

PUTTING A STOP TO ENERGY WASTE

HOW BUILDING INSULATION CAN REDUCE
FOSSIL FUEL IMPORTS AND BOOST
EU ENERGY SECURITY

Policy Briefing May 2022

EXECUTIVE SUMMARY

This paper investigates how improving the energy performance of the building envelope in selected EU Member States would lower fossil fuel consumption, increase energy security and enable the growth of renewable heat. The study shows how improving insulation can reduce energy demand and drastically cut Russian oil and gas imports for heating in buildings. Investing in building renovation can reduce the use of fossil fuels for heating in buildings, reaching 44% in gas savings, save 45% of final energy demand and substantially contribute to securing the EU's energy needs.

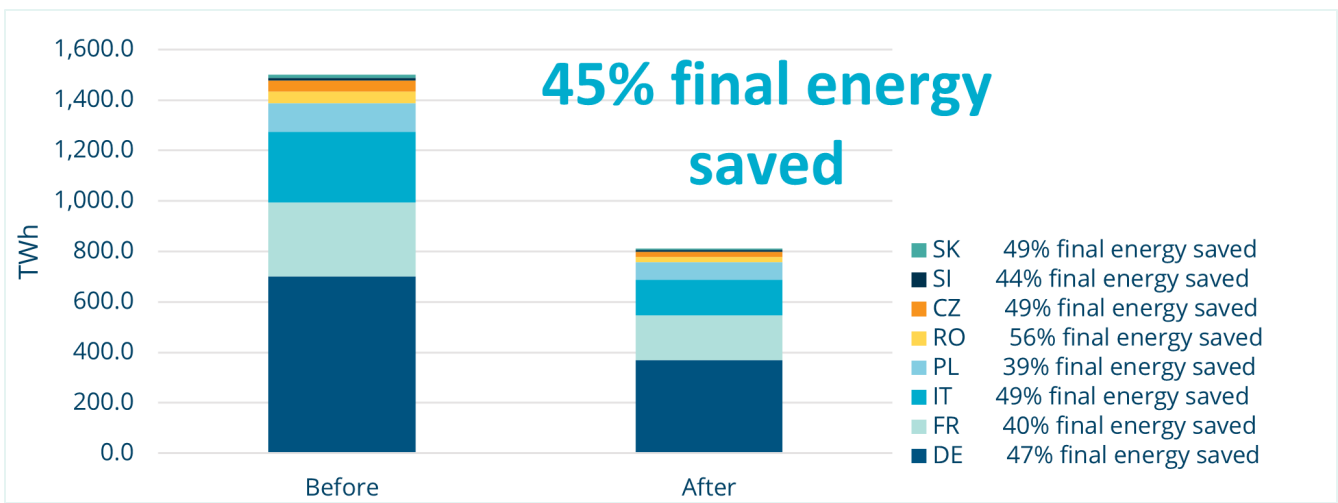


Figure A Final energy consumption for space heating in buildings before and after renovation (in TWh) and final energy saved (%) in each country

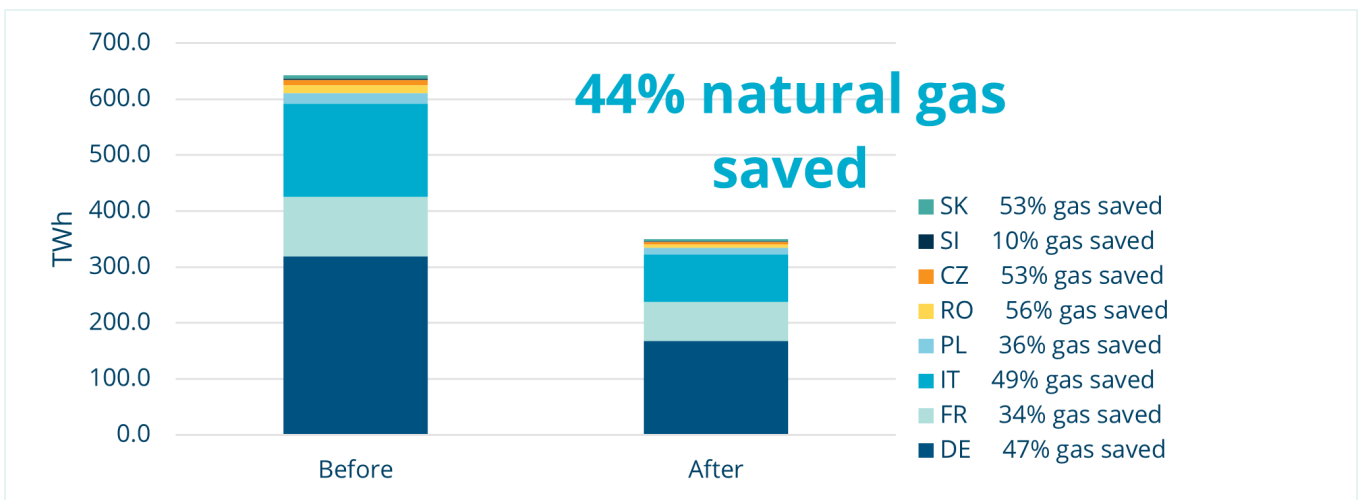


Figure B Final gas consumption for space heating in buildings before and after renovation (in TWh) and gas saved (%) after renovation in each country

Diversifying gas imports should not be considered the only way to quickly avoid Russian gas imports. Reducing demand to allow a steady increase of renewable energy supply as an alternative to fossil fuel imports is the alternative the EU should pursue. REPowerEU and the EU SAVE Plan must treat lowering energy demand as an essential prerequisite to achieve energy independence and a just energy transition.

To this end, the EU SAVE Plan should:

- Recognise that the best way to decrease the EU's energy dependency is to make lasting reductions to energy consumption and apply the 'efficiency first' principle.
- Acknowledge reducing energy demand as an absolute priority by fast-tracking policies to accelerate energy efficiency improvements and renewable energy supply in the Fit for 55 package, and recognise the value of pursuing them in parallel, not as alternatives to each other.
- Direct short- and long-term investments to improve building envelopes and insulate roofs and walls as a priority. Some funding already available under the Recovery and Resilience Facility could be reallocated by renegotiating national recovery plans, boosting and front-loading their building renovation component. To achieve the 2030 and 2050 climate goals, such investments must be sustained over time.
- Recognise that reducing energy demand and securing investments in building renovation are prerequisites to switch from fossil fuels to renewable heat and manage the increase in electricity use which may ensue.
- Urge Member States to update their national renovation strategies and support their implementation with dedicated long-term financing instruments to speed up renovation.
- Stop subsidies to fossil-fuel-based equipment to accelerate their phase-out from the EU market and accelerate financial support to replace fossil fuel heating systems with renewables.
- Help the building supply chain by boosting upskilling activities to have a workforce ready to renovate and install quickly.
- Roll out building renovation passports, one-stop-shops and renovation services while fostering skills to make sure every renovation is aligned with the long-term climate and energy targets and all buildings are ready for future upgrades.



INTRODUCTION

Since Russia's aggression against Ukraine began, the question of the EU's energy import dependency has moved to the centre of energy and security policy. With Russian gas holding the highest share of imports, covering almost 45% of the EU's gas demand, the war in Ukraine is highlighting the risks for the EU of relying on one supplier for a high share of fuel imports.

Driven by the commitment to reduce energy imports from Russia – which support its economy – the EU is now forced to look for alternatives to secure its energy supply. Three options exist:

- 1 Reduce energy demand by stopping energy waste and improving efficiency in all sectors.
- 2 Replace fossil fuels with renewable energy sources as quickly as possible.
- 3 Diversify fossil fuel supply by increasing imports from other countries, including those run by undemocratic or unstable governments.

While all three solutions may have their merits, a higher energy efficiency performance brings a security dividend to our society and economic system. Diversifying the EU's energy supply should not be considered the only priority to secure energy independence and cut imports from Russia. All future decisions must be taken with the double priorities of securing energy independence and meeting our climate targets in mind.

It is essential to recognise that the economics of energy efficiency have changed dramatically in its favour¹, more than ever before. High and volatile energy prices mean that technical energy efficiency potentials which earlier seemed too costly have become attractive investments. The importance of lowering energy demand has a new geopolitical meaning and must lead to a paradigm shift in energy policy.

It has now become obvious that buildings are part of the EU's vital infrastructure as they are critical to sustainably reduce energy dependence. Buildings must be treated as a critical factor in Europe's strategic decisions on energy and security policy exactly because they can provide the same services with lower energy consumption if their energy efficiency performance is improved and their energy demand minimised.

The graph below shows the importance of the building sector in the energy demand profile of the countries analysed in this paper. It is obvious that energy security cannot be achieved without changes in buildings' energy demand and it is well known that in many countries the buildings sector is particularly vulnerable to gas supply disruptions, as BPIE also showed in a detailed earlier analysis.ⁱⁱ

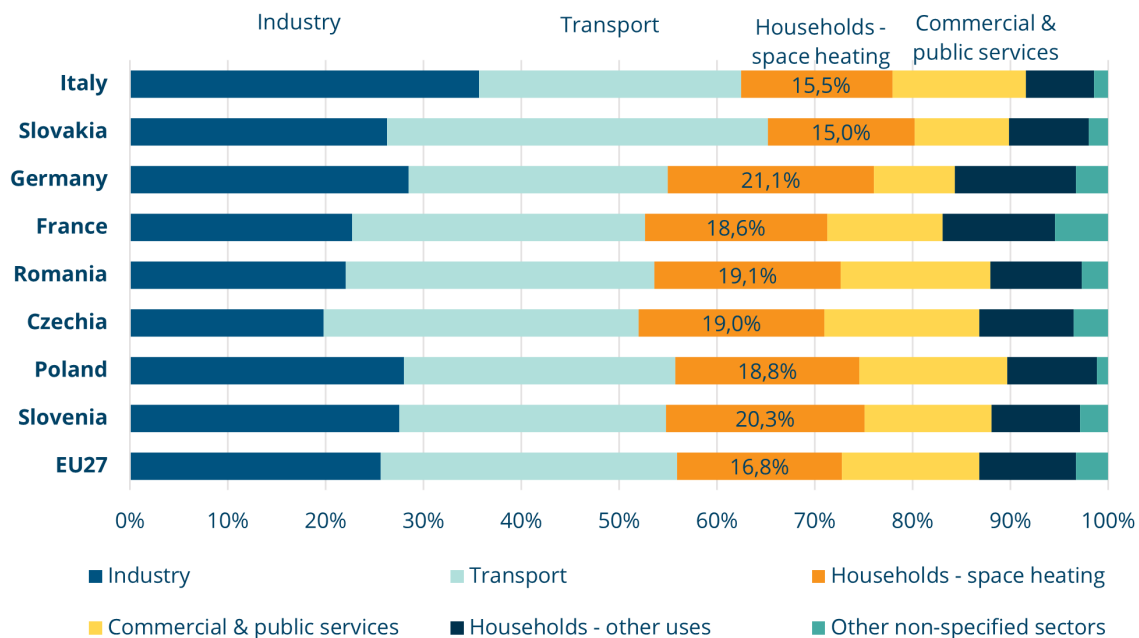


Figure 1 Final energy consumption per sector per country (%)

For these reasons, this paper investigates how an energy performance improvement of the building envelope would lower the fossil fuel consumption in selected Member States. We focus our analysis on residential buildings, due to the low data availability of non-residential buildings. Figure 1 shows the importance of households' energy consumption for heating, while also showing the respective demand in commercial and public service buildings. Improving the efficiency performance of both building types would not only increase energy security but would also enable the growth of renewable heat.



This paper investigates how an energy performance improvement of the building envelope would lower the fossil fuel consumption in selected member states which would increase energy security and enable the growth of renewable heat.

CHOOSING A GEOGRAPHIC FOCUS

This paper focuses on eight countries with diverse profiles for fossil fuel imports for heating of buildings, in relation to gas and heating oil imports from both Russia and other countries. The selection includes countries of different sizes and climatic zones to show the positive impacts of energy efficiency improvements of buildings across different circumstances. The figures below show how relevant fossil fuels are in the fuel mix for space heating in each of the selected countries, how much of this share is covered by gas imports and from which countries this gas is imported from. The picture they provide clearly outlines not only the considerable use of fossil fuels in space heating but also the opportunity to use building renovation to reduce energy demand and lower the need for these imports.

Figure 2 shows the share of gas consumption for heating for the selected countries, with Italy, Slovakia and Germany being the main users of gas for space heating.

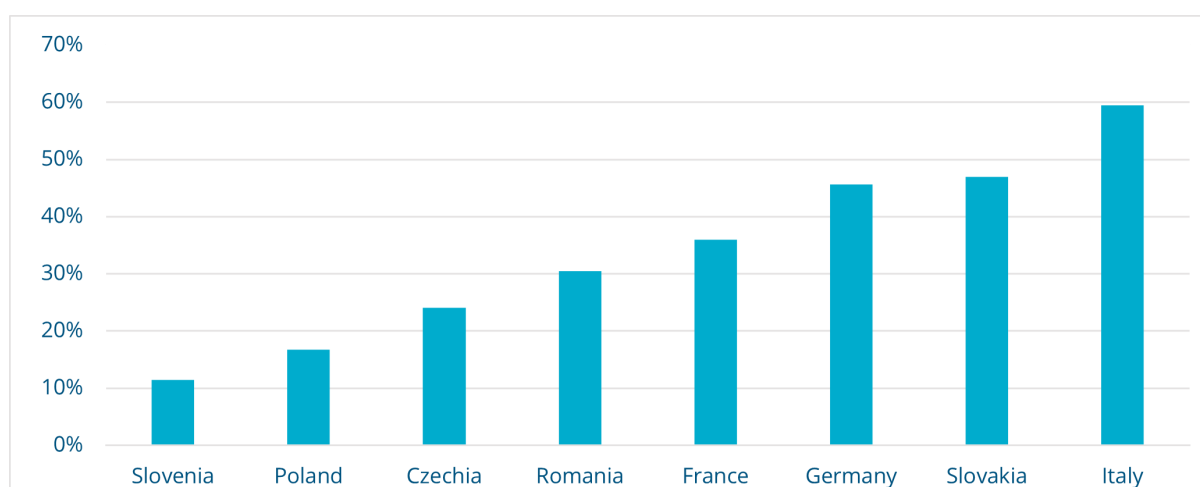


Figure 2 Share of final energy for space heating supplied by gas in 2019 for selected countries (in %); source: Eurostat

Figure 3 shows the share of different fuels used for space heating, with fossil fuels being a relevant share (at least 30%) in the fuel mix in most countries.

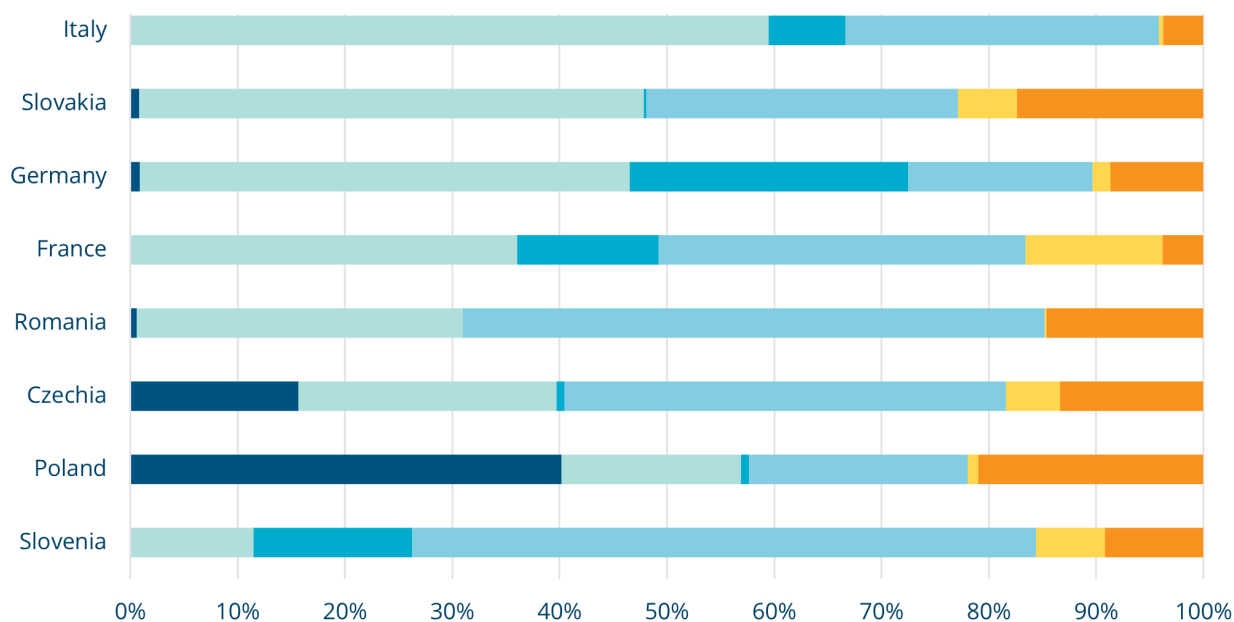
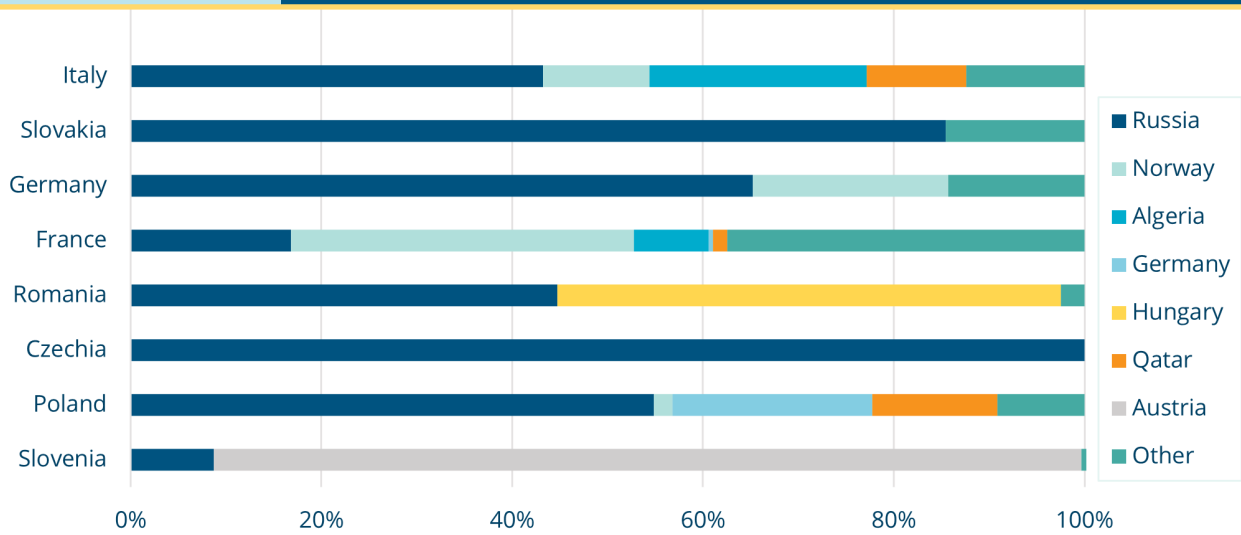


Figure 3 Fuel mix for residential space heating in 2019 for selected countries (in %); source: Eurostat



Other contains all countries with less than 20% gas share in any country's energy import.

Figure 4 Share of gas imports from different countries in 2020 for selected countries (in %); source: Eurostat

Figure 4, above, shows the gas important dependence of the selected countries as published by Eurostat for the year 2020. Except for Slovenia and France, most import over 40% of their gas from Russia. Please note that Eurostat does not provide full information on gas supply trade, according to this data Slovenia gets a high share of gas from Austria, but supply to Austria is not specified. This is also the case for gas imported to Romania by Hungary. According to Eurostat, Hungary imports 95% of its gas from Russia.

The countries analysed in this paper import gas from a variety of suppliers, highlighting the complexity of securing energy supply and finding a common EU response to threats of supply disruption. A strategy of replacing Russian fossil fuels with imports from other countries will simply shift Europe’s dependency onto other suppliers. Similarly, simply replacing fossil fuels with renewables to heat buildings is likely to run into a dead end as economic and/or societal growth limits for renewables are reached. This paper therefore explores to what degree fossil fuel imports could be reduced in eight EU countries through energy efficiency improvements of the building envelope in their building stock.



WHICH GOAL FOR ENERGY EFFICIENCY IMPROVEMENTS

METHODOLOGY

The energy performance of buildings is highly dependent on the quality of the building envelope. The lower the thermal losses through walls, roofs, floors and windows, the less energy is needed to keep a building's indoor temperature at a comfortable and stable level.

For the purpose of this paper, we modelled the improvement of the building envelope with a change in U-values for walls and roofs. The U-value expresses the rate of transfer of heat through a building structure. The lower the U-value the better insulated a structure is. The change in U-values of walls and roofs from higher to lower values is therefore an expression of improved insulation.

The starting point of our analysis is the building stock as described in building typologies with characteristics of walls, roofs, windows and floor for the selected countries (Czechia, France, Germany, Italy, Poland, Romania, Slovakia and Slovenia). We used a dataset produced in the context of the EU-funded Ambience project, which applied data from the Hotmaps and Tabula projects. We then calculated the energy saving potential and the resulting reduction in final energy consumption, split by the different energy carriers, after the renovation of the building envelope.

The calculation of the energy saving potential was based on a pre-defined ambition level for improvement of the building shell. This improvement includes the U-value improvement of pitched and flat roofs as well as solid and cavity walls. For our analysis we assumed the total improvement of the building shell to achieve a minimum of final energy saving of 20%. This threshold was defined to exclude renovation of already highly efficient buildings, which would not be economically feasible.

As the basis for this target (goal U-value), we considered (a) a collection of observed cases and subsidiary requirements from different countries and (b) a review of implemented and proposed building code requirements supported by scientific case studies.

Building component	Slovenia, Poland, Czechia, Germany, France, Romania, Slovakia	Italy
	U-value [W/(m ² K)]	U-value [W/(m ² K)]
Pitched roof	0.15	0.26
Flat roof		
Solid wall	0.2	0.30
Cavity wall		

Table 1 lists the target values (goal U-values). We decided to define a different value for Italy to reflect its architectural characteristics, with a high share of old and historical buildings and small, narrow urban structures that are more difficult to insulate.

¹www.ambience-project.eu, www.hotmaps-project.eu, Tabula

RESULTS



If all goal U-values were achieved across all countries, 45% of final energy could be saved.



If all goal U-values were achieved across all countries, 45% of final energy could be saved and each country would witness a substantial decrease in its final energy consumption. Germany would almost halve its buildings' final energy consumption (47%) and save 331.7 TWh in heating buildings. Poland would save 39% of its final energy demand in buildings while Romania would achieve 56% final energy savings, the highest potential savings in this study.

Table 2 provides an overview of the savings in final energy for heating and the total final energy saved in each country, showing the positive impact of improved insulation across all carriers and in particular on fossil fuels.

Country	Current final energy consumption (TWh)	Savings in final energy for space heating (TWh)						Total
		Coal	Natural gas	Oil	Renewables	Electricity	Heat	
Czechia	43.1	3.3	5.5	0.2	8.7	1.0	2.5	21.1
Germany	700.4	3.0	151.3	86.1	56.9	5.6	28.7	331.7
France	294.7	0.1	36.4	18.4	40.1	17.0	5.1	117.2
Italy	279.7		81.8	9.9	40.2	0.6	5.2	137.6
Poland	113.8	22.3	6.8	0.3	9.0	0.2	5.4	44.1
Romania	45.0	0.1	7.7	0.0	13.7	0.1	3.7	25.3
Slovenia	11.9	0.0	0.1	0.8	3.1	0.5	0.7	5.3
Slovakia	12.6	0.1	3.1	0.0	1.8	0.3	0.9	6.1
	1501.1	28.9	292.8	115.7	173.4	25.2	52.2	688.4

Table 2 Savings in final energy for heating by energy carrier (in TWh) of renovations achieving at least 20% final energy savings

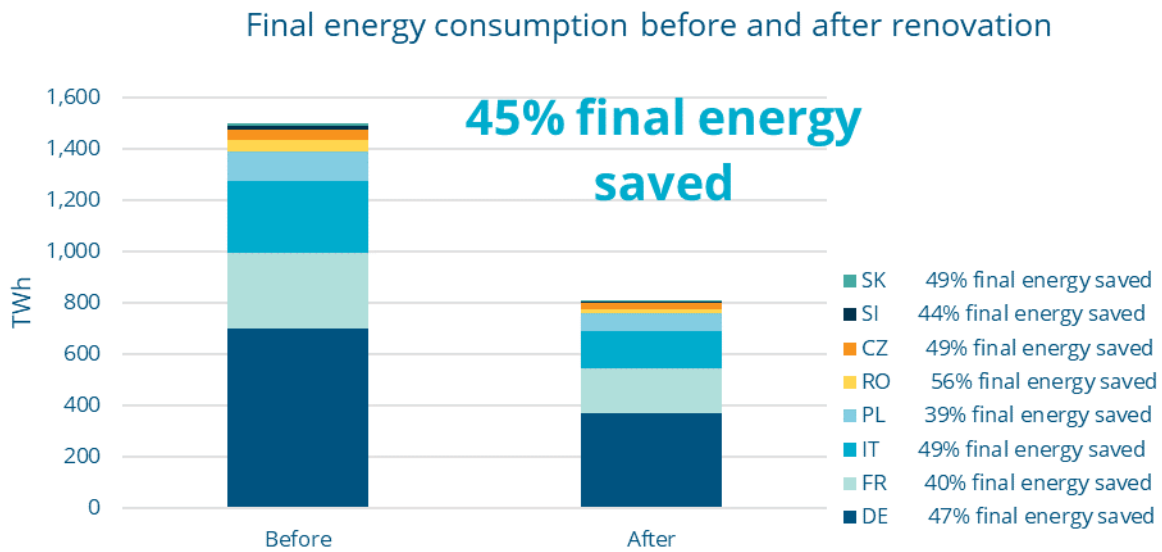


Figure 5 Final energy consumption for space heating in buildings before and after renovation (in TWh) and final energy saved (%) in each country

When looking at gas savings, these renovations would deliver a reduction of 44% of natural gas. Figure 6 shows the different impacts on gas savings for each country: Italy, Slovakia and Romania would see the highest savings (49%, 53% and 56% respectively).

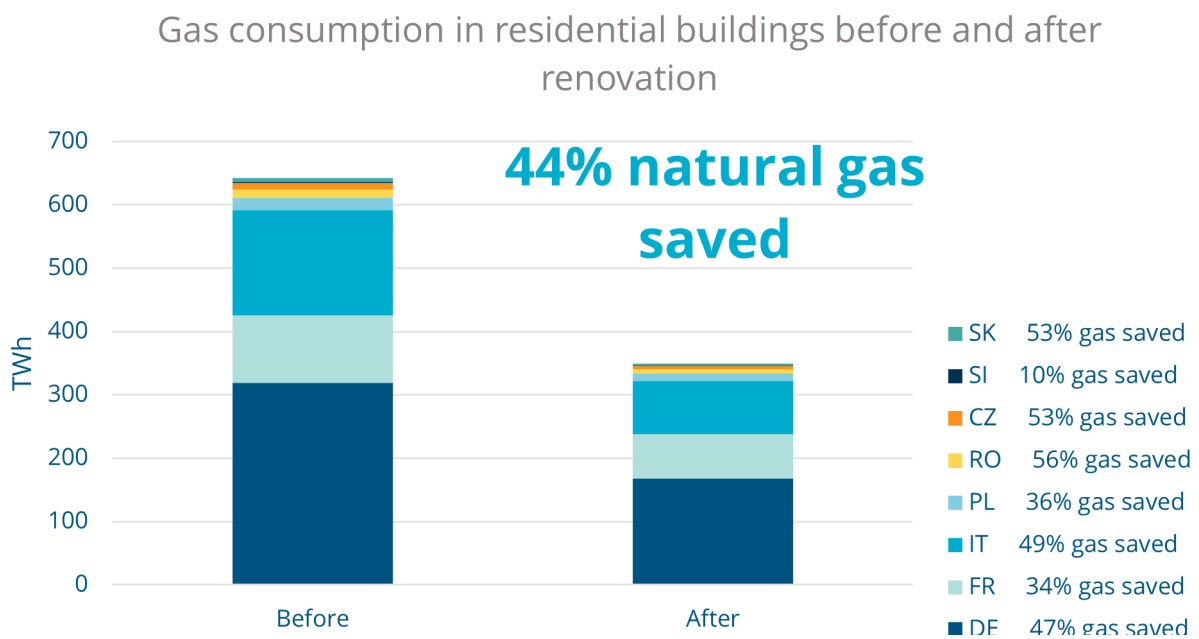


Figure 6 Final gas consumption for space heating in buildings before and after renovation (in TWh) and gas saved (%) after renovation in each country

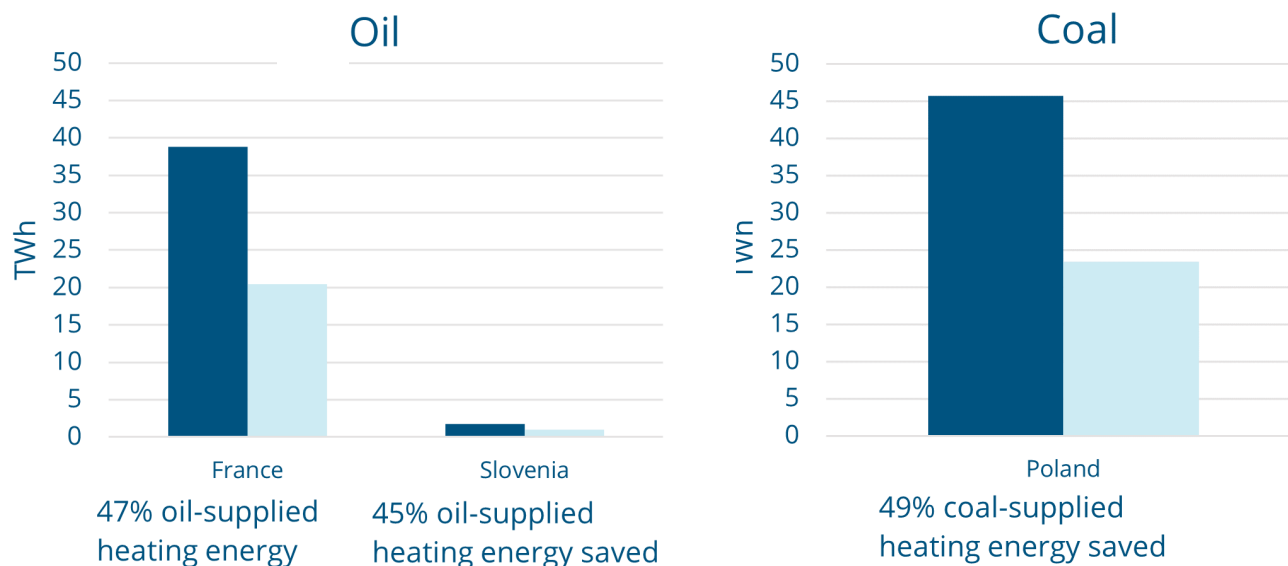


Figure 8 Oil-supplied heating energy saved in France and Slovenia

Figure 7 Coal-supplied heating energy saved in Poland

France and Slovenia would also see a significant reduction of oil-supplied heating energy (see Figure 8 below). In addition to saving 39% of its final energy consumption, Poland would lower coal-supplied heating energy by 49% (Figure 7).

EFFICIENCY OR RENEWABLES - A FALSE COMPETITION

In recent years, the deployment of renewable heating technologies has grown significantly, though mainly in new buildings rather than renovation projectsⁱⁱⁱ. Heat pumps are the dominant technology on the market: they have seen annual double-digit growth rates in the past 10 years and are forecast to continue or accelerate this rate in the future. If coupled with a steady decrease in heating energy demand, heat pumps would not only support the decarbonisation of heating and cooling but would also significantly contribute to reducing electricity peak consumption and enabling the growth of renewable heat.

In a moment when policymakers at all levels are compelled to find solutions to guarantee energy supply and lower energy prices it is necessary to consider all solutions, but it is imperative to advance those aligned with the EU Green Deal and the climate agenda. Aligning efficiency measures with the deployment of renewable heating technologies enables optimal solutions in terms of cost-effectiveness, reduced CO₂ emissions, low environmental impacts and energy security.

Improving the energy performance of the building envelope must go hand-in-hand with aggressive deployment strategies for heat pumps and other renewable heating technologies. Several recent studies show how lowering energy demand in buildings is essential to meeting the building sector's climate target and maximises the benefits of installing renewable heating technologies.

An in-depth modelling of decarbonisation strategies for the building sector, which described in detail in a comprehensive energy systems study for Germany^{iv}, provides relevant insights. The study compared five scenarios to reduce CO₂ emissions in the building sector, combining different efficiency levels of buildings with different energy supply options. It concluded that “higher efficiency in the building sector is not only more cost-effective than the alternative approaches; it is also a more feasible way to meet the sector’s climate targets.”^v

A 2015 study^{vi} comparing two efficiency scenarios for heating energy demand of buildings concluded that “the reduction in peak load from reduced electricity demand for electric heat pumps due to high efficiency buildings [...] matches the current total electricity production capacity (renewable and non-renewable) of Austria and the Netherlands combined.”

Similar arguments are illustrated in two recent papers for the UK^{vii} and Germany^{viii} which created scenarios based on renovation projects that included measured consumption data after renovation. The papers argue that the installation of heat pumps without reducing thermal losses of the building shell through renovation, combined with the projected increase of electric vehicles, would more than double electricity winter peak loads in both countries. By contrast, reducing the heating needs of buildings which are equipped with heat pumps would reduce electricity peak consumption significantly and would enable a smaller electricity supply system.

CONCLUSIONS

This analysis confirms that investing in building renovation can drastically reduce the use of fossil fuels for heating and substantially contribute to securing the EU’s energy needs and independence. Sustained energy saving will increase the EU’s independence from fossil fuels. Reducing the energy demand of buildings is also a critical precondition for the expansion of the renewable energy supply system and will contribute to improving the economics of renewable heating technologies. Increasing the market uptake of renewable heat technologies without reducing buildings’ energy demand by improving the building shell would create challenges by increasing electricity consumption, including risk of peak loads and the need to rely on fossil fuel generation to compensate for fluctuations in supply. The technologies and solutions to make buildings an active and highly efficient component of our energy systems are available and should be implemented in Europe’s Renovation Wave.



Investing in building renovation can drastically reduce the use of fossil fuels for heating and substantially contribute to securing the EU’s energy needs and independence.



POLICY RECOMMENDATIONS

The EU and its Member States are called to show leadership and guide the transition towards a secure and decarbonised energy market in uncertain times. In the current geopolitical context, buildings must be considered part of the EU's vital infrastructure as they are critical to reducing energy dependence and carbon emissions. They must be treated as a critical factor in Europe's strategic decisions about energy policy and security.

The cost of missed opportunities to improve the energy performance of the EU building stock is all too apparent. Our study shows how improving insulation of residential buildings can reduce energy demand and drastically cut oil and gas imports for heating. Diversifying gas imports should not be considered the only way to quickly get rid of Russian gas. Reducing demand to allow a steady increase of renewable energy supply as an alternative to fossil fuel imports is the solution the EU should pursue.





REPowerEU and the EU Save Plan must treat lowering energy demand as an essential prerequisite to achieve energy independence and a just energy transition.

To this end, the EU Save Plan should:

Recognise that the best way to decrease the EU's energy dependency is to make lasting reductions to energy consumption and apply the 'efficiency first' principle.

Acknowledge reducing energy demand as an absolute priority by fast-tracking policies to accelerate energy efficiency improvements and renewable energy supply in the Fit for 55 package, and recognise the value of pursuing them in parallel, not as alternatives to each other.

Direct short- and long-term investments to improve building envelopes and insulate roofs and walls as a priority. Some funding already available under the Recovery and Resilience Facility could be reallocated by renegotiating national recovery plans, boosting and front-loading their building renovation component. To achieve the 2030 and 2050 climate goals, such investments must be sustained over time.

Recognise that reducing energy demand and securing investments in building renovation are prerequisites to switch from fossil fuels to renewable heat and manage the increase in electricity use which may ensue.

Urge Member States to update their national renovation strategies and support their implementation with dedicated long-term financing instruments to speed up renovation.

Stop subsidies to fossil-fuel-based equipment to accelerate their phase-out from the EU market and accelerate financial support to replace fossil fuel heating systems with renewables.

Help the building supply chain by boosting upskilling activities to have a workforce ready to renovate and install quickly.

Roll out building renovation passports, one-stop-shops and renovation services while fostering skills to make sure every renovation is aligned with the long-term climate and energy targets and all buildings are ready for future upgrades.

REFERENCES

ⁱEichhammer, W. (2022). *Assessing the impact of high energy prices on the economic potential for energy savings in the EU*. Fraunhofer Institute for Systems and Innovation Research Germany. https://www.isi.fraunhofer.de/content/dam/isi/dokumente/ccx/2022/FraunhoferISI_Scheuer_Report_EE_Potentials_HighEnergyPrices_final.pdf

ⁱⁱBPIE (2016). *Safeguarding Energy Security in South-East Europe with Investments in Demand Side Infrastructure*. Building Performance Institute Europe. <https://www.bpie.eu/wp-content/uploads/2016/09/Safeguarding-energy-security-in-South-East-Europe-with-investment-in-demand-side-infrastructure.pdf>

ⁱⁱⁱDelta Energy and Environment (2022). *The Time Is Now: Accelerating The Decarbonisation Of Heat - Assessing The Impact Of European Decarbonisation Policies And REPowerEU*. Presentation from slide 14 onwards available at https://mcusercontent.com/bfc2e18bc7b091b9b2f6c30f9/files/898f0c0e-69e6-a065-1fb3-234cf95c315a/The_time_is_now_REPowerEU_online_seminar.pdf

^{iv}ifeu, Fraunhofer IEE, Consentec (2018). *Wert der Effizienz im Gebäudesektor in Zeiten der Sektorenkopplung*. Studie im Auftrag von Agora Energiewende.

^vIbid, p. 36

^{vi}Boermans, T. et al (2015). *The role of energy efficient buildings in the EU's future power system*.

^{vii}Knauf Energy Solutions: Heat Pumps: the new Winter Peak. https://pim.knaufinsulation.com/files/download/download_62712bd568e47.pdf

^{viii}Knauf Energy Solutions: Heat Pumps and Germany: the new Winter Peak. https://pim.knaufinsulation.com/files/download/download_62712c1c01f32.pdf

Authors

Mariangiola Fabbri
Oliver Rapf
Judith Kockat
Xerome Fernández Álvarez
Ivan Jankovic
Hélène Sibileau

BPIE review and editing team

Caroline Milne, Jo Junkel

Acknowledgement

BPIE would like to thank Knauf Insulation for their dedicated support.



Copyright 2022, BPIE (Buildings Performance Institute Europe).



Except otherwise noted, the reuse of this document is authorised under the Creative Commons Attribution 4.0 International (CC BY 4.0) licence. This means that reuse is allowed provided appropriate credit is given and any changes are indicated.*

How to cite this briefing: BPIE (Buildings Performance Institute Europe) (2022). Putting a stop to energy waste: How building insulation can reduce fossil fuel imports and boost EU energy security. Available at: <https://www.bpie.eu/publication/putting-a-stop-to-energy-waste-how-building-insulation-and-reduce-fossil-fuel-imports-and-boost-eu-energy-security-2/>



Rue de la Science 23 B-1040
Brussels Belgium

Sebastianstraße 21 D-10179
Berlin Germany

www.bpie.eu

BPIE (Buildings Performance Institute Europe) is a leading independent think tank on energy performance of buildings. Our vision is a climate-neutral built environment, aligned with the ambition of the Paris Agreement, and in support of a fair and sustainable society. We provide data-driven and actionable policy analysis, advice, and implementation support to decision-makers in Europe and globally.

