ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ
ECONOMIC STUDIES

Volume 33(8), 2024

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HUNGARIAN GAS MARKET TRENDS IN A RISKY AND UNPREDICTABLE ENVIRONMENT: A COMPARISON OF THE SITUATION BEFORE AND AFTER RUSSIA'S 2022 INVASION OF UKRAINE[2]

Russia's invasion of Ukraine in February 2022 has had a profound impact on the European and thus Hungarian natural gas market, though substantial changes had begun to occur in Europe from 2021, as evidenced by the wholesale price surges for natural gas that year. This paper examines (1) the demand- and supply-side developments in the Hungarian natural gas market before and after the outbreak of Russia's war on Ukraine; (2) how the Hungarian government has intervened in the natural gas sector from February 2022 onwards; and (3) how these measures fit in with pre-war Hungarian energy strategy documents and the energy policies carried out. Secondary analysis of related statistics is combined with documentary analysis of relevant materials. We find that Hungary did not believe it could wean itself off Russian gas, and thus enhanced cooperation with Russia and bought even more Russian gas. There have been only small steps towards gas import source diversification, and quite late, with priority given to affordability. Demand-side measures, prompted by supply and financial constraints, proved to be relatively successful.
Keywords: energy crisis; natural gas demand and supply; Hungary; Russia-Ukraine war
JEL: L71; L95; O13; P28; Q41

1. Introduction

Gas is versatile in use and is widespread in Hungary. It is the largest energy source in total and final energy consumption and holds a predominant share in derived heat generation and residential final energy consumption (in both space heating and cooking) in addition to being the number two fuel for electricity (Eurostat, 2023a, 2003d; MEKH, 2022, 2023a, 2023b). Prior to 2022, Hungary's gas market was around 10 billion cubic metres per annum (bcma), with the residential sector being the main consumer at 3.4-4.0 bcma, making up a larger share than the transformation sector. To meet the country's gas needs, Hungary relies on domestic gas production of only around 1.5 bcma, which it is trying to increase (MEKH, 2023c, 2023f).

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[2] *This article was supported by Széchenyi István University's Deák Ferenc Faculty of Law and Political Sciences, Győr, Hungary, as well as the National Research, Development and Innovation Office of Hungary under Grant No. FK-138317.*
This paper should be cited as: *Weiner, C. (2024). Hungarian Gas Market Trends in a Risky and Unpredictable Environment: A Comparison of the Situation before and after Russia's 2022 Invasion of Ukraine. – Economic Studies (Ikonomicheski Izsledvania), 33(8), pp. 167-189.*

The majority of gas imports come from Russia, mostly under long-term contracts, which have guaranteed the availability and relative affordability of supplies. Russian gas deliveries are mainly channelled through the Turkish–Bulgarian–Serbian–Hungarian Balkan Stream gas pipeline – an extension of the trans-Black Sea TurkStream between Russia and Turkey – which bypasses the former Ukrainian transit corridor of Russian gas to Hungary but maintains Hungary's import dependence. The supply of gas from domestic gas fields and from abroad is backed up by extensive underground gas storage facilities in depleted gas reservoirs, with a withdrawal capacity covering the daily peak gas demand (MEKH, FGSZ, 2023). The country has a well-developed gas transmission and distribution infrastructure. More than 90% of Hungarian settlements are supplied with piped gas, and almost three-quarters of all households use such gas (KSH, 2023b). By 2021, Hungary had developed a diversified cross-border gas network, allowing it to move away from reliance on Russian gas, but affordability issues prevented it from doing so. Although Hungary is a landlocked country with no possibility of building a liquefied natural gas (LNG) import facility, its central European geographic location gives it access to non-Russian alternatives, including regasified LNG from Croatia. Because of the dependence on Russian gas and the characteristics of the residential consumer market, gas has been a sensitive issue in Hungarian energy policy and Hungarian-Russian relations. Residential consumers have limited potential to switch to other fuels (REKK, 2023), as well as limited ability to reduce heating costs in a substantial and lasting manner through energy-efficiency investments. Low regulated prices encouraged high gas demand (Weiner, Szép, 2022), but allowing prices to rise would be politically sensitive.

In 2021-2022, issues with the security of gas supply emerged in the EU – concerns mounted first about prices (affordability) in 2021, but in 2022 even the availability of gas was sometimes called into question, following Russia's military invasion of Ukraine on 24 February 2022. Russian gas imports to the EU fell dramatically in 2022. Many refused to pay in roubles and stopped importing from Russia or Russia stopped exporting gas to them (IEA, 2023). The EU has taken a number of gas supply- and demand-side measures, which the Hungarian government has typically been opposed to.

This paper examines the gas market developments in Hungary in the pre-war and war periods. The war period contains information up to September 2023, the end of the 2022/2023 gas year. The reference year is 2021, although long-term pre-war trends are also presented. After the introduction, we first present these selected historical trends, which are necessary to understand the situation of the Hungarian gas market (Section 2). We then look at the situation and government plans immediately prior to the energy crisis, and at gas market developments and government interventions and plans in 2022 and 2023. Section 3 is dedicated to the supply side, and Section 4 to the demand side. We conclude with a summary and some conclusions in Section 5.

In this paper, a secondary analysis of related statistics is combined with a documentary analysis of relevant materials. Official statistics include those from Eurostat, the International Energy Agency (IEA), the Hungarian Central Statistical Office (KSH), the Hungarian Energy and Public Utility Regulatory Authority (MEKH), and FGSZ, the sole owner and operator of the Hungarian high-pressure gas pipeline network. We review national energy policy documents, gas-related EU materials, academic literature, and media sources. The main

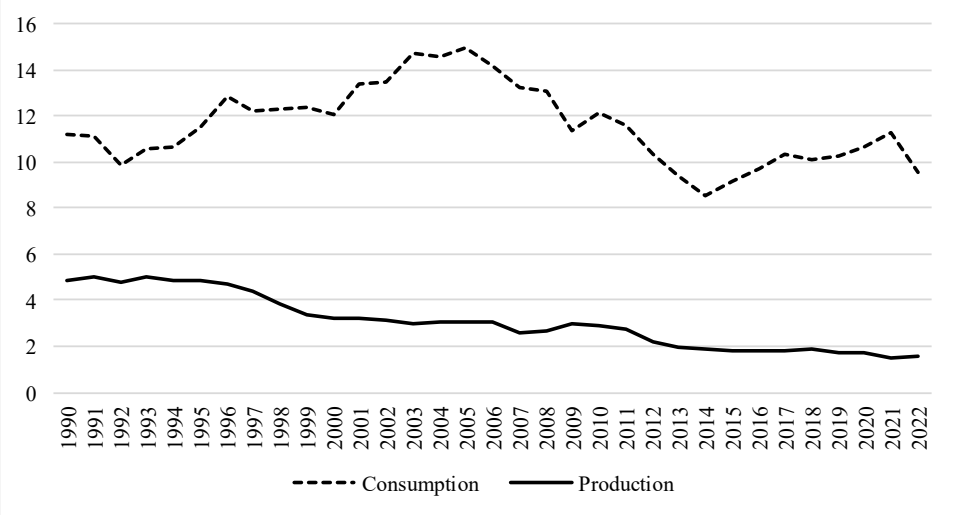
national energy policy documents are Hungary's 2020 National Energy Strategy (NES) and National Energy and Climate Plan (NECP), which are contrasted with the 2023 draft NECP. In this paper, we rely on scenarios that take into account additional measures ('with additional measures' or WAM scenarios) as opposed to 'with existing measures' or WEM scenarios.

2. Some historical aspects of the Hungarian gas market

High gas consumption and dependence on Russian gas have their roots in history. The Hungarian gas market started to develop in the 1960s on the basis of domestic production. Until the late 1980s, production accounted for more than half of consumption (IEA, 2010, 2019). Gas production peaked in 1985 at 7.5 bcm, or 74% of gas supply. Russian (Soviet) gas imports began in 1975 under the Orenburg Agreement, signed in 1974, followed by the Yamburg Agreement in 1985 (IEA, 2003). Over time, Russian gas imports became increasingly important in bridging the gap between gas production and consumption in Hungary. In the 1970s and 1980s, underground gas storage facilities were developed (MFGT, n.d.). After the 2006 Russian–Ukrainian gas crisis, Hungary set up strategic storage capacity alongside new commercial capacity in a new gas storage facility.

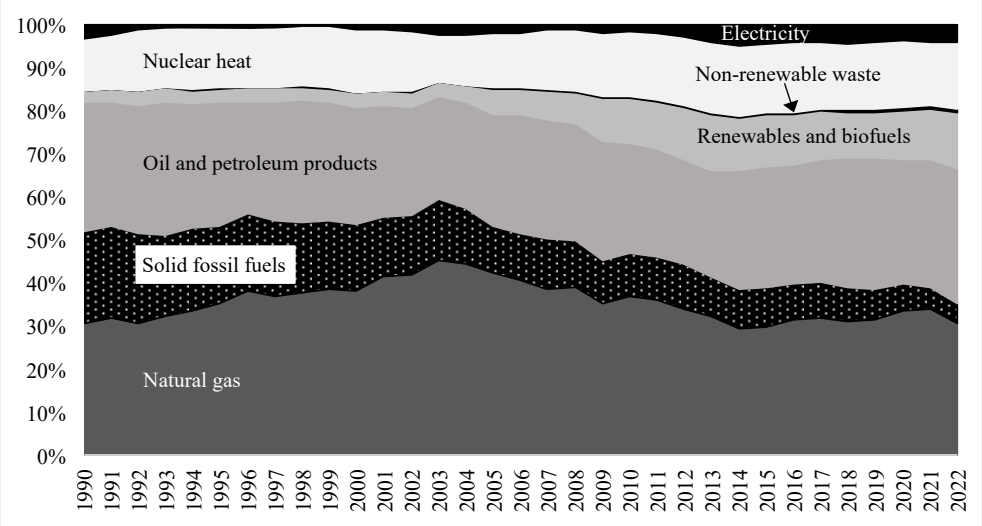
Hungarian gas consumption reached its peak in 2005 at 15 bcm, followed by a sharp decline to reach less than 9 bcm in 2014 (Figure 1) (Eurostat, 2023g). Between 2003 and 2005, Hungary had the largest share of natural gas in gross inland consumption in the EU, with a share of around 42-45%, while the share of gas in final energy consumption in Hungary was also above 40% between the mid-1990s and mid-2010s (Figure 2) (Eurostat, 2023a). Between 2015 and 2021, Hungarian gas consumption was again on an upward trend (Eurostat, 2023g).

Figure 1. Gas consumption and production in Hungary, 1990-2022 (bcm)



Source: Eurostat, 2023g.

Figure 2. Gross inland energy consumption in Hungary, by fuel, 1990-2022 (%)



Source: Eurostat, 2023a.

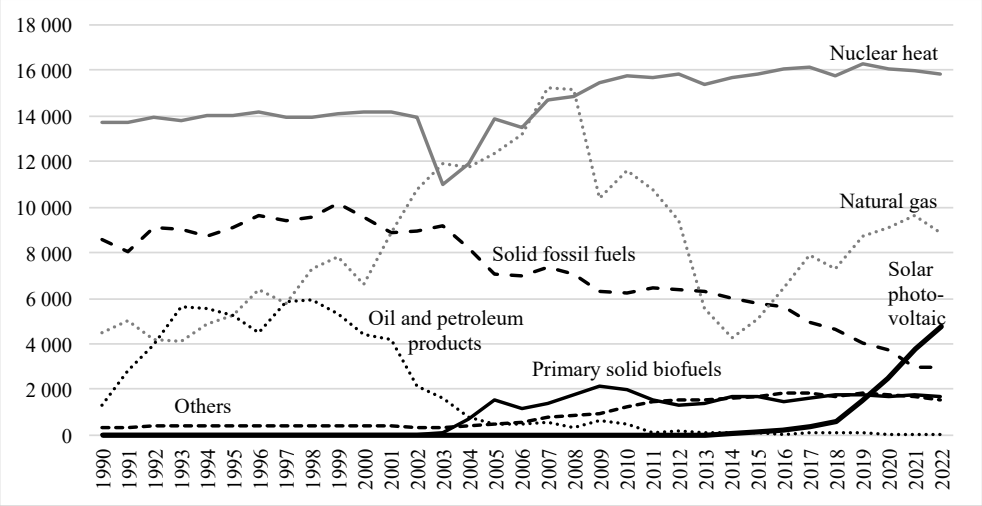
Subsidised domestic gas prices significantly contributed to the penetration of gas to households. Tile stoves and solid-fuel-burning and oil-fired boilers were being massively replaced by new gas-fired boilers in the 1990s. Such gas penetration was a positive phenomenon in terms of environmental sustainability, but it posed risks in terms of availability and affordability, the latter mainly because of the low purchasing power of the Hungarian population and because houses in Hungary were typically designed without proper insulation and heating systems. The politicisation of household gas prices is no coincidence.

The various advantages of the technology were also reflected in the preference for building gas-fired power plants between the 1990s and the early 2010s. In 2007 and 2008, gas accounted for the largest share of electricity generation in Hungary, peaking at 38.1% in 2007, slightly over nuclear. Subsequently, market developments did not favour gas-based generation. By 2014, it had fallen to less than a third of its 2007 level. Between 2015 and 2021, however, the trend was towards an increasing importance of gas (Figure 3). Gas is even more important for heat production. The share of gas rose from 49.9% in 1990 to 80.2% in 2005. Since the mid-2010s, it has remained slightly below 70% (Eurostat, 2023d).

Until the collapse of the communist regime in 1989, the Hungarian gas market was controlled by a single state-owned company (OKGT, the predecessor of the Hungarian oil and gas company Mol), with the exception of gas distribution and supply in Budapest (Főgáz) and Hungarian gas imports (Mineralimpex). Privatisation began in 1995. The major regional gas distribution companies were taken over by foreign investors (IEA, 2003). However, it was only in 2006 that Mol's gas wholesale and storage activities were sold to the German energy group E.ON. In the early 2010s, gas wholesale, retail, distribution, and storage were controlled or dominated by foreign multinationals (Weiner, Szép, 2023). In contrast, Mol

remained the dominant player in Hungarian gas production and, through its subsidiary (FGSZ), owns and operates the Hungarian high-pressure gas pipeline network.

Figure 3. Gross electricity production in Hungary, by fuel, 1990-2022 (GWh)



Source: Eurostat, 2023d.

The role of the state in the Hungarian gas sector increased significantly in the 2010s. This was mainly done through the state-owned energy group MVM. During this renationalisation campaign, however, both state assets and domestic private property also expanded, the latter referring to owners with close and intensive coordination with the government (Weiner, Szép, 2022). Today, MVM owns the 'old' commercial storage facilities with four sites (Hungarian Natural Gas Storage – MFGT); has an important role in distribution (MVM Égáz-Dégáz Natural Gas Network, MVM Főgáz Natural Gas Network); MVM Next Energy Trading is the sole universal gas supplier;[3] and MVM CEEnergy (formerly Hungarian Natural Gas Trade – MFGK), which signed the long-term Russian gas supply contract in 2021, is the largest gas trader in Hungary. For a while, all gas storage facilities in Hungary were state-controlled, but in 2019 the state sold its controlling stake in the newer facility mentioned above, which includes both strategic and commercial storage capacity, to the Hungarian Hydrocarbon Stockpiling Association (this storage company is now called HEXUM).

[3] In 2021, 4.0 bcm of gas were used by households (MEKH, 2023c), which were almost exclusively supplied from the regulated segment of the retail gas market, called the universal service since 2009. In the few years before 2022, a couple of hundred million cubic metres (mmcm) of gas per year (mmcma) were purchased by selected eligible small non-residential consumers in the universal service, in addition to the 3.4-4.0 bcma of gas that residential customers bought at regulated prices (MEKH, FGSZ, 2023; MEKH, 2023d). Since 2017, there has been only one universal gas service provider, because other players withdrew from this market due to unfavourable price regulation. In 2022, MVM became the sole universal electricity supplier.

Until the Austrian–Hungarian gas interconnector became operational in 1996, Hungary could only import gas via Ukraine. That year, a new long-term gas supply contract was signed with Russia, which was due to expire in 2015. However, the need for Russian gas imports was overestimated, partly because gas consumption in Hungary turned out to be lower than expected and partly because of cheaper gas imports from Western Europe which became available in large quantities from the late 2000s onwards. Therefore, Hungary did not take a significant amount of Russian-contracted gas until 2015, and the parties agreed that unused gas would be available in the following years (Weiner, 2016, 2019). In this context, two contracts were said to be effective until 2019 and two until 2021 (Gazprom, 2016). In addition to these contracts, further amounts were also purchased by Hungarian Natural Gas Trade on Gazprom Export's Electronic Sales Platform and under short-term bilateral contracts with Gazprom Export (anonymous personal information from MVM, 17 February 2021).

In the 1990s and most of the 2000s, Hungary had limited cross-border infrastructure capacity, EU gas market integration and liberalisation processes were at an earlier stage of development, and therefore Hungary's diversification options were limited. In the absence of the necessary infrastructural capacities, diversification was only possible on the Ukrainian and Austrian pipelines until the late 2000s, and Hungary took advantage of these opportunities. Non-Russian gas supplies were initiated in the 1990s. These supplies included those from Germany's Ruhrgas (later E.ON Ruhrgas, then E.ON Global Commodities, and now Uniper Global Commodities) and from the French Gaz de France (later GDF Suez, now Engie) through the Austrian–Hungarian gas interconnection on the one hand, and those from Ukraine and then from Central Asia through Ukraine on the other. While Eastern diversification strengthened affordability, gas under Western contracts mitigated availability risks, but was more expensive than Russian gas and therefore unfavourable from an affordability perspective. Until the changes in the European gas market in the late 2000s, it was inconceivable that Western gas could be imported into Hungary more cheaply than Russian gas. The Western geographical diversification of gas import sources was contractual rather than physical; gas from Germany and France was not physically delivered to Hungary via Austria. These were considered to be Russian gas molecules supplied by swaps of Russian gas *en route* to Germany and France (IEA, 2003; Weiner, 2016, 2019).

While import possibilities from directions other than Ukraine have increased significantly since the late 2000s due to improvements in the gas market and infrastructure development, diversification possibilities from the Eastern direction[4] have become more limited than before (Weiner, 2016, 2019). By 2021, with the exception of Slovenia, gas interconnections had been established with all neighbouring countries – the Romanian pipeline was opened in 2010, the Croatian in 2011, the Slovakian in 2015, and the Serbian in 2021. The capacity of the Austrian interconnector was also expanded. The old link with Serbia was dedicated only to the transit of Russian gas in the direction of Serbia and Bosnia and Herzegovina. However, in 2021, these transit flows were redirected to Balkan Stream.[5]

[4] These included Russian-involved geographical and non-geographical diversification options.

[5] Until 2022, Russian piped gas entered the EU via four main gas corridors: the Ukrainian gas pipeline system since Soviet times; Yamal-Europe from 1999 to 2022; Nord Stream from 2011 to 2022; and Balkan Stream since 2020. Completed in September 2021, Nord Stream 2 was not put into operation.

The EU's Second Gas Package was implemented right after Hungary's 2004 accession. The Third Gas Package, adopted in 2009, further liberalised the gas markets. The EU developed a security of supply framework and provided dedicated EU funds for infrastructure projects. However, the Fourth Gas Package published in December 2021, the Hydrogen and Gas Market Decarbonisation Package, focuses on sustainability, proposing rules for the replacement of fossil gas with renewable and low-carbon gases, like hydrogen, and addressing methane emissions. In February 2022, the European Commission adopted a Complementary Climate Delegated Act that labels specific gas and nuclear activities under certain conditions as environmentally sustainable but will make the implementation of new natural gas projects increasingly difficult. On the way to its 2050 carbon-neutrality target, the EU aims to reduce net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels, which would require a reduction in gas consumption.

In 2022, renewable energy accounted for only 15.1% of gross final energy consumption in Hungary, compared to 23.0% in the EU. The 2022 level in Hungary is lower than in 2013 (Eurostat, 2023e). Biomass is the most important renewable energy source (MEKH, 2023h), but solar power generation has exploded since the late 2010s, which allowed it to be the leading renewable power source in 2020, and reach a share of 13.2% in 2022 (MEKH, 2023a). Nuclear power is expected to remain a key factor in Hungary's low-carbon electricity supply. The greater role of other renewables is only partly constrained by natural limitations; policy decisions also play an important role, as in the case of wind energy (Weiner, 2019, 2021).

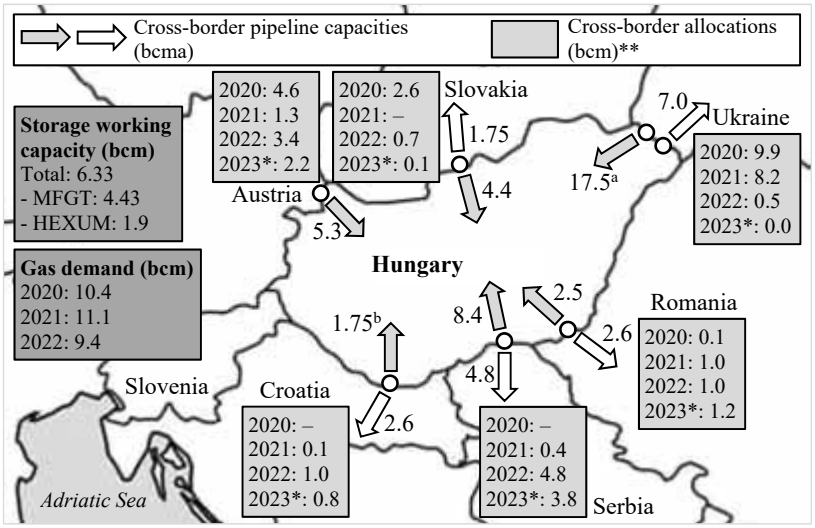
3. Gas supply in Hungary before and since 2022

Domestic gas production contributes only a small share to Hungary's gas supply but provides some insulation from gas market shocks, as a portion (gas from hydrocarbon fields in production before 1998) is purchased by the universal service provider at low, regulated prices (67/2016. (XII. 29.) NFM rendelet). Notwithstanding the prominent role of gas and the higher gas demand, and despite tenders for concessions since 2013 and optimistic government projections, domestic gas production was again on a decline between 2019 and 2021, after a few years of growth (Eurostat, 2023g; MEKH, 2023c). With decreasing gas production and increasing gas demand, the production-to-consumption ratio fell to 12.7% in 2021 (MEKH, 2023a), while the NES, prepared at a time of increasing gas production, expected this ratio to rise from below 20% to close to 30% by 2030 and above 30% by 2040, mainly due to declining gas consumption. The NES believed that by 2030, conventional gas production might continue to grow, reaching 2.4 bcm but declining to 1.6 bcm by 2040. However, no significant production of unconventional and biogas was assumed: only 35 mmcm of unconventional gas and 85 mmcm of biogas by 2030, and 270 mmcm of unconventional gas and 100 mmcm of biogas by 2040 (ITM, 2020a, 2020c, 2020d).

Russian gas reached Bulgaria through Balkan Stream in 2020, then Serbia, Bosnia-Herzegovina, and Hungary in 2021.

The other two elements of the supply side – imports and storage – involve both the construction of the appropriate infrastructure and the conclusion of the necessary supply and capacity contracts. As a result of cross-border pipeline developments, a total of 132.1 mmcm of gas per day (mmcmd)[6] can now be imported into Hungary, while peak daily consumption stood at 63.3 mmcm in 2021 (Figure 4) (MEKH, FGSZ, 2023).

Figure 4. Cross-border gas pipeline capacities and allocations, gas storage capacities, and gas demand in Hungary (bcm and bcma)



** January–September 2023. ** The cross-border allocations also include transit and exports in addition to the quantities allocated for domestic purposes. [a] Of the 26.0 bcma (71.3 mmcmd) of entry capacity, 17.5 bcma (48.0 mmcmd) is non-interruptible and 8.5 bcma (23.3 mmcmd) is interruptible. This figure also includes gas transit to Serbia and Bosnia and Herzegovina, which ended in 2021 with the opening of Balkan Stream. [b] The Hungarian side is able to receive and send 7.0 bcma (19.2 mmcmd) of gas from and to Croatia but the capacities are limited due to shortcomings in the Croatian system. Accordingly, in addition to the 1.75 bcma (4.8 mmcmd) of non-interruptible capacity, 5.3 bcma (14.4 mmcmd) of interruptible capacity is also available towards Hungary. Note: figures are at 15°C. Source: MEKH, 2023c; MEKH, FGSZ, 2023; Szokodi, 2023 (Blank map: http://www.freeworldmaps.net/europe/europe-blank-map-hd.jpg).*

The annual working gas capacity – i.e., the total volume of gas that can be injected into and withdrawn from storage – of the old commercial gas storage facilities is 4.43 bcm, which corresponds roughly to the annual gas volume needed for the universal service. The 'new' storage facility has an annual working gas capacity of 1.9 bcm. Of this, 1.2 bcm was originally intended for strategic gas stocks with a daily withdrawal capacity of 20 mmcm. This gives a total working gas capacity of 6.33 bcma, compared to Hungary's annual gas demand of around 10 bcm. The total daily withdrawal capacity amounts to 74.8 mmcm,

[6] More precisely, Hungary is capable of receiving a total of 146.5 mmcmd of gas but the pipeline capacities are limited to 132.1 mmcmd due to shortcomings in the Croatian system (Table 1).

which exceeds the daily peak demand of 60-70 mmcm reported in recent years (Table 1) (MEKH, FGSZ, 2023). The size of the strategic gas stocks has changed several times since its creation, in line with government decisions, and a portion of cushion (or base) gas – which is permanently stored in storage to maintain sufficient pressure – from the old commercial storage facilities has sometimes been sold or lent when cheaper gas was needed. Some such cases occurred sometime around the turn of 2021 and 2022, when the surge in European wholesale gas prices prompted the government to sell 550 mmcm of strategic gas stocks and lend 100 mmcm of cushion gas to support the universal gas supplier, with the stipulation that both quantities must be replenished in 2022 (695/2021. (XII. 13.) Korm. rendelet; 59/2021. (XII. 15.) ITM rendelet).

Table 1. Capacities to satisfy domestic gas demand in Hungary (mmcmd)

Capacities	Non-interruptible	Interruptible
Cross-border pipeline capacities	108.8	37.7
Ukraine	48.0	23.3[a]
Non-Ukraine	60.8	14.4
Austria	14.4	–
Slovakia	12.0	–
Romania	6.7	–
Croatia	4.8	14.4[b]
Serbia	22.9	–
Domestic production	4.4	–
Storage withdrawal	68.3	6.5
commercial	48.3	6.5
strategic	20.0	–
Domestic demand		
Peak day in 2021	63.3	
Peak day in 2022	61.8	
Peak day so far: 2005	89.7	

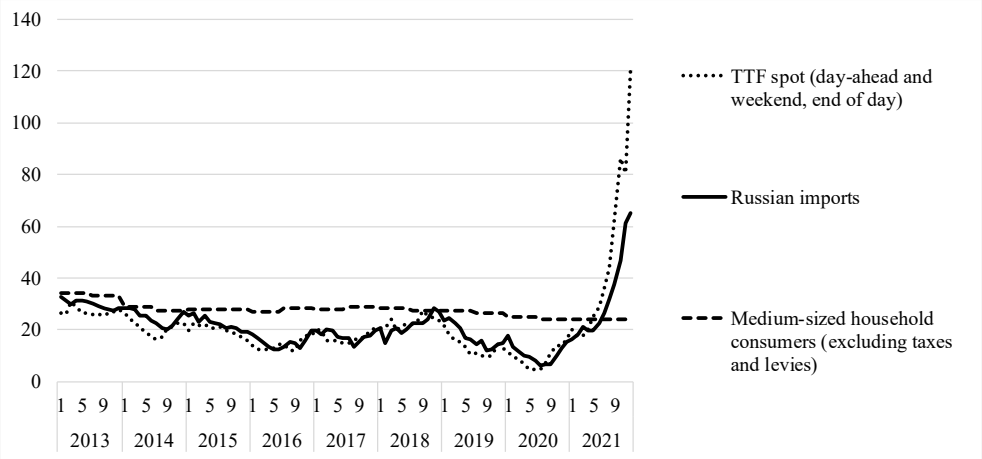
[a] See Note (a) below Figure 4. [b] See Note (b) below Figure 4. Note: figures are at 15°C. Source: MEKH, FGSZ, 2023; Szokodi, 2023.

The year 2021 saw a number of significant changes in Hungary's gas imports: signing a new long-term supply contract, launching the trans-Balkan gas transit route, regasified LNG entering Hungary via Croatia, and spiking wholesale gas prices. The new Russian gas supply contract, which covers the period October 2021 to September 2036,[7] is for 4.5 bcma,[8] not much more than the gas demand of the universal service. The majority of this volume, 3.5 bcma of gas, enters Hungary from the new Southern transit direction with the delivery point of the Serbian–Hungarian border, with the remaining 1 bcma being delivered through the Austrian border crossing. This means that the largest gas import infrastructure, the Ukrainian–Hungarian import pipeline, has been cut out of Russian gas imports, while Russian-contracted gas was partly transiting through Austria even before October 2021.

[7] The contract is for ten plus five years. After ten years, the contract quantity to be delivered can be modified or the contract may be even terminated.
[8] The various NES scenarios included only 3 bcma of Russian gas (ITM, 2020d).

In 2020, the Croatian units of Hungarian-related firms – MVM's MFGK Croatia (MVM CEEnergy Croatia since September 2021) and MET's MET Croatia[9] – booked a significant part of the regasification capacity of the Croatian LNG facility, a floating storage and regasification unit (FSRU), for the first seven years of its operation,[10] and the first Hungarian-bound long-term LNG supply contract was also signed. MFGK Croatia agreed with Shell to buy 250 mmcma of LNG between 2021 and 2027 (Ministry of Foreign Affairs and Trade, 2020). The key question for the Hungarian side regarding Croatian LNG imports has been the price of LNG, which was favourable during that period. Figures 5 and 6 show the evolution of TTF spot gas prices compared to gas import prices from Russia to Hungary and Hungarian residential gas prices.

Figure 5. Gas import prices from Russia to Hungary, TTF spot gas prices, and Hungarian residential gas prices, 2013–2021 (EUR/MWh)



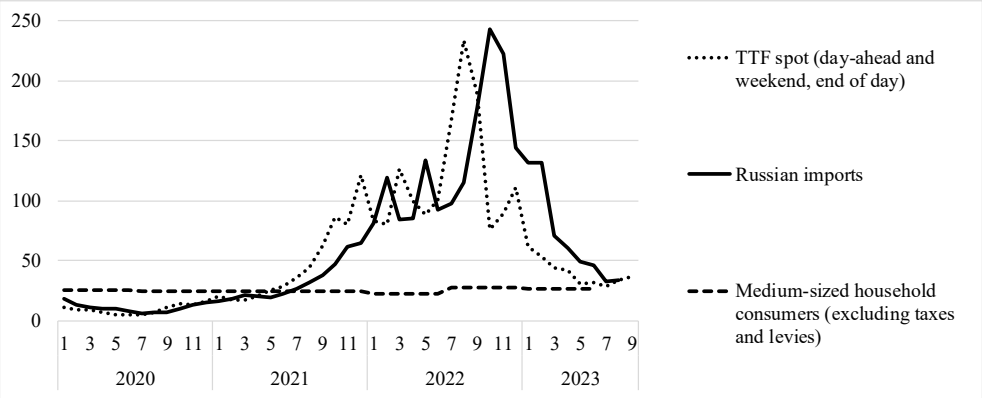
Source: EEX, 2023; Eurostat, 2023b; REKK (Péter Kotek's compilation).

In July 2022, Hungary declared a state of energy emergency. The government announced a seven-point action plan, later followed by other measures. Three of the seven were related to the supply side of the Hungarian gas balance (1335/2022. (VII. 15.) Korm. határozat). One was the target of increasing gas production from 1.5 bcma to 2 bcma, but additional output cannot be obtained from producing fields (in fact, efforts are being made to slow the decline in production, B. Horváth, 2022), while new projects need time to achieve success and are surrounded by uncertainties. However, the government can improve the regulatory environment and participate directly in projects. The hoped-for source of production increases is the so-called Corvinus project, in which MVM has acquired a 50% stake and which has been declared an investment of overriding public interest and an issue of major

[9] The Swiss-registered MET International is a Hungarian-controlled group.
[10] MFGK Croatia booked a total of 6.8 bcm of capacity for seven years and MET Croatia a total of 1.3 bcm for three years (Pavlova, 2020). The regasification capacity of the FSRU was initially 2.6 bcma, but was increased to 2.9 bcma.

national economic importance. The unconventional project aims to produce 500 mmcma of gas, with production having started in February 2023. In the end, Hungarian gas production stagnated in 2022 (MEKH, 2023c). The 2023 draft NECP is more conservative than the 2020 NES, with the optimistic case assuming 1.8-2 bcm of gas production in 2030 from conventional and unconventional sources combined (EM, 2023a).

Figure 6. Gas import prices from Russia to Hungary, TTF spot gas prices, and Hungarian residential gas prices, 2020-2023 (EUR/MWh)



Note: In the figure, TTF spot prices are shown, but gas import prices from Russia to Hungary appear to follow the front-month futures prices with a two-month lag. A source suggests that Russian long-term contract prices are also aligned with the front-month futures prices at the Austrian VTP in addition to those of the TTF (Weinhardt, 2023b). Source: EEX, 2023; Eurostat, 2023b; REKK (Péter Kotek's compilation).

The other two measures of the seven-point action plan included additional gas imports to be contracted and the necessary gas stocks to be stored. In 2022, gas volumes which were used to help the universal gas service provider had to be partially replenished to storage: all of the 100 mmcm of gas lent from commercial storage and 300 mmcm of the 550 mmcm sold from the strategic gas stocks were subject to such an obligation (695/2021. (XII. 13.) Korm. rendelet; 59/2021. (XII. 15.) ITM rendelet). On top of the strategic stocks, which increased to 1.2 bcm by the end of 2022, the so-called special gas stocks with 739 mmcm of gas were created from the end of summer 2022. The purchase of these additional volumes required the active diplomatic involvement of the Hungarian Foreign Minister, while shortly before Russia's February 2022 invasion of Ukraine, the Hungarian Prime Minister asked to contract an additional 1 bcma of gas on top of the existing 4.5 bcma (Budapest Business Journal, 2022). Hungary purchased these extra gas volumes from Russia during the time of the highest wholesale gas prices in Europe,[11] and the relevant Hungarian regulation prohibits selling it for less than the purchase price, while the loan that was used for the purchase will have to be repaid (Weinhardt, 2023a).

[11] This amounts to a total of 1.94 bcm, while the universal gas service provider had the mandatory stockpiling obligation of 1.87 bcm in the 2022/2023 gas year (Horváth, 2022; Weinhardt, 2023a).

Hungarian gas storage reached high levels in the winter of 2022/2023. They were 86.0% full, with 5.44 bcm of gas stored in mid-November 2022 (compared to 4.56 bcm as of mid-November 2021), while the EU's minimum gas storage rules required Hungary to have only 3.65 bcm of gas in storage by 1 November 2022. Even at the end of March 2023, the level was still 45.2% (MEKH, 2023g). The storage facilities did not have to deal with a specific situation.[12]

In 2022, Hungarian gas consumption came to 9.4 bcm, which was covered by producing 1.5 bcm of gas and importing 7.9 bcm. Out of the amount imported, 5.8 bcm of gas came from Russia, according to Eurostat,[13] which means that the alternative sources amounted to 2.1 bcm (Szokodi, 2023). In 2022, 1 bcm of gas of LNG origin entered Hungary from Croatia. Eurostat data suggest that the average price of LNG imported into Croatia was EUR 132/MWh, as opposed to the average price of Russian gas to Hungary at EUR 139/MWh (or EUR 149 in line with the methodology of the Hungarian National Statistical Agency). The exact price of the regasified volumes imported into Hungary via Croatia is unknown, but when comparing Russian and Croatian prices, Croatian prices should be adjusted to also include the additional pipeline transportation fee from Croatia to Hungary.

Since Hungary has not sought the political goal of a complete phase-out of Russian gas imports, there has been nothing spectacular in gas import source diversification, but only small steps have been taken. Most of these are relatively recent, including MVM's supply contracts for symbolic quantities through Bulgaria and Romania, with the Azerbaijani state-owned oil and gas company SOCAR in June 2023 for a total of 100 mmcm to be supplied in 2023 and with the Turkish state-owned oil and gas company Botaş in August 2023 for 275 mmcm due in 2024. Everything else is only in the planning stages, such as future imports of 2 bcma of gas from Azerbaijan, Qatari LNG via Croatia, and deliveries from a Polish LNG terminal project in Gdańsk and Romania's Neptun Deep Black Sea gas project.

In April 2023, Bulgarian, Romanian, Hungarian, and Slovak gas transmission system operators signed a memorandum of understanding with Azerbaijan's SOCAR on the implementation of the Solidarity Ring project, envisaging the upgrade of transmission

[12] At the end of 2021 and 2022, small quantities were released from the strategic stocks to help certain gas consumers (Hungarian Hydrocarbon Stockpiling Association, n.d.).

[13] According to KSH, gas imports from Russia to Hungary totalled only 4.3 bcm. National statistical agencies may apply slightly different methods than Eurostat does (though providing data with Eurostat in line with the Community concept). One of these main differences is that Eurostat data include quasi-transit, i.e., goods imported from a non-EU country, cleared through customs, and immediately dispatched to another member state (the member state of final destination) as well as goods imported from another member state (the member state of actual export), cleared through customs, and immediately dispatched to a non-EU country. Simple transit is not included in imports and exports, neither by Eurostat nor by national statistics (Eurostat, n.d.). This is why price data for Russian imports into Hungary given by Eurostat differ from those of KSH (KSH, 2023c). We are not aware of any firms other than MVM importing Russian gas into Hungary since the outbreak of the war. Previously, two Russian-owned Hungarian-based firms, Centrex Hungary and WIEE Hungary, as well as the aforementioned MET, bought gas from Gazprom (Gazprom Export, 2020, 2021). The decision on voluntary liquidation of Centrex Hungary was taken in 2021, while WIEE Hungary was a 'victim' of European and Russian sanctions in 2022.

infrastructure to enable additional gas deliveries from Azerbaijan (Portfolio, 2023b). The Hungarian government expects to receive Qatari LNG via Croatia from 2027 (VG, 2023b). There are plans to increase the capacity of Croatia's Krk LNG terminal from the current 2.9 bcma to 6.1 bcma. Meanwhile, two floating storage and regasification units are planned in the Gdańsk Bay in Poland. The total capacity of the first has already been booked by the Poles, while MVM has stated its intention to secure capacity from the second (LNG Prime, 2023; VG, 2023a). Production from the Neptun Deep project in Romania could start in 2027 (OMV Petrom, 2023). The 2023 draft NECP envisages the construction of Hungary's only missing gas interconnector, the Hungarian-Slovenian pipeline, which has not yet been realised for market reasons. The Slovak and Romanian interconnectors are also slated for expansion (EM, 2023a).

Ultimately, in addition to the 739 mmcm of Russian gas that arrived in Hungary in the summer and autumn of 2022, the Russian side helped Hungary out in two ways. First, in the autumn of 2022, it offered the possibility of deferred payment for its long-term contract gas above a certain price threshold between October 2022 and March 2023 (Portfolio, 2022), and then, in the spring of 2023, it introduced flexibility, an option to buy additional Russian gas if day-ahead (spot) prices to be paid for Russian gas are lower than the European front-month futures prices (so that Hungary can gain on the spread between the two) (Weinhardt, 2023b).

4. Gas demand in Hungary before and since 2022

The shares of gas in Hungary's gross inland consumption and final energy consumption are still very high in the EU context, at 33.9% and 31.2% respectively in 2021. Gas demand was on an upward trend and exceeded 10 bcma at the time the NES and NECT were adopted in 2020 (Eurostat, 2023g; MEKH, 2023c). Energy policy planners expected that gas consumption would not fall drastically and would remain high in the long term – around 8.7 bcm in 2030 and below 6.3 bcm in 2040 (ITM, 2020c, 2020d).

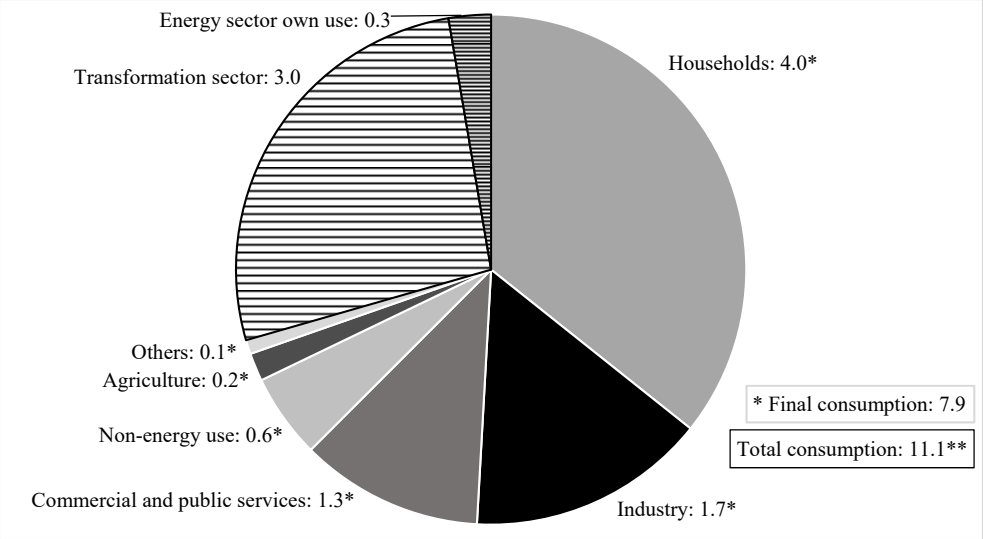
The main elements of the demand side, totalling 11.1 bcm in 2021, are the final consumption (with 7.9 bcm in 2021, mainly by the households, industry, and commercial and public services) and the gas demand of the transformation sector (with 3.0 bcm, primarily used for electricity and heat generation) (MEKH, 2023c). Of the 7.9 bcm of final consumption in 2021, 4.0 bcm were used by households (Figure 7) (MEKH, 2023c, 2023f).

Gas demand increases between 2015 and 2021 were largely driven by the residential sector, where a residential energy price reduction programme ('utility cost reduction programme') with the long-term promise of cheap energy has been in place since 2013, with the effects of discouraging energy conservation, energy-efficiency improvements, and fuel switching to renewables, though in most of the period between 2013 and 2021, gas price cuts could have also been achieved on a market basis, and market developments would have even justified further cuts for a long time (Weiner, Szép, 2022).

In 2021, 71.9% of household energy consumption went to heating homes, of which 56.9% was covered by natural gas. District heating accounted for a further 8.2% of space heating, while gas provided 69.9% of total derived heat production in Hungary (MEKH, 2022,

2023b). Households – along with essential social services and partly the district heating producers[14] – belong to the category of protected customers, i.e., those whose supply cannot be restricted.[15] Strategic gas stocks are mainly reserved for the benefit of the protected consumers (MEKH, 2021). Their supply security is also ensured by the fact that the universal gas supplier has to comply with the mandatory provision of supply sources (i.e., such sales should be backed by purchase contracts – even option contracts – for sourcing of gas to be sold to these customers) and the mandatory stockpiling obligation.

Figure 7. The structure of Hungarian gas consumption by sector, 2021 (bcm)



*** The sum of the individual items differs slightly from the total due to distribution losses, statistical differences, and rounding. Source: MEKH, 2023c.*

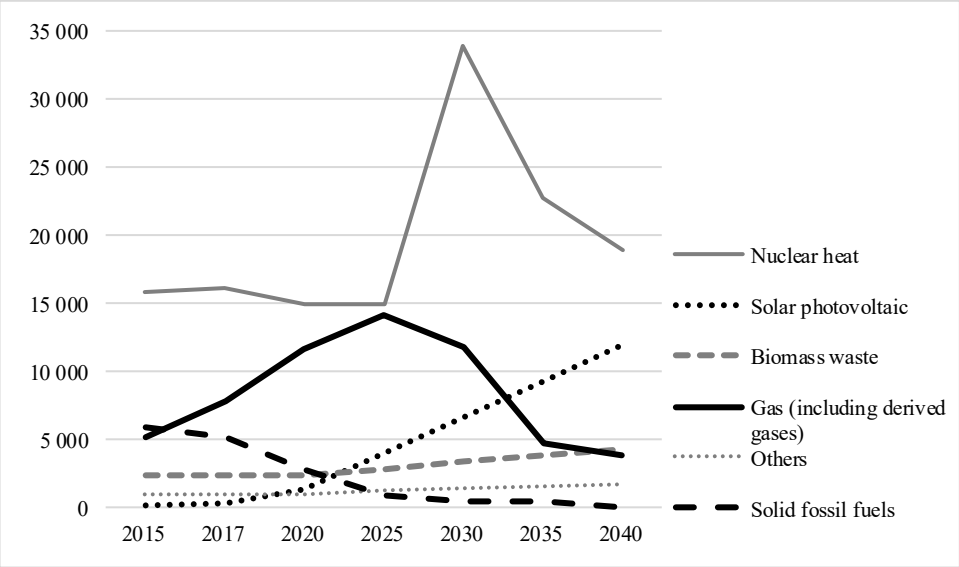
Hungary's 2020 NES and NECT expected a significant drop in residential gas consumption. According to these documents, it should have started to decline as early as 2020, to reach 1.5 bcm by 2030 (ITM, 2020a, 2020c, 2020d). However, in the period before 2022, the government's demand-side measures were very modest, providing little funding for energy-efficiency improvements of homes and with no plans to change this, despite ambitious plans to cut consumption, while maintaining the utility cost reduction programme remained one of the main government promises (Weiner, Szép, 2022).

In addition to the growing final gas consumption, gas demand in the transformation sector also increased between the mid-2010s and 2021. In 2021, due to high solar penetration, the nuclear–natural gas–lignite–biomass electricity composition transformed into a nuclear–

[14] District heating producers are protected up to the level of heat consumption of the households and essential social services produced exclusively from natural gas.
[15] This notion should not be confused with 'consumers to be protected' because of their social situation or health status (i.e., vulnerable consumers).

natural gas–solar–lignite–biomass mix (Figure 3) (Eurostat, 2023d) on the way to ending in a nuclear–solar–biomass–natural gas focus in 2040 (Figure 8) (ITM, 2020b). The 2020 NES and NECP believed that the upturn in gas use for and also the share of gas in electricity generation might be maintained until the mid-2020s, before a downward trend begins. After that, regarding gas, a greater level of flexibility would be advantageous, as flexible backup generation capacity would be required (ITM, 2020a). In derived heat production, the plan was to decrease the share of gas to 50% by 2030 from a rate above 70% due to renewables (ITM, 2020a, 2020c, 2020d).

Figure 8. Gross electricity production in Hungary, by fuel, according to the 2020 NECP's WAM scenario, 2015–2040 (GWh)



Note: 2015 and 2017 are actual data. Source: ITM, 2020b.

In industry, the food industry is the largest user of gas for energy purposes. The chemical and petrochemical industry is virtually the only consumer of gas for non-energy feedstocks (Eurostat, 2023g). In line with the government's reindustrialisation plans, gas use was to continue to increase in the industry sector by 2030, and the same is true for the agriculture, forestry and fishery sectors, the transport sector, and gas consumption for non-energy use, as opposed to the tertiary sector, where lower gas consumption was projected for 2030 (ITM, 2020b, 2020c, 2020d; REKK's modelling results for the NECT provided to the author).

Only one point, the redesigning of the residential energy price reduction programme, can be considered a substantive demand-side measure in the government's seven-point action plan of July 2022. By the summer of 2022, European wholesale gas prices and thus Russian gas import prices – linked to probably two major European gas benchmarks (see the note to Figure 6) – were so high that the government and the state-owned supplier of the regulated segment of the Hungarian gas and electricity markets, MVM, could no longer cope with the

pressure. No more special and additional taxes could have been imposed on certain economic sectors to cover such a high gap between market and regulated prices. Under the new scheme, above-average gas and power consumption is charged with much higher prices, called 'residential market price'. At the time of the exceptionally high European wholesale market gas prices, regulated residential market prices were lower than would have been justified by the actual market prices, but since the latter gas prices calmed down, MVM has been making money on this administrative price band. In contrast to gas and electricity, residential district heating prices have not changed, as the original scheme has remained in place.

Reducing internal temperatures in schools as well as public institutions and companies soon followed. In schools, autumn break was cancelled and winter break was extended.[16] The government suddenly started communicating the need to switch from gas to electricity and biomass. The government put out a flurry of ideas for dealing with the situation. Among others, regulated firewood prices were introduced along with the much-maligned new regulation regarding tree felling to provide the necessary firewood. A boiler and stove programme was also promised, and there was even talk of subsidising the purchase of wall-split air-conditioning units for the population. Ultimately, prices for firewood increased by more than 50% in 2022, and those of coal by more than 60% (KSH, 2023a).

Nonetheless, Hungarian demand-side measures were relatively successful. Like the EU, Hungary exceeded the EU's voluntary gas consumption reduction target of 15% for the period August 2022 to March 2023 compared to the average consumption over the past five years, as gas use dropped by 17.7% in the EU, and 20.2% in Hungary (Eurostat, 2023f), in which unusually mild weather also played a role. Gas consumption in Hungary decreased in the residential, industrial, and power sectors in each month between summer 2022 and April 2023 compared to the same month of the previous year (MEKH, 2022-2023). In 2022, it went down to 9.4 bcm from 11.1 bcm in 2021 (MEKH, FGSZ, 2023). Households saw their gas demand shrinking by 14.0% from 4.0 bcm in 2021 to 3.5 bcm in 2022 (MEKH, FGSZ, 2023; MEKH, 2023d), while demand declined by 12.1% in industry and by 10.2% in the transformation sector. The largest decline was experienced in gas use for non-energy feedstocks, down by almost 40%, followed by the agriculture, forestry and fishery sectors by more than 30%. In industry, three sectors exhibited a fall of more than 20% of gas demand for energy purposes, but of these, only the construction industry uses significant amounts of gas (MEKH, 2023c).

Companies and municipalities found themselves in a difficult situation when their lower-priced gas purchasing contracts expired *en masse* in September 2022, and the already narrow scope of the universal service for non-household consumers buying at a reduced price was further narrowed to micro-enterprises. To those no longer eligible for the universal service, as 'customers of last resort', service was provided at a higher but not yet market price until the end of 2022, but from 2023 onwards they could only receive gas at market prices. High energy prices have forced small- and medium-sized enterprises (SMEs) to develop energy procurement strategies, just like larger companies do (Varga, 2023).

[16] Schools had to share buildings, museums and sports centres closed down to save on heating bills.

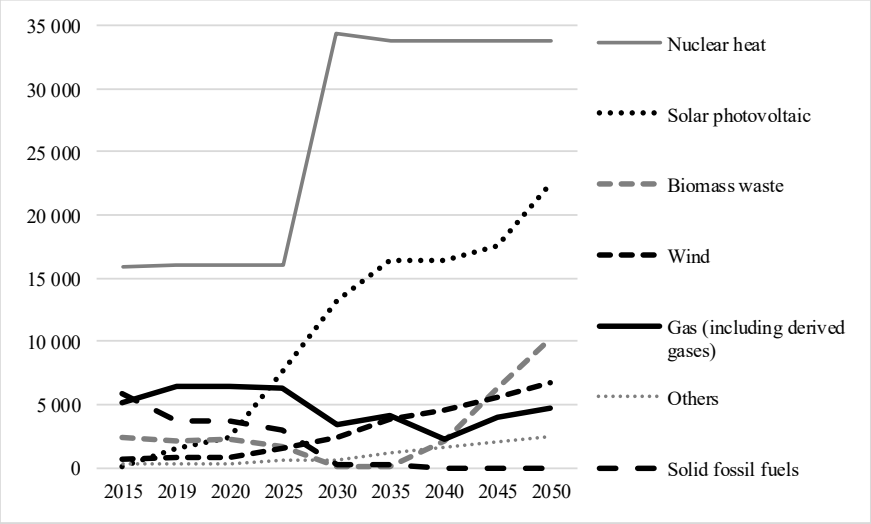
The government has launched a few initiatives to help non-residential customers buying gas at market prices. For energy-intensive SMEs in the manufacturing sector, a support scheme, the so-called Energy Cost and Investment Support Programme, was introduced from October 2022 to partly cover the increase in gas and electricity costs and to provide the down payment required to arrange loan financing for energy-efficiency investments. As of December 2022, this programme was extended to SMEs operating in the accommodation and catering sector. The so-called Factory Rescue Programme for large companies was opened in November 2022 to support investments in energy efficiency and renewable energy production. With high energy prices, the payback period for investments in renewable energy production and energy-efficiency projects in the industry has plummeted, but the installation of solar photovoltaic systems to meet the producers' own needs faced obstacles in 2022 (Kiss, Vitéz, 2022). Further, municipalities, churches, and budgetary units with index-based gas contracts were allowed to fix prices in the period March to September 2023, though the evolution of European wholesale gas prices suggests those who took advantage of this opportunity did not fare well.

The 2023 draft NECP foresees similar gas consumption for 2025 and 2030 as in the 2020 NECP but reduces the volumes for 2035. The relevant figure for 2040 is missing from the 2020 NECP, but its data for the transformation sector and final consumption suggest that gas consumption in 2040 will be much lower than calculated in the 2020 NECP (EM, 2023b). The 2023 draft NECP assumes a 27% reduction in residential gas use between 2019 and 2030, with gas phased out by 2050. This means that although a significant reduction is envisaged (to 2.4 bcm in 2030) (EM, 2023a), it is much less than the amount that the 2020 NES included (when 1.5 bcm was projected for 2030). According to calculations, energy-conservation measures alone could save 1 bcma of gas, and a combination of energy-efficiency and energy-conservation measures offer a total of 1.9 bcma of gas savings (Csoknyai et al., 2022). The problem appears to be that a recent survey shows that households are not planning to invest more in energy efficiency despite the increase in residential gas prices (REKK, 2023). For many years, the Hungarian government had no intention of launching tenders for projects to improve the energy efficiency of homes but the so-called REPowerEU chapter to the Hungarian Recovery and Resilience Plan for EU funding, submitted for public consultation in July 2023, shows that progress is being made in this respect, since such a tender with a budget of HUF 224 billion has been promised for energy-improving retrofit of at least 20,000 properties (Portfolio, 2023a). This is a step forward, but far from enough. On the negative side, the government has again postponed the introduction of the nearly zero energy requirements for new residential and other buildings. Instead of January 2021, the new date is July 2024.

Against the aim of moving away from gas, the government has decided to build new gas-fired capacity (combined cycle gas turbine plants, CCGTs) in the power sector in the eastern part of Hungary. Out of the total capacity of around 1,650 MW, two units with a capacity of 499 MW each are planned to be built at the Tisza Power Plant site in Tiszaújváros and a 650 MW unit at the Mátra Power Plant site in Visonta. The 2023 draft NECT already includes these gas-fired capacities, although with 1,500 MW instead of 1,650 MW (EM, 2023a). With the new gas power plants belonging to MVM, the state will also take on the task of supplying them with gas. The importance of new gas capacities was already evident in the 2020 NES

and NECT. They are needed mainly for the long-overdue reserve capacity building,[17] but also because while the goal should be to reduce energy use, the Hungarian government has decided to turn Hungary into a 'superpower' for the production of batteries for electric vehicles, which will require a lot of electricity in the eastern part of the country, and the project to build a new nuclear power plant (Paks II) is not progressing as planned. The 2023 draft NECP projects much higher electricity generation in 2035 and 2040 than the 2020 NECP. However, although much more gas-fired capacity is planned for 2030, 2035, and 2040 than had been proposed a few years ago, gas-fired generation will still be lower under the new plans (Figure 9) (EM, 2023b). Like the 2020 NES and NECP, the 2023 draft NECP also intends to replace natural gas with renewables in heat generation as much as possible, but expects the share of gas to be even lower by 2030, below 50% (EM, 2023a). According to the 2023 draft NECT, gas use in industry will increase substantially by 2030 compared to 2019, and the use of gas for transport may also increase from its current very low level. By contrast, in the tertiary sector, it will decrease slightly, and gas use in the agriculture, forestry and fisheries sectors will be virtually phased out by 2030 (EM, 2023a).

Figure 9. Gross electricity production in Hungary, by fuel, according to the draft 2023 NECP's WAM scenario, 2015-2050 (GWh)



Note: 2015, 2019, and 2020 are actual data. Source: EM, 2023b.

5. Summary and conclusions

Prior to the 2022 gas market changes, Hungary's gas consumption was on an upward trajectory, while gas infrastructure investments contributed to diversification, though Russian

[17] Power supply needs to be ensured without solar and wind power (even during peak hours), and the intraday variability of solar generation is a major challenge.

gas continued to be a critical part of the gas balance and gas production was declining. The high share of gas in Hungary's energy consumption, the dependence on Russian supplies, and the affordability issues of gas were all significant risks. However, despite the Hungarian government declaring an energy emergency in 2022, the country survived the 2022/2023 heating season without a real emergency, with 'only' gas imports becoming dramatically more expensive in terms of GDP. The year 2022 made it very clear that there is no cheap Russian gas for Hungary, though alternative gas sources may be more expensive. Normal working relations have been maintained between Hungary and Russia, with the active participation of the Hungarian Foreign Minister. Not only have Russian gas deliveries been uninterrupted, but Hungary received some additional gas supplies from Russia in the summer and autumn of 2022, and has been given the possibility of deferred payment for gas imports for the 2022/2023 heating season and then that of receiving extra Russian gas from spring 2023. Hungary did not believe it could wean itself off Russian gas and has bought even more Russian gas, while the legally binding long-term gas supply contract will be in place at least until 2031. The Russian–Ukrainian gas transit contract expires at the end of 2024, and Ukraine does not intend to extend it. If gas transit ceases through Ukraine, i.e., the third of the four gas corridors, Russian gas exports to Europe could fall further, and 1 bcma of gas from Russia to Hungary, i.e., the smaller portion of long-term Russian-contracted gas imports, could be diverted to the south from the current Austrian direction.

Since 2022, there have been only small steps towards Hungarian gas import source diversification, and these have been taken quite late. Affordability, i.e., price, is the determining factor in these decisions. Domestic gas production cannot help the Hungarian gas balance in any meaningful way, and previous ambitious gas production forecasts have been proven wrong. But active support to grasp opportunities is indeed necessary, and the government still has room to manoeuvre in this respect. Accordingly, preliminary figures show a 3.2% increase in gas production in 2023, after stagnation in 2022 (MEKH, 2024a). As far as the third leg of the supply side is concerned, gas storage facilities did not have to deal with any emergencies. The question is what will happen with the special gas stocks acquired at record-high purchase prices.

Demand-side measures, prompted by supply and financial constraints, proved to be relatively successful. Gas use fell slightly below 2016 levels in 2022, partly due to mild weather. The fall in demand is good news, but only if we ignore the fact that there are also negative trends behind this drop. It is not good news if adequate indoor temperatures are not maintained in homes and workplaces, public institutions have to close, or production stops due to high gas prices. However, the general experience is that firms have typically been able to pass on cost increases to their clients.[18]

Preliminary data suggest that gas consumption fell to around 8.4 bcm in 2023, the same level as in 2014 (MEKH, 2024a), but with year-on-year demand growth in the last quarter of 2023 (MEKH, 2023e, 2024b). This level is still quite high and it will not be easy to reduce it substantially in the future. It will require a further substantial reduction in residential consumption, as there is no energy transition without the active participation of the

[18] This statement was made at the GasCon 2023 Conference, Budapest, 7 June 2023. See also REKK, 2023.

households. However, the issue of residential prices remains unresolved. As with the original residential price reduction programme, there are social justice issues with the redesigned system. This new system now provides a price signal to encourage energy conservation and to make decisions in favour of energy efficiency, but it seems fairly clear that the necessary energy-efficiency investments in the residential sector will not be realised without a public programme, whose future depends on the arrival of EU funds.

This study is limited to one country, Hungary, but it may be useful in the future to compare and evaluate the demand- and supply-side measures taken by each Central and East European country during the European energy crisis, which may lead to some generalisations and typologies.

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