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QUICK AND DIRTY?

EVALUATING SHORT-TERM GAS DEMAND REDUCTION POTENTIAL IN EUROPE

The previous REKK policy brief examined short-term supply side options available for the EU to substitute for an annual volume of Russian gas (1560 TWh) through the upcoming 2022/2023 winter. With short-term alternative pipeline sources maximized, only an additional 500 TWh (~50 bcm) of LNG is available to the EU.

Still the EU would be forced to reduce short-term gas demand by about 1000 TWh (~100 bcm) to make up the difference. This would come at very high cost given global market dynamics, adding approximately EUR 100 billion to the bill for European consumers. That is where this policy brief picks up, to determine the short-term demand side and fuel switching potential across three main sectors – power, heat and industry. This short study finds that:

- In a worst-case emergency scenario, power and heat sector switching to coal can nearly match the value on its own (990 TWh). This would increase EU coal power plant utilization from 44% in 2021 to 72% and commensurate CO₂ emissions.
- Voluntary heat reduction in residential and services buildings by 1°C could save 85 TWh.
- Industry sector switching potential is limited (276 TWh)

Considering a bloc of the EU27+UK+9 Contracting Parties¹ of the Energy Community, the three main sectors were responsible for 97% (4937 TWh) gas consumption in 2020:

- Electricity and heat generation - 37% (1823 TWh)
- Residential and services - 36% (1779 TWh)
- Industry - 24% (1195 TWh)
- Transport and other - 3% (140 TWh)

Each sector with over 5% share will be evaluated and analysed in the following sections.

HEAT DEMAND IN BUILDINGS

Heat demand is by nature seasonal and highly variable, depending on temperature, the state of the building stock, and consumer behaviour. For the purposes of this study, a simple top-down approach is used to fit a linear relationship between daily gas demand and heating degree days (HDD) at the country-level.

First, the consumption figures were derived from the ENTSOG transparency platform which tracks daily gas flows across the European gas transmission network by listing entry and exit volumes.² The exit to distribution networks represents building heat and hot water demand, while the final consumers are large electricity and heat generation plants or industry, such as cement and steel factories. Then HDDs were calculated using the Eurostat methodology: if the daily average temperature is below 15°C, then HDD is equal to 18°C minus the daily mean temperature, otherwise it is 0.

HDDs were then fitted to the daily gas consumption of each individual country. The effect of heating buildings to lower indoor temperature was estimated as a function of lower HDDs calculated as 17°C minus the daily mean temperature, instead of 18°C.

Based on the linear relationship, the effect of a lower heat setting on total consumption could be determined: a 1°C reduction in heat temperature equates to 5% less consumption, 2°C to nearly 9%, and 3°C 14%. This 0.5-3°C adjustment translates to 51-305 TWh (~5-30 bcm). It must be said that consumer behaviour cannot be monitored or enforced easily, and the above estimate assumes that 100% of the household consumers apply the temperature reduction.

In reality, the high European gas price environment of late 2021 to early 2022 triggered some demand response from households. In Belgium, household non-weather adjusted demand fell by 16% in January compared to the year before, and then 18% in February – though this was partly a consumer response to the invasion of Ukraine. A March 2022 UK survey reported that 43% of households are using less gas and electricity because of the high cost of energy. In an online questionnaire conducted in late 2021, 2/3rds of interviewed French households indicated that they would

limit heating temperature to pay less. This demonstrates the power of price signals to exploit household demand flexibility, but in Central Eastern Europe (CEE) households are typically not exposed to these market prices and pay a regulated rate. Moreover, the various countries have different preferences for indoor heat, some heating buildings more than others.

If the price does not provide the signal, governments can request consumers turn down the thermostat. While there is no direct financial cost (in fact the consumer is ‘saving’), it does affect comfort level and depends on proactive government communication and voluntary cooperation. Such consumer information campaigns are less prevalent in CEE, and there is even a counterexample in Hungary with the government imploring consumers not to lower thermostats.

1 This region includes the following countries: Belgium, Bulgaria, Czech Republic, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden, United Kingdom, Montenegro, North Macedonia, Albania, Serbia, Bosnia and Herzegovina, Kosovo (under United Nations Security Council Resolution 1244/99), Moldova, Ukraine, Georgia

2 Data available for 20 countries covering 94% of EU27+UK+EnC natural gas consumption: Germany, United Kingdom, Italy, France, Netherlands, Spain, Ukraine, Poland, Belgium, Romania, Hungary, Austria, Portugal, Bulgaria, Croatia, Slovenia, Lithuania, Czech Republic, Slovakia, Greece

3 For the missing countries, a similar neighbouring market was selected to assess the effects (e.g. relative effect of 1 degree Celsius reduction on Belgium was applied for Luxembourg as well).

4 IEA estimates a 10 bcm gas demand reduction potential for the EU related to 1 Celsius demand reduction, see [IEA \(2022\): A 10-Point Plan to Reduce the European Union's Reliance on Russian Natural Gas](#)

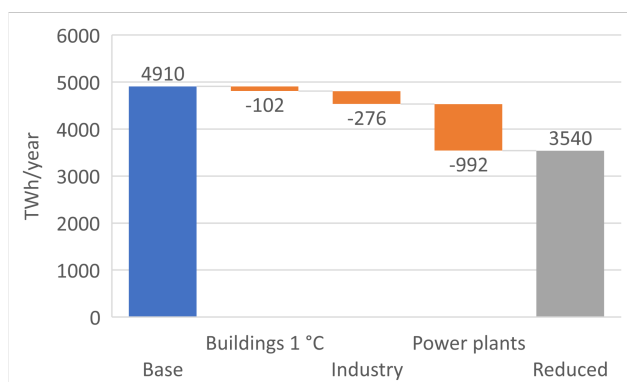
5 [Ook de thermostaat een graadje lager gezet? Vlaamse gezinnen verbruikten voorbije maanden veel minder gas](#)

6 [Coronavirus and the social impacts on Great Britain: 18 March 2022](#)

7 [Nearly 2 in 3 French people turn down the heating to reduce their bill](#)

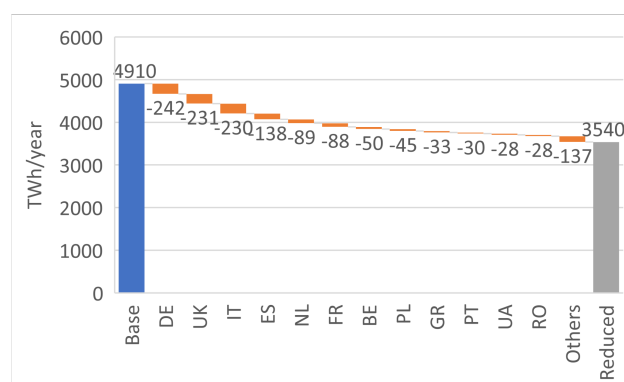
8 e.g. Hungarian consumers tend to heat the buildings to higher temperature than German consumers. Csutora, M. et al (2021): The Grounded Survey – An integrative mixed method for scrutinizing household energy behavior, Ecological Economics, Volume 182, 2021,106907, <https://doi.org/10.1016/j.ecolecon.2020.106907>.

FIGURE 1. POTENTIAL NATURAL GAS SAVINGS BY SECTOR, TWH/YEAR



Source: REKK estimation

FIGURE 2. POTENTIAL NATURAL GAS SAVINGS BY COUNTRY, TWH/YEAR



Source: REKK estimation

INDUSTRY

The industrial sector uses gas either as direct feedstock or to generate high-temperature heat for industrial processes. Feedstocks can't be replaced in the short-term but industrial heat can be switched to a substitute fuel if the infrastructure is in place.

For this exercise, we assume cement, iron and steel have the capability to switch from natural gas to oil or other fossil fuels. Together these three sub-sectors make up 25% of industrial demand, or 276 TWh.

POWER AND HEAT GENERATION

This study only takes into account power plants because there is no available database for heating plants. In 2021, natural gas accounted for 20% of electricity generated (600 TWh) in the EU27+UK+EnC bloc. The consumption can be estimated using the baseline assumption of 50% efficiency, 5% self-consumption, and 90% technical availability, totalling 1265 TWh.

Switching must meet two criteria: (i) the technology cannot be intermittent and (ii) spare capacity must be sufficient to ramp up production. This excludes both renewable energy sources (RES-E) that cannot 'ramp up' production in this short time frame and nuclear power, which sits at full capacity, leaving only fossil lignite, coal and oil-based alternatives. In 2021, these fossil installations were running an average of 44%. If utilization is pushed to 72% these sources would meet a 600 TWh gap in electricity produced by natural gas. Most of this additional generation is from carbon intensive hard coal (68%) and brown coal and lignite (18%), which would increase the CO₂ emissions by nearly 80%.

In the real world, infrastructure bottlenecks and locational availability would constrain the potential of these plants. The REKK EPMM (European Power Market Model) can address this by modelling the amount of energy in the system that would not switch even with prohibitively high gas prices. This "minimum natural gas-based generation," was estimated to be 134 TWh, equating to ~282 TWh/year natural gas consumption. Given the 1265 TWh of total gas consumption in the power sector in 2021, this implies that 990 TWh/year is capable of switching to other fuels.

SUMMING UP ALL SECTORS

Based on the above assumptions, the potential of each sector to reduce gas consumption is presented below.

Accounting for interconnector capacity constraints, the theoretical switching potential of the power and heat sector is 780 TWh. By increasing the utilization of fossil (almost exclusively coal) plants from 44% to 72%, nearly all natural gas in the electricity sector can be substituted. In addition, lowering thermostats by 1°C can save 100 TWh and industry can contribute and additional 280 TWh reduction. It should be noted that these numbers relate to maximum potential with no associated costs.

Altogether an estimated 1300 TWh/yr of short-term gas demand reduction can be achieved with existing infrastructure, which is 80% of Russian gas consumed in 2020 (1560 TWh).

CONCLUSION

The headline 'quick and dirty' solution switching from natural gas to lignite and coal should only be considered for extreme emergency scenarios if Russian gas is cut suddenly, completely and unexpectedly. This should not steer away from Europe's long term decarbonisation plans which naturally reduce exposure to Russian gas imports, but rather serve as an illustration of the short-term resilience of the current European energy sector.

Households can implement basic energy efficiency improvements (e.g. insulation of windows, doors, etc.) to alleviate the discomfort associated with a drop in the thermostat, and go a step further by switching from gas to biomass or electric heating in the medium term. This potential is not assessed here due to a lack of data.

Taking also into consideration supply side options highlighted in our previous policy brief, there are ample supply and demand side solutions capable of responding to a cut in Russian natural gas supply: (i) increasing LNG and pipeline flexibility from other suppliers; (ii) allowing price signals to reduce consumer heat demand; (iii) readying coal plants for a security of supply emergency. Besides these more extreme immediate responses available for the 2022-2023 winter, the medium and long-term solutions for ending Russian energy dependence are at the heart of the European Green Deal, namely RES deployment, energy efficiency measures, and electrification of heating.

We are grateful for the useful insights and comments of András Vékony, András Mezősi, Adrienn Selei, Nolan Theisen and László Szabó. The content is the sole responsibility of the authors.

9 An official letter distributed by the Hungarian Government to all registered for COVID vaccinations 22 March 2022 makes an explicitly negative connotation to the initiative supported by „the vice president of the European Commission and some others” to lower the thermostats as a measure that negatively affects Hungarian households and against which the Hungarian Government will protect its consumers.

10 Increased renewable installations might alleviate this issue.

11 Emission factors based on 2006 IPCC Guidelines for National Greenhouse Gas Inventories Chapter 2 Stationary combustion: Natural gas 56 100 kg/TJ, Hard coal 94 600 kg/TJ, Lignite 101 000 TJ/kg, Oil 74 100.

REKK FOUNDATION

The goal of the REKK Foundation is to contribute to the formation of sustainable energy systems in Central Europe, both from a business and environmental perspective. Its mission statement is to provide a platform for open-ended, European-wide dialogue between government and business actors, infrastructure operators, energy producers and traders, regulators and consumers, professional journalists and other interested private entities. The Foundation will develop policy briefs and issue papers with forward-looking proposals concerning challenges posed by energy and infrastructure systems and organize regional forums allowing stakeholders to become familiar with the latest technological and regulatory developments within the industry.

AUTHORS



Péter Kotek graduated in 2009 at the Corvinus University of Budapest as an economist, majoring in market analysis. He joined REKK in the same year as a research associate. From 2015, he is working as a senior research associate. His areas of interest are ancillary services market in electricity, LNG and gas storage markets. He has participated actively in REKK's gas market modelling work since 2015.



Enikő Kácsor is a senior research associate at REKK. She studied Economics and Actuary at the Corvinus University of Budapest, and received her PhD in Economics in 2021. Her research topic is renewable support allocation through auctions. She joined REKK as a trainee in 2011, since then she has become a senior research associate. She works on projects related to electricity market modelling and renewable energy policies (international price comparison, monitoring, regulation, support schemes), and on natural gas related projects (transmission tariffs, benchmarking, regulation). She is a regular lecturer at different REKK trainings.



Borbála Takácsné Tóth has worked with REKK since its creation in 2004. In 2001 she received an M.A. in International Relations and European Studies at the Central European University in Budapest. Borbála is an economist and received her degree from the Budapest University of Economic Sciences in 1998. She spent 5 years as a civil servant in government administration mostly in the field of energy regulation. Between 2001 and 2003 she was Head of the President's Secretariat responsible for international relations of the Hungarian Energy Office. In this capacity she worked closely with ERRA and CEER. With REKK she has been leading several international and national consultancy projects, with many using the EGMM as the primary analytic tool. Her main fields of expertise include: regional co-operations; security of supply issues; energy geopolitics; major infrastructure initiatives in the gas sector and incentives for investments; competition cases in the gas market; and the effect of gas release programs on competition in the gas market in Europe.



Gábor Horváth joined REKK as a research associate in September 2019. He completed his bachelor degree at Corvinus University of Budapest in Business Administration and Management. After that he started his MA degree in economics at Eötvös Loránd University and absolved in 2019. During his university studies he was also a member of Rajk László College for Advanced Studies, a college of Corvinus University of Budapest. Before joining REKK he was working as a data analyst and research assistant at various projects.

TABLE 1. DETAILED SAVING POTENTIALS BY COUNTRY AND SECTOR, TWH/YEAR

	Gas consumption 2020	Residential and heating (1 degree)	Power&heat	Industry	Total savings	Savings (Share of 2020)
	TWh/year	TWh/year	TWh/year	TWh/year	TWh/year	%
AL	0.4	0.0	0.0	0.0	0.0	0%
AT	84.8	0.9	17.2	10.1	28.2	-33%
BA	2.0	0.0	0.0	0.3	0.3	-16%
BE	176.5	4.0	33.9	12.5	50.4	-29%
BG	29.3	0.1	5.8	4.3	10.1	-35%
CZ	84.6	1.7	11.8	8.7	22.3	-26%
CY	0.0	0.0	0.0	0.0	0.0	0%
DE	867.6	18.8	167.7	56.0	242.5	-28%
DK	28.6	0.5	5.5	2.2	8.1	-28%
EE	4.0	0.0	0.0	0.1	0.2	-4%
ES	324.8	1.0	107.1	29.9	138.0	-43%
FI	24.7	0.0	7.0	2.3	9.3	-38%
FR	407.8	10.4	51.7	26.0	88.1	-22%
GR	57.3	0.2	31.8	0.8	32.8	-57%
HR	29.4	0.3	5.5	1.1	6.8	-23%
HU	102.0	2.3	17.0	3.3	22.6	-22%
IE	53.0	0.8	3.9	0.3	5.0	-10%
IT	678.8	17.9	173.0	39.4	230.4	-34%
KO	0.0	0.0	0.0	0.0	0.0	0%
LT	22.9	0.1	1.1	0.3	1.5	-6%
LU	7.3	0.3	0.4	2.3	3.0	-41%
LV	10.6	0.1	0.0	0.4	0.5	-4%
MD	9.0	0.2	0.0	0.5	0.7	-7%
ME	0.0	0.0	0.0	0.0	0.0	0%
MK	3.2	0.0	0.0	0.3	0.3	-10%
MT	3.7	0.0	0.0	0.0	0.0	0%
NL	367.8	7.8	72.9	7.9	88.6	-24%
PL	202.8	2.0	22.2	20.3	44.5	-22%
PT	60.4	0.1	23.6	6.3	30.1	-50%
RO	112.6	2.3	18.8	7.3	28.3	-25%
RS	23.1	0.1	0.0	1.9	2.1	-9%
SE	14.6	0.1	0.0	1.7	1.8	-12%
SI	8.6	0.0	1.0	1.8	2.8	-33%
SK	47.5	0.2	7.8	3.1	11.1	-23%
UA	278.2	3.7	0.0	24.8	28.4	-10%
UK	781.7	25.8	205.2	0.0	231.0	-30%
Total	4910	102	992	276	1370	-28%