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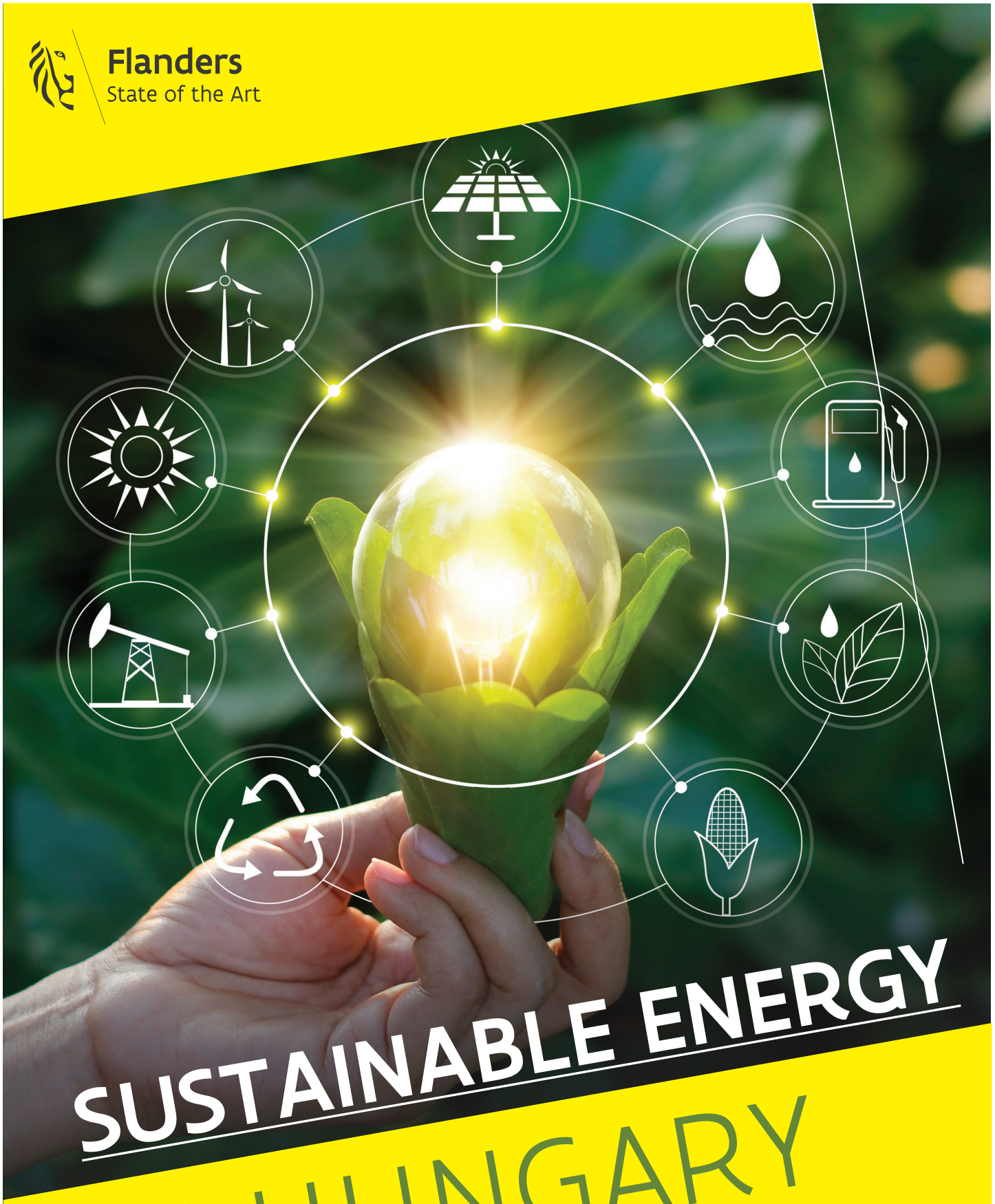

SUSTAINABLE ENERGY IN HUNGARY

FLANDERS INVESTMENT & TRADE MARKET SURVEY

FLANDERS
INVESTMENT
& TRADE

Market Study

SUSTAINABLE ENERGY IN HUNGARY

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CONTENT

1. OVERVIEW OF THE ENERGY SECTOR IN HUNGARY

Hungary's energy generation decreased slightly or stagnated between 2018 and 2020, and after a rise in 2021, in 2022 it was again less than a year earlier: 37 billion kWh of electricity was generated.[1] 2022 was an exceptionally memorable year for the energy market, as electricity and gas prices rose at unprecedented rates while consumption fell at the same time. In the second half of 2022, new electricity tariffs and limits were announced, which doubled the price of electricity consumption above the limit and increased gas prices sevenfold. This was also reflected in consumption, which was 400 MW below the figures for the same period in 2021.[2]

In 2021, Hungarian consumption grew at a higher rate, by 6%, than the EU-27 average (+4.3%) with the second highest increase in Hungarian demand compared to 2019. In 2021, the increase in consumption was driven in equal parts by imports and Hungarian production. The volume of imports was 9.2% higher compared to 2020, but fell short of the record high net imports in 2018.[3]

Hungarian electricity consumption in 2022 was 47.32 TWh (2021: 48.03 TWh). In the last ten years, two factors have come to the fore that have a significant impact on long-term consumption trends: electric cars and heat pump technology. In April 2023, the country's electricity consumption continued to decline, with total gross monthly consumption in the electricity system 7.7% lower than a year earlier. This brings to 11 months the negative streak that started in June 2022, mainly due to the effects of rising energy prices.[4]

Hungary typically produces heat and electricity from renewable energy sources, which are key to sustainable growth. In 2022, Hungarian electricity generation excluding residential solar was 33.6 TWh, and 35.2 TWh including residential solar.[5] Electricity generation from renewable energy sources in 2022 reached 7494 GWh in 2022, generated in decreasing order from solar, biomass, wind, biogas, hydro, municipal waste renewables and geothermal. Compared to present figures, in 2015 we produced almost zero energy from solar, with biomass being the most significant source.[6]

Hungary's combined share of zero carbon technologies (64%) is above the EU average and in terms of renewable technologies combined, the country is among the leaders. Within this, we have the highest share of solar generation in relation to total generation among EU Member States. Other Member States have a much higher share of hydro and wind generation. The gross installed capacity available on the Hungarian market in 2021 has only changed significantly for solar power plants. The capacity of solar power plants subject to licensing increased by 422 MW, while the capacity of household sized power plants increased by 406 MW. Hungarian electricity generation in 2021 increased by 3.4%. In 2021, the system continued to be based on nuclear units

[1]Hungarian Central Statistical Office, *Magyarország, 2022*, https://www.ksh.hu/docs/hun/xftp/idoszaki/mosz/mosz_2022.pdf
[2] Dr. Hugyecz Attila, *A MAGYAR VILLAMOSENERGIA-PIAC 2022-BEN*, https://paks2.hu/documents/20124/286244/Elemz%C5%91+percek+134.+r%C3%A9sz+-+2023.+01.+20.+-+VER+2022.+%C3%A9vi+riport.pdf/345b9a2e-60a2-4ec7-9c70-29fb7bae3e0d?t=1674478594652
[3] MEKH, *MEKH Piacmonitoring Villamosenergia-piacok Éves riport 2021*
[4] Portfolio, Nagyot zuhant Magyarország áramfogyasztása - Mégis miért?, https://www.portfolio.hu/gazdasag/20230516/nagyot-zuhant-magyarorszag-aramfogyasztasa-megis-miert-615264
[5] Dr. Hugyecz Attila, *A MAGYAR VILLAMOSENERGIA-PIAC 2022-BEN*, https://paks2.hu/documents/20124/286244/Elemz%C5%91+percek+134.+r%C3%A9sz+-+2023.+01.+20.+-+VER+2022.+%C3%A9vi+riport.pdf/345b9a2e-60a2-4ec7-9c70-29fb7bae3e0d?t=1674478594652
[6] Hungarian Central Statistical Office, *Magyarország, 2022*, https://www.ksh.hu/docs/hun/xftp/idoszaki/mosz/mosz_2022.pdf

operating in the grid and at high utilisation rates, which provided 44.7% of gross Hungarian generation and 32.9% of consumption. Contrary to European trends, there was no gas-coal substitution in the Hungarian market, with gas-fired power plants continuing to expand (by 4.9%), while lignite-fired generation fell by a further 19.2% after a decline in 2020.[7]

Hungary's 2050 climate neutrality target does not only come from EU law: the Hungarian Parliament adopted the Climate Protection Act in June 2020, a year before the EU Climate Change Act, which set two targets: to be climate neutral by 2050 and to reduce emissions by 40 percent by 2030 compared to 1990 levels.[8] To ensure that the 2030 common targets are met, each Member State must develop a National Energy and Climate Plan (NECP).[9] The Hungarian NECP[10], adopted in early 2020, sets targets for 2030 to: achieve a 40% reduction in emissions compared to 1990 (compared to 31.5% in 2019), achieve a 21% share of renewable energy in gross final energy consumption (compared to 13.9% in 2020), and achieve a 20% share of renewable energy in electricity consumption, with a large share of this coming from the expansion of solar PV capacity: from not quite 680 MW in 2016 to nearly 6 500 MW in 2030, coal and lignite would be completely eliminated from electricity generation, with a maximum final energy consumption of 785 petajoules (2005 level), with the addition that the source of final energy consumption above the target would be carbon neutral (735 PJ in 2020). Along with this, the maximum allowable share of Hungarian import dependence by 2030 is: 70 percent for natural gas, 85 percent for oil and 20 percent for electricity. This is summarised in more detail in the National Energy Strategy 2030, looking out to 2040 (NES).[11] By 2030, electricity generation should be 90 percent carbon-free, total gas consumption should be reduced from the current 10 billion m^3 per year to 8.7 billion m^3, and total gas consumption should be reduced to below 6.3 billion m^3 by 2040.

Hungary's Recovery and Resilience Plan includes among the reforms of the energy component:

- restructuring of electricity regulation

- facilitating investment in wind energy

- simplifying the authorisation procedure for renewable energy investments

- improving the transparency and predictability of the grid connection process

- improving the effectiveness of energy efficiency programmes[12]

[7] MEKH, *MEKH Piacmonitoring Villamosenergia-piacok Éves riport 2021*
[8] 2020. évi XLIV. törvény a klímavédelemről.
https://net.jogtar.hu/jogszabaly?docid=A2000044.TV
[9] A NEKT kötelező felülvizsgálata 2023-ban kezdődik.
[10] Innovációs és Technológiai Minisztérium, Magyarország Nemzeti Energia- és Klímaterve.,
https://energy.ec.europa.eu/system/files/2020-01/hu_final_necp_main_hu_0.pdf
[11] Innovációs és Technológiai Minisztérium, Nemzeti Energiastratégia, kitekintéssel 2030-ig. Tiszta, okos, megfizethető energia,,
https://www.enhat.mekh.hu/strategiak
[12] Magyar Kormány, *Magyarország Helyreállítási és Ellenállóképességi Terve*, p. 217

2. SOLAR POWER

Total actual generation from solar power plants in 2021 was about 2.26 TWh.[13]

Solar power has a prominent role to play, and a recent analysis shows that Hungary has the sixth largest share of solar energy in the electricity mix in the world and the third largest in Europe. In 2022, 1,100 megawatts of new solar PV and solar panel capacity was added in the country, more than in any previous year, and by June 2023, the total installed solar capacity was over 4,850 megawatts. This is more than two-thirds of the country's average electricity consumption.[14] According to current government energy and climate strategy targets, Hungary's solar capacity, which is close to 5,000 MW according to the latest data, will rise to 6,500 MW by 2030, but the cabinet is expected to raise this target significantly soon.[15] In addition, a further 4,500 MW of capacity has already been licensed, so that by 2030 there could be at least 10,000 MW of installed capacity. This could increase the weight of renewable generation in the mix to around 27-29%.[16]

At the end of 2022, the capacity of solar power plants above 50 kilowatts in the Hungarian electricity system was 2,525 megawatts, while total installed industrial capacity exceeded 3,000 megawatts on 1 June, an increase of around 500 megawatts over the past six months. The installed capacity in the residential solar under 50 kilowatts category is currently 1,854 megawatts. Here too, growth has been dynamic, exceeding 360 megawatts in the first half of this year, and the number of household-sized solar systems exceeded 200,000 in April. In the first five months of 2023, some 840 megawatts of new capacity were added to the Hungarian electricity system, compared to 1100 megawatts last year.[17]

A gigantic solar power plant with an installed nominal capacity of 250 MW was inaugurated in Mezőcsát, covering an area of 440 hectares, consisting of 466,000 solar panels and capable of producing enough energy to meet the energy needs of Debrecen with its 200,000 inhabitants for half a year, or Mezőcsát with its 5,700 inhabitants for 21 years. The investment of more than HUF 90 billion will create the largest contiguous solar farm in the country, accounting for 8 percent of the electricity generated by all Hungarian solar power plants. The plant is capable of producing 372 gigawatt hours (GWh) of electricity per year. Once operational, the plant could reduce the country's carbon dioxide emissions by up to 130 000 tonnes per year.[18]

[13] MEKH, *MEKH Piacmonitoring Villamosenergia-piacok Éves riport 2021*
[14] Portfolio, *Egészen elképesztő méretű naperőművet adtak át Mezőcsáton*, https://www.portfolio.hu/uzlet/20230606/egeszen-elkepeszto-meretu-naperomuvet-adtak-at-mezocsaton-619764
[15] Portfolio, *Olyan rekord született a naperőművek miatt, amelynek nem lehet örülni*, https://www.portfolio.hu/gazdasag/20230531/olyan-rekord-szuletett-a-naperomuvek-miatt-amelynek-nem-lehet-orulni-618264
[16] Portfolio, Felrobbant a geotermikus energiaprojektek piaca Magyarországon, és ez még csak a kezdet https://www.portfolio.hu/uzlet/20230605/felrobbant-a-geotermikus-energiaprojektek-piaca-magyarorszagon-es-ez-meg-csak-a-kezdet-619442
[17] Portfolio, *Egészen elképesztő méretű naperőművet adtak át Mezőcsáton*, https://www.portfolio.hu/uzlet/20230606/egeszen-elkepeszto-meretu-naperomuvet-adtak-at-mezocsaton-619764
[18] Portfolio, *Egészen elképesztő méretű naperőművet adtak át Mezőcsáton*, https://www.portfolio.hu/uzlet/20230606/egeszen-elkepeszto-meretu-naperomuvet-adtak-at-mezocsaton-619764

3. WIND POWER

The total installed capacity of the Hungarian electricity system is 10 313,8 MW of which 323,275 MW (3.13% of total electricity system) is the sum of IC of wind power plants. The installed capacity of smallest power plant is 50 kW, while it is 48 MW in the case of largest wind farm. (In Hungary the installed capacity is most commonly 2 MW per unit.) In 2021, the electricity generation from wind, as primary energy was 642,492 GWh, that is 1,37 % of total electricity consumption on the basis of data previously collected by MAVIR.[19]

By 2010, 37 wind farms had been built in Hungary, with a total of 172 turbines. Most of the wind turbines in operation in Hungary are privately owned, but the Sopronkövesd wind farm is owned by MVM[20]; the total capacity of Hungarian wind farms now stands at around 325 MW, or 3.8 percent of the country's electricity generating capacity. However, after an initial boom, there has been virtually no new tower installation over the past decade, due to the strict rules adopted in 2016, detailed below.[21] Most wind farms are located in the north-western part of the country, mainly around Komárom and Mosonmagyaróvár.

Hungary has an average wind energy potential. The existing, lean wind turbine park is operating at high utilisation, with an average capacity factor (actual production as a ratio of maximum production at rated capacity) of 23.3 percent in Hungary between 2011 and 2018, compared to 22.1 percent in the EU and only 19.2 percent in Germany.[22]

According to data from the Global Wind Atlas, the average wind speed in Hungary is 5.9 m/s at an altitude of 100 metres, and 6.7 m/s at the windiest 10 per cent of the area. At an altitude of 150 metres, the annual average is above 6 m/s, which results in a capacity factor of around 25 per cent and at the same time economical operation.[23] The above values are sufficient to allow market investors to build wind farms without one euro cent of state aid.[24]

There is huge investor interest in the Hungarian wind energy potential, but it could take at least two years to restart the "rusty machine".[25]

However, the regulation may cause some confusion: no new wind farms or wind farms may be installed within 12 kilometres of the built-up area and the boundary of the built-up area, 40 kilometres from radars operated by the Hungarian Defence Forces and 15 kilometres from military airfields. Within these protection distances, the height of existing wind farms may not be increased and wind farms may not be extended. In addition, they may be built with a maximum capacity of 2 MW compared to the average installed capacity of 3 MW, and their height may not

[19] MEKH, DATA OF THE HUNGARIAN ELECTRICITY SYSTEM, 2021
[20] Világgazdaság, *Ha valamikor, most feltámadhat poraiból a szélenergia*, https://www.vg.hu/vilaggazdasag-magyar-gazdasag/2022/07/ha-valamikor-most-feltamadhat-poraibol-a-szelenergia
[21] Qubit, *Zöldnek zöld a szélturbina, de vannak sötétzöld oldalai*, https://qubit.hu/2021/09/14/zoldnek-zold-a-szelturbina-de-vannak-sotetzold-oldalai
[22] Energiaklub Szakpolitikai Intézet Módszertani Központ, Szélenergia a 21. században – és Magyarországon https://energiaklub.hu/files/study/Energiaklub_Sz%C3%A9lenergia%20a%2021.%20sz%C3%A1zadban_2.pdf
[23] https://globalwindatlas.info/en/area/Hungary
[24] Világgazdaság, *Ha valamikor, most feltámadhat poraiból a szélenergia*, https://www.vg.hu/vilaggazdasag-magyar-gazdasag/2022/07/ha-valamikor-most-feltamadhat-poraibol-a-szelenergia
[25] 24.hu, *Ekkortól épülhetnek szélerőművek az országban, lépéskényszerben a kormány*, https://24.hu/fn/gazdasag/2023/02/15/szeleromu-szelturbina-megujulo-energia-energetika-szelfarm-elektromos-aram-szelenergia-gulyas-gergely-eu-rrf/

exceed 100 m compared to the average of 125 m.[26] This regulation is currently being relaxed or lifted. The Green Transition component of Hungary's Recovery and Resilience Plan includes ensuring the regulatory conditions necessary to increase the share of renewable energy in electricity generation, and to increase related investments and facilitate investments.[27]

[26] Greenfo.hu, *A világ legabszurdabb szeles szabályzása a magyar*, https://greenfo.hu/hir/a-vilag-legabszurdabb-szeles-szabalyzasa-a-magyar/
[27] Magyarország Helyreállítási és Ellenállóképességi Terve, p. 217

4. HYDROGEN

According to the Hungarian Hydrogen Strategy by 2030, the first pilot plants, launched in the 2020s and producing carbon-free (or low-carbon) hydrogen, may go live, aimed at reducing the use of "grey" hydrogen. By 2040, a rise is expected in the use of low-carbon hydrogen and electrolysis-based carbon-free hydrogen. By 2050, industrial hydrogen usage may become significantly decarbonized. The decarbonization of industrial hydrogen usage is also supported by the creation of hydrogen valleys / hydrogen clusters, which act as a demonstration of an entire hydrogen ecosystem in a region, as a portfolio of interconnected projects. Hungary plans to establish two new hydrogen valleys by 2030.

There are 6 prioritised projects, which are meant to implement the primary goals of the Hungarian Hydrogen Strategy and which should be launched as soon as possible, are as follows (with the estimated subsidy requirements in parentheses):

1) Green Truck Programme for making freight traffic more green (HUF 35-40 bn)
2) Green Bus Programme Plus for making public services, concerning transportation at the local level, more green (HUF 10-20 bn)
3) Establishment of hydrogen valleys in Hungary to promote the establishment of interconnected networks of the hydrogen value chains within the given geographical regions (HUF 10-15 bn)
4) Hydrogen Highway Project for creating a foundation for carbon-free hydrogen production, transportation and energy storage (HUF 20-30 bn)
5) Blue Hydrogen Project for reducing the carbon footprint of industrial hydrogen usage (HUF 20 bn)
6) Research, development and innovation in service of the establishment of a hydrogen economy (HUF 10 bn).

The implementation of one of the first pilot projects just started at the Bükkábrány Energy Park, which produces hydrogen in a controlled way from pure green electricity when the solar park is overloaded. The pilot development of the Bükkábrány Photovoltaic Power Plant Project Ltd. and the University of Szeged, partly funded by an EU innovation grant, was expected to be operational from August 2023. The project, which is an international first, will produce green hydrogen for the first time in Hungary and will also provide an opportunity to scientifically monitor the control of overproduction by the solar power plant.

Since Hungary has fewer locations suitable for the construction of pumped electricity storage facilities, a possible solution for seasonal electricity storage could be the production of hydrogen through the electrolysis of water using occasional electricity surpluses. Considering the increasing popularity of weather-dependent renewables, Power-To-Gas (P2G) plants producing carbon-free hydrogen may play a key role in balancing the electricity system and in treating regional and local network-related problems in Hungary.

Within the context of the increasing popularity of hydrogen technology, international cooperation is not just advantageous, but necessary. Areas that typically require EU-level cooperation are the development of rules for the use and market design of the unified natural gas network, the development of a guarantee of origin system for hydrogen, and the establishment of sale and purchase rules for green guarantees of origin that can be applied commonly throughout the continent. Regional-level cooperation shall be necessary for the creation of hydrogen corridors and a coordinated hydrogen refueling infrastructure network; however, it would also be practical to establish a network of relations between hydrogen valleys in a given region.

The question arises as to whether it is preferable to use batteries or hydrogen. There is no doubt that the industrial demand for hydrogen is unlimited, e.g. for the production of steel, cement, glass, bricks, fertilisers, etc but both have a role to play in transport. The use of hydrogen as a fuel is still very costly, currently three times more expensive than diesel, and the construction of filling stations for trucks is extremely expensive.[28]

[28] Greentech Conference in Zalaegerszeg, 26 May 2023

5. OTHER RENEWABLE ENERGY SOURCES

Small-scale, decentralised renewable energy production may require the construction of hundreds of biogas power plants scattered across the country, each with a capacity of 1-2 MW, providing constant (non-weather-dependent) production. The operation of a biogas plant has the potential for multiple uses: not only for hot water production, but also for combined heat and power generation and the production of biomethane as natural gas. Much more emphasis should be put on biogas production based mainly on agricultural waste.[29]

Waste-to-energy plants can also help to increase the share of renewables in power generation, as 50 percent of the electricity generated is renewable energy. Currently, about 5 percent of district heating production in Hungary, roughly 2 PJ, comes from waste. However, there is only one power plant that produces energy from municipal waste, which contributes 1.3 PJ to the energy production. The construction of new waste-to-energy plants could reduce the amount of municipal waste generated and increase the share of waste in district heating production, thereby further reducing the share of natural gas.[30]

Hungary is a geothermal powerhouse, but we are using less of it than we could, with only 10% of the energy used in district heating coming from geothermal sources. The amount of geothermal energy used in Hungary could be increased tenfold.[31] According to the relevant government strategies, the annual geothermal potential in Hungary is 65 PJ.[32] This refers to the deep geothermal potential, with an additional potential of 30-40 PJ per year for the deployment of heat pumps requiring less deep drilling.[33] This is a total of 100 PJ of energy that can be produced, of which we are at about 6 PJ/year of the 387 PJ/year of energy used for heating. A 10 to 15 percent substitution would be a significant step forward not only in terms of climate policy but also in terms of energy security, especially in the context of the Russia-Ukraine war.[34]

Hungary is characterised by geothermal energy based on thermal water with a medium temperature range (40-80 degrees Celsius), which is less suitable for electricity generation - therefore the focus on geothermal energy should definitely shift to heat generation. Today, there are about a dozen locations in Hungary with excellent thermal water resources and a well-developed district heating system[3536]

The legislation to be enacted in spring 2023 will provide a predictable framework for geothermal energy production and operation, without unnecessary bureaucratic rules, and will support the advancement of geothermal energy in Hungary not only through legislative changes, but also by developing and making available the data and databases needed for research and production, and for the integration of geothermal energy into district heating. While in the past decade

[29] Egyensúly Intézet, *Hogyan újítsuk meg 2030-ra Magyarország Energiarendszerét?*
[30] Egyensúly Intézet, *Hogyan újítsuk meg 2030-ra Magyarország Energiarendszerét?*
[31] Portfolio, *Felrobbant a geotermikus energiaprojektek piaca Magyarországon, és ez még csak a kezdet*, https://www.portfolio.hu/uzlet/20230605/felrobbant-a-geotermikus-energiaprojektek-piaca-magyarorszagon-es-ez-meg-csak-a-kezdet-619442
[32] *Nemzeti Energiastratégia, Nemzeti Energia- és Klímaterv*
[33] Magyarhoni Földtani Társulat, *A geotermikus energia kutatása és hasznosítása Magyarországon az elmúlt 150 év tükrében*, https://ojs.mtak.hu/index.php/foldtanikozlony/article/view/4356/4464
[34] Egyensúly Intézet, *Hogyan újítsuk meg 2030-ra Magyarország Energiarendszerét?*
[35] Portfolio, Felrobbant a geotermikus energiaprojektek piaca Magyarországon, és ez még csak a kezdet https://www.portfolio.hu/uzlet/20230605/felrobbant-a-geotermikus-energiaprojektek-piaca-magyarorszagon-es-ez-meg-csak-a-kezdet-619442
[36] Egyensúly Intézet, *Hogyan újítsuk meg 2030-ra Magyarország Energiarendszerét?*

there was only 1 successful geothermal research project in Hungary and 4-5 small geothermal investments per year, in the spring of 2023 alone, the Authority received more than 70 new applications.

On the initiative of the Supervisory Authority for Regulated Activities, the Hungarian Geothermal Cluster was established on the 9th of February 2023. It is a cooperative group of geothermal-related actors, whose members aim to enhance the exploitation of the exceptional geothermal potential of the Carpathian Basin by all possible means in the interest of Hungary's energy sovereignty.[37]

[37]Szabályozott Tevékenységek Felügyeleti Hatósága, https://sztfh.hu/tevekenysegek/foldtani-tevekenyseg/geotermia/magyar-geotermia-klaszter/

6. OPPORTUNITIES ON THE MARKET AND FUTURE TRENDS

In the coming years and decades, the transition to climate neutrality will aim to sharply increase the share of electricity in energy use. The increased use of electricity leads to increasing system loads, which can be seen in the steady rise in peak loads.[38] In addition to peak load, electricity demand from consumers will also increase significantly over the next 10 years or so: the National Clean Development Strategy forecasts that Hungarian electricity demand could rise to 46-52 TWh by 2030, and there will be a shift in its spatial and temporal focus. The planned grid upgrades (transmission and 132 kV distribution) are necessary to ensure that the steadily increasing electricity consumption does not cause large-scale system outages, possible black-outs or even prolonged customer restrictions.[39]

The current Hungarian strategic targets call for increasing the share of renewable energy in gross final energy consumption to 21 percent by 2030 (from 13.9 percent in 2020) and the share of electricity generated from renewable energy sources to 20 percent from 11.9 percent. However, experts and expert institutions say the target should be increased by at least 5 to 10 percentage points. According to benchmark calculations, we could easily reach around 30 percent by 2030, but if increasing the share of renewables is a priority, a more intensive increase could be realistic.[40] A further target is for Hungarian installed photovoltaic capacity to exceed 6 000 MW by 2030 and to approach 12 000 MW by 2040, up from 2 000 MW today.[41]

By the end of 2023, Hungary would increase its solar power capacity from 3 gigawatts to 8 gigawatts, but other alternative energy sources (e.g. biogas) are also planned, and together with investments in geothermal and wind power, € 16 billion could be invested over the next ten years. Hydrogen is also an important energy carrier, and its possible future use will require cooperation at European level.[42] The 3 GW already achieved in 2022 exceeds the trajectory projected in the National Energy and Climate Plan (NECP), which should be achieved in 2024. However, this positive development will require investments to make the electricity grid more capable of integrating electricity from variable renewable generation and balancing the grid.[43]

Increasing Hungary's energy autonomy can only be achieved by diversifying the energy mix as much as possible, and this transformation must be based to a significant extent on Hungarian renewable sources. The current technological and market framework allows for a more rapid capacity increase of solar and wind energy in particular, and therefore a special emphasis should be put on this in the future. The integration of wind and bioenergy in the electricity system is an essential element to increase flexibility and stability. An analysis of many years of production data in Hungary shows that the winter period is the most favourable for wind power, when solar production falls.

[38] Paks II. Zrt., *A MAGYAR VILLAMOSENERGIA-RENDSZER HAVI ADATAI – 2021. Február*
[39] Ministry of Innovation and Technology, *Nemzeti Tiszta Fejlődési Stratégia 2020-2050*, p. 56.
[40] Egyensúly Intézet, *Hogyan újítsuk meg 2030-ra Magyarország Energiarendszerét?*
[41] Magyarország Helyreállítási és Ellenállóképességi Terve, p. 223
[42] Anadolu Ajansı, *Macaristan Teknoloji ve Sanayi Bakanı: Türkiye'nin ürettiği İHA'lar savaş alanında yeni bir yol olduğunu gösterdi*, https://www.aa.com.tr/tr/gundem/macaristan-teknoloji-ve-sanayi-bakani-turkiyenin-urettigi-ihalar-savas-alaninda-yeni-bir-yol-oldugunu-gosterdi/2662087?fbclid=IwAR31JtC6uaZtz0FOFcphRcVp0xUm6CiNl2DfuepNIJSpaKHxBDEEO7v_EEA
[43] Magyarország Helyreállítási és Ellenállóképességi Terve, p. 224

According to data from the Finnish LUT University, the optimal share of wind energy in the overall energy mix in Hungary would be between 10-20% instead of the current 1% if we were to switch to carbon-neutral power generation.[44] And this is the stated goal for 2050, so the sector is set for huge growth in the coming decades. The production of hydrogen, which is increasingly entering the energy mainstream, requires large amounts of electricity, which wind farms can feed into the grid.[45] Compared to solar power plants, wind farms require much less land, but can produce two to three times the amount of energy: the machines in the Great Plain are capable of producing 4,500-5,000 megawatt hours per year. With the more modern designs now in use, this can be as high as 6,000.[46]

The building sector is one of the most urgent areas for action to reduce energy use and emissions. 3.5 million dwellings are expected to be occupied in Hungary by 2030, of which 3 million are already existing - all of which need to be renovated by 2050. To achieve climate neutrality in 2050, more than 100,000 homes will need deep renovation every year, instead of the 4-5,000 homes currently in need of it.[47] A long-term energy efficiency roadmap for Hungary's building stock is being developed. According to the current National Energy Strategy for Buildings (NESB), buildings account for about 40% of primary energy use in Hungary, with residential buildings accounting for the largest share of nearly 60%.[48]

In particular, it is important to accelerate the deployment of smart systems at multiple levels: national grid and distribution systems, urban systems, and residential and industrial customers.[49]

The concept of 'backyard power generation' includes the development of heat pump and efficient biomass heating solutions, in addition to residential solar electricity generation, so a strong renewable energy market expansion in individual heating is expected. This will be helped in particular by the mandatory 25% renewable energy target for new buildings after 2020, which is set at 'near-zero' energy in buildings.[50] Polluting fuel types are widely used to heat residential buildings. A third of households in the lowest income quintile, mainly in rural areas: the Sajó Valley, the Pécs region and the capital, do not have access to gas or district heating, and therefore use more expensive and polluting solid fuels (coal and poor quality wood) for heating, which is a major source of air pollution, causing serious health and environmental consequences. Particulate matter concentrations are particularly high in these areas. Electrification of the heating system in the households concerned could make a significant contribution to reducing this.[51]

The flagship project "Energy-conscious and modern Hungarian homes", which implements the relevant strategic direction of the new NES, encourages the installation of solar systems to partially or fully replace own electricity consumption. The strategic goal is to have at least 200,000 households with an average of 4-5 kW of roof-mounted solar panels by 2035. It also

[44] Deutsche Welle, *Where does wind power make sense?*, https://www.dw.com/en/wind-power-costs-renewable-energy/a-60046761
[45] Világgazdaság, *A magyar és a szerb miniszter egyetértett, mi Európa legfontosabb ügye*, https://www.vg.hu/vilaggazdasag-magyar-gazdasag/2022/07/a-magyar-es-a-szerb-miniszter-egyetertett-mi-europa-legfontosabb-ugye
[46] Világgazdaság, *Ha valamikor, most feltámadhat poraiból a szélenergia*, https://www.vg.hu/vilaggazdasag-magyar-gazdasag/2022/07/ha-valamikor-most-feltamadhat-poraibol-a-szelenergia
[47] Egyensúly Intézet, *Hogyan újítsuk meg 2030-ra Magyarország Energiarendszerét?*
[48] Nemzeti Épületenergetikai Stratégia (2015.), p. 24
https://www.kormany.hu/download/d/85/40000/Nemzeti%20E%CC%81pu%CC%88letenergetikai%20Strate%CC%81gia%2 0150225.pdf
[49] Egyensúly Intézet, *Hogyan újítsuk meg 2030-ra Magyarország Energiarendszerét?*
[50] Innovációs és Technológiai Minisztérium, Nemzeti Energiastratégia 2030, kitekintéssel 2040 ig,
[51] Magyar Kormány, *Magyarország Helyreállítási és Ellenállóképességi Terve*, p. 221

aims to increase the installed capacity of residential heat pumps to nearly 400 MW by 2030 (from 148 MW in 2019).[52]

A strong focus should be placed on the future direction of solar energy: installations on residential buildings (roofs, balconies), support for the creation of energy communities, especially in urban areas, the provision of local small-scale community-based renewable energy production, the possibility of dual use on farmland and water bodies, the review of the solar installation permit procedure, taking into account the protection of historical monuments and the townscape, the maximum possible use of roof structures of industrial buildings, landfills, noise barriers.[53]

The following investments will be essential over the next decade:

- improving the technical characteristics of the electricity system
- expanding international electricity transport infrastructure
- developing smart systems
- weather-dependent generators should be made disconnectable to relieve the system when neither export capacity nor demand-side management is sufficient to cope with peak loads
- improving the quality of solar radiation and wind speed forecasts
- flexible production capacities should be expanded
- the use of electric cars and their smart charging should be intensively promoted
- exploiting new possibilities for energy storage (batteries, green hydrogen, power to gas, compressed air, pumped storage, brines, polymers, etc.) and expanding our capacities in this area.[54]

Future plans for hydrogen include the construction of hydrogen refuelling stations in all major cities and at least every 200 kilometres along the Trans-European Transport Network (TEN-T), while in Hungary there are currently few h2-powered trucks. In addition, there are promising projects in the field of vehicle production: hydrogen-powered refuse collection vehicles are already being tested, and innovations in bus production are also expected.[55]

The priority list for review in 2024 includes the following elements:

- Electricity generation and use from renewable sources;

- Improving energy efficiency, including investments in energy efficiency in transport, buildings, agriculture and waste;

- Energy storage;

- Modernisation of energy networks, including district heating networks and electricity transmission networks;

- Increasing interconnections between Member States;

[52] Magyarország Helyreállítási és Ellenállóképességi Terve, p. 224
[53] Egyensúly Intézet, *Hogyan újítsuk meg 2030-ra Magyarország Energiarendszerét?*
[54] Energiaklub Szakpolitikai Intézet Módszertani Központ, Szélenergia a 21. században – és Magyarországon https://energiaklub.hu/files/study/Energiaklub_Sz%C3%A9lenergia%20a%2021.%20sz%C3%A1zadban_2.pdf
[55] Greentech Conference in Zalaegerszeg, 26 May 2023

- A fair transition in "carbon-dependent regions", "to support the redirection, retraining and upskilling of workers, education, job search initiatives and start-ups".[56]

[56] Ministry of Innovation and Technology, National Energy and Climate Plan, p. 283

7. KEY PLAYERS, ASSOCIATIONS

7.1 MOL

MOL Group is a leading integrated Central Eastern European oil and gas corporation headquartered in Budapest. It has operations in over 30 countries and employs 25,000 people worldwide. MOL's exploration and production activities are supported by 80 years' experience in the hydrocarbon field.[57]

MOL produces up to 160 kt/year of hydrogen for their utilization on-site at the refineries (of which 57 kt is produced in Hungary). With the current technology the company produces grey hydrogen from natural gas via steam methane reforming. Hydrogen utilization at MOL includes desulphurization, hydrocrack technologies and polyol production. MOL Group has made first steps in the hydrogen development roadmap. They have small-scale initial investments in H2 production, H2 logistics, first HRS in the retail network in core countries (CR, HU, SK) to gain experience and to develop competence. The firm is going to establish its presence in the whole renewable hydrogen value chain between 2026-2030: from RE generation and storage, via green H2 production and distribution till the serving H2 mobility demands.[58]

Also, the Group is going to build one of the largest green hydrogen plants in Europe in Százhalombatta Danube Refinery starting operation in 2024 Q1. (called the Nebula Project). The € 22 million investment will enable MOL to produce 1,600 tonnes of green hydrogen per year using electricity from renewable sources, reducing its carbon dioxide emissions by 25,000 tonnes. The introduction of this new technology will make MOL a key player in the region's sustainable hydrogen economy.[59]

MVM

MVM Group (www.mvm.hu) is a dominant player of the Hungarian energy system, assuming an eminent role in implementing the country's strategic energy targets through its successful and competitive activities. MVM Group's expanding portfolio covers the entire Hungarian energy sector. The present MVM Group represents the all-time most complex MVM, as it can practically embrace all segments connected to the energy sector: generation, storage, trade, distribution, provision of services, planning and design, construction, transmission, data transfer, incubation. MVM Group is the 2nd largest company in Hungary, and the 10th in Central Europe. It is a dynamic, innovative fully state-owned company group continually gaining dominance also on regional level, acting also as the largest domestic energy knowledge centre, and through its professional competences offering significant contribution to the security of supply in Hungary and Central Eastern Europe.

7.2 ALTEO

One of the most important players in wind-farms is Alteo (https://alteo.hu), a Hungarian energy service provider with business activities in renewable energy production, energy trading and

[57] Mol Group Company Overview, https://molgroup.info/en/about-mol-group/company-overview
[58] Renewable Energies in Wallonia and in Hungary Webinar, 13 May 2023
[59] MOL Group, Press Release: ÚJABB LÉPÉS AZ ENERGIAFÜGGETLENSÉG FELÉ: ZÖLD HIDROGÉN GYÁRTÁSÁBA KEZD A MOL, https://molgroup.info/hu/media-kozpont/sajtokozlemenyek/ujabb-lepes-az-energiafuggetlenseg-fele-zold-hidrogen-gyartasaba-kezd-a-mol

industrial energy management services. Its total renewable energy capacity currently amounts to 69 megawatts, of which 47 megawatts are wind, 19 megawatts are solar and a further 3 megawatts are hydro and biogas. In December 2022, a 61.6 percent stake in Alteo was acquired by MOL and its partners.

PannErgy

PannErgy Plc (www.pannergy.com) started pioneering activities in Hungary for the utilization of geothermal energy. With respect to the fact that the use of geothermal heat in energy supply itself is an innovative solution, PannErgy Group aspires to support these operations by deploying state-of-the-art solutions in the current technological settings, while strengthening its professional knowledge base by driving continuous research. With its many years of experience and competences in the fields of the exploration of energetically utilizable geothermal resources, the drilling of geothermal wells and the use of geothermal energy, PannErgy Group holds nearly unique capabilities to implement further heat supply investments in the Carpathian Basin for use both in the household and corporate sectors. In addition to the construction, geothermal utilization, implementation and operation of conventional systems, PannErgy Group has worked out complex energy and control engineering systems that can also be used in international settings. PannErgy's R&D systems can be used in the design and development of district heating services based on geothermal energy in Europe and beyond, or for the optimization of obsolete district heating services that utilize conventional energy carriers and geothermal heat energy systems operated with suboptimal efficiencies.

Magyar Szélenergia Ipari Társaság Wind Energy Association
2612 Kosd, Őszi Lőrinc tér 43
E-mail: mszit@mszit.hu
Web: www.mszit.hu

Megújuló Energia Szervezetek Szövetsége Renewable Energy Association
1139 Budapest, Forgách u. 37.
Tel: +36 30 927 0601
E-mail: info@megujuloszovetseg.hu
Web: www.megujuloszovetseg.hu

Magyarországi Üzleti Tanács a Fenntartható Fejlődésért Business Council of Sustainable Development in Hungary
1118 Budapest, Ménesi út 9/a.
Tel.: +36 30 229 2391
Web: www.bcsdh.hu

Magyar Hidrogéntechnológiai Szövetség Hungarian Hydrogen Technology Association
1117 Magyar Tudósok körútja 2.
Web: www.hh2.hu/index.php/en/fooldal-english/

Bay Zoltán Alkalmazott Kutatási Közhasznú Nonprofit Kft. Bay Zoltán Nonprofit Ltd. for Applied Research
1116 Budapest, Kondorfa utca 1.
E-mail: bayzoltan@bayzoltan.hu
Web: www.bayzoltan.hu

Megújuló Energia Szervezetek Szövetsége Renewable Energy Association
1139 Budapest, Forgách u. 37.
E-mail: info@megujuloszovetseg.hu
Web: www.megujuloszovetseg.hu

Magyar Napelem Iparági Egyesület Hungarian Solar Industry Association
1097 Budapest, Könyves Kálmán Krt. 12-14. (Lurdy Ház)
E-mail: info@manap.hu
Web: www.manap.hu

Magyar Napelem Napkollektor Szövetség Hungarian Solar Panel Solar Collector Association
1214 Budapest, Orion u. 14.
E-mail: info@mnnsz.hu
Web: www.mnnsz.hu

Magyar Geotermális Egyesület Hungarian Geothermal Association
1021 Budapest, Ötvös János u. 3.
E-mail: info@mgte.hu
Web: www.mgte.hu

Magyar Termálenergia Társaság Hungarian Thermal Energy Society
1143 Budapest, Hungária krt. 83.
E-mail: termalenergia@termalenergia.hu
Web: www.termalenergia.hu

European Geothermal Energy Council
1050 Bruxelles, Place du Champ de Mars, 2 5eme étage
E-mail: com@egec.org
Web: www.egec.org

Szabályozott Tevékenységek Felügyeleti Hatósága Authority for the Supervision of Regulated Activities
1123 Budapest, Alkotás utca 50.
E-mail: sztfh@sztfh.hu
Web: www.sztfh.hu

8. EVENTS

Szolár Konferencia

A professional and investor workshop organized by Hungarian Solar Panel Solar Collector Association every year at Hungexpo during spring.
https://www.mnnsz.hu/xv-szolar-konferencia-szakmai-es-befektetoi-workshop/

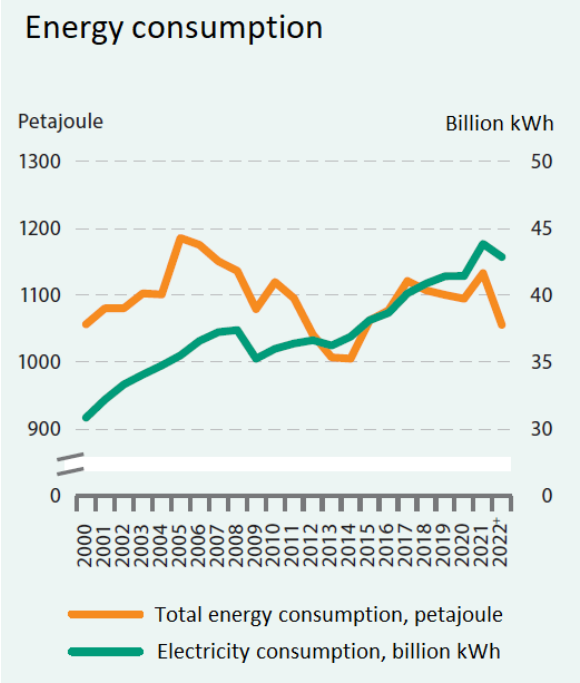
Sustainable World 2023

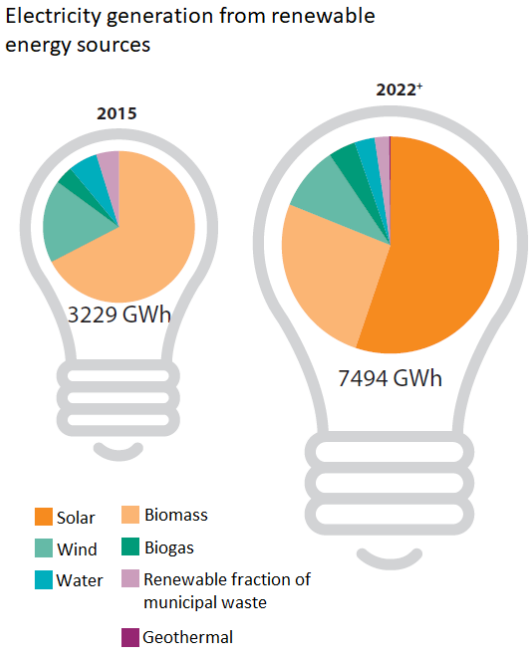
A conference hosted by Portfolio every year. This time it will be held on 12 September.
https://www.portfolio.hu/rendezvenyek/konferencia-gazdasag/sustainable-world-2023/1500/attekintes

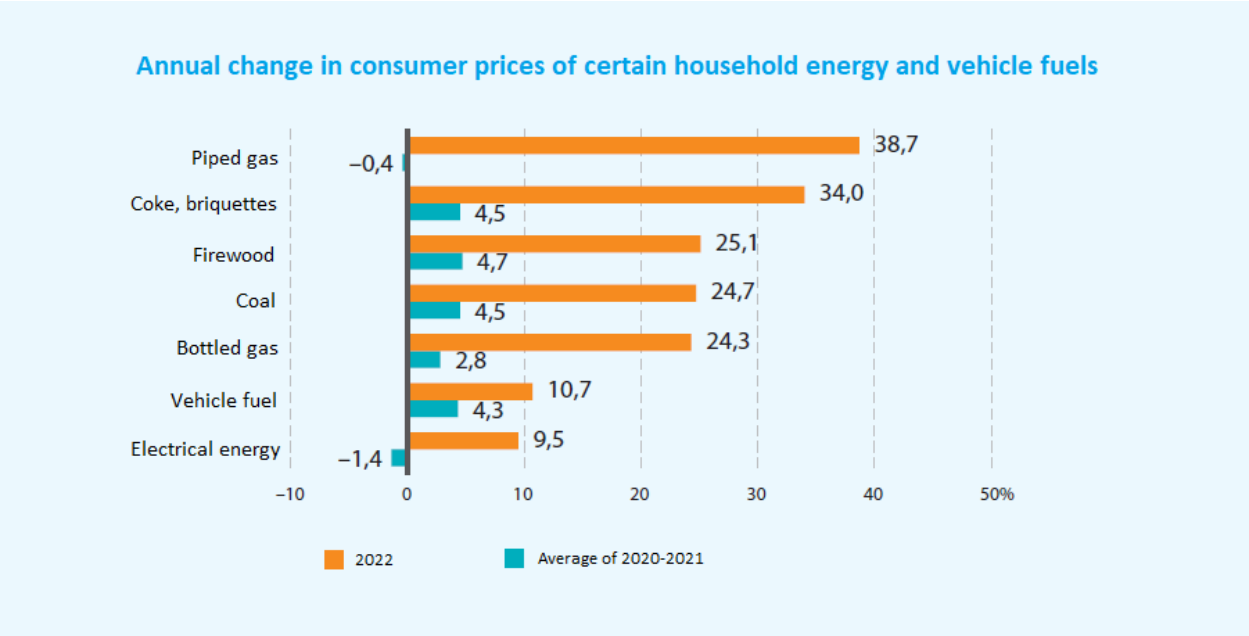
Zöld Energia És Fenntarthatóság Szakkiállítás, Konferencia

The host institution ZalaZone testing track organizes a 2 day conference on green technology every year during spring in Zalaegerszeg.
www.greentechzalaegerszeg.hu

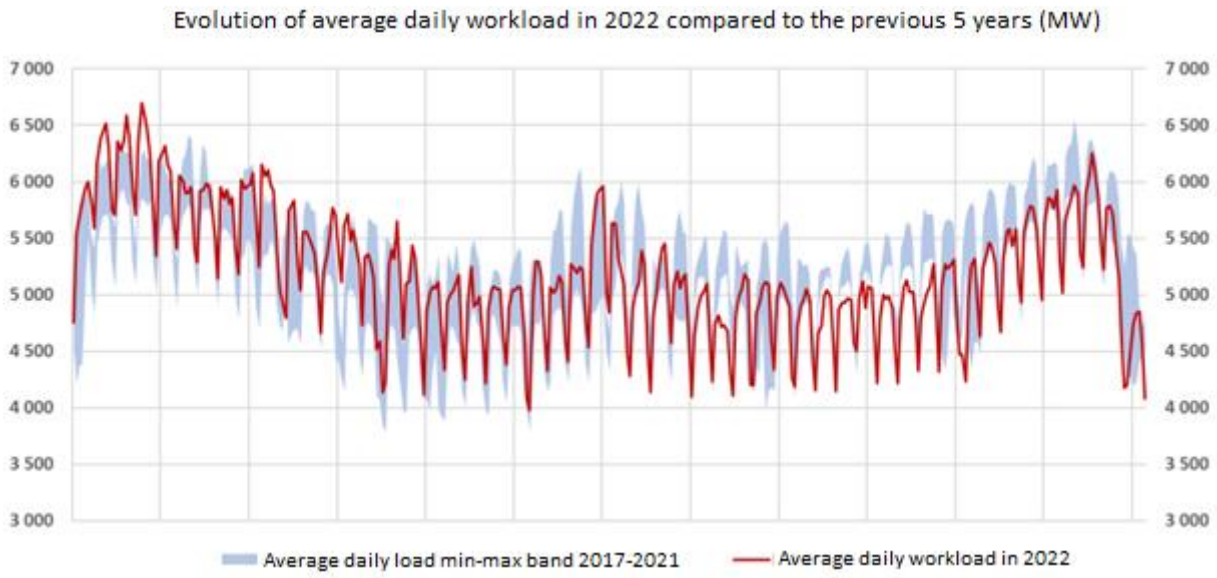
9. FIGURES


Energy consumption
Petajoule
Billion kWh
1300
1200
1100
1000
900
0
50
45
40
35
30
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022+
Total energy consumption, petajoule
Electricity consumption, billion kWh

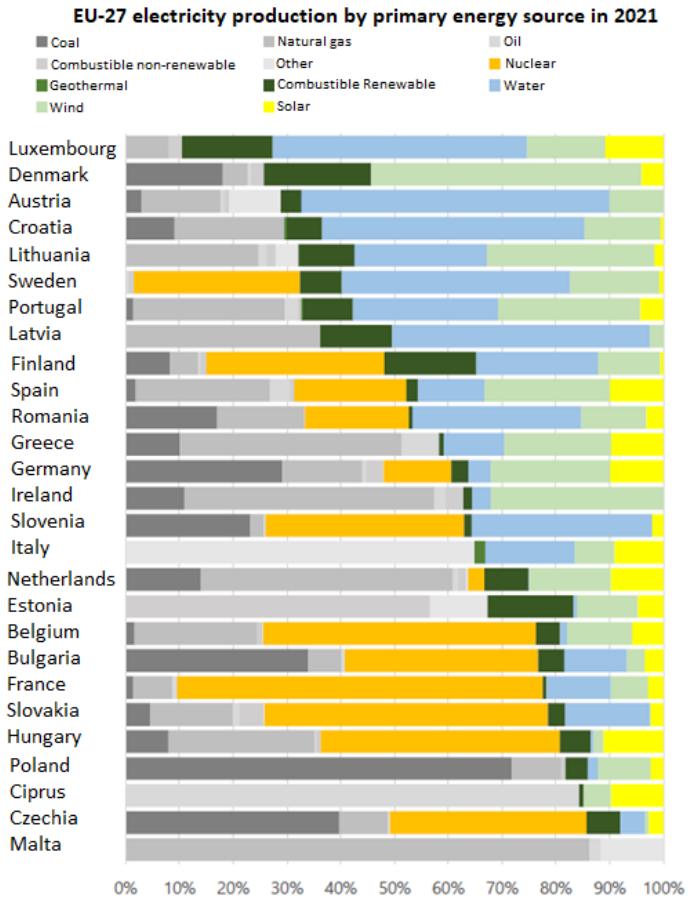

Electricity generation from renewable energy sources
2015
2022+
3229 GWh
7494 GWh
Solar
Biomass
Wind
Biogas
Water
Renewable fraction of municipal waste
Geothermal



Source: HCSO: Hungary, 2022



Source: MEKH



Source: Eurostat

2.2 MEGÚJULÓ ENERGIAHORDOZÓK FELHASZNÁLÁSA, 2021[1]
CONSUMPTION OF RENEWABLE ENERGY SOURCES, 2021[1]

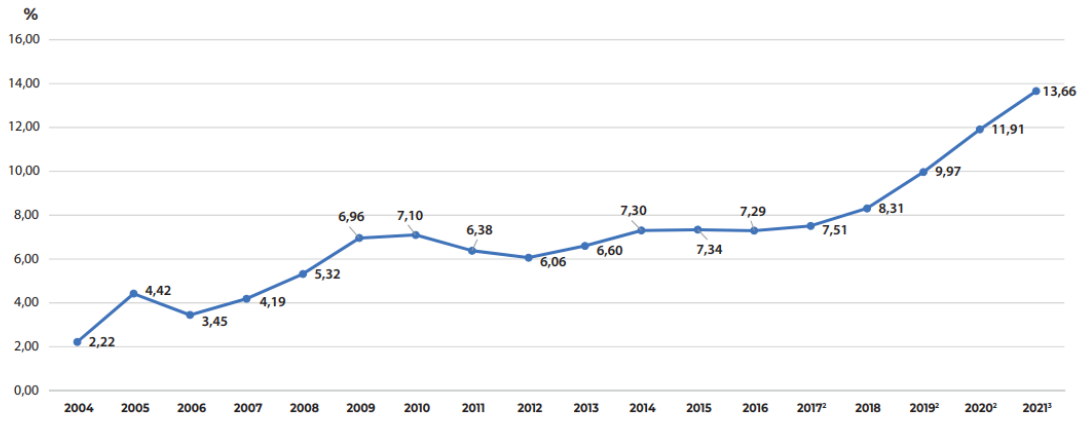
MEGNEVEZÉS NAME		ELSŐDLEGES MEGÚJULÓ ENERGIAHORDOZÓK ÖSSZESEN TOTAL OF PRIMARY ENERGY SOURCES OF RENEWABLES
Vízenergia | Hydropower	PJ	0,7
Szélenergia | Wind power	PJ	2,4
Geotermikus energia | Geothermal energy	PJ	6,4
Napenergia | Solar energy	PJ	14,5
Biomassza[2] | Biomass[2]	PJ	86,9
Kommunális hulladék (megújuló része)[3] | (The renewable part of) communal waste[3]	PJ	3,4
Biogáz, depóniagáz, szennyvíziszapgáz | Biogas, landfill gas, sewage gas	PJ	3,6
Bioüzemanyagok | Biofuels	PJ	12,0
ÖSSZESEN | TOTAL	**PJ**	**129,9**
Primerenergia-felhasználás | Primary energy consumption	PJ	1 157,5
Összes elsődleges megújuló energia hordozó-felhasználás Total primary consumption of renewables	PJ	129,9
Elsődleges megújuló energiaforrások és a kommunális hulladék részaránya az összes primer energiafelhasználásból[4] | Ratio of primary energy sources of renewables and municipal wastes to primary energy consumption[4]	%	11,2%

[1] **Előzetes adatok.** | Preliminary data.
[2] **Tűzifa, tűzifának nem minősülő biomassza, állati eredetű biomassza – becsült adat.** | Firewood, biomass not qualified as firewood, animal biomass – estimated figures.
[3] **Energetikai (erőművekben, fűtőerőművekben történő) felhasználási célú.** | With the purpose of being utilized in power plants and CHP.
[4] **A részaránymutató kiszámítása az Európai Parlament és a Tanács 2009. április 23-i 2009/28/EK Irányelve szerinti teljes bruttó végső megújuló energiahordozó felhasználás mutatótól eltérő módszertannal történt.**

Source: MEKH

2.3 MEGÚJULÓ ENERGIAFORRÁSOKBÓL ELŐÁLLÍTOTT VILLAMOS ENERGIA RÉSZARÁNYA A TELJES BRUTTÓ VILLAMOSENERGIA-FOGYASZTÁSON BELÜL[1]

RATIO OF RENEWABLES WITHIN FINAL ENERGY SOURCES CONSUMPTION[1]



		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017²	2018	2019²	2020²	2021³
Megújuló energiahordozók felhasználásának részaránya a villamosenergia-fogyasztásban The share of renewables within the electricity consumption	%	2,22	4,42	3,45	4,19	5,32	6,96	7,10	6,38	6,06	6,60	7,30	7,34	7,29	7,51	8,31	9,97	11,91	13,66

[1] **Az Európai Parlament és a Tanács 2009. április 23-i 2009/28/EK Irányelve szerinti végső energiahordozó felhasználás részarány a villamosenergia-fogyasztásban.** | Ratio of final energy sources in electricity consumption according to DIRECTIVE 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009.
[2] **Az adat pontosításra került az előző évi kiadványhoz képest.** | The data have been updated compared to last year's publication.
[3] **Előzetes adat.** | Preliminary data.

Source: MEKH

4.6A VILLAMOSENERGIA-TERMELÉSHEZ FELHASZNÁLT ENERGIAHORDOZÓK (TJ) 2017–2021

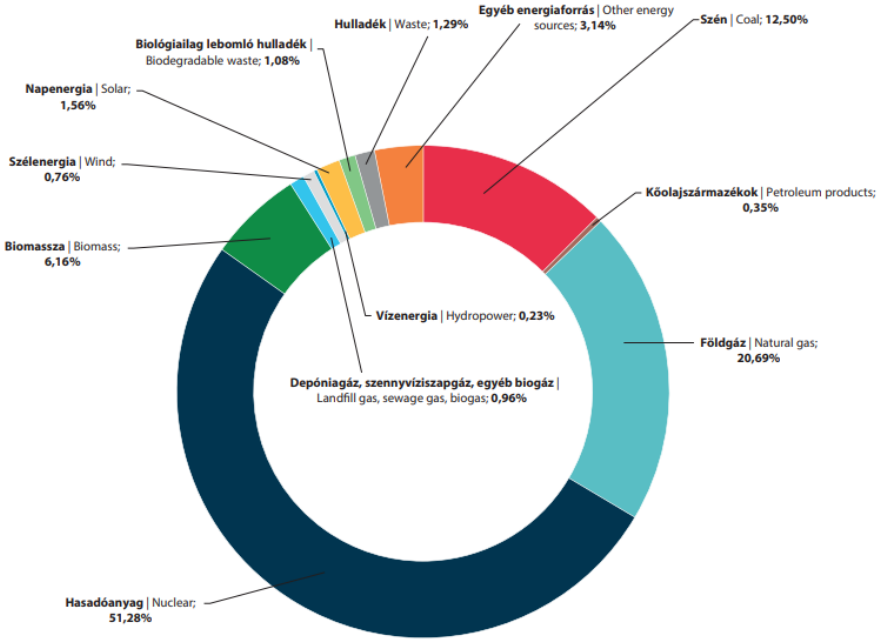
ENERGY SOURCES USED FOR ELECTRICITY GENERATION, (TJ) 2017–2021

	2017	2018	2019	2020[4]	2021[5]
Szén Coal	54 863	50 037	43 307	40 452	32 928
Kőolajszármazékok Petroleum products	1 113	940	1 212	716	857
Földgáz Natural gas	66 008	61 567	71 679	75 124	79 917
Hasadóanyag Nuclear[1]	175 610	171 638	177 684	175 145	174 433
Biomassza Biomass	20 378	22 100	21 352	20 272	21 726
Biogáz, depóniagáz, szennyvíziszapgáz Biogas, landfill gas, sewage gas	3 818	3 613	3 331	3 261	2 895
Szélenergia Wind[1]	2 722	2 187	2 624	2 357	2 381
Vízenergia Hydropower[1]	792	799	790	880	765
Napenergia Solar[1]	1 248	2 345	5 398	8 844	13 660
Biológiailag lebomló hulladék Biodegradable waste	3 624	3 374	3 733	4 154	4 428
Hulladék Waste[2]	3 535	3 822	4 486	4 608	4 852
Egyéb energiaforrás Other energy sources[3]	9 148	11 986	10 883	8 065	8 205
Összesen Total	342 858	334 409	346 478	343 879	347 048

[1] **A nukleáris energiahordozó elszámolása a nemzetközi statisztikában használt 1 kWh = 10,90909 MJ átszámítással történt. A nap-, víz- és szélerőművek energiahordozó-felhasználása a nemzetközi statisztikában használt 1 kWh termelt villamos energia = 3,6 MJ hőegyenértékkel került figyelembevételre.** | The settlement of nuclear fuel was performed by the conversion of 1 kWh = 10.90909 MJ as used in international statistics. The energy source consumption of hydro and wind power plants and photovoltaic systems was considered at a heat equvialent of 1 kWh generated electricity = 3.6 MJ as used in international statistics.
[2] **A Hulladék energiahordozó-adat a halmozódás elkerülése végett nem tartalmazza a biológiailag lebomló hulladék részarányát.** | In order to avoid clustering, the waste-to-energy does not contain biodegradable waste.
[3] **Egyéb energiaforrás: geotermikus energia, mesterséges gázok (kohógáz, kamragáz stb.) stb.** | Other energy sources: geothermal energy, artificial gases (blast furnace gases, coke oven gases, etc.), etc.
[4] **A 2020. évi adatok pontosításra kerültek az előző évi kiadványhoz képest.** | The 2020 figures have been revised compared to the previous year's publication.
[5] **A 2021. év adatai előzetes adatoknak minősülnek.** | 2021 figures are preliminary data.

Source: MEKH

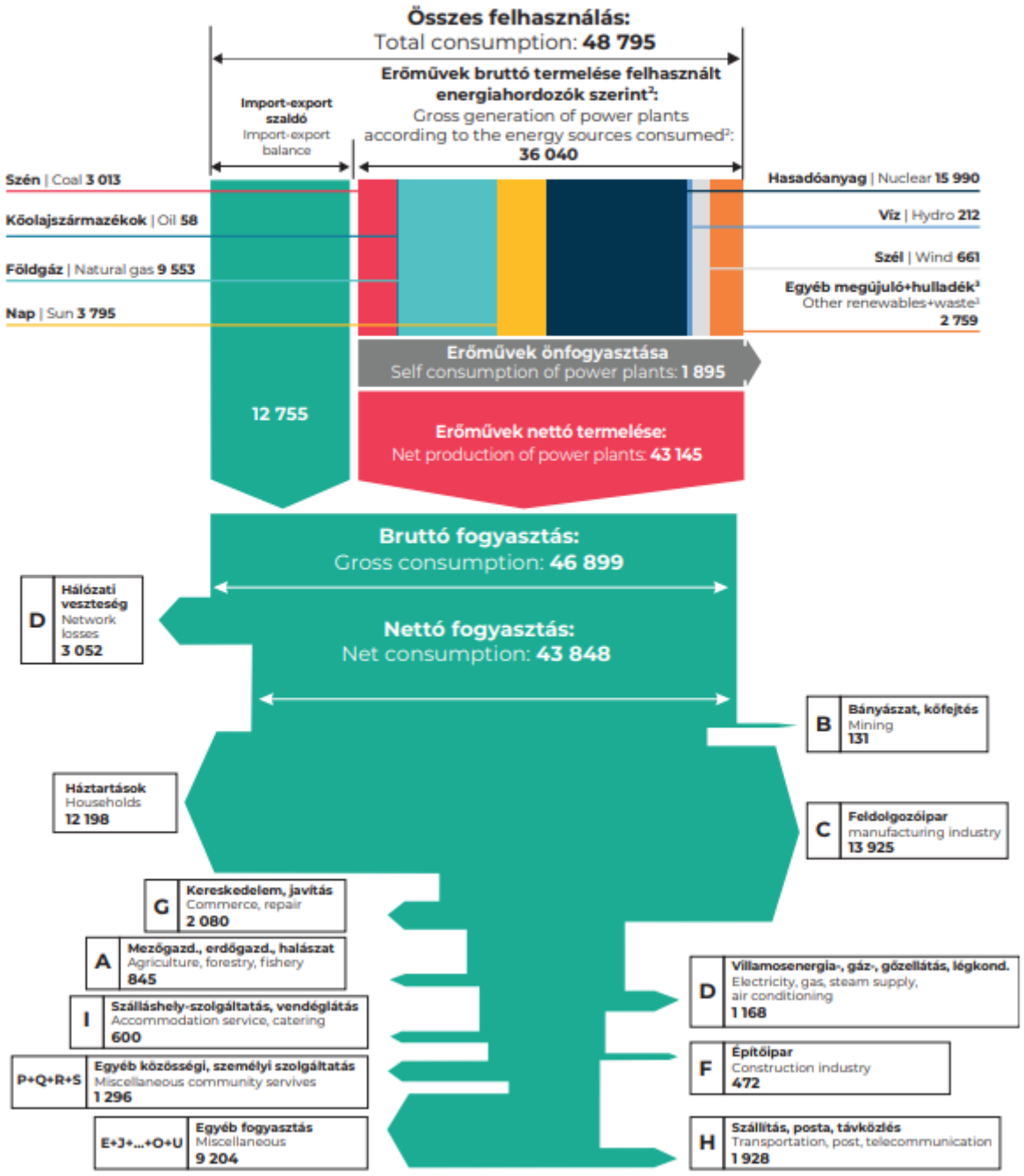
4.6B VILLAMOSENERGIA-TERMELÉSHEZ FELHASZNÁLT ENERGIAHORDOZÓK ARÁNYA, 2021
RATIO OF ENERGY SOURCES USED FOR ELECTRICITY GENERATION, 2021



Source: MEKH

7.4 MAGYARORSZÁG VILLAMOSENERGIA-TERMELÉSE ÉS -FELHASZNÁLÁSA, 2021 (GWh)[1]

HUNGARY'S ELECTRICITY GENERATION AND CONSUMPTION, 2021 (GWh)[1]

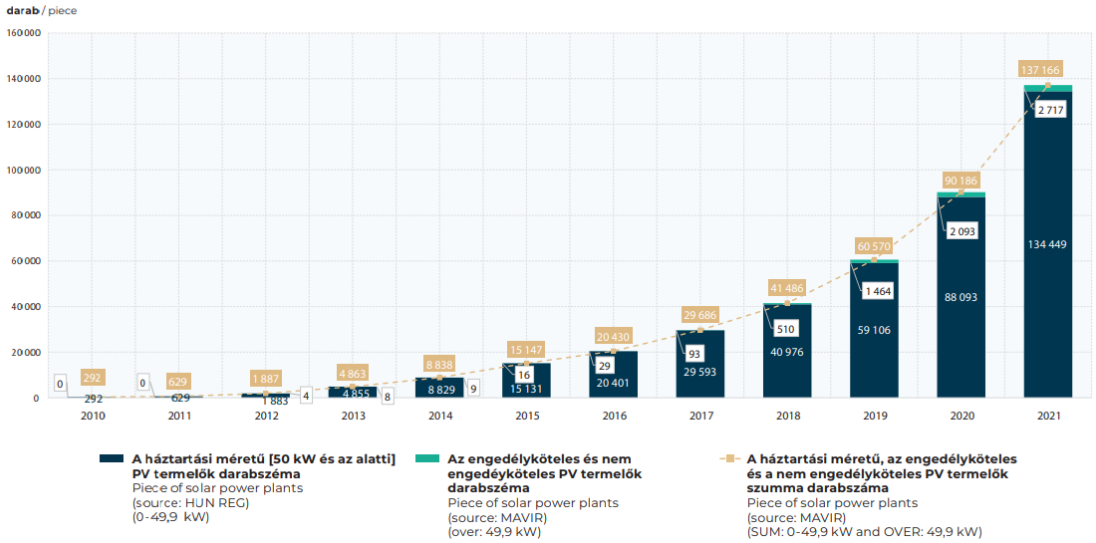


[1] **Előzetes adatok.** | Preliminary data.
[2] **A háztartási méretű kiserőművek és egyes saját felhasználásra termelő kiserőművek adatait nem tartalmazza a táblázat.** | The table does not include the data of smallscale power plants and certain small power plants producing for private use.
[3] **Egyéb energiahordozók: biomassza, kommunális és ipari hulladék, kohó- és kamragáz, biogáz és geotermikus energia.** | Other energy sources: biomass, communal and industrial waste, blast furnace and coke oven gases, biogas and geothermal energy.

Source: MEKH

4.9F A HÁZTARTÁSI MÉRETŰ [50 KW ALATTI], AZ ENGEDÉLYKÖTELES ÉS A NEM ENGEDÉLYKÖTELES FOTOVOLTAIKUS [50 KW ÉS AZ A FELETTI] KISERŐMŰVEK DARABSZÁMÁNAK VÁLTOZÁSA, TREND, 2011–2021

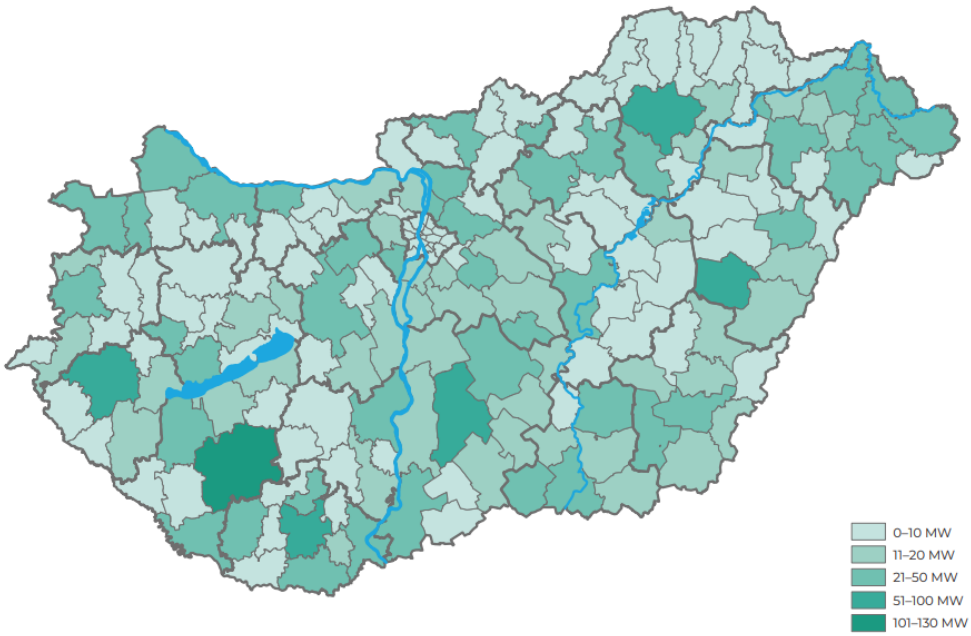
CHANGES IN THE NUMBER OF OVER 50 KW LICENSED AND NON-LICENSED SMALL PHOTOVOLTAIC POWER PLANTS 2011–2021, TREND



Source: MEKH

4.9G NAPERŐMŰVEK JÁRÁSONKÉNTI ELOSZLÁSA

DISTRIBUTION OF SOLAR POWER PLANTS BY DISTRICTS



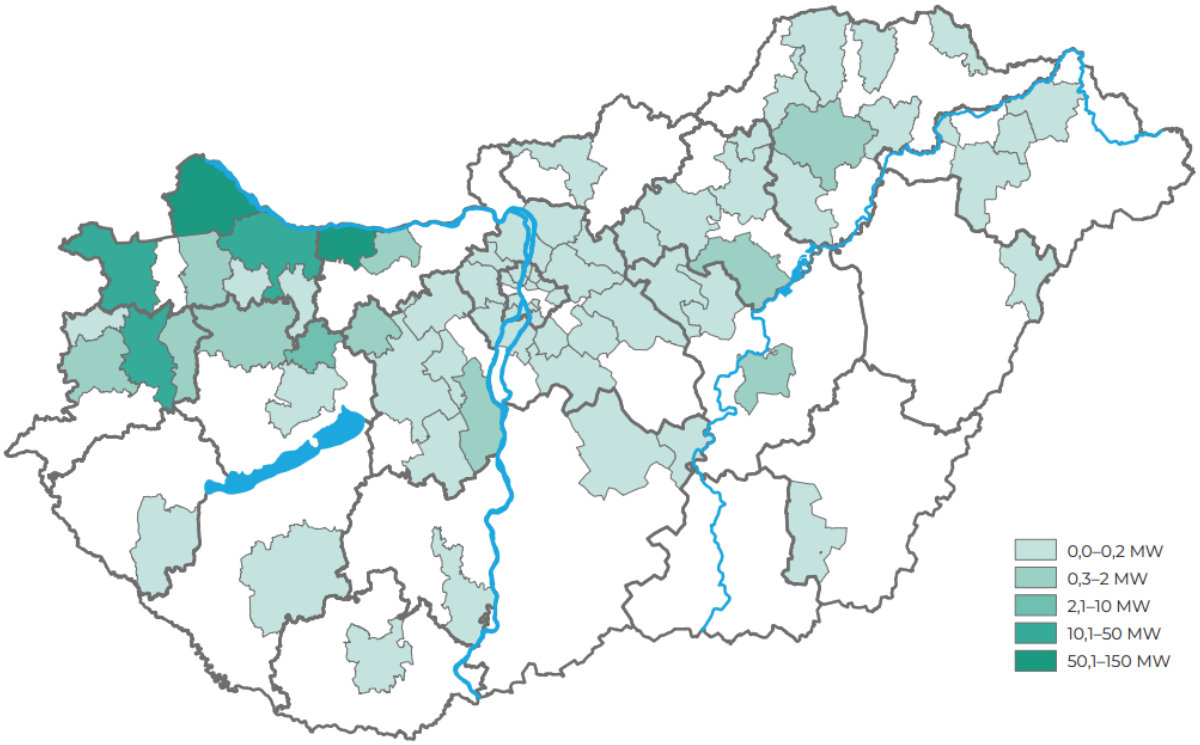
Source: MEKH

4.10A SZÉLERŐMŰVEK ADATAI, 2011–2021
DATA OF WIND POWER PLANTS, 2011–2021

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	
Napi termelt energia max. | Maximum daily generated energy	6860,8	6699,6	7352,9	7047,8	7058,4	6847,7	7014,9	6347,7	6907,7	7663,9	6855,2	**MWh**
Napi termelt energia min. | Minimum daily generated energy	5,6	39,2	0,628	14,4	2,4	1,88	0,1	3,9	25,329	0	0,015	**MWh**
Előállított éves villamos energia | Annual electricity generation	615,12	750,17	693,28	633,86	670,58	664,754	737,1	589,1	709,9	637,734	642,492	**GWh**
P max. nettó (15 perces átlag alapján) | P max. net (based on 15 minute average)	319,4	312,5	317,9	312,7	315,3	315,059	317	310,2	316,5	305,719	302,367	**MW**
P min. nettó (15 perces átlag alapján) | P min. net (based on 15 minute average)	0	0	0	0	0	0	0	0	0	0	0	**MW**
Kihasználtság (éves átlag) | Load factor (annual average)	21,3	26	24,1	22	23,3	23,07	25,9	20,7	24,75	22,53	22,72	**%**
Legkisebb szélerőművi gépegység BT | Smallest wind power unit (IC)	0,225	0,225	0,225	0,225	0,05	0,05	0,05	0,05	0,05	0,05	0,05	**MW**
Legnagyobb szélerőművi gépegység BT | Largest wind power unit (IC)	3	3	3	3	3	3	3	3	3	3	3	**MW**
Legnagyobb szélerőműpark BT | Largest wind farm (IC)	48	48	48	48	48	48	48	48	48	48	48	**MW**
Szélerőművek BT maximális értéke | Maximum IC value of wind power plants	329,275	329,275	329,275	329,275	328,900	328,900	324,900	324,900	327,500	323,275	323,275	**MW**
VER BT | IC of Hungarian electricity system	10108,800	10093,800	9113,080	8936,400	8558,400	8575,873	8617,000	8878,500	9441,760	9909,155	10313,8	**MW**
Szélerőművek BT/ VER BT | IC of wind power plants/IC of Hungarian electricity system	3,26	3,26	3,61	3,68%	3,84%	3,84%	3,77%	3,66%	3,47%	3,26%	3,13%	**%**

Source: MEKH

4.10E SZÉLERŐMŰVEK JÁRÁSONKÉNTI ELOSZLÁSA
DISTRIBUTION OF WIND POWER PLANTS BY DISTRICTS



Source: MEKH