Danube Transnational Programme
DanuP-2-Gas

Deliverable D.T2.2.1

Infrastructure Report (Hungary)

Activity A.T2.2: Infrastructure analysis

A PROJEKT AZ INTERREG DANUBE TRANSNATIONAL PROGRAMBÓL, AZ EURÓPAI REGIONÁLIS FEJLESZTÉSI ALAP TÁMOGATÁSÁVAL, AZ EURÓPAI UNIÓ ÉS MAGYAR ÁLLAM TÁRSFINANSZÍROZÁSÁVAL VALÓSUL MEG.

April 1, 2022

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www.interreg-danube.eu/danup-2-gas

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DOCUMENT CONTROL SHEET

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Acronym	DanuP-2-Gas
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Project coordinator	TZE

Short Description
The potential for exploitable organic residue for each participating country listing key aspects such as location, amount, transport options and costs.

Document Details	
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Version	Date	Author	Organization	Description
v1	26.10.2020	Kiril Raytchev	BSERC	Initial version
v2	05.11.2020	Kiril Raytchev	BSERC	Suggestions from the Supervisory board meeting (03.11.2020)
v3	21.12.2020	Kiril Raytchev	BSERC	Suggestions from PP12
v4	21.01.2021	Kiril Raytchev	BSERC	Internal call for feedback. See Meeting-minutes-20210127_V2 and Meeting-minutes-20210121
v5	31.12.2021	Kiril Raytchev	BSERC	Synching with the Interface of the Optimization tool; Added request for information about biochar transport prices; Added request for information about costs for connecting to water / gas / electrical grid; Accompanying versions of other templates: V6_D.T2.1.2_Biomass Database_COUNTRY; V6_D.T2.2.2_Infrastructure Database_COUNTRY; V1_Pre-feasibility Study__COUNTRY; V4_D.T2.1.1_Biomass Report_COUNTRY
v5-1	26.02.2022	Kiril Raytchev	BSERC	Secondary market regulation info has been marked as not mandatory, but nice to have,

1. METHODOLOGY

This document provides the overview of the several infrastructure data in the case of Hungary. The backbone of the data sources of the excel spreadsheet for the study is the registers of the Hungarian Energy and Public Utility Regulatory Office, but several other sources where used.

The Hungarian Energy and Public Utilities Regulatory Office's annual database of industrial electricity license holders1 provided sufficient information to identify renewable energy points. However, an approximate value had to be used for the GPS coordinates. In the case of renewable energy production units, the annual average energy per unit produced is calculated, for which no public database is available.

For industrial plants, the largest energy consumers were selected, and the companies listed in the table were contacted to determine their exact energy consumption, but only two responses were received from the companies surveyed. For the other industrial installations, approximate estimates have been entered in the table.

The definition of the connection points required different databases for each sector. For the definition of the connection points of the water utility networks, the service providers contacted could not provide exact connection points, so the GPS coordinates of the water utility network centre of the region were used as a necessary solution. In the case of natural gas, the connection points for both the distribution and transmission networks were determined using the FGSZ Natural Gas Transmission Ltd.'s annual Natural Gas Transmission System Delivery - Receipt Points Settlement Order database[2]. For the electricity network, the distribution network points were determined from a data request from the Hungarian Electricity System Operator. Industrial plants and renewable energy production points have also been identified as connection points.

[1] www.mekh.hu/villamosenergia-ipari-engedelyesek-listaja
[2] FGSZ - Földgázminőség elszámolási rendje

Among the many transport hubs in Hungary, the Danube transport could be of particular importance, given its capacity to carry a significant volume of goods.

For biochar, Hungary has neither significant production nor significant consumption capacity, so this is not relevant for this study.

The exact geographic locations of the border crossing points are not publicly available, so an approximate value was used for their GPS coordinates.

2. BRIEF DESCRIPTION OF HUNGARIAN INFRASTRUCTURE LANDSCAPE

In recent years, Hungary has shown dynamic growth in renewable energy infrastructure, which will continue to grow even more dynamically in the future, according to the strategies and plans published so far. Of all the weather-dependent renewable energies in the country, solar energy has the highest potential and is therefore the most dynamically developing renewable energy source, in some cases at the expense of synergies with other potential weather-dependent renewable energy sources.

Strengths:

- The country's energy network is a well-developed system, including border crossing points, designed in accordance with EU standards and regulations;
- Natural gas accounts for a high share of the country's final energy consumption, which implies a high share of industrial and residential appliances that can use natural gas. This fact could help and facilitate the boosting of demand for biogas and hydrogen;
- The share of electricity generated from renewable energy in the country is growing dynamically, which could also be an excellent opportunity to create a supply side for P2G installations in the future.

Weaknesses:

- The Paks nuclear power plant represents a high share of the country's electricity supply, resulting in a relatively concentrated energy system in the country;

- The political and economic interest in biogas varies in intensity across the country, making it difficult to provide a stable backdrop for long-term biogas development projects;
- The regulatory environment is not yet mature for biogas, which could be an option for a supportive regulatory environment in the future.

Opportunities:

- Paks II, one of the largest ongoing projects in Hungary, is currently on hold and may become impossible in the long term. As a consequence, it is possible that the country will have to rely on alternative energy sources to provide the necessary energy capacity that the project will need. This could help in the construction of P2G hubs;
- There is growing interest in hydrogen, not only in Hungary but also globally, which could be an excellent opportunity for power-to-gas hubs;
- High energy prices could boost demand for renewable energy sources.

Threats:

- Currently, the country has a high demand for energy imports, which results in a low surplus of available energy;
- In the field of a common European green policy, including energy policy, there is still far from a unified position among countries, and therefore decisions can be taken in a long process of discussion and debate, which can slow down the dynamic stimulation of interest in power-to-gas.

2.1 ELECTRICAL ENERGY SECTION

In the supply chain of the energy system, electricity suppliers sell the electricity they produce to traders, universal service providers, who sell electricity on the wholesale market, as well as electricity provided to consumers. Electricity is supplied from the producer to the consumer through the transmission and distribution network. Although the owners of the transmission infrastructure have a monopoly, domestic regulations ensure non-discriminatory access to the infrastructure in accordance with the regulations. Transmission and distribution activities must be carried out by separate companies and may not be used for production or commercial activities.

Trade in electricity generated from renewable and waste-based energy sources is a separate sales category. This electricity is purchased from producers by the transmission system operator (MAVIR Ltd.) through compulsory purchase (KÁT) at a price set by law, in the quantities and for the periods specified in the decision issued by the Hungarian Energy and Public Utilities Regulatory Office. The purchased product is sold on the organised electricity market.

Transmission case:

- Day period
  - The following daily schedule is applied on the transmission network[3]:
    - 01:00 - 07:00 (Night)
    - 07:00 - 11:00 (Morning)
    - 11:00 - 15:00 (High Noon)
    - 15:00 – 19:00 (Afternoon)
    - 19:00 – 01:00 (Evening)
  - ELECTRICITY PRICE without grid/operators fees, including taxes; [0,298 – 0,335 €/kWh[4]]

[3] Heti adatok - HUPX

- GRID/OPERATORS FEES for buyers connected to the grid system, including taxes.
  1) For a network user using the electricity system for the purchase of electricity,
     a) if it is connected, directly or indirectly, to the transmission system at a voltage level higher than 132 kV 7,48 €/kWh
     b) if it is connected, directly or indirectly, to the transmission system at a voltage level not exceeding 132 kV, 8,08 €/kWh
  2) 7,48 €/kWh for a distribution system connected to the transmission network
  3) for the implementation of Commission Regulation (EU) No 838/2010 of 23 September 2010 laying down guidelines for a compensation mechanism between transmission system operators and a common regulatory framework for transmission charges, the transmission charge for transmission to or from a country not party to a contract concluded by the transmission system operator (peripheral country)
     (a) the value published by ENTSO-E on its website in €/MWh and
     (b) the official mid-market exchange rate of the National Bank of Hungary on the day of the transaction

     expressed in €/kWh, multiplied by the value of the national daily exchange rate of the national central bank of the day of delivery or of collection of the electricity, expressed in €/kWh, to be paid for electricity delivered or supplied according to the international hourly schedules.
  4) 0 €/kWh in all other cases

- Night period
    - NIGHT PERIOD [hours-hours]
    - ELECTRICITY PRICE without grid/operators fees, including taxes [€/kWh]
    - GRID/OPERATORS FEES for buyers connected to the transmission system, including taxes [€/kWh]
- Weekend period
    - WEEKEND PERIOD (hours here span from 00:00 to 48:00); [hours-hours]
    - ELECTRICITY PRICE without grid/operators fees, including taxes; [€/kWh]
    - GRID/OPERATORS FEES for buyers connected to the grid system, including taxes; [€/kWh]
- Peak monthly pricing
    - 15-minutes PEAK POWER, including taxes; [0,42 €/kWh][5]
- TAX
    - VAT percentage applicable to electricity business; [27%]

Distribution case:

- Day period
    - DAY PERIOD
        - Winter [06:00-22:00]
        - Summer [07:00-23:00]
    - NIGHT PERIOD
        - Winter [22:00-06:00]
        - Summer [23:00-07:00]

[5] HUPX ID piaci adatok - HUPX

1. Table: Residential electricity tariffs (€/kWh)[6]

Tariffs	Electricity price	Grid fee	VAT (27%)	Gross electricity price
A1 discounted	0,033	0,044	0,021	0,097
A1 normal	0,035	0,044	0,021	0,1
A2 peak	0,046	0,044	0,024	0,11
A2 valley	0,024	0,044	0,018	0,086
B	0,024	0,025	0,013	0,062
B Geo	0,026	0,025	0,014	0,065
H	0,024	0,025	0,013	0,062

Distributor base fee:

- HUF 153,035 gross/connection point/month ("A1" and "A2" tariffs)
- HUF 50,165 gross/connection point/month ('B' tariff).

[6] Villamosenergia-tarifák (mvmnext.hu)

2. Table: Non-residential electricity tariffs (€/kWh)[7]

Tariffs	Electricity price	Grid fee	VET § 147. based on payable funds	Excise tax	VAT (27%)	Gross electricity price
A1	0,082	0,044	0,0041	0,00083	0,034	0,17
A2 peak	0,1	0,044	0,0041	0,00083	0,039	0,19
A2 valley	0,062	0,044	0,0041	0,00083	0,029	0,14
A3 peak	0,1	0,021	0,0041	0,00083	0,034	0,16
A3 valley	0,063	0,021	0,0041	0,00083	0,023	0,11
B	0,05	0,025	0,0041	0,00083	0,02	0,1
B Geo	0,054	0,025	0,0041	0,00083	0,021	0,11
H	0,05	0,025	0,0041	0,00083	0,02	0,1

[7] Villamosenergia-tarifák (mvmnext.hu)

Distributor's reactive energy charge:

- 0,015 €/kVArh[8] gross ("A1", "A2" and "A3" tariffs)

Distributor base charge:

- 0,42 € gross/connection point/month ('A1' and 'A2' tariffs)
- 14,4 € gross/connection point/month (for 'A3' tariff)
- 0,14 € gross/connection point/month ('B' tariff)

Distributor power charge:

- 2,79 € gross/kW/month ("A3" tariff)

- Weekend period
  - On days that are not working days, the peak period is also considered a valley period.
  - WEEKEND PERIOD
  - ELECTRICITY PRICE without grid/operators fees, including taxes
  - GRID/OPERATORS FEES for buyers connected to the grid system, including taxes
- Peak monthly pricing
  - For distribution case in Hungary this data is not available and not relevant.
- TAX
  - VAT percentage applicable to electricity business; [27%]

Distribution Price structure[9]:

- A1 tariff:
  - This is a single-zone tariff (in common parlance, daytime electricity), which is consumed at the same price day and night.
  - Up to 1320 kWh per year, it is available at a reduced rate.

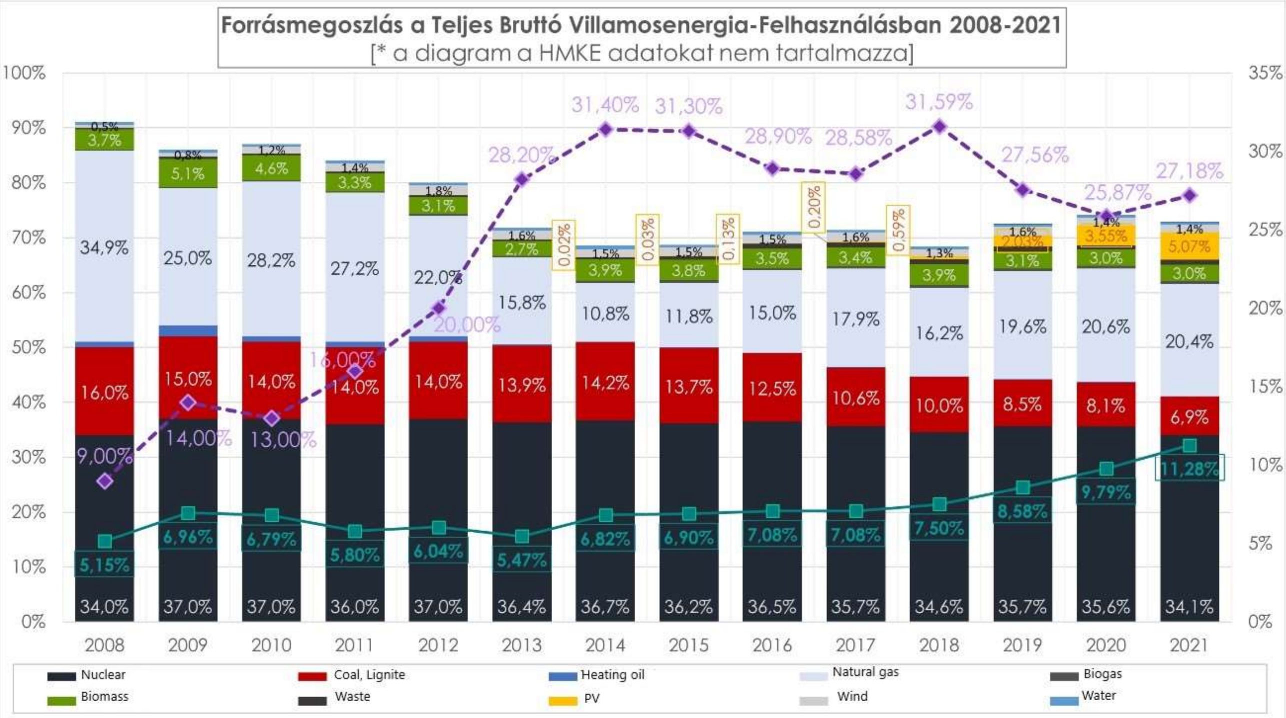
[8] purchased energy useful work the cost of the part of the energy that is not used.
[9] 4/2011. (I. 31.) NFM rendelet a villamos energia egyetemes szolgáltatás árképzéséről - Hatályos Jogszabályok Gyűjteménye (jogtar.hu)

- A2 tariff:
  - This tariff includes both night and day price categories.
  - Valley time is defined as the period between 22:00 and 06:00 on weekdays, 23:00 and 07:00 on daylight saving time, and peak time on non-working days.
  - This tariff requires a remote-controlled electricity connection point and two separate electricity meters.
- B tariff:
  - It can only be used for equipment that has a controlled connection point, i.e. it is connected to a separate meter and is not plugged into the socket, but is permanently connected to the mains.
  - It is recommended for the operation of heat storage appliances such as boilers.
  - Off-peak electricity is available for only 8 hours a day.
- B Geo tariff:
  - This tariff can only be applied for the electric supply of heat pumps.
  - It can only be claimed if the heat pump meets certain requirements.
- H tariff:
  - can be used for renewable energy systems
  - for use with fan-coil heat pump or direct evaporative heat pump air conditioning systems for heating
  - for split air conditioners, for appliances with a minimum COP (A2/A20): 3 COP

In Hungary, households have benefited from a reduction in utility bills since 2013. Within the limits set by law, the cuts include a 20% reduction in the price of natural gas, electricity and district heating, and a 10% reduction in water and waste charges for residential consumers.

No weekend pricing is applied for the Hungarian energy system.

1. Figure: Source distribution of Total Gross Electricity Consumption 2008-2021[10]



Source: [2021 – a rekordok éve - MAVIR - Magyar Villamosenergia-ipari Átviteli Rendszerirányító Zrt.]()

The share of renewables in the total installed capacity of the Electrical Energy System exceeds 25.3%, of which PV generators of 50 kW and above account for more than 17.7%.

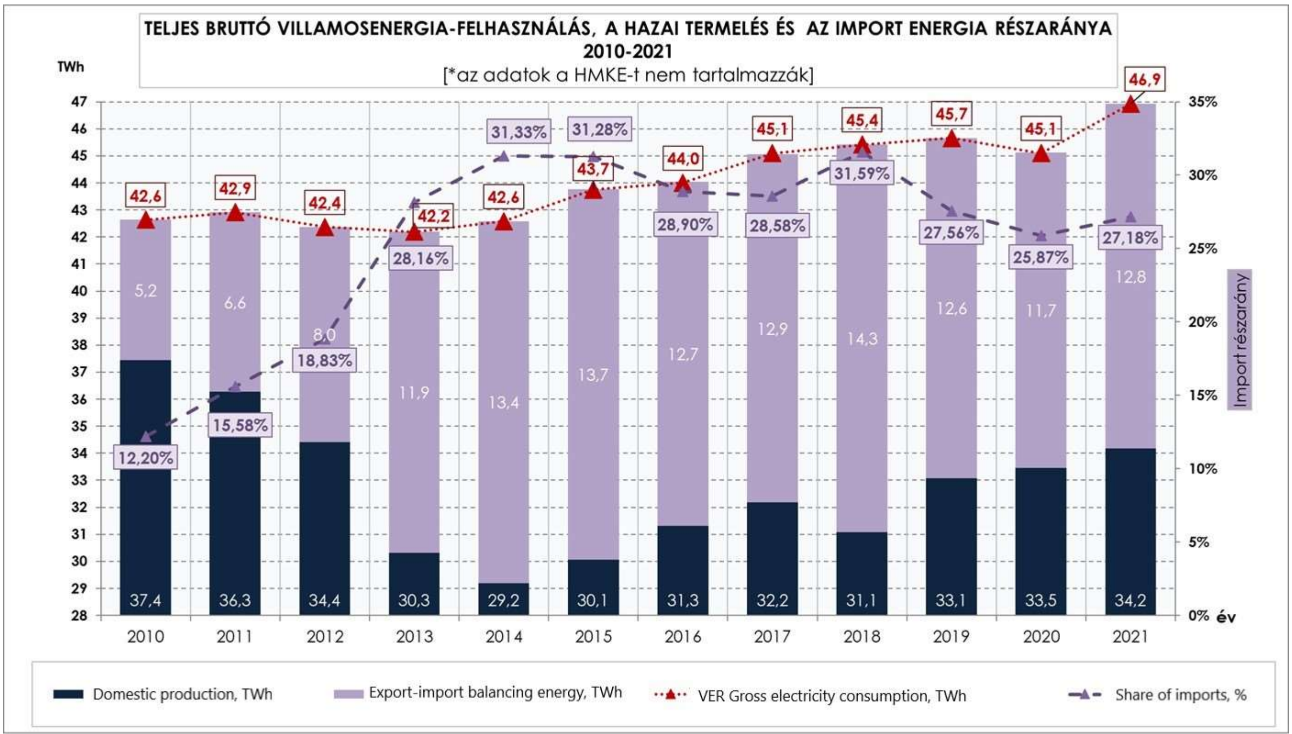
The share of renewable energy sources, especially photovoltaic energy, in gross domestic production and total gross energy consumption has reached record levels and this trend is expected to continue as the number and capacity of renewable energy producers continues to grow. In 2021, renewable energy production accounted for 11.28% of total gross electricity consumption (including photovoltaic production: 5.07%).

However, if only the total gross domestic production is considered, this renewable share was 15.49%, of which solar energy accounted for 6.96%. The share of renewables in

[10] The diagram does not include data from small household-scale small power plants.

domestic production has nearly tripled in the last 10 years, while their share in total gross electricity consumption has also more than doubled.

2. Figure: Total gross electricity consumption, share of domestic production and share of imported energy 2010-2021[11]



Source: [2021 – a rekordok éve - MAVIR - Magyar Villamosenergia-ipari Átviteli Rendszerirányító Zrt.]

The preliminary total gross electricity consumption for 2021 registered by MAVIR was 46.923 terawatt hours (TWh), which is also an absolute historical record, even though it does not include the production of small household-scale power plants, typically solar photovoltaic (PV). The annual average increase reached 3.96%, while the annual increase adjusted for the value of the estimated HMKE (household-scale small power plants) production, and the surge was 5.09%.

[11] The diagram does not include data from small household-scale small power plants.

Looking at the monthly data, the total gross electricity consumption for December 2021 (4 338.5 GWh) is also a record, annual record monthly consumption. A higher monthly value (4 345.2 GWh) has only occurred once before in the history of the Hungarian electricity system, in January 2020. This year, it was still not possible to meet consumer demand without imported energy, which accounted for 27.18% of the total, up 1.31 basis points on the previous year.

How the electricity market works in Hungary

In the electricity supply chain, electricity suppliers sell the electricity they produce to traders, universal service providers, who either sell the electricity on the wholesale market or supply electricity to users. Electricity is transmitted from the producer to the consumer through the transmission and distribution network. Although the transmission infrastructure owners have a monopoly, domestic regulation ensures non-discriminatory access to the infrastructure, in line with EU standards.

Transmission and distribution activities must be carried out by separate companies which are not allowed to engage in generation or trading activities.

The sale of electricity from renewable and waste-based energy sources is included in the scheme as a separate sales category. This electricity must be purchased by the transmission system operator (MAVIR Ltd.) from generators by means of compulsory purchase (KÁT) (at a price set by law, in the quantities and for the periods specified in a decision issued by the Energy Office) and sold on the organised electricity market. Non-residential consumers bear the direct costs of the RES-E support schemes (RES-E KÁT and RES-E METAR).

The description of the RES-E support schemes KÁT and METÁR is presented in a later chapter.

Producer and wholesale market

At the end of September 2020, the total installed capacity of the Hungarian power plants connected to the grid - excluding small household power plants - amounted to 9,371 MW, of which 2,000 MW were provided by the four reactor blocks of the Paks nuclear power plant. After Paks, the natural gas-fired Dunamenti power plant (794 MW) and the mainly lignite-fired Mátra power plant (950 MW) continue to represent significant power plant capacities. At the end of 2019, Opus Global Plc, the majority shareholder of the Mátra Power Plant, reached an agreement with MVM Ltd. on the sale of its 72.66% stake in the plant. The transaction closed in 2020, thus the power plant became part of the asset portfolio of the state-owned company. The Tisza power plant (900 MW), owned by MVM Ltd., also ceased operations in 2020 and did not generate electricity.

Model for a renewable support scheme

METAR[12] support is available for renewable electricity generation, except for brown premium[13] and small household-scale plants, which is linked to a new investment and where the investment has not yet started at the time of application for support. Mixed-fuel or waste-fired power plants can only receive aid for the part of their production that is considered as renewable energy (pro rata to the heat generated).

Under METÁR, support for new investment can currently only be claimed in the form of a green premium type of entitlement allocated through a tendering procedure. Under the premium scheme, the producer sells the electricity himself and receives the subsidy above the market reference price. Under the premium scheme, producers have to bear

[12] www.mekh.hu/megujulo-tamogatasi-rendszer-metar

[13] premium-type aid to encourage the maintenance of electricity production using biomass or biogas pursuant to Article 11(2)(b) of Act LXXXVI of 2007 on electricity (hereinafter referred to as the "Act on electricity")

the costs of deviations from the schedule. The Minister responsible for energy policy decides on the tenders.

Existing power plant units using renewable energy sources that are undergoing significant renovation or upgrading, at a cost of more than 50% of the initial investment cost, can also apply for support.

In Hungary, wind energy is subject to very strict regulations, as a result of which no wind power plant or wind farm, with the exception of small household power plants, can be located within 12 km of the area or boundary of the area intended for construction, and therefore no new wind power plant can be installed anywhere in the country.

For power plants below 1 MW (except wind power plants), it was possible to obtain green premium type entitlements without participating in the tender, but from 1 May 2019 no new applications can be submitted and the limit for new subsidies to be allocated for the years 2020-2026 is HUF 0 per year.

Compulsory purchase entitlements (METÁR KÁT) were available for power plants (excluding wind) and demonstration projects below 0.5 MW, but from 26 April 2018 no new applications can be submitted and the limit for new aid to be allocated for the years 2020-2026 is HUF 0/year.

From 1 January 2022, renewable energy units with a rated capacity of less than 0.4 MW may benefit from METÁR KÁT without a decision of the Office, but only with compulsory purchase at the reference market price, without subsidy content. For power plant units put into operation after 1 January 2026, only power plant units with a rated capacity of less than 0.2 MW using renewable energy sources may benefit from such compulsory purchase at the reference market price.

The aim of the brown premium is to maintain the operability of power plants using biomass or biogas, and eligibility can be requested from MEKH for 5 years without a tender.

Under the VET (Electric Energy Act), MAVIR Ltd.[14] is responsible for:

The operation of the balancing group established for the settlement of the electricity subject to the take-or-pay obligation in connection with the reception and transmission of electricity subject to the take-or-pay obligation, the balancing and the sale on the organised electricity market of the total amount of electricity subject to the take-or-pay obligation. The determination and accounting of premium support for electricity subject to premium support. The determination, distribution and accounting of the amount of the CTC and Premium funds to be paid by the cost bearers defined in the VET, in accordance with the legal provisions.

Mandatory Transmission System (KÁT):

Each month, the members of the KÁT Balancing Group (or Scheduling Group Representatives) are obliged to forecast their production for the next 12 months for the KÁT Balancing Group with a production plan broken down by zone, and to provide a daily production schedule for each day of the month and are entitled to modify their daily schedule within one day. The KÁT producer (or Scheduling Group Representative) is fully liable for any deviation from the schedules. On the basis of the submitted schedules (daily or intraday) and the production data, the Receiver determines the schedule deviations of the KÁT generators, on the basis of which a regulatory surcharge is invoiced to the KÁT Balancing Group Members (or Schedules Group Representatives).

As of 1 March 2022, Scheduling Members (Scheduling Group Representatives or self-scheduling Cogeneration Producers) will have the possibility to reduce their imbalances through schedule-based and real-time balancing in the framework of an independent balancing energy management.

[14] The System Operator in Hungary

Generation facts of the Balancing Group members are published by the Receiver on a monthly basis. The total amount of electricity planned to be produced by the KÁT generators according to the daily schedule is sold on HUPX (HUPX DAM, HUPX ID).

Costs of connecting to the network:

- The unit costs of connection to the gas grid connection are highly dependent on the amount of voltage capacity required and the type of line (overhead or underground cable), in both Transmission and Distribution cases, so the companies contacted provided approximate figures in this respect and could not provide precise figures due to commercial confidentiality.
- capacity cost for transmission electrical grid connection [12,22€ / kW][15]
- capacity cost for distribution electrical grid connection
    - the costs are detailed in the table below

3. Table: Connection line installation fee

Overhead cable	Below 30 meters	free of charge
	Above 30 meters	3,53 € / m
Underground cable	Below 15 meters	free of charge
	Above 30 meters	16,29 € / m
Mandatory connection by underground cable[16]	Below 15 meters	free of charge
	Above 15 meters	3,53 € / m

Source: EON - Bekapcsolás

[15] Megjelent a Mavir uzemviteli szabályzat mely alapján 4.500.000 Ft/MW lett a csatlakozási díj - Magyar Napelem Napkollektor Szövetség (mnnsz.hu)

[16] In special cases, in areas where an overhead line cannot be installed according to § 178/J of the VET

2.2 NATURAL GAS ENERGY SECTION

Transmission case

- WINTER PERIOD (October-March)
    - GAS PRICE without grid/operators' fees, including taxes; [0,26 €/kWh][17];
    - GAS SUPPLY FEE, including taxes; [0,11€/kWh];[18]
    - Average yearly grid system CAPACITY PRICE for CONSUMPTION OF GAS from the grid, in yearly reservations mode, including taxes; [2,4 €/kWh/h/year][19];
    - Average daily grid system CAPACITY PRICE for INJECTION OF GAS in the grid, in daily reservations mode, including taxes [2,24 €/(kWh/h/year)];
- SUMMER PERIOD (April-September)
    - GAS PRICE without grid/operators' fees, including taxes; [0,13€/kWh][20];
    - GAS SUPPLY FEE, including taxes; [0,11€/kWh];[21]
    - Average yearly grid system CAPACITY PRICE for CONSUMPTION OF GAS from the grid, in daily reservations mode, including taxes; [2,4 €/kWh/h/year][22];
    - Average yearly grid system CAPACITY PRICE for INJECTION OF GAS in the grid, in yearly reservations mode, including taxes [2, 24€/(kWh/h/year)];
- Conversion factor
    - Lower Heating Value; 7,76-11,37 kWh/m3[23]
- TAX
    - VAT percentage applicable to gas business; [27%]

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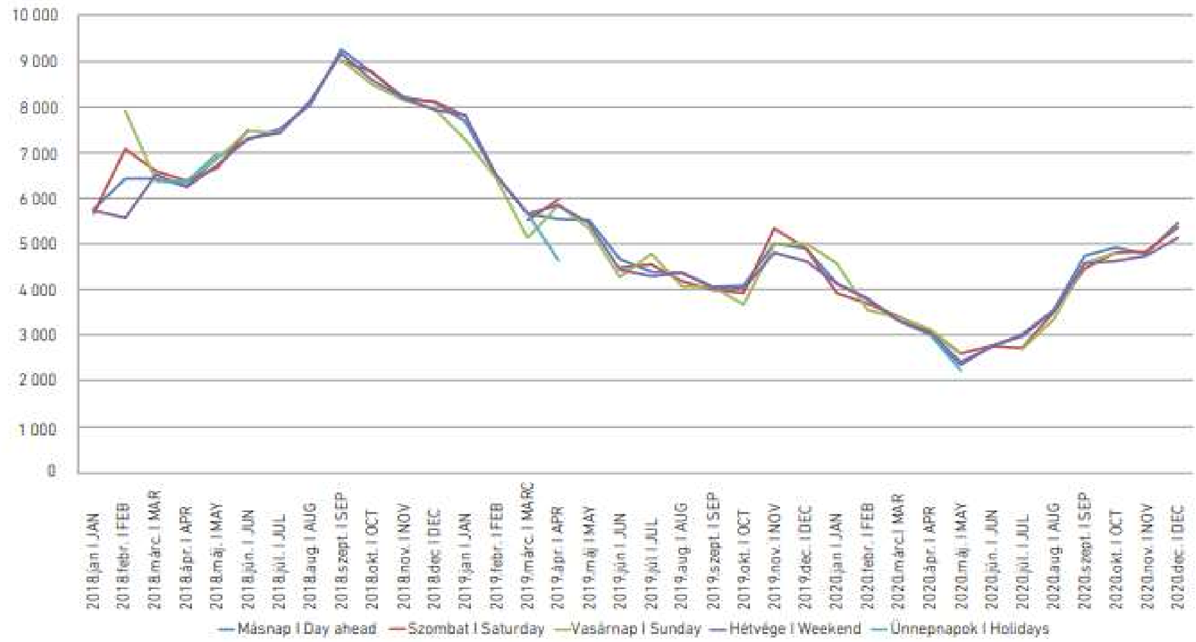
17 CEEGEX
18 Változó földgáz rendszerhasználati díjak 2021. október 1-től – Wattler
19 www.mekh.hu/a-tar-nc-30-cikke-altal-eloirt-kozzeteteli-kotelezettseg-teljesitese-2020
20 CEEGEX
21 Változó földgáz rendszerhasználati díjak 2021. október 1-től – Wattler
22 www.mekh.hu/a-tar-nc-30-cikke-altal-eloirt-kozzeteteli-kotelezettseg-teljesitese-2020
23 19/2009. (I. 30.) Korm. rendelet a földgázellátásról szóló 2008. évi XL. törvény rendelkezéseinek végrehajtásáról - Hatályos Jogszabályok Gyűjteménye (jogtar.hu)

3. Figure: Day ahead average prices by month [thousand HUF/GWh]



Source: [A magyar foldgazrendszer 2020 evi adatai.pdf (mekh.hu)]

Distribution case:

- WINTER PERIOD (October-March)
  - GAS PRICE without grid/operators' fees, including taxes; [0,02€/kWh][24];
  - GAS SUPPLY FEE, including taxes; [0,17€/kWh][25];
  - Average yearly grid system CAPACITY PRICE for CONSUMPTION OF GAS from the grid, in yearly reservations mode, including taxes; [0,13€/(kWh/h/year)][26]
  - Average yearly grid system CAPACITY PRICE for INJECTION OF GAS in the grid, in yearly reservations mode, including taxes [0,33€/(kWh/h/year)];

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[24] havi_elszamolo_foldgazar_201801_201909.pdf (mekh.hu)
[25] Változó földgáz rendszerhasználati díjak 2021. október 1-től – Wattler (measuring category above 500 m3/hour)
[26] Változó földgáz rendszerhasználati díjak 2021. október 1-től – Wattler (measuring category above 500 m3/hour)

- SUMMER PERIOD (April-September)
  - GAS PRICE without grid/operators' fees, including taxes; [0,013€/kWh][27];
  - GAS SUPPLY FEE, including taxes; [0,17€/kWh][28];
  - Average yearly grid system CAPACITY PRICE for CONSUMPTION OF GAS from the grid, in yearly reservations mode, including taxes; [0,13 €/(kWh/h/year)]
  - Average yearly grid system CAPACITY PRICE for INJECTION OF GAS in the grid, in yearly reservations mode, including taxes [0,33€/(kWh/h/year)]
- Conversion factor
  - Lower Heating Value; 7,76-11,37 kWh/m3[29]
- TAX
  - VAT percentage applicable to gas business; [27%]

In Hungary, households have benefited from a reduction in utility bills since 2013. Within the limits set by law, the cuts include a 20% reduction in the price of natural gas, electricity and district heating, and a 10% reduction in water and waste charges for residential consumers.

In the case of Distribution, the unit values of the transport and storage charges recognised in the universal service price are fixed and variable costs associated with transport and storage shall be established.

[27] havi_elszamolo_foldgazar_201801_201909.pdf (mekh.hu)
[28] Változó földgáz rendszerhasználati díjak 2021. október 1-től – Wattler (measuring category above 500 m3/hour)
[29] 19/2009. (I. 30.) Korm. rendelet a földgázellátásról szóló 2008. évi XL. törvény rendelkezéseinek végrehajtásáról - Hatályos Jogszabályok Gyűjteménye (jogtar.hu)

Regulation and functioning of the natural gas market

In the natural gas market, domestic users are free to choose a gas trader to supply them, or they can choose to purchase gas on their own. Sources of supply can come from imports or domestic production.

In order to stimulate natural gas trade, interest in the limited natural gas trading operating licence introduced a few years ago remains buoyant, with 9 new market players being allowed to enter the domestic natural gas market in 2020 under a simplified licensing procedure. The change in the regulatory environment at the end of 2016 has made it possible for domestic operators to apply for a limited wholesale natural gas trading licence for resale, and the number of Hungarian-based licensees is increasing. However, the market behaviour of this segment of licensees may differ from that of foreign traders.

Imports were supplied from the east via the Brotherhood pipeline at the Beregdaróc network point and from the west via the HAG pipeline from Baumgarten in Austria. The Slovak-Hungarian gas interconnector, built by Magyar Gáz Tranzit Ltd. (MGT Ltd.) and which started commercial operation on 1 July 2015, was taken over by FGSZ Ltd. in the fourth quarter of 2019 and then by the end of the year, and the automatic reversal of direction was completed in Balassagyarmat and Szada.

The Ukrainian-Hungarian border point has been continuously outbound since 1 June 2013.

In 2020, the Ukrainian outbound and inbound will operate as a virtual point of entry and exit, where the clearing of inbound and outbound deliveries will be netted.

On the Croatian-Romanian interconnection, bi-directional transport was already fully implemented in 2018, with the completion of the Csanádpalota compressor station (1.75 bcm) and the conversion of the existing metering station as part of the Romanian-Hungarian (RO-HU) transport corridor Phase I, where bi-directional transport was typical in 2020.

By 2020, the reconstruction of the nodes of North-Eastern Hungary - Városföld, Hajdúszoboszló, Nemesbikk, Beregdaróc, which was necessary due to the uncertainty of the Ukrainian transport routes, was completed.

By the end of 2020, the Croatian LNG terminal was completed, providing the country with new import sources via the HRHU entry point.

The seasonality of residential gas consumption, i.e. the increased demand for natural gas during the winter heating period, requires that, in addition to available import sources and domestic production, full supply can be ensured from storage facilities filled during the summer period. Under a legal requirement, the obligated suppliers had to store at least 60 % of the highest winter consumption of the last ten years in storage, which led to the universal service providers storing larger quantities of natural gas, typically from sources purchased under the offer and indirectly. In 2020, all gas storage facilities continued to be fully filled, due to the exploitation of the price advantage (spread) caused by the different natural gas prices in winter and summer.

In view of the same uncertainty, the level of security of gas supply was increased as of 1 August 2019. Hungary has 15,374,000 MWh (about 1,450 million m3) of storage capacity and natural gas in storage at the level of injections[30] set by the Minister of Energy Policy. The security gas reserve is intended to alleviate the shortage of resources resulting from the possible loss of import sources, mainly to supply sheltered users. Beyond this shortage, the security reserve will provide the necessary natural gas resources for a maximum of 7 days until the appointment of a new trader. The emergency reserve may also be used to supply non-universal customers in the event of a gas supply crisis or to supply protected customers in another Member State requesting solidarity on a solidarity basis as required by the SoS Regulation.

[30] Paragraph (1) of Article 2 of NFM Decree 13/2015 (III. 31.) on the level of natural gas security stocks.

Wholesale and retail trade

The sources of imported gas are predominantly Russian, including much of the gas purchased through the HAG pipeline from Baumgarten in Austria. The share of domestic production in natural gas resources has increased, in contrast to the decreasing trend of previous years, and the volume imported has decreased significantly compared to the previous year. The ratio of domestic production to imports has remained stable at around 10-90%. As in previous years, eastbound imports (34.7%) exceeded westbound imports (31.5%) in 2020, while northbound imports also accounted for almost 17.8%.

The retail market has had a split structure from its inception in 2004, with the official pricing segment and the free-price section separated. Since the beginning of the market, the relative balance of the two segments has shifted steadily in favor of the free market. The official public utility service, which was previously open to all customers, was superseded on July 1, 2009, by the universal service, which was offered to a significantly smaller set of eligible users.

Users entitled to universal service (residential customers, other users with purchased capacity not exceeding 20 m3/hour and local authorities to the extent of supplying the consumption points of the municipal tenants) continue to be supplied predominantly by the universal service, supplied by the universal service provider NKM Energia Ltd. The universal service provider is obliged to sell and contract natural gas to the users entitled to the universal service.

Users not eligible for universal service either already purchased energy from the free market or only entered the free market when they lost their eligibility for universal service (small and medium consumers and district heating producers).

Natural gas transmission

Transmission Operator (FGSZ Ltd.)

The FGSZ performs its tasks as an ITO (Independent Transmission Operator) certified transmission system operator in accordance with EU Directive 2009/73/EC. The Company's infrastructure is one of the most modern in Europe, in line with industry tradition. Its highly automated high-pressure transmission systems deliver the quantities of natural gas of the required quality and pressure to ensure a continuous supply to system users. Their high-pressure natural gas transmission pipeline system receives and transfers natural gas from domestic production and underground storage, as well as from abroad, at 25 domestic entry points, including 5 cross-border entry points, and at around 400 exit points, including 5 cross-border exit points. At all entry and exit points, particular attention is paid to the application of quality control protocols in compliance with the legislation in force and to the application of valid measurement requirements. The safe and continuous operation of the 5,874 km long high-pressure natural gas transmission pipeline system covering the whole country is ensured by the cooperation of 3 gas transmission regions and 8 compressor stations, as well as the coordination of the company's system control centre in Siófok.

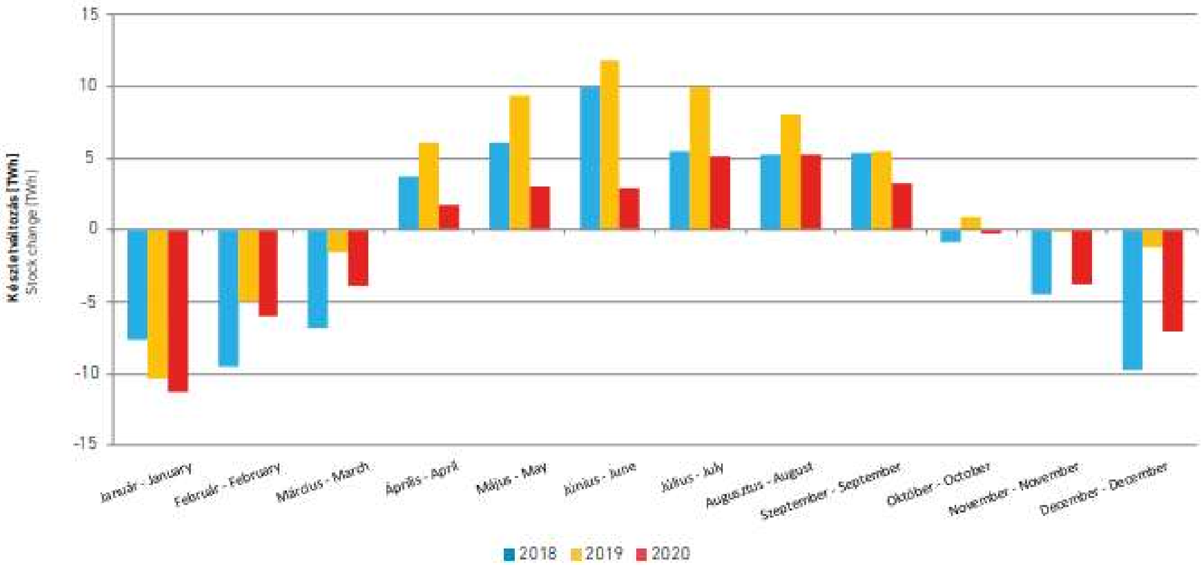
Natural gas storage

Security gas storage

Act XXVI of 2006 on the security of natural gas supply, adopted by Parliament in March 2006, provided for the storage of 1.2 billion m3 of natural gas and the construction of the necessary underground storage by 2010. The emergency stocks of natural gas must be stored in a storage facility with a withdrawal capacity of 20 million m3 /day for at least 45 days. The legally required emergency storage of natural gas is intended exclusively for the secure supply of natural gas to household and municipal customers. In previous years, no use of the emergency reserve was necessary due to a natural gas supply crisis. However, 2019 was an exceptional year in that, until the end of the year, there was a question mark over the supply of natural gas from Ukraine for the period after 1 January 2020.

In view of this uncertainty, NFM Decree No 13/2015 (31.03.2015) on the level of the security stocks of natural gas fixed the level of security stocks at 15,374,000 MWh (approximately 1,450 million m3) as of 1 August 2019. Although the uncertainty of the route to Ukraine has been removed, the level of security of supply remains unchanged.

4. Figure: Monthly stock changes in reservoirs



Source: [A magyar foldgazrendszer 2020 evi adatai.pdf (mekh.hu)]

In 2013, the Hungarian Gas Storage Ltd. (MFGT Zrt.) also received a licence from the MEKH to store security gas, but the Minister of Energy Policy designated MMBF Zrt. as the only company to carry out security gas storage.

Commercial natural gas storage

There were no changes in the operation of domestic commercial gas storage facilities during 2020, with four of the five commercial gas storage facilities operated by MFGT Zrt. and the fifth operated by MMBF Zrt. MMBF Zrt. applied for a commercial gas storage licence, which was granted by MEKH, allowing it to store 450 million m3 of mobile gas at the Szőreg I site due to the change in the level of the above-mentioned security of supply.

Currently, both gas storage licensees hold both commercial and security gas storage licences. Importantly and reassuringly for security of supply, the system can supply two thirds of the national daily peak demand from commercial storage, with sufficient storage capacity.

Price preparation, price regulation

Natural gas price regulation is carried out in four-year price regulation cycles, in accordance with the current GET. Prior to each such cycle, the Hungarian Energy and Public Utilities Regulatory Office carries out an asset and cost review to determine the justified asset value, costs and recovery of each licensee, on the basis of which the so-called initial tariffs and margins are established.

In 2021, a new price regulation cycle started for companies in the gas sector that apply official prices (universal service providers, former wholesale distributors, gas suppliers, storage and distribution companies).

The framework for the determination of natural gas system usage fees, special fees and connection fees for the price regulation cycle starting in 2021 is laid down in MEKH Decree 8/2020 (VIII. 14.).

At the core of the EU's third energy package are the regulations governing the operation of the transmission system, the so-called network codes, which include Regulation (EU) No 460/2017 establishing the network code for harmonised natural gas transmission tariff structures, the so-called TAR NC. The provisions of the Regulation had to be introduced in several phases, but as of 31 May 2019, TAR NC is fully applicable.

The TAR NC aims to facilitate market integration, increase security of supply and promote the interconnection of gas networks. The TAR NC achieves these objectives by establishing transparent transmission tariff structures and tariff setting methodologies, as well as by setting strict publication and consultation requirements. These publication requirements ensure that tariff setting is understandable, transparent and predictable for system users.

TAR NC requires the application of a conditional reference price methodology, which is an algorithm that generates the price of the annual non-interruptible capacity product for each network point from specified input data (the allowed revenue volume, the forecast firm capacities, optionally supplemented by the distance between points, and the network structure).

Price regulation framework for universal service

Customers buying gas under the universal service are supplied at the official price. The universal service is available to residential users and other users with a purchased capacity not exceeding 20 m3/h, and to municipalities up to the level of supply to the points of use of people living in municipal rental housing.

The price of the universal service in the natural gas market includes the recognised unit price of natural gas as a product and, unlike the universal service for electricity, the unit tariffs for the use of the system, as well as the wholesale and universal service margins, the cost of financing mobile gas and corrective price elements (annual settlement element, winter allocation element).

Costs of connecting to the network:

- The unit costs of connection to the gas grid connection are highly dependent on the amount of capacity required (both Transmission and Distribution cases), so the companies contacted provided approximate figures in this respect and could not provide precise figures due to commercial confidentiality.
    - Average cost is between 67 000 – 90 000 € / km.
- capacity cost for gas grid connection [€ / (kWh/h)] [31]
    - if less than 42.20kWh/h: 536,08 €

[31] www.mekh.hu/a-2021-2025-os-arszabalyozasi-ciklusra-szolo-szallitasi-es-elosztasi-csatlakozasi-es-kulondijak-es-kapcsolodo-hatarozatok

- if more than 42,2 kWh/h, but not more than 211 kWh/h: 536,08 € + 20,10 €/(10,55 kWh/h) * (k[32]- 42.20kWh/h)
- if more than 211 kWh/h: 536,08 € + 5,36 €/(10,55 kWh/h) * (k[33]-211 kWh/h)

2.3 BIOCHAR SUPPLY SECTION

There is currently no commercial production and use of biochar in Hungary. Delivery prices are expected to be similar to normal coal in the future.

4. Table: The cost of transporting bulk goods

	€/100 tkm
Road transport	47
Rail transport	79
Inland navigation	30

Source: Data from a freight forwarder

2.4 WATER SUPPLY SECTION

The figures below are based on the tariffs of the water utilities in Budapest[34], given that the tariffs of most of the utilities are not publicly available, so this is taken as a starting point and may vary across the country.

- Price for water supply, excluding sewerage and wastewater cleaning costs, including operators/grid fees and taxes: between 0,68 – 1,48 €/m^3
- The unit costs of connection to the water network are highly dependent on the amount of capacity required, so the companies contacted provided approximate

[32] k = the capacity required
[33] k = the capacity required
[34] szolgaltatasok-dijszabasa.pdf (vizmuvek.hu)

figures in this respect and could not provide precise figures due to commercial confidentiality.

- Average cost is between 65 000 – 85 000 € / km.

The rates for connection to the public drinking water and wastewater network - taking into account the costs of implementation - are set by the Budapest Waterworks Ltd[35].

The construction, disinfection, on-site inspection, pressure test, operability and watertightness test, geodetic survey and installation of the connection water meter shall be carried out by the Budapest Waterworks Ltd. or the contractor commissioned by it.

The total cost of a connection will be determined on the basis of the technical parameters of the connection (e.g. material and diameter of the distribution line, length and diameter of the connection pipe, diameter of the water meter, type of pavement and soil, location) and will include the costs of construction, materials, labour and other costs.

- The costs[36] for building a drilled water well are between 40,21 - 67,01 € / m

2.5 RELATED PLANS AND STRATEGIES

In terms of the future prospects for P2G hubs, there are a number of significant and beneficial changes in the Hungarian energy system in the coming decade. These future plans are presented in this chapter.

[35] Ivóvízellátási és szennyvízelvezetési díj - Kezdőlap (vizmuvek.hu)
[36] 2022 Kútfúrás árak — Kútásás méterenkénti ár (gjob.hu)

2.5.1 NATIONAL ENERGY STRATEGY

The main objective of the revised National Energy Strategy[37] is to strengthening energy sovereignty and security, reducing rents and to decarbonise energy production. Available at Energy Strategy states that these objectives are exclusively based on nuclear and renewable energy. From Energy Strategy, stating that these targets are based exclusively on nuclear and renewable energy sources.

The strategy recognises that Hungary is a country poor in traditional energy resources, and therefore energy sovereignty is a welfare, economic and national security issue. In the strategy's vision for the future, nearly half of Hungary's electricity generation will come from carbon-neutral nuclear energy, an assumption that in itself is a strong starting point for renewable hydrogen production. This makes it possible to produce hydrogen at times of the day (e.g. at night) when the electricity grid cannot economically absorb the electricity generated.

The strategy aims to build the future Hungarian energy system around four main programmes:

- Focusing on the Hungarian consumer.
- Strengthening security of energy supply.
- Implementation of a climate-friendly transformation of the energy sector.
- Exploiting the economic development potential of energy innovations.

The specific targets include reducing natural gas imports, as Hungary's share of natural gas in final energy consumption is 31.8% (2017)[38], making it the largest energy carrier in the domestic energy mix. Imports account for 80% of the natural gas consumed, and this share should be reduced to close to 70% by 2030 and below 70% by 2040. Ways to do this will be to increase energy efficiency, reduce the share of natural gas used in

[37] https://www.enhat.mekh.hu/s/nemzeti_energiastrategia_2030.zip
[38] 33,2% in 2020

district heating and in the longer term reduce the share of natural gas used in electricity generation after 2030.

In terms of our electricity use, ways to reduce import dependence include renewing nuclear capacity and encouraging domestic production based on renewable resources. In addition, the widespread deployment of smart solutions is emerging as an additional means, generating significant distribution and transmission network development, human capacity and competence development and regulatory challenges, which are a time priority in view of the large-scale integration of weather-dependent renewable energy producers into the system. This is essential for system security and cost control. By weather-dependent renewables, the National Energy Strategy mainly refers to solar PV capacity, wind energy does not play a significant role in the document. The targets are to increase the share of domestic electricity generation to 90% by 2030, to increase the domestic installed photovoltaic capacity to over 6,000 MW by 2030 and to close to 12,000 MW by 2040. Also mentioned is the objective of reducing our share of electricity imports from 32% to below 20% by 2040.

Increasing energy efficiency is one of the key objectives for improving security of supply, which can achieve a significant reduction in the final energy consumption of the Hungarian housing stock in poor technical condition. The specific objective is to ensure that the GHG intensity or specific energy consumption of certain sectors of the industrial sector does not exceed the average of the corresponding industrial sectors in the European Union. Our final energy consumption should not exceed the 2005 level of 785 PJ in 2030. The increase in final energy consumption after 2030 can only be achieved by carbon neutral from carbon-based sources.

The other two targets of the strategy are to reach a share of 21% of our gross final energy consumption from renewable energy and to reduce our GHG emissions by emissions should be reduced by at least 40% compared to 1990 levels.

2.5.2 NATIONAL ENERGY AND CLIMATE PLAN[39]

The National Energy and Climate Change Plan - NEKT[40] was created at the same time as the new National Energy Strategy (2020), so the contents of the two documents are closely related and, in some places, duplicated. In the planning of the NEKT, the decarbonisation, energy efficiency, energy security, internal energy market, research, innovation and competitiveness dimensions of the Energy Union were also part of the integrated planning. In the context of the plan, the Hungarian Government has given the Ministry of Innovation and Technology (ITM) the mandate to develop policy programmes and visions on the issues most relevant to the energy sector and other sectors involved in decarbonisation, which require policy decisions on the future of the sectors concerned. With this mandate, the ITM has become one of the main national coordinators of climate change planning and other measures.

One of the most important steps in Hungary's decarbonisation, as highlighted in the plan, is the conversion of the Mátra Power Plant to lower carbon technologies, i.e. the phasing out of coal and lignite from domestic electricity generation by 2030. The Mátra power plant accounts for nearly 50% of the total carbon dioxide emissions of the Hungarian power generation sector, and 14% of total domestic greenhouse gas emissions. In addition to decarbonisation, the planning of the power plant's reorganisation should take into account the need to maintain security of supply in the eastern part of the country and to take due account of socio-economic impacts. This will mainly involve the installation of a new photovoltaic power plant, the construction of an industrial energy storage unit and the energy recovery of Reuse Derived Fuel (RDF). The construction of an industrial energy storage facility is not defined in detail for the Mátra power plant, but the concept of hydrogen-based energy storage is one of the possible elements. Given that renewable electricity generation and natural gas-

[39] National Energy and Climate Plans were made mandatory by Regulation (EC) No 2018/1999 for all EU Member States.
[40] https://www.enhat.mekh.hu/s/magyarorszag_nemzeti_energia_es_klimaterve.zip

based electricity generation will be present on the site of the power plant, and RDF waste recovery.

The energy recovery of waste can be linked to two types of recovery: firstly, the recovery can be by incineration and the heat for the incineration can be provided by hydrogen, and secondly, the waste heat from the incineration can be recovered by SOEL-type electrolysers or can be used by SOFC-type fuel cells.

One of Hungary's largest investments is the Paks2 project, which will be a key element in improving the share of decarbonised electricity generation in Hungary by building two new 1200 MW nuclear power plant units. Nuclear energy is currently the subject of a number of social, environmental and political debates, including within the European Union. Another important issue for Paks2 is the use of electricity generated during valley periods (e.g. at night), one of the proposals being the production of hydrogen during these periods.

In terms of renewable energy, Hungary aims to achieve a renewable energy share of at least 21% of gross final energy consumption by 2030, the details of which are summarised in the following table.

5. Table: Comparison of the estimated timetable for the share of renewable energy in gross final energy consumption by sector and actual data for 2019

(%)	2019 - fact	2020 – plan	2030
RES – H&C	18,12	18,2	28,7
RES – E	9,99	10,8	21,3
RES – T	8,03	6,6	16,9
RES in gross final energy consumption	12,61	13,2	21

Source: NEKT and MEKH statistics, own editing

In terms of renewable energy for heating and cooling, biomass, heat pumps[41] and the implementation of the Green Heat Programme are planned to be the most important measures.

The renewable share target for the transport segment is to be achieved by increasing the share of biofuels and the share of electricity for transport. Hydrogen is not included at this point, however, hydrogen for transport could become significant after 2030[42].

The objective is to increase the share of renewable energy sources in gross final electricity consumption, including the expansion of solar PV capacity, and to maintain the current capacity of wind power (around 330 MW).

The NEKT includes hydrogen in the same quantity and quality as the new National Energy Strategy. Its importance has been stressed by the authors, but there is little specificity at this point, as at the time of publication of the two documents there was no National Hydrogen Strategy and White Paper, the publication of which has brought a marked change in policy making.

2.5.3 NATIONAL CLEAN DEVELOPMENT STRATEGY

In Act XLIV of 2020, the National Assembly set out its intentions towards achieving climate neutrality by 2050, and one of the strategic documents of this Act is the National Clean Development Strategy (NTFS)[43], which outlines the socio-economic and technological development path for the next 30 years.

The Strategy has developed three scenarios through modelling, which are:

1. Hands on Lap (ÖTK) scenario, commonly referred to as BAU or Business-as-Usual in international models.

[41] Napelem Főoldal (gov.hu)
[42] Anthony Wang, Jaro Jens, et al. (2021): Analysing future demand, supply, and transport of hydrogen. European Hydrogen Backbone
[43] 54e01bf45e08607b21906196f75d836de9d6cc47.pdf (kormany.hu)

2. The Deferred Action (HCs) decarbonisation scenario envisages a slower pace of emission reductions in the energy sector. This scenario will essentially achieve carbon neutrality in our country by pursuing cost efficiency.
3. The Early Action (KCs) decarbonisation scenario aims to achieve a carbon neutral Hungary by 2050 by focusing on the economic opportunities of early action. This scenario is based on the model's higher higher productivity and faster GDP growth.

Both the HCs and KCs scenarios assume that CCS and CCUS technologies will be competitive after 2030. Both technologies could play an important role in the production of blue hydrogen, while reducing carbon emissions from industrial processes, but by that time green hydrogen production could also be more competitive. From this assumption the question is to what extent CCS and CCUS and CCUS technologies.

Both net-zero emissions scenarios in the Strategy assign a more important role to hydrogen in both 2040 and 2050 than the two previously considered documents. In the NTFS KCs scenario, hydrogen will contribute 11% of final energy use in 2050, while in the HCs scenario it will contribute 15%, which globally ambitious globally[44] and below average at European level[45].

The document identifies the eight most important technological development directions, one of which is specifically related to hydrogen, and three others that are to some extent related to hydrogen or P2G hubs.

- Electrification in all sectors of the economy, with nuclear and renewable energy as the domestic resource base. Electrification can indirectly facilitate the spread of hydrogen technologies, play an important role in grid network regulation. This role can be important in balancing valley season production, which also makes longer term energy storage possible for solar energy.

[44] The IEA has estimated the global share of hydrogen in total final energy use at 10% in Hydrogen Review 2021.
[45] The EHB study estimated the role of hydrogen in total final energy use at 20-25%.

- The use of carbon capture, utilisation and storage (CCUS) technology in the power generation sector and for industrial installations with high emissions. CCUS technology offers the potential for the production of low carbon 'blue' hydrogen, for which there is still significant demand in the short to medium term.
- Hydrogen use and the deployment of related hydrogen technologies.
- R&D and innovation and appropriate training programmes

2.5.4 NATIONAL HYDROGEN STRATEGY

"Hungary's National Hydrogen Strategy is ambitious, but realistic vision, paves the way for the development of the hydrogen economy, contributing to the achievement of decarbonisation targets and creating the opportunity Hungary to become an active player in the European hydrogen space." - Hungary's National Hydrogen Strategy, p. 3, May 2021

This is the opening paragraph of our National Hydrogen Strategy[46], which is basically a very concise summary message of the strategy. The Strategy was presented together with the accompanying industry White Paper on 4 June 2021, when the Strategy became publicly available, while the latter document is only available to members of the Hungarian Hydrogen and Fuel Cell Association.

The National Hydrogen Strategy identifies four priority objectives, similar to the Czech strategy, but also identifies three additional so-called "supporting" objectives. The strategy sets specific targets up to 2030, and then sets out further ideas for 2040 and 2050.

Priority objectives up to 2030:

Large-scale low-carbon and decentralised decarbonised hydrogen production

[46] Magyarország Kormánya - Magyarország Nemzeti Hidrogénstratégiája (kormany.hu)

A concrete quantifiable target of 36,000 t/year of "green", other carbon-free and low-carbon hydrogen production in 2030 is set, including 20,000 t/year of low-carbon hydrogen, 16,000 t/year of "green" and other carbon-free hydrogen, and associated 240 MW[47] of electrolysis capacity. For comparison, the Czech Republic has a main target of 101,000 t/y of hydrogen production by 2030. In this area, the Hungarian strategy identifies several priority actions, on the one hand, large-scale local industrial demand should be met by centralised production, while small and medium-scale transport and energy demand should be met by decentralised decarbonised production. Participation in the creation of a European system of Guarantees of Origin (GO) is also included in the Hungarian strategy, which was prepared by an international project called HyLaw[48], which was the legal environment of the Member States participating in the project and was part of the task of developing a GO system.

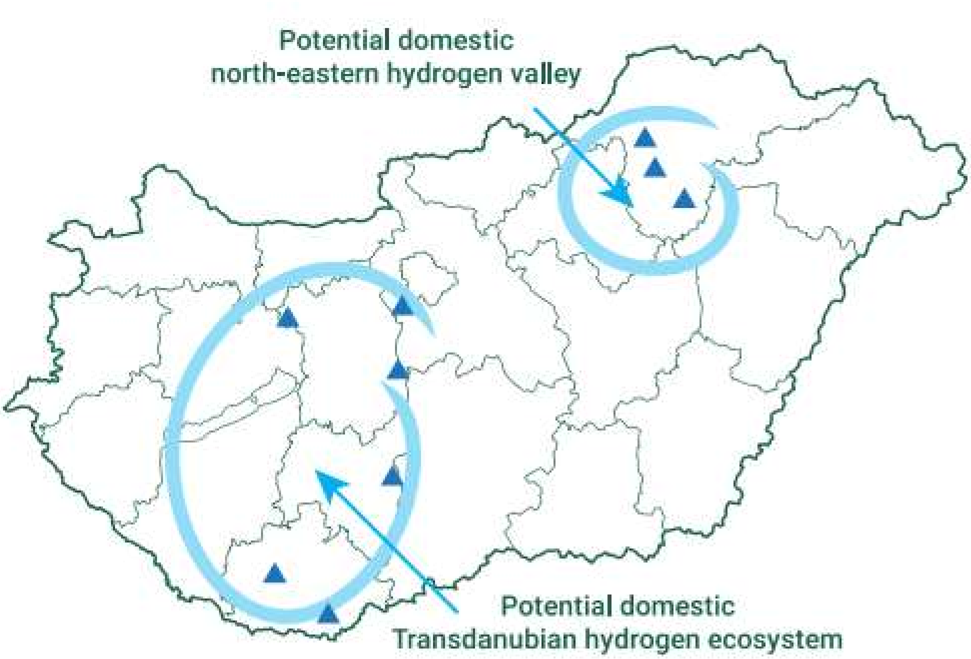
Decarbonisation of industrial use partly with hydrogen

In the field of industrial use, the aim is to achieve a "green", other carbon-free and low-carbon hydrogen use of 24,000 t/year by 2030, which would avoid 95,000 tonnes of CO_2 emissions per year; in 2017, according to the Hungarian Central Statistical Office, our annual CO_2 emissions were 64,830.5 thousand tonnes[49]. This amount of hydrogen is the planned 14.81% of the 162,000 t/year hydrogen consumption projected for 2030. Full industrial decarbonisation could be achieved by 2050.

The strategy identifies two focus regions in Hungary where the development of the hydrogen ecosystem will take place.

[47] Currently, there is nearly 300 MW of global installed electrolysis capacity, 40% of which is located in Europe (https://www.iea.org/reports/hydrogen)
[48] https://www.hylaw.eu/
[49] https://www.ksh.hu/docs/hun/xftp/idoszaki/jelipar/2019/index.html

5. Figure: Potential hydrogen valleys in Hungary



Source: National Hydrogen Strategy, 2021

The first one is the Transdanubian hydrogen ecosystem: there is currently a high capacity of ammonia production in Pétfürdő (currently Nitrogénművek Zrt.) and a refinery industry in Százhalombatta (currently MOL Nyrt.), where already a large amount of hydrogen is consumed. Other potential new users are the Dunaújváros ironworks (currently ISD Dunaferr) and the cement industry in Beremend (currently Duna-Dráva Cement Kft.) and Királyegyháza (currently LAFARGE Cement Magyarország Kft.). A use, the Paks nuclear power plant produces a significant amount of carbon-free electricity for the production of carbon-free hydrogen.

The North-Eastern Hydrogen Valley is composed of Miskolc, Tiszaújváros (currently MOL Petrochemicals Zrt.) and Kazincbarcika (currently Linde Gas Hungary Zrt. and Borsod Chem Zrt.) with strong chemical and petrochemical industries, significant existing hydrogen use, and the Mátra Power Plant area is being investigated as an additional area to be included[50] in this region. It is important to note that the role of hydrogen valleys is also reflected in the EU Hydrogen Strategy with similar features, and, in addition, the use of hydrogen valleys in remote areas or islands that are difficult to access. decentralised energy production.

Greening of transport

The transport sector could reach 10,000 t/year of hydrogen consumption by 2030 and 212,000 t/year by 2050. The main focus will be on heavy duty vehicles (trucks, waste collection vehicles, city buses). The deployment of a hydrogen refuelling network along TEN-T corridors could be a priority, and the general Block Exemption Regulation[51].

Supporting electricity and (natural) gas infrastructure

Hungary's geographical conditions do not allow for the construction of pumped storage, so hydrogen could be part of the solution to this problem when considering other means of seasonal energy storage. The strategy foresees the creation of at least 60 MW of average storage capacity by 2030.

For natural gas infrastructure, the possibility of blending hydrogen into existing internationally well-developed interconnections with six neighbouring countries. with neighbouring countries. A further objective is to connect to the European Hydrogen European Hydrogen Gas Pipeline.

Exploiting industrial and economic development opportunities

In the short term, the aim is to produce "blue" hydrogen, then to build international cooperation in electrolysis production (under license) and to support the domestic SME sector to become a supplier in the hydrogen economy by strengthening the SME sector.

Horizontal conditionality: creating a supportive operating environment

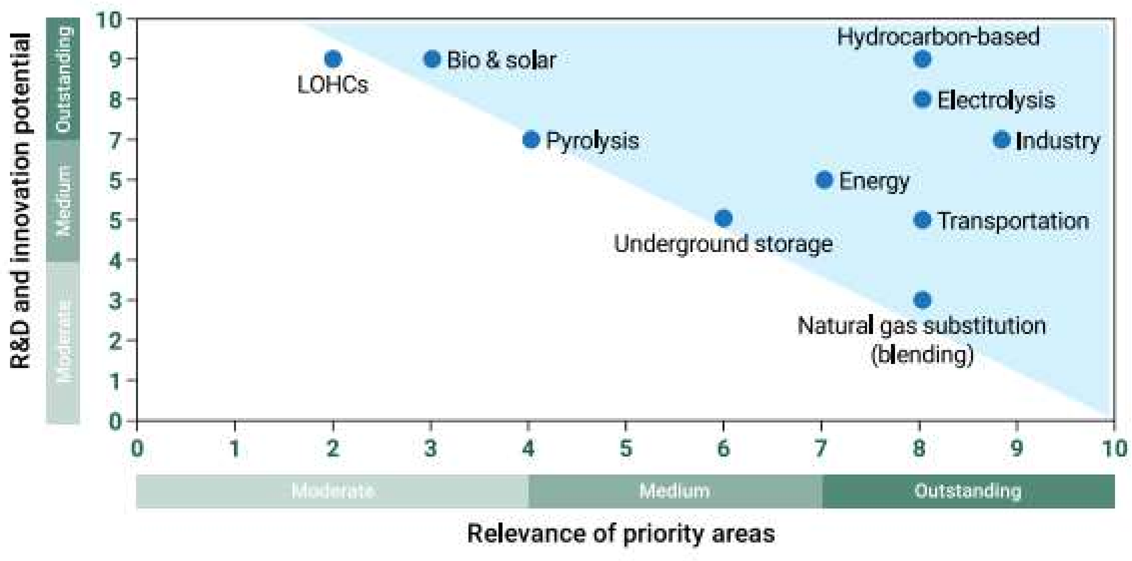
[50] FuelCellsWorks (2021): 8 Billion Euro Greek Hydrogen Plan „White Dragon" Set for Take Off
[51] Commission Regulation (EU) No 651/2014

A key objective is to create a supportive regulatory environment along the entire hydrogen value chain, one of the tools for which is to actively participate in the EU legislative process, representing national interests. At the same time, international cooperation will be strengthened, one of the tools being the establishment of IPCEI (Important Projects of Common European Interest). IPCEI is a special funding authorisation designed to provide a funding framework for projects of strategic European interest[52] in which the public authorities can State aid is allowed.

RDI and education to support hydrogen's success in the transition

Closely linked to the previous point, the domestic potential of Research, Development and Innovation potentials in the domestic economy and to exploit them to the full.

6. Figure: Priority areas based on domestic RDI relevance and potential



Source: National Hydrogen Strategy, 2021

Education and training of professionals and further training and appropriate information for the general public are priorities in this area.

[52] IPCEI certified industries and technologies: microelectronics, battery, hydrogen, industrial cloud

The Strategy mentions the establishment of a National Laboratory for Hydrogen Technology as part of the National Renewable Energy Laboratory, but the National Renewable Energy Laboratory is not yet included in the official list of National Laboratories announced by the National Research, Development and Innovation Office (NRDIO). The establishment of the laboratory could be an important element in exploiting the RDI opportunities in hydrogen technologies, and at EU level, a larger institutional player could open up different opportunities for Hungary than if different universities or smaller laboratories were to work on their own projects separately. It can also strengthen national representation in the European Clean Hydrogen Alliance.

The funding planned to implement the Strategy:

1. Green Truck Programme (35-40 billion HUF)
2. Green Bus Programme Plus (10-20 billion HUF)
3. Development of Hydrogen Valleys in Hungary (10-15 billion HUF)
4. Hydrogen Highway Project (20-30 billion HUF)
5. Blue hydrogen project (20 billion HUF)
6. Research & Development and Innovation (10 billion HUF)

The total funding needs of the projects announced so far amount to HUF 145 billion. The Strategy recognises that, as a result of innovation activities, the sector the document will be reviewed as early as 2025.

3. SUMMARY

(to be filled by PP4)