

Benoît Cœuré: Monetary policy and climate change

Speech by Mr Benoît Cœuré, Member of the Executive Board of the European Central Bank, at a conference on "Scaling up Green Finance: The Role of Central Banks", organised by the Network for Greening the Financial System, the Deutsche Bundesbank and the Council on Economic Policies, Berlin, 8 November 2018.

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2018 has seen one of the hottest summers in Europe since weather records began.¹ I would like to thank Torsti Silvonon, Fabio Tamburrini and Sam Langfield for their contributions to this speech. I remain solely responsible for the opinions contained herein.

Increasing weather extremes, rising sea levels and Arctic melting are now clearly visible consequences of human-induced warming.² Climate change is not a theory. It is a fact.

While only one dimension of the human cost, the consequences in macroeconomic terms look set to be large. Without further mitigation, cumulative emissions pose significant risks of economic disruption.³

While there is a wide recognition that environmental externalities should be primarily corrected by first-best policies, such as taxes⁴, all authorities, including the ECB, need to reflect on, and consider, the appropriate response to climate change.

In recent years, central bankers, led by Bank of England Governor Mark Carney, have started discussing the financial stability implications of climate change.⁵ The first tangible results are trickling in. The Financial Stability Board's Task Force on Climate-related Financial Disclosures published its first status report just a few weeks ago. Only last week, ECB Banking Supervision communicated to banks that climate-related risks have been identified as being among the key risk drivers affecting the euro area banking system.

And, of course, the Central Banks and Supervisors Network for Greening the Financial System published its first progress report just a few weeks ago, reasserting that climate-related risks fall squarely within the supervisory and financial stability mandates of central banks and supervisors.

An area that has received less attention though, both in policy and in academia, is the impact of climate change on the conduct of monetary policy. Today I would like to contribute to this debate and offer a way of thinking about how climate change fits into our current monetary policy framework – the way we react to shocks and the way we think policy propagates through the economy – and how it may affect our monetary policy implementation.

I will argue that climate change can be expected to affect monetary policy one way or the other. That is, if left unchecked, it may further complicate the correct identification of shocks relevant for the medium-term inflation outlook, it may increase the likelihood of extreme events and hence erode central banks' conventional policy space more often, and it may raise the number of occasions on which central banks face a trade-off forcing them to prioritise stable prices over output.

In the more desirable scenario in which humankind rises to the climate change challenge, the implications for monetary policy could be equally far-reaching, in particular if the associated shift in the energy mix changes relative prices to an extent that risks destabilising medium-term inflation expectations.

I will also argue that there is scope for central banks themselves to play a supporting role in mitigating the risks associated with climate change while staying within our mandate.

Climate change and the monetary policy strategy

To appreciate how climate change may affect monetary policy, it is useful to first recall the basic principles of how central banks decide on their actions.

Broadly speaking, implementing monetary policy is the practice of identifying the nature, persistence and magnitude of the shocks hitting our economy.

Policymakers typically differentiate between two broad categories of shocks.

The first is demand shocks. These are shocks that are “benign” or manageable from the perspective of monetary policy because they pull inflation, growth and employment in the same direction – a “divine coincidence” which does not pose a dilemma to central banks.⁶

The second category relates to supply-side shocks. These shocks are less easy to accommodate for central banks as they pull output and inflation in opposite directions. This generates a trade-off for central banks between stabilising inflation and stabilising output fluctuations.

Climate-related shocks – and this is my first corollary – typically fall into this second category of shocks.⁷

Droughts and heatwaves often lead to crop shortfalls, putting upward pressure on food prices.⁸ Hurricanes and floods destroy production capacity, thereby raising input and output prices. And unusually cold winters can be seen as malign productivity shocks – that is, they may raise input prices for the same level of output.

So, much like other supply shocks, weather-related disturbances typically pose a dilemma for central banks, which may then have to choose between stabilising inflation or economic activity.

Policymakers have usually resolved this trade-off by calibrating their response to a supply-side shock according to its estimated persistence and size.

If the shock is thought to be short-lived, and unlikely to affect the medium-term inflation outlook relevant for monetary policy, we usually “look through” the shock – that is, we tolerate its temporary effects on inflation without taking any action.

If the effects prove more persistent, however, and are at risk of spreading more widely through the economy, monetary policy action may be warranted.

The impact of climate change on monetary policy

It is fair to say that most weather-related shocks have been short-lived and contained – at least so far. This year’s extremely hot and dry summer, for example, meant smaller harvests for many European farmers. But its overall price effects have been limited to vegetable prices, and will probably prove to be temporary. Similarly, although the flooding in June 2013 was the most severe in Germany since the 1950s, its macroeconomic impact was limited.

As a result, the ECB, in its short history, has never yet been compelled to take action in response to climate-related shocks. So far their largely temporary effects on output and inflation have allowed us to look through them. This meant that central bankers thought the horizon of climate change was extending well beyond the one of monetary policy.

But this may change. Indeed, I would argue that the horizon at which climate change impacts the economy has shortened, warranting a discussion on how it affects the conduct of monetary policy. That is, climate change is likely to affect monetary policy one way or the other – whether it

is left unchecked or humankind rises to the climate change challenge. This is my second corollary.

Let me start with the more disturbing scenario in which both the private and the public sector fail to take prompt action to cut CO2 emissions in line with the COP21 commitments.

On this trajectory, climate change is likely to affect the conduct of monetary policy in three important ways.

The first relates to our ability to correctly identify the shocks hitting the economy.

In recent years, for example, we have repeatedly observed an unusual blip in economic activity in the United States in the first quarter. This has often been attributed to a harsh winter, despite best efforts to seasonally adjust the data.

But causality is inherently difficult to establish. Indeed, statistical analysis has challenged the hypothesis that cold temperatures are behind the observed deceleration in first-quarter growth.⁹

Similarly, last month, we saw a puzzling persistence in petroleum prices in Germany despite a parallel fall in oil prices. One hypothesis is that this year's hot summer caused the water levels in German rivers to fall to levels that only allow petrol tankers to carry half their capacity, creating supply bottlenecks.

Uncertainty also extends to the effects of regulatory responses by governments to the growing challenges posed by climate change. German growth in the third quarter is currently projected to have stalled or even contracted, probably largely due to bottlenecks in the testing process under the new Worldwide Harmonised Light Vehicles Test Procedure.

But we cannot be sure. Given the current global environment, growth may have slowed for other reasons. Or the recent emission scandal may have led to a more fundamental shift in consumer preferences.

All this means that, to the extent that climate change can be expected to amplify the frequency of adverse weather shocks, and evidence to this effect is mounting, it will become increasingly difficult for central banks to disentangle the variation in the data relevant for the assessment of the medium-term inflation outlook.¹⁰ It will cause the signal-to-noise ratio to deteriorate and thereby increase the risk that central banks take action when in fact they shouldn't, or vice versa.

The second implication relates to the distribution of shocks.

Put simply, the longer the risks of climate change are ignored, the higher the risks of catastrophic events, possibly with irreversible consequences for the economy. In other words, the distribution of shocks may become more "fat-tailed".¹¹

This raises one question and one concern for monetary policy. The question is whether central banks themselves should hedge against such tail risks by taking pre-emptive measures. I will turn to this in the second part of my remarks.

The concern is that monetary policy may be more often forced to adopt non-standard policy measures. The global financial crisis has shown that extreme events can quickly erode central banks' conventional policy space. Catastrophic climate change could thus test the limits of how far monetary policy can go and, in the extreme, force us to rethink our current policy framework.

The third and final implication relates to the persistence of shocks and the inflation-output trade-off central banks may face.

Climate change, for example, will make some areas of the world less habitable, which can be

expected to increase the frequency and intensity of international migration.¹² The events of recent years, though different in nature, highlight how migration can have long-lasting effects on broader labour market dynamics and, ultimately, wage developments.¹³ There is evidence that migration has contributed to dampening wage growth in Germany in recent years, thereby further complicating our efforts to bring inflation back to levels closer to 2%.¹⁴

Similarly, in the absence of clear and tangible evidence that the demand for fossil fuels will decline, and with existing conventional oil fields depleting rapidly, persistent energy shocks cannot be ruled out.¹⁵

There is no shortage of examples in history of this causing material disruptions to growth and employment.¹⁶ In the late 1970s and early 1980s, major central banks raised interest rates to prohibitive levels to avoid what central banks call “second-round effects” – that is, oil price shocks feeding into core inflation.

Central banks, including the ECB, were forced to take similar action more recently.¹⁷ I will come to this in a minute. But the point is that, although the “medium term” notion offers central banks flexibility that caters for different shocks, there is a limit to how much they can look through persistent supply shocks. The horizon of monetary policy is stretchable but it is not infinite. Policy needs to act before risks of broad-based second-round effects materialise. Climate change may raise the odds of this happening.

Relative prices and inflation expectations in the transition towards a low-carbon economy

This brings me to the second scenario in which humanity succeeds in accelerating the transition to renewable sources of energy. Although clearly more desirable for society, it may also create trade-offs for central banks.

Along this trajectory, the marginal cost of harvesting renewable energy may become considerably lower and more stable than in the current regime, in which changes in the effective supply of oil have been a recurrent source of disruption.¹⁸ In other words, a lasting shift in the energy mix can be expected to persistently change relative prices. Although such a change should in principle not bear consequences for monetary policy, if large and persistent enough, it could feed into expectations and affect aggregate inflation.

To see the consequences for monetary policy, consider the events of recent years.

A sharp fall in commodity prices pushed headline inflation into negative territory towards the end of 2014. But because the fall in commodity prices proved so persistent – headline inflation remained close to zero until late in 2016 – we saw growing signs that firms, households and financial market participants had started revising down their medium to long-term inflation expectations, away from the levels we consider as being consistent with price stability. The prevalence of substantial economic slack fed this process further.

Strong and far-reaching monetary policy action, including the purchases of government bonds and the introduction of negative rates, was needed to arrest a fall in inflation expectations that, in an environment of weak aggregate demand, might otherwise have led to a downward spiral in prices and wages.

A faster transition towards renewables, coupled with technological breakthroughs, may pose similar challenges. It may make it more difficult for central banks to attain inflation just below 2% should firms, households and financial markets expect aggregate medium-term inflation to fall as a result of a change in the energy mix.

These risks are exacerbated by the fact that a successful energy transition is unlikely to happen in isolation. It will rather be an integral part of a much broader change in the economic structure linked to the fourth industrial revolution.

The shift towards electric vehicles, for example, may go hand-in-hand with increased autonomous driving, revolutionising the transport industry. Big data analytics will help in mining climate data and facilitating climate adaptation.¹⁹ And artificial intelligence is increasingly being used to increase energy efficiency.²⁰

Together, and if adopted wisely, these trends and innovations have the potential to be an incredible force for good as they will help revert the secular fall in productivity growth. For monetary policy, however, they are akin to a series of persistent positive supply shocks that may force central banks into action should these shocks cause a more general and broad-based re-appraisal by the public of the medium-term inflation outlook.²¹

Greening monetary policy implementation

So, the implications for the conduct of monetary policy could be substantial. The question, then, is whether central banks themselves should be doing more to prevent climate change in the first place.²²

Some argue we have an obligation to act, since the EU Treaty states that “without prejudice to its primary objective, the ECB shall support the general economic policies in the Union”, which include a high level of protection and improvement of the quality of the environment, and mandates environmental protection requirements to be integrated into the definition and implementation of the Union's policies and activities.²³ Certainly, the protection of the environment is not the only transversal objective assigned to EU institutions and hence to the ECB. Under the Treaty one could equally ask, for example, why the ECB should not promote industries that promise the strongest employment growth, irrespective of their ecological footprint.²⁴

But equally importantly, the ECB is subject to the Treaty requirement to “act in accordance with the principle of an open market economy with free competition”.

In the end, the Treaty grants the ECB a high degree of independence and it enjoys broad discretion in implementing its policies. We thus need to carefully weigh all relevant considerations and determine the actions that would be both legal and effective in promoting environmental protection without interfering with the main objective of the ECB's monetary policy under the Treaty, which is price stability.

Views and opinions certainly differ here. But I would argue that the ECB, acting within its mandate, can – and should – actively support the transition to a low carbon economy, in two main ways: first, by helping to define the rules of the game and, second, by acting accordingly, without prejudice to price stability.²⁵

Our actions to protect the environment begin with reducing our own ecological footprint. In 2007 we adopted an environmental policy and registered with the European Eco-Management and Audit Scheme. For more, see ECB (2018), “2018 update of the ECB's Environmental Statement”, October.

Much of this is already happening, although I have no doubt it will intensify in the future.

The ECB, together with other national central banks of the Eurosystem, is actively supporting the European Commission's sustainable finance agenda.²⁶

We are doing this by supporting ongoing work in various international and European fora aimed at enhancing the pricing of climate change and transition risks and promoting the reorientation of financial flows towards sustainable investment products.²⁷

A tangible side effect of these measures is that, once adopted, they will automatically be reflected in our collateral framework. That is, once markets and credit risk agencies price climate risks properly, the amount of collateralised borrowing counterparties can obtain from the ECB will be adjusted accordingly.

We have also joined the Central Banks and Supervisors Network for Greening the Financial System. ECB staff are contributing in all three work streams. My presence here today emphasises that we take our membership seriously. The Network will play an important role in coordinating work among central banks and in defining and promoting best practices.

Finally, we are also supporting work on sustainable finance-related topics at the level of the G20.

Central bank asset portfolios differ in their ability to support sustainable investment

The second step relates to incorporating these best practices into our own activities.

Most central banks typically own and manage three different types of asset portfolios: one dedicated to pension funds, a second related to the central bank's own funds, and a third covering foreign exchange reserves. More recently, some central banks, including the ECB, have also built up separate monetary policy portfolios, resulting from the need to preserve price stability when the room for manoeuvre with conventional policy instruments had become constrained.

Not all of these portfolios are, however, equally suited to promoting green finance.

For our pension fund portfolio, we have already taken concrete steps. The broad investment universe and longer-term investment horizon allow us to pursue a sustainable investment policy based on selective exclusion and proxy voting guidelines.

We delegated proxy voting for equity investments to investment managers that have signed up to the United Nations Principles for Responsible Investment, requiring them to incorporate environmental, social and corporate governance (ESG) standards into their voting policies. And, together with our external asset managers, we are considering broadening the options for ECB staff to invest in sustainable financial products.

For our own funds portfolio, which consists of the ECB's paid up capital and general reserve fund, we have started an internal investigation on how ESG criteria could be implemented in the future.²⁸

Purchasing green bonds from a number of eligible issuers could be an option, as long as the markets are deep and liquid enough. And we could potentially expand our investment universe to other asset classes where the ESG-compliant investment space is broader. Work conducted under the first work stream – that is, the development of a clear and transparent taxonomy – will help accelerate progress on this front.

Now, when it comes to our policy portfolios, our objectives are different.

The main purpose of our foreign reserves is to ensure that the ECB, at any given point in time, has sufficient liquidity in foreign currency to conduct foreign exchange operations if needed. Our portfolio is therefore composed of the most liquid and creditworthy fixed income assets in a few major currencies, leaving little room for climate-related objectives.²⁹

This much is probably uncontroversial. But a more contentious debate has emerged over the potential use of our asset purchases to pursue climate-related goals. Our corporate sector purchase programme in particular has come in for criticism as it includes emission-intensive sectors, such as manufacturing and utilities.³⁰

In this debate, it is important to recall that the ECB decides on and calibrates its monetary policy measures with a view to achieving its price stability objective under the Treaty. As a consequence, more than 80% of the €2.5 trillion of securities purchased under our Asset Purchase Programme were issued by governments or their agencies.

The remaining share consists of purchases of covered bonds, corporate bonds and asset-backed securities. For these assets, the Governing Council concluded that the best way to achieve its monetary policy objective was to follow the principle of market neutrality.³¹

This principle does not preclude supporting environmental objectives, however.³² The ECB has purchased “green bonds” both under its public sector and corporate sector purchase programmes. Under the former, we currently hold around 24% of the eligible “green” universe, estimated to amount to some €48 billion. Under the latter, we hold close to 20% of the eligible “green” corporate bond universe, which currently has an outstanding volume of €31 billion euros. Under both programmes, the share we hold in “green” eligible bonds mirrors, by and large, the share of our holdings of the entire eligible universe.

This also means that, at this stage, the best the ECB can do is to concentrate its efforts on creating the right conditions for supporting the flow of capital into sustainable sectors. In this way, it will remain faithful to its primary objective of price stability and the Treaty requirement of an open market economy with free competition, while supporting environmental objectives.

Conclusion

Let me conclude.

More frequent climate-related shocks may increasingly blur the analysis of the medium-term inflationary pressures relevant for monetary policy. More fat-tailed shocks may erode central banks’ conventional policy space more often in the future. And uncertainties surrounding the speed and scope of the transition towards a low-carbon economy can potentially impact medium-term inflation expectations, posing challenges to central banks as the horizon of monetary policy is stretchable but not infinite. These and other questions deserve further careful analysis.

More imminently, the ECB will concentrate its efforts on supporting market participants, legislators and standard-setting bodies in identifying the risks emerging from climate change and providing a clear framework to reorient financial flows and reduce such risks. A unified framework is the gravitational force needed to finance the greening of our economy. And it is the precondition for central banks themselves to expand the use of ESG criteria in the build-up and management of their own asset portfolios.

Thank you.

¹ I would like to thank Torsti Silvenen, Fabio Tamburrini and Sam Langfield for their contributions to this speech. I remain solely responsible for the opinions contained herein.

² See IPCC (2018), “Global warming of 1.5 °C”, an IPCC special report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty, 6 October.

- ³ See Stern, N. (2007), “The Economics of Climate Change: The Stern Review”, Cambridge University Press. Estimating the economic damage requires assumptions on society’s time preference which are controversial. Discussing these assumptions is beyond the scope of this speech.
- ⁴ See Nordhaus, W. D. (2007), “To tax or not to tax Alternative approaches to slowing global warming”, *Review of Environmental Economics and Policy*, 1(1), pp. 26–44.
- ⁵ See Carney, M. (2015), “Breaking the tragedy of the horizon – climate change and financial stability”, speech given at Lloyd’s of London, 29 September.
- ⁶ The global financial crisis of 2008 is a good example. As house prices fell and firms struggled to access external finance, consumption and investment collapsed while unemployment rose, pushing down prices and wages.
- ⁷ See also McKibbin et al. (2017), “Climate change and monetary policy: Dealing with disruption”, CAMA Working Paper, No. 77/2017, December. Some climate-related shocks may also turn into adverse demand shocks. Rising sea levels, for example, could lead to abrupt repricing of real estate prices in some exposed regions, causing large negative wealth effects that, if uninsured, may weigh on demand and prices. Also, climate-related shocks have uneven macroeconomic effects, with adverse consequences concentrated in countries with relatively hot climates, such as most low-income countries. See IMF (2017), “The Effects of Weather Shocks on Economic Activity: How Can Low-Income Countries Cope?”, *World Economic Outlook*, Chapter 3, October.
- ⁸ For price effects, see also Parker, M. (2018), “The impact of disasters on inflation”, *Economics of Disasters and Climate Change*, Vol. 2(1), pp. 21–48.
- ⁹ See, for example, Gourio, F. (2015), “The effect of weather on first-quarter GDP”, *Chicago Fed Letter*, No 341.
- ¹⁰ Academic studies project that the risks of extreme heatwaves and floods will increase by around another 50% this century. See Mann et al. (2018), “Projected changes in persistent extreme summer weather events: The role of quasi-resonant amplification”, *Science Advances*, Vol 4(10). And evidence of such an increase is already visible. According to the European Academies’ Science Advisory Council, the number of global floods and other hydrological events has quadrupled since 1980 and doubled since 2004. See European Academies’ Science Advisory Council (2018), “Extreme weather events in Europe – Preparing for climate change adaptation: an update on EASAC’s 2013 study”, March; and Stott, P. (2016), “How climate change affects extreme weather events”, *Science*, Vol 352(6293), pp. 1517–1518.
- ¹¹ See, for example, Weitzman, M. (2011), “Fat-Tailed Uncertainty in the Economics of Catastrophic Climate Change”, *Review of Environmental Economics and Policy*, 5 (2), pp. 275–292; and Weitzman, M. (2009), “Additive damages, fat-tailed climate dynamics, and uncertain discounting”, *Economics — The Open-Access, Open-Assessment E-Journal* 3: 1–29.
- ¹² See, for example, Stapleton et al. (2017), “Climate change, migration and displacement – The need for a risk-informed and coherent approach”, report by the Overseas Development Institute and the United Nations Development Programme, November.
- ¹³ See ECB (2018), “Labour supply and employment growth”, *Economic Bulletin*, Issue 1.
- ¹⁴ See Bundesbank (2018), “Wage growth in Germany: assessment and determinants of recent developments”, *Monthly Report*, April.
- ¹⁵ The International Energy Agency estimates that, by 2025, there will be a shortfall of more than 20 million barrels per day. Recent marked oil price increases suggest that the advent of unconventional oil extraction technologies has not yet sufficiently changed supply dynamics to contain sharp increases in prices. One reason may be that the market share of shale producers, despite having expanded considerably in recent years, may still be too low to affect aggregate figures. See, for example, Bjørnland, H., F. M. Nordvik and M. Rohrer (2017), “How Flexible is US Shale Oil Production? Evidence from North Dakota”, *Centre For Applied Macro – And Petroleum Economics (Camp) Working Paper Series*, No 2/2017.
- ¹⁶ The pass-through of oil price shocks is one of the most well studied phenomena in monetary economics. Google Scholar currently shows around 28,800 academic papers containing the exact phrase “oil price shock”. Of those, some 11,600 also contain the exact phrase “monetary policy”.
- ¹⁷ This is despite oil price shocks having had on average much less impact on the economy, largely thanks to the

enhanced credibility central banks have gained over time. See, for example, Choi et al. (2017), “Oil Prices and Inflation Dynamics: Evidence from Advanced and Developing Economies”, IMF Working Paper No 17/196.

¹⁸ See, for example, Bielen et al. (2017), “The Future of Power Markets in a Low Marginal Cost World”, Resources for the Future Working Paper 17–26; and Archer, C. and M. Z. Jacobson (2005), “Evaluation of global wind power”, *Journal of Geophysical Research*, Vol. 110, pp. 1-20.

¹⁹ See, for example, the Platform for Climate Adaptation and Risk Reduction on www.placard-network.eu.

²⁰ Google, for example, managed to reduce its energy consumption by more than a third by optimising its cooling system through artificial intelligence controlled systems.

²¹ On the positive side, however, the associated increase in the economy’s trend growth rate will help lift the natural rate of interest, thereby increasing the policy space available for central banks to manage fluctuations in the business cycle. See also Cœuré, B. (2018), “Scars that never were? Potential output and slack after the crisis”, speech at the CEPIL 40th Anniversary Conference, Paris, 12 April.

²² See the European Parliament resolution of 29 May 2018 on sustainable finance (2018/2007(INI)).

²³ See Articles 11 and 127(1) TFEU and Article 3 TEU.

²⁴ In addition, there are other structural forces, such as population aging, that may impact bond markets and, hence, the transmission of monetary policy. See, for example, Praet, P. (2018), “Economic policymaking under uncertainty”, speech at the “la Caixa” Chair for Economics and Society conference, Madrid, 17 October.

²⁵ Our actions to protect the environment begin with reducing our own ecological footprint. In 2007 we adopted an environmental policy and registered with the European Eco-Management and Audit Scheme. For more, see ECB (2018), “2018 update of the ECB’s Environmental Statement”, October.

²⁶ See, for example, Villeroy de Galhau, F. (2015), “Green Finance – A New Frontier for the 21st Century”, speech given at the international climate risk conference for supervisors, Amsterdam, 6 April; and Knot, K. (2017), “Sustainability: a role for central banks?”, speech at the CEP/DNB workshop ‘Central banking & Green Finance’, Amsterdam, 28 November.

²⁷ For example, we are part of the Financial Stability Board’s Task Force on Climate-related Financial Disclosures. The ECB is also a member of a technical expert group that is assisting the European Commission in establishing an EU-wide classification system, or taxonomy, for green assets. This taxonomy has the potential to increase transparency, discourage “greenwashing” and improve market pricing of both climate and transition risks. See European Commission (2018), “Action plan: financing sustainable growth”, March.

²⁸ For a more general overview, see ECB (2006), “Portfolio Management at the ECB”, Monthly Bulletin, April.

²⁹ Requirements in terms of liquidity may differ across the national central banks of the Eurosystem.

³⁰ See, for example, Matikainen, S., E. Campiglio and D. Zenghelis (2017), “The climate impact of quantitative easing”, Policy Paper, Grantham Research Institute on Climate Change and the Environment, London School of Economics and Political Science.

³¹ For details of the corporate sector purchase programme, see ECB (2017), “The ECB’s corporate sector purchase programme: its implementation and impact”, Economic Bulletin, Issue 4, p. 40–45.

³² See ECB (2018), “Purchases of green bonds under the Eurosystem’s asset purchase programme”, Economic Bulletin, Issue 7.