POLICY PROPOSAL - 2023 No.2

HOW CAN WE RENEW THE HUNGARIAN ENERGY SYSTEM BY 2030?

The policy proposals of the Equilibrium Institute on the foundations of a more sustainable energy strategy

Equilibrium Institute

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Future for Hungary

Equilibrium Institute

TABLE OF CONTENTS

EXECUTIVE SUMMARY

01

Hungary needs a medium-to-long-term energy strategy that simultaneously serves our supply security, climate policy objectives, and economic competitiveness. To this end, we need to specify – among other things – to what levels we can increase the share of renewable energy in our energy mix over the next decade or two; what we can do about our substantial dependence on Russian natural gas; or what we think about the future of nuclear energy. In other words, what we imagine Hungary's future energy system will look like.

02

Hungary's energy dependence now stands at 54.4% in total. At the same time, the aforementioned statistic considers nuclear power as a domestic energy source. If we add the energy produced by the Paks Nuclear Power Plant, which is dependent on nuclear fuel imported from Russia to our total energy dependence, that figure rises to over 80%.

03

Reducing energy demand, incentivising energy savings, and improving energy efficiency are the preeminent objectives that the plans and design of Hungary's future energy system must strive to realise – the best energy is the energy that's not consumed in the first place. With the proper, intense energy efficiency programmes, Hungary's demand for primary energy could be 25-30% lower in 2030 than it was in 2010.

04

In 2020, the share in the total Hungarian gross final energy consumption of electricity produced from renewable energy sources was 11.9%; by comparison, in the average of the EU countries the corresponding figure was 37%. The pace of growth in the share of renewable energy in Hungary has also been lagging far behind the EU average.

05

Renewable energy production will become more competitive in the next decade, and new energy storage technologies will also facilitate their spread. Hence, the most critical medium-term trend is that fossil fuels will lose ground.

06

In addition to completely phasing out coal in the next decade, we also must radically reduce natural gas use. Electricity supply is the only area in which the demand for natural gas may stagnate due to its balancing role necessary for the spread of electrification and renewable energies. At the same time, in addition to natural gas, we also need to use exports/imports to balance such deficits.

07

When it comes to producing energy, currently the share of renewables primarily refers to solar energy and biomass, even though there is significant potential in wind energy and biogas, too – unlike in hydroelectric power, for example.

08

The share of nuclear energy in Hungary's domestic electricity production is nearly 50% today, and all realistic scenarios suggest that the Paks Nuclear Power Plant will continue to be with us in 2030. To preserve the existing capacities and reduce supply security risks, we must consider the possibility of further extending the lifespan of the currently operational blocks of the Paks plant. We must also keenly monitor the development of small modular reactors (SMRs) so that we can make informed decisions on their potential use in the next decade.

09

The gap between our current electricity-producing capacity and our anticipated level of electricity demand in 2050 is enormous. Without nuclear energy, this gap seems insurmountable today. The proliferation of renewables

and the evolution of storage technologies over the next decade will likely yield radical changes and render obsolete centralised energy systems that centre on major core power plants. However, if the actual trajectory of developments in this area defies expectations and new technologies do not spread as rapidly as anticipated, then already in the 2030s the country's baseload power demand will be increasingly difficult to meet without Paks 2 (the planned new nuclear power plant). In other words, although the new power plant is a project that will almost certainly not provide us with a full return on our investments, halting the project today would be too risky.

10

We need to set ourselves a quicker pace to achieve decarbonisation by increasing the share of renewables and improving energy efficiency. Our current intermediate emissions target for 2030 (40% decline compared to 2010) is insufficient. The new intermediate target ought to fall in the 55-60% range.

11

In the interest of reducing natural gas use, phasing out natural gas needs to be incentivised with detailed schedules and deadlines. Let's end household gas services in buildings where they only use them for cooking! Let's expel gas from every kitchen in every household by 2034! By 2025 at the latest, new buildings should not be allowed to connect to the gas network!

12

The current target of 21% for the share of renewables in the energy mix in 2030 must definitely be raised! Let's increase solar capacity to 9,000 MW and wind power capacity to 40 kilowatts/km2 by 2030! Let's grant new renewable energy-based power plants a ten-year exemption from the payment of the Robin Hood tax, which undermines investors' ability to recoup their investments! Let's further make network planning more ambitious!

13

To make the heat energy supply greener, let's increase the share of geothermal energy in the heating sector from 6 PJ to 8 PJ by 2030! In the interest of sustainable geothermal energy use, let's end the moratorium on the requirement to reinject thermal water! Wherever possible, let's increase the share of geothermal energy in district heating as well as the use of waste in energy production!

14

By 2030, let's reduce our primary energy consumption by 25% compared to the 2010 level and our final energy consumption to 734 PJ! To this end, we need to introduce dynamic pricing for consumers! We need to perform deep renovations on at least 100,000 homes each year!

15

Let's get rid of the 20% import ceiling on electricity that has been laid down as a target figure for 2030! Instead, let's intensify our efforts to expand cross-border capacities! Energy security and independence are not synonymous – energy imported from our EU allies provides greater supply security than natural gas imported from Russia and then used in domestic power plants.

16

We anticipate a total energy demand of 57,839 GWh by 2030. Let's set as a target that in addition to a maximum import level of 30%, 36% of this demand be covered by renewables; 28% by nuclear energy; 5% by natural gas; and 1% by various other sources.

1. WHAT'S THE PROBLEM?

One of the most important European and national challenges facing us in this century is to ensure the secure and sustainable supply of the energy needed by businesses to operate and by the public in everyday household use. As a result of economic growth and the ongoing technological revolution, global energy needs – including those in Europe and Hungary – are continuously increasing, even as the most important and most pressing question facing us today is how we can meet this demand.

The energy revolution and the green transition will effect changes in the global economy of a magnitude that is only comparable in terms of historical impact with the industrial and information revolutions. Such major transformations always yield both winners and losers. If Hungary wishes to be part of the former group, we have to accelerate our transition in the area of energy policy. During the past decades, we were not among the top performers, and thus we now need to close the significant gap we have allowed to emerge in this area.

> The energy revolution and the green transition will effect changes in the global economy of a magnitude that is only comparable in terms of historical impact with the industrial and information revolutions.

We need an energy strategy that simultaneously serves our country's **security of supply, climate policy objectives, and economic competitiveness. At the same time, it also needs to be mindful of the public's ability to endure burdens as well as economic limitations.** To this end, we must answer the following questions:

- **What combination of energy carriers** should make up the electricity production and final energy consumption over the next decade or two?
- **To what extent can we realistically increase the share of renewable energy** in the overall energy mix over the coming decade?
- What can we do about our **substantial dependence on Russian natural gas?**
- What do we think about the **future of nuclear energy?**
- How can we improve **energy efficiency?**
- How can we best prepare for the **electrification that will go hand in hand with decarbonisation?**

2. HUNGARY'S CURRENT ENERGY SYSTEM AND THE MOST VITAL MEDIUM-TERM TRENDS

In 2021, Hungary's primary energy consumption amounted to 1157.5 petajoules, while in 2020, its final energy consumption[1] stood at 735.5 petajoules.

Roughly a quarter of our total **electricity use of 48.560 GWh**, namely 26.3% (12,755 GWh), was imported**. Nearly half (44.7%) of the electricity produced domestically stemmed from nuclear power, over a quarter (26.4%) from natural gas, while roughly a tenth (8.6%) came from coal.** By contrast, a mere 10.6% was provided by solar energy, 5.7% by biomass or biogas, and a mere 1.8% by wind energy (in other words, **the total share of renewables barely exceeded 18%).**

Hungary's energy dependence stands at 54.4% today; if we also include in this figure the nuclear fuel imports used to operate the nuclear plant in Paks, it exceeds 80%.

Before the Russia-Ukraine war, **nearly 90% of our oil and natural gas came from imports, with 64% of imported oil and 95% of imported gas coming from Russia.** This share has remained doggedly high even though already before the war broke out, Hungary had made efforts to diversify its imports. The primary method for reducing our external dependence should be to increase the share of renewables.

> "Hungary's energy dependence stands at 54.4% today; if we also include in this figure the nuclear fuel imports used to operate the nuclear plant in Paks, it exceeds 80%."

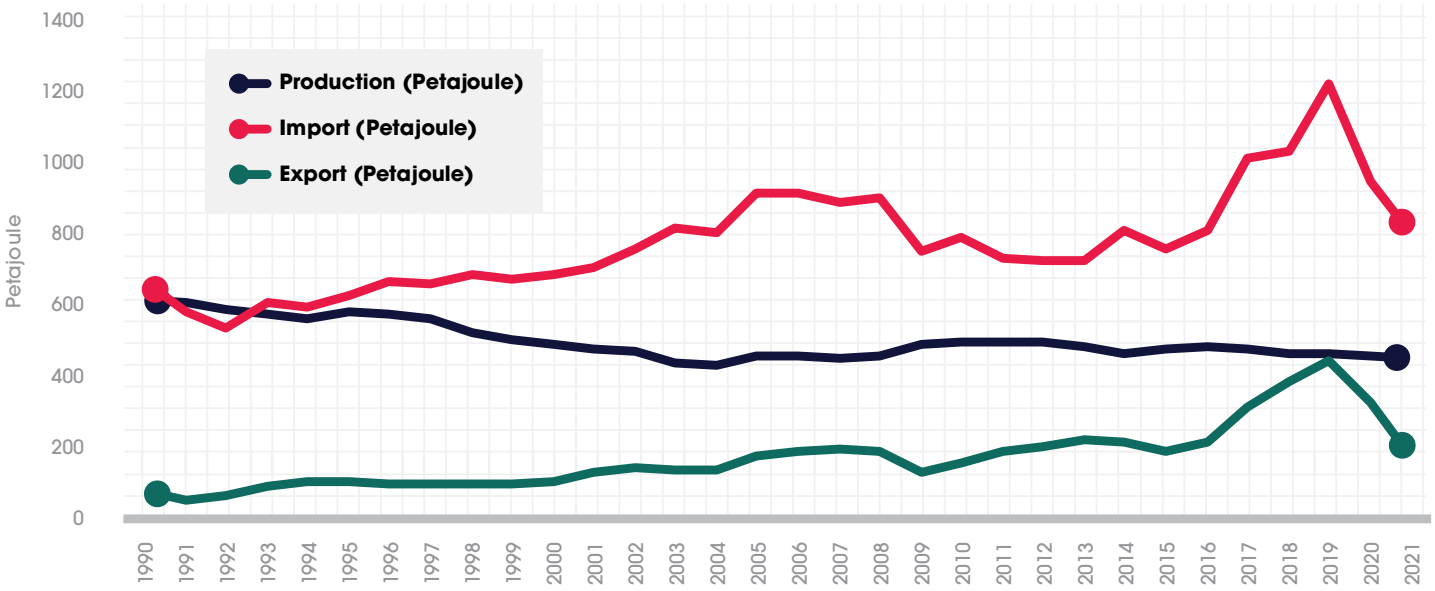


Chart 1: The production, import, and export of energy sources (Source: Central Statistical Office, KSH)

1 The most recent data disseminated by the Central Statistical Office (Központi Statisztikai Hivatal – KSH).

The share of renewables in our domestic energy consumption stood at 12.7% in 2010, rose to 14.5% in 2015, and dropped to 13.9% in 2020 (for the EU overall, the respective figures were 14.4%, 17.8%, and 22.1%). **The share of electricity produced from renewables in our gross final energy consumption** was 11.9% in 2020, while in the EU, the average value was 37.6%. **Based on the share of electricity produced from renewables, Hungary ranks second-to-last among the EU member states, with only Malta lagging further behind.**

The main reason we have fallen behind is that despite a massive proliferation in solar energy use, wind energy expansion **has stalled in recent years due to a lack of tenders and the unreasonably strict criteria governing the installation of wind farms.**

The use of geothermal energy, and especially the use of thermal water for energy purposes, is also at a low level even though there is massive unexploited potential in this area. In Hungary, geothermal energy is typically based on thermal water with medium temperatures, which is less conducive to producing electricity, however. **That is why in the context of geothermal energy, the emphasis must shift to heat production. At the same time, however, due to the low stream gradient of our rivers, hydroelectric energy will not become a relevant element within the overall energy system in Hungary.**

The use of biomass in Hungary overwhelmingly refers to firewood, disregarding other sources available in significant amounts, such as agricultural, industrial, and communal biomass waste (in stark contrast to most Western European countries, biogas power plants are almost entirely absent from the energy system). The situation is similar when it comes to selectively collected **general communal waste,** which also holds out a great deal of unexploited potential for energy use.

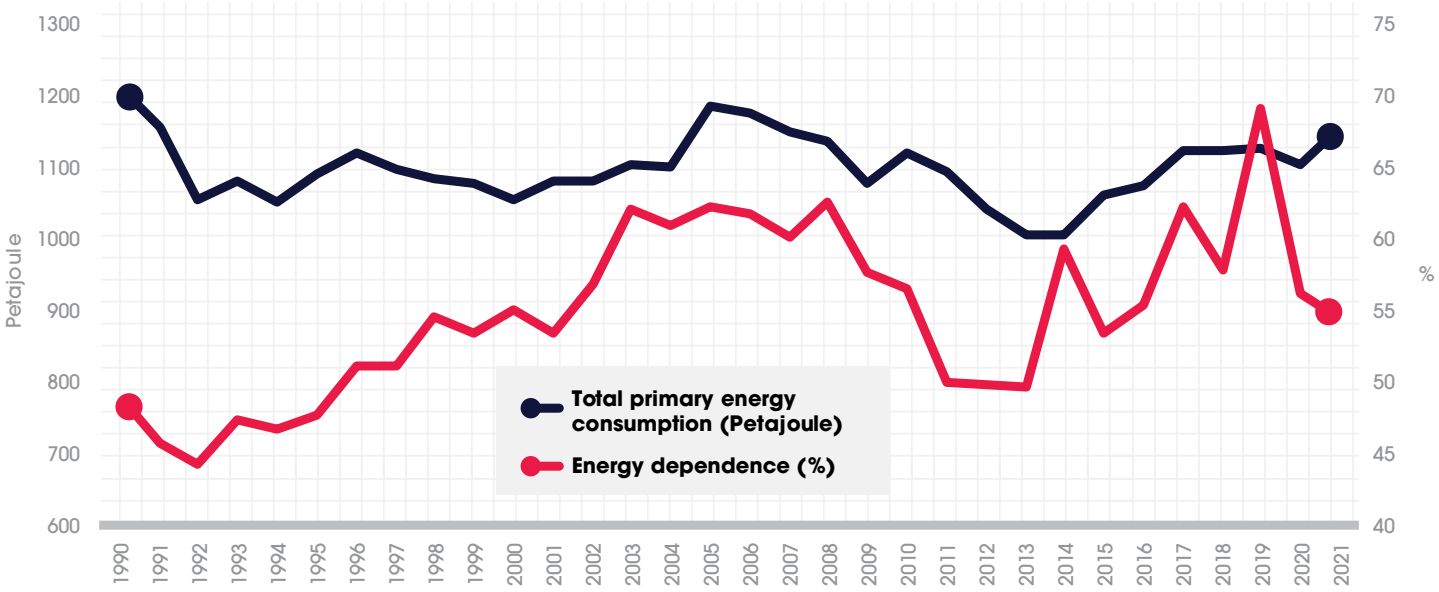


Chart 2: Primary energy use and the share of energy imports in Hungary (Source: Hungarian Central Statistical Office)

To a significant extent, the manoeuvring room available to the Hungarian energy strategy is determined by the European Union and the domestic climate policy framework, which aims to achieve climate neutrality by 2050. The following **are the major milestones that the framework wishes Hungary to accomplish by 2030:**

- **our emissions** decline by 40% as compared to their 1990 level (the EU commitment is a 55% decline overall)
- **the share of renewable energy** use surges to 21% in final energy consumption and 20% in electricity production (data for 2020: 13.9% and 11.9%, respectively)

- coal and lignite need to be completely phased out of **electricity production**
- **final energy consumption** cannot exceed 785 PJ (any excess energy need must be met with energy produced in a carbon-neutral manner)
- the **share of imports** may not exceed 70% in the case of natural gas, 85% for oil, and 20% for electric power.

The most important medium-term trend for our domestic energy strategy will be the **scaling back of fossil fuels and the declining share of fossil fuel imports.** As a result of technological progress, fossil fuel-based energy will become increasingly less competitive economically than renewables.

> The most important medium-term trend for our domestic energy strategy will be the scaling back of fossil fuels and the declining share of fossil fuel imports.

The technology for storing energy is likely to undergo a revolutionary breakthrough in the coming decades, while the cost of storage is likely to decline continuously. Furthermore, owing to the proliferation of electric transport, the storage capacities will also expand continuously (electric vehicles not in active use can be connected to grids and used for storage). Battery technologies are improving rapidly, all the while other solutions that allow for long-term energy storage (chemical, gravitational, flywheel, or hydrogen-based storage, etc.) will also become competitive. **Nevertheless, in the foreseeable future, the problem of seasonal balance (in other words, the issue that renewables cannot produce electricity without interruptions) can be mitigated at best, which is why the continuous supply of heat and electricity during the wintertime will continue to be a vital issue. For now, potential gaps in supply can only be covered by nuclear energy or natural gas.**

The four currently operational blocks of the Hungarian nuclear power plant in Paks will definitely continue to operate in 2030 – based on the current plans, they will be decommissioned between 2032 and 2037. Their operational lifetime could theoretically be expanded by another 10-20 years. Still, for supply security and nuclear safety reasons, such a decision must be preceded by thorough technological testing.

The fundamental dilemma concerning the long-term future of nuclear energy and the Paks expansion is that **there is a shocking gap between Hungary's current energy mix and the level of its greenhouse gas emissions on the one hand, and the target of climate neutrality by 2050 and the satisfaction of the continuously growing demand for baseload power on the other.** Put in simpler terms, we do not currently know how we can satisfy our need for electricity – which is projected to increase substantially over time – in a safe, uninterrupted, and carbon-neutral manner. **Even considering the inclusion of nuclear energy in the overall energy mix, the chasm between the present reality and a climate-neutral future is massive – without nuclear energy, it appears insurmountable.**

> Hence, reducing our energy demand, achieving energy savings, and improving energy efficiency must be preeminent objectives in planning and designing Hungary's future energy system.

The best energy is energy that is not consumed in the first place. Our energy and climate goals can only be met, and our investments into renewable energy and other green projects can only promote a swift energy transition and a reduction in our energy dependence if our energy demand also substantially declines at the same time. Hence, reducing our energy demand, achieving energy savings, and improving energy efficiency must be preeminent objectives in planning and designing Hungary's future energy system. **By 2030, intensive energy efficiency programmes could reduce Hungary's primary energy demand by 25-30% compared to the 2010 value.**

3. THE EQUILIBRIUM INSTITUTE'S POLICY PROPOSALS ON HUNGARY'S NEW ENERGY SYSTEM IN 2030

3.1. A MORE AMBITIOUS EMISSIONS-REDUCTION TRAJECTORY!

A key starting point for our approach to energy production and use is that the current **2030 intermediate emissions-reduction target for greenhouse gases (i.e., 40% as compared to the 1990 level) is inadequate** because it contributes too little to the long-term goal of attaining full climate neutrality by 2050. This holds out the risk that the economic and social burdens of transition will be severely and disproportionately tilted towards the latter stages of the transition period.

LET'S RAISE OUR 2030 EMISSIONS-REDUCTION TARGET FROM 40% TO 55-60%!

For a more secure emissions-reduction trajectory and a more level distribution of the concomitant burdens over time, we need to set more ambitious intermediate goals for Hungary. **The EU's 55% emissions reduction by 2030 would be a better undertaking with respect to both, more evenly spreading out the long-run distribution of burdens and in terms of political communication** – although it bears pointing it that it would still leave too much of the burden to be tackled in the post-2030 period. An even higher, **60% undertaking would be closer to a balanced emissions-reduction trajectory in terms of the distribution of burdens over time.** However, it would also require considerably greater political and economic efforts already in the medium term.

Nevertheless, if we want to reliably and securely achieve the objective of climate neutrality by 2050, and to make sure that the energy transition process becomes a strategic priority, **the new intermediate target for 2030 must fall between the 55-60% range. The medium-term plan of our energy system must also serve this objective, be it with respect to phasing out the use of natural gas as quickly as possible, making transportation electricity-based, or massively increasing the pace of investments in the energy efficiency retrofitting of buildings.**

LET'S INCENTIVISE THE REDUCTION OF OUR GAS DEPENDENCE BY USING A SPECIFIC "ROADMAP" AND DEADLINES!

The programme for a gradual reduction in the use of natural gas must send a clear message to users and gas providers alike. **To this end, a detailed time plan must be developed for weaning ourselves off from gas, with specific deadlines and ongoing public communication about the relevant efforts.**

In the coming years, we need **to focus primarily on reducing household gas use;** this needs to be followed by the spread of alternative solutions designed to scale back industrial gas use; finally, the use of gas by power plants must be reduced, too.

THE STATE SHOULD INTENSELY PROMOTE THE TRANSITION TO ELECTRIC COOKING UNTIL 2026!

As the first step in reducing household gas consumption, we should launch a four-year programme aimed at phasing out the use of natural gas for cooking and baking in households that pay a flat fee (i.e., households without gas meters)! As part of this programme, the state should provide financial incentives for households which use gas exclusively for baking and cooking to transition to electric cooking (providing the necessary expansion of the electric power supply, upgrades, and equipment acquisition)! **In Budapest alone, there are 170,000 such households**.

LET'S ELIMINATE GAS IN ALL KITCHENS BY 2034!

Let's get rid of all natural gas used in kitchens between 2026 and 2034! Launching such a second stage in the efforts to phase out gas in kitchen use would create a predictable market demand for switching household appliances and performing the requisite expansion of household electrical power supplies. **In 2019, roughly 5% of all final household gas consumption was used for cooking.** Based on this figure, we can estimate that replacing all gas-based stoves and ovens with electric appliances in households that use gas also for heating could reduce natural gas consumption by as much as 170-180 million cubic metres (6 petajoules) annually.

LET'S BAN NATURAL GAS FROM BEING INTRODUCED IN NEW BUILDINGS BY 2025 AT THE LATEST!

Following the example of other countries, starting in 2025 newly built homes in Hungary should no longer be allowed to connect to the gas network! The transition of households should be incentivised by non-refundable grants for building renovations and retrofitting. Regarding solutions promoting electric heating (e.g., heat pumps), the state should partially or fully assume the costs of connecting the given heating systems to the electric grid (the necessary power supply expansion and connection fees).

LET'S REMOVE 200,000 HOUSEHOLDS FROM THE GAS NETWORK BY 2030!

To scale back the use of gas for heating purposes, **in addition to setting the appropriate deadlines, decisions must be made to detach individual distribution districts from the natural gas network.** As a first step, **a number of districts (20-30 microregions, ideally including different types of municipalities) should be designated, which could serve as pilot projects that will pave the ground for preparing a comprehensive phasing out of gas-based heating;** the selection should be performed by taking into account the capacity utilisation data of the natural gas distribution network**. By 2030, at least 200,000 households should be detached from the natural gas distribution network.** In the designated districts, state subsidies should be used to install heating systems that are optimal for the given area (be it heat pumps, biomass, district heating, or electric heating).

THE PAKS 2 INVESTMENT MUST CONTINUE!

In addition to the safety and environmental concerns that militate against the expansion of the Paks Nuclear Power Plant, another argument against the Paks 2 project is that the energy production systems are likely to undergo a transformation in the near future: **centralised systems based on large power plants will be increasingly supplanted by decentralised systems (meaning systems made up of countless small power plants).** Already within the next few decades, these will become more competitive than the traditional modes of energy generation – in other words, the expensive new nuclear plant power blocks – which would take a long time to recoup the investment costs – will likely become outdated already in the early stages of their operation, with the result that as a central power plant, Paks 2 will increasingly constitute a deadweight that acts as a drag on the further development of our energy system.

Theoretically, we could decide to hold off on the expansion of our nuclear capacities, take a step back and do the following: intensely expand our renewable

energy system while waiting to see what the next decade of technological progress holds out for us in terms of improved energy storage capacities, renewables, or even more modern nuclear technologies (the modular reactors which are in a trial phase right now – nota bene, Bulgaria, Poland, and Romania have already signed an agreement with the United States to start the preparations for deploying SMRs, so this could potentially pave the way for the further licensing of small reactors in other countries as well). This would also allow for assessing whether such a new project could be planned and implemented with a non-Russian investor instead. However, **the risk of an unfavourable scenario,** in which no critical technological breakthrough is achieved by the early 2030s in either renewable energy production, storage technologies, or small modular reactors, while extending the operational life of Paks 1 is also deemed unsafe, **is simply too big to take.**

It is worth considering that the first actual construction work in the Paks 2 project won't start before a decade after the initial planning phase. Furthermore, realistically even once construction actually begins, the investment project won't be completed before the early 2030s. Meanwhile, a rule of thumb in the case of other European nuclear expansion projects is that lags of at least a decade, but typically more, are the norm. Thus, if a situation were to emerge that would ultimately lead us to expand Paks after all, then, assuming the technology available today – potentially with the involvement of a non-Russian investor –, **we would simply run out of time because of the extended implementation time of the project. And in such a scenario, we might find ourselves in the throes of a potentially unmanageable energy crisis by the end of the 2030s.** Based on the trends today, this does not appear to be the most probable scenario – but it cannot be ruled out, and the stakes are simply too high.

> Because time is pressing, we need to continue the already launched Paks expansion project, even with the awareness that this investment is unlikely to pay off financially in the long run.

In other words, **even though we know that Paks 2 will almost certainly not pay off as an investment – and indeed, it may even set us back on the path of the energy revolution – halting the already-launched project would be too risky in terms of supply security and attaining our climate objectives.** Thus, because time is **pressing, we need to continue the already launched Paks expansion project, even with the awareness that this investment is unlikely to pay off financially in the long run**.

LET'S EXTEND THE LIFETIME OF THE CURRENTLY OPERATING BLOCKS OF THE PAKS NUCLEAR POWER PLANT!

In the case of the currently operating blocks, **we need to review the possibility of extending their lifetime.** However, that is only an option if the proper impact assessment studies have been performed and the requisite safety guarantees are in place. **Nuclear safety has to be the paramount consideration in this decision.** The groundwork for the decision needs to involve the broadest array of experts, environmental organisations, and other stakeholders, who all participate in a high-quality professional dialogue.

BY THE EARLY 2030S, WE MUST MAKE A DECISION CONCERNING SMALL MODULAR REACTORS!

From a scientific and engineering perspective, we must also brace ourselves for the spread of **small modular reactors** (SMRs)**.** We need to track international trends and experiences and be prepared to render informed decisions on this question early in the next decade – with due consideration of the relevant global developments and the experiences of other countries.

LET'S RADICALLY CUT OUR NUCLEAR DEPENDENCE ON RUSSIA!

Given that Russia is now widely regarded as a pariah state in the international arena, **the problem of providing the nuclear fuel to operate the Paks power plant is subject to a growing number of security and supply policy concerns.** That is why in May 2022, the EU set the strategic objective that Member States must wean themselves off their dependence on Russian energy within five years.

In addition to the utmost enforcement of nuclear safety considerations, we must diversify the procurement routes for nuclear fuels over the next decade! This issue is not influenced by the question of who will build Paks 2 since, from a technological perspective, Russian-built nuclear power plants can operate with nuclear fuels stemming from, say, American supplies. Thus, for example, the American Westinghouse Corporation has been supplying nuclear fuel for years for reactors that are technologically similar in design to the Paks power plant blocks. The US company already has nuclear fuel cooperation agreements with several EU Member States, including Finland, Slovakia, and the Czech Republic. Vitally, from the perspective of our EU and NATO membership and the concomitant security policy and supply security implications, a dependence on American supplies for nuclear fuel is an entirely different story from a dependence on Russian imports.

3.2. MORE RENEWABLE ENERGY – 36% BY 2030!

The prevailing Hungarian strategic goal is to **raise the share of renewable energy to 21% of the gross final energy consumption by 2030 (from a level of 13.9% in 2020) and to increase the share of electricity generated from renewables from 11.9% to 20%.** This target is unsatisfactory in terms of security, climate, and energy policy objectives alike.

> By 2030, let's raise the share of renewable energy to at least 30% of gross final energy consumption and 36% of electricity consumption!

We need to increase the target figure by at least 10-15 percentage points! Without such an adjustment, climate neutrality cannot be achieved in time, nor can our dependence on fossil fuels be reduced at the necessary pace. **Pertinent calculations suggest that it would not be unduly difficult to reach a value of around 30% by 2030. In fact, if we treat raising the share of renewables as a priority, we could ensure that they become an even more prominent part of our energy mix by 2030. By 2030, let's raise the share of renewable energy to at least 30% of gross final energy consumption and 36% of electricity consumption!**

A NEW RENEWABLE ENERGY ACT BY 2024!

We need to adopt a new Renewable Energy Act as a general regulatory framework for our energy transition efforts! Compared to the EU average, our country lags behind in transitioning to renewable energy. The primary reasons are the unpredictable regulatory environment, the haphazardly changing system of public subsidies, and the lack of an unequivocal commitment to this transition on the part of the state.

Among other things, the Act on Renewable Energy needs to specify **mandatory targets** (for the share of renewables in the final energy consumption; the share of renewable energy in domestic electricity generation; a reduction in the volume of final energy consumption; the pace of network expansion, etc.), as well as a **monitoring scheme** to track whether the targets have been met. Furthermore, this needs to be connected to the Act on Climate Protection. **It has to make public access to information about the electricity grid mandatory**, which is essential for ensuring that renewables gain ground at the required pace!

OUR SOLAR ENERGY CAPACITY SHOULD RISE TO AT LEAST 9,000 MW INSTEAD OF THE CURRENTLY PROJECTED 6,500 MW!

Hungary's total installed solar photovoltaic (PV) capacity was over 4,000 MW in 2022. With a proper public funding scheme, a further expansion would be realistic in the coming

years: **a total PV capacity of roughly 5,000 MW had already been reserved** in early 2023. **Thus, we could reach 9,000 MW already in 2027, which would** substantially exceed the target figure of 6,500 MW set out in the National Energy and Climate Plan (NECP). **By 2030, we could even achieve a figure between 10,000 and 12,000 MW. However, for this to be realistic, the grid developments must keep up with growing solar energy generation capacities.**

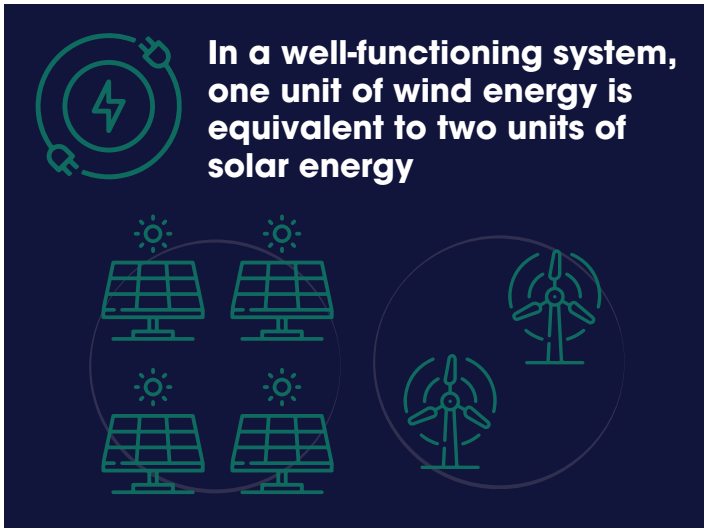
To this end, **the owners of solar panels should again be allowed to feed their electricity back into the grid**, and the development of PV systems operating in island mode should also be incentivised. Furthermore, we need to place a major emphasis on the following:

- **solar installations on residential buildings (roofs, balconies)**
- **supporting the creation of energy communities, especially in urban areas**
- **the possibility of dual-purpose use on arable land and bodies of water**
- **a review of the process for issuing permits, with due consideration of landmark protection and urban landscaping rules**
- **the broadest possible use of the rooftop structures of industrial buildings; waste deposit dumps; and noise barrier walls**

Another important brownfield development possibility stems from the **recultivation of former open-pit mines**, which includes the rehabilitation, management, and monitoring of the affected areas.

LET'S ELIMINATE THE REDUNDANT RESTRICTIONS IN THE WAY OF NEW WIND FARMS!

Ideally, to produce a given amount of electricity annually, we need to have twice the amount of PV production capacity than wind energy capacity within the system. That is why if we can increase the pace of solar capacity expansion, we also need to appreciably speed up the installation of wind farms.



In Hungary today, the wind power capacity per square kilometre stands at 3.5 kW (for comparison, in Germany it is 150 kW). Let's increase this ratio to 40 kW per square kilometre! In order to increase the role of wind energy, **the redundant restrictions in the way of installing wind farms need to be eliminated as soon as possible.** Designing a stable and predictable legal framework is also essential for reinvigorating wind energy use in Hungary**.**

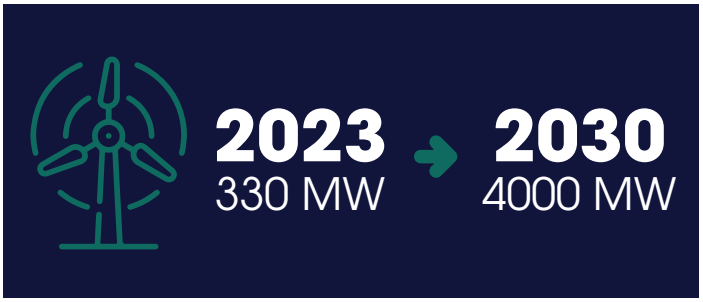
ALL NEW POWER PLANTS BASED ON GENERATING RENEWABLE ENERGY SHOULD RECEIVE A 10-YEAR EXEMPTION FROM THE ROBIN HOOD TAX!

The Robin Hood tax levied on the energy sector impedes the installation of new power plants since it significantly increases the time it takes for investors to recoup their investments. **We should introduce a ten-year moratorium on the payment of the Robin Hood tax for newly created power plants to ensure that investments in renewable energy pay off!** This could motivate investors and lead to the construction of more power plants based on renewable energy.

LET'S INCREASE HUNGARIAN WIND POWER CAPACITY FROM 330 MW TO 4,000 MW BY 2030!

We need to draw on wind energy not only to achieve the general objective of increasing the share of renewable energy but also to complement solar energy (to put it in

simple terms: wind generally tends to be most intense when the sun isn't shining). **Let's increase our wind power capacity from 330 MW to at least 4,000 MW by 2030!**



LET'S INCENTIVISE THE SIMULTANEOUS SPREAD OF SOLAR AND WIND ENERGY WITH A TARGETED SYSTEM OF SUBSIDIES!

The prevailing domestic regulations treat wind and solar power projects separately rather than making it possible to exploit the advantages inherent in the joint use of these two renewables. **The essence of so-called hybrid projects is that a solar and a wind power plant can produce energy for the same grid connection point, making the best possible use of the distinct features of the two underlying technologies.** For one, unlike solar power plants, wind farms can produce energy night and day. At the same time, wind power plants typically produce more energy from autumn to spring, while solar power plants tend to be most productive from spring to autumn. **Let's allow wind and solar power plants to connect to the same electric grid substations!**

IT'S TIME TO PREPARE FOR THE GROWING ELECTRICITY NEEDS OF THE GREEN FUTURE – LET'S EXPAND THE ELECTRICITY GRID INTENSELY!

Due to the growing electricity needs and the increase in the share of renewables in electricity production, a survey of the existing grid capacities, and their expansion where necessary, needs to become a preeminent strategic objective.

In addition to its ongoing planning of the electric grid development, the MAVIR Hungarian Independent Transmission Operator Company Ltd (Magyar Villamosenergia-ipari Átviteli Rendszerirányító Zrt.) **should publish a biannual report that surveys how much additional capacity the grid can handle; what additional capacities it is expected to be able to manage as a result of further developments; and the time when these expansions are scheduled to be completed**! Several relevant investments will become necessary in the coming decade. Thus, we need to:

- improve the technological features of the electricity system
- expand the international electricity transportation infrastructure
- build smart systems
- make sure that weather-dependent renewables can be turned off to reduce the strain on the system in situations when exports are impossible and the demand-side management is no longer sufficient to handle peak loads
- improve further the quality of projections concerning solar radiation and wind speed
- expand flexible production capacities
- intensely support the use of electric cars and their smart charging
- exploit the benefits of energy storage (batteries, green hydrogen, power to gas, condensed air, pump storage, molten salts, polymers, etc.) and expand the relevant capacities.

> "A survey of the existing grid capacities, and their expansion where necessary, needs to become a preeminent strategic objective."

LET'S DEVELOP A NATIONAL STORAGE PLAN!

For electricity storage, we would need facilities that can store between 10% to 15% of the installed weather-dependent electricity production capacity; in other words, we need storage capacities equivalent to 1,300-2,000 MW. We must develop a national storage plan to ensure this is adequately distributed geographically**!**

As part of this plan, we need to survey whether centralised or decentralised storage is more efficient, and we need to provide financial incentives to build the most efficient storage facilities! The construction of storage capacities and the launch of their operations as part of the broader energy system must be predictable. **Let's create a national subsidy scheme for storage facilities! This system should announce successive phases of competitive tenders for subsidies to fund network-sized storage capacities!**

AUTOMATED ELECTRIC CHARGING STATIONS AND LNG CHARGING STATIONS!

To realise the designated e-mobility objectives, we need two things. First, the total capacity of the network of charging stations needs to be expanded and automated systems need to be installed, which are different from existing fossil fuel stations and reduce waiting times during charging. Second, to foster the more intense use of LNG-powered (liquified natural gas) fuels, which have lower relative emissions than either petrol- or diesel-driven vehicles, **rapid LNG charging stations must be installed along the highway and transit route networks**!

LET'S MAKE URBAN PUBLIC AND TAXI TRANSPORTATION GREENER!

Let's set specific deadlines for banning the registration of new fossil-fuelled vehicles in urban public and taxi transportation to incentivise the transition to electric cars and make the process better plannable! An e-mobility replacement programme should be launched in the capital and cities with substantial local traffic; this will require an EU and governmental subsidy scheme.

LET'S ENCOURAGE A RETURN TO HYBRID PROPULSION SYSTEMS ON LOCAL RAILROAD SECTIONS WITH LOW TRAFFIC!

For railroad transportation in areas with low traffic where a network for electric propulsion is unavailable, **we need to incentivise a transition to hybrid propulsion systems!** Our entire railroad network needs renovation – including the realisation of self-generated electricity – primarily leaning on renewable energy sources.

LET'S USE GEOTHERMAL ENERGY FOR HEAT PRODUCTION RATHER THAN ELECTRICITY GENERATION!

Using geothermal energy for producing electricity is far less effective than its use for heating. That is why we need to emphasise the heating/cooling sector in the coming years **rather than electricity generation when it comes to expanding geothermal capacities**! Apart from energy efficiency solutions and making heating electric, this is where the potential for reducing natural gas consumption is the greatest. Thus, we need to substantially increase the funding for transitioning district heating systems to use geothermal energy rather than natural gas while supporting the installation of heat pump systems in private households and industrial use alike!

> We need to emphasise the heating/cooling sector in the coming years rather than electricity generation when it comes to expanding geothermal capacities!

The search for geothermal solutions that rely on thermal water, along with the installation of the necessary equipment, is called for in geographic areas with proven reserves of thermal water (spas) and **extensive district heating networks.**

BY 2030, LET'S INCREASE THE PRODUCTION OF GEOTHERMAL ENERGY FROM 6 PJ TO 18 PJ IN THE HEATING/ COOLING SECTOR!

Hungary uses roughly 10 billion cubic meters of natural gas annually – expert estimates say that **geothermal energy could replace about 1-1.5bn cubic meters (35-60 petajoules), that is between 10-15% of the total amount**. However, as of now, we have only used between 15-20% of the total potential for savings that could be attained through geothermal energy, and even this level took us six decades to achieve. Realising the total attainable savings of 1-1.5 bn cubic meters of natural gas in the seven years left until 2030 is impossible since geothermal energy capacities would need to expand as much every two years as they had previously over a total of 60 years. Nevertheless, we must strive to accelerate the process as much as possible. **For the next decade, we should set the goal that the total amount of geothermal energy used for heating increases at least threefold, from 6 PJ to 18 PJ!**

TO ENSURE THAT THE USE OF GEOTHERMAL ENERGY IS SUSTAINABLE, WE SHOULD NO LONGER DELAY THE REINJECTION REQUIREMENT!

At least two wells need to be drilled to make each thermal water-based geothermal energy project sustainable: **one extracts the water,** while **the other is used to reinject the water** from whence it was extracted (except for thermal spas, where the pollution does not allow for reinjecting the water). Thus, even though the operating costs of geothermal plants are fairly low, on account of the high investment costs, the payback period is relatively long, ranging from 12 to 15 years. **Hence, if we want to increase the share of geothermal energy use threefold by 2030 and five-to-tenfold by 2050, we need a stable and reliable public funding system to support its expansion!**

Reinjection is a very costly procedure, but it has two vital functions: for one, it prevents the geothermal reservoir from which the thermal water is extracted from being depleted, which is vital because our groundwater resources are finite; second, to protect the wildlife, we mustn't discharge the warmer and mineral-rich thermal water into the surface waters. Despite the above, the **reinjection requirements were put on hold in Hungary by a moratorium introduced in 2013**. Hence, although the reinjection requirements have been theoretically applicable since 2012, they have yet to become effective. **According to the current regulations, the moratorium will be in place until 2027 – it needs to be eliminated as soon as possible.**

LET'S DESIGN MULTI-STAGE WATER USE SYSTEMS!

We could improve cost-effectiveness and reduce payback periods by **striving to create so-called cascade systems, in other words, multi-stage water use systems.** This refers to systems that use thermal water for different purposes through a series of distinct stages, activating the various uses one after the other. This integrated system simultaneously features water use for heating, hot water supply, balneology, and agriculture, in line with the gradually declining temperature of the water that has been extracted.

LET'S DECENTRALISE ENERGY PRODUCTION BY BUILDING NEW BIOGAS PLANTS!

We will need to build as many as hundreds of biogas plants **– each with a capacity between 1-2 MW and providing uninterrupted (weather-independent) production** – spread out across Hungary to realise renewable energy production based on small-scale facilities. A biogas plant provider can serve multiple distinct uses: it is suitable not only for producing hot water but can also produce combined heat and power as well as biomethane, which is of the same quality as natural gas. We need to put a much higher emphasis on producing biogas that is mainly derived from agricultural waste!

LET'S BUILD NEW WASTE-TO-ENERGY PLANTS!

When it comes to energy production, waste recovery and disposal plants can also help boost the share of renewables because 50% of the electricity they produce qualifies as renewable energy. Although the heating energy won through waste recycling does not count as renewable, it does help to replace a portion of the natural gas used in district heating services. Of course, it is best to pre-empt excessive waste from emerging in the first place or to recycle it whenever possible – but despite support for such measures, half of Hungary's communal waste **still ends up in landfills**. Creating new recovery and disposal plants can reduce this amount while increasing the role of waste in district heating, reducing the share of natural gas.

New waste incineration power plants need to be operated in locations where either district heating systems are nearby or, alternatively, in industrial facilities that can use the heat thus produced. Proximity is key **because, beyond a certain distance, neither the transportation of waste as a fuel nor of heat as a product is economically viable. The long-planned waste recycling plant in the south of Budapest definitely needs to be built** – this could boost the amount of energy from waste in the final energy consumption to 4 PJ.

3.3. LET'S USE 25% LESS ENERGY BY 2030 THAN WE USED IN 2010! – LET'S INCENTIVISE ENERGY EFFICIENCY!

Let's set the following target for 2030: **by incentivising energy efficiency, we reduce Hungary's primary energy demand by at least 25% compared to the 2010** level!

> By incentivising energy efficiency, we reduce Hungary's primary energy demand by at least 25% compared to the 2010 level!

The Early Action Scenario included in the National Clean Development Strategy estimates that **in 2030, our final energy consumption will amount to 734 petajoules.** Let's set a more ambitious target than the one currently envisioned, and rather than the prevailing 785-petajoule target, let's instead shoot for the goal set out in the Early Action scenario! (Estimating the composition of the final energy use would require complex modelling that exceeds the scope of the current analysis, which is why we will not attempt to specify the percentage shares of various sources of energy in final energy consumption).

DYNAMIC PRICING TO PROMOTE ENERGY EFFICIENCY!

The realisation of the goals above will also be helped by using **dynamic pricing for electricity** to reflect the prevailing level of renewable energy production. A special intra-day rate could be used to incentivise the public to use their household appliances or to charge their electric cars when PV panel electricity generation is soaring; a higher price in the early morning and late evening hours, when consumption tends to peak, could incentivise energy savings during these hours. Thus, **even massive amounts of energy consumption could shift in time to periods of the day when PV panels, which produce the cheapest and most environmentally-friendly energy, play a more significant role in energy production.**

We need to **incentivise major energy consumers to shift annual maintenance and other planned shutdowns from the summer to the winter**, thereby reducing the demand for electric power in the winter season when there are fewer hours of sunlight! Reduced rates will also incentivise industrial users to transform their energy demand patterns over time.

LET'S PERFORM DEEP RENOVATIONS ON AT LEAST 100,000 HOMES ANNUALLY!

By 2030, there will likely be 3.5 million inhabited homes in Hungary, 3 million of which already exist – all of these will have to be renovated by 2050. Refitting these buildings to achieve greater energy efficiency and produce renewable energy would reduce emissions not only in the building sector but also in energy production.

Today, a mere one per cent of the total building stock is being renovated each year. An even greater problem is that there are hardly any deep renovations, in other words, investments as a result of which a building becomes entirely or almost devoid of carbon-dioxide emissions. **To achieve climate neutrality by 2050, we need to perform deep renovations on over 100,000 homes each year instead of the current rate of 4,000-5,000 annually.**

LET'S INCENTIVISE THE SPREAD OF SMART ENERGY REGULATION SYSTEMS!

We need to support the **introduction of smart systems, and we need to do so at various levels: such systems are needed at the level of national network and transmission systems; in city energy management systems; and in the energy systems used by residential and urban consumers.** These systems monitor the efficiency of energy use through an automated mechanism, learning intelligently about regular consumption patterns or supply failures. Introducing such systems and their ongoing application **reduces energy loss in the networks (and other individual systems), including energy theft. At the same time,** it also allows for better planning, thus reducing system maintenance and repair costs. The investment costs of such systems should be partially offset by high-intensity state and EU subsidy programmes, as well as through individually customised consumer packages. **City energy management systems need to be made "smart" in a similar fashion: based on a unified energy use and planning strategy designed for the municipal level.**

3.4. THE ENERGY MIX OF HUNGARIAN ELECTRICITY USE IN 2030: 30% IMPORTS, 36% RENEWABLES, 28% NUCLEAR ENERGY, 5% NATURAL GAS

In 2030, Hungary's electricity consumption is **expected to reach 57,839 GWh**. Of this amount, **a 30% import share should be technologically and financially feasible. In other words, we need to be able to produce 70% of our final electricity consumption on our own, no matter the circumstances.**

Seventy per cent of the 57,839 GWh projected in 2030 amounts to 40,487 GWh. At that point, we will have completely eliminated coal and oil from the energy system, and we can further assume that our **nuclear energy capacity will remain unchanged:** the annual production of 16,000 GWh of nuclear power will cover 28% of our expected electricity usage in 2030.

If we want to increase the share of renewables to achieve a share of 52% in our total electric power production, that means an amount of 20,900 GWh, which would account for 36% of electricity consumption – of these, 10,800 GWh would come from solar energy, 8,000 GWh from wind, and 2,100 GWh from biomass and biogas.

Natural gas would be used to cover the remaining deficit of roughly 3,500 GWh, as well as any potential weather-related shortfalls that arise from the increased reliance on renewables. Thus, gas would **account for 5%** of all electricity consumption. A portion of the natural gas power plants would be kept as reserves in this system to provide electricity when weather-dependent renewables cannot produce enough.

The final figures are thus as follows:

- Total electricity consumption: 57,839 GWh = 100%
- Imports: 17,352 GWh = 30%
- Nuclear energy: 16,000 GWh = 28%
- Renewables: 20,900 GWh = 36%
- Natural gas: 3,200 GWh = 5%
- Other (waste, etc.): 400 GWh = 1%

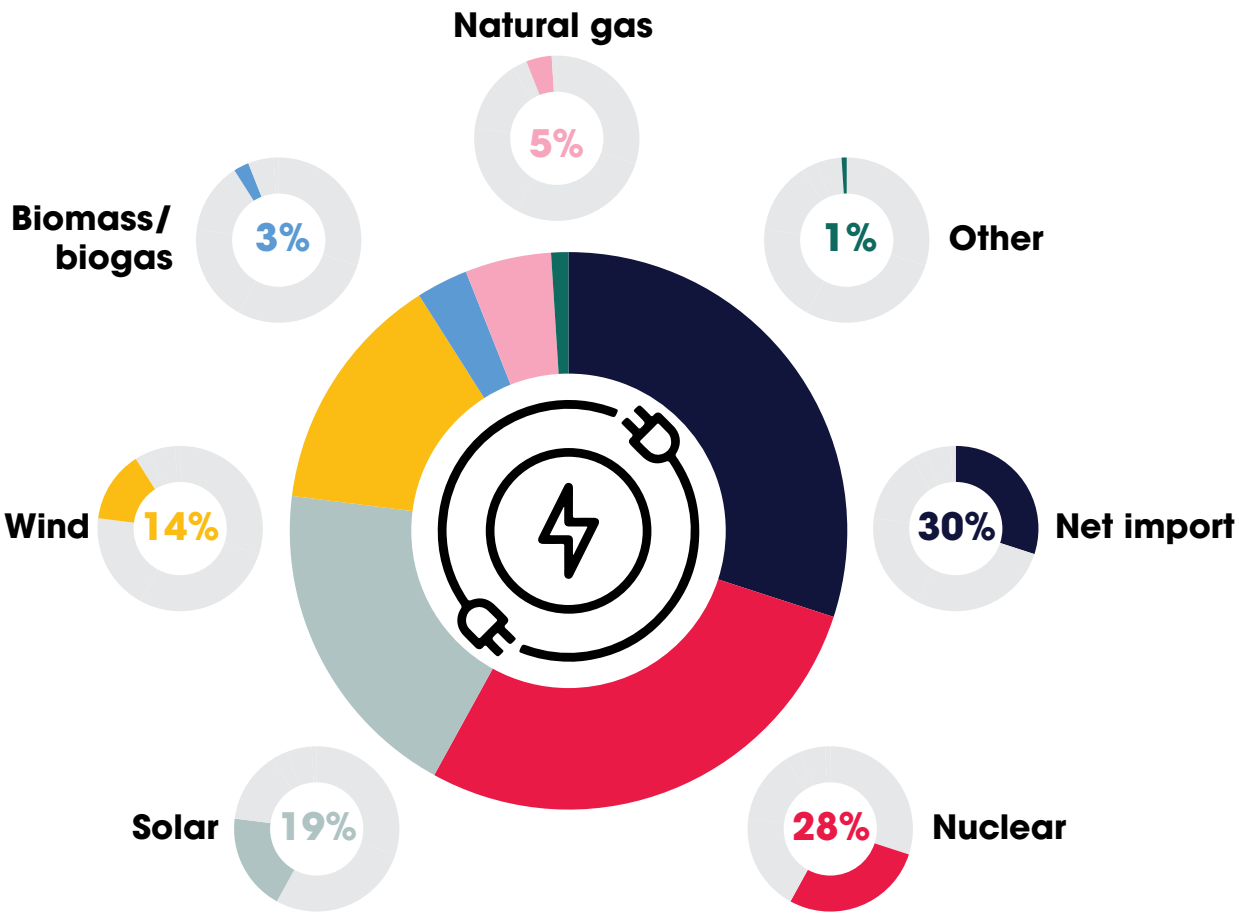


Chart 3: The composition of Hungary's final electricity consumption in 2030[2]

2 Rounded values.

THE EQUILIBRIUM INSTITUTE'S POLICY PROPOSALS

MORE AMBITIOUS EMISSIONS REDUCTION

- Let's increase our emissions-reduction target from 40% to 55-60% by 2030!
- The state should intensely subsidise the transition to electric cooking by 2026! Let's eliminate natural gas from all kitchens by 2034!
- By 2025 at the latest, new buildings should no longer be allowed to connect to the gas network! Let's detach 200,000 households from the gas network by 2030!
- We need to continue the Paks 2 investment to safeguard our supply security!
- Let's extend the lifetime of the currently operating blocks of the Paks Nuclear Power Plant!
- Let's make a decision about the issue of small modular reactors by the early 2030s!
- Let's radically reduce our dependence on nuclear power from Russia by using alternative sources of procurement!

HIGHER INTENSE SPREAD OF RENEWABLE ENERGY

- By 2030, the share of renewable energy should be at least 30% of our final energy consumption and 36% of our electricity consumption!
- Let's adopt a new Act on Renewable Energy by 2024!
- Let's increase our solar energy capacity to 9,000 MW instead of the current target of 6,500 MW!
- Let's eliminate the redundant restrictions impeding the installation of new wind power plants! Let's increase total wind power capacity from 330 MW to 4,000 MW by 2030!
- Every new renewable energy-based power plant should be given a 10-year exemption from the Robin Hood tax!
- Let's use a targeted subsidy scheme to incentivise the joint spread of solar and wind energy systems!
- Let's substantially boost our development of the electricity grid!

ON HUNGARY'S NEW ENERGY SYSTEM IN 2030

AREA	PROPOSAL
HIGHER INTENSE SPREAD OF RENEWABLE ENERGY	Let's develop a national electricity storage plan!
	Automated electric charging stations and LNG charging stations!
	Let's make urban public and taxi transportation greener!
	Let's use geothermal energy for heat rather than electricity production!
	Let's increase the production of geothermal energy from 6 PJ to 18 PJ in the heating/cooling sector by 2030!
	To make geothermal energy use sustainable, let's stop delaying the entry into effect of the reinjection obligation and let's develop multi-stage water use systems!
	Let's decentralise energy production by building new biogas power plants!
	Let's build new waste recovery and disposal power plants!
REDUCING ENERGY DEMAND	Let's use 25% less energy in 2030 than in 2010!
	Dynamic energy pricing for more efficient energy management!
	Let's perform deep innovations on at least 100,000 homes each year!
	Let's incentivise the spread of smart energy regulation systems!
THE ELECTRICITY MIX IN 2030	The electricity used in 2030 should stem from a mix of 30% imports, 36% renewables, 28% nuclear energy, and 5% natural gas!

ABOUT US

The Equilibrium Institute is Hungary's largest independent, future-oriented policy think tank.

In line with the vision of Hungary's future presented in our publication entitled Hungary 2030, the Equilibrium Institute works on creating a smart and environmentally cleaner nation rooted in a strong community. To this end, we write widely appealing and practical policy proposals that serve the development of our country, and we discuss these jointly with the best domestic and international experts.

Our goal is to ensure that the current and future political, economic, and cultural decision-makers learn about our recommendations, come to agree with them and implement them.

The staff members of the Equilibrium Institute and the members of its Advisory Board are renowned experts in Hungary who are considered to be among the best researchers and analysts in their respective fields. The work of the Institute is helped by more than 30 experts, including economists, sociologists, political scientists, lawyers, urbanists, and climate researchers.

OUR EXPERTS

TAMÁS BOROS

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Tamás Boros is the Executive Director of the Equilibrium Institute. He serves as a member of the Scientific Council of a leading European think tank, the Brussels-based Foundation for European Progressive Studies (FEPS). He was the co-founder and co-owner of Policy Solutions, a consultancy and research institute. He is a recurring guest on a variety of political talk shows and often comments about public affairs for leading international media. He previously worked for the European Commission and the Hungarian Ministry of Foreign Affairs as an expert on communication and EU affairs. His research focuses on Hungarian and EU political communication and populism.

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Gábor Filippov is the Research Director of the Equilibrium Institute. Previously he worked as an expert advisor in the Hungarian National Assembly and then as a political analyst and senior analyst at the Hungarian Progressive Institute. His analyses and op-eds have been published by numerous domestic and international media outlets, and he is frequently invited to talk about politics on television and radio shows. His research focuses on the European and the Hungarian far-right, on the histories of anti-Semitism and Islamophobia and their present-day manifestations, as well as the workings of contemporary authoritarian regimes.

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Dóra Csernus is the Senior Climate and Environmental Policy Expert of the Equilibrium Institute. As an expert in environmental issues, she has worked for the Ministry of Environment and Water, the Office of the Parliamentary Commissioner for Future Generations and the Ministry of Public Administration and Justice, representing the Hungarian position in different EU, UN, and OECD fora. She later worked as Director for International Policy Development at Klímapolitika Research and Consultancy Ltd, and as an independent expert in climate and environmental issues. Her main focus is on climate policy, air-quality control and water policy.

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Ákos Kozák is the Director of Business Relations and co-founder of the Equilibrium Institute. Previously, he served as the director of the GfK Hungária Market Research Institute for nearly 30 years. He is the former president of the Hungarian Marketing Association. Formerly, he was also a lecturer at the Budapest Business School and is currently an academic research fellow at the Cyber Economics Research Centre. He is the author or co-author of numerous academic studies on market research. He is the 2008 recipient of the Gábor Klauzál Award (the most prestigious Hungarian state award in the area of trade). He is an expert in futures research and consumer studies and holds a PhD in the sociology of consumption.

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