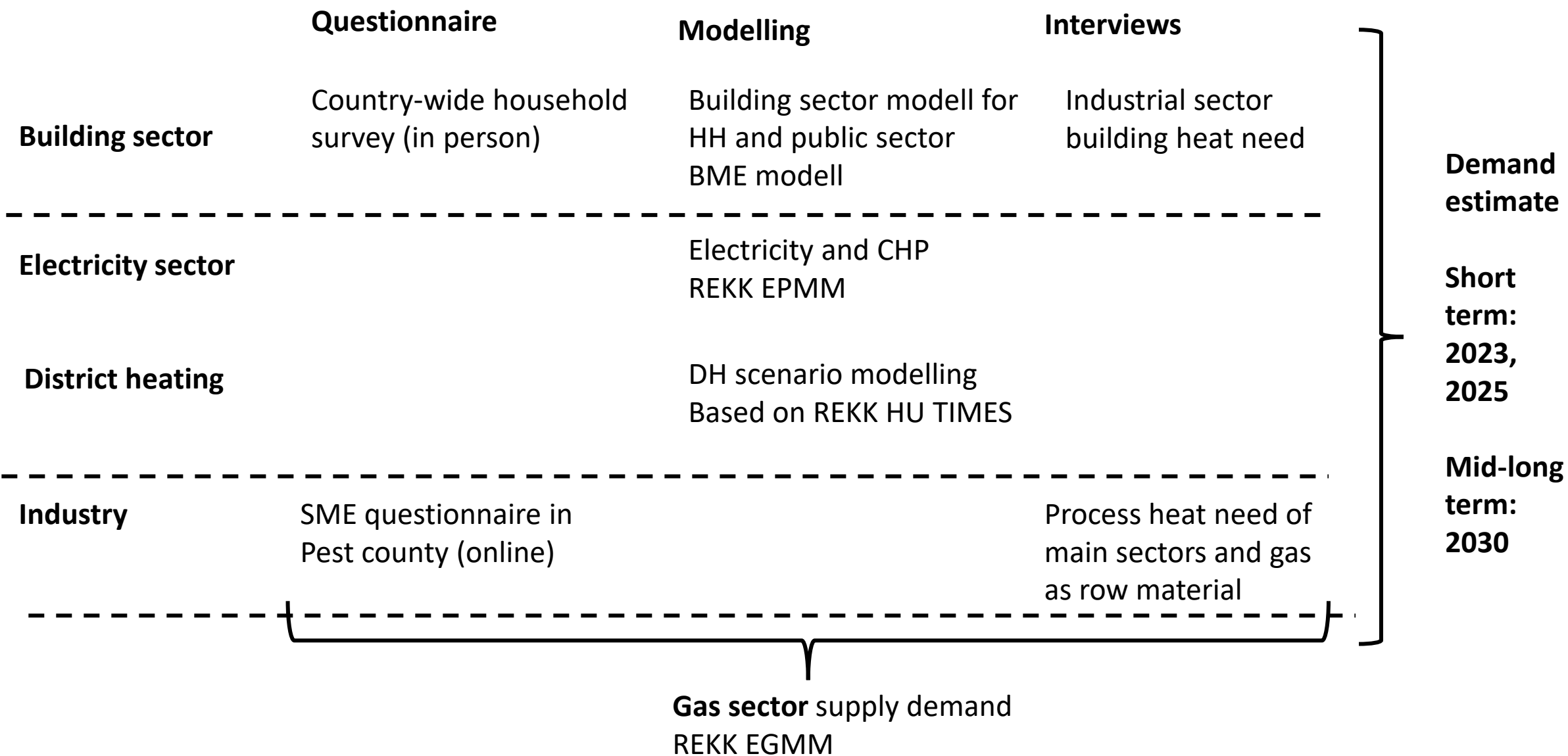




# FINAL REPORT -RUSSIAN GAS PHASE OUT IN HUNGARY-

*REKK and BME experts  
March 2023*

# Analytical and methodological framework



# **DEMAND REDUCTION POTENTIAL IN THE NATURAL GAS SECTOR IN HUNGARY**

# Building sector – Short term gas saving potential

## GAS SAVING POTENTIAL IN THE BUILDING SECTOR

	bcm/yr
Saving by building operation (SFHs built before 1990)	
A: Lowering temperature by 1 degree	0.22
B: Lowering temperature by 2 degrees	0.34
C: Avoiding heating between mid-April and mid-October	0.40
D: Heating set-back at night	0.18
E: Lowering heated floor area by 20%	0.39
B-D combined effect	0.61
B-E combined effect	0.83
Saving by building operation (all residential)	
B-D combined effect	1.04
B-E combined effect	1.41
Saving by building operation (all residential)	
A: Lowering temperature by 1 degree	0.61
B: Lowering temperature by 2 degrees	0.12
C: Avoiding heating between mid-April and mid-October	0.14
D: Heating set-back at night	0.21
E: Lowering heated floor area by 20%	0.17
B-D combined effect	0.41
B-E combined effect	0.53

- In the short term, significant energy savings can be achieved through behavioural change, at nearly no cost
- It may be necessary to make the heating system controllable (payback time less than one season)
- Under the current utility price structure, the motivation to save energy exists for detached houses built before 1990 and for non-residential buildings
- The saving potential through behavioural change, while significant, its long term exploitability is questionable
- The available data and thus the model results are much more reliable for residential buildings than for non-residential buildings

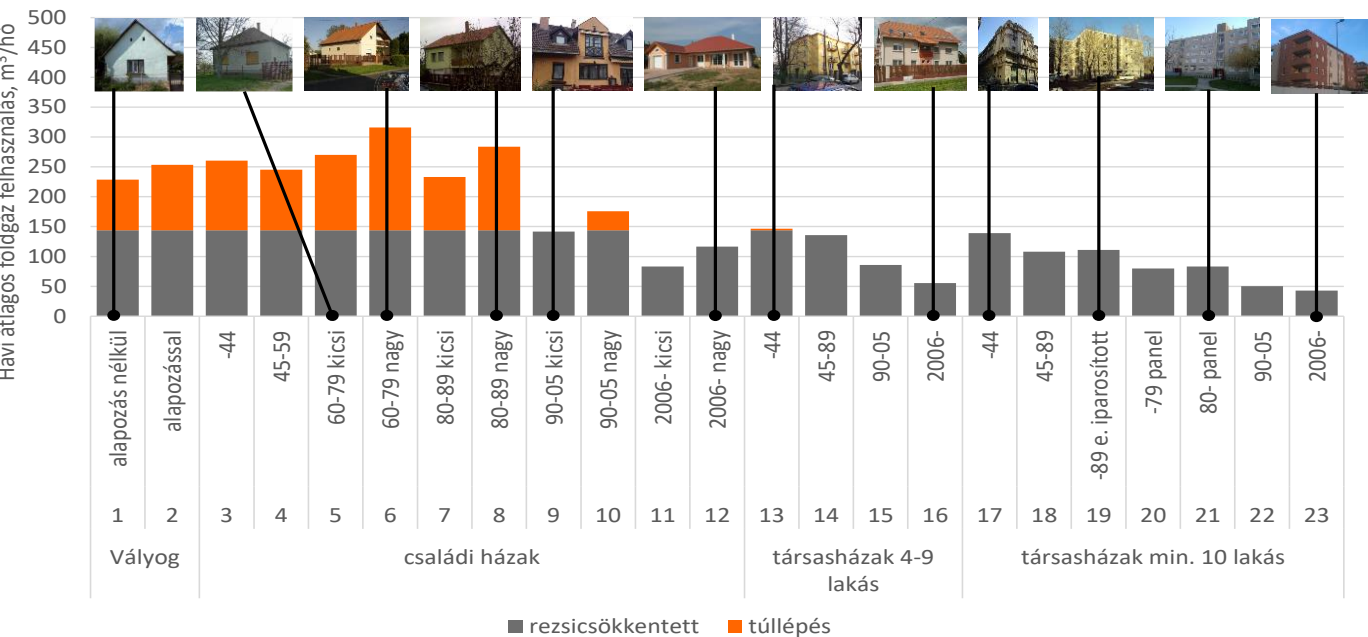
# Building sector – Gas consumption in medium term

## GAS CONSUMPTION IN THE BUILDING SECTOR

bcm	2021	2023	2025	2030
<b>Fact</b>	5.1			
<b>Moderate retrofit rate</b>		4,9	4,6	4,0
<b>Accelerated retrofit rate</b>		4,9	4,4	3,2

- The greatest potential for savings can be achieved in detached houses built before 1990, mainly through insulation of attic slabs and façades.
- Although residential buildings built before 1990 are motivated to save energy, the inhabitants of this segment have hindered than average financing possibilities.
- The great advantage of thermal insulation is that it provides lasting savings regardless of the energy source used.
- All measures must be accompanied by the possibility to control heating.

## GAS CONSUMPTION IN RESIDENTIAL BUILDING TYPES





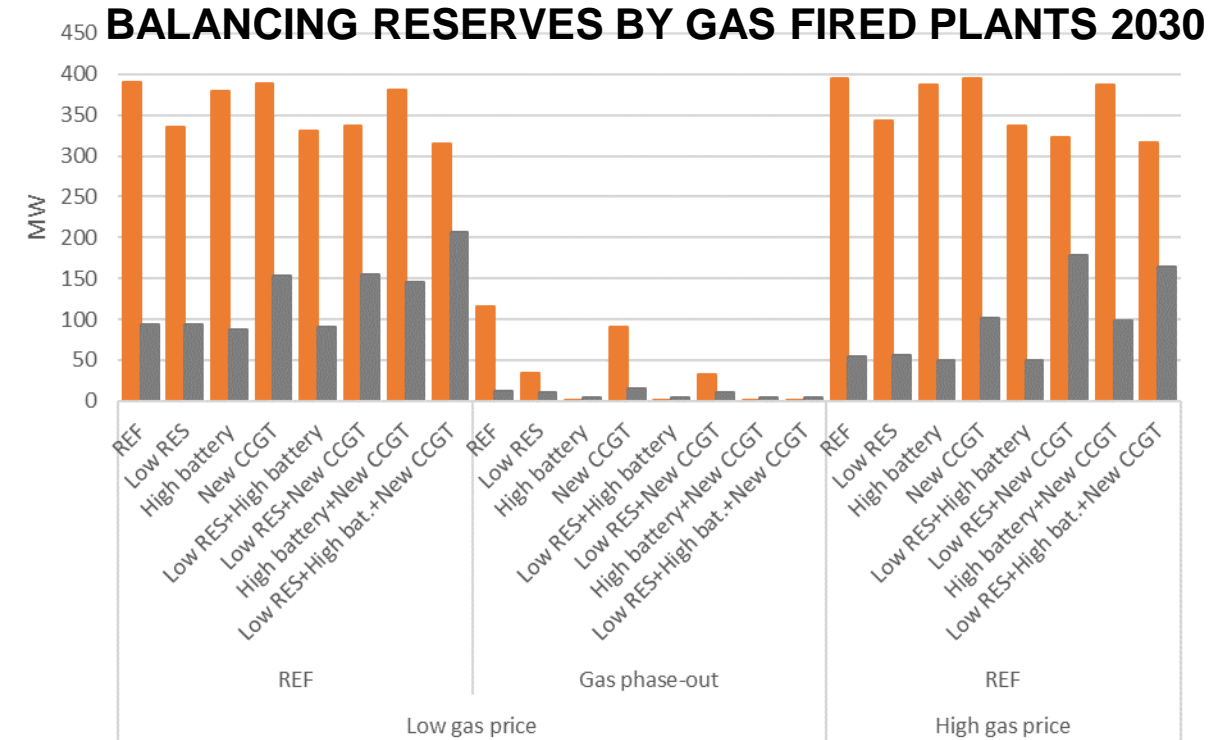
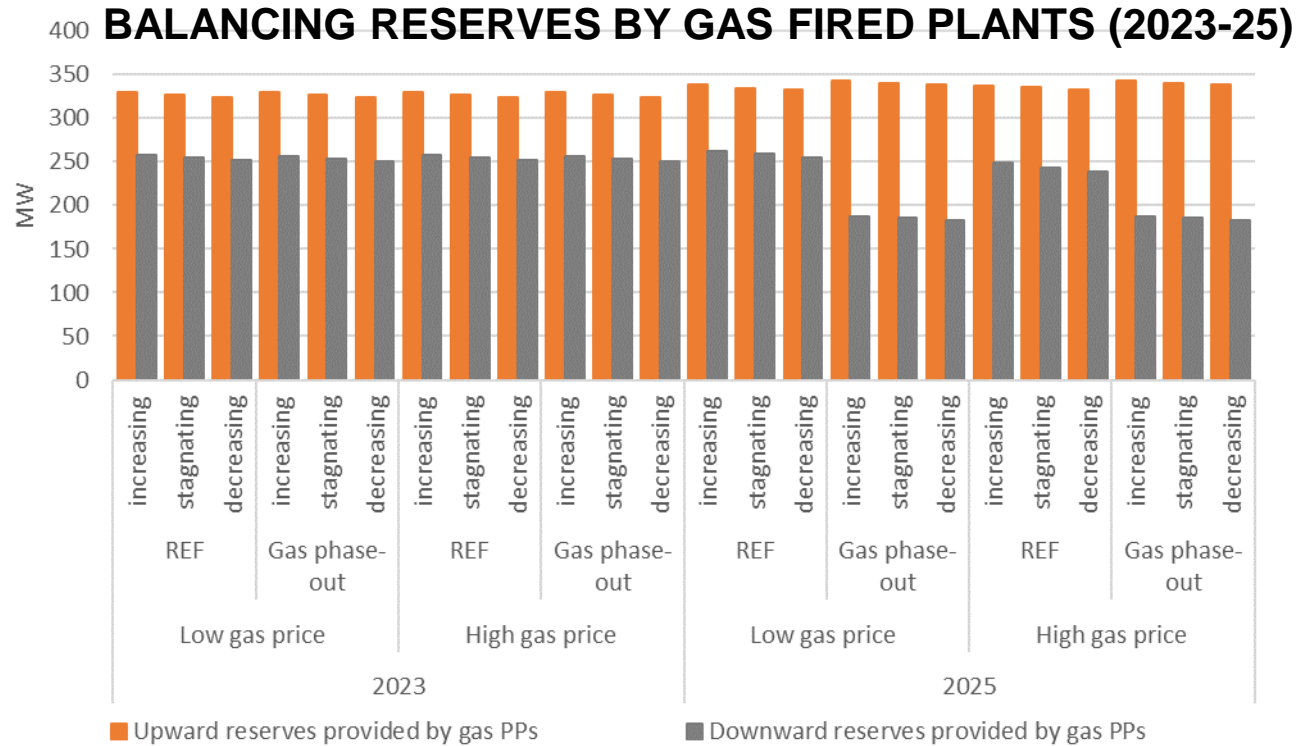
# Gas consumption of the electricity sector in the modelled scenarios

GAS CONSUMPTION IN THE ELECTRICITY SECTOR						
bcm			2021	2023	2025	2030
Fact			1.5			
Generate only for reserve markets (gas phase out)				0.46	0.33	0.05
Generate both for the product and reserve markets	Low gas price environment	No new CCGT		0.65	1.33	0.74
		New CCGTs				1.51
	High gas price environment	No new CCGT		0.64	0.88	0.43
		New CCGTs				1.01

- In the short term, mainly the **electricity demand can adapt**. A reduction in demand will slightly reduce the sector's gas consumption, but this effect is lower than the effect of a change in gas prices.
- In the 2030 timeframe, a **supply-side transformation is possible** that could facilitate gas substitution and may leave more space to policy measures.

- The **annual gas consumption in the electricity sector** - if gas-fired power plants are only present in the reserve market - will **decrease to 0.33 bcm in 2025 and almost zero in 2030**.
- If the power plants are **also present in the product market**, they will consume between **0.43 and 0.75 bcm**.
- If the **new CCGTs** are built and they produce for the product market, **gas consumption will not decrease in a low-price environment** even if relatively large amounts of renewables enter the system. If the construction of CCGTs is combined with a **high gas price environment**, the sector's gas consumption is expected to be around **1 bcm**.

# Balancing reserves provided by gas-fired plants in short (2023-25) and long-run (2030)

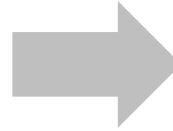


- **In the reserve market, gas-fired power plants cannot be replaced in the short term** upwards (until 2025), but their share decreases in the downwards direction by 2025.
- However, in the **long term (by 2030), gas-fired power plants can be replaced to a significant extent**, and in some scenarios even completely, in the reserve market as well.
- If batteries, renewables and consumers can come on the supply side of the reserve market in larger quantities, the **market will work well without new CCGT plants**.
- If there is still a need for gas capacity in the reserve market, it makes sense to keep plants with low must-runs in the system for gas withdrawal.

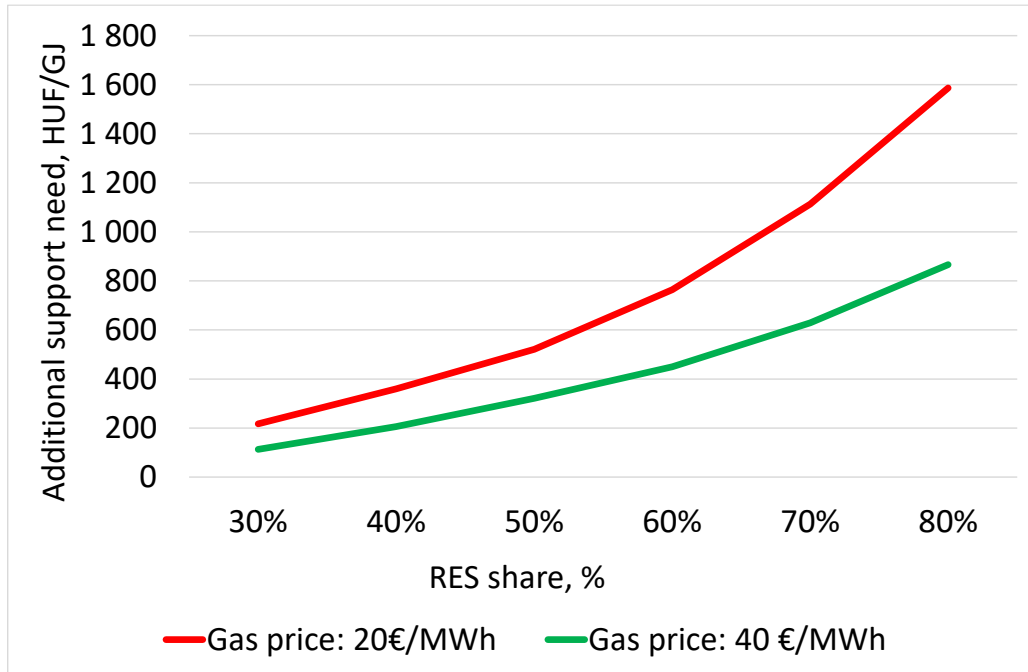
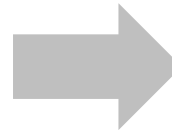
# District heating sector

## NATURAL GAS CONSUMPTION OF THE DH SECTOR

bcm	2021	2023	2025	2030
<b>Fact</b>	1.23			
<b>Optimistic scenario</b>		1.23	1.08	0.82
<b>Pessimistic scenario</b>		1.23	1.18	1.08



- Different **strategic documents** were analysed (Hungarian Energy Strategy, proposed RES Directive changes) and also the historical growth rate of the Hungarian RES-DH penetration were considered
- Based on these documents the annual gas consumption in the **district heating** sector will **decrease to 1.08-1.18 bcm in 2025 and 0.82-1.08 bcm in 2030**



- The higher the price of natural gas (40€/MWh, instead of 20€/MWh), the cheaper it is to achieve a given renewable share in the district heating sector
- 30% renewable rate is already achievable with a subsidy of 110-220 HUF/GJ, 80 % share with an 800-1600 HUF/GJ additional cost.
- Thus, if the current natural gas price level (~40€/MWh) were to remain, this would allow to **achieve an 80% renewable share** in the district heating sector **with an overall 27% increase in incremental costs**, thus radically reducing the use of natural gas

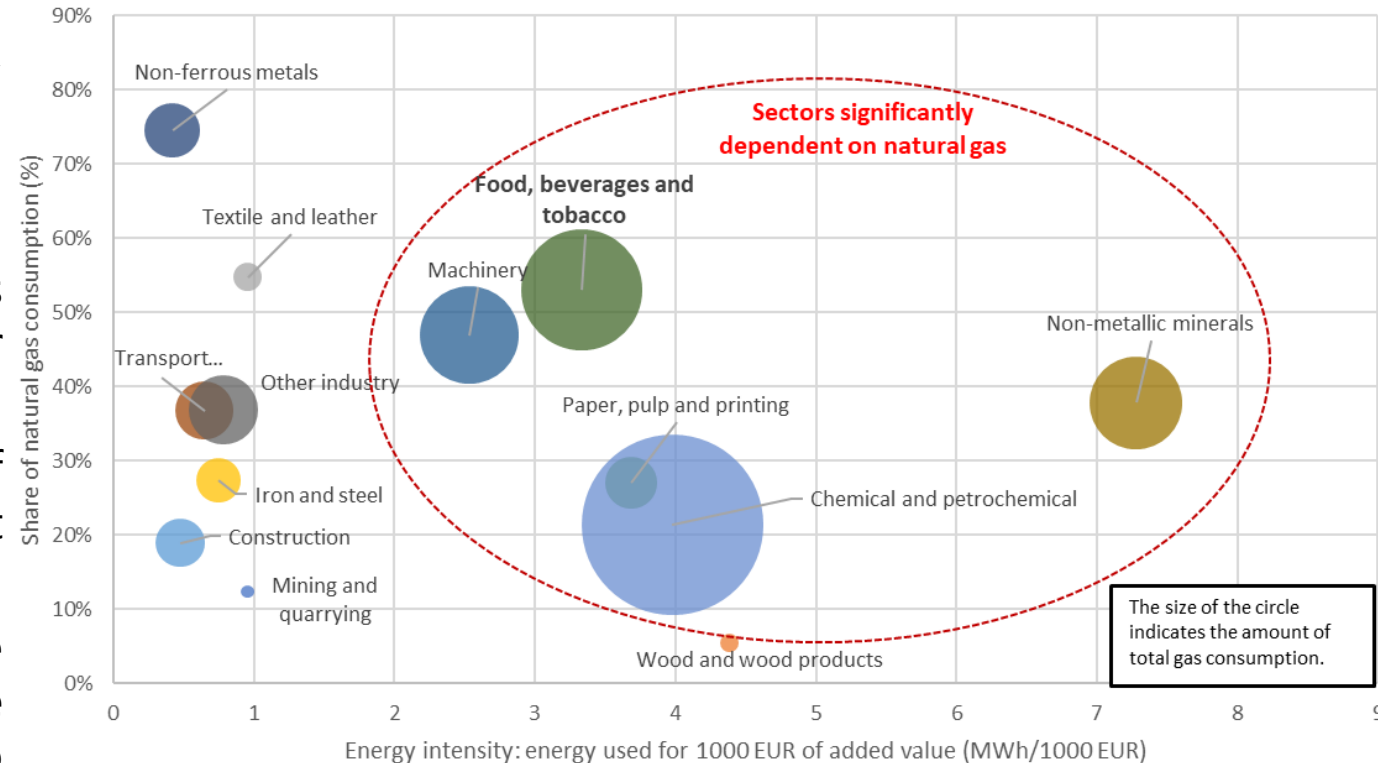


# Industrial sector

- Four sectors are most dependent on natural gas, which account for 77% of the sector's total consumption.
- In the field of **chemical and petrochemical industry** and **non-metallic minerals**, no change is expected due to the lack of opportunities for technological change.
- Due to the significant expansion in the field of **machinery** (battery production), a significant increase in natural gas consumption is expected.
- In the case of the **food industry**, feasible alternative technologies are available, so the natural gas consumption can be expected to decrease.
- Due to these effects, the gas consumption of the sector as a whole will not change significantly until 2030

*Forecasted natural gas consumption based on industrial interviews and REKK's expert estimation*

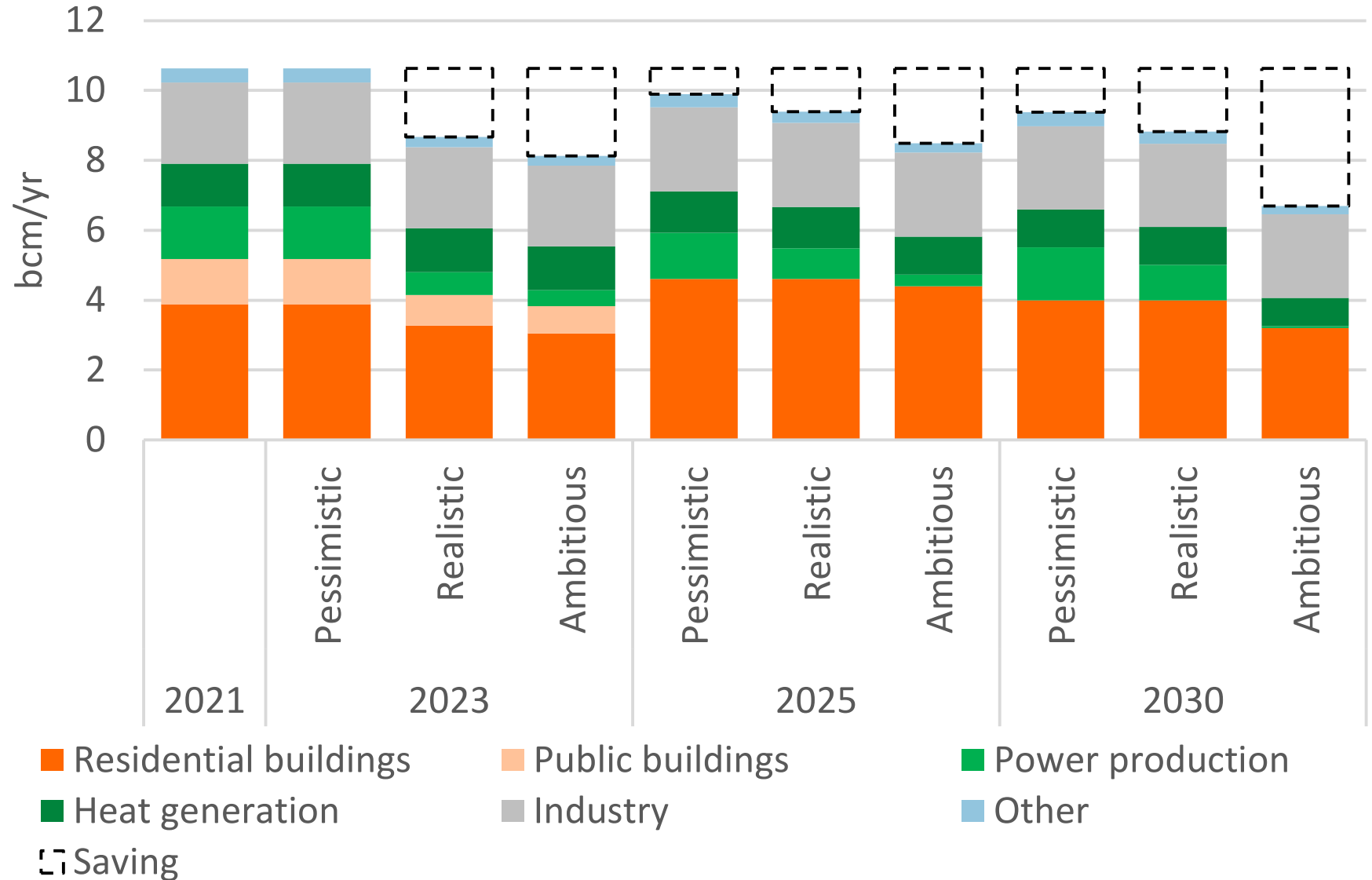
Characteristics of gas consumption by industrial sectors (2021)



	2021	2023	2025	2030
<b>Chemical and petrochemical (bcm)</b>	0,89	0,89	0,89	0,89
<b>Food, beverages and tobacco (bcm)</b>	0,40	0,36	0,28	0,20
<b>Machinery (bcm)</b>	0,26	0,30	0,50	0,60
<b>Non-metallic minerals (bcm)</b>	0,23	0,22	0,21	0,17
<b>Other sectors (bcm)</b>	0,53	0,53	0,53	0,53
<b>Changes of industrial gas consumption compared to 2021</b>		<b>-1%</b>	<b>-4%</b>	<b>3%</b>

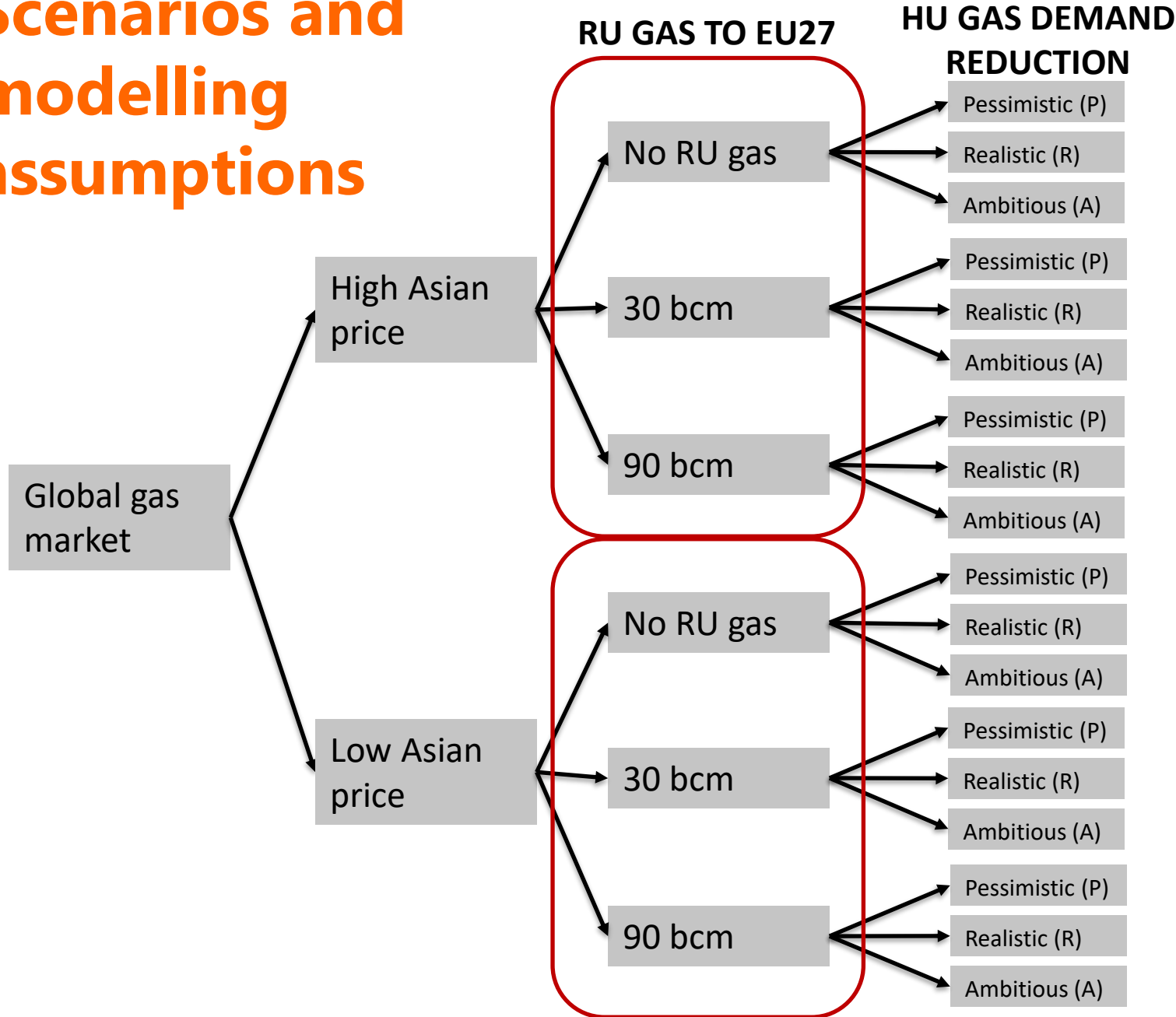
## HU gas need might be reduced by 37% for 2030 in the ambitious scenario

- Pessimistic (**P**): 10.6 bcm in 2023, 9.9 in 2025 and 9.4 in 2030
- Realistic (**R**): 8.7 bcm in 2023, 8.8 in 2025 and 8.1 in 2030
- Ambitious (**A**): 8.1 bcm in 2023, 8.5 in 2025 and 6.7 in 2030
- 2023 reduction potential indicated short-term adjustment, while 2025-2030 mean long-term savings



# **GAS MARKET MODELLING**

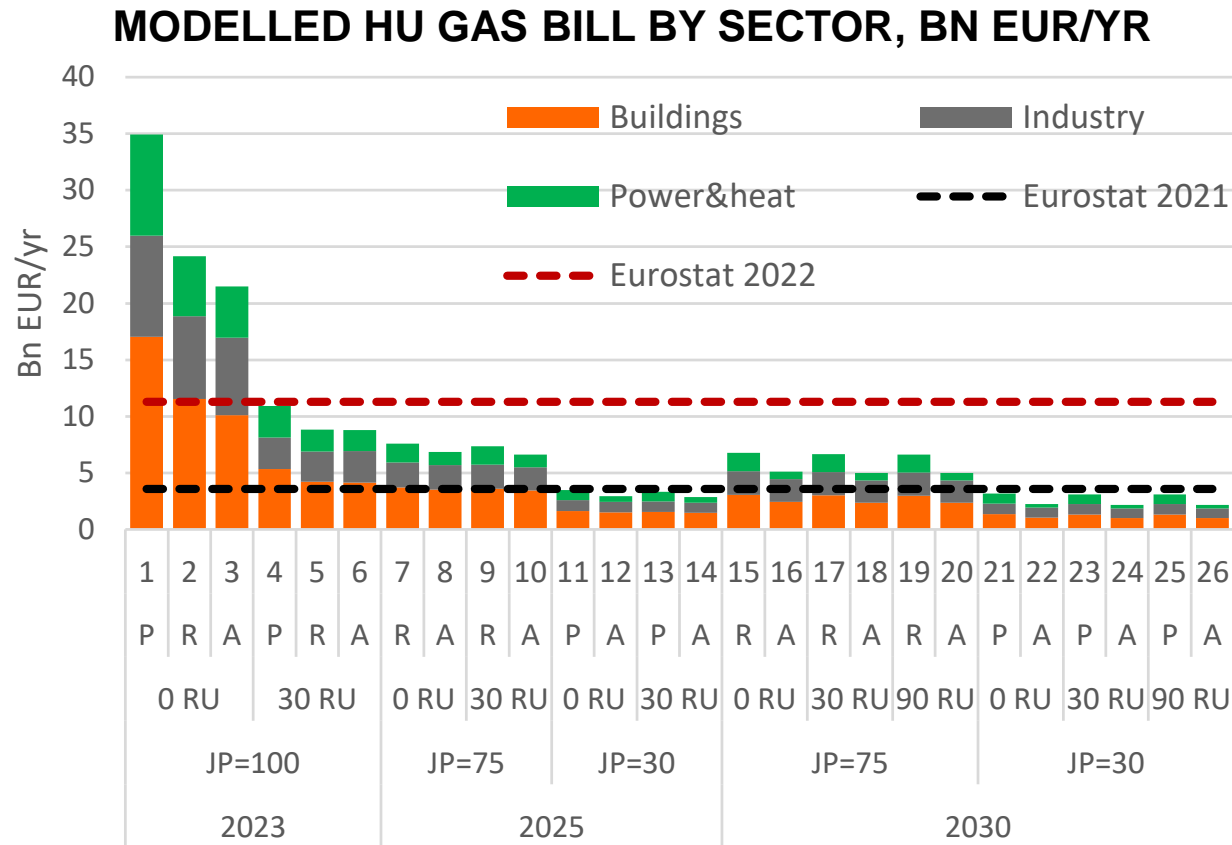
# Scenarios and modelling assumptions



## Common assumptions

- **LNG liquefaction** capacities will **grow by 140%** to 2030 from 2021. Most new capacities will come online in North America
- **LNG regasification capacities** will grow from 8 000 GWh/day **to 12000 GWh/day** by 2030
- **European gas demand** will develop in line with the REPowerEU plan **(-15% in 2023, -19% in 2025 and -30% in 2030)**
- Modelled years: 2023, 2025, 2030

# Cost of gas supply mainly depends on international factors



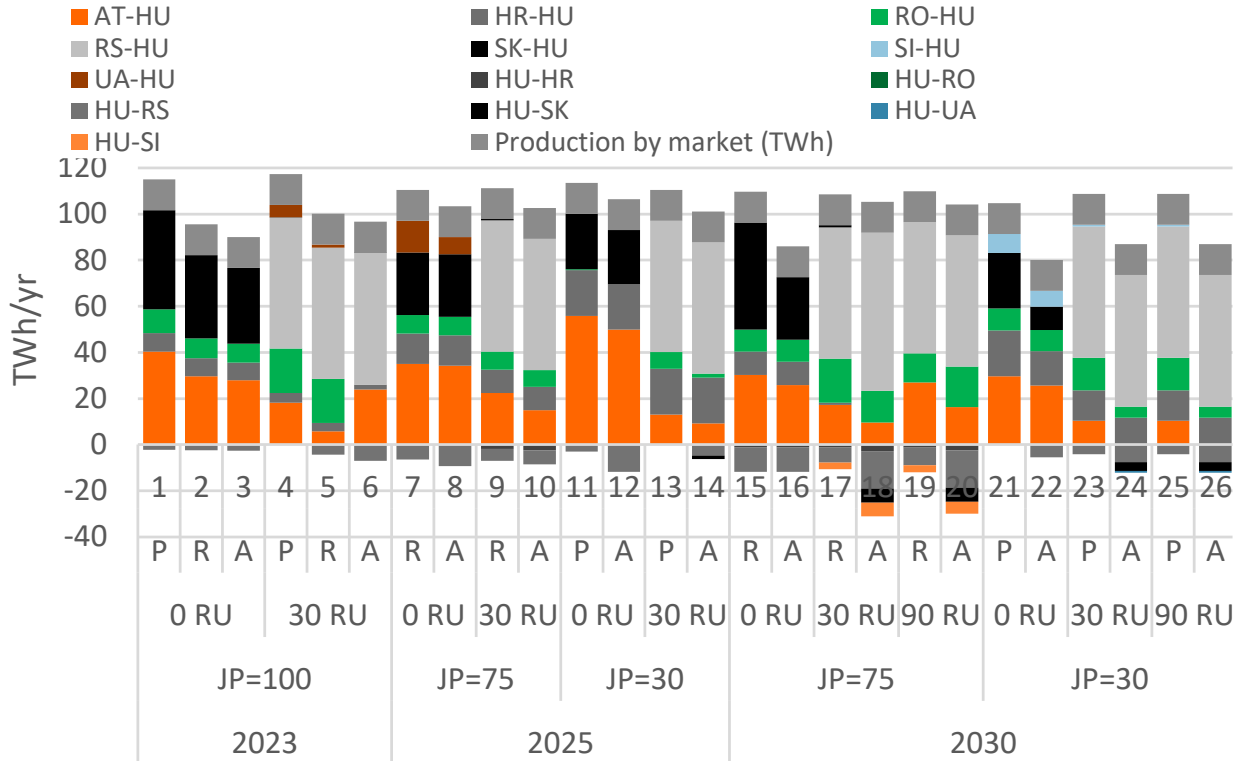
P: Pessimistic  
R: Realistic  
A: Ambitious

- HU gas bill is mainly driven by international price factors (Asian price and RU sales to Europe)
- Stopping all RU deliveries to Hungary would be extremely costly in 2023, but would not cause major price increase from 2025
- Gas demand can be satisfied in all scenarios
- Demand reduction on the long run helps to reduce dependency on Russian (or any other) gas in Hungary

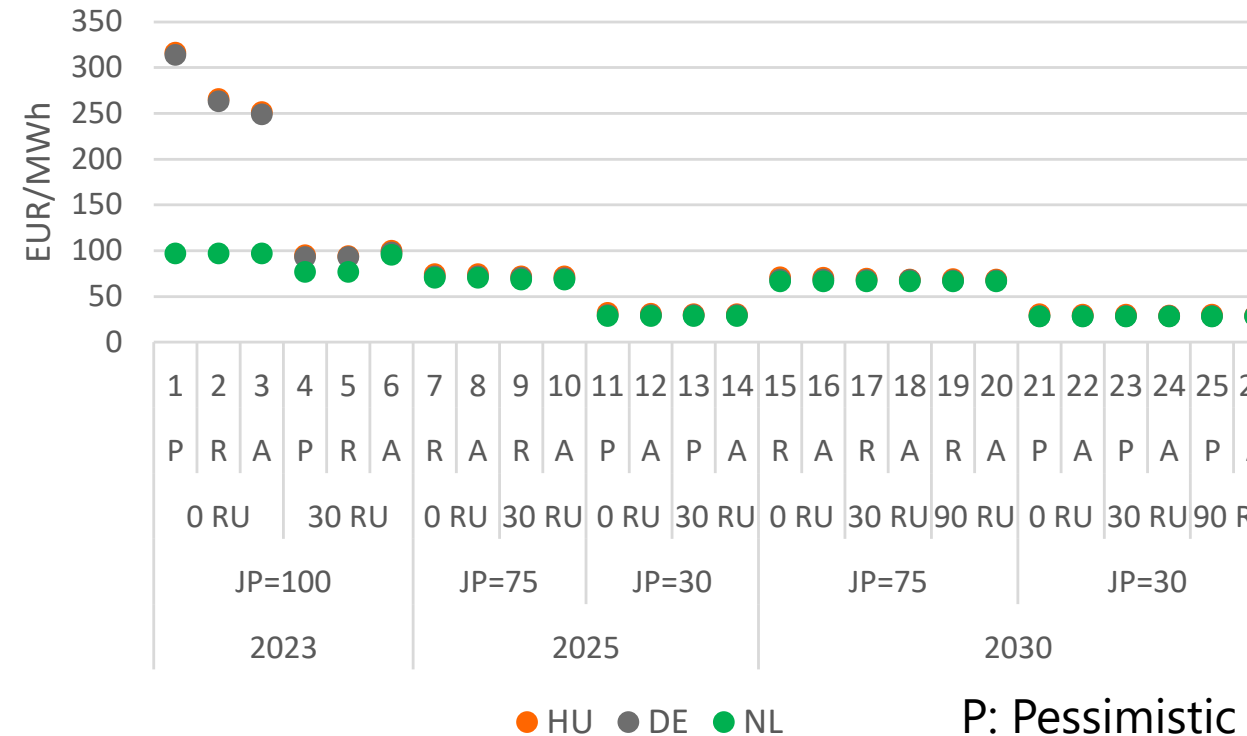


# Existing pipeline infrastructure can supply Hungarian needs

MODELLLED GAS FLOWS TO/FROM HU, TWH/YR



MODELLLED GAS PRICES, €/MWh



- Flow patterns are highly dependent on the availability of RU gas
- Thanks to the well interconnected Hungarian gas market, the supply of the country can be swiftly shifted to alternative routes (e.g. from RS-HU to a diversified mix of AT-HU / SK-HU / HR-HU)
- Gas prices are aligned with the major European markets (except for 2023 no RU gas scenarios, where scarcity is created)

P: Pessimistic  
R: Realistic  
A: Ambitious

# **REDUCING OIL DEPENDENCY – SAVING POTENTIALS OF TRANSPORT & OTHER**

# OIL: Alternative supply options and saving potentials

## SUPPLY

### STATUS

- Dependence from Russian crude oil decreased from 90% to 50% in the previous decade
- Besides to the slowly increasing domestic production, import via Adria pipeline increased significantly

### ALTERNATIVE SUPPLY OPTIONS

- The capacity bottleneck of the Adria pipeline is expected to be resolved soon.
- Crude oil comes in hundreds of different varieties or "grades". MOL refineries are optimized for handling the Urals type. Similar crude oils can be procured in the global market and/or mixed in the refinery after profitable investments (mixer, desaliniser).

## DEMAND

### STATUS

- About 60% of domestic consumption of petroleum products is related to the transport sector and 30% to industry. The consumption of oil products is rapidly increasing, especially in the industry and agriculture.

### SAVING POTENTIAL IN THE TRANSPORT SECTOR

- The consumption is expected to increase with a lower pace until 2030.
- The current growth in motorisation and car use cannot be offset by efficiency improvements and technological change (electric cars) alone.
- Policies should prioritise the shift to more sustainable modes of transport (public transport, rail) and the reduction of transport demand (teleworking, shortening the supply chains) for both passenger and freight transport.

### SAVING POTENTIAL IN OTHER SECTORS

- Consumption in the industrial sector is expected to increase until 2030.
- Based on the predicted ramp-up time of sustainable technologies, oil substitution is not expected to be sufficiently large to offset the increasing energy and feedstock requirements of the sector.

TÁRKI-REKK 2022

# HOUSEHOLD SURVEY RESULTS

# Gas-users in Hungary

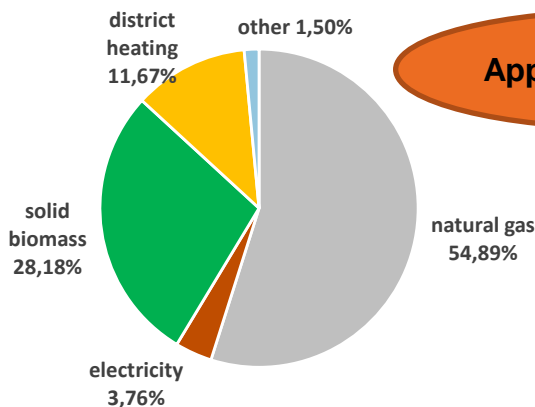
## The survey

- 1826 households were contacted of which **1013 filled the survey**
- The questioning was done between **15.10.2022 and 02.11.2022**
- The questioner consist of 81 questions
- The final database is **representative for the whole population in terms of building type and regional location** with an error margin of 3.4%

- In-house temperature and property size is similar to the country's average
- Tend to live in **Budapest and cities**.
- Tend to be **more educated** than country average
- Tend to have **higher per capita household income** than country average

## Characteristics of primary gas users

## Application of Gas



- 55% of the Hungarian households apply natural gas as primary and 7% as secondary energy carrier in heating.
- Altogether 91% of the households apply gas** in some form (including cooking, and water heating).

## Gas consumption reduction ability

Gas consumption reduction possibilities	With more than 75% of actual consumption	With more than 50% of actual consumption	With more than 25% of actual consumption	With less than 25% of actual consumption	Not possible to reduce consumption
Share of households (%)	1,25%	1,30%	10,68%	42,04%	44,72%

Data shows that for gas users it possible to reduce consumption both through **heating at a lower temperature**, substituting to alternative fuels (biomass, electricity) or making energy efficiency investments

**19% percent of the households using gas for heating** argue that they have absolute **no possibility to replace gas** (they would not heat or move to an other property), if gas supply would be cut

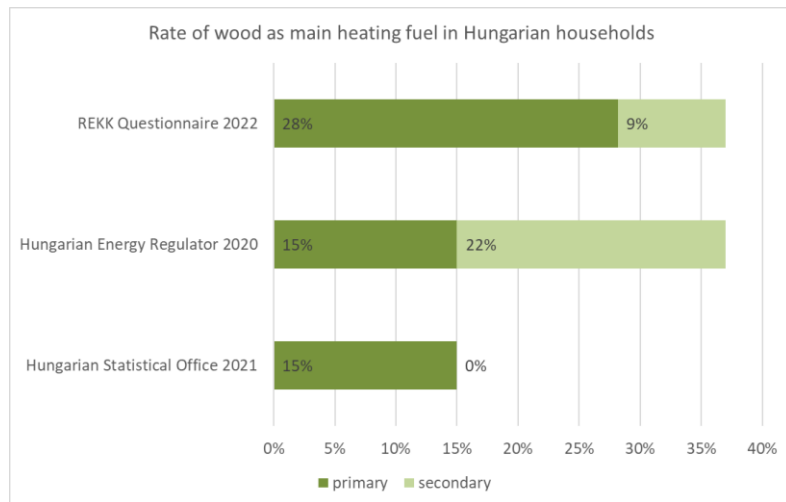


# Saving plans of gas users

Investment plans in the next 3 years (TOP 5)	Share of households planning, relative to households using gas for heating (%)	Energy saving behaviour plans (TOP 5)	Share of households planning, relative to households using gas for heating (%)
Changing windows	8.51	More conscious use of applications	71.11
Attic slab thermal insulation	6.18	Keeping lower temperature	56.43
Installing solar panels	4.85	Intermittent heating	38.96
Facade thermal insulation	4.02	Heating smaller area	24.00
Roof insulation	3.20	Replacement of household appliances	23.26

- The governmental end-user natural gas tariff increase **did not result in the acceleration of energy saving investments** relative to previous years
- Households generally try to save energy through **heating less in the properties**
- Supplementary calculations showed that **saving willingness is higher over the consumption threshold** value defined by the government, but **present in all consumption groups**

# Firewood for space heating – the current picture

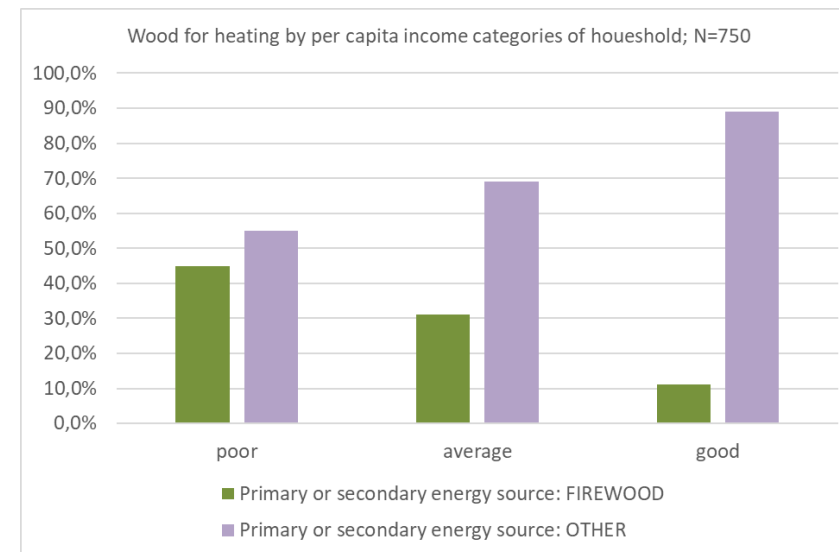


- **37%** of households use wood as main heating fuel. Firewood is now the primary heating fuel in 28% of households and the secondary fuel in 9%, a **significant shift away from the proportions of 2020.**

- Low education and low income are **strongly correlated** with use of wood for heating

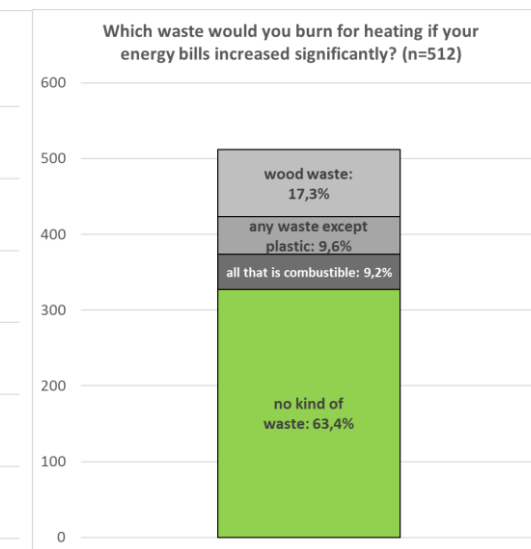
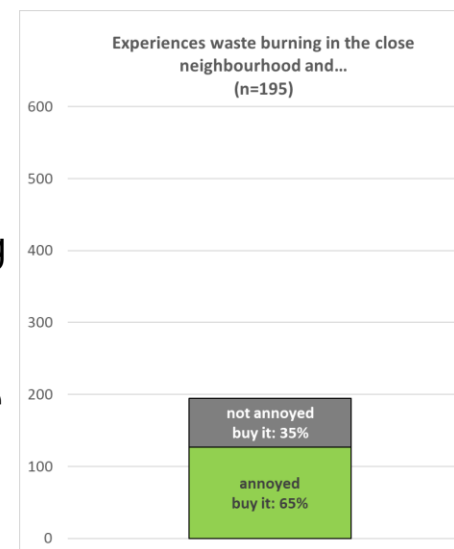
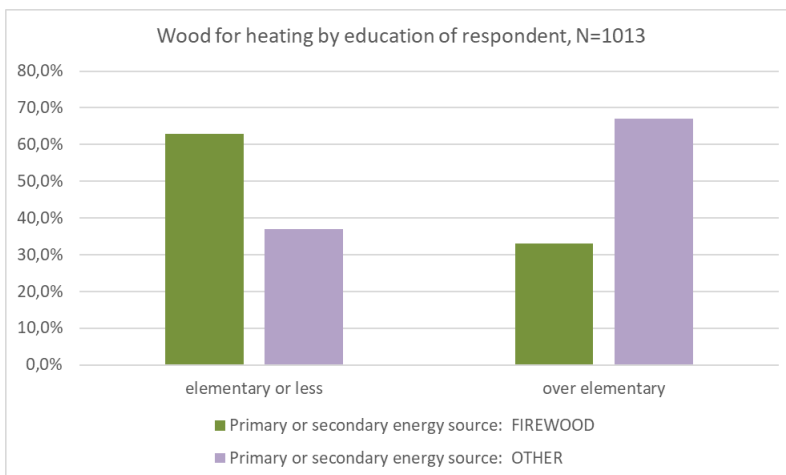
- Households of average social status have the technical capacity to **switch between gas and wood** – to and from

- 20% experiences waste burning and a third of them is not annoyed by it. **36% of those who can technically do so are ready to burn waste of some kind** (~720.000 households)



The average consumption of households who use firewood for heating is **8.7 m<sup>3</sup> annually**

Households let their firewood **dry for 5 months** on average



## Firewood for space heating – policy messages

<p><b>Dramatic increase in volume of firewood</b> used by households for space heating:</p> <p>Energy balance 2020: approx. 5.9 mn m<sup>3</sup></p> <p>Estimate based on REKK Survey: approx. 12.8 mn m<sup>3</sup></p>	<p>If the increase is firewood indeed: <b>source unidentified</b> - if forests: <b>unsustainable</b></p> <p>If the increase is not firewood: <b>unknown combustible</b> materials – note the very high rate of acceptance towards waste burning (previous slide)</p>
<p>Many households are ready to <b>switch</b> between gas and firewood – <b>to and from</b></p>	<p>The switch we measure in 2022 is <b>not permanent</b></p> <p>Many households would shift back to gas if they find that more beneficial</p>
<p>The vast majority of <b>households burn wet firewood</b> with extremely low efficiency, causing much more air pollution than necessary and using much less energy than possible from the firewood.</p>	<p>Firewood <b>should be dried for 2 years</b> before use.</p> <p>We measure 5 months of average drying</p> <p><b>The government should apply a strict and mandatory firewood standard for all the firewood that enters the market</b></p>
<p>Households of <b>low societal status</b> have been already using firewood mostly – gas has been secondary</p>	<p>The status of these households could be improved:</p> <p>they live in <b>buildings of low technical energy efficiency</b></p> <p>they <b>cut and collect for themselves</b> much of their firewood</p>
<p><b>Average status households</b> use firewood and other combustible materials in an <b>unsustainable</b> way</p>	<p>Government authorities should work out the <b>regulatory framework of the firewood market</b> to ensure origing <b>certification, traceability, quality</b></p> <p><b>promotion of efficient techniques</b> (wood gaisfier boilers, etc.)</p>
<p><b>Firewood should not be considered as a long term and sustainable solution for gas phase-out in households</b></p>	

# POLICY RECOMMENDATIONS

# Action plan

SECTOR	SHORT TERM (2025)	MID-LONG TERM (2030)
Building in HH	Targeted to family houses built before 1990: install equipments to regulate heat	Building isolation
	Utility regulation gave good signal for short term demand savings	Regulation should give further signal to other consumers (below the regulatory limit) as well
	Switching to biomass is a feasible option for many houtholds but to regulate wood heating is urgent	Biomass heating should also be modernized and switch to more efficient equipments incentivised
Power production	Incentivize entering of batteries to the secondary market (short trem products)	HU power market can run safely without new CCGTs
District heating	Set cost reflective tariffs When switching from gas, give preference for geothermal and waste heat against biomass	High RES DH (80%) is possible with only 27% cost increase (assuming 40€/MWh gas price)
Industry	Incentivize food industry to switch from gas to clean technologies	On the long term industrial gas demand will depend on sectoral developments, and not much savings are envisaged
Oil	Cost reflective prices (done)	Electrification of transport can alone not compensate for the demand growth



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