How to Avoid Gas Shortages in the European Union in 2023

A practical set of actions to close a potential supply-demand gap

International Energy Agency

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Summary

European and global natural gas markets are not yet out of the danger created by Russia's cuts to pipeline deliveries of gas. Conditions have been turbulent, prices have been extremely volatile, many households and gas-intensive sectors have suffered – as have many gas-importing countries worldwide. Overall gas demand in the European Union (EU) is set to fall by around 10% in 2022, a drop of around 50 billion cubic metres (bcm). Some 10 bcm of this drop is due to curtailed production rather than efficiency gains or fuel switching. But the situation could be worse: European Union and national policies, markets, consumer actions, non-Russian suppliers and mild weather have all played a part in compensating for the missing Russian deliveries. As of early December, Europe's gas storage levels remain above their five-year average.

Several key factors could make 2023 an even sterner test:

- **Russian supplies may have further to fall**. Although far below the levels seen prior to Russia's invasion of Ukraine, total gas volumes delivered by pipeline from Russia to the European Union over the course of 2022 are set to be around 60 bcm. Russian pipeline deliveries are likely to be considerably lower in 2023 and could drop to zero, leaving an even larger hole in European and global gas supply.
- **Supplies of liquified natural gas (LNG) will be tight**. The European Union as a whole is set to add an estimated 40 bcm of LNG import capacity by the end of 2023. However, only around 20 bcm of additional LNG supply is expected to come onto the market over the course of the year. Meanwhile, Chinese import demand could well recover from the unusually low levels seen in 2022, intensifying competition for LNG cargoes. Europe's ability to secure higher LNG imports in 2022 was enabled in large part by lower import demand from China.
- **The unseasonably mild temperatures seen at the beginning of winter may not last.** In our estimation, the mild weather in Europe in autumn 2022 has cut gas demand by more than 10 bcm. There is no guarantee that temperatures will be as forgiving for the remainder of the winter, or for 2023 as a whole.

If pipeline imports to the European Union from Russia drop to zero in 2023 and Chinese LNG demand rebounds to 2021 levels, then the European Union faces a serious supply-demand gap opening up in 2023. In this analysis, we provide a stress test for the EU gas balance in 2023 and find continued risks of renewed price volatility and turbulence in gas markets.

Of the overall supply-demand gap of 57 bcm that could arise in 2023, around 30 bcm is covered by actions that are already visibly in motion. A series of measures have been adopted by the European Union and by individual European

countries to increase security of supply. These will help lead to new improvements in energy efficiency, installations of renewable capacity, installations of heat pumps and so on. A recovery in nuclear and hydropower output from the decade-low levels in 2022 should also help narrow the gap.

Closing the remaining deficit of 27 bcm requires a suite of additional near-term policy actions. This report identifies the practical actions that can be taken by governments and others to fill the potential supply-demand gap in 2023 and avoid excessive strains for European consumers and for international markets. The analysis includes real-world examples of measures that could be implemented and quantifies their impacts.

The key policy actions to reduce demand are:

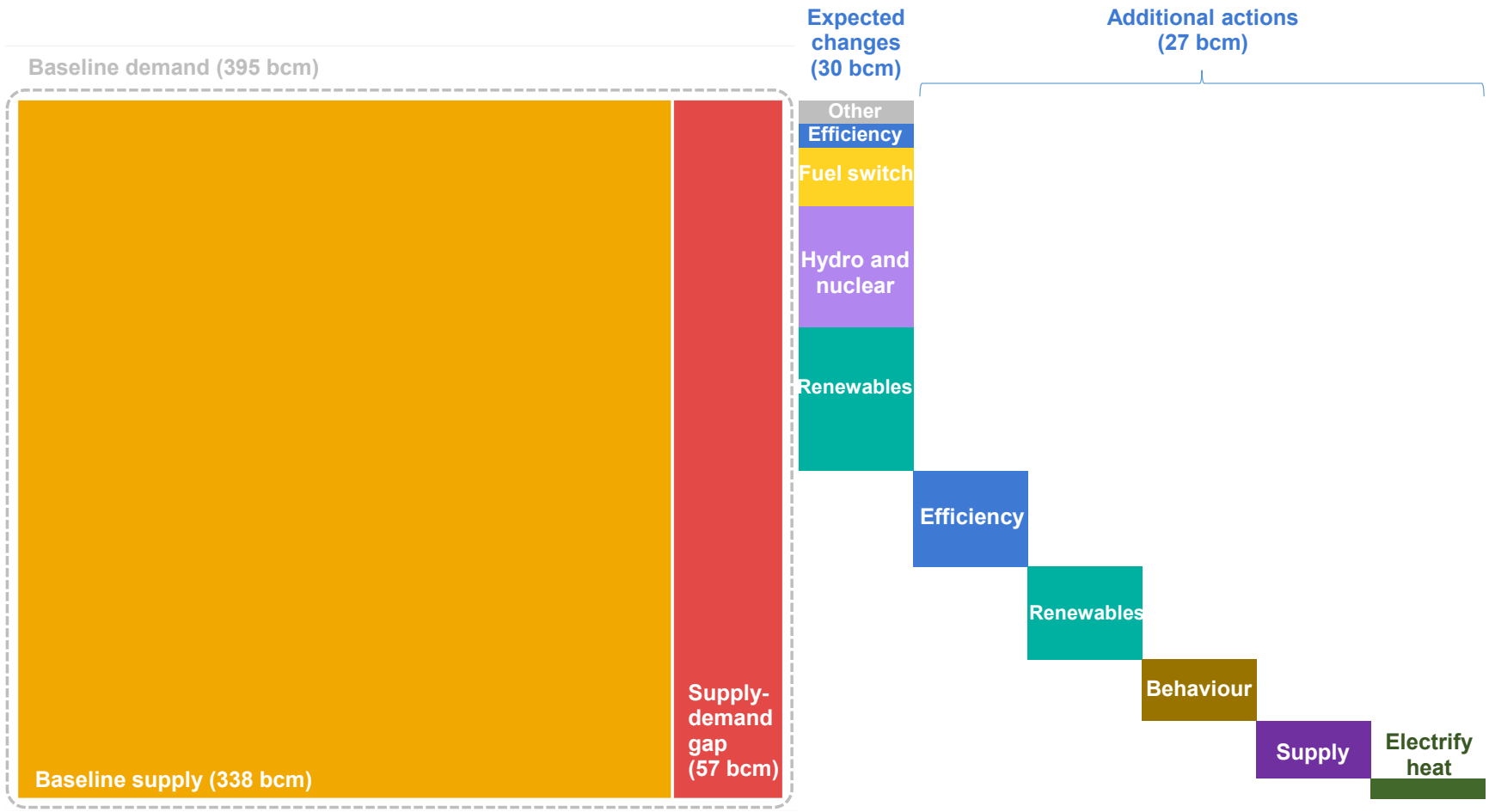
- incentivise faster improvements in energy efficiency
- allow for more rapid deployment of renewables
- accelerate the electrification of heat
- encourage behaviour changes among consumers.

With the short-term horizon of 2023, there is little scope to bring additional supplies to market, but reducing the waste of gas via flaring and leaks to the atmosphere offers some upside, as does boosting production of low-emissions gases.

The actions set out in this report offer a pathway to a more secure and balanced EU gas market in 2023, in ways that are consistent with the EU's climate goals. As ever, solidarity among EU member states and a close international dialogue on energy markets and security will be crucial. If these additional structural measures are implemented, this will minimise the call on less desirable ways of balancing the market, such as price spikes, industrial demand destruction, increased generation from coal-fired plants, or fierce international competition for LNG cargoes.

The additional investment required to implement the actions described in this report is around EUR 100 billion. This is less than one-third of the EUR 330 billion that has been mobilised by EU member states over the last year in emergency packages to shield consumers from high prices. The additional EUR 100 billion in upfront spending, with public support helping to underpin investment by companies and households, leads to lasting reductions in gas demand; a similar amount would be saved in around two years by lower gas import bills. The risks to European and international gas markets are real, but so too are the solutions.

Expected changes and additional actions to close the supply-demand gap in the European Union in 2023



Note: Other = heat pumps and biomethane.

The need for action

Acute strains on natural gas markets

Following its invasion of Ukraine, Russia cut pipeline deliveries of natural gas to the European Union by more than half. Russia's pipeline supplies are expected to decline from 140 bcm in 2021 to around 60 bcm in 2022, a drop that has put unprecedented pressure on both European and global gas markets, with severe knock-on effects on many electricity markets.

The supply shock induced by Russia drove up natural gas prices on European hubs to record levels. Month-ahead prices on TTF – Europe's leading gas hub – averaged over EUR 130 per megawatt-hour (USD 40 per million British thermal units) in the first 11 months of 2022, more than seven times as high as the average between 2016 and 2020.

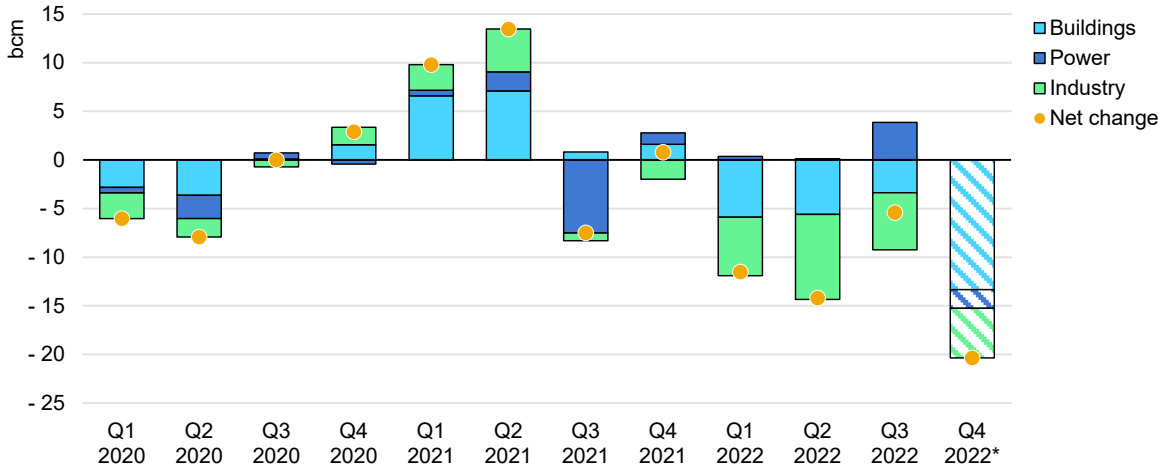
Prices at these levels incentivised an increase in deliveries to the European Union via non-Russian pipelines and via record inflows of LNG. The EU's LNG imports are set to increase by around 60% (or 50 bcm) in 2022 compared with 2021. The United States accounted for two-thirds of this additional LNG supply. As a result, the reliance of Europe on the global LNG market increased dramatically, in particular on destination-flexible LNG procured on the spot market.

The strong LNG inflows to Europe in 2022 were partly enabled by China's lower LNG imports, which are set to decline by 20% (or over 20 bcm) in 2022 from 2021 levels because of slower economic growth and Covid-induced lockdowns. Stronger LNG inflows into Europe drew supplies away from more price-sensitive markets, especially in South Asia. Enforced power outages were introduced in Pakistan and Bangladesh because of the shortfall in gas supply to power plants.

The crisis has also had strong implications for gas demand in the European Union, which is set to fall by more than 10% (or about 50 bcm) in 2022. This is mainly the result of lower gas consumption across the industrial, commercial and residential sectors due to fuel switching, reduced output, behavioural responses to high prices, warmer than average weather, and efficiency gains.

There has also been a strong element of demand destruction, particularly in gas- and energy-intensive industries. The power sector is the only sector in which gas demand in 2022 is set to be above 2021 levels. The power sector's demand for gas has increased despite the record-high gas prices because of very low hydropower and nuclear power output in Europe.

Year-on-year change in EU gas demand by sector



*estimated values

Risks to Europe's gas balance in 2023

The combination of lower demand, a strong increase in non-Russian gas supplies and unseasonably mild weather conditions through October and early November has allowed the European Union to increase its gas storage levels by a record amount so far in 2022. Injections to EU gas storage facilities were over 70 bcm between April and mid-November, enabling them to reach 95% fill levels by mid-November. As of 9 December 2022, they are around 15% (or 11 bcm) above their five-year average.

High storage levels and lower demand put downward pressure on natural gas prices in October and November and reduced the risk of physical gas supply shortages for the 2022-2023 heating season. However, the cushion provided by relatively high storage levels should not lead to overly optimistic predictions about the future, as market fundamentals could well tighten again in 2023.

This is because Europe's ability to weather the storm in 2022 was supported by several factors that might not be repeated in 2023:

- Russia cut deliveries sharply in 2022 but nonetheless supplied some 60 bcm by pipeline to the European Union over the course of the year. This included 30 bcm by pipeline during the April-September period when gas storages were filling, contributing either directly or indirectly to storage injections. It seems highly unlikely that Russian deliveries will reach these levels in 2023. And Russian pipeline supplies could cease entirely.
- Europe's success in increasing LNG imports was enabled in large part by lower import demand from China because of slower economic growth and Covid-

induced lockdowns. A recovery in Chinese LNG import demand would intensify competition for cargoes in 2023 and limit their availability to European buyers.

- Unseasonably mild temperatures in October and the first half of November 2022 effectively delayed the start of the European heating season by around a month. Natural gas consumption in the residential and commercial sectors was around 30% lower during those weeks than in the same period in 2021, leaving a stronger storage buffer for the remaining winter.

Despite a series of measures adopted by the European Union and by individual European countries (see box below) to increase security of supply, a supply-demand gap could open up in 2023 that – if not addressed – could provoke a renewed period of intense price volatility and turbulence in gas markets.

In this analysis, we conduct a stress test for the European gas balance in 2023, building upon the findings of the IEA report, Never Too Early to Prepare for Next Winter, published on 3 November 2022. The coming year presents clear risks to energy security and affordability in Europe and beyond, as Russia continues to seek leverage by exposing consumers to higher energy bills and gas supply shortages.

This report provides a menu of near-term actions and measures that can close a potential supply-demand gap in 2023 and avoid excessive pressures on European consumers and international markets.

Major European initiatives to ease strains on gas markets

Alongside the broader structural changes targeted by the Fit for 55 package and the REPowerEU plan, there have been major additional policy initiatives and infrastructure projects that seek to increase the resilience of European gas markets, strengthen solidarity and limit excessive price spikes. Examples include:

- **Introduction of minimum gas storage obligations:** The European Union adopted a new storage regulation in June 2022, according to which storage sites have to be filled to at least 80% of their capacity before the winter of 2022-23, and to 90% ahead of all following winter periods. Several EU member states adopted more stringent regulations, aiming for fill targets above 90%. The EU intermediate storage targets for 2023 include a 45-55% fill level for 1 February.
- **A regulation on co-ordinated demand reduction measures for gas:** This targets a 15% voluntary reduction in EU gas demand between 1 August 2022 and 31 March 2023, compared with its five-year average. The European Commission has adopted the European Gas Demand Reduction Plan with best practices and guidance for member states to help them reduce gas demand.
- **EU Action Plan to digitalise the energy system**: the European Commission presented an Action Plan in October 2022 on the digitalisation of the energy sector,

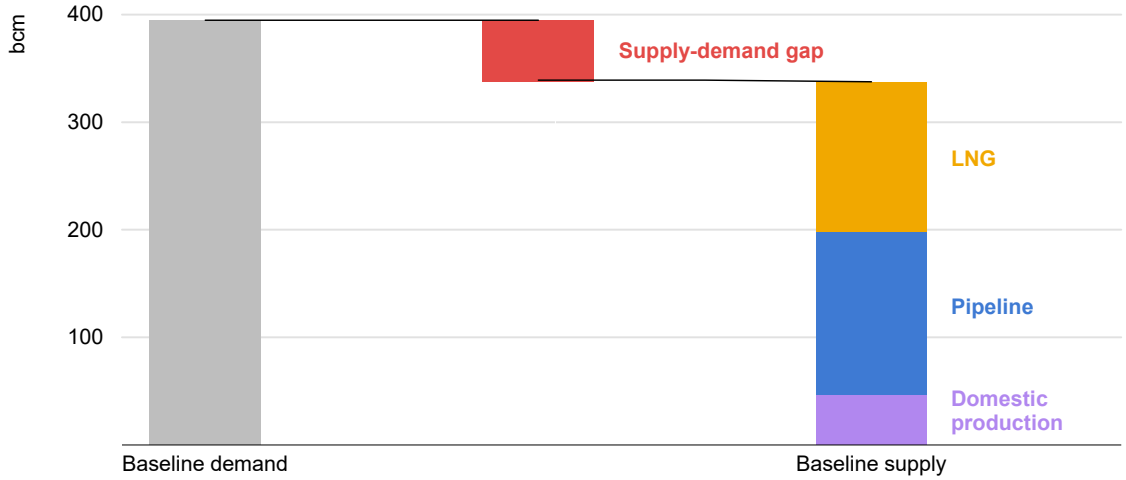
to improve the efficient use of energy resources, facilitate the integration of renewables into the grid, and save costs for EU consumers and energy companies.

- **Energy diplomacy**: the European Union intensified its international outreach to strengthen energy partnerships with key natural gas and LNG suppliers. The EU and the United States announced a Joint Task Force in March 2022 to strengthen European energy security. Among other such initiatives, the European Commission signed a Memorandum of Understanding in June 2022 on a Strategic Partnership in the Field of Energy with Azerbaijan. The EU Energy Platform is intended to aid with a coordinated approach.
- **New floating storage regasification units (FSRUs) and the expansion of existing regasification terminals** will allow the European Union to have 25% more regasification capacity in 2023 than in 2021.
- **Several interconnectors were commissioned** ahead of the 2022-23 heating season that facilitated internal gas flows and diversification of gas supply, including between Central and Eastern European countries that have historically had a higher reliance on Russian pipeline gas.

A supply-demand gap in 2023?

Our analysis of the extent of the potential supply-demand gap requires taking a view on all elements of the EU's gas balance in 2023. For demand, our starting point is to hold demand constant from 2022, but with three adjustments. First, to correct for higher-than-average temperatures over the course of 2022. Second, to adjust in a way that avoids industrial demand destruction. And third, to recognise the need for the European Union to provide gas supply in 2023 for Ukraine and Moldova.

Assessment of the natural gas balance of the European Union in case of total cut-off of Russian flows and limited LNG availability, in 2023



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Note: Baseline demand includes ensuring supply to Ukraine and Moldova. See Annex for assumptions.

Our stress test assumes that Russian pipeline gas supplies to the European Union cease completely from the beginning of 2023, that China's LNG imports recover to their 2021 levels, and that EU gas storage facilities will be around one-third full at the end of the 2022-23 winter heating season. We also take a view on the availability of supply from non-Russian sources. Our assumptions in all these areas and the main sensitivities are described in detail in the Annex to this report. This overall assessment results in a gap between baseline EU demand and supply in 2023 of 57 bcm.

Our analysis of how this gap can be closed is a two-stage process.

The first stage involves considering all the elements that are already visibly in motion or planned, as well as structural changes that are underway, such as new renewable capacity, fuel switching in industry, improvements in energy efficiency, installations of heat pumps, and new biomethane facilities. A potential recovery in nuclear and hydro power output from the decade-low levels seen in 2022 is another crucial variable, and this is assumed to lower EU gas demand by around 10 bcm in 2023 (see box below). Altogether, these factors already account for some 30 bcm of the additional amounts required to balance the European gas market.

Will hydropower and nuclear generation bounce back in 2023?

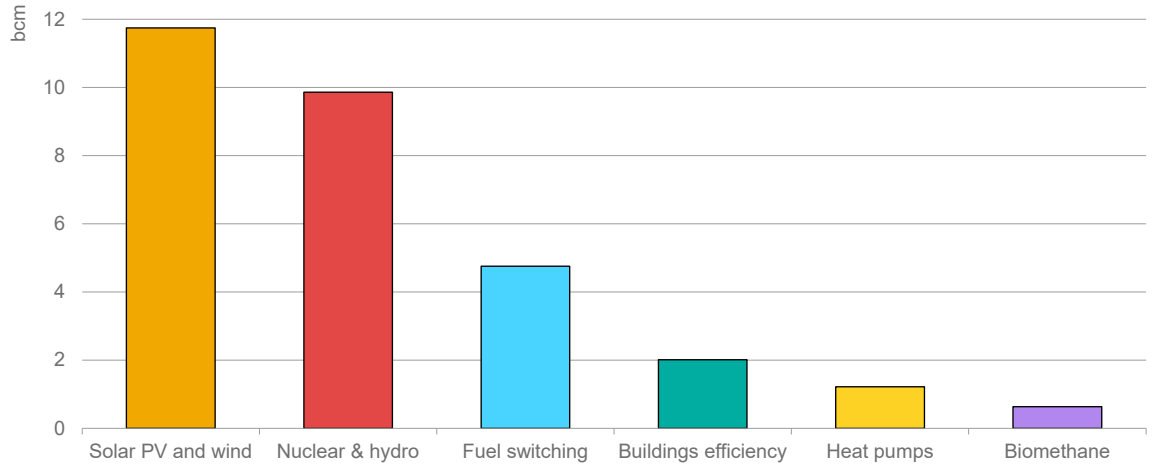
Hydro generation in the European Union is set to drop by nearly 20% in 2022 from the previous year, largely because of lower output in southern European markets. Our baseline assumption is that hydropower output in 2023 recovers to its five-year average, which would increase electricity supply by 45 terawatt-hours (TWh) and reduce demand for gas by around 8 bcm.

Nuclear generation is set to fall by around 20% in 2022 from the previous year, mainly because of lower generation in France and Germany. In France, nuclear power output declined by a quarter due to maintenance at facilities and a large number of unplanned outages. In Germany, nuclear generation is set to drop to half its 2021 level in 2022 (a decline of 30 TWh) under the country's plan to gradually phase out nuclear power.

Germany's three remaining nuclear power plants – Emsland, Isar 2 and Neckarwestheim – have a capacity of 4 gigawatts (GW) and their closure was postponed from the end of 2022 until mid-April 2023. Belgium has also revisited timelines for closing down some of its nuclear plants currently in operation.

Overall, higher French nuclear power generation in 2023 is set to be largely offset by reductions in Germany and plant closures in Belgium (Doel 3 in September 2022 and Tihange 2 in February 2023). We estimate that EU nuclear power generation will increase by around 2% (or 10 TWh) in 2023, leading to gas savings of 2 bcm.

Elements that can already be expected to fill part of the EU supply-demand gap



This leaves a **remaining gap of 27 bcm that needs to be addressed with additional actions** in order to satisfy the conditions of refilling gas storage levels to 95% and maintaining gas supply security through to the spring of 2024 without excessive strains on markets and European consumers[1]. These additional actions are discussed in the main body of this report.

Without these additional efforts, Europe risks much less-desirable ways of bringing supply and demand into balance. These include higher spikes in gas prices to levels that force demand reductions through curtailments, alongside renewed pressure on energy bills, alongside the potential for rationing and emergency measures to protect consumers. This would have broader implications for economies and fiscal positions.

Higher coal-fired generation in Europe and elsewhere could also reduce pressure on gas markets. In 2022, nearly 20 GW of coal-fired power plant capacity in the European Union had its lifetime extended, re-entered the market, or had caps on working hours removed. Coal power plants will generate around 45 TWh more electricity in 2022 than in 2021, resulting in an extra 35 Mt CO_2 power-sector emissions. While additional gas-to-coal switching is possible in 2023, additional emissions would undercut the EU's climate ambitions and are not assumed in our baseline level of demand.

[1] Achieving all of the reductions in demand described in this report would imply total EU gas demand of 330 bcm (this would exclude exports to Ukraine and Moldova). This would be 16% below the 5-year average (2018-2022) for the EU of 393 bcm, and 8% below the 360 bcm estimated for 2022.

Implications for EU gas storage at the end of the 2023-24 winter heating season

The actions identified in this report would allow the European Union to fill its gas storages up to 95% by the beginning of the 2023-24 heating season, even in the event of adverse external pressures. This would enable storage levels to maintain at least 80% of their working capacity until the end of 2023.

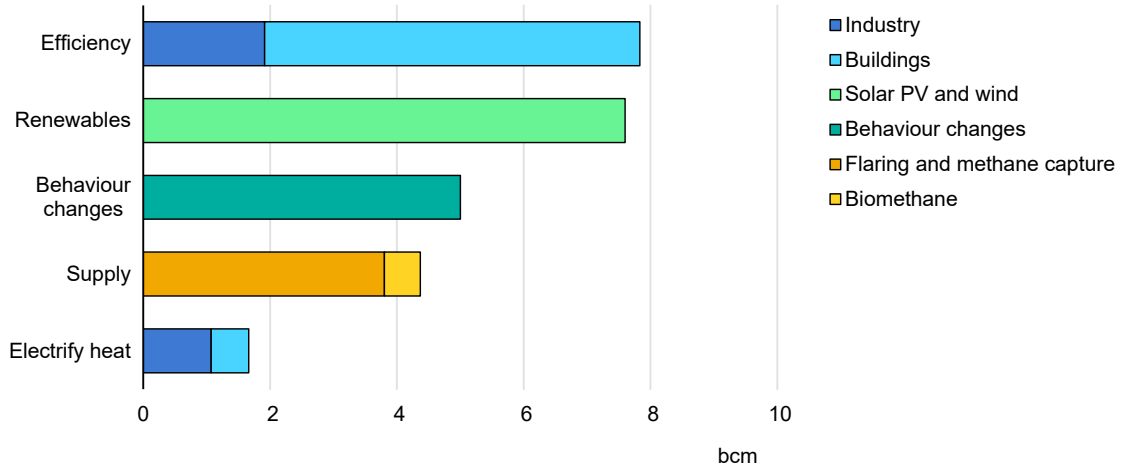
Keeping gas storage at such levels is necessary to ensure an adequate supply buffer through to the end of the first quarter of 2024, assuming the continued absence of Russian pipeline gas deliveries and strong demand for LNG from outside Europe. Our assessment indicates that even if EU gas demand returns to its 2017-2021 average in the first quarter of 2024 – for example due to adverse weather effects – then EU gas storage would still be more than 30% full at the beginning of April 2024. These storage levels would also be critical to weather any cold spell occurring late in the heating season.

Without the implementation of the actions identified in this report, there is a risk that EU gas storage sites would be less than 30% full by the end of 2023. A continued drawdown of storage in line with historical averages would then likely create a risk of widespread gas supply curtailments starting in February 2024 and extreme upward pressure on prices.

Five tools to close the gap

European countries need to act to narrow the potential supply-demand gap identified above. Circumstances vary widely; the opportunities to act – and the vulnerabilities in case of insufficient action – are not evenly distributed across the European Union. But all countries and consumers face detrimental consequences in the event of a return to extreme strains on gas markets. The risks are particularly strong for Europe's industrial consumers, which would be first in line for cuts to gas supply if the situation deteriorates.

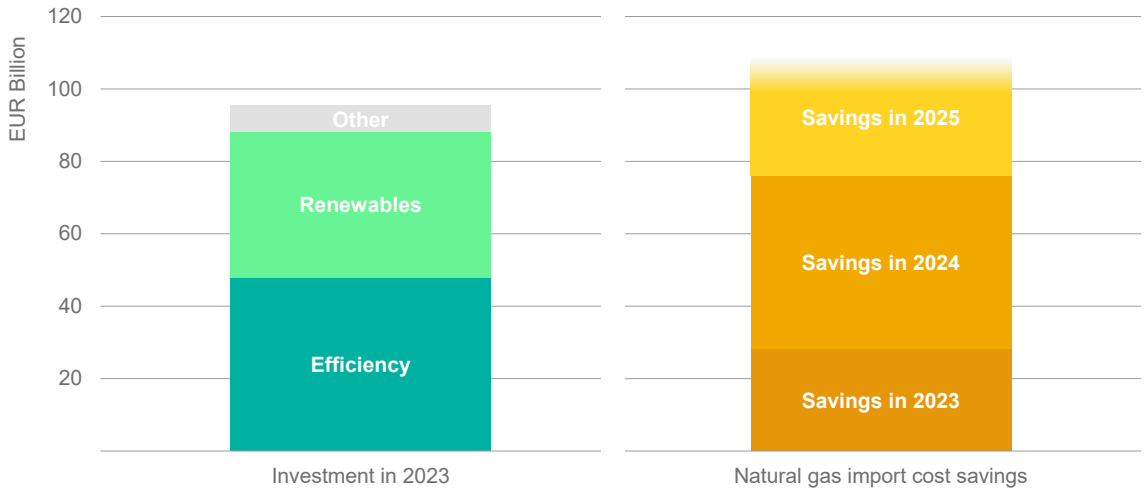
Summary of additional actions required to fill the remaining EU gas supply-demand gap, in 2023



These five areas do not represent a full agenda for progress with energy transitions. The intention here is more specific: to deliver an extra 27 bcm to the gas balance of the European Union in the course of 2023 in ways that are consistent with the EU's broader energy and climate objectives. Most of the solutions are to be found through reductions in demand for natural gas, via greater efficiency, faster deployment of renewables, behaviour changes and the electrification of heat. Time is of the essence, and the focus in our analysis is on pragmatic steps that can deliver quickly.

We estimate that a total investment of around EUR 100 billion is required for the additional actions that close the remaining gap of 27 bcm in 2023. Around half of this is for efficiency improvements, primarily building retrofits, and 40% is for renewables. The remainder is for heat pump installations, biomethane, and projects to cut flaring and methane.

Investment required for the additional actions and resulting saving on natural gas imports over time, in 2023



This investment needs to be mobilised and spent over the course of 2023 and it would immediately start to yield savings through reduced spending on natural gas; these savings would continue to accrue in future years. Import bills would be lower as a result: we estimate that around EUR 30 billion would be saved in 2023 alone (based on current forward gas prices), and that savings on import bills would exceed the initial investment needed in 2023 within two to three years.

The investments to accelerate changes in gas demand would also reduce the likelihood that governments will again be asked for emergency support to shield consumers from excessively high prices. Since November 2021, European Union member states have mobilised an estimated EUR 330 billion in emergency packages to shield consumers from high prices, with budget costs approaching or exceeding 2% of GDP in some large economies. Some of these measures been applied widely across different categories of consumers, dampening in many cases the incentive to save energy.

Such emergency support measures may still be required in 2023, but need to be targeted to the most affected viable firms and to vulnerable households. Available funding can provide much more lasting benefits if it allows consumers to change their energy circumstances through greater efficiency and electrification. Interventions on end-user prices can also be structured in ways that retain strong incentives to save energy, for example by applying only to a certain percentage of the previous year's consumption, with full market prices applying to the remainder.

The energy crisis has also increased the uncertainty facing some investors, in part because of near-term government interventions in prices, market operation and the introduction of new taxes and charges. As the IEA has argued, there is a case

for temporary tax measures where current market conditions are generating highly inflated profits for some companies, to help defray the impacts on vulnerable consumers. But short-term measures taken by governments should not come at the expense of the investments required to transition Europe's energy system.

The measures below require governments to fast-track the pace of change. The gains from doing so are huge but there are risks if the process is badly managed. Such an outcome could drain public support. Strategies to accelerate energy transitions will not deliver unless accompanied by safeguards for the integrity of the process, and clear communication on the need for change.

1. Faster improvements in energy efficiency

Summary of actions

Increase home renovations and efficient appliance sales, enhance energy savings in public buildings and for public lighting, and provide support for industrial energy efficiency programmes that can realise immediate savings.

Total additional savings in 2023: 8 bcm

Energy efficiency actions accelerated in 2022 as governments and consumers increasingly turned to efficiency measures as part of their responses to fuel supply disruptions and record-high energy prices. Most of the near-term potential for additional gas savings in the European Union lies in residential and commercial buildings. In 2022, gas demand in buildings is set to be around 25 bcm (or 17%) lower than in 2021. Most of this decline was due to milder temperatures and behavioural changes, but there were also reductions from building retrofits and other efficiency measures. Continued improvements across Europe's building stock – alongside efforts to accelerate industrial efficiency and electrification – can lead to structural decreases in gas demand, especially during peak periods such as colder winters.

Increase home renovations and efficient appliance sales

Improved energy efficiency in buildings, appliances and lighting (insulation, controls, information, and audits) can play a vital role in direct and indirect savings of natural gas. The key measure is to raise the percentage of the buildings stock in the European Union that is renovated each year. Currently, around 1% of the EU's building stock is renovated each year and with a strong policy push this could rise to 1.7% in 2023. Along with enhanced efforts to replace existing inefficient appliances and lighting, we estimate that these additional actions could save more than 2.5 bcm in 2023.

Expand existing programmes for quick-wins

Boost existing national renovation services, like FranceRenov' in France, BedreBolig (BetterHousing) in Denmark and programmes supporting citizens to disconnect from gas, such as the Dutch AardgasvrijeWijken initiative. Involving sub-national level governments, provinces and cities is an essential strategy to move forward quickly.

Offer more financial support

Deploy more public funds into grants and loans for home renovation; Germany's approach with the KfW renovation programme demonstrated how on-lending can double the original investment and stimulate job creation. Leveraging existing financing instruments created by the European Investment Bank (EIB) (e.g., ELENA, Smart Finance for Smart Buildings initiative) can offer capacity building and required funds to governments lacking the ability to set up comprehensive national programmes.

Prioritise vulnerable households

Prioritise renovation of social housing to reduce energy poverty, support low-income households, and repurpose derelict and vacant buildings. There are multiple examples of policies that target vulnerable households, including sub-national initiatives in Opengela in the Basque Country in Spain, Wallonia in Belgium, the Midlands in Ireland, and national programmes in the Netherlands and Belgium.

Accelerate the adoption of high efficiency appliances and lighting

Replace existing inefficient appliances and lighting. At the consumer level, the use and promotion of EU energy labels encourages efficient purchase decisions. Switching to more efficient equipment can be made more attractive through the use of rebate schemes, for example in Switzerland, or direct swap schemes, for example in Malta, Bulgaria and Hungary. At the government level, purchase specifications can be changed to include a minimum efficiency target, for example as included in Luxembourg's National Energy Efficiency Action Plan.

Deploy smart technology

Encourage the installation of smart thermostats for achieving cost-effective energy savings. Case studies show that 10% savings on heating costs and space cooling costs can be attributed to the installation of the thermostat alone. Smart thermostats offer a step-change in both the ease and speed of implementing energy-saving measures. In France, homeowners can take advantage of a "coup

de pouce" subsidy, and receive a programmable thermostat. Belgium provides tax-free eco vouchers to private sector employees which can be spent on smart thermostats among other sustainability related items. These actions can also facilitate behaviour changes (see section 4).

Promote a unified interoperability framework. This will help enable appliances and equipment to send and receive data using a standard communication protocol, and allow small energy consumers to participate in demand response. Small energy consumers could save as much as 20% on their energy bills, and lower energy consumption. The European Commission will promote a code of conduct for energy-smart appliances in 2023, targeting manufacturers.

Focus on public sector efficiency

The public sector needs to take the lead with a strong push on energy efficiency, including buildings, water treatment and street lighting. Many measures have already been implemented in this space, but we estimate that additional efforts could generate savings on gas and electricity that would amount to nearly 3 bcm in 2023. These savings do not exhaust the potential, and higher levels savings can be achieved in individual municipalities, as outlined in the examples below

Enhance energy savings in public buildings

Mandate energy savings targets for public buildings and for public services. The Greater Nantes area in France has launched an Energy 'Sobriety' Plan targeting a 10% reduction in energy consumption. Other longer-term approaches can include **dedicated energy efficiency programmes** with energy audits, monitoring and targeting systems, energy awareness, and training of staff and building managers. Ireland's Optimising Power at Work programme has realised annual savings of 25% across 300 large buildings. Additional funding for **retrofit and energy saving measures in public buildings** can play an important role, as with the French ACTEE2, national energy efficiency programme that supports local authorities to renovate public buildings.

Improve the efficiency of public lighting

Support early replacement to LED lights for all non-LED public lighting, as was done for example with the Latvia lightbulb replacement programme. Governments and municipalities can prioritise projects that also deploy digital smart control solutions, as was done with smart energy street lighting project in Dortmund, Germany that has achieved a reduction of 55% in electricity use. Another approach to scale up investments in energy efficient actions and bring down costs is through project aggregation and bulk procurement. One example is

the EIB's ELENA funding for national projects that combine energy efficiency in streetlighting and public buildings, as in Lithuania, Italy, Croatia and other countries.

Optimise water and waste water treatment

Process optimisation for water and waste water treatment can deliver significant energy savings, through measures such as right-sizing equipment, replacing motors and pumps with high-efficiency models, installing variable frequency drives on pump motors and reducing the speed to low-flow rates, and carrying out preventive maintenance. Multiple examples from around the world include the United Kingdom, Mexico, Bosnia and Herzegovina, Armenia and Brazil. Additional measures related to implementing energy management monitoring and control in water and waste water services can bring down energy consumption considerably, with a 45% reduction in Brasov, Romania thanks to a new Energy and Water Monitoring programme.

Promote additional savings in SMEs and industry

Many SMEs and industrial players have already made efforts to save energy in today's energy crisis, but we estimate that further support from policymakers could generate additional savings of 2.5 bcm in 2023.

Support for energy savings among small and medium-sized enterprises (SME)

Fund audit schemes for SMEs and include obligations to implement no-cost measures and provide assistance to realise additional energy savings. The latter can be facilitated via funding and an approved product list, for example via the EBRD Green Technology Selector. Support can also come in the form of vouchers (e.g. SEAI Energy Audit Voucher), or through expanding existing efficiency obligations schemes to put more focus on SMEs (see also this recent article from IEA). Examples of financial support mechanisms include the Dutch subsidy scheme for SMEs and Australia's Energy Efficient Communities Program – Small Business Grants.

Push efficiency and gas-to-electricity switching in industry

Concentrate industrial energy efficiency programmes, and information support measures, on actions with immediate impact. These actions can include installing or repairing insulation, replacing and upgrading motor systems, and installing monitoring systems. Delivery mechanisms can be via tax incentives such as the PFE programme in Sweden, where the government steps in to cover the price difference between conventional and greener production

methods until parity is reached, as in Austria, or through Energy Efficiency Agreements as in Finland.

Prioritise investment that introduce substitutes for natural gas. These can include the direct use of waste heat and electric technologies for generating low-temperature process heat, both of which are often very cost-efficient. Efficiency gains can also come from changing the heating source from steam to hot water.The Danish Business Pool programme is an example of a funding scheme that has been switched to prioritise a shift away from natural gas in response to the current crises.

The benefits of 'one-stop shops'

The idea of "one-stop shops" for all permits and authorisations is a practical measure that many governments have pursued to facilitate structural changes in the energy sector. These initiatives can take time to set up, and so are not necessarily a suitable vehicle to deliver rapid changes in 2023 in countries that are starting from scratch, but they can be very effective in shortening lead times for new projects, and ensuring that consumers get access to the information that they need as well as assurances of the quality of service.

In the case of energy efficiency, such initiatives can make high-quality renovations easier to find. The approach taken by the Sustainable Energy Authority in Ireland to incentivise private operators to register with the Authority, thus controlling the quality of renovations, could be applied elsewhere. They can also make it easier for consumers to get information about their eligibility for the various types of financial support on offer. The Electric Ireland Superhomes is one example.

For new renewable projects, single contact points or one-stop shops can provide a much more streamlined service for project developers. This can take the form of a communication channel between all relevant offices (which can typically be done more quickly) or the creation of a single administrative body with permit-granting powers. The latter approach has been implemented in Denmark, Finland, Ireland and Sweden.

2. More rapid deployment of renewables

Summary of actions

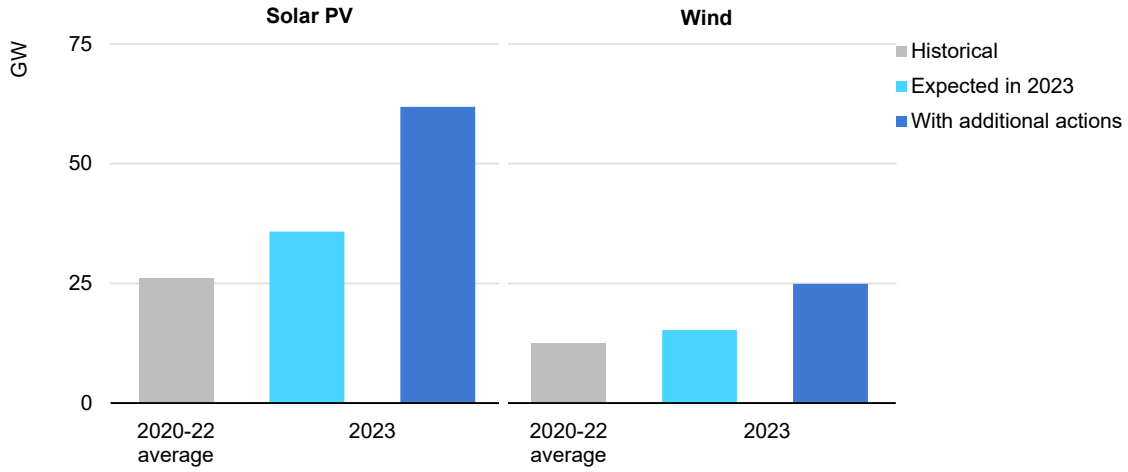
Reduce permitting timelines, increase investor confidence through stronger incentives and market regulation, and promote the integration of renewables and distributed resources.

Total additional savings in 2023: 7.5 bcm

Policy momentum and market conditions were already signalling faster growth in renewable energy, even before the start of the energy crisis. Following Russia's curtailment of gas supply, several EU member countries have introduced more ambitious renewable energy goals and improved the policy environment. In 2022, EU renewable electricity generation is poised to increase by 6%, despite a significant fall in generation from hydropower, thanks to record additions of wind and solar PV capacity.

Our baseline expectation for 2023 is that wind and solar PV generation in the European Union will rise by more than 80 TWh compared with last year, displacing around 12 bcm of natural gas. Additional actions could result in a further 55 TWh of output from wind and solar PV (displacing a further 7.5 bcm). This will require a near-doubling of wind and solar PV annual additions in 2023 compared with our baseline expectation, a huge undertaking. This upside potential hinges mostly upon easing the path to operation of new utility-scale and onshore wind projects in the coming months, accelerating the deployment of rooftop solar PV systems and commissioning large offshore wind projects more rapidly. This would result in the European Union commissioning around 60 GW of new solar PV and 25 GW of wind in 2023, nearly tripling the bloc's average annual deployment over the last three years. Achieving these faster growth targets will require policy action along three main lines: reducing permitting timelines; increasing investor certainty; and promoting the integration of renewables and distributed resources.

EU annual wind and solar PV additions in baseline and with additional actions



Reduce permitting timelines

Today around 80 GW of onshore wind and 150 GW of solar PV projects (utility-scale) are under various permitting stages in the EU. While most of these projects are in the early stages of permitting, a significant share is waiting for final approval

to begin construction. Several member states have already introduced policy tools and regulations to accelerate permitting; filling the gas supply-demand gap will require widespread implementation of these improvements across all EU countries.

The European Commission included a Recommendation on permitting in the communication package of the REPowerEU Plan, and in November 2022 proposed a temporary emergency regulation to accelerate renewables deployment. The IEA recommends prioritising the five main action areas listed below, that have high potential in the short-term.

Coordinate, simplify and digitalise permitting processes

Facilitate coordination, including through the use of digital form of documents, e-communication and digitalisation of the whole administrative process, to accelerate permit processing. Facilitating effective coordination among administrative authorities at different levels (e.g. national, regional and municipal authorities) and identifying clear responsibilities and deadlines is essential. Several countries, including Denmark, Finland, Ireland and Sweden, have set up one-stop shops for administrative procedures. Preventing single jurisdictions from holding up permitting can also be addressed through the 'positive silence' concept, which has been introduced in Spain. Digital platforms can significantly improve communication within administrations and with project developers and stakeholders. Germany and the Netherlands have already digitalised permitting for wind and PV projects while Italy has initiated full digitalisation.

Identify priority areas for renewable energy projects.

Accelerating the identification of suitable areas for renewable energy projects subject to faster permitting can accelerate deployment. The German government requires each Federal State to identify areas favourable to onshore wind. Italy has identified preferential areas for renewable energy projects, which include classified agricultural areas, areas within industrial factories and old offshore oil platforms. Priority zones can be combined with simplified permitting procedures. Moreover, involving local administrations and other stakeholders in spatial planning can also reduce social acceptance issues over time.

Lower hurdles for specific short-cycle projects

Ease the authorisation process for smaller rooftop projects to provide fast returns. These contribute to the majority of installations in the faster case for PV deployment. Italy implemented shorter permitting process to install commercial rooftop PV system with capacities up to 200 kW, instead of 50 kW. Draft

amendments in Poland include a proposal to increase the capacity limit for PV projects not requiring building permits from 50 kW to 150 kW. Greece, Portugal and Ireland have prioritised the processing of applications for small-scale renewables by households and energy communities. There are also EU proposals to accelerate permitting for the 'repowering' of existing onshore wind installations if the increase in capacity does not exceed 15%.

Increase investor confidence

Improve auction design

Adapt the design and frequency of auctions to current circumstances. Auctions foster competition and have proven very effective to reduce the costs of renewables over time. In the current context however, auctions designs need to reflect the recent upward cost pressures on renewables (due to higher commodity prices) as well as their increasing energy security benefits. For instance, France adjusted its auction rules so that developers can increase capacity after the auction. Germany has increased auction volumes for onshore wind and solar PV and increased remuneration for distributed solar PV. Countries may consider to increase the volume of already planned auctions and/or accelerate the calendar and announce additional auction rounds in the first half of 2023.

Monitor impacts of market interventions to avoid unintended effects

Shelter citizens from high costs but without hurting the business case for new renewable energy investments. There is a strong rationale behind market interventions to protect vulnerable customers from high energy prices, their impact needs also to be monitored and assessed in terms of the potential harm to renewable developers' capacity to invest in new projects. Current and proposed market interventions in Europe could create uncertainties for renewable energy investments if they are not well designed or co-ordinated across countries. Moreover, the ongoing energy crisis has also sparked discussions in many parts of the European Union on possible changes to electricity market design. It is important that any proposals be carefully and transparently prepared, with clear visibility on timing and involving all relevant stakeholders, in order to avoid unintended uncertainty among investors.

Promote the integration of renewables and distributed resources

The rapid deployment of renewables and distributed resources, such as heat pumps, will put a strong focus onto integration measures, both operational and in terms of grid reinforcements. The fast growth in renewable electricity generation

can produce a shift in the patterns of power flows across Europe and further strain the transmission grid, while heat pumps will change loads at the distribution level.

Plan ahead for grids to ease rapid renewable deployment

Ensure sufficient grid capacity to allow renewable electricity to displace gas consumption. Accelerated permitting of new grid infrastructure, alongside measures to boost transparency on grid status at the distribution level will help to ensure that renewables are deployed in areas where the network is able to integrate additional distributed resources in a timely and effective manner. Some examples of efforts to improve transparency and visibility include Denmark's data hubs or Piclo in the UK and Portugal. Grid infrastructure operates at different levels, from low voltage distribution all the way to international interconnectors. Expansions of this infrastructure can take a long time, although for low voltage levels this process can take less than a year and support uptake of new renewables ahead of the next winter.

Step up incentives for other forms of flexibility

Maximise flexibility to enable the power system to take advantage of additional renewables. This will minimise the need to draw on natural gas for system balancing. Deploying new storage assets, particularly batteries, and reducing congestion of the distribution system can improve the impact of new renewables. Around 1 GW of new battery storage capacity is expected to come online in the European Union in 2023; in a case where this capacity is used for energy shifting away from hours of high gas generation, this could potentially help displace up to 300 million cubic metres of natural gas. Price signals should incentivise assets to operate in a way that supports the power system. Assets that increase flexibility by acting on both demand and supply (such as battery storage and pumped storage hydro) should not be disadvantaged, for example by double taxation.

Monitor implications for security of electricity supply

Watch closely for signs of strain on electricity security. The fast growth in renewable electricity generation can produce a shift in the patterns of power flows across Europe and further strain the transmission and distribution grids. Although our analysis shows that the increased generation of variable renewables will not compromise security of supply of the transmission grids, swiftly building capabilities for monitoring the operation of the transmission and distribution networks are necessary to pre-empt possible issues at the local level.

3. Electrify heat

Summary of actions

Provide financial incentives for heat pump purchases, change tax measures that disadvantage electrification, and scale up support for industrial electrification.

Total additional savings in 2023: 2 bcm

One-third of the European Union's gas demand is for heating in buildings: replacing gas-fired boilers with electric heating – notably heat pumps – offers a way to improve security, affordability and environmental performance. Heat pumps and other electric heating can also replace gas combustion in low and medium temperature processes in the industry sector. They provide a major improvement in efficiency: the heat pumps currently available on the market are three-to-five times more energy efficient than natural gas boilers.

Step up installations of heat pumps

Our expectation is that new heat pumps will save around 1 bcm of gas in the European Union in 2023 and additional actions could save a further 2 bcm. Achieving this would require the industry to address a number of constraints that contribute to long lead-times for installation, including addressing upfront cost barriers and expanding the number of trained installers.

Boosting deployment of heat pumps to the enhanced level in 2023 would lead to less than 5 TWh of additional electricity demand in 2023. Nonetheless, the gas savings far outweigh increases in gas use in the power system. Carrying out energy efficiency retrofits in parallel help reduce the size of a heat pump, minimising strain on grids, as can installing demand response-enabled devices.

Enhance financial support for households to install heat pumps

Provide consumers with the means to overcome the relatively high upfront costs of heat pump purchase and installation. Incentives are currently available in over 30 countries, together representing 70% of global space heating demand (see the new IEA report on the Future of Heat Pumps for more information). Incentives available today in many countries bring the upfront cost borne by consumers for a new heat pump below that of a new gas boiler, as is the case in Denmark, France, Italy, Poland, and Sweden. Many schemes offer additional support for low-income households, as in France and Poland, or for high−efficiency models, e.g. in Germany and Denmark. Grants are the most commonly used policy tool, however other models, such as equipment rentals or

heat-as-a-service models can similarly address upfront cost hurdles. Regulators should also remove other barriers, such as gas network disconnection charges.

Change tax measures that disadvantage electrification

Adjust the structure of energy taxation and electricity tariffs where they put heat pumps at an unfair disadvantage. In some countries, these considerations reduce the incentives for consumers and businesses to invest in the electrification of heat. Changes in this area are important to ensure that electricity prices align with energy transition and energy security goals, as was done in Finland. Some countries, including France and the United Kingdom, have reduced or completely removed VAT on alternatives to gas boilers.

Expand installation capacity

Increase training programmes for the heat pump workforce, particularly for installers. Certifications for heat pumps, like those in the European Union and the United Kingdom, can build on existing qualification schemes and be incorporated into the existing curriculum for electricians, plumbers, and other heating and refrigeration technicians, or in fire risk safety training. Manufacturers are also offering their own installation training programmes, which can be more targeted and shorter in duration, allowing companies to build up a workforce of certified installers more quickly.

Scale up support for industrial electrification

Deploy heat pumps in industry. Heat pumps have been used in industry for some time, mainly at low temperatures, typically in the industries with a high demand for process heating and drying. The paper, food and chemicals industries have the largest near-term opportunities, with nearly 30% of their combined heating needs able to be addressed by heat pumps. In Europe there is significant potential for the installation of industrial heat pumps in these three sectors, which have been hit hard by recent rises in natural gas prices. Incentives to cover initial costs can play a large roll in kick-starting wider deployment of industrial heat pumps, as was done in Germany.

Will accelerated deployment strain heat pump supply chains?

Rapid growth of the heat pump industry is starting to strain supply chains, although these have not yet resulted in binding constraints on growth. The lack of trained installers is the most visible challenge, notably in the EU, where 19 EU countries have reported shortages of plumbers, heating technicians, electricians, or construction workers—the key occupations that could readily upskill to install heat pumps.

Manufacturing constraints could also intensify in the coming years. In 2021, unutilised manufacturing capacity at existing factories stood at around 20%, with global manufacturing concentrated in China, the United States, the European Union, Japan, and Korea. This spare capacity would not be sufficient to meet the projected increase in sales in the coming two years. The supply of basic materials and specialised components, including compressors, heat exchangers and refrigerants, also needs to be scaled up rapidly. Leading manufacturers have recently announced plans to invest more than EUR 4 billion in expanding heat pump production capacity and related efforts, mostly in Europe.

Supply chain bottlenecks, notably affecting chip sets and copper, were adding to manufacturing costs and threatening to hold back the expansion of heat pump production capacity. Several countries, notably the United States, are responding with incentives to build up domestic manufacturing capacity. Similarly, the REPowerEU plan aims to strengthen European heat pump supply chains, placing increased emphasis on recycling and recovering materials from scrapped heat pumps, air conditioners and fossil fuel boilers.

Supply chain barriers for this and other clean energy technologies will be covered in detail in the forthcoming IEA report Energy Technology Perspectives 2023, which is due to be released in January 2023.

4. Encourage behaviour changes

Summary of actions

Adjust heating controls in gas-heated buildings, deploy smart meters to provide real-time feedback to consumers, embed efficiency into default settings on appliances, and support the public sector to develop and implement emergency energy-saving measures.

Total additional savings in 2023: 5 bcm

Behaviour change can save energy quickly when people and businesses understand what to do and why. This was an important aspect of the IEA's

10-point plan to reduce the European Union's reliance on Russian gas, with the recommendation to "encourage a temporary thermostat adjustment by consumers".

Finding ways to encourage energy users to change their behaviour is not always easy, but it can be done. IEA analysis points to the importance of well targeted messages that will lead to sustained impacts. We estimate that actions by consumers may have saved 3-10 bcm in 2022: these include changes in energy use motivated by higher prices as well as by behaviour. We estimate that behaviour changes – driven by regulatory interventions, awareness campaigns and prices – could help to deliver an additional 5 bcm in gas savings in 2023.[2]

Link thermostat settings to affordability and gas security

Adjust heating controls in Europe's gas-heated buildings to reduce strains on the gas balance. The average temperature for buildings' heating across the European Union at present is around 22°C and there is scope to save gas by turning down the thermostat. Reducing buildings' heating by 1°C reduces gas demand by 10 bcm a year, and also eases pressure on energy bills. Public education campaigns in the Netherlands, Belgium, Ireland and Denmark all encourage limiting space and water heating to reduce dependency on Russia while combatting climate change.

Provide real-time digital feedback to consumers

Deploy smart meters to provide consumers with real-time feedback on energy use. These can often be via connected digital devices, to alert consumers to their consumption patterns or, in cases where they are subject to time-of-use rates, to be alerted to variations in energy prices. Home energy reports are an example of a feedback mechanism which can help reduce residential electricity consumption by 2.2% and natural gas consumption by up to 1.6%. Japan worked with major utilities to send customised energy use reports to 300 000 households, resulting in a 2% sustained decrease in energy consumption. The European Commission is looking to develop a standardised application to be launched in 2023 that will help consumers reduce energy use.

[2] As part of the analysis for this report we identified measures that could be directed through government policy in private and public buildings – including heating systems maintenance, reductions in space and water heating and air conditioning use, and eco-households – with the potential to lower gas demand by up to 30 bcm from 2021 levels if they were to be adopted across the European Union. The savings for 2023, in addition to the savings gained through behaviour changes in 2022, assume that measures would be adopted over the course of 2023 and that adoption may not be universal.

Help consumers take action through utility providers

Utilities can promote energy saving behaviours and help deploy solutions. The Energy Efficiency Obligation Schemes can mandate utility companies to realise energy efficiency savings across their customer base (examples include Croatia, Greece and Slovenia). Such programmes can be tailored to reduce demand at peak demand hours, when gas-fired power is most likely to be used. Utilities can also use competitions and games to engage with their customers and promote efficient choices. These can prompt users to set goals for reducing their own energy consumption in exchange for small rewards (for example Australia and Canada).

Enable efficient choices with smart default settings

Redesign policies, programmes or products so that the default usage option or setting is also the cleanest and most efficient one. An example of a smart default programme is India's regulation for air conditioners, which requires manufacturers to set the default temperature of a new device to 24°C. This means that when someone buys an air conditioner, it will cool to 24°C by default, rather than say 22 or 20°C. Annual maintenance checks of gas boilers can be used to ensure hot water boilers in homes are set at a temperature that optimises efficiency, no higher than 60 °C. A large-scale field study of electricity subscriptions in Switzerland found that setting a 'green' electricity package as a standard subscription increased the share of customers using exclusively renewable electricity from less than 5% to over 80%.

The public sector should lead by example

The public sector has the ability to showcase energy saving policy in action: both achieving energy saving goals and inspiring others to do the same. In the current crises, cities have often been at the forefront of energy crisis response and are leading by example. in Germany, for instance, Hanover committed to cutting city's energy consumption by 15%, switching heating off from and April until September and turning off night-time lights illuminating city hall and museums. Paris switched off the lights off the Eiffel Tower an hour early, thus sending a strong message to residents and visitors alike. Switching off hot water in public building restrooms and reducing the water temperatures of public pools by 1°C is something governments can undertake all over Europe, following France's example.

Crisis measures can open up longer-term savings

Well-structured emergency measures can embed behavioural changes. In 2022 over ten EU countries launched energy saving campaigns asking citizens to

take voluntary actions ranging from taking shorter showers, line-drying clothes, turning down thermostats in the winter and more. Austria's Mission 11, Ireland's Reduce Your Use, Finland's "A degree lower − saving energy towards winter", Estonia's "Together we can handle the energy crisis" and others appeal to solidarity in the face of the crisis by offering citizens a variety of actions and support in the form of grants, subsidies, and resources. Approaching campaign design as a business decision may improve the results. The Netherlands, for instance, looked at the return-on-investment (ROI) of their recent Flip the Switch Campaign by conducting a citizen survey, in this case demonstrating that 95% of the respondents have undertaken at least one of the recommended energy saving measures.

5. Scale up supply

Summary of actions

Capture gas flared and vented in exporting countries, bring new low-emissions gases into the mix, and joint gas purchasing.

Total additional gas in 2023: 4.5 bcm

The scope for near-term large-scale additions to global gas supply is relatively small compared with the possibilities on the demand side. New gas supply developments typically have long lead times, so decisions to develop new resources today take several years to result in additional supply. Our baseline assumptions for global gas supply in 2023 are detailed in the annex, but there is some potential upside.

There is around 170 bcm of non-Russian gas that is currently being produced that are not used productively, because it is leaked to the atmosphere or is flared; some of this could be brought to market relatively quickly. There are also near-term opportunities to scale up low-emissions gas supply, notably biogases. Joint purchasing of gas by European importers may offer a route to mobilise some of these additional resources, and potentially to reduce the price paid. Overall, we estimate that additional actions in these areas could bring a further 4.5 bcm to market in 2023.

Capture gas flared and vented in exporting countries

Incentivise reductions in flaring, venting and methane leaks to bring additional gas to market. New analysis from the World Bank and the Payne Institute's Earth Observation Group suggests that nearly 13 bcm of gas was flared in the first three quarters of 2022 in African countries that could have delivered this gas to the European Union with spare existing export capacity (Algeria,

Angola, Egypt, and Nigeria). We estimate that a further 7 bcm of methane was released to the atmosphere from oil and gas operations in these countries over this period. This occurred despite the very high level of natural gas prices in 2022.

New policy efforts are needed to deliver capture projects. The Netherlands halved methane emissions from its offshore oil and gas industry in two years through an emissions reduction programme. Canada has introduced regulations that could save more than 0.5 bcm by 2025 (a near 40% reduction), and Angola reduced flaring volumes by more than 50% between 2016 to 2021 following its endorsement of the World Bank's Zero Routine Flaring by 2030 initiative. Nigeria has also announced regulations to reduce methane emissions from its oil and gas sector, establishing leak detection and repair requirements, a ban on cold venting, and equipment standards.

Commitments from the European Union to the "you collect, we buy" approach can accelerate the pace of change. From a satellite-based assessment of the flared volumes in 2021 and IEA work on methane leak reductions, we estimate that around 4 bcm of additional natural gas could be made available to the European Union over the next 12 months with concerted efforts by African exporting countries, and incentives from buyers. This includes fast-tracking efforts to implement methane leak detection and repair (LDAR) programs, and targeting those flares that are large, occur on a continuous basis, and lie within 20 kilometres of a gas pipeline, and so could be brought to market relatively quickly. Most of the identified potential that could be exploited in the near-term to bring additional gas to Europe lies in Algeria and Egypt.

Bring new biogases into the mix

Step up support for new biomethane projects and ease their access to the grid. Biomethane production is set to grow by just under 1 bcm in 2022, with France, Italy and Denmark accounting for the bulk of the growth. Alongside existing support schemes, France has issued calls for tender for new biomethane projects and has policies that facilitate access to the grid; Italy has introduced contracts for difference to support biomethane production through its Recovery and Resilience Facility. Several countries are also establishing certification schemes to encourage gas off takers to source a share of their gas requirements as biomethane.

New biomethane projects that start construction in the first quarter of 2023 could be operational before the start of winter. Based on an assessment of plans by large biomethane producers and gas transmission system operators, we estimate that around 0.6-1 bcm of biomethane production capacity is set to come online over the course of 2023, with the potential to displace around 0.6 bcm of natural gas. With faster permitting of projects currently in the pipeline, for example

through the designation of “go-to areas” for development, we estimate that a further 0.6 bcm biomethane could be produced in 2023.

Accelerate support for low-emissions hydrogen

Fast-tracking hydrogen projects will have a limited impact in 2023, but can prepare the ground for larger gains later in the decade. It is unlikely that projects currently in the feasibility phase can be fast-tracked to become operational before the end of 2023. However, around 150 MW of electrolyser capacity is under construction and 650 MW has taken final investment decision and could start production in the coming months. These projects could displace around 75-100 million cubic metres (mcm) of natural gas by the end of 2023. The largest savings are in ammonia production, followed by refining, methanol production and other industrial applications. An additional 15 mcm could also displaced through blending hydrogen into gas grids.

Joint purchasing of gas can relieve price pressures

Joint procurement of gas can increase the bargaining power of EU companies and could help bring low-emissions or wasted gas to market. It can enable more sophisticated risk-sharing mechanisms in a highly volatile price environment, and share best-practices related to gas/LNG trading and support gas/LNG contracting by companies with more limited financial capabilities. This could have particular value in Central and East European markets, which historically relied heavily on Russian gas imports, which have more limited experience in LNG procurement/trading. Joint gas procurement can help to facilitate refilling underground gas storages and can also be linked with flaring avoidance projects as well as providing sufficient anchor demand for investments in hydrogen supply infrastructure.

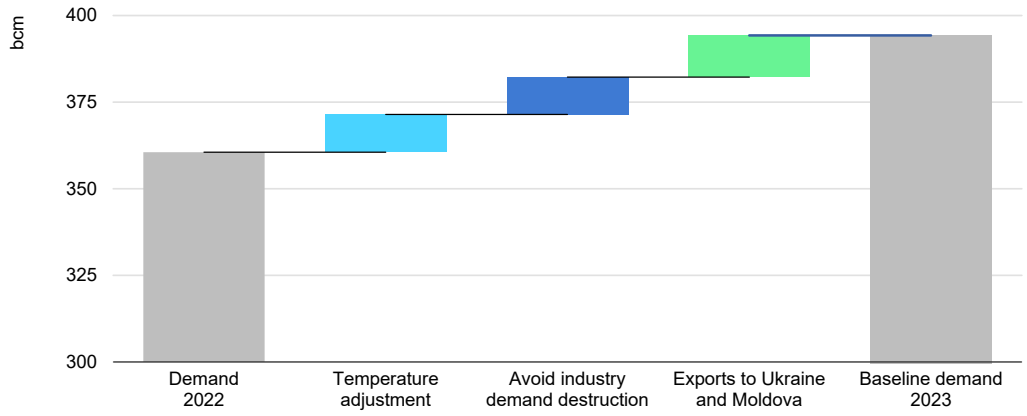
Annex – Baseline EU gas demand and supply in 2023

Assumptions for EU gas demand in 2023

Our starting point for considering gas demand in the European Union in 2023 is consumption in 2022 (360 bcm). This is adjusted for weather, the drop in gas use in industry caused by demand destruction, and the need for additional gas exports to Ukraine and Moldova. This provides the baseline level of demand for the estimate of the supply-demand gap in 2023.

We assume that Europe's gas storages will be around one-third full at the beginning of April 2023, which translates into storage injection needs of 65 bcm over the summer in 2023 to reach a storage level of 95% at the start of the 2023-24 heating season.

Additional levels of EU gas demand in 2023 above demand in 2022



Temperature adjustment

Mild weather in 2022 meant that Heating Degree Days in the first eleven months of 2022 were around 7% lower than the average from 2017-2021. If the number of Heating Degree Days returns to the 2017-2021 average in 2023, this would require 11 bcm of additional gas.

Avoided industry demand destruction

Industrial gas demand is set to be around 20% (or 25 bcm) lower in 2022 than in 2021. We estimate that fuel switching, mainly gas-to-oil, accounts for just under half of this reduction and there are also set to be some efficiency gains. Around

10 bcm of the remaining reduction stems from production curtailments, primarily in the gas- and energy-intensive industries.

The fertiliser industry accounts for more than half of these production curtailments. According to the International Fertiliser Association, around 70% of the EU's ammonia production capacity was offline in August 2022 and around 40% had still not restarted in October 2022. There have also been production curtailments in the steel and aluminium sectors, where high gas and electricity prices led to a 10% drop in production in the ten first months of 2022 compared with the same period in 2021. There was also less natural gas consumed in cement, glass, ceramics, food and machinery production, although most of this was because of efficiency improvements and fuel switching.

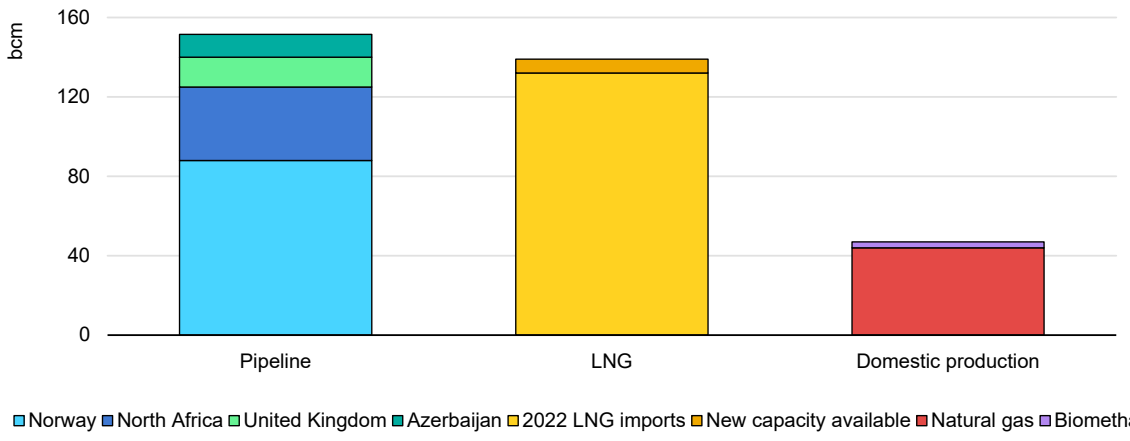
The actions presented in this report aim to provide sufficient natural gas to avoid the need for curtailments in industry in 2023.

Exports to Ukraine and Moldova

The European Union can play a crucial role in refilling gas storage sites in Ukraine and ensuring supply to Moldova. Ukraine's gas storage levels were 14.6 bcm at the beginning of the 2022-23 heating season (against an initial target of 19 bcm). Even with a 25% reduction in the Ukraine's winter gas consumption compared with pre-war levels, storage sites are expected to be severely depleted by the end of March 2023. If there is a full cessation in Russian piped gas supplies, Ukraine and Moldova will require around 12 bcm of gas imports from the European Union during the summer of 2023 to replenish their storage sites by the start of the 2023-24 heating season.

Assumptions for EU gas supply in 2023

Baseline level of gas supply available to the European Union in 2023



Russian pipeline supply

Our assumption in this report is that Russian pipeline deliveries to the European Union fall to zero from the beginning of January 2023. If they were to remain at their current levels, then Russia would supply around 25 bcm over the course of 2023. This is less than half the 60 bcm that is likely to be delivered in the whole of 2022, which in turn is less than half the amount supplied in 2021.

Non-Russian pipeline supply

Non-Russian pipeline suppliers have limited upside potential, with both Azerbaijan and Norway supplying close to their nameplate capacity in 2022. In the case of Algeria, some limited upside is expected with the development of gas fields in the Berkine South basin. Altogether, non-Russian pipeline deliveries are expected to increase by less than 1% (or 1 bcm) in 2023 compared to the previous year. Net pipeline imports from the United Kingdom are assumed to remain close to levels in 2022.

LNG supply

The European Union imported just over 130 bcm of LNG in 2022, a 60% increase from the 80 bcm imported in 2021.

Global LNG supply is expected to increase by 23 bcm in 2023, largely due to the ramp-up of liquefaction projects in Africa and the United States. Europe will be able to receive additional LNG as it expands its regasification capacity, but the availability of LNG cargoes to utilise this capacity is a function not only of additional LNG supply but also of demand from other importers.

Asian LNG imports are set to fall by 7% in 2022, largely as a result of lower LNG import requirements in China (which fell by around 20% or 20 bcm). A return to stronger economic growth and eased covid restrictions could support the recovery of China's LNG imports in 2023, to close to their 2021 levels.

China is less reliant than the European Union on LNG cargoes sold on spot markets and the spot market. China is set to increase its level of destination-fixed contracts in 2023. If China's LNG imports recover to their 2021 levels, it would capture most of the overall increase in global LNG supply in 2023 and limit the LNG volumes available to the European market. Under this assumption, we estimate that the European Union could increase its LNG imports by around 7 bcm in 2023.

There are some short lead-time options that could boost the availability of LNG supply globally in 2023 above the 23 bcm assumed here. This includes improving

the supply of feedstock gas to existing LNG plants and developing new small-scale, floating LNG (FLNG) liquefaction plants. Several small-scale FLNG projects are in various stages of development, primarily in Africa and the United States. Many of these projects still require regulatory approvals, need to secure feedstock gas supplies, and are subject to pending investment decisions. We estimate that the development of small-scale LNG projects and the improved availability of feedstock gas to existing facilities could result in an additional 10 bcm of LNG supply in 2023. Conversely, unplanned outages could limit the growth in new LNG supply to well below 20 bcm in 2023. The possibility of unexpected outages is heightened by high utilisation levels of available capacity in recent years, alongside postponed maintenance at some facilities.

Gas production in the European Union

Natural gas production in the European Union fell by around 9% (or 3.6 bcm) in the first nine months of 2022. This stemmed mainly from reductions in the Netherlands, the European Union's largest gas producer. Gas production at the Groningen field in the Netherlands fell by more than one-third (or 2 bcm) in the first nine months of 2022. Non-Groningen gas production in the Netherlands continued to decline as well, down by 10% compared with last year. In other markets, domestic production remained either flat or fell slightly.

We assume that natural gas output in the European Union will decline by around 5% in 2023. Groningen gas production has been capped at 2.8 bcm for the Gas Year 2022/23 (down from 4.5 bcm during the previous Gas Year) and extraction at the field is due to cease completely by 2024 at the latest. The available technical production capacity at Groningen could play a role in easing supply-demand tensions prevailing in Europe and on the global LNG market. However, raising output remains a measure of last resort due to the risk of earthquakes caused by gas production at the field. By 1 April 2023 the Netherlands will decide whether to close additional production sites at the Groningen field, further reducing its technical capacity.

In Romania, natural gas production is set to increase from the Midia Gas Development project and from the Doina and Ana offshore fields, which started up in June. With an estimated 10 bcm of gas reserves, Midia will be providing 0.5 bcm in 2022 and 1 bcm a year during 2023-2026 –offsetting the declines from more mature fields.

In Denmark, the return of the Tyra field was delayed into late 2023 or early 2024. The field was in redevelopment since 2018 and will supply 2.8 bcm each year to the European market once operational.

There is set to be around 4 bcm of biomethane produced in the European Union in 2022. This includes the contribution of more than 150 additional plants commissioned in 2022, which are expected to have increased production by just under 1 bcm; 80% of the capacity additions were in France.

International Energy Agency (IEA)

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