Chapter 6
Leveraging the financial system to green the European economy
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Investment report 2020/2021: Building a smart and green Europe in the COVID-19 era
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The EIB annual report on Investment and Investment Finance is a product of the EIB Economics Department, providing a comprehensive overview of the developments and drivers of investment and its finance in the European Union. It combines an analysis and understanding of key market trends and developments with a more in-depth thematic focus, which this year is devoted to European progress towards a smart and green future in a post-COVID-19 world. The report draws extensively on the results of the annual EIB Investment Survey (EIBIS) and the EIB Municipality Survey. It complements internal EIB analysis with contributions from leading experts in the field.

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Leveraging the financial system to green the European economy

World economies have agreed to limit their greenhouse gas emissions to inhibit the growing damage caused by climate change. The European economy has made sizeable progress since the Paris Agreement signed in December 2015. Yet that process needs to speed up if the European Union is to achieve carbon neutrality by 2050, a clear goal set by the European Commission under its new leader, Ursula von der Leyen. While public-sector investments should catalyse much of the investment needed, the private sector will also be key to the policy’s success.

Investments in climate mitigation have a specific nature: they are very uncertain, have positive externalities and are dependent on past actions. For these reasons, it is not enough to provide tax incentives, support schemes or guaranteed prices – or even to implement a cap and trade system that provides companies with incentives to reduce their carbon emissions. Greening the economy also depends on a host of individual decisions. Even though green technology is improving rapidly, a wait-and-see attitude explains why investment remains suboptimal and why support from the financial sector is crucial.

In a market-based economy, the financial sector is an efficient system for allocating savings and maximising returns while minimising the overall risk. Investors are already taking into account a firm’s broader impact and its overall corporate conduct. Funds focusing on environmental, social and corporate governance (ESG) investing are in demand. Some niche markets, such as green bonds, are developing, but not rapidly enough, and the premium paid for green investments remains tiny. The uncertainty surrounding the true green content of financial assets is preventing investors from being more discerning. Enhanced information, along with the development of simple and transparent standards, should help spur investor demand.

A more market-based system could speed up the greening process, but the European Union is held back by its bank-based financial system. Banks have a major role to play. In fact, central banks and national supervisors are pushing banks to price climate risks more into their loans, while also encouraging the investors that buy up bank liabilities to take greater account of the risk entailed. Enhanced disclosure guidelines and the increased awareness of climate stress is widening the borrowing costs between green and brown loans. Acknowledgement of climate risk will help green the economy.
**Introduction**

Human activities have contributed to raising the world’s temperature by around 1°C compared to pre-industrial times (Intergovernmental Panel on Climate Change (IPCC), 2014 and 2018). Multiple studies show that without changes in the economic system, global warming is likely to push temperatures up more than 4°C, compared to pre-industrial levels, by the end of the century. People are increasingly concerned about this unsustainable path. At the same time, governments are implementing climate policies that are designed to lower the carbon emissions. Government involvement is necessary, because the private sector has little incentive to offset pollution on its own. Moreover, the tragedy of climate change will play out over the long term, while the costs of climate-change policies will be felt over the short term (Carney, 2015).

Against this backdrop, the Paris Agreement, signed in December 2015, aims to limit the rise in average global temperatures to 2°C higher than pre-industrial levels and to pursue efforts to limit the rise to 1.5°C. The agreement has led countries around the world to set carbon-cutting goals. The European Union is taking the lead in the fight against climate change. It has set EU members the ambitious goal of becoming climate neutral by 2050 and of limiting greenhouse gas emissions by at least 55% by 2030 (European Commission, 2020a), a target revised upwards by the European Parliament at the beginning of October 2020.

This chapter analyses the financing of the investment needed to green the EU economy. It explains why, how, and to what extent the financial sector can help, showing that structural shifts in the EU financial system can alleviate some of the transition costs. Changes are afoot in the financial sector, and they are pushing the climate transition. Asset allocation is changing as investors realise that some investments are not viable or not profitable in the long term. The public sector has a key role to play in this changing environment. It needs to structure the new markets while incentivising transparency and new ways of thinking, so that the balance between risk and return can be seen in the context of climate change.

The remainder of the chapter consists of four sections followed by concluding remarks outlining policy implications. In the first section, we analyse the evolution of energy and pollution trends and show the progress already made. We then provide an overview of the European Green Deal. In the second, we look at the main policy levers that can be deployed and show that price-based policies cannot suffice. The specific nature of climate change investment requires the financial sector to be part of the solution. In the third section, we review the main changes that are already taking place, especially with the expansion of sustainable finance. Finally, in the fourth section, we show how the official financial sector (central banks and national supervisors) is moving to strengthen and deepen the changes taking place in the private financial sector.

**Investment needed to reach the European Commission’s 2030 objective**

We analyse the official statistics to shed light on the current situation and show how far the European Union is from the 2030 target embodied in European Commission’s plans. We then discuss long-term trends in pollution and investments in renewable energy. Finally, we provide a brief overview of the European Commission’s green agenda.

**EU citizens are majorly concerned by climate change**

Global temperatures have already increased by 1.1°C relative to pre-industrial levels (Figure 1). Climate scientists almost unanimously attribute this change to man-made (anthropogenic) greenhouse gas emissions. Based on current mitigation policies, future anthropogenic greenhouse gas emissions are predicted to lead a 3°C increase in warming by the end of the century (IPCC, 2018). However, the future trajectory of global temperatures will largely depend on actions taken to reduce emissions.
Climate change is increasingly important to voters in the European Union (Figure 2). With the increasing frequency of natural catastrophes and heat waves, European citizens are witnessing global warming’s destructive nature. In 2013, voters listed global warming well below immigration, the economy and public finances in the list of challenges faced by the European Union. However, according to the Eurobarometer survey, Europeans have become increasingly concerned about climate change over recent years. Since the beginning of 2019, it has become the European Union’s top challenge.

Figure 1
Deviation in land-ocean temperature index (°C)

![Graph showing deviation in land-ocean temperature index (°C) from 1880 to 2000.]

Source: National Oceanic and Atmospheric Administration.

Figure 2
The top EU challenges (% respondents)

![Graph showing the top EU challenges (% respondents) from 2013 to 2019.]

Source: Eurobarometer Survey.

Note: What do you think are the two most important issues facing the EU at the moment? Two answers maximum. Six-most mentioned items reported. Last record 2019H2.

Carbon emissions related to energy needs have risen since the 1960s, and accounted for 35 gigatonnes in 2019 (Figure 3). However, the trend has flattened somewhat recently. The levelling off is mainly the result of a declining carbon emissions from the power sector in advanced economies, thanks to the expanding role of renewable sources (mainly wind and solar photovoltaic), the switch from coal to natural gas, and higher nuclear power output (International Energy Agency (IEA), 2020). The economic slowdown following the 2008 financial crisis also played a role. Currently, China, India and the United States account for about half of the world’s carbon emissions, with the share of China and India increasing as their economies develop.

In the European Union, carbon emissions have declined for both primary energy consumption and final energy consumption since 2005, with both dropping to 1995 levels (Figure 4). In 2018, the European Union’s primary energy consumption accounted for around 1 400 million tonnes of CO₂ equivalent, a level comparable to 25 years earlier. The decline was stronger in the energy sector as its share in primary energy dropped from 31% to 28%, reflecting the greater efforts made by this sector to reduce its carbon footprint. Despite these favourable trends, primary and final energy consumption are still above the trajectory set by the IEA to monitor progress towards the 2020 energy targets. Those targets are far less stringent than the European Commission’s objectives.

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1 Carbon dioxide is only one of many greenhouse gases; others include methane, nitrous oxide, and hydrofluorocarbons. To facilitate comparisons, it is conventional to convert costs for reducing non-CO₂ greenhouse gases into CO₂-equivalent units.

2 Final energy consumption is equal to primary energy consumption minus the internal consumption of the energy sector.

3 Carbon dioxide equivalent or CO₂-equivalent, abbreviated as CO₂-eq, is a metric measure used to compare the emissions from various greenhouse gases on the basis of their global-warming potential, by converting amounts of other gases to the equivalent amount of carbon dioxide with the same global warming potential. Carbon dioxide equivalents are commonly expressed as million metric tonnes of carbon dioxide equivalents.
EU progress falls short of meeting the looming challenge

The Kaya identity helps us better understand the forces driving emission trends. As shown in equation 1, the Kaya identity states that the emission level of greenhouse gas carbon dioxide can be expressed as the product of four factors: human population, gross domestic product (GDP) per capita, energy intensity (per unit of GDP), and carbon intensity (emissions per unit of energy consumed).

\[ \text{CO}_2 = N \times \frac{\text{GDP}}{N} \times \frac{\text{E}}{\text{GDP}} \times \frac{\text{CO}_2}{\text{E}} \]

N is the population, GDP is per capita GDP, E over GDP is the energy intensity of GDP and CO2 over E is the carbon intensity of energy. Three components, driven by different factors, account for carbon emission trends: GDP, the energy intensity of GDP and the carbon intensity of energy.

Recent history and official estimates suggest that, over the long term, EU growth is about 1 to 1.5% a year. It is well known that Europe has an ageing population, so labour's contribution to GDP should decline. Productivity growth has also declined since the financial crisis, a phenomenon affecting most advanced economies. Overall, long-term growth fell from around 2% in the 1990s to less than 1.5% before the COVID-19 crisis. With the pandemic, uncertainty has increased. We cannot rule out the possibility that beyond the output lost during the lockdowns, the crisis may leave some scars that further reduce long-term growth. Moreover, we don't know how long it will take to return to pre-crisis levels of economic activity. At the same time, the pandemic isn't over, and further waves cannot be ruled out.

Over the last 25 years, the energy intensity, the amount of energy required per unit of GDP, has declined by around 30%. Figure 5 plots the energy intensity in the European Union and the three regions since 1995. The ratio is based to 100 at the beginning of the sample. In the three regions, the ratio has been declining since 1995, with a stronger drop in the economies of Central and Eastern Europe. This decrease can be explained by greater production efficiency as well as growth in services, which are less energy intensive.

The carbon intensity of primary energy consumed has also been falling. Figure 6 plots the carbon intensity in the European Union and the three regions from 1995 to 2018, using a ratio based to 100 at the
beginning of the sample. The ratio illustrates an almost 20% reduction in carbon intensity in the European Union, with a similar decrease in the economies of Northern and Western Europe and Southern Europe. The decrease for Central and Eastern Europe, however, is less pronounced, by about one-half. In addition to progress made in the traditional energy sector, the decline in the carbon intensity of primary energy consumption also reflects the increased share of renewable energy, which is carbon-free.

Renewable energy’s share in final energy consumption has doubled in the last 15 years (Figure 7), from around 9% in 2003 to 18% in 2018. EU economies all made headway, with Southern Europe making the most progress, largely because those countries traditionally had less renewable energy production. The growth was more subdued for Central and Eastern Europe, where the energy sector is based more on coal, and therefore more polluting. The regional differences in efforts to move to less carbon-intensive energy, and the urgency of the need to meet the EU target, explain why the European Union created the Just Transition Fund, a EUR 40 billion fund to help countries catch up.
The nature of renewable energy in the European Union has profoundly changed over the last 25 years. In 1995, solid biofuels represented more than 75% of renewable energy, with wind making up the remainder. From 1995, wind power increased rapidly and accounted for 60% of renewable energy in 2015. Wind power’s contribution has remained 60% to 65% since then. Solar energy contributed only 1% of renewable energy in 2005, but increased substantially from 2015 onward, and now hovers at 20% to 22%.

Declines in energy intensity and carbon intensity explain why carbon emissions have remained close to their 1995 levels, despite a rise in real GDP. We can use the Kaya identity to summarise trends in emissions since 1995. From 1995 until 2018, the European Union’s real GDP increased by almost 50%, a rise that normally would have pushed up pollution. However, the 30% decline in the energy intensity of GDP, together with the 20% decline in the carbon intensity of energy consumption, have offset the positive impact of GDP growth on emission volumes. The result is that the European Union’s carbon emissions have stabilised. Looking ahead, it will be important for GDP growth to continue to be accompanied by declines in energy intensity and carbon intensity to meet the European Union’s climate goals.

Quick overview of renewable energy and climate mitigation in the European Green Deal

Greenhouse gases accumulate over time. Emitted carbon dioxide, the primary greenhouse gas, stays in the atmosphere for many years. It continually increases average global temperatures until a peak is reached about 40 years after the carbon dioxide is emitted. Carbon dioxide then dissipates slowly, and has a half-life of above 30 years (Pizer, 2002). Consequently, limiting the damage from climate change requires large reductions in cumulative emissions over time – yearly fluctuations do not matter much.

Given the long-term nature of the problem, it is important to accurately measure the social discount rate, or the present value of the costs and benefits that will be felt in the future. Opinions differ widely as to the appropriate ethical framework for analysing climate policy’s impact on welfare. Any such policies will have important distributive effects, both within and across generations. Ethical parameters such as the pure rate of time preference, or how much we value our own welfare relative to the next generation, and the elasticity of marginal utility, or how much we care about inequality in consumption, have been shown to be crucial determinants of the timing and intensity of optimal policy responses (Nordhaus, 2008 and 2020).

The ultimate policy mix is multifaceted and difficult to design. Carbon reduction can generate significant environmental benefits – for example, increased life expectancy in urban areas. However, decarbonisation will also incur costs, change the value of certain assets and contribute to unemployment in different sectors. A democratic approach requires understanding the social trade-offs when analysing the impact on society’s welfare. It is not easy to account for the ethical preferences of diverse groups of individuals.

The huge uncertainty regarding the climate should not be an excuse for maintaining the status quo. Increases in concentrations of greenhouse gases are causing shifts in the climate. We don’t know precisely how large these changes will be, or when and where they will occur. We also do not fully understand the social and economic consequences of these changes, or how we will be able to deal with them in the future. We do have an enormous amount of useful information about the perils of climate change, certainly more than enough to recognise that it is an issue requiring immediate policy attention. The downside risk from ignoring climate change is likely to be far worse than the downside risk of aggressive policies to mitigate it. That in itself supports aggressive policy action (Millner et al., 2013).

To reach the European Commission’s objective, renewable energy must account for more than one-third of primary energy consumption by 2030. Good policies are based on clear targets and in transparent monitoring of those targets. To reach climate neutrality by 2050 and limit global warming to 1.5°C, the new European Green Deal sets a target to reduce greenhouse gas emissions by 55% of their

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4 This requires net-zero greenhouse gas emissions.

**The energy sector should contribute majorly to reducing emissions.** The European Commission’s Clean Energy package calls for 32% of final energy consumption to come from renewables in 2030. If that goal is met, electricity generation should cut emissions by half from 2015 to 2030, more than any other sector.\(^5\) Almost all capital expenditure will go towards the rollout of wind and solar energy, and almost none to new fossil fuel capacity. Exposure to coal, gas and carbon prices will be reduced as well as the investments needed to maintain existing fossil fuel plants. The savings will help finance the shift towards renewable energy.

**Large increases in energy related investment and low-carbon capital investment are needed.** The European Commission’s latest impact assessment analysis (2020) indicates that annual energy-related investment should increase considerably over the next decade. In total, around EUR 550 billion is needed to achieve the new proposed greenhouse gas emissions target of 55% by 2030. This means almost EUR 350 billion (including transport) of investment above historic levels from 2011 to 2020, and around EUR 80 billion (or EUR 200 billion including transport) above the baseline scenario, which was targeting a 40% reduction in greenhouse gas emissions by 2030. For companies, low-carbon capital investments would also need to more than double from EUR 59 billion in 2019 to around EUR 122 billion a year (Carbon Disclosure Project (CDP) and Oliver Wyman, 2020). While this is a significant increase, low-carbon investment would still represent a modest share of corporate capital expenditure, growing from 12% to 25% of the total.

The new European Union budget, known as the Multiannual Financing Framework, and the coronavirus recovery fund will help pay for the European Green Deal. Over the next few years, 30% of both the European Union’s budget and the recovery fund will be dedicated to climate action and clean energy, representing more than EUR 500 billion. Painful adjustments in carbon-intense sectors and regions will be addressed by the Just transition Mechanism, which will tap the Just transition Fund budget proposed to amount to EUR 40 billion.

### Contours of a climate policy

**Various policy tools can be deployed to shift investment towards low-emission and climate-resilient options (Figure 8).** The greening of the economy is too slow under current policies and regulations. Policies need to be overhauled to push the private sector to adequately account for the social and environmental impact of climate change. As shown in Figure 8, these policies should address carbon pricing, fossil fuel subsidies, support for renewable energy,\(^6\) regulations (overcoming barriers or shortening the administrative steps needed for energy efficiency investments or to limit the use of fossil fuels), targeted investment incentives (such as feed-in tariffs or tenders for renewable energy), providing reliable quantitative information to facilitate the computation of economic returns, and support for innovation, among other things (Gillinham and Stock, 2018).

In addition to regulation, altering prices and/or the finance cost of investments are two ways to green the economy faster. Figure 9 is based on a simplified representation of a closed economy comprising four sectors: households, non-financial corporations, the government and banks. Consumers consume two goods: a brown and a green good, each produced by two different technologies, one green and one brown. The brown good is produced combining labour and brown capital and the green good is produced using green capital and labour. Production and consumption result in greenhouse gas emissions which, by definition, are lower for the green good and technology. While capital is sector-specific and renewed each period, labour is free to move across sectors.

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5 The European Commission’s Clean Energy Package that set different targets across sectors. Over 2015-2030, it requires the energy sector to reduce emissions by 46%. The target for the transport sector is for 14% of energy to come from renewables.

6 According to the Carbon Disclosure Project, estimates for fossil fuel subsidies in the European Union range from EUR 55 billion to EUR 112 billion a year, comparable to corporate low-carbon capital investment.
Greening requires changing the relative prices of brown vs. green goods and technologies. Greening the economy requires reducing the consumption of brown goods and/or technologies and/or increasing the use of green goods or technologies. To achieve this, the price of brown goods relative to green goods has to increase and/or the relative price of brown capital relative to green capital has to increase. The representation depicted in Figure 9 emphasises the two main policies for changing relative prices: taxing capital or consumption, or altering the relative cost of finance.

Given its pivotal role in the allocation of savings, the financial sector can become a cornerstone of greening policies. The financial sector collects the household savings invested in green and brown capital (Figure 9, left-hand side). When financed by bank loans, an investment’s financing cost is calculated as a mark-up on the risk-free rate of funds plus the capital cost. The capital cost is the cost of the equity required to cover the risk of the bank loan. Since the cost of equity is well above the risk-free rate (EIB, 2019), an increase in the share of equity required to back the loan increases the finance cost and reduces the amount that can be invested. More generally, for non-bank finance, investors’ expectations or preferences help decide where they put their money, and changes in those preferences can impact the relative costs of brown and green investments.

The European Union is a large open economy, but not large enough to influence prices worldwide. If major economies were to combine their efforts, they could leverage their market power to foster the development of carbon-efficient utilities, production processes and services. By aligning incentives, standards and penalties, they could push greater economies of scale and reduce production and transaction costs for green products and technologies. Aligned policy action would accelerate a shift in consumption and production patterns, which, given the market share involved, would spill over to the rest of the world. Coordinated policy action is therefore paramount to tackling climate change.

Trade policies can also favour a greener economy. Goods and capital are almost entirely mobile across borders. In the absence of international agreements regarding environmental standards, international
investors can relocate investment and production to less stringent areas and export back to consumers. Shapiro (2019) shows that in most countries, import tariffs and non-tariff barriers are substantially lower for dirty than for clean industries. The differences in trade policy effectively subsidises carbon emissions. New policies that correct this bias would decrease carbon emissions substantially without affecting global real income.

Figure 9
The macroeconomic channels of the main climate mitigation policies

Source: EIB Economics Department.

A level playing field must be guaranteed globally, despite insufficient international coordination. By nature, agreements reached at the international level distort trade flows less. By raising the cost of energy, climate policies can increase competitive pressures. The European Union needs to avoid a race to the bottom that would harm production without altering global pollution trends. For that reason, the European Union is discussing a Carbon Border Adjustment Mechanism to be implemented by 2023. Such mechanism should incentivise foreign producers to reduce their carbon emissions and therefore contribute to raise standards globally.

Why the carbon pricing and trading system must be supplemented

Implementing a price for greenhouse gas emissions is crucial to climate mitigation. As shown in Figure 9, pricing emissions encourages users to reduce their energy consumption and emitters to switch to cleaner production alternatives. Pricing policies are a cost-effective way to reduce emissions. They provide emitters with an incentive to cut emissions, as long as cutting emissions is cheaper than paying the carbon price. Pricing policies tend to have a neutral economic impact. Because the policies do not stipulate which emissions should be reduced and/or which technology should be favoured, they overcome the information asymmetry between governments and polluters. Pricing emissions can be achieved through taxes or tradable permits. Incidentally, pricing policies stimulate innovation (Organisation for Economic Co-operation and Development (OECD), 2016a) that will develop new technologies.

Setting a clear and credible path for carbon pricing fosters investment as it enables investors to better calculate returns. Tax-based policy sends market signals that affect expectations. The introduction and strengthening of carbon prices signal a strong policy commitment, which can indirectly impact behaviours...
and activities not directly subject to the carbon price. Moreover, the expectation of a permanent increase in prices modifies the technological trajectory of the economy (Fried, 2019). The longer-term effects of higher prices are important for the pricing of financial assets, particularly since the financial sector tends to be forward-looking. Fried et al. (2019) shows that US firms are making investments choices in less polluting processes, despite the uncertainty surrounding if and when a carbon price will be imposed, that reflects an implicit carbon tax of more than USD 3 per tonne.

However, there is wide uncertainty regarding the price of carbon. In principle, carbon prices can be set to reflect the societal or other external costs of carbon emissions or to meet abatement targets. The US government estimated the social cost of carbon at approximately USD 46 per tonne of emissions in 2017 (Interagency Working Group on Social Cost of Greenhouse Gases, 2016). In one scenario for greening the economy, a French study came up with a price as high as EUR 775/tCO2 in 2050 (Quinet, 2019). The European Commission’s studies to achieve net-zero greenhouse gas emissions by 2050 calculate a carbon price of EUR 350/tCO2 by 2050 (European Commission, 2018).

It is possible to raise taxes without damaging the economy. Some case studies show that it is possible to raise carbon taxes and reduce carbon emissions without damaging economic activity. Sweden, for example, has raised its carbon tax since the middle of the 1990s, reaching USD 127 per tonne by 2018. Over the period, emissions were cut 25% while real GDP grew by 75%, above the European Union’s level of 50%. A well-designed package, with more extensive carbon pricing across EU countries and sectors, combined with cuts in distortionary taxes and targeted support for green investment, would allow the European Union to reach its emission goals with practically no effects on aggregate income (Chen et al., 2020). The EU recovery plan brims with this possibility. It expects climate-related investments to account for at least 30% of recovery spending.

Abrupt increases in carbon prices can have elevated social costs. Increasing the price of carbon sharply would have a major impact on production costs, and therefore prices in many sectors. According to Nordhaus (2017), for temperature increases to remain below 2.5°C by the end of the century, the carbon price would need to increase from USD 15 to USD 30 per tonne of carbon to USD 60 to USD 200. At global level, a USD 25 tax per tonne of carbon would increase transcontinental air fares by 6%, the cost of driving a car by 8% and overall consumer price inflation by 1%. The required increase in prices would exacerbate social tensions. An obvious example is the “Gilets Jaunes” (yellow vests) movement initiated in France late 2018.

Carbon taxes can also generate substantial fiscal windfalls. Pricing all emissions at EUR 30 per tonne would generate revenues averaging 1% of GDP across the G20 countries, at current emission levels (OECD, 2017). Most estimates suggest that a USD 35 per tonne tax in 2030 would generate revenues of 1% to 2% of GDP.7

To ensure the public’s support, environmental tax revenues could be used to finance environmental spending or offset adverse effects. The “Gilets Jaunes” experience in France emphasises the need to gain public support before embarking on sharp increases in the carbon tax. In general, government revenues are used to finance social spending, public services, technology and infrastructure. To boost the carbon tax’s legitimacy, the spending breakdown of the resulting revenues could be adjusted.

Public political support could be shored up at minimal cost, especially in the case of housing renovation. Housing is an important contributor to carbon emissions, as insulation and heating system have not kept up with technological progress for most old buildings. Box A elaborates on the on-bill financing scheme, which provides financing for households to invest in energy efficiency. Basically, the investment costs are backed by the savings resulting from the investment meaning that households do not see major changes on their energy bill.

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7 The range of estimates is consistent with Nordhaus (2017) which suggests that a USD 25 tax would generate a windfall of USD 168 billion in revenues.
There is mild evidence that governments collecting more revenues from environmental taxes develop greener policies. Across European countries, environmental tax revenues collected by governments amount to 1.5% to 4% of GDP (Figure 10). Nominal spending on environmental protection is well below, from 0.5% to 1.5%. More importantly, the correlation revenues and environmental spending is very weak (R-squared of only 3%). Dedicating carbon taxes to spending for the green transition would have benefits, but it would also constrain governments, which prefer to have more leeway in dedicating tax revenues.

**Box A**

**On-bill financing – an innovative financial instrument to support residential energy efficiency**

High initial investment costs are a key barrier to investing in energy efficiency improvements in residential buildings, even if in many cases such investments would otherwise have a positive return. The upfront cash flow needs – together with the lack of eligibility for financing that could bridge the cash flow gap – are preventing improvements in large segments of the residential sector.

On-bill financing is a special method of funding energy efficiency or renewable energy investments for households. The unique feature of these programmes is that utility bills are used as the vehicle for repayment. In a typical on-bill programme, the utility company or a third-party lender provides a loan for a customer’s energy efficiency projects. The customer then repays the loan through additional charges on their regular utility (gas, electricity) bills (Figure A1).

**Figure A.1**

**The structure of an on-bill financing scheme**

![Diagram of on-bill financing scheme]

Source: EIB Investment Survey (EIBIS), SAFE, Enterprise Surveys, EIB calculations.

On-bill programmes generally attempt to achieve bill neutrality, meaning that the savings from the efficiency improvements are expected to equal or exceed the new on-bill loan payments. To achieve this, an energy auditor reviews the efficiency improvements and estimates the reduction in utility expenses expected after the project. On-bill financing schemes can also be combined with grant elements, which can significantly increase the scale of feasible investment, reduce the repayment period and can help to ensure bill neutrality.

The advantages of on-bill financing compared to a simple housing renovation loan are manifold. Most importantly, it can provide access to funding to households that otherwise would not be eligible for a conventional loan or may find a loan too expensive. Many such households with limited or no bank contacts would be able to take out an on-bill loan if their monthly payments are not expected to increase. On-bill agreements are typically very simple, and making repayments directly on a utility bill is convenient. In addition, most of these households have good track records for utility payments, and past bill repayment can be used as a convenient proxy for evaluating the loan applications.
addition, on-bill financing schemes can better align the incentives to carry out energy efficiency renovations in tenant-occupied properties, where landlords are often reluctant to finance the upfront costs of energy-efficient renovations as they do not directly benefit from the subsequent financial and other advantages.

However, on-bill financing schemes often pose significant legal and organisational challenges. Coordination among the various stakeholders – such as the utility company, the lender, the grant provider, the eligible contractors and the beneficiaries – is often difficult. Furthermore, in many jurisdictions it is difficult to find solutions that are compatible with banking regulations, the legal framework governing utility service provision, and consumer protection regulations. These obstacles hinder the more widespread use of on-bill financing in many countries.

In the United States and Canada, on-bill schemes have become widespread in the last 30 years, and they are a key driver of the building renovation market. Most programmes are implemented by rural utility co-operatives and municipality-owned utility service providers. In Europe, only a handful of attempts have been made so far. These include the UK Green Deal programme and the Horizon 2020-funded SUNShINE (Save your bUildiNg by SavINg energy) project in Latvia, which aimed to carry out the in-depth retrofit of multi-family buildings. A pilot initiative to scale up energy efficiency investments by promoting the implementation of on-bill schemes and focusing on Germany, Italy, Lithuania and Spain is ongoing under the umbrella of the RenOnBill consortium.

The Emission Trading System (ETS) provides an alternative to taxation. ETS provides some flexibility, balancing the uncertainty of the benefits gained by emission reductions and the political risks of high carbon prices. In the European Union, the ETS is based on emission caps. When companies exceed their cap, they buy extra allowances in an open auction. That market is in turn fed by companies selling their unused allowances. The empirical literature shows that the cost increases resulting from the requirement to purchase carbon allowances are passed on to the consumer, producing similar effects to a tax (Dinan, 2009).

The ETS has succeeded in reducing EU emissions in the sectors covered. Firstly, the cap can be adjusted over time to enable a smooth transition of the economy. Secondly, the range of sectors subject to the ETS can be enlarged. While increasing over time, the range of sector remains low, covering around 40%
of total EU emissions, excluding transport and housing (International Monetary Fund (IMF), 2020b). In the European Union’s case, the policy has been instrumental in reducing carbon emissions (Martin et al., 2018). For the industrial sectors covered by the scheme, the share of auctioned allowances (or the extra allowances companies pay for) reached 57% of total allowances in 2019.

**However, highly uncertain ETS prices may cloud investment returns.** After remaining relatively stable at about EUR 6 per tonne of carbon from 2012 to 2017, the price of carbon traded on the ETS rose significantly in 2018 and 2019, hitting EUR 25 per tonne (Figure 11) at the end of 2019. Prices dropped again during the first coronavirus lockdown, dipping to a low of EUR 16 per metric tonne, in line with the 10% to 20% decline in electricity demand in several major European economies (International Economic Agency, 2020). Changes in demand majorly affect ETS prices (Osterloh, 2020; Hale and Leduc, 2020). This price volatility complicates the task of evaluating returns on investments for alternative or less-polluting technologies.

**Renewable energy investment and the associated financing**

**Following years of investment, the cost producing renewable energy has fallen substantially.** Figure 12 shows the decline in the cost of energy for onshore wind in the European Union and selected economies. On average, costs have declined more than 50% over the last 25 years. Costs have also fallen for many other sources of renewable energy. These technologies are relatively new and gain in efficiency as their development progresses, benefiting from quick gains in knowledge and large economies of scale.

**It was relatively unexpected that many sources of renewable energy would become less expensive than fossil energy (Figure 13).** Quantifying current costs is necessary when designing climate policy, but it is not enough. Climate change is a long-term problem that can be addressed through a range of technologies whose cost is path-dependent. The optimal mitigation policy is the one that minimises the longer-term costs of adaptation, bearing in mind that actions taken today can influence future costs. Spending on certain technologies today influences the options that will be available to others in the future. By conveying information, the financial markets, decentralised and forward-looking by nature, reduce the risk of locking the economy into a poor technological choice.

**A wait-and-see attitude and the irreversible aspects of certain decisions help explain why renewable energy investments are not higher.** Investments made by others today tend to bring down overall costs tomorrow. Today’s spending also affects investment in infrastructure. The purchase of electric or hydrogen cars, for example, will lead to varying demand for charging stations. Given that substantial parts of the investments are irreversible, there is an incentive for investors to wait and see how things will play out (Vogt-Schilb, Meunier and Hailegate, 2018). Gerarden et al. (2015) review the factors explaining the energy efficiency gap. The authors show that renewable energy investments do not appear to be adopted by consumers and businesses to the degree that might seem justified, even on a purely financial basis.

**Green investments are specific in nature.** They enhance welfare but are risky for investors. While regulatory uncertainty can be reduced by long-term commitments from policymakers, technological changes and shifts in consumer preferences remain flux. Hence, the transition is likelier to be financed by risk-taking and risk-absorbing instruments such as equity. Longer-term investors also need to be attracted.

**Financed-constrained firms tends to invest less in energy efficiency.** In the European Union, energy efficiency investment by non-financial firms is unevenly distributed across the Member States, sectors and size classes. Across EU regions, however, the share of this kind of investment is very similar. It varies in a narrow range of around 10%, but overall a high proportion of firms do not invest in energy efficiency. Figure 14 shows separately the proportion of finance-constrained firms investing in energy efficiency and those which do not. In the European Union, particularly in Southern, Central and Eastern Europe, firms not investing in energy efficiency tend to have less access to finance. This relationship suggests adverse conditions for accessing external finance help explain why firms aren’t investing in energy efficiency.
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Figure 12
Global weighted levelized cost of energy of onshore wind (2018 USD/KWh)

Source: International Renewable Energy Agency (Irena).
Note: Estimates are derived from the US Energy Information Administration’s Annual Energy Outlook 2018. Costs are projected for facilities that are due to come online in 2022 and do not include federal renewable energy tax credits or other subsidies.

Figure 13
Comparing costs (USD per tonne of CO2 in 2017 dollars)


Figure 14
Proportion of finance-constrained firms (%)


Figure 15
Difference in dissatisfaction between firms not investing in efficiency investment and those investing (percentage points)


Firms not investing in energy efficiency tend to be more dissatisfied with financing offers they receive. Figure 15 compares the levels of this dissatisfaction. It depicts the difference between firms not investing and firms investing in energy efficiency according to various characteristics of the financing offer. For most of these features, the firms not investing in energy tend to be more dissatisfied. Hence, dissatisfaction
with the financing offer may be a factor limiting a firm’s capacity to invest in energy efficiency. The difference in finance costs and collateral requirements is especially pronounced in Southern Europe.⁸

More indebted firms are showing hardly any progress in reducing carbon emissions. A sample of publicly listed firms in 28 EU members (including the United Kingdom) shows the average ratio of greenhouse gas emissions to sales halved from 2007 to 2017. Large differences exist between firms, however, on their ability to make their production greener. In particular, the most highly leveraged firms do not follow the EU-wide patterns (Figure 16). For highly indebted firms, emission ratios are not declining, and varied from 80 to 140 during 2007-2017. This suggests that excessive leverage reduces a firm’s ability to shift production towards greener processes.

In sectors with the most stringent environmental regulations, highly indebted firms emit more carbon than their less-indebted peers (Figure 17). We have estimated how carbon emissions respond relative to legislative constraints, depending on the level of corporate indebtedness.⁹ The results shown in Figure 17 confirm that higher debt financing reduces the responsiveness of firms to the regulatory environment, impeding the green transition. Looking more closely at the type of debt and the breakdown between short- and long-term debt, the debt-to-carbon relationship seems to be mostly driven by short-term debt, with no visible effects observed for long-term debt. Overall, the results suggest that there is no significant difference between high- and low-debt firms in sectors with little regulation. However, in the more environmentally regulated sectors, highly indebted firms seem to be less able to lower their carbon emissions than their less-indebted peers.

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⁸ The population of firms represented differs across Figure 14 and Figure 15. Those dissatisfied received bank finance while those financially constrained did not.

⁹ We built LEX, a legislative index based on the number of environment-related legal documents published in the EU Lex database in a given year in a given sector. We then drew up estimates based on the following equation:

\[
\log(\text{CO}_2)_{it} = \beta_0 + \beta_1 \text{LEX}_{st} \times \text{DEBT}_{it-1} + \beta_2 \text{DEBT}_{it} + \beta_3 X_{it-1} + \mu_{cst} + \epsilon_{ict}
\]

where I is the firm, c is the location country, s is the sector and t is the year. CO₂ is the CO₂ emission (in million tonnes) and DEBT is the firm’s total debt divided by total assets. X denotes a vector of logged control variables including the logarithm of total assets, the ratio of cash flow to total assets, and the ratio of sales to total assets. Its inclusion allows us to capture the independent impact of various firm-specific characteristics.
A call for a more equity-based financial system

It is well known that the European Union’s financial system is bank-based (Figure 18). The financial sector has exploded in recent years and is now more than twice the size it was in the 1990s. Since the financial crisis, growth in bank finance has trailed market sources of finance. Despite this, bank-based finance continues to dominate in the European Union (EIB, 2019). This picture is relatively unusual as financial markets develop more at later stages of economic development (Beck and Levine, 2002; Hsu et al., 2014).

Empirical literature suggests a link between the nature of the financial system and the ability of an economy to go green. This is consistent with the nature of green investment, which is longer-term and riskier. For example, De Haas and Popov (2019) show that stock markets are superior to banks in decarbonising the economy. The authors consider a hypothetical increase in the share of market finance of 20 percentage points on average for 80% of the world economies (from an average of 30%). This would align the financing structure of these economies with that of Australia, Canada, Finland and the Netherlands. According to the authors’ estimates, this structural change would likely result in an 11% reduction in aggregate carbon emissions.

We have looked at whether the European Union’s financial system is affecting the level of carbon emissions, or the economy’s capacity to invest in renewable energies. We focused on the EU economies, where the differences in economic development are much less pronounced than at global level. The sample covers all EU economies from 2000 to 2018.10 However, because some records are missing, the equations are estimated using fewer observations – 399 to 484 – than what would normally be available over the period. We defined the ratio of market-based finance as equity over equity and bank assets. These definitions are in line with prior studies on the link between financial development, financial structure, and growth (such as Beck and Levine, 2002; Hsu et al., 2014). Note that we did not include funding through corporate bond markets, for two practical reasons. First, comprehensive data on corporate bond financing are missing for many of the countries in the dataset. Second, in the vast majority of countries for which we have data, corporate bonds account for a negligible share of overall financial intermediation compared with credit markets and stock markets. We controlled for a given level of economic development by incorporating the level of real GDP at the beginning of the sample in 2000. We assessed the link between various brown intensity indicators and the financial structure.

We found evidence that EU economies generate fewer carbon emissions per capita if they receive more market-based finance. Our results are indicated in Figure 19. They suggest that a 1 percentage point increase in the share of market finance is accompanied by a reduction of 6.9 to 9.1 in the carbon intensity of primary energy consumption. The effect is statistically significant at a level of at least 5%. An increase in the size of the insurance sector also has a positive but not effect. A 1 percentage point increase in the share of insurance assets in GDP is also accompanied by a reduction of 0.1 percentage point of greenhouse gas emissions per capita. Overall, these results suggest that more developed financial markets or larger long-term investors facilitate the financing of renewable energy investment and are therefore associated with a greener economy.

Innovation and the level of tangible assets partly explain why equity investments reduce the carbon footprint more than debt. Energy-efficient sectors – sectors that have lower carbon emissions per sales – tend to be more innovative but poorer in tangible assets than carbon-intensive sectors. At the same time, equity is known to be supportive of innovation and intangible investment (EIB, 2019). As shown by Kim and Weisbach (2008) or Brown et al. (2017), sectors rich in tangible assets expand faster in bank-based economies while innovative sectors grow faster in economies with deeper stock markets. Economies with deeper stock markets are also associated with more “green patenting” in traditionally carbon-intensive industries. Private equity is also important in energy efficiency, confirming the important role that

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10 Data related to emissions come from the OECD. Data related to financial structure come from the World Bank Financial Structure Indicators. GDP is taken from Eurostat.
Investing in the transition to a green and smart economy

investors such as venture capitalists play in innovation and technological adoption (Kortum and Lerner, 2000). More developed financial markets tend to have higher governance standards, and the quality of those markets’ institutions can limit the environmental impact of economic growth (Dees, 2020).

The analysis points to existing synergies between two major policy agendas in the European Union, namely the European Green Deal and the Capital Markets Union. With the Capital Markets Union, Europe is trying to foster financial markets and integrate them across different countries. On the one hand, supporting equity investment is one way policymakers can accelerate the transition to a low-carbon economy. On the other, banks that largely finance carbon-intensive sectors could be encouraged to reduce the carbon emissions generated by their loans. As a first step, policymakers could push for more public disclosure, which could result in banks’ lending more to firms active in the low-carbon economy.

How the financial sector supports the green transition

In this section, we review the investors most likely to be interested in long-term assets and the development of sustainable finance, looking at environmental, social and corporate governance funds (ESG) as an asset class. We then analyse the various hurdles standing in the way of long-term investment in the green economy, as well as the ways policymakers could remove those hurdles. Finally, we provide evidence that more transparent or greener companies enjoy lower costs of capital.

The need for more involvement from long-term investors

According to the Global Infrastructure Hub, EUR 94 trillion is needed to meet the world’s infrastructure requirements by 2040, a large part of which could support the green transition. The needs are
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multifaceted, with transport and energy accounting for more than three-quarters of investment (Figure 20). These sectors are prime candidates for climate change mitigation. Infrastructure investments therefore offer important opportunities for decarbonising the economy, in addition to providing returns and diversifying portfolios.

**Compared to other investments, infrastructure generates less volatile and more predictable cash flow over a longer horizon.** Infrastructure contracts are long, reflecting the length of the construction itself and the significant period over which services are expected to be delivered. The demand addressed tends to be inelastic, or less dependent on price. At the same time, the price of the service provided, which is sometimes subsidised by public authorities, can be pegged to inflation. Infrastructure investments therefore protect revenue streams from fluctuating price levels and provide predictable cash flow. As the associated goods or services tend to be delivered as part of a monopoly, they also often bring elevated returns.

**Figure 20**
Global infrastructure investments needs by sector (2016-2030, in %)

**Figure 21**
Global trends in renewable energy investment by asset class (USD bn)

About USD 300 billion is invested globally in renewable energy a year. The flow has remained almost constant since 2015 (Figure 21), falling short of what is needed in the years to come. The bulk of the investment is financed through assets, with very little money coming from public markets. Pension funds and insurance companies are the likeliest to invest in infrastructure. Figure 22 provides a breakdown of infrastructure investors for 2015 and 2019, the latest record available. Nearly one in five private sector pension funds invests in infrastructure, making pension funds the biggest category of investor. Next, more than one in ten public sector pension funds and insurance companies also invest in infrastructure.

Although pension funds and insurance companies traditionally invest in infrastructure, their sizeable assets under management mean that infrastructure only accounts for a small portion of their balance sheet (Figure 23). Sovereign wealth funds tend to invest the most in infrastructure (EUR 153 million mean commitment). They are followed by asset managers (EUR 79 million), public pension funds (EUR 60 million), and insurance companies (EUR 43 million). With average investment of EUR 6 million, corporate investors lag far behind. Some of this is caused by regulatory hurdles for private investors. Removing those hurdles could increase private investors’ participation.
Figure 22
Infrastructure investors by type (proportion of investors, %)

<table>
<thead>
<tr>
<th>Type</th>
<th>2015</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private sector pension fund</td>
<td></td>
<td></td>
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<tr>
<td>Public sector pension fund</td>
<td></td>
<td></td>
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<tr>
<td>Foundation</td>
<td></td>
<td></td>
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<tr>
<td>Insurance company</td>
<td></td>
<td></td>
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<tr>
<td>Bank/investment bank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asset manager</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Family office</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Endowment plan</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Wealth manager</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Corporate investor</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Government agency</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Superannuation scheme</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Fund of funds manager</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sovereign wealth fund</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: EIB Economics Department calculations based on Prequin Pro.

Figure 23
Median current allocation to infrastructure by type (% of assets under management)

<table>
<thead>
<tr>
<th>Type</th>
<th>2015</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superannuation scheme</td>
<td></td>
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<tr>
<td>Corporate investor</td>
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<tr>
<td>Sovereign wealth fund</td>
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</tr>
<tr>
<td>Wealth manager</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Asset manager</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Family office</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Endowment plan</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Public pension fund</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Private sector pension fund</td>
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<tr>
<td>Insurance company</td>
<td></td>
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<tr>
<td>Foundation</td>
<td></td>
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</tbody>
</table>

Source: EIB Economics Department calculations based on Prequin Pro.

Long-term investors could be brought into infrastructure projects in larger numbers. In the Official Monetary and Financial Institutions Forum (OMFIF) GPI Survey 2019, respondents from central banks, sovereign funds and public pension funds were asked whether they were allowed to invest in real assets, which includes infrastructure. 60% of respondents said that they were not permitted to, either by the laws and regulations in force, or by their fund mandate (OMFIF, 2020).
While publicly listed infrastructure firms give investors a way to participate, unlisted infrastructure projects also provide opportunities. A common but indirect manner of investing in infrastructure is through publicly listed infrastructure projects. Becoming a shareholder of a publicly listed infrastructure company or buying corporate or project bonds allows investors to diversify and gain exposure to the sector, possibly with small investments that reduce risk. Infrastructure funds allow institutional investors without specific expertise or resources to buy into projects and to diversify their investments at relatively low cost. Because these infrastructure assets are traded on public stock exchanges, more transparency can be expected on the project itself and on pricing. However, a large number of infrastructure projects are unlisted. These make it possible to reduce risk by increasing diversification.

By nature, infrastructure investments have to be sustainable and should therefore meet ESG criteria. The long-term nature of infrastructure investment makes sustainability critical, as only sustainable assets can increase in value over the long term. For this reason, infrastructure investors increasingly factor in sustainability considerations measured by ESG criteria when making investment decisions. Investors have aligned investment practices more broadly with the United Nations’ Sustainable Development Goals or the G20 Principles for Quality Infrastructure Investment (OECD, 2019). Many pension funds, insurers and asset managers are now required to allocate a portion of their investments to ESG projects.

Measuring and comparing ESG performance is cumbersome. A variety of market-driven strategies and approaches are used to take sustainability into account in investment decisions, including numerous private sector initiatives and platforms. However, a lack of standardisation in ESG data and information make it difficult to measure a project’s sustainability. Many different sustainability reporting standards exist, each with their own objectives and set of stakeholders. Asset managers and asset owners face a fragmented, increasingly burdensome system.

The European Union’s green taxonomy is an important step towards investor and corporate disclosure. In June, the European Parliament adopted a regulation that established a European Union-wide classification system, or “taxonomy,” with the aim of setting a common language for determining the economic activities that may be considered sustainable from an environmental point of view. The taxonomy complements the European Commission’s proposals on improved disclosures on sustainable investments and risks, and benchmarks for low-carbon measures and efforts to improve the carbon footprint. The proposed regulation provides guidance for companies on how to report climate-related information in line with the Task Force on Climate-related Financial Disclosures (TCFD) recommendations. The EU taxonomy will be further developed through a new platform on sustainable finance. The first company reports and investor disclosures using the EU taxonomy are due at the start of 2022.

The new EU taxonomy helps standardise data, information and criteria. Project data disclosure remains very scarce and the correlation between various ESG metrics is very weak (European Central Bank (ECB), 2019). The inconsistent measurement of ESG criteria is a major impediment to the development of ESG assets. The EU taxonomy covers several infrastructure assets, such as transport and electricity, bringing clarity on the environmental impact (especially for the climate), while also considering social and governance aspects. As such, the new taxonomy can help to label financial products as ESG-compliant. The EU green taxonomy and green bond standard provide a very good starting point. Later, projects can be further broken down into assets that are neither brown nor green, but lie on a spectrum between the two.

Growing sustainable finance

ESG investing is growing fast and new securities are being developed. The Global Sustainable Investment Alliance estimates that at the beginning of 2018, more than USD 30 trillion in institutional assets worldwide were allocated to ESG strategies. This is expected to grow significantly in the coming years as investors increasingly integrate sustainability considerations into their investment decisions.
were invested in products that were sustainable, environmental, social and governance-focused, or green. New ESG bonds labelled “blue bonds,” as defined by the World Bank, fund coastal restoration, marine biodiversity, sustainable fisheries and pollution control. “Humanitarian bonds” target pandemic disease and migration. Specialised issuers have emerged and several organisations track green finance and follow the broader set of so-called impact bonds.

The capital reallocation prompted by the expansion of ESG investing could trigger “carbon correction” in asset prices. Figure 9 shows that lower financing costs or a stronger investor preference for greener production processes help accelerate the green transition. Some investors refuse to support management teams of companies that do not properly disclose their environmental footprint. Following this policy, “brown” companies might face slumps in their valuations because of their poor carbon footprints or because investors steer clear.

Reputational and litigation risks can help explain investor aversion to non-green assets. The greening of carbon-intensive sectors is, to a large degree, explained by equity investors pushing these sectors to adopt and develop greener technologies because they are concerned about future litigation costs. Investors see green firms as less likely to suffer from environmental disasters – and therefore less likely to be involved in litigation (Klassen and McLaughlin, 1996; Hong Kacperczyk, 2009).

Shifts in investor preferences can be accompanied by efforts to clean up companies. For example, Gollier and Pouget (2014) show that large activist investors can generate outsized returns by investing in non-responsible companies and turning them into responsible ones.

Green bonds are continuing to develop rapidly but still represent a small portion of the market. “Green bonds” are debt securities whose proceeds are used to finance investment projects with an environmental benefit (Ehlers and Parkers, 2017). The first green bond was issued in 2007 by the European Investment Bank. From 2008 to 2017, global annual issuance rose from less than EUR 1 billion to more than EUR 120 billion (ECB, 2019). Since 2013, the average net issuance of euro-denominated investment grade green bonds represented around a quarter of the global net green total. However, despite strong growth, green bonds accounted for only 1% of the overall supply of euro-denominated bonds over the same period. Green bonds represented 3% of global bond issuance in 2018 and, despite their dynamism, they appear insufficient in their current setup to finance the greening of the economy.

Green bonds are not unlike other bonds in that they tend to be priced closer to the initial guidance and are often oversubscribed. They generally offer similar yields to comparable conventional bonds, but there is evidence that in some markets, issuers can borrow at lower rates than through conventional bonds. These lower rates are consistent with the idea that investors are prepared to forgo some income in the pursuit of sustainable investments (Baker et al., 2018).

The absence of a properly recognised and harmonised classification makes greenwashing a risk for some assets. New securities and investment structures are emerging in a market where the risks and rates of return are not fully transparent, comparable or accessible in ways that can be consistently monetised. Green issuers can expect lower financing costs and a possible premium created by attracting investors willing to accept a lower return. But the growing scale, complexity and diversity of green bonds may yet pose the most significant challenge for sustainable finance. Credibility must be safeguarded.

13 The aggregate comprises six major markets: Australia, Canada, Europe, Japan, New Zealand and the United States.
14 In January 2020, BlackRock, the world’s largest investment manager, announced that it would divest from companies that made 25% or more of their revenues from coal, and that it would start using its voting power to force companies to disclose climate risks. According to InfluenceMap, in late 2019, BlackRock controlled shares in fossil fuel companies worth USD 87.3 billion. It was a top-three investor in all eight of the world’s largest oil companies, and a top-ten investor in the 12 most systemically important banks in the world.
15 Salinger (1992) shows that large-scale ecological accidents, such as the Bhopal gas tragedy or the Exxon Valdez oil spill, are associated with extremely high litigation costs. In recent history, several major US equity funds have divested from tobacco companies when it became clear that litigation risks could become prominent.
Harmonising the taxonomy limits the incentive to “greenwash” assets. For sustainable investment to go truly mainstream, it needs to do more than exclude irredeemably brown industries and finance new, deep-green technologies. Sustainable investing must catalyse and support all companies that are working to shift from brown to green. It is very important that the temptation to “greenwash” existing spending be avoided.

The EU taxonomy and the green bond standard initiative are very important steps. The proposed EU taxonomy regulation aims at clarifying green definitions and putting in place a verification and accreditation process to enhance credibility. Green bond principles have been developed by the private sector (International Capital Market Association (ICMA), 2014) and the European Commission is building on these and the taxonomy regulation to establish an EU Green Bond Standard. As part of this initiative, banks, corporate issuers, multilateral development banks, regulators and governments are working together to improve standards further (Ehlers and Packers, 2017).

Some evidence of a green premium

Evidence suggests that more transparent companies are increasingly seeing valuation gains. Four-fifths of the largest 1100 companies worldwide now disclose climate-related financial risks, as some recommendations from the Task Force on Climate-related Financial Disclosures (TCFD) advise. Three-quarters of investors who use this information have seen an improvement in the quality of climate disclosure. Figure 24 plots the change in TCFD disclosure and the variation in stock prices for a set of EU manufacturing companies covered in the dataset. While the change is computed over a short period of time, from 2015 to 2019, it appears that more compelling corporations with increased TCFD disclosure are enjoying premiums in their share prices.

![Figure 24](image)

Change in TCFD disclosure (x-axis, 2015-2019, %) and in stock prices (y-axis, 2015-2019, %)

![Figure 25](image)

ESG performance and greenhouse gas emissions per sales across time (index, 100=2008)

Source: EIB Economics Department calculations based on Bloomberg.  
Note: Manufacturing sector only. Sample of 76 EU companies.

Source: EIB calculations based on Bloomberg.  
Note: Sample of listed companies from all economic sectors in advanced economies. Greenhouse gas emissions per sales is based on 100 in 2008 and reported on an inverted axis.

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16 In 2017, the Financial Stability Board’s Task Force on Climate-related Financial Disclosures highlighted the need for comparable and consistent disclosures about the risks and opportunities of climate change and issued recommendations to this end. The supporters of the Task Force on Climate-related Financial Disclosures (TCFD) have balance sheets totalling USD 120 trillion and include the world’s top banks, asset managers, pension funds, insurers, credit-rating agencies, accounting firms, and shareholder advisory services.
We have analysed the existence of a relative equity premium for green corporations. We built a granular database merging balance sheet information from Orbis with Datastream data on equity prices and the Bloomberg database on environmental, social and corporate governance scoring for more than 500 corporations. The dataset covers several economic sectors with almost half of the companies operating in the manufacturing sector and more than 35% in the electricity, mining, finance and insurance and communication sectors.

Over time, the companies report increased performance. Figure 25 shows the median greenhouse emissions to sales ratio and ESG score. The ESG score goes up, while greenhouse gas emissions trend downward (on an inverted scale in the figure), reflecting better ESG and emission performances. The findings may be influenced by the survey’s composition as public awareness has increased pressure on top companies. However, the relationship was similar at the upper and lower end of the sample.

Since the global financial crisis, a portfolio of green equities has typically outperformed a portfolio of brown equities. We split the companies from the sample above into two groups, green and brown, depending on their average greenhouse emissions over the period. Companies with a ratio below the median are in the green portfolio and those with a ratio above are included in the brown portfolio. We computed the return on each portfolio, using each company’s share of the pool’s average capitalisation, its stock price trends and dividend ratio. The results in Figure 26 suggest that green portfolios have mainly outperformed since the financial crisis and are less volatile. The volatility may reflect the sector composition of the portfolios, with the green equities being more service-based and brown more manufacturing-oriented, and therefore more cyclical.

A simple analysis suggests that as a company’s ESG standards rise, its shares tend to outperform the market. For the sample of EU firms, Figure 27 shows the relationship between the change in ESG disclosure from 2006 to 2009 and from 2014 to 2017, and the stock’s deviation from the market return. The positive relationship suggests the market returns on two companies for which the ESG index differs by 4 percentage points – other things else being equal – differ by 1%. The simple relationship has a relatively weak explanatory power however and more factors should be taken in consideration to better explain differences in market returns.
After accounting for a firm’s overall performance, returns significantly increase with the ESG rating. We then looked at estimates based on more sophisticated equations run on the whole dataset of around 1,075 corporations. The equations incorporate sectoral dummies and variables for the firm’s economic performance (asset turnover, profit margin, price to book ratio) to explain the market return and total return. Each indicator was entered separately in different equations. The coefficients are fairly similar across the estimates. They are statistically significant at the 5% level at least. Moreover, they are around twice as high as the elasticity obtained from the scatter plot, suggesting that a 2 point increase in ESG raises returns by 1%. The conclusion that ESG bonds lower the cost of finance for corporates is broadly supported by the literature: Friede et al. (2015) combines the findings of about 2,200 studies published in academic journals and reaches a favourable conclusion.

Given limited data availability, simple linear models must be handled with caution. It may well be that the effect is not linear and will increase over time. From a long-term perspective, climate change awareness is in its infancy. As it gains momentum, it will likely have an effect on the equity premium of green versus not green companies, with the equity premium likely widening over time. The relationship may also evolve with new, major policy announcements, causing the economy to adjust and prices to be revised. Finally, there is a danger that markets could suddenly overreact, with the prices of brown assets falling off a cliff. However, limited data makes it difficult to test these hypotheses.

Why and how institutions and financial supervisors can accelerate and deepen the transition

As explained above, several changes suggest that the financial sector is becoming increasingly concerned with environmental issues. However, the change is relatively slow – or at least too slow to meet the looming challenges. In this section, we review the actions undertaken by the financial sector, central banks and bank supervisors to accompany and strengthen this change.

Improved transparency is necessary to assess climate risks

The financial sector is becoming increasingly affected by two types of climate-related risk. We can make a distinction between very different types of climate risk: physical risks, resulting from global warming, and transition risks, resulting from shifts in investors’ expectations/preferences. When physical risks materialise, they erode asset values, reducing collateral value for banks’ loans. They also increase the payments made to insurance companies. Transition risks materialise when mitigation policies, technological advances or changes in public sentiment lead to a repricing of assets.

Physical risks are becoming more prominent, with potential losses increasing. There is evidence of an increase in the scope and frequency of the losses resulting from natural disasters: extreme weather events are more severe, more frequent and last longer. The share of weather-related losses has increased steadily, accounting for over 80% of insured natural catastrophe losses in 2018 (Giuzio et al., 2019). Besides, rising sea levels, droughts and floods and a higher incidence of extreme weather events can cause losses for homeowners and diminish property values. The risk in banks’ mortgage portfolios is increasing, mirroring the rise in the likelihood and concentration of adverse events that were previously considered unrelated.

Credit ratings agencies are starting to incorporate climate change into their models. As a result, physical risks are beginning to be priced into these models, but at a fairly slow pace. As climate change intensifies, the risk of significant losses – through damage to property, infrastructure and land – is rising in high-risk regions. This risk is eroding asset values, which in turn is affecting their value as collateral.

17 See Davradakis and Maurin (2020) for more details. Regressions estimated with random effects estimator, sector fixed-effects are used as control, standard errors clustered at the sector level.
for a large number of financial institutions. Insurance liabilities are particularly exposed, and properties in areas vulnerable to floods, fires and hurricanes have become more expensive to insure. While new models have improved insurers’ ability to forecast and measure risk for insurance coverage and pricing, climate change is so strong and rapid that the historical data needed to build accurate models are lagging.

So far at least, climate disasters have had a negative but limited impact on stock prices. The IMF (2020a) finds that, on average, climate disasters have resulted in a drop of 2% for banking stocks and 1% for the overall stock market. In one out of ten cases, the impact on the aggregate market is greater than 14%, indicating that some climate disasters can have a material effect on financial stability. Hong et al. (2018) investigated the impact of drought on food companies’ cash-flows. They show that a portfolio which shorted food stocks in countries experiencing a drought and went long on those in countries not experiencing a drought generated a 9.2% annualised return from 1985 to 2015. This excess return is larger in countries with little history of droughts prior to the 1980s, suggesting that markets inexperienced with climate change underreact to such risks.

Transition risks materialise when mitigation policies, technological advances or changes in public sentiment lead to a repricing of assets. Changes in climate policy, technology and shifts in consumer and investor preferences exacerbate the risks associated with the climate transition. During the transition, carbon-intensive firms or fossil fuel companies could see their earnings decline. An extreme case is companies focused on fossil fuel extraction, which could find themselves stuck with worthless assets in a new, low-carbon global economy. Funding costs for those companies are increasing because of higher default risks and lower profit expectations. Investors already holding assets from these companies could see their values decline.

Assessing whether the transition risk is priced correctly is even more challenging because transition risk plays out over the long-term and is contingent on many other factors. While physical risk can be measured objectively, transition risks are very much forward-looking and more difficult to price. Transition risks depend the policies crafted and policymakers ability to deliver on those new policies, the impact of emerging technologies, social preferences and a company’s capacity to adapt its business model. The literature shows that transition risk pricing is not straightforward (Delis et al., 2018; Friede et al., 2015).

Policies to curb or prevent climate change can also strongly affect asset valuations. Policies implemented to try to prevent or curb climate change (climate change mitigation) may also have wide-ranging effects that hit different sectors – the energy, transport, manufacturing and construction sectors in particular. If the mitigation efforts are too timid in the present, the magnitude and pace of the necessary adjustment will be greater in the future, creating the potential for a sudden and general market correction or even an economic recession (Lane, 2019).

Overall, climate change-related risks have the potential to become systemic (ECB, 2020). Banks’ could have significant exposure to the largest carbon emitters, making a disorderly transition to a low-carbon economy a systemic risk for the financial sector. Exposures to transition risk, although contained in relative terms, may be significant for some banks in absolute terms. The ECB (2020) shows that banks’ exposures to the 20 largest emitters represent 20% of total large exposures, or 1.8% of the total assets of the banks in the sample. Together, these 20 emitting firms are responsible for more than half of the reported aggregate carbon footprint contained in the large asset exposures of euro area banks. Correct pricing reduces the risk of banks’ suddenly reassessing the assets’ worth, which could result in fire sales or abrupt slumps in the asset prices of specific firms or sectors (European Systemic Risk Board (ESRB), 2016; Bank of England, 2018).

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18 The study considers around 350 large climate disasters over the past 50 years, on a sample of 68 economies, representing 95% of global GDP. For example, Hurricane Katrina, in 2005, with the largest damage in absolute terms in our sample (1% of US GDP), had no discernible impact on the US stock market index. The 2011 Thai floods, by contrast, with the largest damage relative to the economy’s size, caused a 30% drop in the stock market over 40 days.

19 Efforts to gauge financial institutions’ exposures to transition risk have so far mostly concerned investments in certain industrial sectors. Typically, the most climate-sensitive sectors are selected in the NACE classification on the basis of an aggregate environmental metric, such as a metric for carbon emissions for the sector. Battiston et al. (2017) remap all the sectors at NACE2 4-digit level into new climate policy-sensitive sectors, combining criteria including carbon emissions, the role of the sectors’ supply chains, and the existence of traditional policy institutions for the sectors.
Banks’ ability to address climate risks is limited by the available data. A survey by the Institute for International Finance looks at the impediments that prevent financial firms from developing an explicit process for identifying and addressing climate risks and opportunity. A lack of available data is listed by 28% of respondents, followed by a lack of experience (16%) and a lack of regulatory requirements or supervisory expectations (also 16%).

Institutions are developing frameworks to improve the awareness and pricing of climate risks

Climate change affects central banks as guardians of monetary policy role and as bank supervisors. On the monetary policy side, climate risks impact relative prices, expectations, capital stock, balance sheets and financial markets, therefore affecting productivity, potential output, interest rates and the output gap (Blatten et al., 2020). Monetary policy’s challenge is to disentangle the temporary and permanent shocks arising from climate change, and to react to the risks that natural disasters represent. On the supervisory side, climate change potentially requires an update of the prudential framework, and in any case careful monitoring based on enforced disclosure.

For the Network on Greening the Financial System (NGFS), ensuring the financial system is resilient to climate-related risks falls within the remit of central banks and supervisors (NGFS, 2020). The network, which consists of around 70 members, aims to analyse, define and promote best practices that contribute to the proper management of climate risk in the financial sector. It has released several reports intended for central banks and supervisors, itemising the necessary measures to foster a greener financial system, focusing on (1) supervisory practices, (2) climate-related stress testing, and (3) data gaps and disclosures. The NGFS emphasises the importance of acting in a swift but orderly fashion to incorporate physical and transition risk in prudential frameworks.

Figure 28
Current initiatives related to financial risks

<table>
<thead>
<tr>
<th>Are banks surveyed in your jurisdiction?</th>
<th>Do banks disclose in your jurisdiction?</th>
<th>Supervisory guidance issued?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Note: Yes and to some extent for Q2, yes and in the process for Q3. The numbers of responses vary by question, from 23 to 27 reporting central banks.

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20 This network, created late 2017, brings together central banks, supervisors and international institutions.
21 The report develops reference climate policy scenarios for central banks and supervisors and gives them guidance on how to integrate climate risk analyses into macroeconomic and financial stability surveillance, capturing the macro financial impact of these risks. Climate-related risks are non-linear, will to a large extent manifest themselves in the future and can therefore not be based on historical data. As such, we need to develop forward-looking risk management techniques.
Changes have already been implemented and climate disclosure is on the rise. A survey from the Bank of International Settlements (BIS) conducted on 27 central banks and supervisory authorities shows that banks disclose in a large number of jurisdictions and that supervisory guidance is issued in around one-third of them (Figure 28). Currently in the European Union, there is a lack of granular public data detailing complex and evolving exposures both within and across economic sectors. For the purposes of their regulatory disclosures, institutions are expected to publish meaningful information and key metrics on climate-related and environmental risks that they deem to be material.22

The European Central Bank’s Single Supervisory Mechanism has recently published its guide (ECB, 2020), outlining its understanding of the safe and prudent management of climate-related and environmental risks under the current prudential framework. The guide describes how the European Central Bank (ECB) expects institutions to consider climate-related and environmental risks – as drivers of established categories of prudential risks – when formulating and implementing their business model and strategy (in the short, medium or long term), their governance and risk appetite and their risk management framework (identification, quantification, credit-granting process, monitoring, internal reporting, stress testing and liquidity).

While everything does not have to be green or brown, green-supporting factors and brown-penalising factors can be distinguished. The former lowers capital requirements for financial institutions conducting more green investments by assigning lower risk weights to sustainable assets. Given the higher cost of bank equity, lower capital requirements incentivise banks to raise the volume of credit to green investment. Brown-penalising factors assign higher risk-weights to carbon-intensive assets, requiring banks to raise capital requirements to cover for the higher risk and therefore penalises credit allocation to unsustainable investments by raising their cost of finance.

Freeing up capital by lowering the capital charges for climate-friendly investment would jeopardise prudential frameworks. For the integrity of financial institutions and financial stability, it is important that prudential frameworks remain risk-based. In its action plan, the European Commission also proposed exploring the feasibility of including climate-related risks in banks’ capital requirements frameworks. While the idea of a green-supporting factor – a risk-weight reduction in the prudential framework for banks’ exposures to green assets – has been discussed, providing capital relief or lower capital charges for green investment would blur the objective of risk-weighting.

However, increasing capital charges for loans to brown companies does make sense and is aligned with the principle of prudential capital. On the one hand, the purpose of weighting bank assets is not to estimate their societal impact. Climate investment is welfare-enhancing, but can be exposed to changes in technology. On the other hand, the value of stranded assets, defined as assets affected by unanticipated or premature write-downs, devaluations or converted to liabilities, can affect banks’ net worth and therefore their capital buffers. The possibility of stranded assets should be acknowledged when calculating risk-based capital requirements. Climate stress tests are a good way to start.

In Europe, the European Systemic Risk Board highlighted the potential impact of physical and transition risks on the European financial system and recommended that authorities consider developing climate stress-test methodologies (ESRB, 2016; Vermeulen et al., 2018). Stress tests and scenario analyses can be used to gauge the quantitative impacts of various climate mitigation scenarios. While work is ongoing, especially on data and methodologies, stress test methodologies push institutions to look forward and think about climate change. Compared with traditional stress tests, climate stress tests carry greater uncertainty given the long time horizon of the expected impact, the choice of the appropriate discount rate and the timing of new policies and changes in technology.

22 One can isolate three levels of emission disclosure. Scope 1 relates to direct emissions from owned or controlled sources (company facilities, machinery and vehicles), scope 2 relates to indirect emissions from purchased electricity, steam, heating and cooling, scope 3 relates to all other indirect emissions (business travel, employee commuting, purchased paper, waste, office equipment, etc.). An ECB study based on the 12 largest banks and 14 largest insurers in the euro area estimates that more than 80% of institutions disclose business travel and around one-third of them report commuting (ECB, 2019).
What matters for the allocation of capital flows is the spread between brown loans and green loans. As shown in Figure 9, since the cost of equity is much higher, more capital is required to back a bank loan, making it more expensive. This influences the allocation of savings across various investments, which depends on the relative returns. What matters for the allocation of credit is the wedge – the difference between the returns on green and brown investments. Whether the gap widens from the two sides does not really matter. Higher financing costs for brown investment would divert the flow of credit to green investment.

Banks are starting to price in exposure to climate policy. Dellis et al. (2017) compare the loan rate charged to fossil fuel firms – along with their climate policy exposure – with that charged to other firms. The authors find that before 2015, banks did not price in exposure to new climate policies. After 2015, however, the authors find that fossil fuels firms exposed to stricter climate policies saw their credit costs rise, particularly for those holding more fossil fuel reserves. “Green” banks also charge higher loan rates to fossil fuel firms.
Conclusion and policy implications

We have analysed the financing of the investment needed to meet the European Green Deal, emphasising that support is needed from the European Union’s financial sector. We show that structural shifts in the European Union’s financial system can alleviate some of the costs of the transition toward a cleaner economy.

Changes are already taking place as investors become increasingly aware of the long-term unsustainability of some investments and adjust their preferences accordingly. As shown with green bonds, new products and markets are emerging. But ESG investing still falls short of the challenge, and green investment premiums, when they exist, remain tiny. Green assets are still in their infancy, and are largely in the hands of private initiatives. But to truly take off, fledgling markets have to be structured, and the financial sector could contribute to the building of those markets.

The public sector has a key role to play in structuring a green-friendly financial system. The financial system needs more transparency and new ways of thinking so that risks and returns can be re-evaluated in the light of the greening of the economy. Very recently, European authorities, central banks and bank supervisors have issued recommendations and guidance that will provide companies with the information required, helping to expand these markets.

Transitioning the whole economic system takes time and requires public support as oligopolistic powers shift and the value of assets fluctuate widely. The strategy has to be coordinated and phased in to avoid adjusting too quickly, which could harm economic competitiveness and fuel social unrest. However, the European Union’s green agenda can also benefit from synergies with the Capital Markets Union and public support for the coronavirus recovery.
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Glossary of terms and acronyms