BEYOND FOSSIL FUELS

Freedom From Fossil Fuels

Eliminating Russian fossil fuels and securing Europe's future with renewables and energy savings

March 2023

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Layout

Designers For Climate

About Beyond Fossil Fuels

Beyond Fossil Fuels, an expansion of the Europe Beyond Coal campaign, is a coalition of civil society organisations striving for a just transition to a fossil-free, fully renewables-based European power sector by 2035.

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Overview

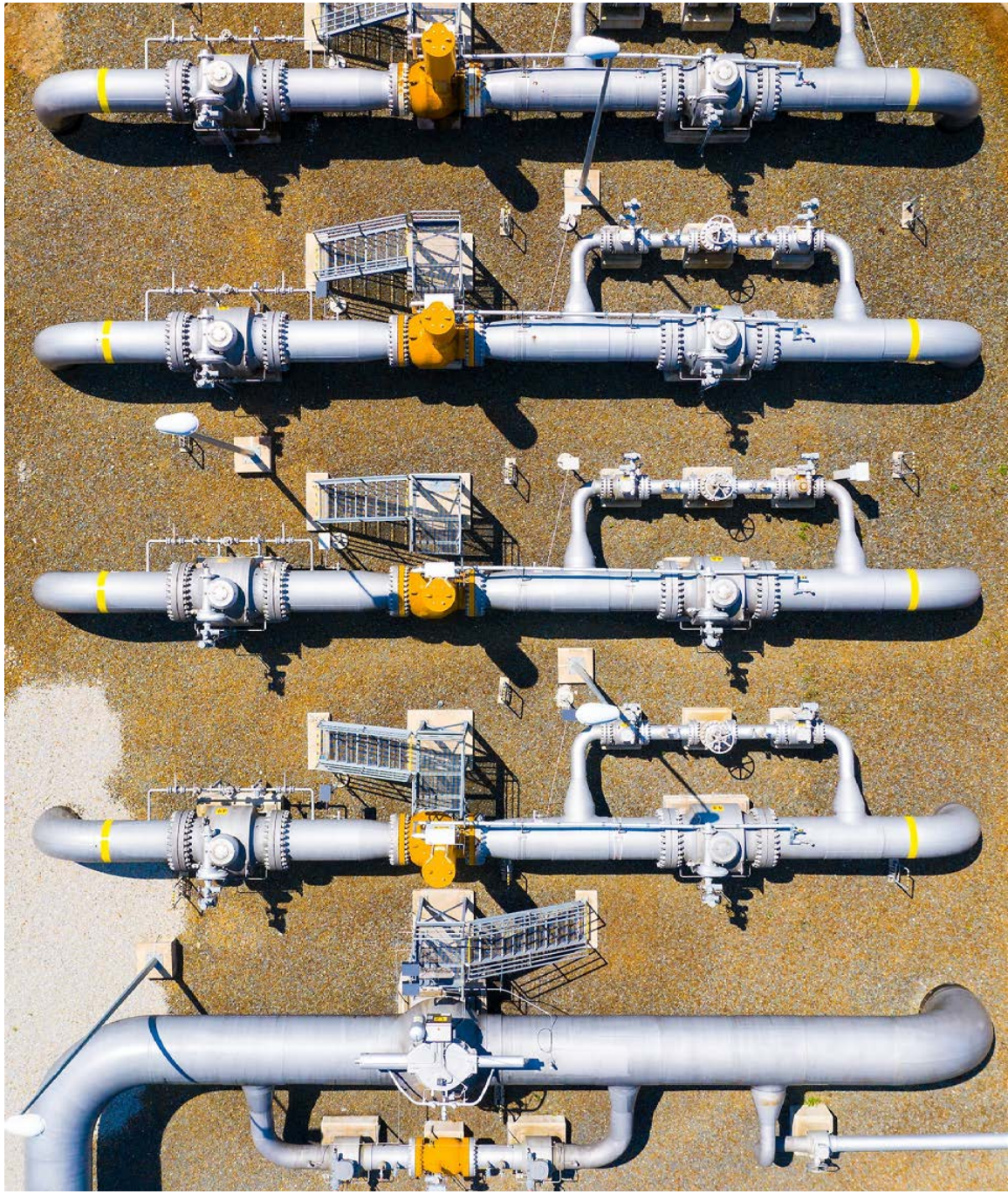
Overview

Europe is besieged by multiple crises: energy insecurity, surging cost of living, war on the continent, worsening climate change and destruction of nature and communities. All share a significant contributing factor: the continent's dependence on fossil fuels.

Since Russia invaded Ukraine in February 2022, most European countries have resolved to end imports of Russian coal, gas, and oil. However, despite a European Union (EU) embargo on its Russian coal imports, and its fossil gas imports being substantially curtailed, European countries are still buying fossil gas from Russia in 2023,[1] and have already spent more than 3.3 billion euros in the first weeks of the year.[2] Additionally, many of the energy measures put in place in the year since Russia launched its war on Ukraine have been short-term, unsustainable or emergency in nature.

The real challenge for Europe[3] is securing a rapid, permanent cut in coal, fossil gas, and oil consumption in the coming few years.[4] This would allow for the total and permanent removal of Russian fossil fuels from Europe's energy mix without replacing one dependency with another, nor by increasing domestic fossil production. It would also put Europe firmly on the pathway to a completely fossil-free, renewables-based power sector by 2035, which is necessary to meet its long-term commitments under the UN Paris Climate Agreement.

Eliminating fossil fuels from Europe's energy mix is not only a duty borne out of respect for peace and the many human lives around the world endangered by conflicts exacerbated by fossil fuels,[5] but also essential to transforming the continent's energy system into an efficient and renewables-based one that works for everyone and our environment.



1 Via Turkstream, Ukraine transit and LNG. Source: European natural gas imports, Bruegel, March 2023.

2 The 27 EU member states have paid Russia more than EUR 61.814 billion for coal and gas supplies since the start of the Russian war in Ukraine, and EUR 3.303 billion between 1 January and 19 March 2023. Source: Financing Putin's war: Fossil fuel imports from Russia during the invasion of Ukraine, CREA.

3 In this report, Europe refers to the European continent: the EU-27, the United Kingdom, Norway, Switzerland, Turkey, Ukraine, Moldova, and all countries in the Western Balkans. It excludes Russia and Belarus. EU-27 will be used to refer to the European Union.

4 This report addresses coal and gas demand for the power and heating sectors, and does not tackle oil, much of which is used in transport and in the case of industry for non-energy purposes.

5 African NGOs have warned of human rights violations linked to projects such as the Cabo Delgado gas fields in Mozambique and the East African Crude Oil Pipeline: https://dont-gas-africa.org/

A package of measures to cut coal and gas demand by 2025

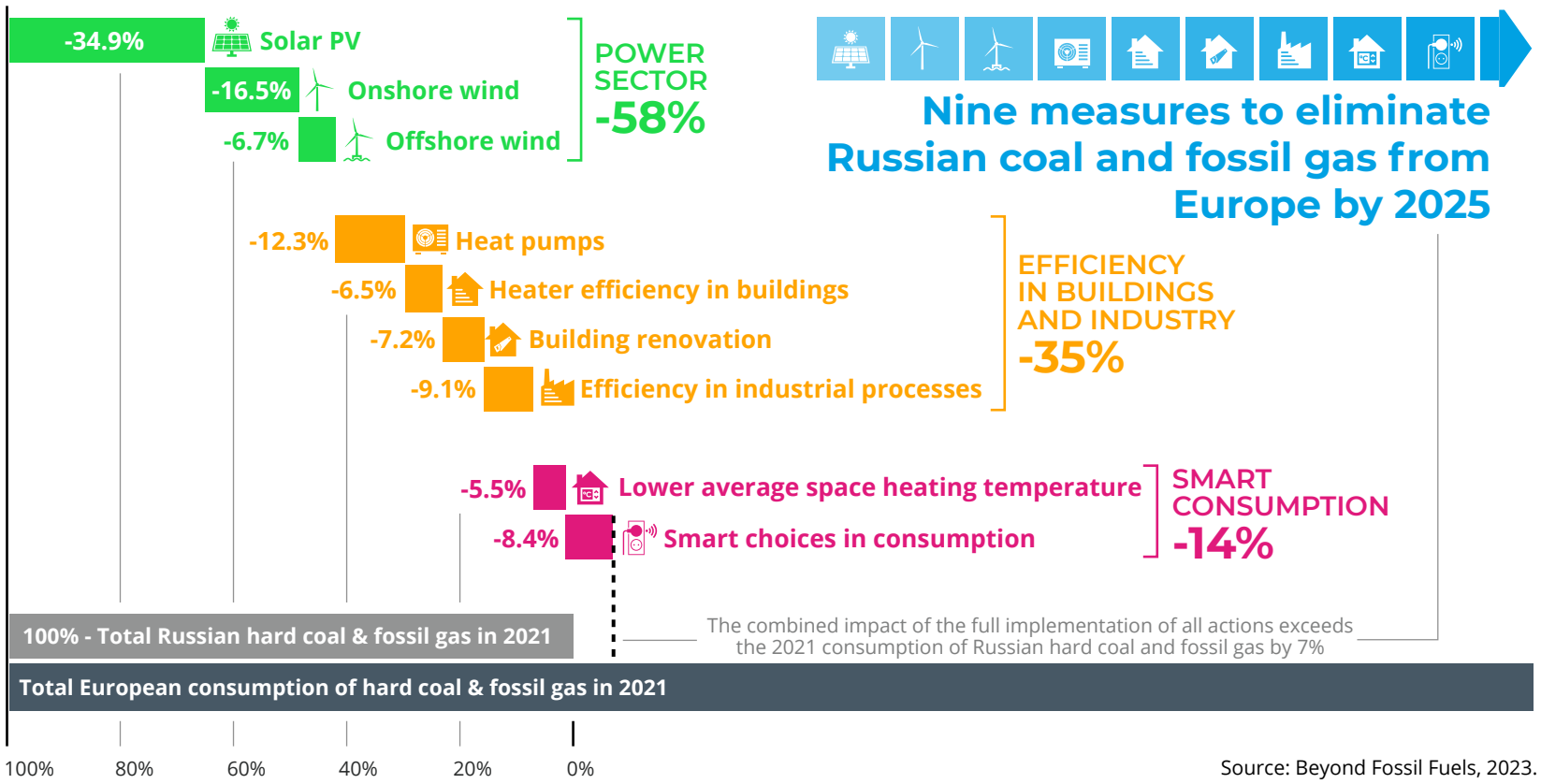
This meta-analysis builds upon a wide range of studies and research published since Russia's invasion of Ukraine. We present an ambitious but very achievable package of measures across three action areas for implementation by the end of 2025. These comprise the deployment of solar photovoltaic (PV), wind power and heat pumps, building and industry efficiency, as well as measures for lower and smarter consumption of heat and electricity.

Together with targeted, temporary measures to reduce electricity and heat demand and balance supply in order to manage the next two winters, this package will allow Europe to finally end all Russian coal and gas imports. This can be done without resorting to imports of fossil fuels from other countries, and without driving fossil extraction and new export infrastructure across the world.

The last year has made it abundantly clear that what we do in Europe matters, not just for Europe's future, but also for that of people around the world who would be deeply affected if Europe engages in a global dash for gas and coal. Cutting Europe's reliance on Russian fossil fuels without increasing imports from other countries improves energy security through reducing dependence, and protects citizens and businesses from volatile, expensive international gas markets. Importantly, it also avoids exacerbating energy access issues and poverty in the Global South.

Cut fossil gas demand to be on track for a 2035 fully renewables-based power system

Europe is already set to phase out coal by 2030, although this must be safeguarded. Europe must also plan to phase out fossil gas in the power sector by 2035, as a key milestone for the rapid exit from all fossil fuels across our economies. To ensure coal and gas demand reductions are in line with those phase-out pathways, decision-makers will need to move past the emergency measures after the 2022 Russian invasion and focus on structural solutions. Confident strides must be made to transform our power sector and industry, transport and building sectors, with electrification, renewables, and energy savings at the heart of Europe's future.



Source: Beyond Fossil Fuels, 2023.

Graph 1: Impact of the nine categories of measures on fossil gas and hard coal demand and on the level of imports from Russia in 2021

Concretely, this meta-analysis shows that a set of actions in the electricity and heating sectors could reduce Europe's gas and coal use by 35% and 44% respectively by 2025,[6] compared to 2021 levels. This is a similar amount to the gas and coal Europe imported from Russia in 2021.[7] For just the EU-27, this means gas demand would fall by 40% by 2025 and hard coal demand by 48% for both heat and power production, while lignite use is nearly halved in the power sector. These measures would reduce Europe's overall energy consumption by nearly 11% by 2025.

Fully removing the above-mentioned shares of fossil gas and hard coal from Europe's energy system requires three areas of focus: deployment of renewables in the power sector, efficiency measures in buildings and industry as well as savings induced by smart choices in consumption (see Graph 1).

6 Gas demand and import data from Enerdata. For more details on the data collected, see chapter 4.

7 This refers to the reduction of gas or coal demand relative to pre-war imports from Russia to Europe (2021).

Solar, wind, and heat pumps can replace more than two-thirds of Russian coal and gas

While actions in all three areas are necessary to achieve the right levels of fossil-generated energy cuts, accelerating the deployment of solar, wind and heat pumps alone would substitute more than two-thirds of Europe's pre-war fossil gas and coal imports from Russia. Overall, European countries and their businesses need to add 481 gigawatts (GW) of solar (459 GW in the EU-27), 102 GW of new wind capacities (78 GW in the EU-27) and nearly 29 million heat pumps (24 million in the EU-27) between 2022 and the end of 2025.

Some of these additions have already occurred in 2022: solar and heat pumps were deployed at record pace, reaching 41.4 GW and nearly 3 million units respectively in the EU-27. While this is an encouraging increase, these annual deployment rates will have to considerably grow for the remainder of the 2022-2025 period to meet the potential identified in our report. With 19 GW of new wind capacity added in 2022, European wind installation rates are closer to what is needed for this 2022-2025 period (i.e. 25.5 GW/year).

To achieve the proposed set of measures, the entire European region covered by this analysis will need to sustainably install 14 wind turbines[8] and 37 large solar plants per day to cover areas such as car parks and brownfields sites.[9] In addition, nearly 54,000 homes across the continent should be either solarised, equipped with heat pumps, or deeply renovated per day. This scale of an industrial project is achievable in a continent where each day nearly 45,000 new cars are manufactured,[10] and more than 12,000 gas boilers are installed in homes.[11]

Lastly, the set of measures we propose would displace 107% of Russian gas and coal imports in Europe (104% in the EU-27) to ensure that enough coal and gas demand will definitely be removed from the energy system, but also enough power and heat will for sure be available through the structural measures we propose to heat our homes and run the European economy.

8 Onshore and offshore wind turbines.

9 We assume that a car park could accommodate 2.2 MW of solar capacity. For brownfield sites we assumed solar plants of 10MW.

10 World motor vehicle production, European Automobile Manufacturers' Association (ACEA), 2022.

11 4.3 million gas boilers were installed in 2020 in the following 11 European countries: Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Spain, Sweden, Switzerland and the UK. Source: Heating Market Report, European Heating Industry (EHI), 2021.

Building on the recent positive deployment trends for solutions

Europe has so far weathered the fossil fuel crisis resulting from the Russian war on Ukraine through enormous effort, public spending, and luck. According to the International Energy Agency (IEA), in 2022, fossil gas demand saw a record cut of 55 billion cubic metres (bcm) in the EU.[12] This drop was due to cyclical factors such as warmer weather and a temporary fuel switch in the industry but also initial structural changes: 2022 has shown great promise driven by record deployment of solar PV and heat pumps by private households and medium-sized companies, and efforts by individuals, businesses and communities to cut their energy use.

Never before have European countries installed so many solar panels, wind turbines and heat pumps in a single year. Germany saw a 53% growth in its domestic heat pump market with nearly 300,000 units added.[13] Nearly ten times that figure was installed across Europe.

Meanwhile, the continued increase of solar and wind capacity in Greece - with a record 1.7 GW in 2022 - has contributed to reducing gas demand in the power sector by 14%.[14] Poland has reduced its gas demand by 26% in the power sector[15] and its electricity generation from coal by 3%.[16] The Polish heat pump market recorded the highest growth[17]in Europe, with 200,000 units sold, more than double the previous year. For the first time, Poland added 1.5 GW of new wind capacity despite continued reluctance from the Polish government to fully unlock wind investment.[18]

Too much effort is going into building unnecessary gas supply infrastructure

However, much of the effort and spending has not been on long-term, structural solutions but on emergency measures. Confronted with rising anger from citizens and small and medium-sized businesses owners struggling to pay spiralling energy bills and the risk of shutdowns of factories, governments have spent vast sums of public money (EUR 768 billion) shielding households and companies.[19] Meanwhile, some parts of the fossil fuel industry have made enormous profits,[20] while others relied on state bailouts to avoid bankruptcy.[21] While many emergency measures were necessary to deal with the immediate crisis, this level of emergency spending is not sustainable and competes with investments in structural solutions.

Across Europe, decision-makers have voiced support for shifting away from Russian fossil fuels by investing in genuine, long-term solutions. Regrettably, political commitments to boost renewable energy and energy savings have fallen short, and have been overshadowed by efforts to secure alternative fossil fuel imports. Europe has embarked on an extensive rollout of alternative, unnecessary fossil gas supply infrastructure in the form of new LNG terminals and gas pipelines that go beyond any temporary emergency substitution measures (see Box 2 - Several studies show there is no need for new LNG infrastructure and pipelines in Europe).

These fossil gas plans reveal that Europe's leaders have not yet fully decided on the energy pathway the continent should set itself on. If this panicked response becomes orthodoxy, then Europe will lock itself into continued reliance on a failed fossil-based energy system. Because so much attention is going into sourcing alternative gas supplies, the plans by governments, utilities, businesses and municipalities for renewable energy, electrification and efficiency solutions are far below the potentials we have identified as achievable and necessary in this report.

12 Europe's energy crisis: What factors drove the record fall in natural gas demand in 2022?, IEA, March 2023.

13 "In contrast, gas-based systems declined by eight percent and 598,000 units sold last year." (translated from German to English), Bundesverband der Deutschen Heizungsindustrie e.V. (BDH), February 2023.

14 Trends in electricity production, the Green Tank, December 2022.

15 Yearly electric data, Ember, March 2023.

16 European Electricity Review 2023, Ember, January 2023.

17 Heat pump record: 3 million units sold in 2022, contributing to REPowerEU targets, EHPA, February 2022.

18 Wind in the sails. The 10H principle and the potential of onshore wind energy in Poland, Instrat, May 2021.

19 National fiscal policy responses to the energy crisis, Bruegel, November 2022.

20 Crisis year 2022 brought $134 billion in excess profit to the West's five largest oil and gas companies, Global Witness, 9 February 2023.

21 In a press release published in December 2022, the German ministry of economy announced the federal government decision to take over around 99% of the shares in the company Uniper, BMWK, December 2022.

European governments, municipalities, financial institutions, utilities and businesses must implement the following nine recommendations to reduce their dependence on fossil fuels

Now is the time to look beyond emergency, short-term fixes, and instead adopt robust transition action plans to prioritise the needed structural answers. The acceleration of the phase-out of fossil fuels in Europe will only be possible if European governments, financial institutions, utilities and business leaders, as well as local governments, recognise that switching from Russian fossil fuel imports to reliance on fossil fuel imports from other countries does not bring about energy security, lower the cost of living, create stable investment conditions, nor address the climate crisis. Only altogether cutting sufficient levels of coal and gas demand will.

Governments and companies need to reinforce the recent dynamic in order to greatly increase the speed and scale of solution deployment and to invest every cent into transforming our energy systems, protecting the vulnerable, and empowering communities with modern solutions.

These plans should include commitments to a 2035 fossil-free, renewables-based power sector, and translate into clear and immediate actions to transform Europe's electricity and heating sectors. For coal, this means a phase out by 2030 or earlier, for its use in power and heat production.

In light of the findings of this report European governments, municipalities, financial institutions, utilities and businesses must implement the following nine recommendations:

1

Accelerate solar PV and heat pump deployment: A swift acceleration of solar photovoltaic and heat pump deployment could displace 47% of fossil gas and coal imports from Russia and nearly 16% of overall fossil gas and coal demand. It means setting the level of ambition for all economic sectors across Europe and securing coherent and robust deployment frameworks that remove existing barriers, including permitting, grid modernisation, workforce training, supply chain build-up and financial support. These frameworks should include specific provisions to support installations by households (prioritising vulnerable households), communities and small and medium enterprises (SMEs).

2

Urgently fix the barriers slowing down wind project deployment: Current wind power growth rates and short-term market forecasts are far below potential, which risks seriously derailing Europe's efforts to rapidly phase out fossil gas and coal. National and local governments, grid operators, wind developers and utilities must come together to solve these barriers and ensure wind (in addition to solar and heat pumps) is identified as a strategic priority. This means investing in transparent, digitalised, and well-staffed planning and faster permitting procedures, including community energy projects, without compromising biodiversity, community participation and social safeguards. It also means restoring investor confidence in the European wind market through stable electricity market design, ensuring the profitability of wind projects by developers, and boosting community support through shared financial benefits.

3

Drive deep building renovations: A breakthrough is needed, with public sector buildings leading by example, to fully realise the significant potential for a permanent cut in Europe's energy demand by improving the energy performance of buildings. Europe must make deep building renovations easier and more affordable, prioritising the vulnerable and those with low incomes, and create long-term certainty to enable the supply chain and workforce to build up. The construction industry must increase its innovation efforts to scale up serial renovation solutions and renovation depth, and at least triple current renovation rates.

4

Maximise measures at all public, commercial and industrial sites and operations: By 2025, all such locations should have implemented the proposed measures to their maximum potential (e.g. solar panels are mounted on every possible rooftop, every building has installed a heat pump and undertaken renovation measures) or have a plan in place for further measures post-2025.

5 **Adopt an industrial scale-up plan embracing social, environmental and public participation standards:** The energy transition should be seen as a strategic industrial priority for Europe. This requires a scaled-up industrial plan that addresses supply chains and the workforce and embraces social, environmental, and public participation standards, as well as a responsible and fair approach to global sourcing and supply chains.

6 **Public and private financial institutions must support the transition:** Banks, investors and insurers must deliver the necessary investments in the energy transition (renewable energy, efficiency in industry, building renovation etc.) that will secure deployment at an unprecedented scale. This includes funding for enabling technologies (e.g. grids, storage, demand-side flexibility, digitalisation), as well as workforce training and the expansion of the European supply chain.

7 **Maintain emergency measures to cut energy demand to avoid new gas infrastructure:** National and local governments as well as industry should continue with targeted, temporary emergency measures aimed at reducing energy demand for the coming two winters. This would secure the supply and demand balance in all European countries until 2025. Combined with the structural measures proposed in this report, they would reduce European gas demand to a level that there would be no need to build more gas import infrastructure in Europe, such as gas pipelines and LNG terminals.[22]

8 **Protect and empower vulnerable households:** More dedication, fast tracking and preferential treatment for vulnerable households are needed to ensure all Europeans can actively participate in and reap the benefits of a renewables-based, efficient energy system. More public funding and schemes are needed, especially from public institutional investors, to help communities, households, SMEs, regional economies and municipalities to transition away from fossil fuels.

9 **Tax fossil fuel profits:** Fossil fuel companies enjoyed huge profits even before the current energy crisis. They should be taxed to help meet the investment needs of the energy transition, ensuring the burden does not fall on citizens and the rest of the economy.

These recommendations are a response to European government and business leaders' inadequate, or often missing, plans for a rapid and permanent end to Europe's dependence on fossil fuels.

Europe's deep fossil dependence has come at a great cost, and too many decisions are fawning over the fossil industry that made us vulnerable to this crisis in the first place. It does not have to be this way. Steep growth trends in solar and heat pump deployment, swift decision making by governments, and the energy saving potential demonstrated by industry showed what Europe is capable of, and laid the foundations of the needed scale up. In just a few years Europe can replace every joule of Russian fossil gas and coal it was relying on by committing to accelerated deployment of solar and wind, by determinedly looking for real energy savings in industry and building modernisation, and by encouraging smarter use of energy across the board. Europeans overwhelmingly want this renewable transition,[24] and given it addresses our critical challenges of cost of living, peace, energy security, and necessary climate action, we have every reason to vigorously pursue it.

22 In 2022, EU governments agreed to a set of voluntary energy reduction targets: a 15% reduction in gas demand, to end on 31 March 2023. This should be transformed into a structural measure (to be increased gradually to achieve 2035 gas phase out), including an obligation to reduce electricity demand by at least 5% during peak hours through demand-side flexibility and energy savings. Source: Energy system of tomorrow, CAN Europe, February 2023.

23 See Box 2 - Several studies show there is no need for new LNG infrastructure and pipelines in Europe.

24 "A great majority of EU citizens (84%) agree that the EU should reduce its dependency on Russian sources of energy as soon as possible. They also overwhelmingly agree that the EU should support the green transition by investing massively in renewable energies (86%). 85% of Europeans are convinced that increasing energy efficiency of buildings, transport and goods will make us less dependent on energy producers outside the EU.", Standard Eurobarometer 98 - Winter 2022-2023, February 2023.

BEYOND FOSSIL FUELS

2

Reducing Europe's dependence on fossil fuels: an inescapable change

A fossil-free, renewables-based power sector in Europe by 2035 is a necessary step towards limiting global warming to 1.5°C, and would significantly decrease energy-related air pollution.

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The Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report (AR6) published in April 2022[25] identifies that net-zero greenhouse gas emissions should be reached globally by 2050 and net-zero carbon emissions should be reached before 2040 to ensure the increase of average global temperatures remains below or equal to 1.5°C by the end of the century.

In September 2022, Climate Analytics published its assessment of the transformation that may be necessary for the EU-27 to do its part for the 1.5°C temperature limit, based on the latest energy and emissions global pathways included in the IPCC's AR6.[26]

The conclusions are clear that in 'all member states, coal is effectively phased out of the power sector by 2030. The pathways also demonstrate that it is feasible to phase out electricity generation from fossil gas in the 2030s […]". In another study assessing CAN Europe and the European Environmental Bureau's (EEB) Paris Agreement Compatible (PAC) scenario, Climate Analytics identified that securing a 100% fossil-free power sector by the mid-2030s is a key milestone for reaching net zero emissions in Europe by 2040.

These important milestones in the European and global energy transition were confirmed in May 2021 by the IEA in their study "Net Zero by 2050 A Roadmap for the Global Energy Sector".[27] The agency identifies that advanced economies, including most European countries, should phase out 'unabated coal' by 2030 and reach 'overall net-zero emissions electricity' by 2035.

In recent years, several governments have identified 2035, or earlier, as a credible milestone for a fossil-free or decarbonised power sector, including the US, the UK, Canada and the G7 countries - though the strength of wording varies. Estonia, Austria, and Denmark aim to reach a fully renewables-based power sector by 2030.

25 6th assessment report, IPCC, April 2022.

26 1.5°C Pathways for the EU27: accelerating climate action to deliver the Paris Agreement, Climate Analytics, September 2022.

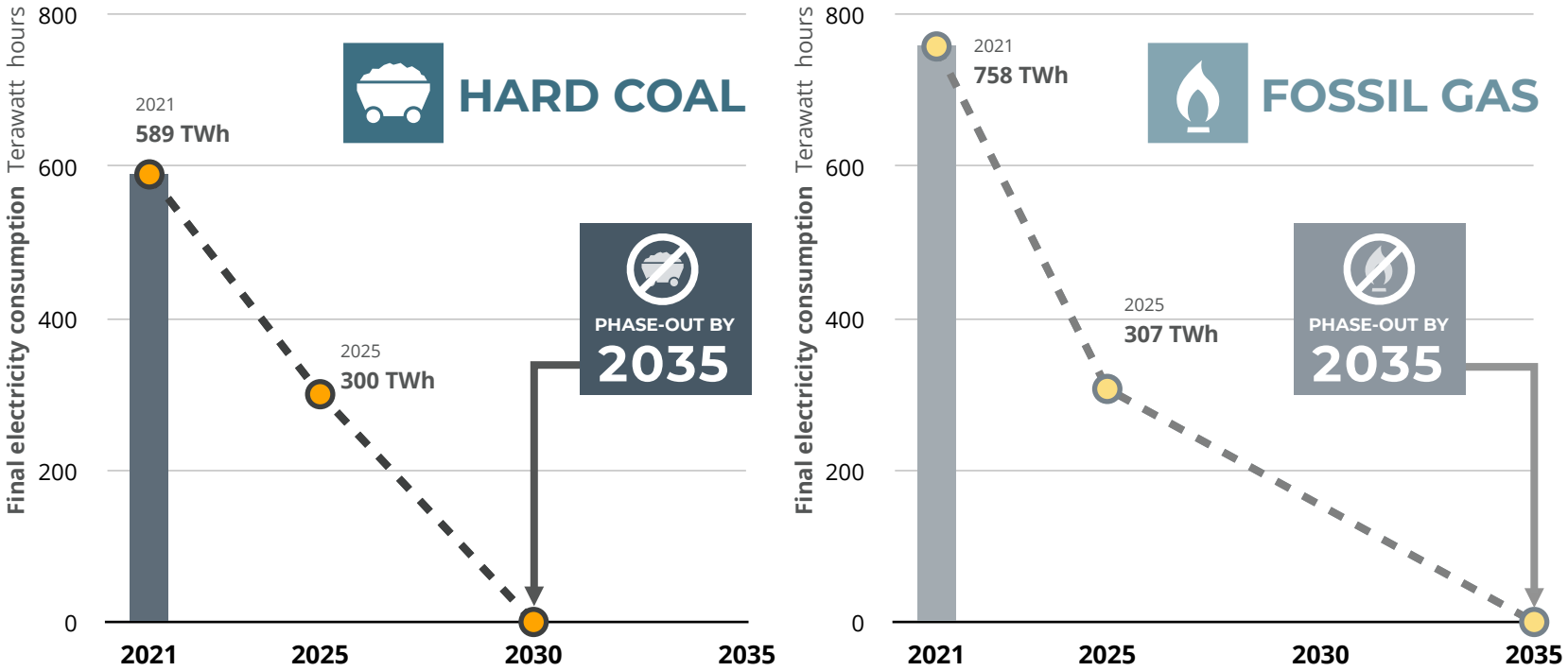
27 Net Zero by 2050: A Roadmap for the Global Energy Sector, IEA, May 2021.

Reducing Europe's dependence on fossil gas and coal by more than a third by 2025 would allow for reaching lignite and hard coal phase-out by 2030 and a full fossil gas phase-out by 2035.

The below graphs show how much impact such a reduction of fossil fuel consumption in Europe by 2025 would have on coal and fossil gas use in the power sector:

It would lead to an immediate and fast decrease in electricity generation from fossil gas. This not only ensures we are on track towards a fossil-free, renewables-based power sector by 2035 but also contributes at scale to the decarbonisation of the transport and heating sectors as they electrify. This would put Europe on a path to reach a fossil-free, renewables-based energy system by 2040 or earlier.

Phase-out trajectory for fossil fuels in Europe's power sector



Graph 2: Evolution of electricity generation from coal (left) and fossil gas (right) in Europe. Source: Beyond Fossil Fuels, 2023.

Reducing fossil gas by a third and halving coal consumption by 2025 would significantly decrease the energy-related air pollution, prevent health impacts and cut health costs.

In 2016, research from the EEB, the Health and Environment Alliance (HEAL), CAN Europe, the WWF European Policy Office and Sandbag[28] showed that sulphur dioxide (SO2) and nitrogen oxides (NOx) emissions from European coal plants (operated with hard coal and lignite) were responsible for almost 25,000 premature deaths, over 11,000 new cases of adult chronic bronchitis and over half a million days of children suffering from asthma symptoms and 6.6 million lost working days. Burning coal was shown to be responsible for an annual total health bill of between 33.3 and 63.2 billion EUR. The report also shows that halving SO2 and NOx emission levels would halve the associated annual premature deaths.[29]

In Turkey, home to the second biggest coal fleet in Europe, HEAL and the Centre for Research on Energy and Clean Air (CREA) have identified[30] that a complete coal phase-out by 2030 would bring tremendous health benefits. In particular, they identify that phasing out coal by 2030 would cut 100,000 premature deaths, noting that this is 20 times more than deaths from traffic accidents in Turkey per year. The report also highlights that it would prevent nearly 28 million lost working days and cut health costs by up to EUR 194 billion. Using a similar approach, HEAL and CREA have produced reports[31] proving that air pollution from coal power plants will cause a total of more than 64,000 deaths in the Western Balkans by 2030, rising to more than 77,000 by 2050.

In addition, research by HEAL, CREA, Ember and Food and Water Action Europe, published in May 2022, revealed that burning fossil gas, like other fossil fuels, also poses a significant health risk.[32] The report identified that "the price tag for the EU's and UK's reliance on electricity generation from fossil gas adds up to EUR 8.7 billion in health costs in 2019 alone, with the largest health burden in Italy, Germany, the UK, France, the Netherlands and Spain. These costs stem from direct impacts on health from air pollution by gas combustion, including over 2,800 premature deaths, over 15,000 cases of respiratory impacts in adults and children and over 5 million days in lost productivity because of illness."

28 Lifting Europe's dark cloud: how cutting coal saves lives, EEB, HEAL, WWF, CAN Europe, Sandbag, 2016.

29 Reducing emissions from 2013 levels (500mg/Nm3 for NOx and 400 for SO2) to the level induced by 2016's IED and LCP's BREF documents (between 150 and 200 mg/Nm3 for NOx and between 130 and 200 mg/Nm3 for SO2) would lead to halving the annual numbers of premature deaths.

30 Curing Chronic Coal: Turkey, HEAL, December 2022.

31 Curing Chronic Coal: Western Balkans, HEAL, December 2022.

32 False fix: the hidden health impacts of Europe's fossil gas dependency, HEAL, CREA, Ember, F&WA Europe, May 2022.

Box 1 - Analytical approach

This study is a meta-analysis, drawing on and extrapolating from existing studies and market outlooks (see References). We identify energy-related measures grounded in the real world and quantify them. We have analysed power and heat generation as well as energy consumption in buildings and industry and assessed how much gas and coal each measure could displace.

These measures rely on solutions that can be deployed immediately and deliver towards a credible ambition of permanently removing enough fossil fuels demand in Europe by 2025 to accelerate towards a coal phase-out by 2030 and deliver a fossil-free, renewables-based power sector in Europe by 2035. The amount that needs to be removed from Europe's energy systems to be in line with those energy transition objectives is in fact similar to the amount of coal and fossil gas Europe has been importing from Russia, using 2021 as the base year. This is why for the purpose of this analysis we quantify the ability of measures to displace coal and gas compared to how much Europe imported from Russia.

The set of measures we propose would displace 107% of Russian gas and coal imports to Europe (104% in the EU-27) to ensure that enough coal and gas demand will definitely be removed from the energy system, but also enough power and heat will for sure be available through the structural measures we propose to heat our homes and run the European economy.

The ability to displace coal and gas through those measures are quantified for two geographical areas most immediately influenced by disruptions to Russian coal imports and pipeline gas deliveries: the European Union (EU-27) and the European continent, which includes the EU-27, the UK, Switzerland, Norway, Turkey, the Western Balkans countries, Ukraine and Moldova (see Graph 3).

Graph 3: Geographic scope of this meta-analysis. EU-27 is in dark blue and the European continent (excluding Russia and Belarus) is in light blue.

3

The nine categories of measures in detail

Europe could remove all Russian gas and hard coal imports by 2025 through implementing a set of measures for the power sector, efficiency in buildings and industry, and smart consumption of energy

Summary of proposed measures

Reducing fossil gas and coal demand by at least a third by 2025 is both necessary and achievable to address the multiple crises fueled by Europe's dependence on fossil fuels. It means decreasing fossil gas and hard coal demand down to levels that allow Europe to permanently end Russian imports, without substituting those imports through increased use of domestic fossil fuels or importing fossil fuels from elsewhere. By doing this Europe is preparing itself to undertake the necessary changes in its energy and power systems in a short period of time, because a fossil-based system functions very differently from a renewables-based one.

In this meta-analysis, we have analysed a broad range of measures aimed at creating a massive scale up in renewable energy deployment in the power sector, generating significant energy savings, and contributing to the electrification of heat. We grouped these measures into three action areas: the power sector, efficiency for buildings and industry, and smart consumption which includes action by industry and business to reduce energy demand as well as voluntary consumption reduction by individuals.

Table 1: The three action areas and nine subcategories considered

POWER SECTOR	Solar power
	Onshore wind
	Offshore wind
EFFICIENCY IN BUILDINGS AND INDUSTRY	Heat pumps
	Building renovation
	Heater efficiency in buildings
	Efficiency in industrial processes
SMART CONSUMPTION	Lower average space heating temperature
	Energy cuts due to smart consumption choices

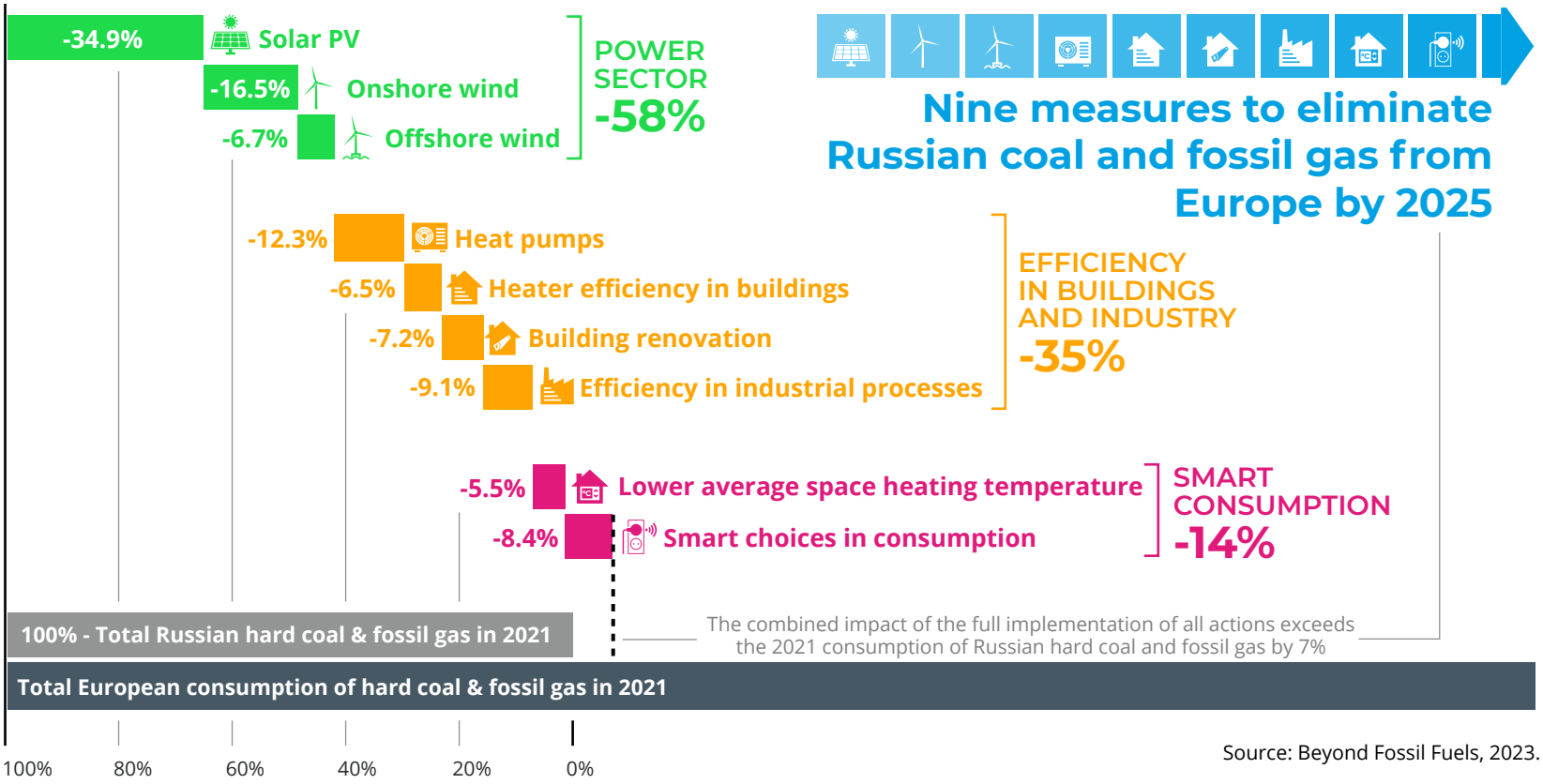
In total, implementing these measures in Europe's electricity and heating sectors allows for removing 44% of Europe's coal (75Mt) and 35% of fossil gas demand (199 bcm).

In the EU-27, these measures allow for a 40% reduction in fossil gas demand (159.4 bcm) compared to pre-war levels (2021) and 47.5% of hard coal demand (48.6 Mt). Overall, these measures bring about an estimated reduction in primary energy demand of 11% in the EU-27.

The graph below shows how much each identified measure impacts fossil gas and hard coal demand relative to the pre-war volumes of imports from Russia.

By accelerating the deployment of renewable energy in the power sector and the installation of heat pumps in buildings beyond the current deployment trends could remove more than two-thirds (70%) of the hard coal and fossil gas imported from Russia. This is equivalent to saving 119 bcm of fossil gas (63% of Russian imports) and 64 Mt of hard coal (nearly 94% of Russian imports).

While the European solar, wind and heat pump industries have already identified that a significant amount of new capacity could be deployed across the continent in the next five years, the measures identified here moderately outperform these forecasts while remaining within a feasible range for delivery.



Graph 4: Impact of the nine categories of measures on fossil gas and hard coal demand and on the level of imports from Russia in 2021

European countries, businesses, municipalities and citizens should deploy an extra 481 GW of solar (459 GW in the EU-27), 102 GW of new wind capacities (78 GW in the EU-27) and nearly 29 million heat pumps (24 million in the EU-27) between 2022 and 2025 (see Table 2). This means that every day, Europe needs to install 14 wind turbines[33] and 37 large solar plants to cover areas with lowest environmental impact such as car parks or degraded land. In addition, nearly 54,000 homes need to be either solarised, equipped with heat pumps or deeply renovated each day.

2022 has shown great promise, largely driven by record deployment of solar PV and heat pumps by private households and medium-sized companies, and the efforts by individuals, communities and businesses to cut their energy use. Never before have European countries installed so many solar panels, wind turbines and heat pumps in a single year.

Germany saw a 53% growth in its domestic heat pump market with nearly 300,000 units added. Nearly ten times that figure was installed across Europe. Meanwhile, the continued increase in solar and wind capacity in Greece - with a record 1.7 GW in 2022 - has contributed to reducing gas demand in the power sector by 14%.[34] Poland has reduced its gas demand by 26% in the power sector[35] and its electricity generation from coal by 3%.[36] The Polish heat pump market recorded the highest growth[37] in Europe, with 200,000 units sold, more than double the previous year.

33 Onshore and offshore wind turbines.

34 Trends in electricity production, the Green Tank, December 2022.

35 Yearly electric data, Ember, March 2023.

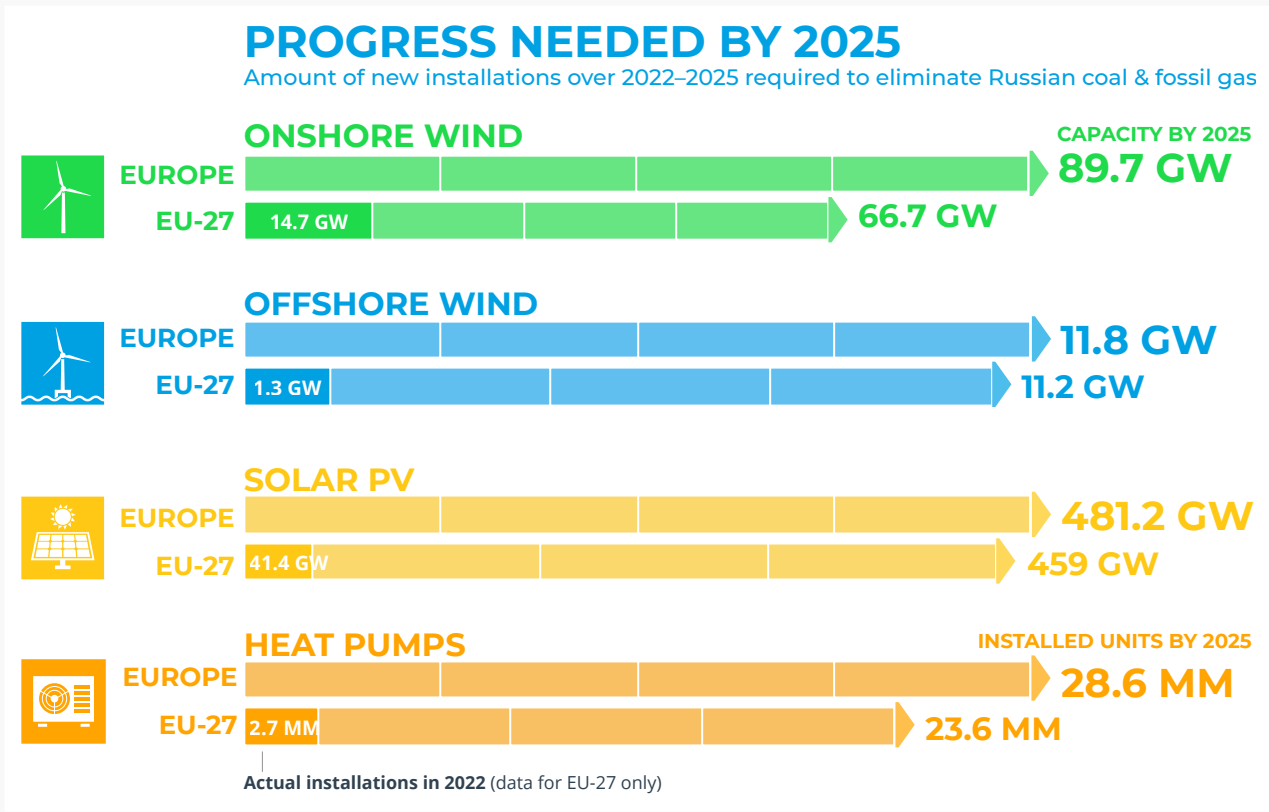
36 European Electricity Review 2023, Ember, January 2023.

37 Heat pump record: 3 million units sold in 2022, contributing to REPowerEU targets, EHPA, February 2022.

Table 2: New wind and solar capacities, heat pumps and renovated dwellings by 2025

	POWER SECTOR			EFFICIENCY IN BUILDINGS & INDUSTRY	
Region	Solar PV	Onshore wind	Offshore wind	Heat pumps	Deeply renovated buildings
Europe	481.2 GW	89.7 GW	11.8 GW	28.6 Million	21.9 Million
EU-27	459.0 GW	66.7 GW	11.2 GW	23.6 Million	16.1 Million

Source: Beyond Fossil Fuels, 2023



Graph 5: Progress made in 2022 in the deployment of wind, solar and heat pumps, and the gap with 2025 expected levels. MM = million. Sources: SolarPower Europe, WindEnergy, EHPA & Beyond Fossil fuels, 2023.

Poland added a record 1.5 GW of new wind capacity. While this is a positive development, the Polish government has not thrown its weight behind the Polish renewables industry. The recent revision of the so-called '10H rule', introduced in 2016 and blocking 99.7% of wind investment in the country,[38] allows for more wind deployment but will not unlock the full potential of Poland's wind energy. The government decided to set the new distance limit at 700 metres instead of the expected 500 metres.[39]

In addition to acting on the power sector and deploying heat pumps in buildings, Europe needs to build more efficient heating systems in buildings and the industrial sector. Industries such as chemicals, food and non-metallic minerals sectors, could significantly reduce their fossil gas consumption with more waste heat recycling and heat pump deployment.

Deep building renovations show great potential to decrease energy demands in homes and offices, in particular in reducing fossil gas, coal and oil demand in these sectors. However, it would require an immediate acceleration of deep renovation rates, to reach full potential. In 2021, the annual rate for deep building renovation was 15 times slower (0.2% of building stock) than the necessary level identified by the Building Performance Institute in Europe (BPIE).[40] Only 1% of the building stock was renovated to any extent each year, far from the nearly 4.5% necessary.

All these measures together could reduce energy consumption in the industry and the buildings and save up to 35% of Europe's imports of coal and fossil gas from Russia.

Finally, voluntary smart choices of consumption could contribute to cutting nearly 14% of fossil gas demand. These choices range from acting on space heating and cooling temperatures in offices and public buildings, cautious use of electricity, especially at peak times, and reducing manufacturing demand on energy intensive products that perpetuate Europe's hunger for fossil fuels such as SUVs and aeroplanes.

The nine measures identified and their impacts are described in more detail in the following sections.

38 Wind in the sails. The 10H principle and the potential of onshore wind energy in Poland, Instrat, May 2021.

39 Poland risks losing half of previously greenlighted onshore wind land potential due to recent parliamentary amendment, Instrat, February 2023.

40 Deep renovation: shifting from exception to standard practice in EU policy, BPIE, November 2021.

Impact on primary energy demand in the European Union

For each measure, we assessed its impact on total primary energy demand in Europe compared to pre-war levels. In 2021, the total primary energy demand in all sectors, including transport, the residential and commercial sectors, services, industry, agriculture and energy production, added up to a total of 12,686 TWh.[41] Table 3 shows these impacts.

For each measure in the power sector and the building sector, we have assessed the amount of all fossil fuels (e.g. oil in building, lignite in the power sector) that could be displaced in addition to hard coal and fossil gas. Therefore, the impact of these measures on primary energy demand will be larger than the displacement of fossil gas and hard coal in the power and heating sectors. In the power sector, primary energy corresponding to electricity generation from new wind and solar capacities is considered equal to final energy, whereas we assumed an average efficiency for electricity generation from fossil gas and coal of 50% and 40% respectively. Hence, the amount of primary energy generated from wind and solar is smaller compared to the primary energy content of fossil gas and coal they replace.

41 Including industry feedstocks, excluding transport bunkers, excluding heat pump ambient heat related to buildings. Source: Climact, 2023.

Table 3: Impact of all measures on primary energy demand in Europe and the EU-27

POWER SECTOR	
Solar PV	274 TWh
Onshore wind	
Offshore wind	
EFFICIENCY IN BUILDINGS AND INDUSTRY	
Heat pumps	307 TWh
Building renovation	160 TWh
Heater efficiency in buildings	115 TWh
Efficiency in industrial processes	172 TWh
SMART CONSUMPTION	
Lower average space heating temperature	97 TWh
Smart consumption choices in consumption	238 TWh
COMBINED IMPACT	
Primary energy demand reduction by 2025 (TWh)	**1363 TWh**
Share of total primary energy demand (% relative to 2021 levels - all energy - all sectors)	**10.75%**

Sources: Climact (Primary energy demand in Europe - 2021 levels) and Beyond Fossil Fuels 2023

Box 2 - Several studies show there is no need for new LNG infrastructure and pipelines in Europe

Since February 2022, most European countries have resolved to end Russian imports of gas and other fossil fuels. They have implemented a range of emergency measures targeted at immediately reducing fossil gas consumption, and looked to diversify gas supply sources and routes by pipeline or by ship, alongside discussions on how to scale up implementation of renewables, electrification and efficiency measures.

Connected to the push to diversify the sources for gas supply are plans to build costly new gas infrastructure across Europe, without proper Europe-wide analysis of how much the existing gas infrastructure is capable of providing. In the panic after the Russian invasion of Ukraine, governments scrambled to secure gas deals to build 35.2 bcm of new LNG import capacity and 11.1 bcm of new pipeline import capacity. In total, according to data by the Global Energy Monitor (GEM) Europe is currently planning to build 227.2 bcm of LNG terminals and 60.5 bcm of import pipelines.[43]

Yet the past winter showed that Europe already has enough gas import infrastructure to secure the necessary fossil gas supplies. The IEA analysed the factors that helped Europe come through the winter and concluded it was a mix of high levels of wind and solar power generation, emergency policies, alternative gas supply, energy savings by citizens and businesses and warmer weather. In fact, they note that renewable energy was "the single largest structural driver of reduced natural gas demand" in Europe over the winter.[44] Any newly contracted floating LNG terminals (FSRUs) hardly contributed this winter, as it also only just came online. Instead Europe managed to rely on its existing infrastructure.

Concerns are already being raised over the risk of significant LNG overcapacity, particularly in Germany where the government is planning to build an additional import capacity of 70.3 bcm by 2026.[45] Internal analysis commissioned by the German ministry of economy and climate action reveals that the German government is planning significant LNG overcapacity.[46] The New Climate Institute has called these plans 'massively oversized'.[47] Moreover, the length of time it takes to build new import infrastructure means that in two to three years when these terminals and pipelines come into operation at the very earliest, they will not be needed because gas demand will be coming down due to the implementation of demand reduction measures.[48]

These investments are also incompatible with European[49] and national climate targets, including Germany's.[50] The EU-27 cannot afford to build more fossil fuel infrastructure if it wants to meet its obligations under the Paris Climate Agreement. In its latest assessment, the Intergovernmental Panel on Climate Change (IPCC) stated that the projected carbon emissions from existing fossil fuel infrastructure would exceed the remaining carbon budget for 1.5°C.[51] This means there is absolutely no room for additional fossil fuel infrastructure, including LNG terminals and import pipelines.

Global LNG markets are expected to remain tight for at least the next few years with strong uncertainty that additional LNG will become available,[52] particularly if Asian demand grows off the back of an economic recovery, notably in China.[53] It must be underlined, therefore, that additional gas infrastructure capacity would not guarantee additional LNG imports into Europe. On the contrary, the more Europe wastes political focus and investment on gas imports, the less scope it will have to drive the necessary investments in credible solutions.

To navigate the coming period there is no need to add any additional gas infrastructure beyond what is already in place. Instead, national and local governments as well as the industry should continue with targeted, temporary measures aimed at reducing energy demand for the coming two winters. The voluntary target to reduce gas demand by 15% over the winter of 2022/3 should be transformed into a structural measure and increased gradually to achieve a gas phase out by 2035. The voluntary target to cut electricity demand by at least 5% during peak hours should also be maintained. Together then with rolling out the other structural measures as proposed in the meta-analysis, the continent will also have enough inbuilt redundancies in case of a harsh winter or infrastructure failures.

43 European Gas Tracker Report 2023, Global Energy Monitor, March 2023.
44 Europe's energy crisis: What factors drove the record fall in natural gas demand in 2022?, IEA, March 2023.
45 ibid.
46 Analyse der globalen Gasmärkte bis 2035, EWI, January 2023.
47 Plans For German Liquefied Natural Gas Terminals Are Massively Oversized, New Climate Institute, December 2022.
48 How Long Does it Take to Build an LNG Export Terminal in the United States?, Global Energy Monitor, April 2022.
49 Does phasing-out Russian gas require new gas infrastructure?, Artelys, April 2022.
50 The Federal Government's LNG planning is oversized and contradicts climate targets, DUH, 2023.
51 Synthesis Report of the IPCC's Sixth Assessment Report (AR6) Summary for Policymakers, IPCC, March 2023.
52 Europe's energy crisis: What factors drove the record fall in natural gas demand in 2022?, IEA, March 2023.
53 Gas Market Report, Q1-2023, International Energy Agency, February 2023.

Assumptions related to the power sector

Electricity demand

In our calculations[54] we assume a 6% growth in final electricity consumption between 2021 and 2025 in the EU-27, owing to a significant increase in new electric vehicles (EVs)[55] and the integration of up to 27 million heat pumps. With this assumption, we intend to ensure robustness with potential accelerations in the sales of EVs and installations of heat pumps. Based on our own calculation, we estimate this would lead to a 134 TWh higher electricity demand in 2025 than the European Commission anticipated in its 2030 Climate Target Plan.[56] It also provides for a conservative approach regarding the amount of fossil fuel that new renewables capacity could displace (more on this below). Considering lower predicted consumption in the energy branch (e.g. self consumption, system loss), the gross generation of electricity is only 3.57% higher in 2025.

For non-EU countries, we used demand trajectories from national scenarios. For the UK we used the "Leading The Way" scenario from National Grid's 'Future Energy Scenarios' report,[57] for Turkey we used the joint NGO scenario 'The Roadmap for a Paris-Compatible Turkish coal exit'[58] and for Norway we assume that electricity demand growth remains stable compared to recent years (+1.8%/yr).

Electricity generation

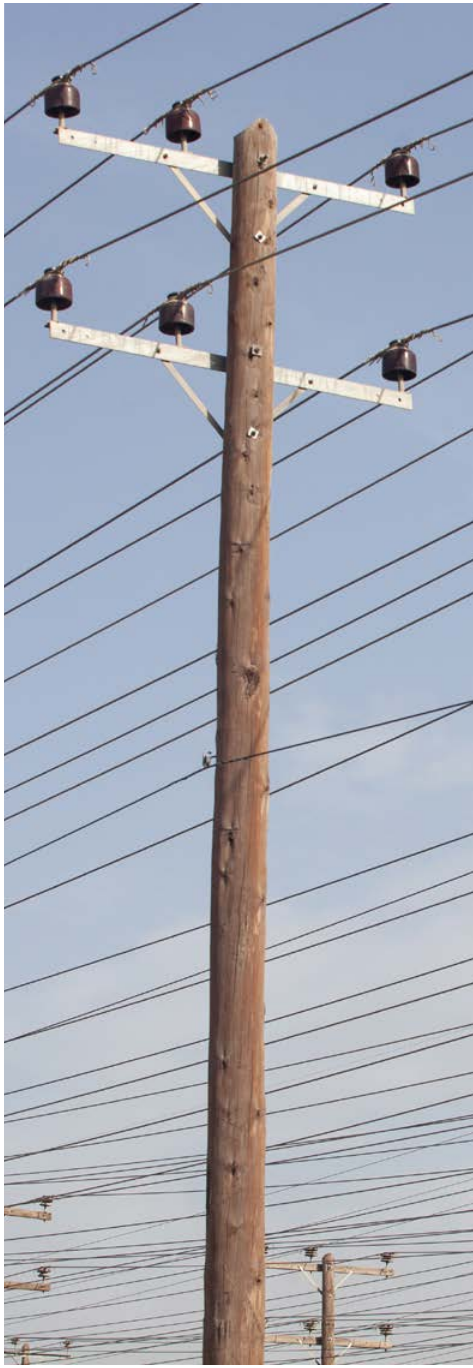
The way in which new wind and solar capacities affect the demand for fossil gas and hard coal is assessed by assuming they impact the power market in the following order:

1. Fill the gap between existing generation and increased demand
2. Displace hard coal and lignite generation consistent with a linear decrease towards a 2030 coal phase-out.
3. Displace gas-fired power generation.

Two trajectories for wind and solar

We have tested two trajectories for solar PV and wind deployment. The first one, named 'Regular Trajectory', is based on the most recent market outlooks for the five next years from SolarPower Europe and WindEurope. The second one, named 'Adjusted Trajectory', assumes Europe will exceed these market predictions. For solar PV, the upward adjustment is based on the fact that the solar industry has set the ambition of deploying about 1 TW of solar by 2030. As for wind, we took into consideration that according to the IEA 80 GW of projects are under different levels of permitting and development in Europe, of which a significant number is waiting for final approval before construction starts.[59] Unblocking some of these projects would not only ensure that Europe could reach WindEurope's market forecast, but also exceed it. We therefore consider 11.5 GW wind capacity could be deployed in the EU-27 in addition to WindEurope's predictions.[60]

For the 'Adjusted Trajectory' we assume that the extra wind and solar capacity additional to the regular trajectory impacts the fossil gas and hard coal generation in a way that is proportionate to their share in the power mix.[61]



54 Calculations in the power sector were made with the support from Ember.

55 Electricity share in the energy demand for road transport reaching 3.4% by 2025 instead of 0.21% in 2021.

56 EU Climate target plan, European Commission, 2020.

57 Future Energy Scenarios, National grid, July 2022.

58 The Roadmap for a Paris-Compatible Turkish coal exit, NGO coalition, November 2021.

59 How to Avoid Gas Shortages in the European Union in 2023, IEA, 2022.

60 For countries outside the EU, we considered the additional capacities for wind and solar in the "Adjusted Trajectory" as coming in addition to the targets identified in the "Leading The Way" scenario for the UK, and the "Roadmap for a Paris-Compatible Turkish coal exit", in Turkey.

61 It means that, for the EU, each TWh from wind and solar capacities additional to the 'regular trajectory', displace three times more fossil gas than hard coal. For Europe overall, we use a slightly lower ratio of 2.34.

Other assumptions

For other sources of power generation, our assumptions are as follows:

- Nuclear energy: we assume 109 GW of operational capacity in 2025, slightly lower than the 112 GW in operation in 2021. This corresponds to national plans, which would see installed capacity reduced in Germany, Belgium, the UK and Sweden and increased in Slovakia, France, Finland and Turkey. Nuclear generation levels in 2025 are considered 90% lower than in 2021 due to the capacity change, but primarily because we expect France's nuclear fleet will only return to 2021 production levels, significantly below its highest historical production levels.[62] The difficulties France has been encountering in maintaining its ageing fleet, and the recurring faults identified in some units require caution regarding the potential output the French nuclear fleet could reach by 2025.
- Hydropower: we assume that hydropower generates the same amount of electricity in the EU-27 in 2025 as it did in 2021, with a slight increase in Turkey.[63]

Changes and impact

Solar and wind capacity could significantly increase by the end of 2025. A minimum of 583 GW of new capacities (536 GW in the EU-27) could be deployed, which could generate 890 TWh of electricity (770 TWh in the EU-27). This could meet a quarter of Europe's electricity needs in 2025. While some of this new generation would cover new power demand, about 80% could replace fossil gas, hard coal and lignite in the electricity mix.

In Europe, these new wind and solar capacities would remove 92 bcm of gas, representing 49% of pre-war imports from Russia, and 59 Mt of coal, 88% of former Russian imports levels.

In the EU-27, these new wind and solar capacities would contribute to reducing the primary energy demand by 2%.

62 Press release, EDF Group, March 2023.

63 Karbon Nötr Türkiye Yolunda İlk Adım Kömürden Çıkış 2030, Europe Beyond Coal, 2021.

Solar photovoltaic

Context and expected deployment by 2025

The year 2022 has shown a record 41.4 GW of newly installed solar PV capacity in the EU-27. It represents an almost 50% increase in the annual rate of installations compared to 2021. The 2022 levels are 16% higher than the European solar industry's own forecast from the year before. These encouraging results demonstrate the ability of the solar industry to scale up rapidly when politicians and businesses invest in the sector.

SolarPower Europe expresses confidence by stating "that further annual market growth will beat all expectations, exceed 50 GW deployment level in 2023, and more than double from today to 85 GW in 2026". SolarPower Europe also acknowledges that Europe could install an additional 350 GW of solar in the EU-27 by 2025.[64] In their most recent assessment of how the European Union can avoid a gas shortage, the IEA identifies that "150 GW of solar PV projects (utility-scale) are under various permitting stages in the EU" and that a significant number of these projects are waiting for final approval and could see their construction accelerated by local or national administrations.[65]

SolarPower Europe's Market outlook for the period between 2022 and 2026, published in December 2022, shows that around 300 GW could be installed by the end of 2025, a 50% increase on the previous year's prediction. The same year, it adopted their solar energy strategy with the aim to bring online over 320 GW of new solar photovoltaic by 2025 and almost 600 GW by 2030. SolarPower Europe is now anticipating that Europe will install 1 TW of new solar PV by 2030.[66]

64 EU Market Outlook for Solar 2022-2026, Solar Power Europe, 2021.

65 How to avoid gas shortage in Europe in 2023, IEA, 2022.

66 EU solar energy strategy communication, European Commission, May 2022.

Despite this, SolarPower Europe warns of the installation bottleneck created by the lack of trained installers in Europe, and the necessary scale-up of Europe's domestic solar manufacturing capacity to secure volumes and increase the sustainability of solar panels. In 2021, countries from the EU-27 spent more than EUR 10 billion importing solar and wind technologies from countries outside the EU.[67] Furthermore, European grid operators must invest in the strengthening of transmission and distribution grids to support the integration of solar power in Europe's power grids.

To ensure the rapid deployment of these solar projects, which will supply European households and businesses with cheap and reliable solar energy, CAN Europe identifies that a minimum 60% of these projects should be rooftop solar owned by households, municipalities and SMEs[68]. Solar mandates for new residential buildings as well as new and existing commercial and public buildings will be key measures to drive installation rates. By 2025, all such locations should have implemented the proposed measures to their maximum potential (e.g. solar panels are mounted on every possible rooftop) or have a plan in place for further measures post-2025.

Taking into account the solar industry's current trends and forecasts, we consider that a minimum of 481 GW of solar PV capacity could be added in Europe by the end of 2025. The UK alone could add around 10 GW by 2025 according to National Grid.[69] Turkey has updated its solar targets and aims at deploying 45 GW of new solar capacity by 2035. This means the country should install an average of 15 GW every five years.

Table 4: Expected new solar capacity and corresponding electricity generation in Europe by 2025

Solar PV
2025 Benchmarks

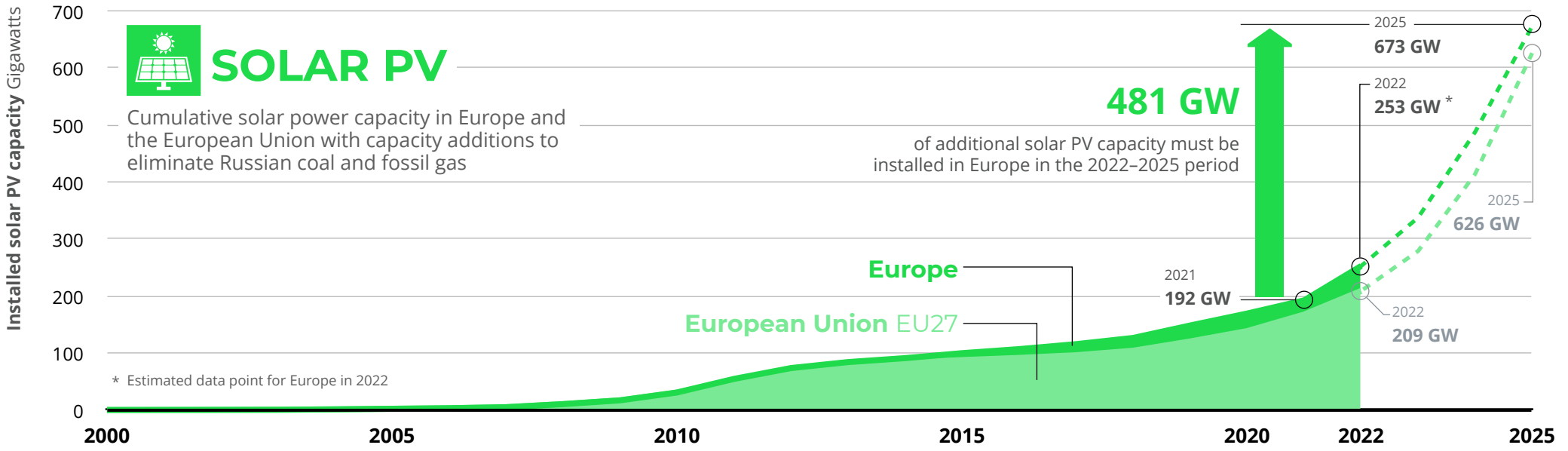
Region	New capacity additions 2022-2025	Cumulative installed capacity by 2025	Cumulative electricity generation by 2025
Europe	481 GW	673 GW	713 TWh
EU-27	459 GW	626 GW	642 TWh

Source: Beyond Fossil Fuels, 2023

67 EU green energy product imports: EUR 13.8 billion, Eurostat, 2022.

68 REpower for the people: new report indicates how the eu can wean off russian fossil gas by 2025, CAN Europe, June 2022

69 Leading the Way pathway in the Future Energy Scenario, National Grid, 2022.



Graph 6: Cumulative solar capacity in Europe and the EU-27. Sources: Historical values from Ember, 2022. Linear projection for the period 2022-2025, Beyond Fossil Fuels.

Impact on fossil gas and hard coal demand in Europe

Of all the measures included in this report, solar PV represents by far the greatest potential to cut fossil fuel consumption in the European power system. Adding 471 GW of new solar capacity by the end of 2025 would remove enough fossil fuels from the power system to reduce by a quarter Europe's pre-war fossil gas imports from Russia and halve those of hard coal.

Table 5: Volumes of fossil gas, hard coal and lignite replaced by new solar capacities in the power sector

Solar PV
Reductions in fossil fuel demand in 2025

Region	Fossil gas	Hard coal	Lignite
Europe	55.4 bcm	35.6 Mt	55 TWh (final energy)
EU-27	49.1 bcm	23.3 Mt	55 TWh (final energy)

Source: Beyond Fossil Fuels, 2023

Wind energy

Because of its significant potential, both on land and at sea, the improving efficiencies of the technology and lower manufacturing costs, wind energy is one of Europe's best promises to decarbonise its power system.

However, the deployment of new wind capacities is also one of the European energy transition's most persistent weaknesses. European leaders must accelerate wind development at scale in the coming years to deliver significant cuts in Europe's fossil fuel dependence.

In recent years, new wind projects have faced growing difficulties, including long and complex permitting processes, a lack of spatial planning, underinvestment in grids and even governments actively hindering new investments. These hurdles have led to permitting times ranging from 30 months to 10 years in European countries.[71]

The impact on the sector is clear: in the past ten years, annual installations of new wind capacity have stagnated between 12 and 18 GW. While onshore wind projects nearly doubled, from 9.5 GW installed in 2018 to 16.7 GW of new capacities in 2022, offshore wind projects reached their lowest levels since 2017 (2.5 GW), a third less than 2019's record high of 3.9 GW. The IEA estimates that in total nearly 80 GW of wind projects are under various permitting stages in the EU[72] but the European wind industry association, WindEurope, has drawn worrying conclusions from 2022's investments levels: 'Europe announced EUR 17 billion of new investments which cover 12 GW of new capacity that will be built this year and beyond. This was less than half the amount invested in 2021. Not a single large-scale offshore wind farm reached a final investment decision'

70 For example, the so-called '10H rule' in Poland (which by now has been loosened), the effective moratorium on onshore wind in the UK, and Hungary's so-called '12K rule'.

71 Europe's Race for wind and solar, Ember, 2021.

72 How to Avoid Gas Shortages in the European Union in 2023, IEA, 2023.

Table 6: Expected new onshore wind capacity and corresponding electricity generation in Europe by 2025

Onshore wind
2025 Benchmarks

Region	New capacity additions 2022-2025	Cumulative installed capacity by 2025	Cumulative electricity generation by 2025
Europe	89.7 GW	304 GW	670 TWh
EU-27	66.7 GW	240 GW	572 TWh

Source: Beyond Fossil Fuels, 2023

WindEurope identifies two main factors: the high inflation in input costs and unhelpful electricity market interventions by national governments, which have undermined investor confidence.

As a result, WindEurope's market outlook for the next five years remains very cautious. WindEurope foresees an average annual level of new wind capacity at 26 GW for Europe, and 20 GW for the EU-27. This is well below the 30 GW WindEurope says must be installed every year to meet the EU's 2030 renewable energy target.

Given this challenging context, we estimate that by 2025 Europe could deploy 60% of WindEurope's forecast for the period 2023-2027 (53% for the EU-27). This leads to an addition of 102 GW of onshore and offshore wind in Europe for the period 2022-2025 (78 GW in the EU-27).

Table 7: Expected new offshore wind capacity and corresponding electricity generation in Europe by 2025

Offshore wind
2025 Benchmarks

Region	New capacity additions 2022-2025	Cumulative installed capacity by 2025	Cumulative electricity generation by 2025
Europe	11.8 GW	38.7 GW	203 TWh
EU-27	11.2 GW	26.8 GW	102 TWh

Source: Beyond Fossil Fuels, 2023

Impact on fossil gas and hard coal demand in Europe

Despite the challenging circumstances, onshore and offshore wind could greatly contribute to reducing fossil demand in the European power system. Adding 102 GW of new wind capacity in Europe by the end of 2025 would remove enough fossil fuels from the power system to reduce fossil gas imports from Russia by 20% and hard coal imports by a third.

Table 8: Volumes of fossil gas, hard coal and lignite replaced by new onshore and offshore wind capacities in the power sector

Combined onshore and offshore wind
Reductions in fossil fuel demand in 2025

Region	Fossil gas	Hard coal	Lignite
Europe	36.9 bcm	23.7 Mt	45.7 TWh (final energy)
EU-27	27.5 bcm	13.0 Mt	43.1 TWh (final energy)

Source: Beyond Fossil Fuels, 2023

Assumptions related to efficiency in buildings and industry

Buildings

Today, fossil gas meets a third of the energy demand in the residential sector, where it plays a central role in space and water heating. Large volumes of fossil gas could be displaced by deploying more efficient heating technologies and better building insulation. We assessed potential short-term gains in the EU-27, considering the following three publications:

1. The European Heat Pump Association's (EHPA) most recent market outlook, which anticipates that by 2030 Europe could triple its stock of installed heat pumps compared to 2022.
2. The Building Performance Institute for Europe[73] (BPIE)'s recently published roadmap for building renovation in line with European climate ambition. By no later than 2030 - 3% of Europe's building stock should be deeply renovated[74] which is 15 times faster than the current rate.
3. Agora Energiewende's estimation of potential short-term gains in the residential sector as part of a broader assessment to reduce fossil gas demand in Europe by 2027.[75] We considered their proposal to increase the efficiency of unabated gas boilers and their proposal to increase building connections to existing district heating networks.

The impact on energy demand of heat pump deployment is assessed based on an average European home.[76] In order to determine the amount of fossil gas and coal consumption a new heat pump or a renovated home would displace, we use the energy mix for heating and power in the residential sector in the EU-27 in 2021. Hence for each heat pump deployed and home or office renovated, we considered that the amount of oil, hard coal and fossil gas displaced is proportional to the relative share of oil, hard coal and fossil gas in the residential sector. In addition, power demand is increasing due to the demand from heat pumps (see chapter 3.3.1 - Electricity demand) while other sources of heat are considered as remaining stable between 2021 and 2025.[77]

Industry

Fossil gas provides 28% of the EU-27's industrial energy supply. We assessed potential short-term gains from Climact's report[78] on opportunities to reduce natural gas demand in the EU-27's industry sector (e.g.materials and heat recycling, electrification of low temperature heating, efficiency improvements in small ceramic factories, renewables for electricity generation). We estimated the impact that these measures could have on all European industry by extrapolating these trends to the rest of the continent.[79]

73 'Deep renovation: shifting from exception to standard practice in EU policy', BPIE, 2021.

74 Deep renovation is defined by BPIE as a process of capturing, in one or, when not possible, a few steps (maximum number to be defined), the full potential of a building to reduce its energy demand, based on its typology and climatic zone. It achieves the highest possible energy savings and leads to a very high energy performance, with the remaining minimal energy needs fully covered by renewable energy. BPIE refers to a range of 60-90% of energy savings for deeply renovated buildings. Source: Ibid.

75 Regaining Europe's Energy Sovereignty, 15 Priority Actions for REPowerEU, Agora Energiwende, 2022.

76 We assume an average home of 65 m2, with an average consumption of 250 kWh/m2/year, with heating demand accounting for 80% of total energy demand. This means that each installed heat pump would displace [65m2 * 0,250 MWh/m2/year * 80% =] 13MWh of annual heating demand.

77 For each MWh of energy demand reduction, 0.70 MWh of fossil gas, 0.21 MWh of oil and 0.09 MWh of coal are removed from the sector's energy consumption. We assumed the overall European potential would be 136% higher. This conversion rate corresponds to the ratio between the number of dwellings in Europe (300 million) and the number in the EU-27 (220 million). Source: 'EU Building Stock Observatory database' , 2023.

78 Opportunities to get EU industry off natural gas quickly, Climact, May 2022.

79 Extrapolation was using a GDP ratio between Europe and the EU-27.

Changes and impact

Efficiency in spatial heating in buildings and heat generation for the industry could displace 80 bcm of fossil gas and 6 Mt of hard coal. This represents nearly 42% of the pre-war level of fossil gas imports from Russia and almost 9% of the hard coal imports in Europe.

Overall, it could displace 5.5% of European primary energy demand.

Recent trends in the European heat pump market and the renovation of buildings in the context of high energy prices are encouraging. However, the gap between current trends and the necessary speed and scale is worrying. 3 million heat pumps installed in 2022 but needs to reach annual installation rates three times that by the end of 2025. The gap is even more significant for building renovations: less than a million homes are deeply renovated every year, far below the objective laid out in this report of 9 million annual deep home renovations (6 million in the EU-27) that Europe must reach no later than 2030 in order to meet its climate targets.

Heat pumps

Context and expected deployment by 2025

The deployment of heat pumps has seen a swift acceleration in Europe in 2021 in the context of increasing energy prices. This trend continued in 2022 as households, confronted with increased energy costs, looked for cheaper alternatives.

Three million heat pumps were installed in 2022, this number needs to triple by the end of 2025. Some countries saw incredible growth with sales in Belgium and the Czech Republic doubling and a 120% increase in sales in Poland. As a result, Europe had nearly 20 million heat pumps installed by the end of 2022. EHPA estimates that these heat pumps in Europe are meeting 16% of Europe's building heating needs, replacing approximately 4 bcm of fossil gas every year.[81] Table 9 illustrates the remarkable growth in European markets in 2022.

In their most recent market outlook, EHPA anticipates that nearly 50 million heat pumps could be deployed in the EU-27 and UK by 2030. The UK government plans to grow the domestic market to 600,000 annual heat pump sales by 2028, while the German government plans to install 500,000 heat pumps as of 2024.[82]

For 2030, EHPA predicts up to 58 million heat pumps could be installed in 22 countries[83] in Europe by 2030, some of which would replace the oldest heat pumps deployed two decades ago.

80 How the energy crisis is boosting heat pumps in Europe, Carbon Brief, March 2023.

81 Heat pump record: 3 million units sold in 2022, contributing to REPowerEU targets, EHPA, February 2023.

82 Habeck große 'soziale Unterstützung' bei Heizungseinbau, Der Spiegel, 7 March 2023.

83 AT, BE, CH, CZ, DE, DK, EE, ES, FI, FR, HU, IE, IT, LT, NL, NO, PL, PT, SE, SK UK. It doesn't include Western Balkans, Turkey, Ukraine and Moldova).

Table 9: Sales of heat pumps in Europe in 2022

Heat pumps
2022 Sales

Region	Sales of heating heat pumps 2022	Growth in sales 2021 to 2022 (% of additional heat pump units sold)	Growth in sales 2021 to 2022 (number of additional heat pump units sold)
Austria	49,204	+59%	+18,227
Belgium	32,965	+66%	+13,121
Czechia	60,065	+99%	+29,886
Denmark	88,833	+20%	+14,892
Finland	196,359	+52%	+66,984
France	462,672	+20%	+76,176
Germany	236,000	+53%	+82,000
Italy	502,349	+37%	+134,429
Netherlands	123,208	+80%	+54,796
Norway	156,295	+25%	+31,267
Poland	195,480	+102%	+98,540
Portugal	29,969	+17%	+4,357
Sweden***	215,373	+60%	+81,875
Switzerland	41,209	+22%	+7,505
Spain	161,800	+21%	+28,129
UK****	59,862	+40%	+17,103

Source: European Heat Pump Association (EHPA), Feb 2023

Table 10: Expected new heat pumps deployed in the residential sector in Europe by 2025

Heat pumps
2025 Benchmarks

Region	New heat pumps (more ambitious trajectory)
Europe	28.6 Million
EU-27	23.6 Million

Source: Beyond Fossil Fuels, 2023

We assumed a minimum lifetime of 20 years for heat pumps installed before 2021 and applied a 5% replacement rate per year which leads to replacing half of the pre-2021 equipment by 2030. We, therefore, feel comfortable with an assumption of 51 million heat pumps added by 2030 on top of the 20 million stock in 2022. This leads to an ambition of 71 million heat pumps installed in Europe by 2030.

Based on the above projections, we tested two trajectories: a more cautious trajectory assumes that 44% of the 51 million heat pumps will be installed by 2025, which would lead to an additional 24.3 million heat pumps in Europe. The second more ambitious trajectory assumes that the 51 million heat pumps could be installed even faster leading to 28.6 million additional units by 2025.

Impact on fossil gas and hard coal demand in Europe

Heat pumps have great potential to reduce fossil gas consumption in residential buildings. Accelerating the market could lead to heat pumps displacing 14% of Europe's pre-war levels of fossil gas imports from Russia and more than 6% of hard coal imports. By 2025, heat pump deployment could reduce Europe's total primary energy demand by nearly 2%.

Table 11: Volumes of fossil gas and hard coal displaced by heat pumps installations

Heat pumps
Reductions in fossil fuel demand in 2025

Region	Fossil gas	Hard coal
Europe	26.4 bcm	4.3 Mt
EU-27	21.9 bcm	3.5 Mt

Source: Beyond Fossil Fuels, 2023

*** Sweden's heat pump calculations now include air to air heat pumps, which is why the growth displayed is so significant.
**** The UK's figures are not official but are an estimate based on expert opinion.

Building renovations

Context and expected deployment by 2025

European buildings represent an important opportunity to reduce European gas demand. According to BPIE, renovating millions of buildings could reduce the sector's energy demand by 60% by 2030 (compared to 2015 levels) which is needed to ensure that the building sector contributes to Europe's climate and energy targets.

Concretely, the yearly rate for deep renovations, i.e., renovations that reduce energy demand by at least 60%, should reach 3% as soon as possible before 2030. Deep renovations should make up at least 70% of all building renovations, while the remaining 30% should be medium-depth renovations, i.e. renovations that achieve between 40% and 60% energy savings.

Yet in 2021, only 1% of the European building stock was renovated, and only 0.2% of the building stock was deeply renovated which is 15 times smaller than the necessary renovation rate by 2030. European countries and the building sector must adopt the necessary measures to rapidly accelerate the renovation rate, with a focus on deep renovations.

Aligning with BPIE's realistic trajectory, we have assumed a progressive evolution of the annual renovation rate of 4.3% of the total building stock per year of which 70% are deep renovations (achieving 70% energy savings per renovation) and 30% are medium-depth renovations (achieving 50% energy savings per renovation).

The estimated reduction of fossil gas and hard coal demand has been derived from the reduction of final energy demand and the share of fossil fuels used for heating generation in the residential and tertiary sectors.[85] Table 12 and 13 show the number of dwellings and offices that could be renovated each year in Europe and the EU-27, the average renovation depth reached by 2025 and their impact on fossil field demand.

84 Deep renovation: shifting from exception to standard practice in EU policy, BPIE, 2021.

85 We considered that cuts to gas and hard coal demand correspond to generation from gas boilers and coal stoves (with an estimated average efficiency of 60%)

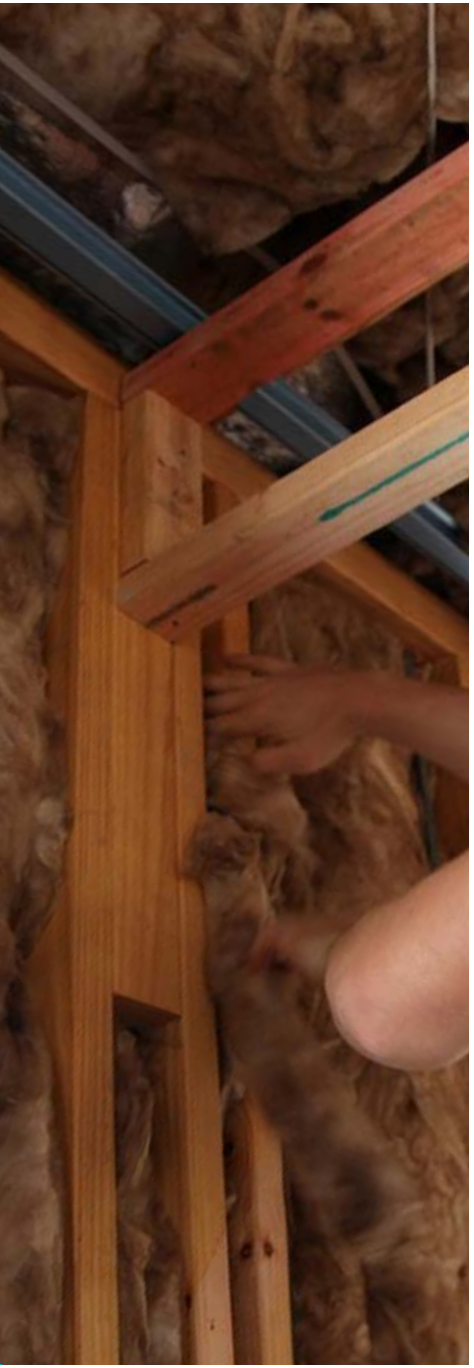


Table 12: Number of renovated residential buildings and offices and the rate of deep renovations

Building renovations
2025 Benchmarks

Region	Number of renovated units (2022-2025)	Average annual rate of deep renovation in 2025
Europe	21.9 Million	1.4 %
EU-27	16.1 Million	1.4 %

Source: Beyond Fossil Fuels, 2023

Table 13: Volume of fossil gas and hard coal displaced by building renovations

Building renovations
Reductions in fossil fuel demand in 2025

Region	Fossil gas	Hard coal
Europe	15.8 bcm	2.0 Mt
EU-27	11.6 bcm	1.4 Mt

Source: Beyond Fossil Fuels, 2023

Impact on fossil gas and hard coal demand in Europe

The renovation of nearly 22 million buildings across Europe would remove a large amount of fossil fuel demand in the residential sector. Building renovations could displace 8% of pre-war fossil gas imports from Russia and nearly 2.9% of hard coal imports. Measures in buildings could reduce Europe's total primary energy demand by up to 1%.

In this report, we have assumed the renovation trajectory recommended by BPIE. It means Europe must accelerate both the scale and depth of building renovations so that by 2025, 21.9 million buildings are being renovated annually in Europe (16.1 million in the EU-27). It also means reaching a deep renovation rate of 3% by 2030. These measures would remove nearly 16 bcm of gas and 2 Mt of hard coal from European energy demand (11.6 bcm of gas and 1.4 Mt of hard coal for the EU-27).

Heater efficiency in buildings

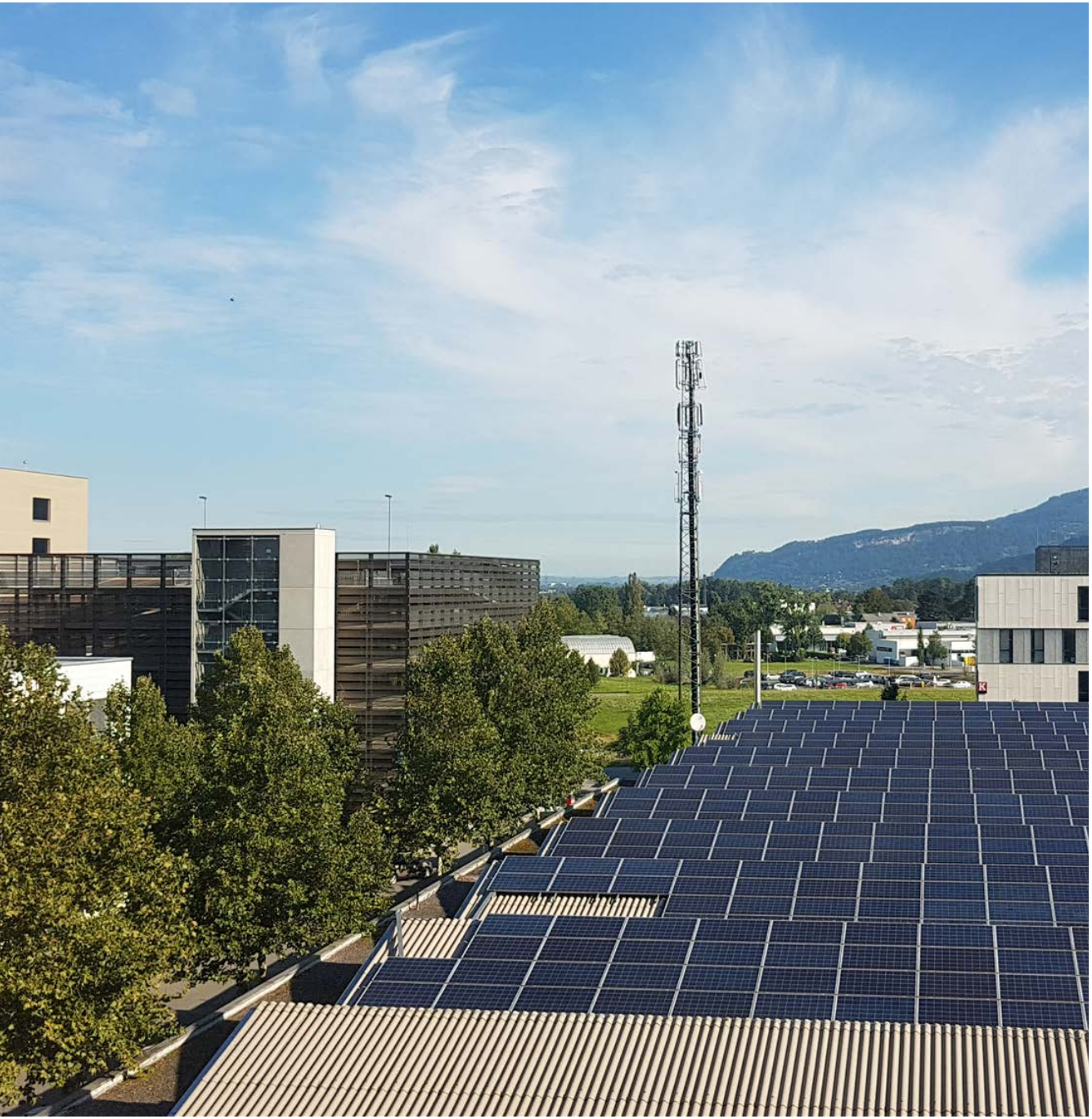
In a study published soon after the Russian invasion of Ukraine, Agora Energiewende identified seven actions that could lead to nearly 50 bcm of fossil gas savings in the housing sector by 2027. The measures include optimising existing fossil gas boilers and the expansion of existing district heating systems.

The optimisation of existing fossil gas boilers, so that they achieve their full technical efficiency potential, involves reducing boiler temperatures to maximum 60°C, avoiding the installation of oversized boilers, installing improved controls and ensuring heat is evenly distributed to all radiators. These measures could save nearly 7.5 bcm of fossil gas in the EU-27 by 2027.

District heating systems are important providers of heat to millions of Europeans, particularly in Scandinavia and some Eastern European countries. Even when run off fossil fuels, they are more efficient than individual heaters. Existing district heating networks could be expanded to service new customers, and new networks could be built to cover 50% more heating demand. Agora Energiewende concludes that these measures could save nearly 13 bcm of fossil gas in the EU-27 by 2027.

We assumed that the optimisation of existing boilers could be almost fully implemented by 2025 (i.e. 90% completed) while most of the expansion of district heating systems would require more time. We therefore assume that an expansion to cover 40% more heating demand could be achieved by 2025. Overall, these two measures could save approximately 16 bcm of fossil gas in Europe (11.8 bcm in EU-27) by 2025 and save up to 1% of European total primary energy demand.

86 Regaining Europe's Energy Sovereignty, Agora Energiewende, March 2022.



Industry efficiency

The industrial sector in the EU-27 consumes 3,700 TWh of energy each year, of which nearly 1,000 TWh or 28% is fossil gas. Just three sectors account for almost 70% of industrial demand: chemicals, food, beverages and tobacco, and non-metallic minerals.

For each of these sectors, the research organisation Climact has identified a series of actions that could reduce fossil gas demand by 2027.[87] For all sectors, the solutions applied range from the electrification of heating and cooling processes, heat recovery, digitalisation, building insulation, solar heat or heat pump deployment and other efficient technologies, as well as plastic recycling.

In particular, Climact identifies the following potentials:

- **Petrochemical industry**: plastic demand can be significantly reduced through better reuse policies.
- **Food industry**: low-temperature heating and cooling present a significant electrification and efficiency potential that can be leveraged in the short-term.
- **Glass industry**: potential for additional glass recycling through better end-of-life treatment of flat glass in construction and automotive sectors. However, electric melting tanks remain the only credible alternative.
- **Ceramics industry**: as 80% of production comes from small factories, there is scope for energy efficiency improvements, with a focus on waste heat recovery and electrification.

Climact identifies that 238 TWh of fossil gas could be saved by 2027 in the industry's final energy demand. In our meta-analysis, we concluded that 65% of this potential, 155 TWh final energy, could be saved by the end of 2025. This corresponds to an estimated minimum of 22.2 bcm of fossil gas in Europe (17.6 bcm of gas in the EU-27).

87 Opportunities to get EU industry off natural gas quickly, Climact, May 2022.

Smart consumption

Smart consumption refers to action by industry and business to reduce energy demand as well as voluntary consumption choices by individuals. It relies on choices rather than changes in technology. This set of measures could reduce Europe's demand for fossil gas and hard coal equivalent to nearly 14% of Russian imports. We identified two broad sets of measures to implement: lowering building thermostats and reducing wasteful consumption.

1. Lowering the average temperature of heating in buildings across Europe, in order to get a reduction of 1°C at the European level (current average temperature is estimated at 22°C [88]) would reduce heating-related energy demand by 7% leading to removing 12 bcm of fossil gas a year in Europe (10 bcm in the EU-27) and approximately 1.6 Mt of hard coal (1 Mt in the EU). This measure should be implemented in offices, industrial sites and public buildings as well as wealthier households. It should not be targeted at vulnerable households, which are frequently under heated and instead require support to improve comfort and affordability. Two significant benefits of this measure are that it does not require major investments and can be implemented immediately.

2. Reducing certain excessive forms of energy consumption could bring quick savings in European fossil fuel imports. Examples of these measures include driving less, preferring shared car journeys, lowering speed limits to 110km/h, reducing meat consumption and limiting food waste, reducing car and aircraft manufacturing, turning off lights, shifting electrical use away from peak hours, switching off hot water in public buildings and restrooms and reducing the water temperature of public swimming pools. If implemented at scale, this set of measures could contribute to saving 13.9 bcm of fossil gas and 7.8 Mt of hard coal in Europe. This assessment relies on an estimation of a 2.9% cut in electricity demand, (compared to the trajectory described in chapter 3.1.1 electricity demand), and a 4.4% cut in energy demand in the manufacturing sector.

88 For more detail see: Playing my part, European Commission and IEA, April 2022.

BEYOND FOSSIL FUELS

4

Assumptions and methodology

Hard coal and fossil gas demand in 2021 and Russian imports

In this report, we analyse imports from Russia to Europe of hard coal and fossil gas used for energy. We have taken 2021 as the reference year because it comes after the lockdowns of 2020 and before the Russian invasion of Ukraine. Where data from 2021 was not available the latest available data was used as a substitute. [90] The data was last accessed on 27 January 2023.

Hard coal is defined as the sum of its two subcategories: 'anthracite' and 'other bituminous coal'. Coking coal (also known as met-coal) has been excluded from this calculation as it is used primarily in industrial processes and production, not for the production of electricity or heat. For fossil gas imports, we integrated imports coming via pipelines and LNG. Finally, to prevent double counting, world imports of hard coal and fossil gas were normalised by calculating their net imports.

All data was extracted from the Eurostat database using the following datasets:

- supply, transformation and consumption of fossil gas (nrg_cb_gas)
- supply, transformation and consumption of solid fossil fuels (nrg_cb_sff)
- imports of natural gas by partner country (nrg_ti_gas)
- imports of solid fossil fuels by partner country (nrg_ti_sff)
- exports of natural gas by partner country (nrg_te_gas)
- exports of solid fossil fuels by partner country (nrg_te_sff)

Base units for our report are billion cubic metres (bcm) for fossil gas and million tonnes (Mt) for hard coal. For coherence with other similar reports, we have applied uniform conversion factors for both commodities: 9.7694 TWh/bcm for fossil gas and 8.141 TWh/Mt for hard coal.

For fossil gas, this assumption results in an underestimation of the amount of energy different measures would displace. Indeed, while Eurostat reports values in both energy and volume for fossil gas, we have decided against using reported values and instead use converted values of bcm based on the conversion factors mentioned previously. This is so that we stay coherent with other studies and that the values calculated are comparable with our baseline statistics. The difference for the whole of Europe amounts to 169 TWh.

For coal, we decided to use the internationally standardised value for one tonne of coal equivalent (tce), which is defined as being equal to 8.14 MWh. Other approaches, such as using the heating value as outlined in the European Commission's energy balance guide,[91] would lead to a lower conversion rate of ~7.187 TWh/Mt, which lies at the lower end of the conventionally used scale for coal conversion. The difference for these two approaches amounts to approximately 64 TWh.

89 The following countries did not have data on fossil gas available for 2021. We therefore used data from the most recent year available as indicated in brackets: United Kingdom (2019), Ukraine (2020) and Bosnia and Herzegovina (2020). For the same reason, we used data on coal from the most recent year available as indicated in brackets for the following countries: United Kingdom (2019), North Macedonia (2020), Turkey (2020), Ukraine (2020), Bosnia and Herzegovina (2020) and Kosovo (2020).

90 Energy balance guide, European Commission, January 2019.

Table 14: Gross inland consumption and net imports to Europe, for fossil gas and hard coal in 2021

	Hard coal			Fossil gas		
Region	Gross inland consumption	Net imports - World	Imports - Russia	Gross inland consumption	Net imports - World	Imports - Russia
Europe	170 Mt	110 Mt	68 Mt	556 bcm	338 bcm	188 bcm
EU-27	102 Mt	65 Mt	46 Mt	400 bcm	341 bcm	154 bcm

Source: Eurostat, 2023

Assumptions and conversion rules

Demographics and buildings

- European dwellings: 215 million households (Eurostat, EU-27 - 2.17 people/household) - 309 million ('European continent' assuming 2.17 people/household)
- Population: 446.8 million (EU-27, Eurostat), 671 million for European continent (excl. Russia and Belarus, Eurostat)

Conversion rates

- 1 bcm = 9.77 TWh primary energy fossil gas
- 1 tonne of coal equivalent = 8.14 TWh primary energy hard coal

Renewables capacity factor, thermal plant efficiency and heating system efficiency

- Onshore wind
  - current average capacity factor: 26.5% in the UK (source: Renewable UK), 25% elsewhere
  - average capacity factor for new capacities: 32.5 %
- Offshore wind
  - current average capacity factor: 40.5% in the UK, 40% elsewhere
  - average capacity factor for new capacities: 58.4 % in the UK (source BEIS - CfD), 48.5 % elsewhere
- New solar PV capacity average load factor: 12%
- Gas plant efficiency: 50%
- Coal plant efficiency: 40%
- Gas boiler efficiency: 60%
- Heat pump coefficient of performance (COP): 3.1 for spatial heating

Appendix - **Details of sectoral changes**

Table 15: Details of sectoral changes

		Europe		EU-27	
Solution category	Trajectory description	Additional	Cumulative	Additional	Cumulative
Solar	Additional capacity (2021-2025) & cummulated capacity by 2025	481.2 GW	673.8 GW	459.0 GW	626.0 GW
Onshore wind	Additional capacity (2021-2025) & cummulated capacity by 2025	89.7 GW	304.0 GW	66.7 GW	240.0 GW
Offshore wind	Additional capacity (2021-2025) & cummulated capacity by 2025	11.8 GW	38.7 GW	11.2 GW	26.8 GW
Heat pump	New units added (2021-2025)	28.6 Million		23.6 Million	
Building renovation	Renovated dwellings and offices (2021-2025)	21.9 Million		16.1 Million	
Fossil gas	Gas cut in energy demand (2025 vs 2021)		198.9 bcm		159.4 bcm
	Gas cut in electricity demand (2025 vs 2021)		92.3 bcm		76.6 bcm
	Gas cut in electricity demand (2025 vs 2021)		901.5 TWh		748.6 TWh
Hard coal	Hard coal cut in energy demand (2025 vs 2021)		75.0 Mt		48.6 Mt
	Hard coal cut in electricity demand (2025 vs 2021)		56.0 Mt		36.3 Mt
	Hard coal cut in electricity demand (2025 vs 2021)		483.0 TWh		295.5 TWh
Lignite and hard coal	Hard coal and Lignite cut in electricity demand (2025 vs 2021)		723.6 TWh		541.5 TWh
Hard coal, lignite and fossil gas	Coal (hard coal and lignite) and fossil gas demand reduction in the power sector		1625.1 TWh		1290.1 TWh
	Coal (hard coal and lignite) and fossil gas demand reduction in power and heat sectors		2793.7 TWh		2533.6 TWh
Primary energy demand overall	% age of demand drop in the heat and power sector (2025 vs 2021)		36.96%		41.23%
	Net primary energy demand reduction (2025 vs 2021)		1892.1 TWh		1363.5 TWh
	% of net primary energy demand reduction (2025 vs 2021)		N/A		10.75%

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Photos

- **Cover page 1**
  Solar panels now cover increasingly large tracks of former mining land in Kozani, Greece in 2021, where state-owned utility PPC is rapidly transitioning from coal to renewable energy.
  Photo by: Greg McNevin / Beyond Fossil Fuels.
- **Cover page 2**
  Buir, Germany, October 6, 2018: Windmills dot purple fields in coal country, outsite Cologne.
  Photo by: Greg McNevin / Beyond Fossil Fuels
- **Page 1**
  Solar panels now cover increasingly large tracks of former mining land in Kozani, Greece in 2021, where state-owned utility PPC is rapidly transitioning from coal to renewable energy.
  Photo by: Greg McNevin / Beyond Fossil Fuels.
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  One part of Nord Stream fossil gas pipeline from Russia to European Union.
  Photo by: Kletr
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  Coal ash field, Magara village of Sivas, TURKEY, in 2021.
  Photo by: Barbaros Kayan / Europe Beyond Coal.
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  PPC owned coal-fired power plant in the background of a view from a new new solar farm in Kozani, Greece.
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  Worker installing solar panels on a barn roof on Grange farm, near Balcombe, UK.
  Photo by: Kristian Buus
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  Windmills in Buir, Germany, outsite of Cologne.
  Photo by: Greg McNevin / Beyond Fossil Fuels
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  Solar panels in Kozani, Greece.
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  Aerial view of the coal mine of İkizköy thermal power plant in Türkiye.
  Photo by: Mert Çakır
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  A young girl sweeps snow off solar panels.
  Photo by: Oliver Rudkin
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  Anargyroi, Greece, March 17, 2019: The message COAL = DEAD END is spelled out on a road in Anargyroi, a village in the northern part of Western Macedonia, Greece, which is being eaten away by coal mine expansion. On June 10th, 2017, a huge landslide caused
  Photo by: Greg McNevin / Beyond Fossil Fuels.
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  Rhineland, Germany, Jan 8, 2018 - RWE Power's Neurath coal power plant, which is fed by the vast Garzweiler open pit lignite mine that is swallowing up small villages like Immerath.
  Photo by: Greg McNevin / Beyond Fossil Fuels
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  Banister House Solar, Hackney's first community solar installation, has been developed by Repowering London in partnership with local estate residents and Hackney Council.
  Photo by: Andrew Aitchison / Ashden
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  Solar panels in Kozani, Greece.
  Photo by: Greg McNevin / Beyond Fossil Fuels.
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  Aerial view a wind turbine in Germany.
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  Electric Vehicles charging on the street.
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  Power lines in Kozani, Greece.
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  Aerial view of state-owned utility PPC's coal fired power plant in Kozani, Greece.
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  Solar panels in Kozani, Greece.
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  Solar farm , Hamal village of Sivas. Türkiye, 2021.
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  Caption/Description: Offshore wind turbine farm
  Photo by: Teun van den Dries.
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  Wind turbines in the field
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  Worker installing styrofoam insulation sheets on house facade.
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  Industrial area in Linz, Austria.
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  An air source heat pump operating during winter.
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  Worker installing a piece of mineral wool insulation.
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  Worker installing insulation in a timber framed house.
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  Overground district heating pipes.
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  Solar panels above the "Rhombergs Fabrik" factory in an industrial park in Dornbirn, Austria in 2019.
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  Hand lowering the indoor temperature using a thermostat.
  Photo by: Commercial RAF
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  Athens, Greece, 15 September, 2021 - Konstantinos Mavros, CEO of Greek state-owned utility PPC's Renewables business discusses the companies plans for the rapid transition from coal to renewable energy in Kozani.
  Photo by: Greg McNevin / Beyond Fossil Fuels.
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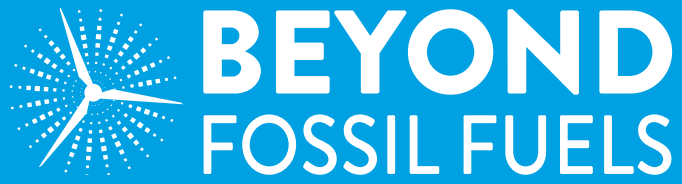
  New solar farm in view of PPC owned coal-fired power plant in Kozani, Greece.
  Photo by: Greg McNevin / Beyond Fossil Fuels.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