting the dwellings on the spot, but from outside the dwellings.

Table IV.4: Findings of the nationwide survey of ÉMI (National Building Energy Strategy, 2015)

	Detached houses	Apartment blocks	Industrialised apartment blocks
Development in unbroken rows and semi-detached form	9–40%	>50%	
Insulated	5-30%		
Partially sealed + insulated	5-60%		50%
Doors and windows (houses before 2011)	27-75%	40-50%	20-50%

ÉMI also reported on the findings of a sociological survey based on which it can be concluded that **most of the renovated buildings were only partially renovated**, and the number of complex renovations including renewable energy sources is small. Door and window replacement and insulation were registered in 74% of houses, facade insulation in 74%, roof insulation in 41%, and modernisation of the heating system in 36%, while the use of renewable energy sources was registered in only 2% of the houses.

Another survey was carried out by the Hungarian Energy Efficiency Institute (Magyar Energiahatékonysági Intézet, MEHI) in 2016 in which 2 507 telephone interviews were conducted within the framework of a nationwide representative research. According to the findings, **41% of the respondents implemented some form of energy efficiency investment in the last 5 years.** Of these, 67% replaced their doors and windows, 42% performed insulation works, and 31% replaced their boilers and water heaters.

The HCSO also has two data sources on the renovation of buildings: the microcensus of 2016 and the analysis titled *What do we live in? – Housing conditions* (*Miben élünk? – Lakásviszonyok, 2015*) of 2015. In addition, the Negajoule study and MEHI also conducted a survey on dwelling renovations.

The **2016 census of HCSO** assessed what kind of renovation works were performed in occupied dwellings between 2006 and 2016. Based on the above, **895 000 dwellings were insulated**, **670 000 dwellings had their heating system modernised and/or switched to renewable fuels, and doors and windows were replaced in nearly 1.5 million** (1 468 907) **dwellings.**

The findings of the different surveys are presented in Table IV.5.

An **underheating ratio** can be estimated from the difference between the theoretical primary heating energy demand taking into account the renovation rate and calculated according to ISO standards and the energy actually used, which indicates how much less heating energy the population uses compared to what would be needed to have a minimum of 20°C in buildings throughout the year. The rate thereof varies according to the **type of buildings, and is between 35–42%.**

Table IV.5: Findings of the HCSO surveys assessing the renovation level of buildings

	Replacement of doors and	Insulation of walls	Modernisation of the heating system	Renovation period	Source

	windows				
Detached house **Traditional apartment blocks** **Industrialised apartment blocks**	21% 33% 39%	23% 21% 39%	13% 20% 19%	until 2011	Negajoule (2011)
Total number of buildings **Total number of buildings**	1 200 000 350 000		0 130 000	2006-2015 Planned renovations in 2016–2018	Based on HCSO's *What do we live in?* analysis of 2015
Before 1919 **1919-1945** **1946-1960** **1961-1970** **1971-1980** **1981-1990** **1991-2000** **2001-2011** **2012-2016** **Total** **of which district heating (with transmission lines from the heat source)**	80 668 121 790 170 420 270 371 444 084 276 886 67 836 32 130 4 722 1 468 907 353 260	36 787 62 800 82 272 143 483 266 357 174 476 64 854 57 014 7 267 895 310 197 017	47 630 62 874 70 536 103 392 162 414 124 626 54 921 38 896 5 336 670 625 84 312	2007-2016	HCSO microcensus 2016
Dwellings in total	31%	17%	13%	2011-2016	MEHI

The projections assume that the rate of underheating will decrease by 0.27% as GDP grows by 1%.

Renovation costs were taken into account based on the TRENECON database as assumed in the table below.

Table IV.6: Renovation characteristics of buildings (TRENECON)

	Cost-effective renovation		Nearly-zero renovation	
	Energy demand after renovation, kWh/m2/year	**Renovation cost, HUF/building**	**Energy demand after renovation, kWh/m2/year**	**Renovation cost, HUF/building**

detached house under 80m2 –1945	140	3 721 304	100	4 615 516
detached house over 80m2 –1945	128	5 610 300	100	6 191 130
detached house under 80m2 1946–1980	139	3 372 811	100	4 581 456
detached house over 80m2 1946–1980	135	4 234 578	100	5 714 384
detached house 1981–1990	109	2 962 510	86	4 653 625
detached house 1991-2000	114	3 217 550	92	4 973 000
detached house or terraced house 2001–	123	2 717 619	91	3 916 359
apartment block with 4–9 apartments –2000	111	10 019 914	92	18 962 718
apartment block with 4–9 apartments 2001–	99	9 087 167	82	17 140 466
apartment block with 10 or more apartments –1945	99	57 932 377	95	57 114 222
apartment block with 10 or more apartments 1946–2000, brick and other	95	23 035 877	67	41 385 955
apartment block with 10 or more apartments medium or large blocks of concrete	85	21 870 559	78	23 611 783
apartment block with 10 or more apartments 1946–1980 concrete panel blocks	84	49 221 119	74	51 243 796
apartment block with 10 or more apartments 1981– concrete panel blocks	84	37 992 734	74	39 965 742
apartment block with 10 or more apartments 2001–	84	35 549 674	74	26 053 478

The model calculates the renovation rate of the building stock in an endogenous way. Renovation is carried out if it is worth based on the investment costs, the energy saved and the supports available. For each building type, the model chooses between the maintaining of the current renovation level, a cost-effective level and a nearly zero renovation level.

Public and commercial buildings

In the case of commercial buildings, no data are available on the type and floor area of the buildings. In the absence of data, the following method was used for calculation:

- the total energy consumption data in the energy balance were used as starting point,
- the allocation of data in the total energy balance to different end-use categories based on the data found in the energy performance certificates issued in the period of 2016–2018 available at the Lechner Knowledge Centre,
- the breakdown of heating, cooling and domestic hot water data by building type based on the proportions specified in the energy performance certificates.

The energy consumption of public and commercial buildings is allocated according to the following: heating, cooling, hot water, ventilation, lighting and other energy consumption. The estimate of other energy demands was carried out based on expert estimate.

Table IV.7: Energy consumption of public and commercial buildings

	Primary energy demand of heating	Primary energy demand of domestic hot water	Primary energy demand of ventilation	Primary energy demand of cooling	Primary energy demand of lighting	Other
kWh/m2/year	214.94	20.52	3.54	1.90	19.94	29.91
%	73.9%	7.1%	1.2%	0.7%	6.9%	10.3%

According to the study conducted by Comfort Consulting Kft, there were a total of 37 871 public buildings in the country in 2012. Of these, 32 176 were buildings of local governments, while 5 695 buildings were owned by the State.

Based on the updated data of the HCSO, the building stock of local governments reached 32 233 by 2016, and there are no exact data on buildings owned by the State, but according to the report on the verification of the energy efficiency of public buildings[8] prepared by the State Audit Office of Hungary in 2018, due to the restructuring actions in 2016, the floor area of central government buildings to be renovated under Act LVII of 2015 on energy efficiency decreased; therefore, it can be assumed that the number of State-owned buildings also decreased in some degree, but at least did not increase. As the number of State-owned buildings is small compared to the number of buildings owned by local governments, we consider their change to be negligible, so we use the previous data from the above-mentioned study.

However, public buildings make up only a small part of the total non-residential building stock; therefore, the data of Comfort Consulting Kft cannot be used for the estimate of the entire stock of **public and commercial buildings**. Instead, data concerning the building type in the energy performance certificates were used. The estimate made in this way is presumably not representative because energy performance certificates are usually issued in two cases, namely in case of an opportunity to apply under a call for proposals, and in case of selling/letting, thus the distribution of the building types in the database is influenced by which buildings become subject to calls for proposals and which buildings are let/sold (in this latter category some building types are underrepresented, e.g. schools and healthcare facilities, which are usually not let or sold). (It is therefore necessary to correct these data at a later stage, when more reliable data are available.)

In the LTRS, the typology set up by the background study of NÉeS was the starting point for public buildings as

[8] State Audit Office of Hungary (2018): Verification of the energy efficiency of public buildings. Report. (https://asz.hu/storage/files/files/jelentes/2018/18144.pdf)

well. The above-mentioned background study establishes five key categories based on the function of buildings:

- healthcare and social buildings,
- office buildings,
- commercial buildings,
- cultural buildings,
- educational buildings.

These categories are narrow in some cases; they do not cover every function. Thus, for example, the available data do not allow for the interpretation of sports facilities owned by the State and local governments, despite the fact that significant energy consumption can be assumed in their case.

We do not assume underheating in the case of commercial and public buildings. When forecasting the building stock, the condition was that for all buildings of all building types, their total floor area would increase in line with GDP. When estimating growth, a coefficient of elasticity of 0.3 was applied uniformly for all uses (education, healthcare, office, etc.). Like in the case of residential buildings, new buildings will partly satisfy the increased demand and partly replace ceasing buildings. The assumed cessation rate is 1.17% per year, based on the TRENECON database.

IV.2. Milestones of the long-term renovation strategy (LTRS)

In order to monitor the achievement of the goals set by the LTRS, Hungary establishes the following indicative milestones for the energy efficiency of buildings for 2030, 2040 and 2050.

1. Reduction of CO_2 emissions, which will be realised through the reduction of primary fossil energy demands for building energy purposes (operation of heating, cooling, domestic hot water production, cooking, lighting, ventilation, electric charging station connected to a building, building energy systems) compared to the 2018–2020 average, (%)

Table IV.8: The LTRS's goal to reduce CO_2 emissions

YEAR	Reduction of CO_2 emissions related to the use of buildings for energy purposes from the average level in 2018–2020
2030	20% (residential building) + 18% (public building)
2040	60%
2050	90%

2. The percentage of nearly zero-energy buildings (without taking into account the buildings specified in Article 4(2) of Directive 2010/31/EU); (%)

Table IV.9: The LTRS's goal concerning nearly zero-energy buildings

YEAR	The percentage of nearly-zero energy buildings
2030	20%
2040	60%

2050	90%

3. Decrease in the number of eligible energy-poor households compared to the baseline level of 2021, (%)

Table IV.10: The LTRS's goal to reduce energy poverty

YEAR	The reduction of the number of eligible households from the baseline level of 2021
2030	50%
2040	80%
2050	100%

4. The reduction of final energy consumption of public buildings compared to the average level of 2018–2020, (%)

Table IV.11: The LTRS's goal concerning public buildings

YEAR	The reduction of final energy consumption of public buildings compared to the average level of 2018–2020
2030	18 %
2040	40%
2050	60%

5. Guaranteed minimum number of recipients of energy efficiency advice of engineering level

Table IV.12: The LTRS's goal concerning advisory network

YEAR	Guaranteed minimum number of SMEs receiving engineering advice on energy efficiency	Guaranteed minimum number of natural persons receiving engineering advice on energy efficiency
between 2021–2030 in total	6 000 pcs	8 000 persons/year
between 2031–2040 in total	15 000 pcs	30 000 persons/year
between 2041–2050 in total	10 000 pcs	15 000 persons/year

IV.3. Development scenario in the residential sector

Based on the large-scale survey conducted between 2012 and 2016, the current renovation rate of the residential sector is estimated at 3.9% (European Commission, 2019). The annual rate of heating system modernisations is estimated at 1.7% based on the data of the 2016 microcensus (one of the subcategories of the 3.9% rate). The proposed renovation rate for both scenarios is 3.4–3.7% with greater depth of renovation. Normally, comprehensive renovation is only 0.1%, but it is 0.35–1.4% in the scenarios. In addition, since the 2016 census data do not differentiate between minor upgrades (e.g. installation of thermostatic valves) and major developments (e.g. boiler replacement), it is assumed that the depth of all renovations will increase on average.

Residential scenarios (alternative to each other)

Optimistic: Targeted buildings undergo cost-optimal renovations. Renovation rate starts at 0.5% and reaches 2.7–5.4% by the end of the period, depending on the type of building. Boilers are replaced (partial renovation) at an annual rate of 1.7% to take into account the normal renovation activities.

Realistic: The targeted buildings are the same as in the optimistic scenario, but three quarters of detached houses under cost-optimal renovation are only partially renovated, meaning that only the heating and hot water system is modernised. The same changes apply to multi-apartment residential buildings, with the difference that where there is no partial renovation option that we would prefer, there will be no renovation at all (that is, there will be a decline in the total renovation rate, not only in the degree of renovation). Boiler replacement according to normal procedure is the same.

IV.4. Development scenario in the public institution sector

According to our estimate based on the database of energy performance certificates, the current renovation rate for low or medium level renovation concerning all public buildings, including the buildings of local governments, is 1%. The scenarios would significantly accelerate renovation, and would also increase its depth.

The main difference between cost-optimal + renewable energy-based renovations in public buildings and the residential cost-optimal approach is the involvement of renewable energy sources. Renewable energy sources were omitted from the residential scenario in order to reduce the costs borne by residents.

The new provision of Act LVII of 2015 improves the efficiency of the renovation under the scenarios, which makes the requirement of nearly zero-energy demand for new buildings mandatory in the case of mandatory 3% annual renovation of central government buildings.

Public building scenarios (complement each other)

Cost-optimal + renewable energy: Every building undergoes a comprehensive renovation in order to achieve the cost-optimal + renewable energy performance level. Renovation rates start at 1% and reach 2.8–3.4% by 2030, depending on the type of building.

PV scheme: Solar panel systems are installed on buildings excluded from the scope of comprehensive renovation (buildings built after 1990). Renovation rates start at 1% and reach 3% by 2023, then remain unchanged until 2030.

Results

Modelling results are shown below. It is clear that the renovation of buildings itself can make a significant contribution to achieving planned energy savings.

Table IV.12: Summary of the results of the scenarios

Scheme and scenario	Annual energy	Annual financial	Share in the energy saving goals	Total cost	Total cost per savings

	savings	savings (2030)			
	PJ	*HUF billion*	*%*	*HUF billion*	*HUF billion/PJ*
Optimistic DH	23.97	111.6	32%	3 844	160
Realistic DH	13.97	80.2	20%	2 156	154
Optimistic MAB	5.64	15.8	8%	1 147	203
Realistic MAB	1.92	5.6	2%	396	206
Public buildings cost-optimal + renewable energy	3.40	17.0	17%	395	116
Public buildings solar panel	0.06	0.6	0%	17.4	290

Payback by building group

Numerous studies have shown that there are other motivations for energy efficient renovation of buildings than energy savings. This is often the increase in the value of the asset, as it is pointed out in the study of Beillan et al.[9] (2011). These apply primarily to commercial buildings, such as hotels, restaurants, etc., as well as to residential buildings in large cities (Budapest).

In Lithuania, the price of apartments in modernised multi-apartment buildings increased by 20–25%[10]. According to the report of Notaires de France (2017), the low energy efficiency of buildings is reflected in class F and class G of energy performance certificates, which reduced selling prices by 6–7%; the price of buildings with a high class A and B energy performance certificate is 6–13% higher than average; the analysis was conducted in France in 2016 among residential properties with similar characteristics. The Joint Research Centre (2018)[11] examined and analysed the impact of energy efficiency on the value of buildings in all EU Member States. The report recommends several methods for calculating the value of real property; however, we suggest using proxy variables due to the shortness of time. Based on the observations, it is suggested that the following proxy variables should be used for EU Member States:

- an increase of 3–8% in the selling price of residential buildings,
- an increase of 3–5% in the rent of residential buildings,
- an increase of 3–8% in the selling price of commercial buildings,
- an increase of 2–8% in the rent of commercial buildings.

The proxy variables taken into account are in line with the study of Horváth et al. (2013) (although a little more conservative than that)[12], which examined the impact of greater energy efficiency on the prices of residential buildings in Hungary, for which they used data on real estate sales from 2003 to mid-2012, and concluded that, as a result of the renovation, selling prices increased by 9.42% compared to non-renovated buildings, which is HUF 1 million for an average dwelling.

[9] https://www.eceee.org/library/conference_proceedings/eceee_Summer_Studies/2011/5-saving-energy-in-buildings-the-_time-to-act-is-now/barriers-and-drivers-to-energy-efficient-renovation-in-the-residential-sector-empirical-findings-from- five-european-countries/
[10] Valius Serbenta, slide 14
https://www.diw.de/documents/dokumentenarchiv/17/diw_01.c.790781.de/esif_snapfi_workshop_serbenta_27032020.pdf
[11] See the table on pages 18–22 here:
https://publications.jrc.ec.europa.eu/repository/bitstream/JRC113215/jrc113215_kjna29471enn_v2_ipo_final.pdf
[12] https://eltinga.hu/data/_uploaded/file/research/faluhaz.pdf

In addition, as a minor improvement to the model, payback time is calculated using the actual inflation of energy prices instead of using the forint tariffs of 2020 as a starting point.

Payback times for the complex renovation packages are based on the differences in estimated energy costs in the basic and renovation packages, with different assumptions:

- with and without inflation real value,
- in the residential sector, with or without rise in the property price. Real property prices were estimated based on HCSO data regarding Budapest, on the prices per square metre in the first quarter of 2020. We assumed a price increase of 5.5%, which is an extremely conservative value (according to the Lithuanian report, in the case of multi-apartment buildings, a 25% increase in property prices was observed after modernisation).

Table IV.13: *Payback time for the main building groups*

Type of building	No inflation and property price increase	Only inflation	Inflation and property price increase
Detached houses (cost-optimal)	37–90	33–70	21–56
Apartment blocks (cost-optimal)	42–107	40–78	18–45
Industrialised apartment blocks (cost-optimal)	41–47	37–86	2–9
Public buildings (cost-optimal + renewable energy)	10–67	10–62	n.a.

These results are in line with the results of similar studies conducted in other Member States. In Germany, for instance, the total cost of the modernisation of heating systems is higher than the energy costs saved, and payback time is very long compared to Hungary, even with higher energy prices (Figure 32). In addition to reducing energy consumption, most building renovations are motivated by other reasons, such as improving the exterior of the building. If the general modernisation also involves a heating component, its cost drops to about one third of the total cost of heating modernisation and is closer to the reduction in energy costs resulting from modernisation. The rest of the situation is not significantly different from the situation in Hungary. The same was reported from Latvia. The country finances its building renovations from the European Structural and Investment Funds, and payback time of the investments regarding industrialised apartment blocks may be up to 30 years (Aleksejs Kanejevs, Altum, presentation: 24 January 2019).

It is also worth noting that the large difference in payback time for public buildings reflects the differences between building types and energy use patterns (full/part-time), as well as other initial conditions which make these sectors very heterogeneous. This fact also reinforces the importance of the selection and ranking process for buildings, by which it can be ensured that buildings with the greatest potential for cost-effective energy savings are renovated first.

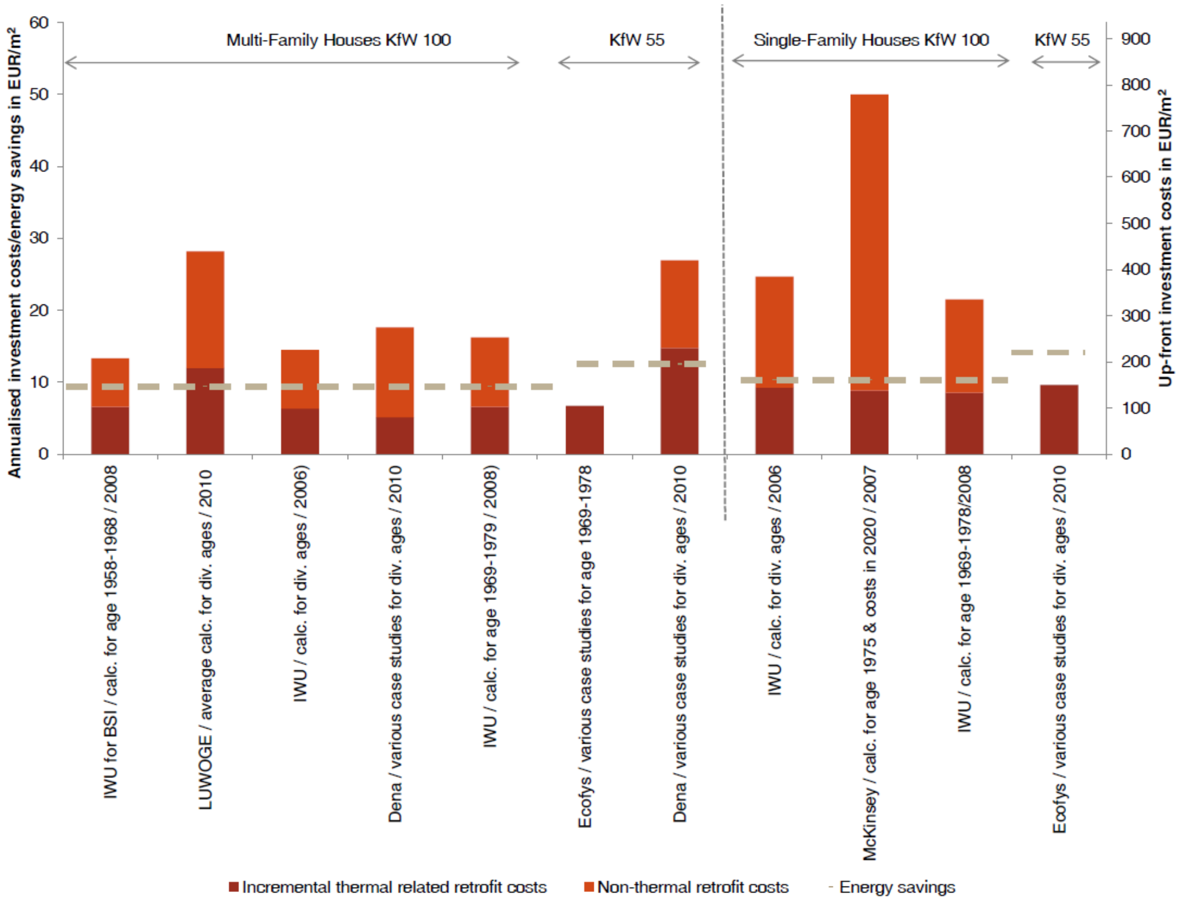


Figure IV.7: Summary of several studies regarding modernisation costs

This figure shows the costs of heating and other (non-heating) modernisations compared to the costs of saved energy. The left-hand axis of the chart shows costs and savings over the years, while the right-hand axis of the chart shows costs as initial investments.

Germany justifies financing its energy efficiency scheme on the grounds that it has a positive impact on the economy. The degree of these impacts depends on the structure of the economy, its energy dependence, and the extent to which the materials and technologies are produced domestically or imported from abroad. Reduction of CO2 emissions of buildings has real macroeconomic impacts; these include:

- impact on economic development, which are measured by GDP and GVA,
- impact on employment and disposable income,
- impact on the State budget,
- impact on avoidable imports of energy carriers and/or impact on the materials and technologies reflected in the commercial balance.

Partial renovation and payback

The structure of CAPEX, i.e. capital expenditure, has been broken down in the modernisation packages into individual measures and/or groups of measures, so that their impact on energy savings and payback can be assessed separately. This type of analysis is useful to determine those measures which are relatively appealing in terms of payback time; therefore, may be eligible for market-based financing, as well as those measures which require further incentive and more forms of preferential financing.

The following table provides an analysis of the payback time for partial and complex measures for the eight pilot buildings. The analysis took into account energy prices and actual inflation, but did not consider maintenance and repair costs, which cannot be regarded as ancillary costs.

Table IV.14: Analysis of heating modernisation packages by groups of measures

Group of measure	**Payback (year)**							
	Detached house	*Multi-apartment building*	*Multi-apartment building (industrial)*	*Community*	*Administrative*	*Educational*	*Hospital*	*Sports facility*
Modernisation of lighting system	n.a.	n.a.	n.a.	17	22	20	4	2
Windows	-10	73	58	32	29	130	31	16
Roof insulation	-4	66	-7	15	15	14	25	17
Wall insulation	-387	32	119	10	10	29	14	11
Renewable energy system	21	26	21	13	24	14	20	15
Heat pumps	127	73	n.a.	17	25	53	54	9
Cost-optimal + renewable energy package	36	55	49	12	20	34	17	13

The negative values of the residential sector are explained by the empirical correction factor (from the Tabula project) which we used for estimating the actual consumption of the buildings after energy modelling. This factor is non-linear, and changes depend on final energy consumption. This can be interpreted as meaning that partial measures are not expected to lead to real energy savings. It can be concluded therefrom that complex packages have a positive correlation with the impacts of partial measures.

V. POTENTIAL NEW STRATEGIES AND POLICY MEASURES

V.1. Introduction of the EEOS and financing measures

Introduction of the EEOS

As of 1 January 2021, Hungary put its energy efficiency objectives on a new footing, and in addition to already existing achievements, it wants to promote investments improving residential and corporate energy efficiency with a new market-based policy. That is why the National Energy and Climate Plan published on 16 January 2020 established as one of the key elements of the energy efficiency dimension that it intends to introduce the so-called Energy Efficiency Obligation Scheme (EEOS). The aim of the scheme is to enable organisations selling electricity, natural gas and transport fuels to meet the Member States' final energy savings target of 0.8% per year measured against the baseline energy consumption of 2017–2019, as set out in the EED Directive from 2021, through the implementation of new cost-effective investments. This may – mutatis mutandis – be realised with investments that result in proven energy savings on the end-user side.

The legal basis for the EEOS is established by the amendment of Act LVII of 2015 effective as from 1 January 2021. The scheme starts with a pilot year, and the level of the obligation will increase gradually with the aim that obligated companies should gradually find the most cost-effective method for the investments to be implemented, so the introduction of the scheme is expected to achieve energy efficiency targets in an economically optimal way. The scheme also gives obligated parties free choice regarding in which customer base they want to implement the investment: whether in the industrial, residential, public building or service sector.

The EEOS is not only for obligated parties, it is also an incentive for other companies interested in energy efficiency investments, as well as for the general public. In order to promote the above, the legislation – for instance – provides an opportunity to sell eligible and certified energy savings on so-called secondary markets, essentially transforming into a right representing marketable assets. This means that, if a homeowner, for example, modernises the heating system, he or she may have an obligated party finance the investment following certification by a professional energy auditor, since it can be accounted for by the obligated party in the EEOS. According to the plans of the Government, this will result in a significant volume of domestic industrial developments, and several investors who do not qualify as obligated parties or who have a contractual relationship with an obligated party may enter the scheme. The scheme will also generate market-based competition, as those investments will be favoured which can achieve energy savings in the most cost-effective way.

Alternative policy measures

Although the market-based operation of the EEOS puts Hungary's energy efficiency objectives on a new footing, in itself does not cover the energy saving obligation of the Member States set out at the Directive level, which is cumulatively 0.8% per year compared to the baseline energy consumption in 2017–2019. It is important that other alternative policy measures and quasi-governmental interventions remain, because it is estimated that 5 PJ of the expected savings of 7 PJ per year will still be covered by these measures.

There are several forms of alternative policy measures. There are programmes for shaping attitude, tax advantage-type aids, and investment aids granted directly. A programme for shaping attitude, for example, is the National Network of Energy Experts (Nemzeti Energetikusi Hálózat) reimagined at the beginning of 2020, which is a body specialised in free energy consultation.

In addition, such policy is the mandatory employment of an energy officer in the case of entities with high energy consumption, who is responsible for promoting the integration of energy efficiency approach and energy efficient patterns of behaviour in the company, and who undergoes specialist training at the Hungarian Energy and Public Utility Regulatory Authority.

Tax advantage-type State aid is the corporate tax allowance of investments and renovations for energy efficiency purposes which may amount to 30–65% of the eligible cost of the investment in accordance with the block exemption regulation, depending on the geographical region and on whether the company qualifies as an SME.

Investment aids granted directly

Nevertheless, the most important alternative policy measures are direct investment aids granted under the operational programmes which may be primarily for energy efficiency purposes (e.g. resources of the Environmental and Energy Efficiency Operational Programme or the Green Infrastructure and Climate Protection Operational Programme), but they may also be primarily for non-energy efficiency purposes, i.e. although they do not have energy efficiency indicators, actual energy savings are generated indirectly, and they can be eligible using a transparent methodology (e.g. certain resources of the Economic Development and Innovation Operational Programme or the Settlement Development Operational Programme). The Recovery and Resilience Facility (RRF) is also a new aid, which is intended to mitigate the effects of the economic recession caused by the coronavirus pandemic. At the local government level, measures to improve energy efficiency implemented within the framework of the Modern Cities Programme or the Hungarian Village Programme with budget support are also significant, but in the future, the new home renovation support programme of the Government will also be included in the eligible alternative policy measures.

The explicit aim of alternative policy measures based on supports is to promote the deep renovation of residential buildings, as these investments mostly involving structural renovations result in significant energy savings over decades, but without any support, they do not result – on a purely market basis – in a quick payback to the investor. This is also facilitated by the legal provision that up to 70% of State aid can be accounted for in the EEOS in the case of energy efficiency investments in residential buildings.

The EEOS and the alternative policy measures can be combined accordingly, the scheme is flexible, and the share of the State and the obligated party of the accounts is assessed by the Hungarian Energy and Public Utility Regulatory Authority.

The ESCO scheme

The method requiring the least State intervention for the promotion of investments improving energy efficiency is the energy efficiency-based (ESCO) contract, i.e. a contract concluded between the energy consumer and the energy efficiency service provider, which is controlled and monitored throughout its duration, and in which energy efficiency services are compensated in connection with the fulfilment of the energy efficiency improvement at the level agreed in the contract.

This means that the energy consumer does not have to directly pay a fixed amount for the implementation of an energy efficiency project, the consideration must be paid post factum within a specified period of time, in light of the energy savings verified and achieved. The most common form of application is perhaps the so-called on-bill payment method, i.e. the consumer pays the original or slightly lower fee on the energy bill instead of the energy bill reduced due to the investment implemented, part of which is still the fee for the energy used, but the difference is the consideration for the investment. In this case, the energy efficiency service provider is usually the energy service provider itself or a person in a contractual relationship with said service provider. The advantage of on-bill payment is that it does not impose an additional administrative burden on the consumer, and the consumer does not have to make payment in two directions.

Energy review

The improvement of energy efficiency can be interpreted in the dimension of energy efficiency improvement investments in most of the cases described above, however, it is important to emphasise principally regarding the operation of heating and air conditioning systems that achieving optimal operation does not necessarily require investment-scale costs. It is often enough to adjust a valve or to set up proper automation for better energy efficiency and lower energy bills. The energy review, like the building energy requirement levels, is a separate energy efficiency rule, and it does not result in accounting at the policy level.

Articles 14 and 15 of Directive 2010/31/EU on the energy performance of buildings, as amended, facilitate the above, since they require regular energy reviews for heating and air-conditioning systems with a rated output of more than 70 kW, with the involvement of independent experts and on-site inspection, by producing a report of a high professional standard which can be verified by the competent authority, and said report must contain recommendations for the operators of large-scale systems on how to optimise their systems. The professional training of the reviewing persons and the control of the content of the reports are carried out by the Hungarian Chamber of Engineers, while the database of the reports is managed by the National Climate Protection Authority.

The obligation to review will be required under Act LVII of 2015 from 1 January 2022, generally with an eight-year interval, but large companies with high energy consumption must have the review performed during the four-year energy audits. In case of apartment blocks and housing cooperatives, the results and recommendations of the review must be communicated to the residents through a decision of the general meeting.

Financing

Regarding the financing of energy efficiency goals, the new National Energy Strategy states the following: 'Targeted solutions offered by companies obligated under obligation schemes in all sectors of the economy, with the support of ESCO-type financing schemes. The own resources of economic operators, the credit products of the European Bank for Reconstruction and Development and the credit institutions of financial markets should also be included.

The resources may be supplemented by repayable supports available from the relevant operational programme for the period 2021–2027 and by sources of financing from the national budget (e.g. maintaining corporate tax allowance aimed at energy efficiency investments). Promoting industrial energy efficiency innovation from domestic innovation sources through the financing options offered by the operational programmes for the 2021–2027 period and the programmes under direct EU management. Market-based loans and loans offered by the European Investment Bank are also potential financing instruments.'

On 18 June 2020, within the Financing Working Party of the EEOS, a Task Force was established under the management of the Hungarian Central Bank, whose task is the following: 'Proposal for the creation of financing products supporting the implementation of energy efficiency measures, taking into account the structure of the instruments of the potential obligated parties.'

The Task Force identified several important subtasks in connection with its task:

- exploring financing options and good practices,
- consulting with the obligated parties and commercial banks,
- information material on the financing options of the EEOS: economic calculations based on the consultations with the banks and obligated parties,
- examining the EEOS and its financing options on a macro level: the aggregated financial implications of the 2 PJ/year energy savings expected within the EEOS and the volume of necessary contractual obligations for the parties involved (party granting the support, obligated party, financing bank, contractors, end users),
- examining the practical application of financing and energy law,
- developing specific financing products and collaborations.

After the introduction of the EEOS, on 20 April 2021, the Financing Working Party continued consultations, now taking into account the Catalogue pages published on the MEKH website.

The Ministry of Innovation and Technology (Innovációs és Technológiai Minisztérium, ITM), with the help of an adviser, must explore and contact key international financing organisations (especially the EBRD and the EIB) for highly effective international good practices and credit-type financing.

The ITM and the adviser must use the conclusions and recommendations of the Financing Working Party to develop the tasks of a central (a) financing, (b) guarantee and (c) ESCO institution.

During product development, we must pay attention to the need for competitiveness-enhancing support of each segment, their solvency, interest subsidy method, and the structural nature of the collateral.

We wish to use the experience of international financing institutions in gathering residential projects by aggregators.

V.2. The development of regulations on renewable energy communities and the introduction of gross accounting

With regard to renewable energy communities, the focus in Hungary is on communities aiming the use of renewable energy sources, the legal framework of which was adopted in 2020. These communities could aim at satisfying the participants' own energy demand. There is no legal possibility to create an energy community in the heating and cooling sector yet. From 2021, more support options will be available for the establishment of energy communities in the financing of the Renewable Energy Economy priority axis of the KEHOP Plusz, partly for the establishment of renewable energy communities and partly for the building of solar power station capacities to be used by the community. A call for proposals for pilot projects was published from the national budget in 2020, and the implementation of the winning projects is already underway. The support contents and directions will be finalised based on the consultations to be conducted with trade associations.

Sections 66/B and 66/C of Act LXXXVI of 2007 on electricity, as amended, provide for the rules regarding generating consumers, which provisions allow the community to satisfy its own demands based on Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources, as well as Directive (EU) 2019/944 of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU.

Under the current regulations for small-scale units of household size, generating consumers may use the public network as virtual storage free of charge: the total annual generation and consumption can be reconciled, and payments must be made to the service provider only for consumption beyond the balance. Virtual storage naturally needs to use the system, but its cost is currently cross-financed by consumers who do not have the opportunity to implement a solar panel investment. In addition, the generating party receives premiums for generation beyond the balance.

Based on Directive (EU) 2019/944, Member States that use the above-mentioned schemes must not grant new rights under such schemes after 31 December 2023. It is therefore necessary to recast the regulations in order to comply with the Directive. The details of the gross accounting scheme are being developed in cooperation with the professional organisations involved in the solar sector.

Target group

Direct target groups of the reform are electricity producers, parties involved in the operation of the electricity network, consumers, and the organisations distributing electricity, natural gas and fuels.