INVESTMENT REPORT
2022/2023

Resilience and renewal in Europe

European Investment Bank

Chapter 6
Green transition and the energy crisis

EUROPEAN INVESTMENT BANK INVESTMENT REPORT
2022/2023

Resilience and renewal in Europe

Part II Resilience and renewal

Chapter 6
Green transition and the energy crisis

Investment Report 2022/2023: Resilience and renewal in Europe.

About the report
The annual EIB report on investment and investment finance is a product of the EIB Economics Department. The report provides a comprehensive overview of the developments and drivers of investment and investment finance in the European Union. It combines an analysis and understanding of key market trends and developments, with a thematic focus explored in greater depth. This year, the focus is on how Europe is progressing towards a digital and green future amid an energy crisis. The report draws extensively on the results of the annual EIB Investment Survey (EIBIS) and the EIB Municipality Survey, combining internal EIB analysis with contributions from leading experts in the field.

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The mission of the EIB Economics Department is to provide economic analyses and studies to support the Bank in its operations and to help define its positioning, strategy and policy. The director of the Economics Department, Debora Revoltella, heads a team of 40 economists.

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Chapter 6

Green transition and the energy crisis

Europe is experiencing an unprecedented energy crisis that threatens to derail the post-pandemic economic recovery and undermine political and social support for the green transition. Fuelled by Russia's invasion of Ukraine, energy prices — especially for natural gas — soared to record highs in mid-2022, draining households of their income and altering the competitiveness of European firms. To shield individuals and businesses, national governments have provided temporary measures like direct transfers to consumers to cover high energy bills, as well as other incentives to save energy and switch to cleaner sources. In parallel, the European Union has agreed on several measures and proposed a "toolbox for action and support" to strengthen the internal energy market and ensure that national measures are in line with the Fit for 55 package, a set of proposals to revive and update EU legislation on reducing emissions at least 55% by 2030, compared to 1990 levels. While energy prices have stabilised and lowered as they converged among EU countries, uncertainty remains as prices continue to be volatile and sensitive to potential future supply shortfalls.

The energy price shock has been felt throughout Europe, but the impact varies among EU members, reflecting the fragmentation of the European energy market. Factors like national fuel mixes, competition, import diversification, network costs and energy policies (such as taxation or energy subsidies prompted by the crisis) explain the uneven economic hardship experienced in different countries and consumer groups. Energy-intensive industries suffered the most. Likewise, countries in Central and Eastern Europe appear to be more at risk because of their direct and indirect exposure to Russia. However, most countries (especially in the Baltics and Western and Northern Europe) moved swiftly to reduce their reliance on Russian fossil fuels by diversifying gas supplies and saving energy.

Rising energy costs are pushing firms to pursue climate action, but growing uncertainty holds them back. The EIB Investment Survey (EIBIS) for 2022 shows that the rise in the share of firms engaging in climate action accelerated in 2021, a post-pandemic rebound which is expected to continue, based on the share of firms with plans to invest in the future. In parallel, almost 90% of firms have implemented at least one measure to reduce their carbon footprint, with waste management and energy efficiency being the most popular choices. By contrast, only one-third of firms have developed or invested in one or more measures for building resilience to physical risks. Nevertheless, the current economic environment is marked by considerable risks, including decelerating demand and tighter financing conditions that may well constrain firms' investments.

The current energy crisis calls for enhanced coordination and coherent governance of European energy markets to ensure proper internal functioning and affordable energy for all. Bolstering investment by companies will require a combination of policies to reduce uncertainty, which is currently on the rise. Here, it could prove beneficial to de-risk instruments, which would protect investors from the cost of uncertainty. In parallel, short-term policy interventions to manage the energy crisis should be carefully examined so that they do not disincentivise investment in the green transformation. Complementary public and private investment opportunities could also play a role. Despite the many efforts — common regulations and practical initiatives — and ample political will, the energy crisis has once again shown how much remains to be done before national energy markets are integrated. Preparing Europe to better respond to the current climate crisis and any future crises will require structural reforms, support for green finance, innovation and new infrastructure developments — to enhance the security of energy supply, maintain corporate competitiveness and achieve climate goals.

Introduction

The war in Ukraine has provoked a structural overhaul of the EU energy market that has ramifications for the entire economy. The energy crisis poses an immediate challenge, with policymakers facing a key question of how to diversify away from Russian energy dependency while ensuring sufficient supply of affordable energy to the continent.

But as it unfolds, the energy crisis is also unveiling structural weaknesses and inefficiencies in the EU energy market, beyond the dependency on Russia. The energy shock is, in fact, a formidable opportunity to design a more integrated, efficient, resilient market structure for the future — one that fully exploits the advantages of European integration. The current turmoil underscores the need to reduce the overall EU dependence on fossil fuels and boost investments in clean energy technologies, with far-reaching benefits for sustainability, affordability and security of supply.

Against this backdrop, this chapter explores the compound effects of energy supply shocks by laying out key macro-level shifts and their impact. The first and second sections give an overview of the energy crisis in Europe, including recent patterns in energy price movements and aspects of the security of supply in the short and longer term. The third section covers firm-level responses, based on EIBIS results. Focus is placed on the key factors that influence firms' climate change strategy, their awareness of climate risks, sustainable choices, financial levers and the communication of firms' strategies. The final section discusses the financial sector's support for climate strategies.

Rising energy costs threaten Europe's competitiveness

Energy is a key input for economic growth, which means that any price shock would bring significant economic challenges. This part of the chapter discusses current energy price developments and how price turbulence flows from energy producers to consumers. Findings show that high energy prices weighed on the welfare of people and on the competitiveness of industries in Europe more than in other areas of the world. Although this shock is common to European countries and end users, some groups appear to be more vulnerable than others, indicating that European energy markets are fragmented.

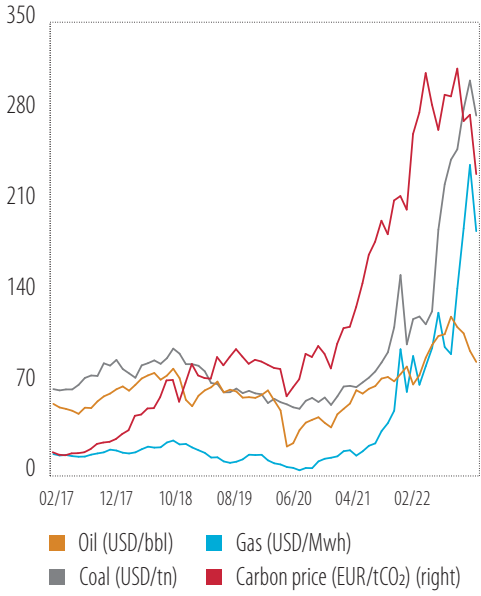
Energy prices reach record highs, displaying great volatility

Energy prices were volatile and reached unprecedented highs in mid-2022, and they are showing no sign of returning to pre-pandemic levels just yet. The world faced the lowest fuel prices in decades in 2020, the result of low global demand because of the COVID-19 crisis. Starting in 2021, by contrast, energy prices rose to extraordinarily high levels, pushed by the strong global economic recovery (among the fastest post-recession growth surges in the last 80 years), a long cold winter in Northern Europe, weaker-than-expected supply growth and mounting supply concerns resulting from the war in Ukraine (Figure 1).

Geopolitical tensions and fear of being cut off from the Russian gas supply increased prices and volatility on European energy markets. Uncertainty is being exacerbated by the temporary supply bottlenecks, diversification efforts and demand swings generated by the rush to accumulate energy reserves. When war broke out in Ukraine, energy spot prices rose steeply, followed by major swings that reflected fears of a disruption to Russian imports. Major events that affected energy prices included Russia's move to decrease or terminate gas shipments to several European countries in the early summer of 2022, the coordinated push to fill gas storage facilities, and news of the physical disruption of pipelines. On the opposite side, September 2022 saw prices converge to lower levels amid announcements that storage facilities had been filled successfully and energy sources were being diversified. Energy efficiency measures and policy intervention also helped to contain prices. A mild winter has allowed for relatively low energy prices at the beginning of 2023, but uncertainty will continue to unsettle European energy

markets. Those markets will remain sensitive to short-term news about the war, increasing global demand (largely from China), extreme weather conditions, infrastructure bottlenecks or concerns about refilling gas storage facilities for the next European winter.

Figure 1
Evolution of oil, gas, coal (left axis) **and carbon prices** (right axis)



Source: *Bloomberg.*

Figure 2
Capacity utilisation factor of EU coal and gas-fired power plants (in %), **2015-2022**

Source: *European Network of Transmission System Operators for Electricity (ENTSO-E), International Energy Agency (IEA), EIB staff estimates.*
Note: *Estimations for 2022 are based on data from the first half of the year. Capacity utilisation factor refers to the ratio of a solar plant's actual output over the year (kWh) compared to the maximum possible output from it for a year (kWh) under ideal conditions.*

Natural gas prices have risen the most among energy commodities, as the role of liquified natural gas increased in the energy supply vs. pipeline gas; coal is also back on the scene. In mid-2022 the Dutch Title Transfer Facility (TTF) gas futures contract[1] soared to a record high, increasing tenfold compared to 2020 and surging well above EUR 200 per megawatt hour. Similarly, international coal prices rose to around five times their levels a year earlier. Diversification resulted in supplies shifting away from Russia, a reduction in pipeline gas and an increase in liquified natural gas (LNG). The steep increases in natural gas prices have also prompted some substitution away from natural gas to coal to generate electricity in the very short term in the United States, Europe and Asia. While use of coal-fired power plants in Europe had fallen since 2018 (Figure 2), the trend reversed in 2021.[2]

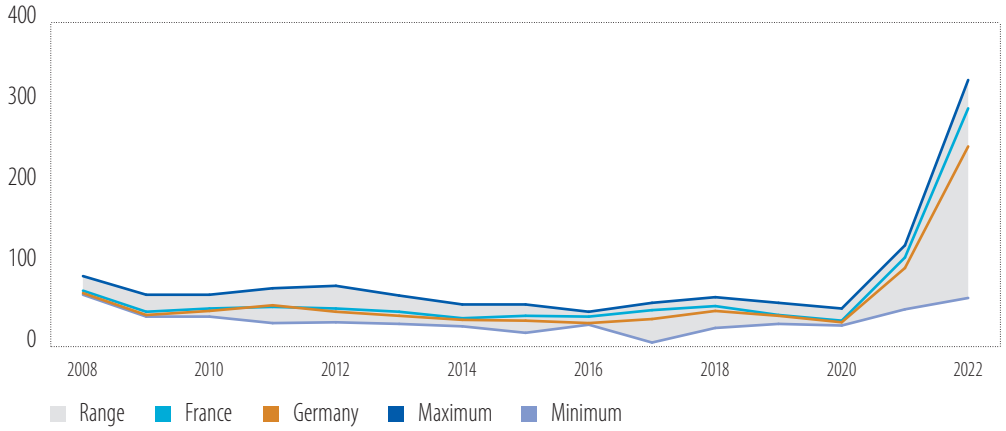
1 The Dutch TTF is a virtual trading point for natural gas in the Netherlands. It combines pipeline and liquified natural gas, and has traditionally been considered as a benchmark for the EU gas energy market. However, transport bottlenecks have raised concerns about the market's ability to represent actual conditions. The European Commission has proposed developing a new alternative liquified natural gas price benchmark, based on the effective price of physical transactions.

2 Coal has benefited from the unexpected changes in the prices of different energy sources and the fear of supply restrictions and possible energy embargos. The increased usage of coal-fired power plants, however, is at odds with the European Union's climate objects and plans to gradually phase out coal. Germany is considering putting retired coal-fired plants back online. Slovenia and the Czech Republic have declared their intention to end coal use by 2033. According to pledges by other EU countries, coal will only be used in Poland and the Western Balkans.

The increased use of coal is driving up carbon prices in Europe and carbon emissions from electricity generation globally. EU carbon prices have been steadily increasing, to hit around EUR 80 per tonne of carbon as coal grew in the energy mix (Figure 1). Carbon prices have risen steadily since 2017, with the pandemic providing a brief respite. In parallel, crude oil prices have also been supported by higher natural gas prices and remain above USD 80 per barrel.

Higher gas and coal prices combined with rising European carbon prices have resulted in higher rates for wholesale electricity, reflecting the merit order principle[3], with significant differences among EU countries. The highest prices were expected in markets dependent on gas for a large share of their electricity generation (Figure 3). In contrast, markets with large shares of hydropower, including the Nordic countries, managed to control price increases and recorded the lowest prices in Europe. Electricity prices in all wholesale electricity markets have generally increased since the start of the war in Ukraine. At the end of 2022, they stood more than four times above their pre-pandemic levels, with massive variation between countries. This increase contrasts with the more contained changes recorded over the last 15 years.

Figure 3
Wholesale electricity prices (EUR/MWh) **across European countries**



Source: Bloomberg, ENTSO-E.

Existing pricing models, in which the overall price of electricity is set by the most expensive source, enabled some electricity generators to record windfall profits. Prices in most European wholesale electricity markets are set by natural gas plants. As their prices reached record levels, consumers ended up paying far more for their electricity than the (average) cost of electricity production. Electricity generators with a mix of renewables, nuclear and lignite plants in their portfolio appear to have benefited the most, as they were paid windfall revenues well above their levelised cost of electricity[4] production. Similar benefits were also seen by fossil fuel companies that operate in wholesale and retail markets, whose profits swelled from the higher spot prices for energy that resulted from concerns about the Ukraine war.

The energy shock has also prompted countries to nationalise utility companies. Volatile prices caused problems for several utilities that were hedging their exposure, and eventually led to liquidity shortfalls. Those shortfalls prompted margin calls on certain hedges, putting the financial health of the utility companies in jeopardy. As a result, utility companies have been nationalised in countries including Austria, Finland, Denmark, Germany and France.

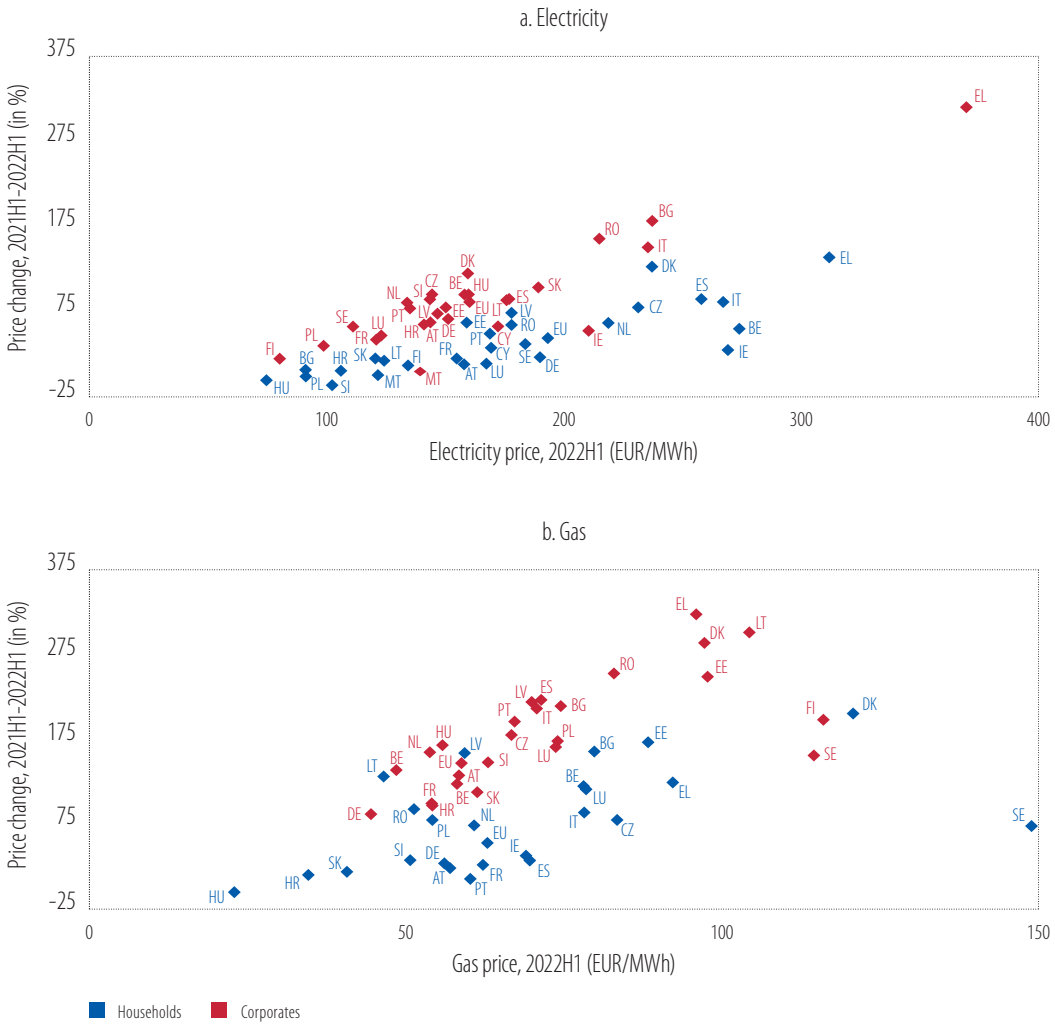
3 The merit order principle refers to the mechanism by which the market price is set. In the energy-only market, the merit order effect describes the sequence in which power plants contribute power to the market, with the cheapest offer made by the power plants with the smallest operating costs setting the starting point (renewables and nuclear, for example) and the most expensive offer usually made by natural gas power plants.

4 The levelised cost of electricity is a measure of the average net present cost of electricity generation for a power plant over its lifetime.

Surging energy prices erode Europe's competitiveness and broaden price gaps

In line with global energy prices, electricity and gas prices for European consumers have risen considerably, but asymmetrically among countries and end users. Despite differences, a consistent rise in electricity and gas prices was recorded in almost all EU members in the first half of 2022, for households and firms alike (Figure 4). For the electricity and gas markets, consumers in the EU countries with the highest prices are paying three times as much as those in countries with the lowest prices. Household retail gas prices, prices are almost six times higher. This gap has widened over time, especially in the case of household gas prices. Price differences between countries persist due to differences in the fuel mix, competition, import diversification, network costs and national policies (like taxation). Despite many efforts — common regulations and practical initiatives — and ample political will, the energy crisis has shown (once again) how much remains to be done to integrate national energy markets.

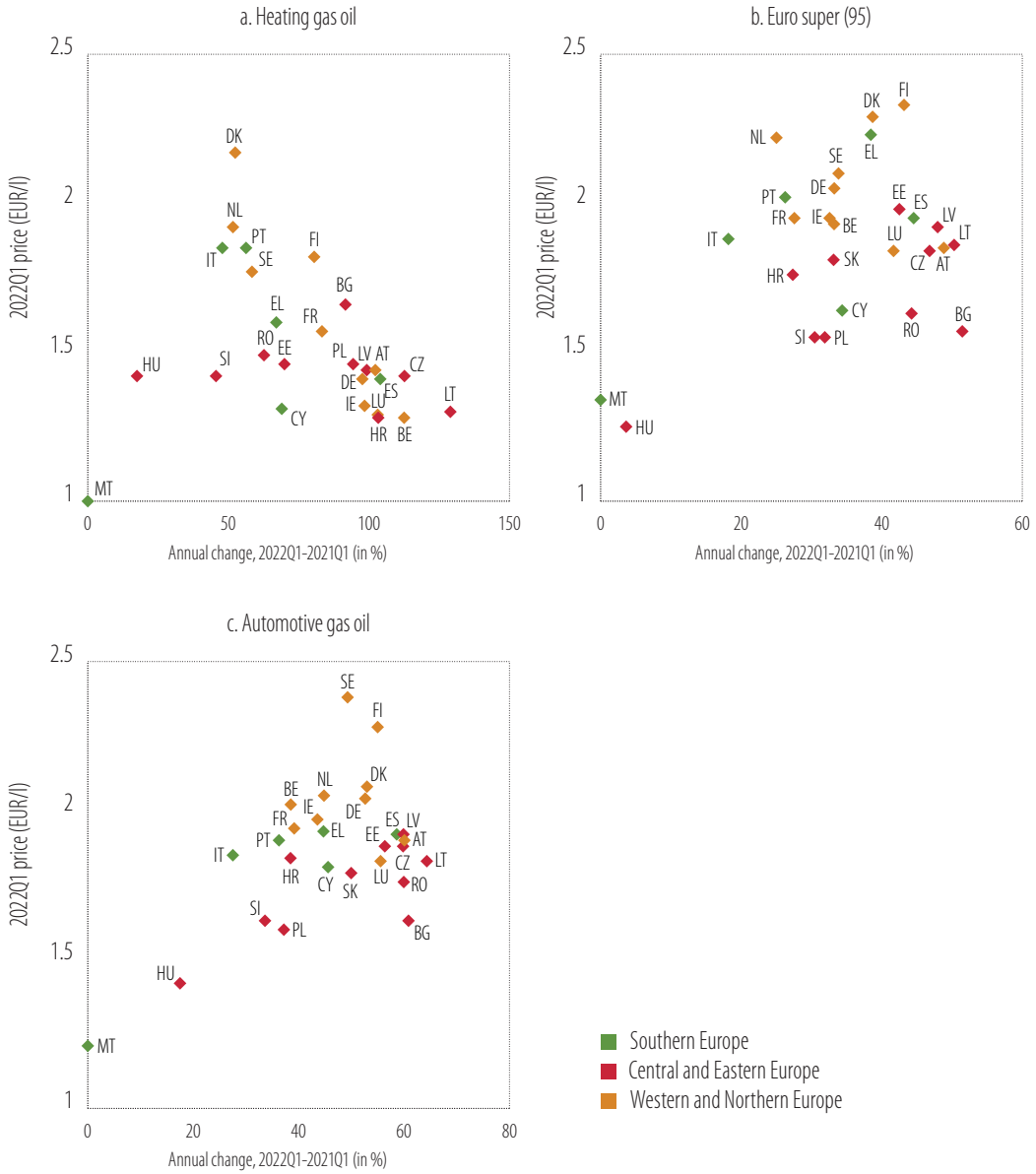
Figure 4
Electricity and gas price developments in EU members



Source: *Eurostat, European Commission Directorate-General for Energy.*
Note: *Changes in electricity and gas prices for households (consumption bands: DC and D2) and firms (consumption bands: IC and I3) in first half 2022 compared with the same half of previous year.*

In all European countries, industrial consumers appear the most affected by price increases. Gas prices for EU industrial users increased 147%, compared with 53% for households, in the first half of 2022, vs. the same period a year earlier (Figure 4). The same was true for electricity prices (+86% for industry vs. +44% for households). Industrial gas prices increased most, compared to household gas prices, in Spain, Greece and Portugal, while industrial electricity prices increased most, compared to household electricity prices, in Greece and Bulgaria.

Figure 5
Oil price developments in EU members

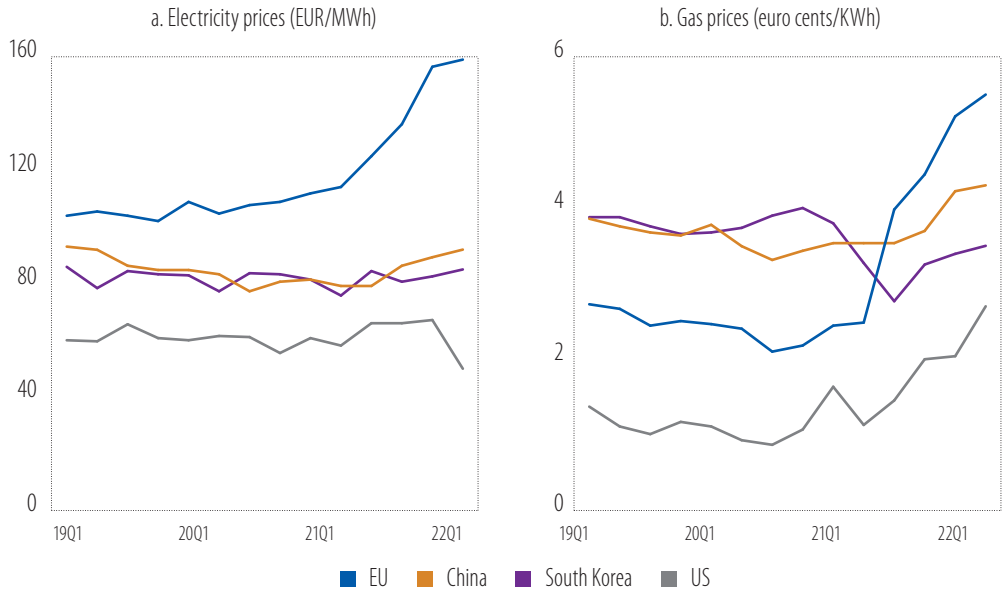


Source: *European Commission Directorate-General for Energy.*

Prices for oil products, like heating oil, in EU members followed the evolution of crude oil prices, but absolute levels differ considerably. The large differences in oil product prices are mainly driven by excise duties and value-added taxes, which vary by product and country, reflecting energy policy preferences (Figure 5). These extra costs affected the prices of oil products among countries, which rose

by more than 50%, and in some cases doubled (notably for heating gasoil). The prices of oil products in Western and Northern Europe are among the highest, while fluctuations in prices appear more pronounced in Central and Eastern Europe.

Figure 6
EU retail electricity and gas prices of industry vs. major trading partners



Source: *Eurostat, IEA, CEIC, European Commission's Directorate-General for Energy computations.*
Note: *Eurostat (EU average, for industrial consumption band I4) and CEIC. EU prices are without value-added and other recoverable taxes.*

High energy prices are harming Europe's competitiveness, especially for energy-intensive industries. In the electricity and the gas markets, industrial retail prices in Europe were higher than for international competitors (Figure 6). This gap in costs remained constant until the second quarter of 2021 and widened exponentially following the increased global demand for gas, various supply constraints and especially the war in Ukraine. While industrial electricity prices were always higher in Europe than for its international peers, those for gas peaked at the end of the COVID-19 crisis and the beginning of the war in Ukraine. Industrial electricity prices increased by 40% in the second quarter of 2022 compared to the same quarter of the previous year, while in China they rose by only 12% and in the United States they declined by 8%. Similarly, gas industrial prices in Europe were 23% higher than in China and 53% higher than in the United States.

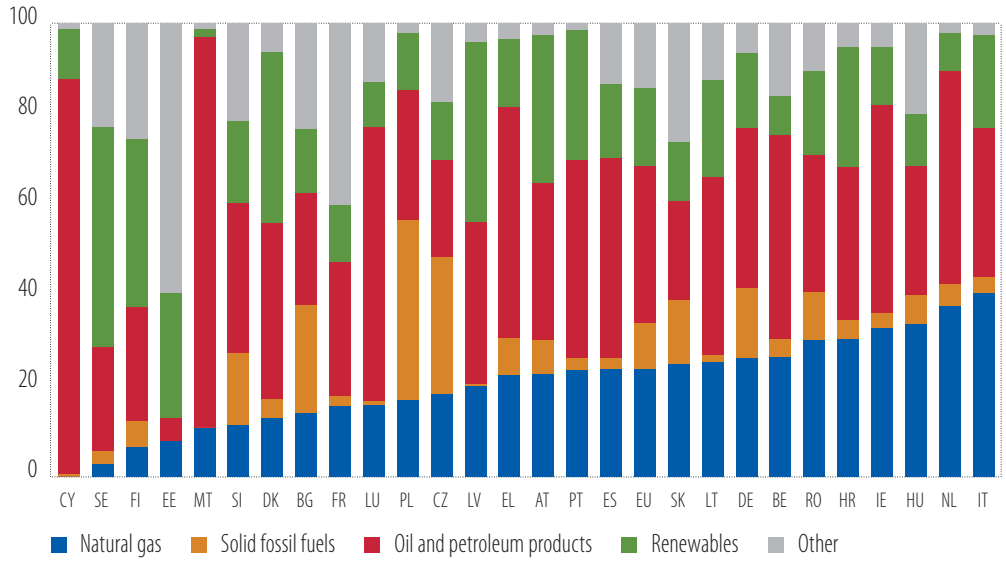
Security of supply tops the EU policy agenda

The unfolding energy crisis has pushed security of supply to the top of the energy policy agenda, requiring a revision of the policy framework and energy market design. This part of the chapter presents key features of the energy infrastructure in Europe and in EU countries to identify vulnerability to supply disruptions. It also discusses the progress made after the adoption at the EU level of coordinated measures to tackle the current energy crisis. Findings show that Europe has moved swiftly to reduce its reliance on Russian fossil fuels, notably by diversifying gas supplies and filling up gas storage facilities. Nevertheless, challenges persist across European countries, which have different starting points, resources and capacities for tackling potential supply disruptions.

EU members are addressing energy security from vastly different starting points

Because fuel mixes and dependence on Russian energy vary considerably between EU members, the same energy shock has different implications for European economies. Fuel mixes result from resource availability, geographic position, economic structure and national energy policy. For example, the share of solid fuels (hard coal, lignite and coal products) was highest in Poland (40%) and the Czech Republic (30%), while Estonia has a unique mix with peat and peat products accounting for 52% (Figure 7). The share of petroleum products stood out in Cyprus (87%) and Malta (86%), as well as in Luxembourg (60%).[5] Natural gas accounted for more than 30% in the Netherlands, Hungary, Ireland, Croatia and Romania. France had the highest nuclear share (41%), followed by Sweden (25%), Slovakia (25%), Bulgaria (24%) and Slovenia (23%). Generally, countries that were less dependent on fossil fuels had a mix of nuclear and/or renewables, including Sweden, France and Denmark.

Figure 7
Energy mix (in %) **in Europe, 2020**

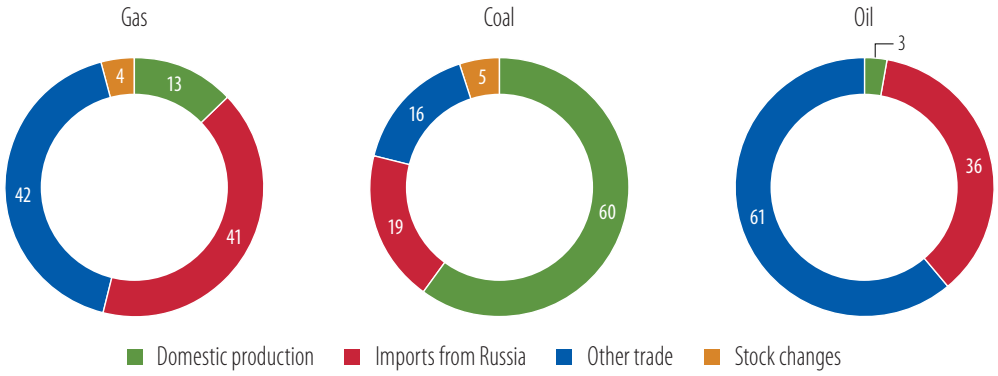


Source: *Eurostat.*
Note: *Other includes nuclear, non-renewable waste, electricity and heat. The graph shows for each EU country the energy mix by source.*

Overall, Europe imports around 60% of its energy needs. With a small and declining production of fossil and solid fuels, Europe is heavily reliant on imports to satisfy its domestic energy needs, which amplifies the implications of energy supply disruptions (Figure 8). From 2010 to 2020, domestic oil production declined by 35%, while gas production fell 63% and coal production declined 43%. Although the domestic production of renewable energy rose by 39%, and energy efficiency increased significantly in the same period, it was insufficient to compensate for the decline in production of EU coal, lignite and gas. The European Union remained dependent on imports for gas (83% of consumption), oil (97%) and hard coal (70%).

5 Cyprus and Malta are small islands with limited alternatives, while Luxembourg figures are affected by fuel shopping by consumers from neighbouring countries (due to lower fuel prices).

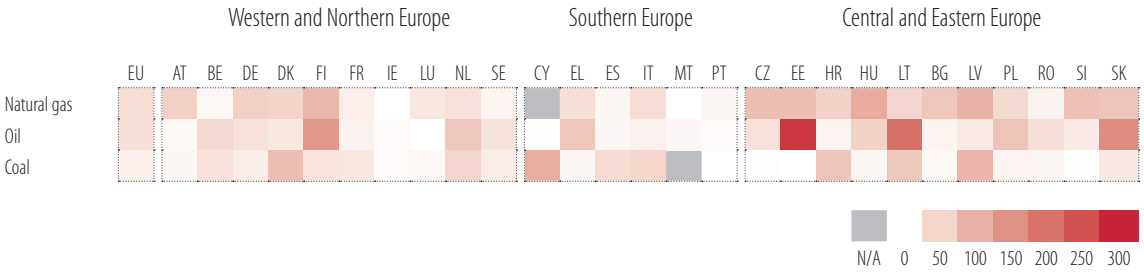
Figure 8
EU production trade and imports in gas, coal and oil (in %)**, in 2020**



Source: *Eurostat.*

Russia has been the main exporter of oil, gas and coal to Europe for many decades. Russia's aggression against Ukraine puts the bloc's energy security at risk. Before the war began, Europe's energy imports from Russia equalled just under 1% of the EU gross domestic product on average. In the gas sector, Russia provided around 45% of total EU gas imports in 2021, with an average of around 40% in recent years. The other main gas suppliers to the European Union were Norway (23%), Algeria (12%), the United States (6%) and Qatar (5%). Russia was also the largest supplier of crude oil imports (27%), followed by Norway (8%), Kazakhstan (8%) and the United States (8%). Coal imports have declined in recent years, but Russia remains the leading supplier here as well (46%), followed by the United States (15%) and Australia (13%).

Figure 9
Russian imports of gas, oil or coal as a share of gross available energy (in %)**, in 2020**



Source: *Eurostat estimates.*
Note: *Above 100% indicates that the country imports more than it needs for domestic consumption and exports different energy products (for example, oil in Estonia, Lithuania, Slovakia and Finland).*

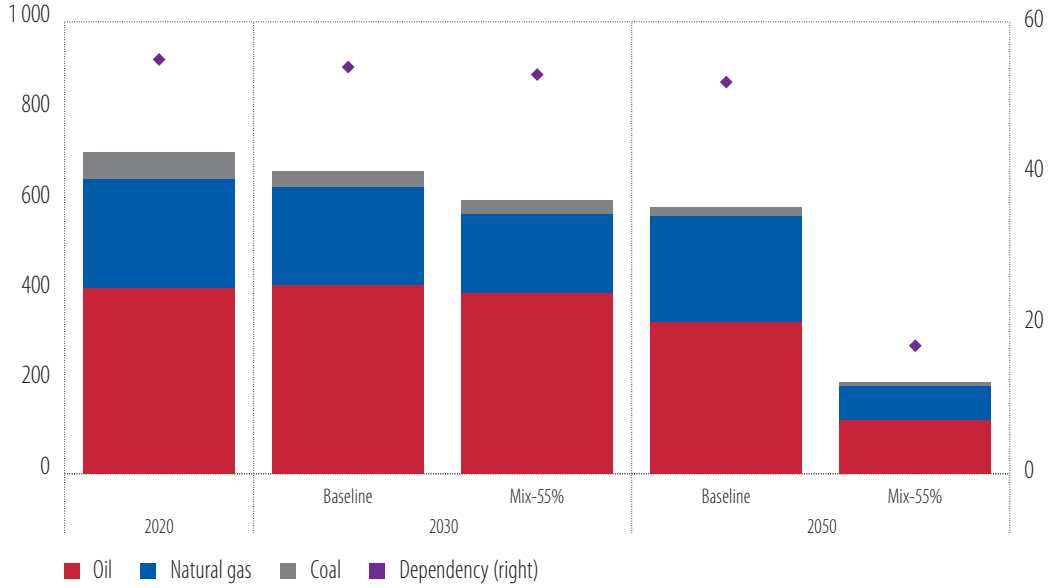
EU members' dependence on Russian energy exports varied greatly. Most countries in Central and Eastern Europe, including Bulgaria, Latvia and Slovakia, depended on a single Russian supplier (and often a single supply route) for 80% to 100% of their oil consumption (Figure 9). This was also the case for gas imports. Other countries relied on a more diverse range of suppliers, in which Russian imports nevertheless dominated. Some EU countries (Ireland, Spain, Cyprus, Malta and Portugal, for instance), did not import any fossil fuels from Russia.

Energy imports are expected to remain significant contributors to final energy demand (albeit to a lesser extent than they are today), justifying concerns about energy security in the event of geopolitical tensions. In the latest available simulations published by various institutions (Figure 10), coal imports trickle off by 2030, driven by more stringent climate policies, while oil accounts for 30% of final energy demand and gas 17%. Assuming a 55% net reduction of greenhouse gas emissions by 2030, simulations show that the volume of fossil fuel imports will fall by 27% over the same period, coal

declines by 71-77%, natural gas shrinks 13-19% and oil 23-25% (depending on the model). However, energy dependency (imports over gross domestic consumption) will remain high (around 55%) until 2030, shrinking dramatically only thereafter. By 2050 imports of coal, natural gas and oil will be reduced by at least 70% compared to 2020.

Figure 10

European energy imports (left axis, Mtoe) **and energy dependency** (right axis, in %) **in 2020, 2030 and 2050**



Source: *European Commission.*
Note: *Dependency is the ratio between total net imports and gross available energy (gross inland consumption and maritime bunkers). MIX-55% achieves the 55% reduction in greenhouse gas emissions, by expanding carbon pricing and moderately increasing policy ambitions, but to a lesser extent than if regulations were changed. The baseline assumes that the 2030 targets for emission reduction, renewable energy and energy efficiency are achieved.*

Box A

Sensitivity of the European economy to energy sectors

The energy shock is likely to propagate differently across sectors and countries, depending on the relevance of each energy sector to economic activity. An analysis based on input-output tables is presented below to better understand the role of different energy sectors in European economies. This analysis assesses the degree of interconnectedness across economic sectors and the relevant linkages (the relative importance of the energy sector for other industries in Europe).

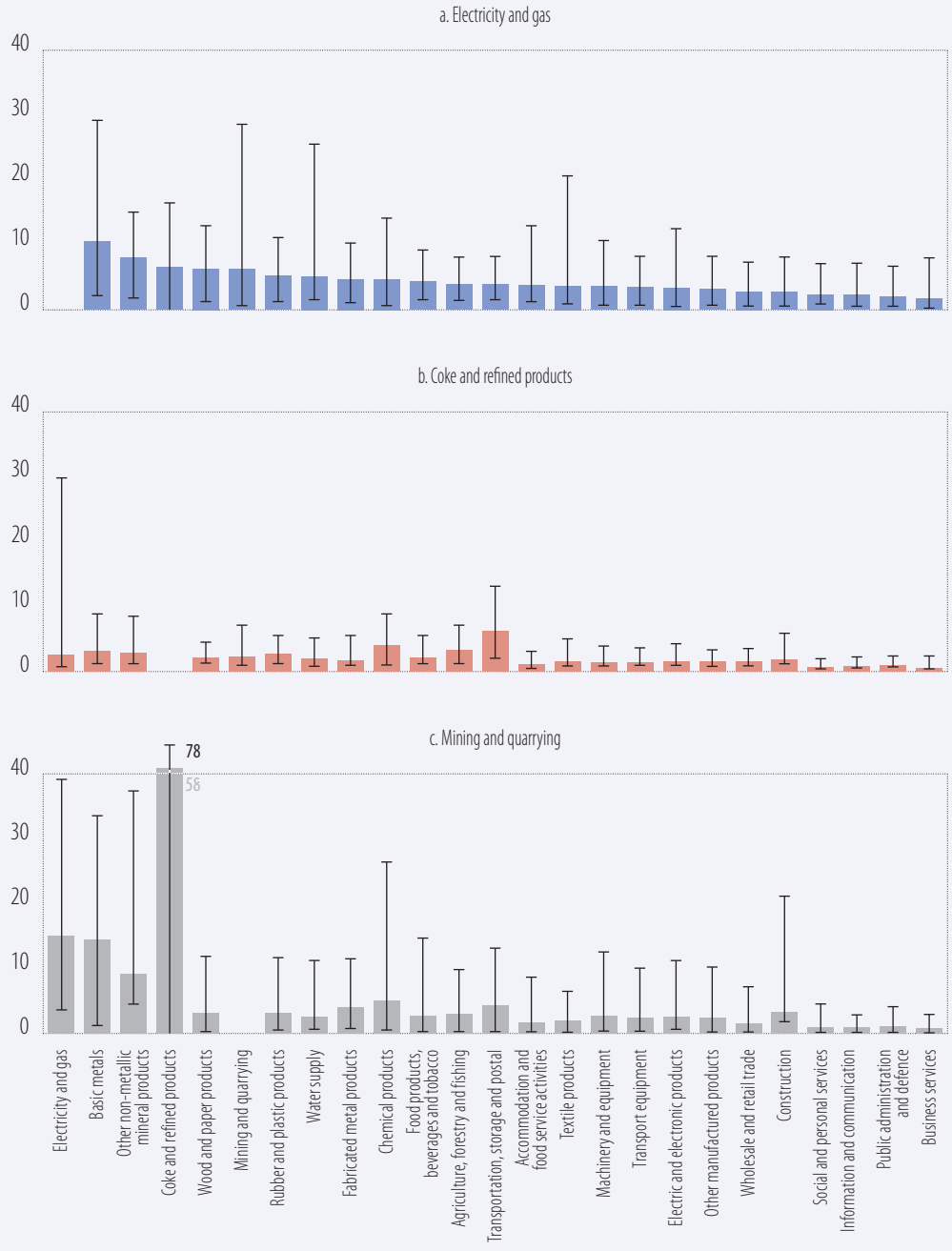
Linkages are multipliers that are estimated within an input-output framework to show a sector's relationship as a supplier (intermediate products) vs. as a customer (inputs) with respect to other producers in the market. When compared against all other sectors, a single sector's importance in the whole economy can be determined based on its input and output with the other sectors. It can also be determined how connected the sector is to downstream or upstream suppliers. These linkages can be defined as first-round (direct only) and/or second-round (direct or indirect) economy-wide effects induced by the sector's final demand or supply.

The input-output tables compiled by the Organisation for Co-operation and Development (OECD, 2021) show that among the energy sectors, electricity and gas are particularly relevant for energy-intensive industries and countries. The mining and quarrying sector is an important supplier for the

oil sector, which in turn largely feeds the electricity generation of non-interconnected islands (such as Cyprus) and the transportation sector. By contrast, most sectors — including basic metals, water supply, mining and quarrying and the manufacturing industries in general — tend to rely more heavily on energy and electricity for production (Figure A.1). Among EU members, the electricity and gas sectors' input is less pronounced in the Nordic countries, including Sweden, Denmark and Finland.

Figure A.1

Direct and indirect inputs for the production of various energy sectors (in %)



Source: *Estimation based on OECD (2021) input-output tables (see Kalantzis and Musto, 2022).*
Note: *The total impact (Leontief coefficients) are derived from input-output tables. The error bar represents the range of the impact across European countries.*

After the linkages of all economic sectors are normalised using the above classification, the sectors with the strongest economic impact can be identified. The linkages are normalised by the average of all domestic sectors, to capture the overall economic implications. Specifically, when normalised by the average forward and backward linkages in each economy, a value greater than one for both types of linkages indicates a "key" sector for the economy overall (Table A.1). A shock to such a sector will generally cause larger-than-average disruptions to several industries, based on its connection with the rest of the economy. If only the normalised backward value is greater than one, then the sector depends on other sectors' supplies, whereas if only the normalised forward value is greater than one, then the sector depends on other sectors' demand for its output.

Table A.1

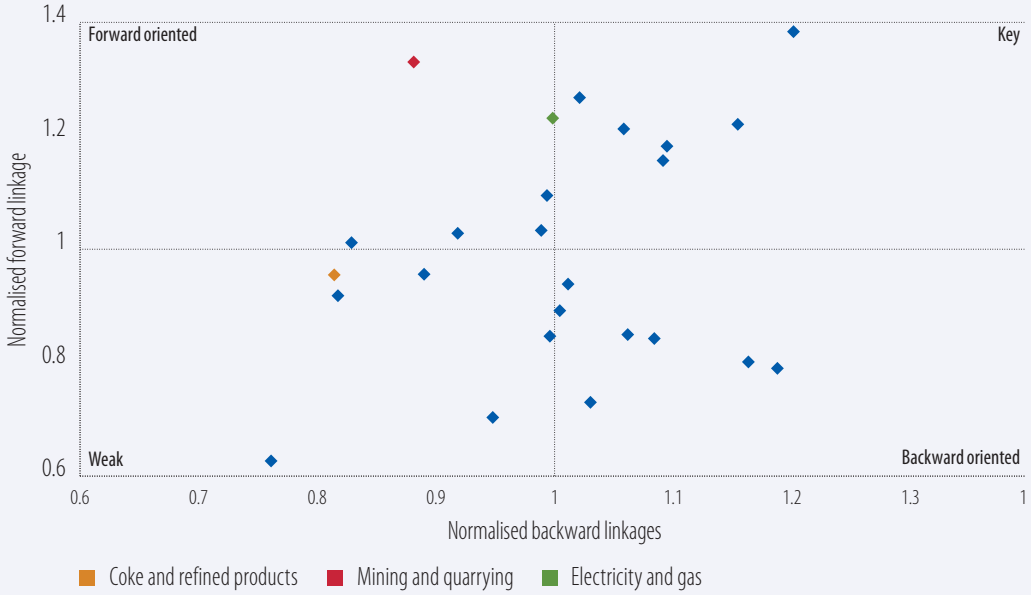
Classification of sectors according to network linkages

		Forward linkage	
		Low (<1)	High (>1)
Backward linkage	Low (<1)	Weak	Forward oriented
	High (>1)	Backward oriented	Key

Source: Miller and Blair (2009).

Figure A.2

Normalised linkages of selected European sectors



Source: Estimation based on OECD (2021) input-output tables (see Kalantzis and Musto, 2022).
Note: The blue diamonds represent other sectors (including basic metals, chemicals etc.), as specified in Figure A.1.

Looking at energy sectors alone, electricity and gas generally appear to be interconnected upstream and downstream (meaning that electricity and gas markets are important suppliers and customers of other sectors) with normalised forward and backward linkages well above one (Figure A.2). This implies that changes in these sectors' demand and supply could heavily influence the broader European economy. Coal is placed in the lower-left quadrant, with normalised forward linkages above one and backward linkages below one. Coal, therefore, could be viewed as a major supplier of the European economy, and as highly dependent on intersectoral demand. By contrast, oil has normalised linkages below one, and thus appears to be generally independent of energy sectors upstream and downstream. This implies that changes in oil have less of an impact on the rest of

the European economy. Finally, the key sector quadrant in Figure A.2 shows that sectors outside of energy could have major implications for the European economy. These effects are estimated at a European level, and they may change across EU members whose economies are structured differently.

Coordinated measures to break the European Union's dependence on Russian energy

Since the crisis erupted, European policymakers have been working on a plan to thwart the impact of a cut in supplies of Russian gas and oil. On 18 May 2022, the European Commission presented REPowerEU, a plan to rapidly reduce reliance on Russian fossil fuels and speed up the green transition. The aim is twofold: first, to end Europe's reliance on Russian fossil fuel imports by 2027, with an interim target of replacing two-thirds of Russian gas consumed by the end of 2022; second, to ensure a secure energy supply and access to affordable energy, and to promote long-term sustainability goals by slowly ending the long-standing relationship with Russia.

This package was complemented by several other regulations to enhance the security of energy supplies and to address the negative consequence of the crisis on European economies. For example, a new regulation (2022/1032) on gas storage was imposed before the winter of 2022, accompanied by a voluntary commitment (2022/1369) from all EU members to reduce their gas consumption by at least 15% in the same period. At the same time, a political agreement (2022/1854) was reached to tackle high energy prices by capping the windfall profits of specific electricity generators and fossil fuel companies and by using these funds to counter the negative implications of the recent revision of greenhouse gas reduction targets.

Box B

Beating the energy crisis — an overview of the REPowerEU package

The REPowerEU package includes several short- and long-term objectives and measures, structured across three main pillars. The first is to reduce demand for fossil fuels. The second is to diversify energy supply routes and reinforce of existing infrastructure. The third is fostering a faster transition to renewable energy, including hydrogen. The range of measures seeks to change behaviours across energy markets (Table B.1). For example, individuals are expected to do their part by consuming less energy. EU members are expected to adopt more climate-friendly policies and enhance coordination with one another, and the European Union is expected to adopt more ambitious climate targets and strengthen its negotiating power and collaboration with non-EU countries.

In the short-to medium run, reorienting natural gas imports is more challenging than reorienting oil and coal imports. This is due to different needs in supply infrastructure, transportation and storage. While part of the long-term solution lies in promoting renewable energy sources and energy efficiency savings (Figure B.1), the European Union will still need large volumes of natural gas imports in the short and medium term. It is therefore important to diversify gas supplies in the short run, for example by encouraging imports from non-Russian suppliers and by increasing the use of liquified natural gas.

According to the European Commission's analysis, REPowerEU will require additional investment of EUR 300 billion by 2030, compared to the approximately EUR 100 billion the European Union currently spends on Russian energy imports each year. This investment is on top of an additional estimated EUR 390 billion per year needed to deliver the European Green Deal, including meeting Fit for 55 objectives. More than two-thirds of the money should be invested by 2027, and the bulk will go to projects that accelerate the transition to renewable energy and energy savings. Only a small percentage will be allocated to fossil fuel infrastructure (Figure B.2). These investments are expected to be financed by a mix of national and EU funding sources, including private funding. For this purpose, the Recovery and Resilience Facility, which supports Europe's pandemic recovery, will provide EUR 225 billion in loans, with the remainder covered by grants.

Table B.1

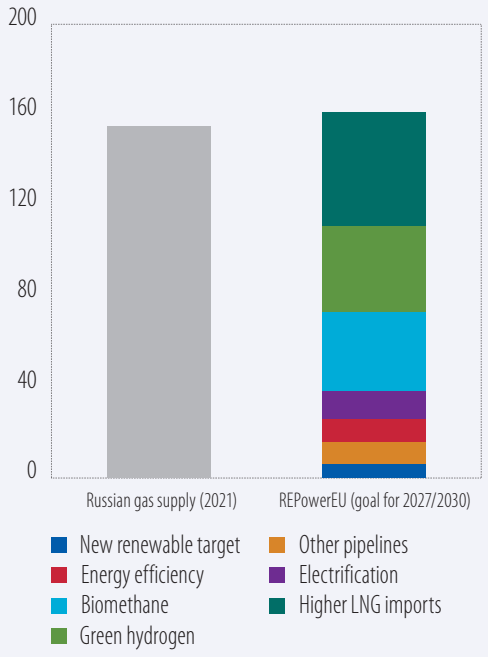
Mapping the level of intervention based on the REPowerEU package

Individuals	Member States	EU wide	Third partners
Eco-design and energy labelling information	Guidance on national energy and climate plans, power purchase agreements, state aid, and the prioritisation of non-protected customers	Energy efficiency directive target for 2030 increased to 13% from 9%	EU external energy engagement strategy
European Solar Rooftops Initiative	EU recommendation on permitting corresponding high-level summits and country-specific recommendations	Renewable energy directive target for 2030 increased to 45% from 40%	EU energy platform for pooled purchase of gas, liquid natural gas and hydrogen
EU Save Energy communication	Designation of "go-to" areas for renewable energy infrastructure development	Solar strategy targeting 320 GW of solar photovoltaic energy by 2025 and 600 GW by 2030	Emergency synchronisation of third countries to the EU electricity grid
	Guidance on application of recovery and resilience plans	Complete the legislation for the production of hydrogen from renewable sources	Global European Hydrogen Facility
	Update of emergency and risk preparedness plans	Progress report on hydrogen uptake	Engagement on critical raw materials with third countries
		35 billion m^3 of biomethane production by 2028	
		EU Solar Photovoltaic Industry Alliance	
		A coordinated EU plan for the curtailment of industry	

Source: Conti and Kneebone (2022).

Figure B.1

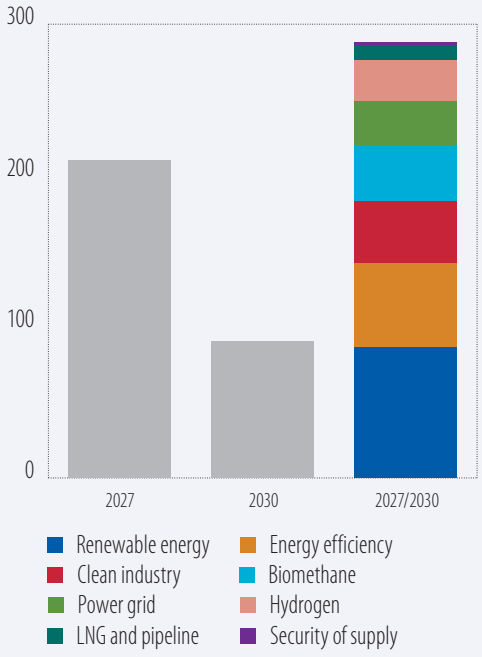
EU plans to substitute Russian gas
(billion m^3/year)



Source: EIB staff estimates based on REPowerEU.

Figure B.2

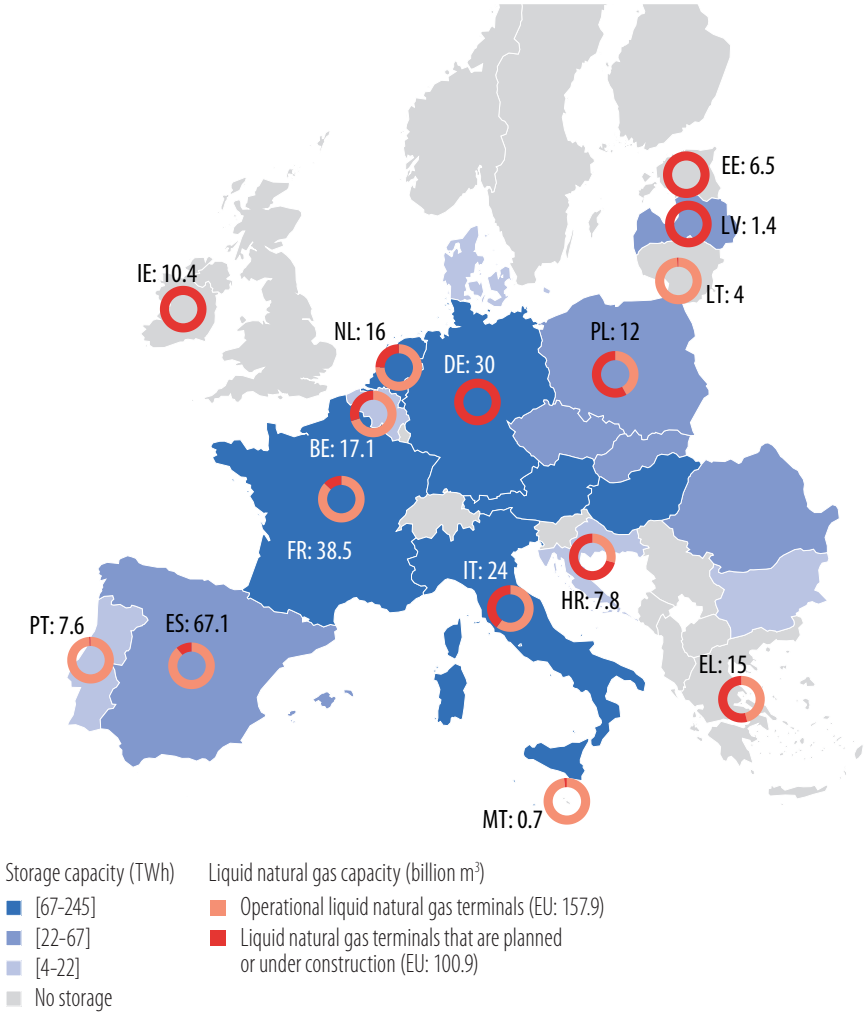
Investment needs of REPowerEU
(EUR billion)



Source: EIB staff estimates based on REPowerEU.

Ramping up the capacity of liquified natural gas terminals is central to Europe's energy response. The main advantage of liquified natural gas over pipeline gas is that it can be easily imported from a wide range of countries, and so enhances the security of supply. The main disadvantage of liquified natural gas is that supplies are often more costly, and also raise some environmental concerns because of the emissions from transportation and regasification, or the process of converting liquified natural gas to pipeline gas. In addition, specific infrastructure must be built so that the gas can be received and regasified before entering the pipeline network.

Figure 11
Storage (TWh) **and LNG capacity** (billion m^3) **in the European Union**



Source: *Bruegel, ENTSO-G.*

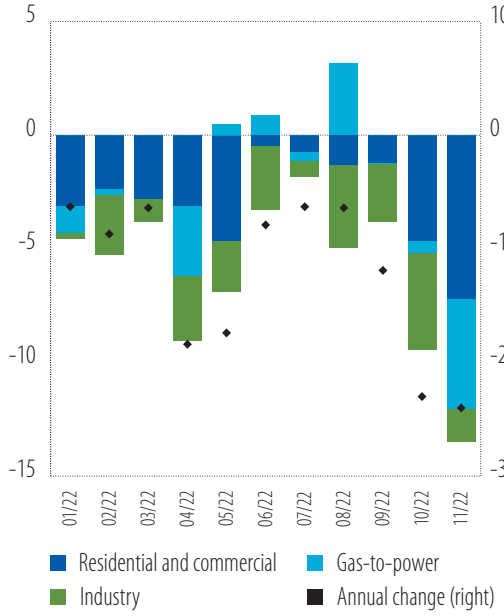
Liquified natural gas capacity is unevenly distributed across the European Union and pipeline connections are weak, while coordination between EU countries remains challenging for security reasons. The European Union has a total annual capacity to receive and regasify 158 billion m^3 of liquified natural gas per year, with more than 100 billion m^3 of new projects either planned or under construction (Figure 11). Some EU members, even large ones such as Germany, are currently building infrastructure to import liquified natural gas. Around 37% (60 billion m^3) of the European Union's total capacity is located in Spain, which has limited pipeline connections to France and the rest of Europe. Other major liquified natural gas importers within the European Union are France (33 billion m^3), Italy (15 billion m^3), the Netherlands (12 billion m^3) and Belgium (11 billion m^3). Liquified natural gas capacity is lower in Eastern

and Southeastern Europe, the areas most dependent on Russian gas. To counter the energy shock and ensure access for all countries, a process for rapid investment in infrastructure connections has been developed so that no country will be isolated in the event a shortfall in Russian supply.

However, these steps alone will not be enough to replace deliveries from Russia in the short run. That is why the European Union is also attempting to ensure that all underground gas storage facilities are filled to at least 80% by November 2022 (and 90% in the following years). So far, the data shows that Europe is on track[6], but challenges remain. Total EU gas storage capacity is around 114 billion m^3 (Figure 11), much lower than overall annual gas imports from Russia, which are 155 billion m^3. Even worse, like liquified natural gas transport capacity, storage capacity is not evenly distributed across the European Union. Five countries account for almost three-quarters of the total (Germany, Italy, France, the Netherlands and Austria), while around one-third of smaller EU countries have no storage capacity of their own (although some have arrangements to access gas stored in neighbouring countries).

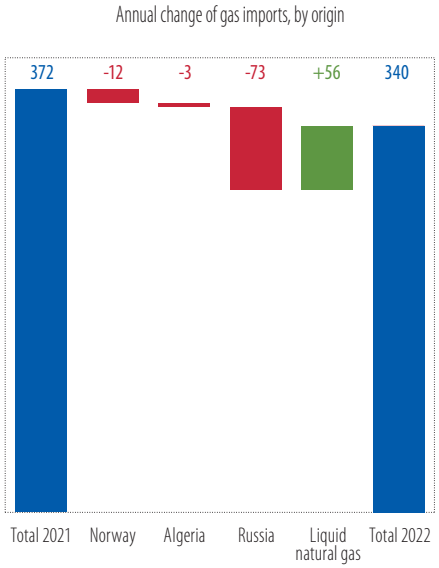
The good news is that energy savings — the quickest and the cheapest way to tackle the current energy crisis, according to Europe's plan — are taking centre stage. According to the most recent data (Figure 12), Europe's natural gas demand declined by almost 25% in November 2022, a new record. Most of these savings come from the power sector and households, and to a lesser extent from industry. Among EU members, the savings achieved in the Nordic countries and the Baltics stand out.

Figure 12
Gas demand reductions, 2021-2022
(left: billion m^3; right: in %)



Source: *IEA.*

Figure 13
Change in European and UK gas imports, 2021-2022
(million m^3)



Source: *Bruegel.*

6 The plan also suggests measures to address energy pricing (taxes on windfall profits, price regulation and state aid) and gas storage (storage obligations, coordinated gas refilling and investigations into operators' behaviour).

Another positive development is that, after years of Russian dominance of fossil fuel imports to Europe, new energy trade partners are now emerging. As Russian imports shrank throughout 2022 (Figure 13), EU countries signed bilateral deals with new trading partners, including the United States, Algeria, Egypt and Azerbaijan. Joint purchase agreements were forged in the autumn of 2022 to better coordinate the crisis response at the EU level, allocate available resources more efficiently to EU members and preserve the integrity of the single market.

The corporate sector faces twin climate and energy challenges

The turmoil in the energy markets underscores the need for further investment in clean energy technologies, with far-reaching benefits for sustainability, security of supply and affordability. This section investigates how firms are responding to the twin climate and energy challenges based on EIBIS results. Findings show that firms are engaging in climate action to maintain competitiveness amid high energy prices, but that growing uncertainty remains a fundamental challenge to investment. Firms' characteristics and degree of climate awareness play a key role in their willingness to invest in adaptation and mitigation measures.

Corporate investment in climate is set to grow despite persistent challenges

Energy market disruptions, combined with soaring prices in the wake of the war in Ukraine and following the pandemic, are challenging European businesses. Russia's invasion of Ukraine and the consequent reduction in energy supplies to Europe are influencing the European Union's transition to a net-zero carbon economy by 2050. Plans to reduce reliance on fossil fuels could speed up the climate transition. However, climate goals could be undermined by the temporary switch many EU countries have chosen to make to carbon-emitting fuels, such as coal, in reaction to immediate energy security issues and soaring energy prices.

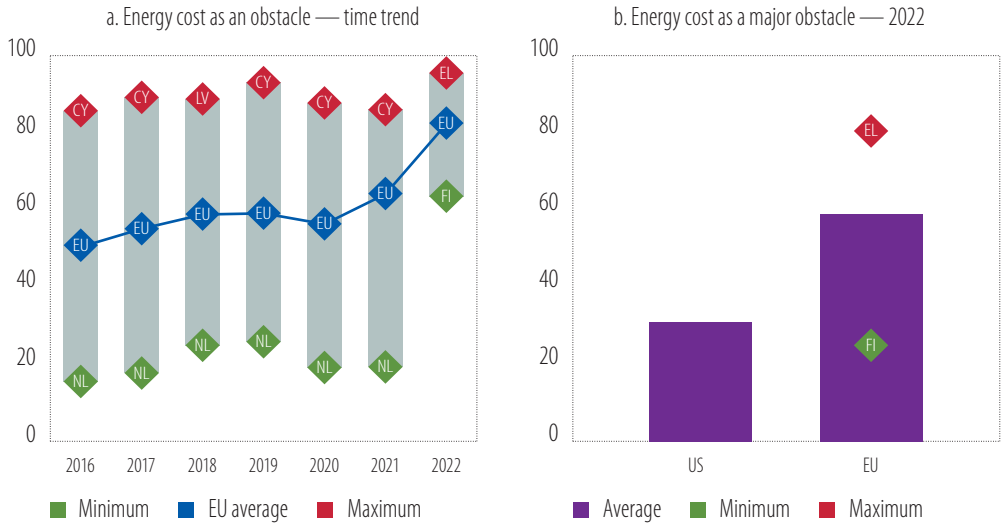
Amid growing uncertainty, the share of firms that see rising energy costs as a constraint to their investment skyrocketed in 2022. According to EIBIS data, the perception that energy costs were stymying investment has increased over the years, and especially after 2020 (Figure 14). In 2022, 58% of European firms said energy costs were a major impediment to investment — almost 20 percentage points above US firms, implying that the energy crisis is playing out differently across the Atlantic. The growing concerns appear across European countries, with the upper end of the spectrum almost always marked by Cyprus and the lower by the Netherlands. The range of responses across Europe shrank considerably in 2022, indicating the ubiquitous nature of the energy shock.

Higher energy costs influence firms' decision to invest — and their investment focus. On the one hand, high energy prices result in higher production costs, reducing output and spurring downsizing, which negatively affects investment decisions. On the other hand, higher energy prices can also push firms to modernise their operations, using capital to replace old equipment and renovate buildings. This modernisation effect has an ambiguous impact on overall investment, as spending on energy-efficient technologies crowds out investments not related to energy.

EIBIS 2022 shows that the share of firms engaging in climate action rebounded after stalling in the previous year. Some 51% of firms have already invested in climate action, of which 8% invested for the first time in 2022. A similar share (51%) is also planning to invest in the future. This figure has risen constantly since 2020 (41%), implying that green investments are becoming essential to competitiveness (Figure 15). Nevertheless, the European Union-wide figures mask great heterogeneity across countries, which appeared to widen in 2022, especially for those firms that have invested in climate action.

Figure 14

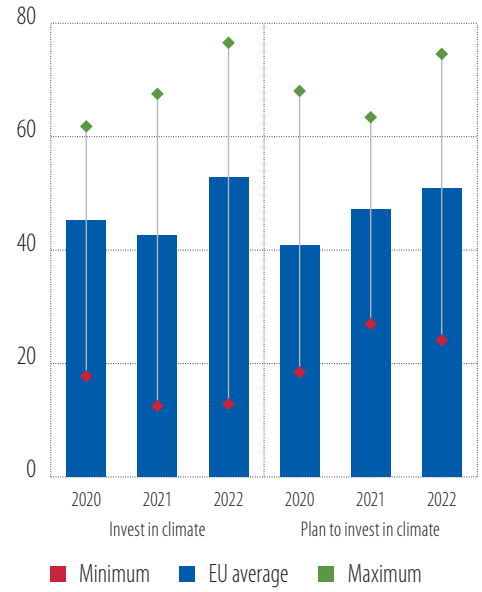
Share of firms (in %) **considering energy cost to be an obstacle to investment**



Source: *EIBIS 2016-2022.*
Note: *The chart on the left represents the share of firms saying that energy cost is a major and minor obstacle, whereas the chart on the right represents firms saying energy cost is a major obstacle.*
Question: *Thinking about your investment activities, to what extent is energy cost a major, minor or not an obstacle?*

Figure 15

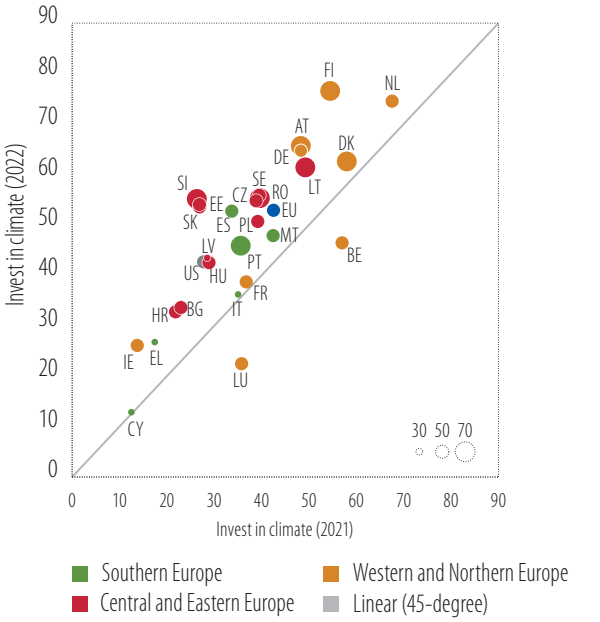
Share of firms (in %) **investing in climate or planning to invest**



Source: *EIBIS 2020-2022.*
Note: *The graph represents the EU average and the maximum and minimum across EU countries.*
Question: *Thinking about investments to tackle the impacts of weather events and to deal with the process of reduction in carbon emissions, which of the following applies?*

Figure 16

Comparison of firms (in %) **that have invested in 2022 vs. 2021, with those that plan to invest in 2022** (bubble size)

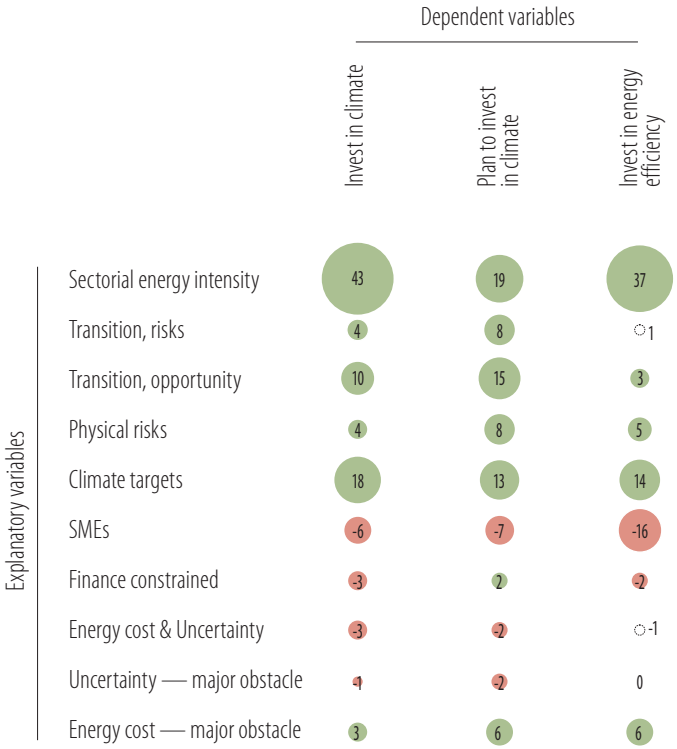


Source: *Bruegel.*
Note: *The bubble sizes represent the percent of firms planning to invest.*

Firms in Western and Northern Europe are at the forefront, while those in some Central European countries are catching up. Climate investment in these two regions is gaining momentum, with a high share of firms planning to continue investing (Figure 16). By contrast, firms in certain countries (including Cyprus, Greece, Ireland and Luxembourg) constantly lag behind, and also show little interest in investing in climate in the next three years.

As the energy crisis unfolds, it raises questions about climate investment's resilience to the shock. Interesting evidence emerges from an analysis of firms' investments in energy efficiency and their ability to cope with climate change. The empirical analysis (Figure 17) shows that energy cost concerns positively influence investment decisions on climate action. However, the data show that increasing uncertainty might outweigh or cancel out the incentive to engage in climate action (including energy efficiency). How these two investment obstacles — uncertainty and high prices — interact is relevant in the current context. To some extent, uncertainty prevails over energy cost concerns, leading to reduced investment. The effect of credit constraints, which are increasing because of the crisis, is also relevant. The analysis shows that firms affected by credit constraints are less likely to engage in climate action. On a more structural level, the analysis finds that small and mid-sized enterprises (SMEs) are less likely to invest in energy efficiency and climate action. Climate change awareness is also important, with firms more likely to invest if they have climate targets, have been affected by extreme weather or perceive that the transition to a low-carbon future will impact their businesses.

Figure 17
Likelihood of adopting greener profiles (in percentage points)



Source: *EIB staff estimates.*
Note: *The graph presents the estimated average marginal effect of several factors, based on logistic regression with robust standard errors. The dependent variables are in columns and the explanatory variables are in rows. All dependent variables are binary, based on firms' answers to the related questions. Regression controls include the fixed effects for countries and sectors. Sectorial energy intensity represents estimates of the total importance of energy sectors in 13 selected sectors based on the OECD input-output country tables. Other explanatory variables represent whether the firm has invested in climate, plans to do so in the next three years, invests in energy efficiency, views energy cost and uncertainty about the future to be major investment impediments, sets climate targets, is finance constrained views the climate transition as a risk or opportunity, was affected by physical risks, and is an SME or large firm. The colours green and red represent positive and negative coefficients that are statistically significant, at least at 10%. No colour indicates that the coefficient is not statistically significant at least at 10%.*

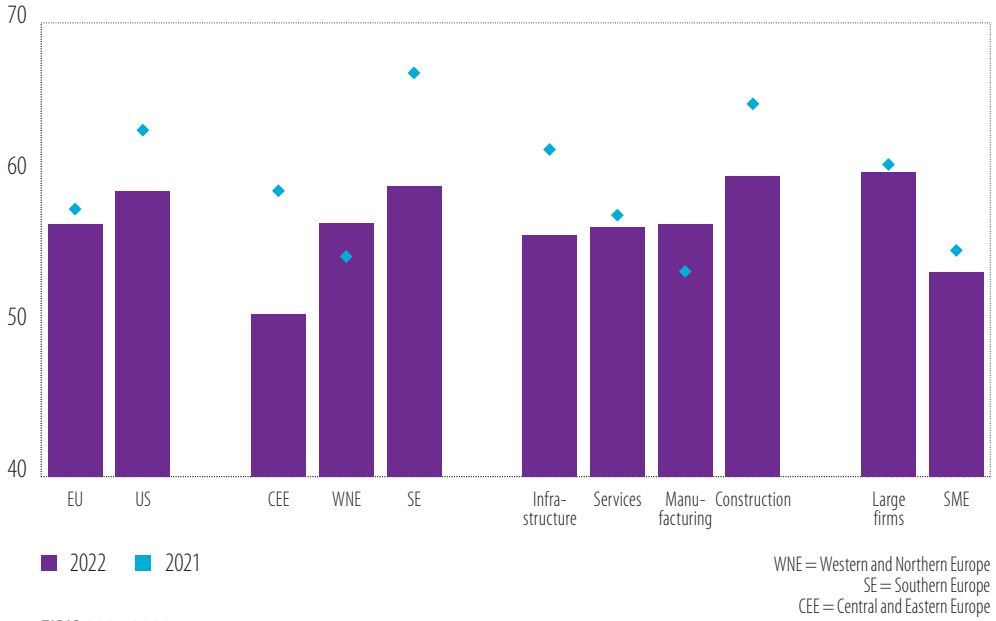
The energy crisis is creating promising investment opportunities

The ongoing energy crisis presents an opportunity for the private sector to accelerate its green plans and position itself at the forefront of the fight against climate change. Firms have a crucial role to play in tackling the climate emergency and in addressing the associated climate change risks. For some, extreme weather events and changes in weather patterns have already proved detrimental. In parallel, the impact of immediate decarbonisation measures (transition risks) is now spreading widely to all industries, not just carbon-intensive ones. While in the past many companies overlooked the array of pressing climate risks they faced, they are realising that understanding these risks is the only way to protect their business, and they are identifying ways to compete in a carbon-neutral economy.

Climate change risks are no longer a distant reality

In 2022, extreme weather events across the globe led to loss of life and large-scale economic damage. Heatwaves, forest fires and a persistent drought in several European regions in the summer of 2022 had dire consequences for a number of industries, from agriculture to transportation. The scientific community warns that climate change will increase the frequency of these kinds of events. European companies must act swiftly if they are to meet the challenge.

Figure 18
Share of firms (in %) **affected by physical climate risks**

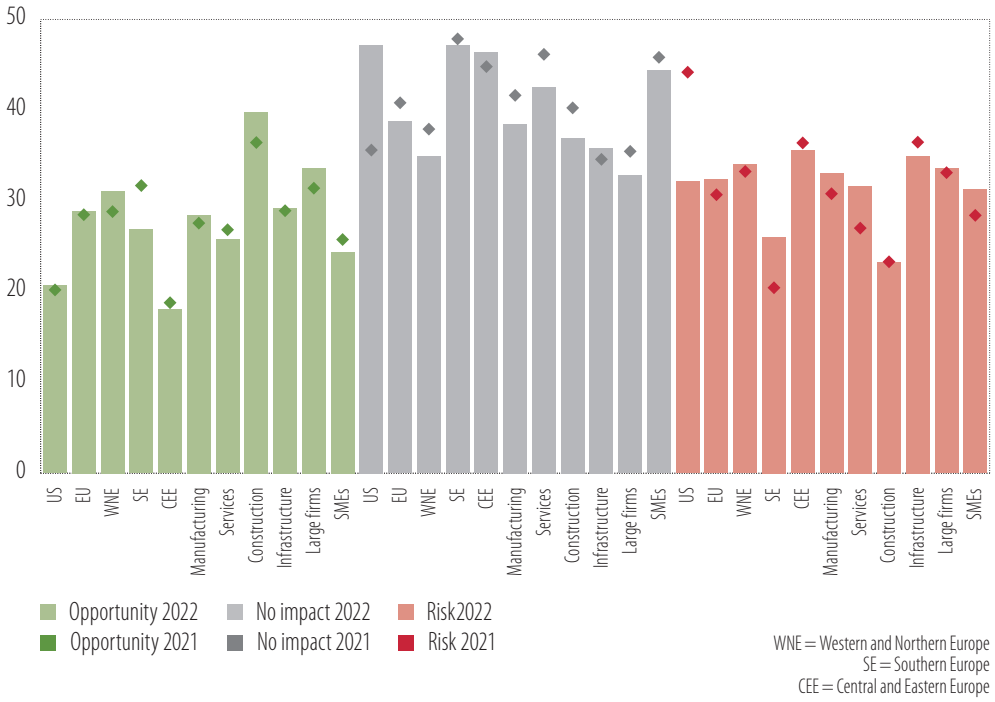


Source: *EIBIS 2021-2022.*
Question: *Thinking about climate change and the related changes in weather patterns, would you say these weather events currently have an impact on your business?*

A large swathe of European firms is aware of the risks climate change poses. The share of companies that perceive themselves as at risk is broadly similar in the European Union, 57%, and the United States, 59% (Figure 18). However, more companies in Europe (17%) report being extremely affected by climate change than in the United States (13%). In Southern Europe, indicators for vulnerability to global warming — as measured by location, exposure to extreme weather events and inability to cope with their consequences — are higher than on the rest of the continent. This is reflected in businesses' high awareness of the issue — 64% of firms in Portugal, for example. This awareness is understandable given

the persistent wildfires Portugal endured during the hot and dry summer of 2022. At the same time, Central and Eastern European countries also appear to feel more vulnerable, although the perception of climate change risks in this region is lower (apart from Romania).

Figure 19
Impact of the energy transition on firms (in %)



Source: *EIBIS 2021-2022.*
Question: *Thinking about your company, what impact do you expect this transition to stricter climate standards and regulations will have on your company over the next five years?*

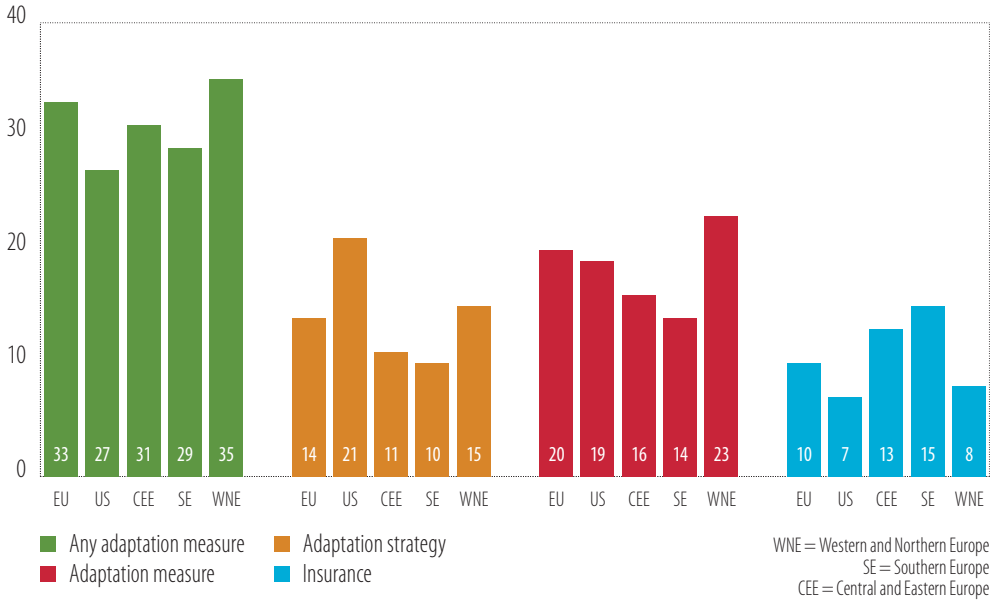
European firms' perceptions of transition risks remained broadly stable from last year, whereas firms in the United States have become less concerned about the transition's negative impact. Firms in Central and Eastern Europe continued to feel that the transition to a low-carbon future poses risks, while those in Western and Northern Europe see opportunity (Figure 19). Among European sectors, firms in construction have positive views overall, as they did last year, while a higher share of firms in the remaining sectors see the transition as a risk rather than an opportunity to be seized.

Wide variation in responses to the climate emergency across Europe

Attitudes towards adaptation measures differ between EU members, with countries in Western and Northern Europe pursuing more active strategies. EIBIS 2022 data reveal that, at the European level, 33% of firms have taken at least one action towards adaptation (Figure 20). However, this is much lower than the share of firms reporting that their business had been affected by physical risks. Despite worrying about the physical risks of climate change, firms may feel that the problem needs to be dealt with more broadly by government and not simply by their individual actions.

One-fifth of firms in the United States claimed to have an adaptation strategy, compared to 14% in the European Union (Figure 20). However, European firms invested more in reducing their exposure and offsetting climate-related losses through insurance products. Firms' adoption of active measures seems to go hand-in-hand with the existence of an adaptation strategy.

Figure 20
Firm (in %) **investing in specific adaptation measures**



Source: *EIBIS 2022.*
Question: *Has your company developed or invested in any of the following measures to build resilience to the physical risks to your company caused by climate change?*

Firms in most Western and Norther European countries were clearly oriented towards more active strategies. Some 23% of companies took steps to reduce their exposure to climate change risks, whereas 15% claimed to have an adaptation strategy. A larger share of companies in Southern Europe (15%) had bought insurance, following a passive adaptation strategy, instead of investing in measures to reduce their exposure to direct physical risks. Central and Eastern Europe followed a similar pattern, although more companies in that region acted to reduce exposure than to insure against climate risks (16% vs. 13%).

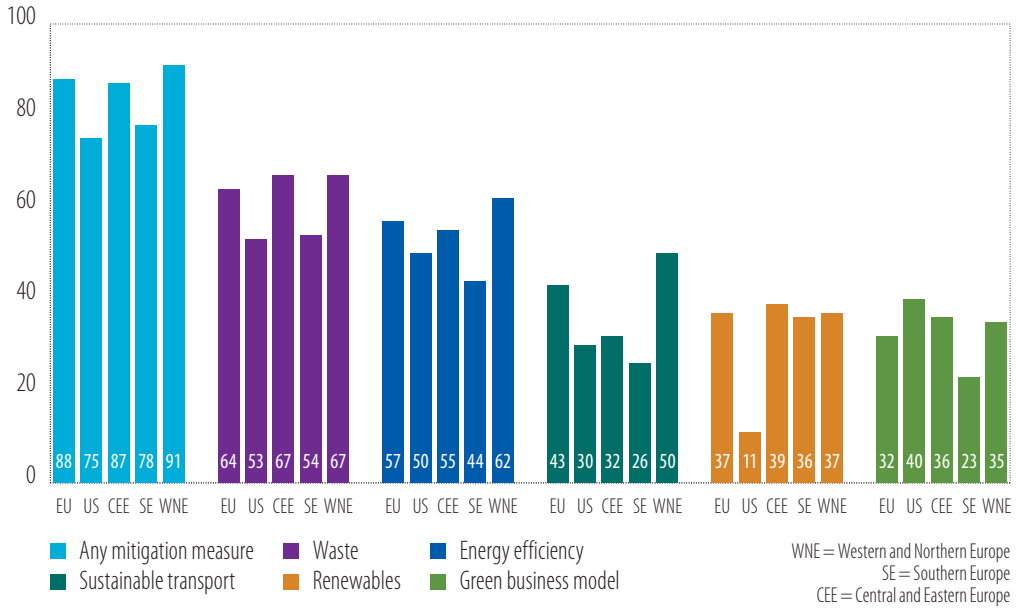
Turning to investment in climate change mitigation in Europe, 88% of firms have taken at least one action to reduce their carbon footprint. The majority of firms are taking action to invest in waste minimisation or energy efficiency (Figure 21). Interestingly, 32% of firms are considering changing their production and business models to shift the business towards less polluting activities — a sign of radical transformation of firms' behaviour. This strategy is more likely to be pursued in Central and Eastern Europe and in Western and Northern Europe, and less likely in Southern Europe.

Engagement in climate change mitigation also appears to follow a regional divide. Western and Northern European countries lead the way, with only 9% of all companies saying they are not pursuing any of the five mitigation measures proposed in the EIBIS. Investment in sustainable transport is one of the top mitigation measures chosen, with about half of all companies pursuing it (more than in other regions). Central and Eastern Europe follow suit, with only 13% of companies not investing in at least one of the five measures (a result largely driven by Romania, where the share reaches 23%). Finally, Southern Europe lags behind, with the highest share of companies deciding not to invest in mitigation (22%) or investing in only one measure (28%).

Through investment in climate change adaptation and mitigation, the corporate sector can and must play a key role in the climate transition. Businesses are an important economic engine. They bring growth, drive innovation in technologies and influence consumption choices. Their actions to address climate change will benefit society at large. Their level of activity, however, depends partly on their size. A greater share of larger firms, 18%, had adopted an adaptation strategy in 2022, compared with just 10% of small and medium firms. Small businesses also have the largest share, 18%, that did not implement any

mitigation measures at all in 2022. That figure drops to 5% for other firms. Public policies to encourage climate change adaptation and mitigation need to include small and medium firms, which account for more than half of the EU economy.

Figure 21
Firms (in %) **investing in specific mitigation measures**



Source: *EIBIS 2022.*
Question: *Is your company investing or implementing any of the following to reduce greenhouse gas (GHG) emissions?*

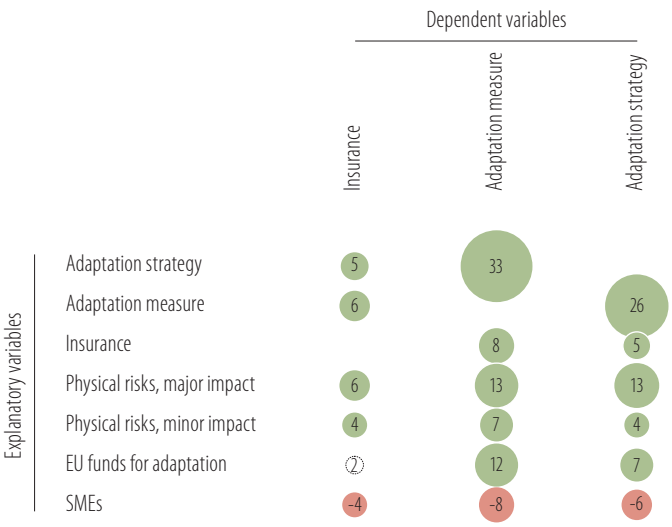
Firm characteristics and their climate awareness influence investment

Adaptation choices depend on firm characteristics and their awareness of climate change risks. The EIBIS 2022 shows that firms with an adaptation strategy are more likely to implement specific measures to address climate change (Figure 22). The likelihood that these firms will buy insurance (a more passive approach to adaptation) is less closely tied to having an adaptation strategy, but still positively correlated. Firms' awareness of physical risks posed by climate change also determines the kinds of adaptation measures they choose to implement. Firms that say physical risk is a major concern, rather than a minor one, are twice as likely to take action. Firms that are experiencing major climate change effects tend to employ active strategies rather than passive ones. The availability of EU funds also plays a role. Firms are more likely to adopt active strategies (have a strategy in place or implement adaptation measures) when these funds are available. On a more structural level, small businesses are far less likely than other firms to implement measures to protect themselves against the physical risks of climate change.

The specific mitigation measures a firm pursues reflect its climate objectives and level of ambition. The scope of a firm's transition to a low-carbon economy determines just how much adjustment is required (Kalantzis et al., 2022) or the extent to which it will reduce its environmental impact (Figure 23). A firm may choose to implement multiple strategic measures at the same time, perhaps to different degrees. Therefore, a firm's mitigation strategy can be understood as the combination of mitigation measures it takes, possibly marked by distinct strategic preferences.[7]

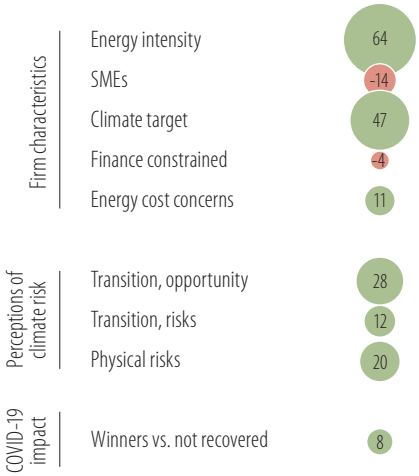
7 A first fundamental distinction between the mitigation measures sought by firms to reduce energy cost vs. to reduce carbon footprint was made by Thollander et al. (2007), and more recently by Kalantzis et al. (2022).

Figure 22
Likelihood of implementing specific adaptation measures (in percentage points)



Source: *EIB staff estimates.*
Note: *The graph presents the estimated average marginal effect of several factors, based on logistic regression with robust standard errors. The dependent variable is a binary variable indicating whether or not a firm has adopted the specific adaptation option — for example, having an adaptation strategy, implementing adaptation measures or buying insurance. Regression controls include the fixed effects for countries and sectors. EU funds for adaptation represents the allocation of EU funds to countries for adaptation purposes. For definitions of the remaining variables, please see the notes of Figure 17. The colours green and red represent positive and negative coefficients that are statistically significant, at least at 10%. No colour indicates that the coefficient is not statistically significant at least at 10%.*

Figure 23
Likelihood of implementing more mitigation measures (in percentage points)



Source: *EIB staff estimates.*
Note: *The graph presents estimated average marginal effect of several factors, based on count outcome (poisson) regression with robust standard errors. The dependent variable represents how many mitigation measures a firm has adopted. Regression controls include the fixed effects for countries and sectors. Peer effects have been calculated based on the leave-one-out formula. The rest of the variables have been defined in Figure 17 and 22. The colours green and red represent positive and negative coefficients that are statistically significant, at least at 10%. No colour indicates that the coefficient is not statistically significant at least at 10%.*

A firm's decision to take action on climate change can be influenced by its history and culture, core competencies and the competitive environment, along with prevailing market and economic conditions. The EIBIS 2022 shows that, all other things being equal, each additional unit (percentage point) in the energy intensity of the sector in which a firm operates (Figure 23) increases its likelihood of being greener (implementing more green measures) by 64%.[8] Similarly, firms that set climate targets are 47% more active than those without them. Firms that acknowledge climate change effects are also greener. For example, those that see the transition as an opportunity are 28% more likely to invest in green measures. This impact drops to 12% for firms that perceive the transition as a risk, and to 20% for firms affected by the physical risks. At the same time, firms that have not recovered from the pandemic

8 The increase per numerical quantity of measures is calculated at a compounding rate so that the effect is no greater than one.

invest less in green measures — by 8% — than firms considered to be pandemic "winners." Firms that view the cost of energy as an investment obstacle are 11% keener to invest in green measures than those that do not have these concerns. Firms with credit constraints are about 4% less green than those without, and small businesses are about 14% less green than large firms.

Figure 24
Likelihood of adopting specific mitigation measures (in percentage points)

Source: *EIB staff estimates.*
Note: *The graph presents estimated average marginal effect of several factors, based on logistic regression with robust standard errors. The dependent variable is a binary variable indicating whether a firm has adopted the specific mitigation measure. Regression controls include the fixed effects for countries and sectors. Peer effects have been calculated based on the leave-one-out formula. The rest of the variables have been defined in Figure 17 and 22. The colours green and red represent positive and negative coefficients that are statistically significant, at least at 10%. No colour indicates that the coefficient is not statistically significant at least at 10%.*

A firm's specific situation influences the green measures adopted, although the importance differs from measure to measure (Figure 24). For example, firms with energy cost concerns are 9 percentage points more likely to invest in energy efficiency — almost twice as much as for other mitigation measures, like renewable energy. This highlights the importance of energy efficiency measures in controlling energy costs. Finance constraints appear more relevant for firms considering investment in sustainable transport (a capital-intensive activity). Climate targets are more strongly linked with firms investing in new, less polluting products and services, energy efficiency and sustainable transport. It is likely that firms consider these measures to be the most effective in reducing their carbon footprint. Another interesting finding is that the pandemic "winners" are more likely to invest in renewable energy and in less polluting products and services. Finally, for all mitigation measures except sustainable transport, firms' decisions to invest are positively correlated with the strategies of their peers in the same sector or region, implying that most firms make an effort not to lag behind their peers.

Financial mechanisms to support climate strategies

Finance plays a pivotal role in mobilising capital for green investment and making the European economy more sustainable. This section investigates banks' role in financing green activities and discusses current trends for other financial mechanisms that implement climate initiatives. Findings suggest that the stability of the financial system and its capacity to fund the green transition are interlinked, and that financial instruments focusing on environmental, social and governance (ESG) measures are gaining momentum.

The financial system is a catalyst for green investment

With its key role in allocating resources, the financial system is instrumental for addressing climate change. Whether investors fund "green" or "brown" industries can affect the trajectory of carbon emissions. One strand of literature examines which financial system characteristics are conducive to reducing emissions. De Haas and Popov (2019) find that emissions are lower in economies with greater equity funding, as stock markets reallocate investment towards less polluting sectors and lead carbon-intensive sectors to transition towards greener technologies. Delis et al. (2019) find that banks did not price in climate risk before the approval of the Paris Agreement in 2015. A potential explanation is that banks use the securitisation market to shift climate risk off their balance sheet (Mueller et al., 2022). Market structure can also play a role. Evidence suggests that a more concentrated banking system in a given industry will make fewer loans to green firms, because they risk undermining the value of the bank's portfolio (Degryse et al., 2020).

Combining data from the EIBIS with financial statements taken from Moody's Analytics' BankFocus makes it possible to examine whether firms' climate-related investments are associated with the strength of bank balance sheets. EIBIS 2020 contained a range of questions on firms' climate mitigation activities. Specifically, it asked respondents whether they had already invested in climate or had plans to do so in the next three years. The survey elicited firms' views on obstacles to climate investment, such as whether they saw the availability of finance as an obstacle. For the empirical analysis reported below, data for each firm were combined with bank information. In this way, bank-specific features could be matched with the availability of green finance. Here, banks' return on average assets is taken as a measure of their profitability, and their ratio of non-performing loans to gross loans as a measure of asset quality.

Table 1

Climate investments and bank balance sheets

	Invest in climate	Invest in climate	Plan to invest in climate	Plan to invest in climate	Finance as obstacle to green investments	Finance as obstacle to green investments
Bank ROAA	1.303**		1.584**		-2.322***	
NPL ratio		-0.095		-0.438**		-0.146
Exporter	0.023	0.023	-0.017	-0.011	-0.016	-0.010
Young	-0.020	-0.025	0.015	0.014	0.039*	0.037
managerial practices in the firms	0.062***	0.061***	0.084***	0.079***	0.003	0.001
Observations	4 596	3 831	4 596	3 831	4 537	3 780
R-squared	0.111	0.105	0.076	0.082	0.100	0.103

Source: *EIBIS 2020 and BankFocus.*

Note: *Bank ROAA refers to bank's returns on average assets. NPL refers to non-performing loans. Young firms are less than ten years old. All regressions control for firm size, exporter status, age, management practices as measured by whether the firm uses a strategic business monitoring system, and control-sector fixed effects. Exporter is an indicator equal to one if the firm exports more than 10% of sales. Standard errors are clustered at the bank level. Statistical significance: *** p-value<0.01, ** p-value<0.05, * p-value<0.1.*

Banks with higher profitability and better asset quality are more likely to fund firms that invest in climate change mitigation and adaptation. Table 1 reports regression results that control for differences in firm size, exporter status, age and management practices (as measured by whether the firm uses a strategic business monitoring system). Columns 1 and 2 show that bank profitability is positively associated with green investment, while there is no such correlation with asset quality. Firms with strategic business monitoring systems are more likely to have implemented green investments at the time of the EIBIS interview. Columns 3 and 4 show that more profitable banks and banks with better asset quality are more likely to fund firms that plan future green investments. Moreover, firms that borrow from more profitable banks are less likely to view finance as an obstacle to green investment (column 5).

The results suggest that the stability of the financial system and its capacity to fund the green transition are interdependent. Alogoskoufis et al. (2021) document the impact of physical and transition risks on bank balance sheets. They also show that these risks are concentrated in banks with a comparatively low likelihood of being able to bear them. To the extent that these risks materialise, they weigh on the balance sheet of banks, especially those that are most vulnerable.[9]

ESG financial instruments are gaining momentum

To reduce greenhouse gas emissions 55% by 2030, compared to 1990 levels, Europe will need to invest an estimated EUR 390 billion more per year in the energy system than during the previous decade. On top of these additional investment needs, Europe will have to spend EUR 300 billion by 2030 to reduce its reliance on Russian energy imports. Public funds will continue to play an important role in unlocking private investment to support the energy transition, via existing programmes under national public investment schemes, NextGenerationEU and the multiannual financial framework.

However, the bulk of the necessary investments will have to come from private funds. Fortunately, sustainable finance activities have increased significantly over the last five years, quantitatively and qualitatively. Those activities range from green debt to equity fundraising for green-tech firms and technologies to mitigate or reverse the impact of human activity on the environment.

Most companies fund their climate strategies through a combination of approaches. The main options for financing firms' climate strategies include bank loans and international capital markets. For funds raised on international markets, firms can use a combination of financial instruments, including:

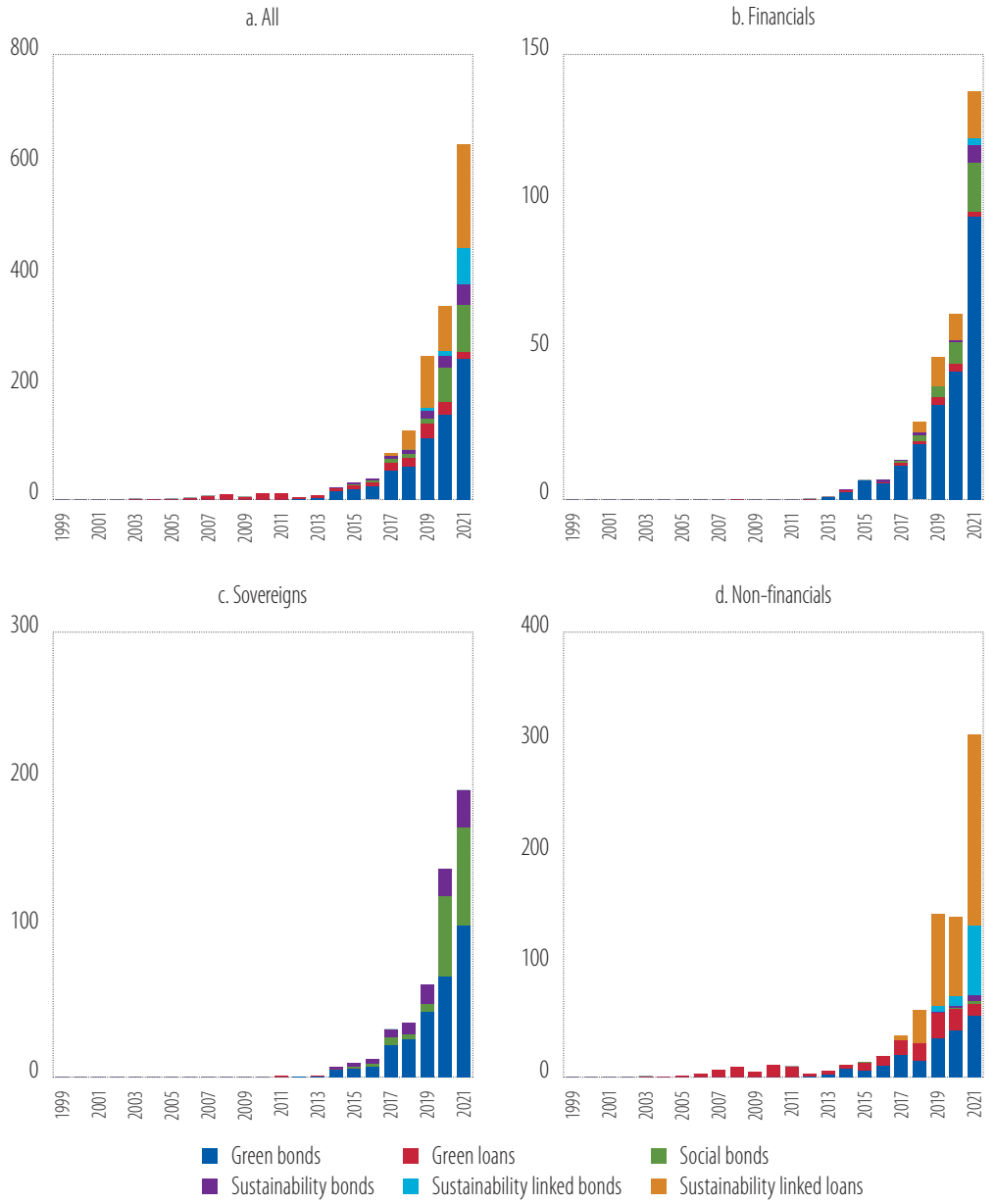
- **Green bonds/loans:** Proceeds from the bonds or loans fund green projects and activities that promote climate change mitigation or adaptation, or other environmental sustainability purposes.
- **Sustainability bonds:** Proceeds go to projects devoted to environmentally sustainable outcomes (eligible projects encompass a combination of green and social activities).
- **Social bonds:** Proceeds go to projects that directly promote social welfare and help underprivileged, low-income, marginalised, excluded or disadvantaged populations.
- **Sustainability-linked bonds:** Proceeds are generated by a bond whose terms are based on a company's (issuer/borrower) performance against predetermined sustainability targets, enhancing the corporate sustainability profile.

Global green bond issuance continued to break records in 2021 driven in part by pandemic bonds, a subset of social bonds. The green bond market more than doubled in 2021, reaching USD 1.7 trillion (from USD 810 billion the previous year). The green debt market has gradually snowballed, from a relatively slow start at its inception to an impressive average growth rate of 67% over the last five years. Reaching annual green debt issuance equivalent to USD 1 trillion has long been viewed as a milestone for green finance. It was first cited as a target for annual green investment at the 2016 United Nations Climate

9 Though the results in Table 1 are not to be interpreted as causal effects, they are consistent with causality in both directions, with banks with strong balance sheets more likely to fund efforts to reduce their borrowers' carbon footprint.

Change Conference (COP22), and there have been repeated calls for policymakers, investors and issuers to support its achievement. Hitting this milestone at the start of the decade is a clear sign that capital is being shifted towards climate solutions at scale, as the world races against the clock. Nevertheless, the current growth trajectory is still below the annual investment needed to achieve net-zero emissions by 2050.

Figure 25
ESG debt issued by European entities (USD billion)**, by debt and issuer type**



Source: EIB staff estimates and Bloomberg.

Environmental, social and governance debt issuance by European entities also continued to rise, reaching USD 642 billion in 2021 (from USD 348 billion the previous year), an 84% increase (Figure 25). Over the last five years, ESG debt issuance in the European Union has grown by an average of 79% annually. Now, 36% of the world's ESG debt is issued by EU entities, compared with 25% half a decade ago. Among that debt issuance, green bonds remain the most important asset class by issuance volume,

followed by sustainability-linked loans and social bonds. For 2021, sustainability bonds increased the most, followed by sustainability-linked loans and green bonds, signalling the growing relative importance of sustainability bonds and loans in ESG issuance in the European Union.

Social bonds continued to rise in 2021, but to a lesser degree than the previous year. Pressure from the pandemic on healthcare and welfare systems eased as COVID-19 vaccinations increased. The significant increase recorded in sustainability-linked bonds was mainly driven by non-financial firms, and sustainability-linked bonds constituted 20% of non-financial firms' ESG issuance in 2021 (vs. 6% the previous year). Financial firms and national governments prefer to issue green and social bonds, while non-financial firms mostly issue sustainability-linked loans and bonds.

Uncertainty over the global economic outlook caused by rising inflation and the impact of the Ukraine war is expected to weigh on green bond issuance in 2022. International investors are faced with significant uncertainty, as most central banks are hiking interest rates to tame inflationary pressures, and financing costs for green bond issuers are rising. The high-quality of green debt makes it more sensitive to changes in interest rates, hampering bond returns and issuance.

Green bond issuance has soared in recent years, but demand continues to outstrip supply. The strong demand is reflected in the premium paid for green bonds, with green bonds offering a lower yield than non-green bonds. For government bonds, the green premium is estimated to be anywhere from 2 to 9 basis points. Most green government bonds now trade at lower yields compared to conventional debt than when they were first issued, while more recently issued long-dated bonds trade closer to conventional debt (Standard and Poor's, 2021). Supply explains part of the difference. Newer bonds, those issued in 2022, tend to have longer maturities, with recent issuers. In corporate bond markets generally, green premium estimates vary from 0 to 25 basis points (around 5 basis points on average).

Green premiums paid for corporate debt depend on the debt's maturity (Neuberger, 2021). Based on euro-denominated corporate debt issuances completed in 2020 and 2021, the median green premium to date is 2 basis points (it can be much higher depending on the when the debt was issued). Similar levels of green premiums are reported by other studies. IHS Markit reported a modest green premium of around 2 basis points for euro-denominated senior corporate bonds that were investment grade. That premium was more pronounced, around 3 basis points, when compared to the narrower iBoxx EUR Green Bonds Select Index (IHS Markit, 2021). Due to the lack of high-yielding securities within green bond indices, like the Bloomberg MSCI Green Bond Index, higher-yielding, lower-rated bonds tend to have significantly higher premiums — more than 10 basis points (Natixis, 2021).

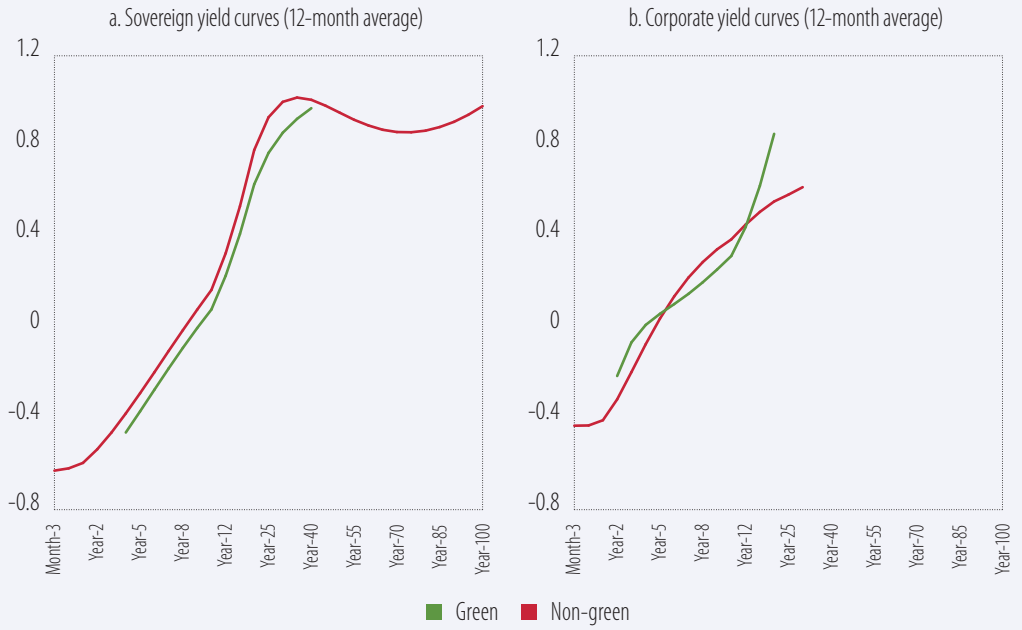
Box C

Sovereign debt attracts a higher green premium than corporate debt

This analysis examines the existence of a green premium on the secondary market, looking at bonds issued in recent years by governments and firms. All euro-denominated, bullet, fixed-coupon and investment grade bonds issued over the last two years by EU governments and firms are split into two groups. The first is the green group, which includes bonds bearing Bloomberg's Green Bond instrument indicator (net proceeds go towards green projects and activities that promote climate change mitigation or adaptation, or other environmental sustainability purposes). The second group is the non-green group, which includes bonds without the green bond instrument indicator. For each of the two groups, a yield curve is fitted for the daily yields using the Nelson-Siegel method to construct a parametric term structure of interest rates.[10] A pair of green/non-green yield curves is calculated for EU governments, and another pair for EU firms. Both pairs of curves are shown in Figure C.1.

10 The method is based on Nelson and Siegel (1987). It uses a long-term yield rate, curve slope, curvature and time-decay factors to generate a standard best-fit model that is widely used in academia and by central banks to calculate yield curve constant maturity points.

Figure C.1
Yield curves (in %)**, by institutional sector**



Source: EIB staff estimates and Bloomberg.

For EU government debt, the green premium is found across the yield curve, while it is more pronounced towards the long end of the yield curve at 30-year tenors. For EU government debt, the green premium averages 10 basis points, and 6 basis points for firms. This finding confirms similar findings in the available literature, where sovereign green bonds have lower interest rates than their non-green peers (ING, 2021). While the existence of a green premium is confirmed for EU corporate bond issues, the premium is only evident for maturities of 5 to 10 years (Natixis, 2021). Comparing green yield curves between EU governments and firms, it becomes clear that the maximum tenor of green bonds is higher for government debt than for firms (as is also the case for non-green bonds).

Conclusion and policy implications

The energy crisis has laid bare Europe's dependency on Russia and on fossil fuels. Volatile energy markets have pushed energy prices to multi-year highs, and they are unlikely to return to stable low levels. Europe needs to fully replenish gas stores before the winter of 2024 to be able to effectively fend off another crisis, if one emerges. Governments, regulators, energy suppliers and consumers will have to cooperate closely to optimise their access to scarce energy resources and avoid rationing. Unfavourable weather conditions — a persistent element of uncertainty — and infrastructure bottlenecks could arise and strongly impact energy consumption, potentially disrupting economic activity and social cohesion.

Although this energy crisis is being felt throughout Europe, the intensity of the shock and the degree of resilience to it differ across EU members, reflecting the fragmented state of the energy market. Stark differences in domestic electricity and gas prices among EU countries pre-date the energy crisis. Differences in the domestic mix of fuels and in the policies applied to energy producers and network operators are to blame. Domestic conditions may also differ across countries, such as market openness and strategies to diversify imports. More generally, diverging trends in electricity and gas prices across Europe signal that energy systems are vulnerable to systemic shocks and lack resilience (caused, in part, by insufficient integration).

While the energy shock calls for governments to act to protect industries and households in the short term, it is crucial that governments preserve and strengthen incentives for a greener, more efficient and better integrated energy market. Firms show an appetite for investing in the green transition and adapting to changing environmental conditions. More than half of firms are already investing in climate action, with 88% taking steps to reduce their carbon footprint, while one-third have developed or invested in measures that help build resilience to physical climate risks. The high cost of energy is driving corporate climate investment, enhancing firms' energy efficiency and increasing their investment in renewables. At the same time uncertainty, decelerating growth and tightening financing conditions are pushing companies to invest less.

Supporting firms' investment requires a combination of policies that reduce uncertainty. EIBIS findings underscore that reducing uncertainty is crucial, including policy and regulatory uncertainty concerning decarbonisation. Here, instruments that reduce financial risk and protect investors could be beneficial. Policies to manage the crisis in the short term should avoid measures that reduce incentives to invest in the green transition. Complementary relationships between public and private investment also play a role, as does pressure within different economics sectors or from regions.

This crisis should serve as a turning point towards a cleaner, more secure future in which European economies are well shielded from energy market turbulence. National and local governments, financiers and firms must all seize the opportunity presented by the energy crisis and make European energy systems more secure and climate resilient. The successful implementation of the REPowerEU plan — and the recent announcement of the tightening of Europe's goal of to reduce emissions 55% by 2030 — will lessen Europe's dependence on gas and bring the European Union one step closer to carbon neutrality. Structural reforms and the overhaul of existing energy pricing rules to accommodate cleaner electricity sources are under discussion, and these reforms could help bring competitively priced energy to consumers and ensure adequate revenues to finance the green transition. Fast-tracking the licensing of renewable energy projects, upgrading and reinforcing network infrastructures, establishing new industrial partnerships, greening supply chains with secure access to critical raw materials and targeted measures to ensure a fair transition are among the initiatives that policymakers should prioritise.

The financial sector has a role to play in the green transition and in tackling the crisis. Financiers' appetite for clean energy projects is gaining momentum, and they are putting innovative financial tools at the disposal of firms looking to roll out climate strategies. In addition to traditional bank loans, most companies now have a combination of instruments they can tap to fund their climate investments,

including green bonds and loans, sustainability bonds and social bonds. In recent years, green bonds, which can be issued by governments and businesses alike, have helped push down financing costs for companies' green investments. However, greenwashing remains a risk. Initiatives like the European Green Bond Standard should give investors greater clarity about which activities truly qualify as sustainable.

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