



GREENING THE EUROSISTEM COLLATERAL FRAMEWORK

HOW TO DECARBONISE ECB'S MONETARY POLICY

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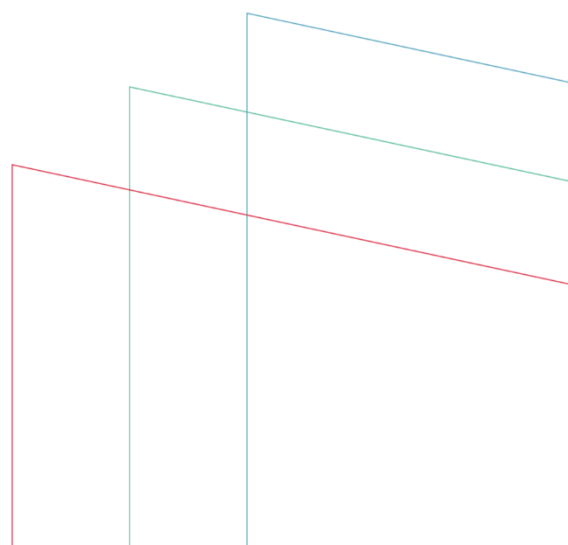
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EXECUTIVE SUMMARY

For some, money is the “root of all evil”, while others have suggested “money is power”. What is definitely true is that our economy simply cannot function without it. At the centre of our monetary system lies central bank money, because it is what banks use to make payments to each other. The collateral framework specifies the rules via which central banks inject money into the banking system, so that banks can make these payments. Furthermore, as modern financial markets are increasingly organised around collateral, central banks’ treatment of collateral – the terms on which they accept bonds or loans posted by banks – sends a powerful signal to private financial markets. Central banks’ collateral rules have significant knock-on effects for monetary and financial conditions in the wider economy.

The collateral framework of the Eurosystem – the European Central Bank (ECB) and the euro area national central banks – is at the heart of the ECB’s monetary policy implementation. Problematically, the rules dictating this central component to the ECB’s monetary policy operations are not fit for purpose.

In its current form, the collateral framework is not only at odds with democratically defined goals of the Paris Agreement and the EU’s Green Deal, but it also actively underpins financial market failures and reinforces the carbon lock-in. It further contradicts the ECB’s own principles of strong risk standards needed for the sound implementation of monetary policy, whilst undermining the high prudential standards to which it attempts to hold private financial institutions to account.

Key findings and recommendations

We focus on the collateral rules for corporate bonds and show that the Eurosystem collateral framework has a carbon bias – it favours fossil fuel companies and other carbon-intensive companies disproportionately to their contribution to EU employment and the direct production of goods and services. Overall, carbon-intensive companies issue 59% of the corporate bonds that the ECB accepts as collateral, while their overall contribution to EU employment and Gross Value Added (GVA) is less than 24% and 29%, respectively. The ECB’s collateral framework implicitly encourages fossil fuel companies to increasingly tap bond

markets – for example, we show that four large (mostly gas) fossil fuel companies rely on bonds subsidised by the ECB collateral framework for more than half of overall financing.

Eligibility is not the only way through which the ECB supports carbon-intensive sectors – lower haircuts play an important role too. The average haircut in non-carbon intensive sectors (13.93%) is demonstrably higher than carbon-intensive sectors, including fossil fuel companies (13.33%), energy-intensive companies (11.03%), non-renewable utilities (13.36%) and companies that engage in carbon-intensive transportation (10.27%). The 10 fossil fuel companies with the lowest company-level haircuts, benefit from a haircut of between nearly 1% - 4%. These low haircuts effectively signal to financial markets that these ‘dirty’ assets carry very low risk, creating favourable financing conditions for them.

To help structurally re-align the ECB monetary policy implementation (and the wider financial sector) with the goals of the EU Green Deal and a socially just green transition, we propose three policy scenarios that would allow the ECB to green its collateral framework. We consider the climate footprint of each bond, and illustrate how our scenarios would reduce the weighted average carbon intensity (WACI) of the Eurosystem collateral framework from around 243 tCO_{2e}/\$m as follows:

- 1) The *climate-aligned haircuts* (more conservative) scenario maintains the existing list of eligible bonds, but adjusts the haircuts on collateral – that specify how much banks can borrow from the ECB against that collateral – according to the bonds’ climate footprint, using a ‘shades of dirty and green’ approach. This approach is specifically designed to generate incentives and market signals for firms to issue green bonds and improve their climate performance, for example by reducing their emissions. This first scenario would see the WACI fall to 235 tCO_{2e}/\$m.
- 2) The *lower-carbon, climate-aligned haircuts* scenario excludes dirty bonds issued by fossil fuel companies and adds climate-friendly bonds that meet the ECB’s eligibility criteria. It also applies climate-aligned haircuts to the adjusted collateral list. This scenario would see the WACI fall to 196 tCO_{2e}/\$m.
- 3) The *low-carbon, climate-aligned haircuts* scenario no longer allows banks to post dirty bonds issued by either fossil fuel companies or other carbon-intensive companies as collateral. Rather, it replaces them with other bonds that are not

carbon-intensive which satisfy the eligibility criteria fully or partly. This third scenario would see the WACI fall to 71 tCO₂e/\$m.

Our scenarios provide two important insights. First, even an aggressive calibration of haircuts to reflect the relative greenness/dirtiness of collateral will not reduce significantly the carbon intensity of the ECB's collateral list. Second, for the ECB to seriously tackle the carbon bias hardwired into its collateral rules, it needs to adjust the collateral list alongside a climate-aligned haircut framework. The ECB has to rewrite eligibility criteria and replace dirty bonds with greener bonds, including those issued by carbon-intensive companies. Critically, even our more climate-friendly scenario does not eliminate carbon-intensive companies from the list of eligible issuers, but restricts the eligibility of their debt in the ECB's collateral list to green bonds. This encourages companies to accelerate the transition to low-carbon activities.

These scenarios preserve banks' access to central bank money – the maximum funding that banks can obtain from the ECB and the national central banks using corporate bonds as collateral remains roughly the same. However, by design, they significantly alter the types of bonds banks need to hold to access central bank funding. This incentivises banks (and the wider financial sector) to invest in greener rather than 'dirtier' corporate bonds, which in turn incentivises non-financial companies to align their practices with the Paris Agreement.

As we continue to grapple with the greatest health, social and economic shock of our lifetime, there is no better time to change the rules so that we come out of this crisis better than when we went in. A well-designed financial system is not a silver bullet to fix all our economy's flaws, but it is one of the most important things to get right if we are to genuinely build back better. In the absence of reform, the current rules to the collateral framework risks 'locking-in' and exacerbating large swathes of the financial sector's prevailing weaknesses.

1. INTRODUCTION

The Eurosystem collateral framework is at the heart of the ECB's monetary policy implementation. It determines how banks in the Eurozone get access to central bank money, which is vital for their daily operations and has knock-on effects for broader monetary and financial conditions in the economy. However, the existing Eurosystem collateral framework is at odds with the Paris Agreement. It favours carbon-intensive companies while failing to provide incentives for the decarbonisation that is urgently required to avoid a climate catastrophe. It is also a barrier to the EU Green Deal climate policies.

Although there is a growing consensus in the central banking community for the need to climate-align the Eurosystem collateral framework, there is no consensus on how this should be done. On the one hand, there are views, like those expressed by Bundesbank President Jens Weidmann,¹ according to which the collateral framework should consider climate risks but without violating the 'market neutrality' principle – this principle suggests that the collateral framework should not distort markets by treating specific assets, companies or sectors differently. On the other hand, other Eurosystem policy makers recognise that 'market neutrality' hardwires a carbon bias into the ECB's monetary policy operations. This requires active interventions to climate-align monetary policy instruments. For example, DNB Governor Klaas Knot has recently argued that “[c]entral banks can also help to correct the carbon bias in capital markets...[they] could explore how, within the boundaries of their mandates, they can redesign their monetary policy instruments to prevent such biases from occurring, and instead contribute to unlocking more green investments”.²

In this report, we develop proposals that are in line with an active approach to the greening of the Eurosystem collateral framework and move beyond the market neutrality principle. The adherence to the market neutrality principle has been criticised not only because central banks have in practice engaged in market-shaping interventions,³ but more crucially because of the widely recognised failure of markets to address the climate crisis. This failure – which has for instance been emphasised by ECB Executive Board Member Isabel Schnabel⁴ – implies that by refusing to 'distort' markets that are clearly not aligned with the Paris Agreement,

central banks reproduce markets' inability to tackle the climate crisis and undermine the collective efforts for the transition to a low-carbon economy. An active approach to the greening of the Eurosystem collateral framework is also consistent with the recent decision of the Bank of England to incorporate the climate impact of bond issuers into the design of its corporate QE programme.⁵

Our policy proposals rely on the adjustment of haircuts and eligibility criteria to green the collateral framework. We use a climate footprint approach that considers the 'greenness' and 'dirtiness' of the activities of bond issuers but also company-level information about emissions, energy use and decarbonisation plans. We add to the growing list of proposals towards decarbonising the ECB's corporate quantitative easing programme⁶ and the greening of Targeted Longer-Term Refinancing Operations (TLTROs)^{7,8}

The report is structured as follows. In Section 2, we explain how collateral frameworks work, with specific reference to the importance of eligibility criteria and haircuts. Section 3 examines how the Eurosystem collateral framework ends up implicitly creating favourable financing conditions for fossil fuel companies – through both eligibility criteria and haircuts. Section 4 reviews the wider carbon bias in the collateral framework. In Section 5, we present our three policy scenarios for greening the Eurosystem collateral framework. Section 6 concludes.

2. HOW DOES THE COLLATERAL FRAMEWORK WORK?

Within the Eurozone monetary architecture, the Eurosystem (i.e. the ECB and the national central banks of the euro area) creates money for commercial banks in the form of central bank reserves. Indeed, central bank reserves are also known as base money or high-powered money because commercial banks use reserves in the same way that households use deposits. Reserves are electronic records that allow banks to make payments to other banks as part of their daily activities, as deposits allow households to make payments in their daily life.⁹

In the Eurosystem, central banks supply reserves to banks through several channels, such as the main refinancing operations (MROs) and the longer-term refinancing operations (LTROs). The MROs provide liquidity to banks on a weekly basis, while the LTROs do so on a longer-term basis (e.g. three months).¹⁰ These operations ensure the smooth function of the banking system.

Explaining collateral and eligibility

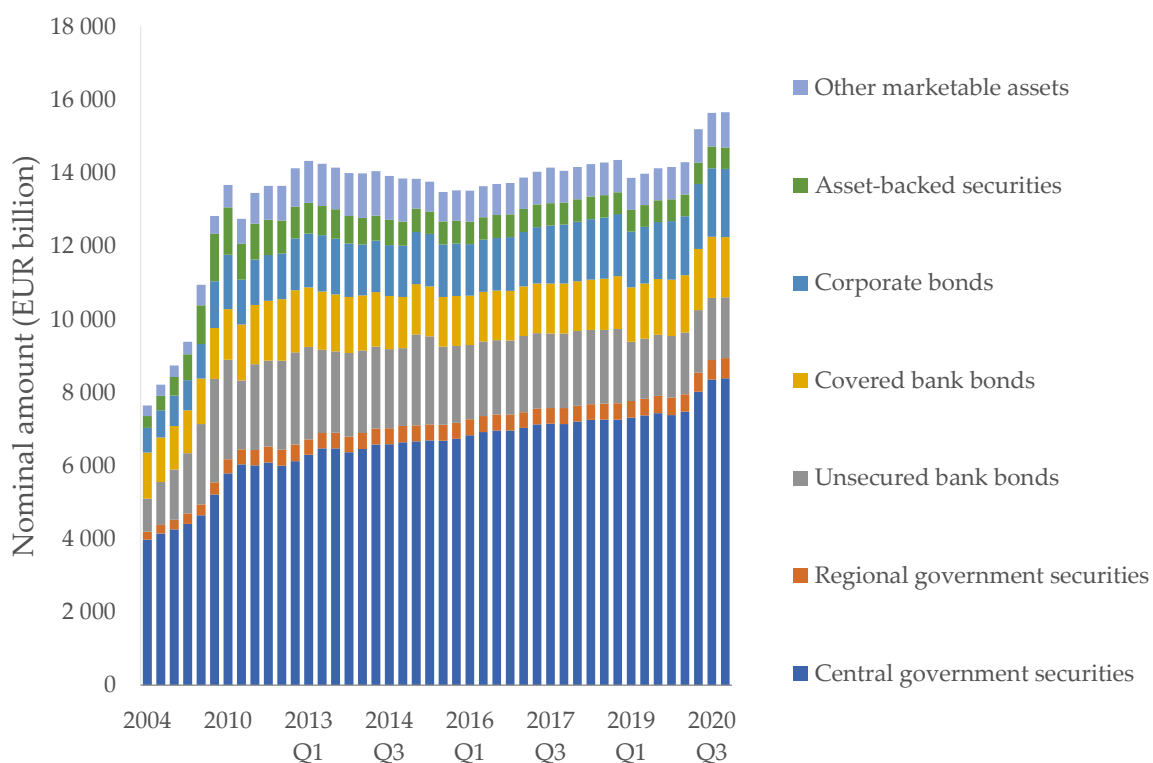
The Eurosystem only lends central bank money to the banking sector against guarantees, a form of insurance, referred to as collateral. To understand the concept of ‘collateral’, we can use home mortgages as an example. When people receive mortgages, banks use the house that will be purchased as an insurance: if borrowers fail to repay their mortgage, banks can sell the house to avoid financial losses. Similarly, the ECB and the national central banks of the euro area ask for collateral when they lend to banks. But instead of accepting houses as a collateral, the ECB and other central banks accept financial assets, like government or corporate bonds. The ECB justifies the use of collateral on the basis that it protects the Eurosystem from financial losses in case banks are unable to pay back the loans they receive.

The Eurosystem accepts a broad range of financial assets (primarily debt instruments) as collateral. These are the so-called ‘eligible assets’. Eligible assets can be marketable assets, for example, those assets that can be converted into cash quickly on financial markets, like government bonds and corporate bonds.

Alternatively, they can be non-marketable assets, like fixed-term deposits and credit claims, which are more difficult to sell or buy since they are not traded on major financial market exchanges. The eligibility criteria for these two asset classes include the place of issuance, the currency in which the asset is denominated and the credit rating. For marketable assets, the ECB announces the list of assets that the Eurosystem accepts as collateral on a daily basis.

Figure 1 shows the nominal amounts of the eligible marketable assets in the Eurosystem over the last two decades or so. Central government securities (government debt issued on financial markets) constitute the vast majority of the eligible assets, while corporate bonds correspond on average to about 10% of eligible assets. Note that only a proportion of these eligible assets has been used by banks in the past for obtaining access to central bank liquidity.

Figure 1: Eligible marketable assets, EUR billion, nominal amount, averages of end of month data over each time period shown



Source: ECB, <https://www.ecb.europa.eu/paym/coll/charts/html/index.en.html>

Importantly, the Eurosystem's eligibility criteria have significant and continuous implications for market prices and the allocation of capital, that reverberate

throughout the financial sector. If banks are short of central bank money needed to clear payments with other banks, and want to borrow money from a central bank, they need to put up some form of eligible collateral. As a consequence, the assets which are deemed eligible as collateral by the Eurosystem unavoidably become more valuable (relative to other non-eligible assets) to the banking system. Banks demand these eligible assets to directly access credit lines from central banks, or in case they need to access such credit in the future.

Conscious that such eligible assets are critically important to the functioning of the banking sector, other investors and creditors will want to hold them, prompting yet more demand. The overall increase in demand for these assets can increase their price. This means a lower interest rate and borrowing cost for the government or corporate that issues the debt instrument.

Explaining haircuts

The ECB applies a specific 'haircut' to each eligible asset in its collateral framework. A haircut establishes the amount of cash that borrowers receive in return for collateral: if an asset has a market value of EUR 1 million on the day it is posted as collateral, and the haircut assigned to it is 10%, the bank receives a loan of EUR 0.9 million. In this example, it effectively means the ECB treats the asset as though it has a value of EUR 0.9 million, even though it has a market value of EUR 1 million. Thus, the higher the haircut, the lower the secured funding that commercial banks can obtain for a given asset. In addition to interest rates, haircuts thus constitute an important element of the overall cost of funding for banks.

Haircuts are a risk management tool that are intended to act as a safety cushion for central banks. In exchange for lending money to a bank, central banks acquire legal ownership of the collateral, which can be sold to recover the money lent should the borrower default. Collateral that is traded on the financial markets is, however, subject to price fluctuations. The price at which the central bank will be forced to sell the asset may be lower than when it was posted as collateral. This would generate a loss for the central bank.

To protect themselves against such potential price falls, central banks tailor their haircut regimes to reflect the expected price volatility of eligible collateral. In the

example above, the 10% haircut is applied because in the event the central bank has to eventually sell the asset to recoup its losses it may not be able to sell the asset for EUR 1 million (because the bond may fall in price by the time the central bank sells it).

In the Eurosystem collateral framework, the value of haircuts depends on a number of factors, including the credit quality of the bond issuer (i.e. the credit rating), the remaining time until the repayment of the bond, and the interest rate paid on the asset at regular intervals, which can be fixed, zero, or floating (i.e. subject to periodic changes due to market conditions).

But haircuts are not only important for the relationship between central banks and commercial banks. Private financial institutions also lend against collateral and apply their own haircuts, and their eligibility criteria and haircut standards are highly influenced by those set by the Eurosystem.¹¹ In that sense, the Eurosystem collateral framework has wider implications for the functioning of the financial system.

The literature on shadow banking – by which we mean collateral-based activities undertaken by both banks and the lenders, brokers, and other credit intermediaries that fall outside the realm of traditional regulated banking – has established that haircuts can amplify fluctuations in the financial cycle.¹² This is so because financial institutions that lend against collateral tend to increase haircuts during bad times, and lower them during good times. More substantial haircuts can force private financial actors to deleverage (reduce debt levels) via fire sales of securities (the quick sale of assets at heavily discounted prices), which dries up collateral market liquidity and pushes haircuts higher.¹³

This logic also applies to central banks: as monopoly suppliers of reserves via collateralised loans, central banks' decisions to vary haircuts according to credit risk can reinforce liquidity spirals¹⁴ and significantly influence the underlying price dynamics and allocation of capital in the financial sector more widely.

The collateral framework as a monetary policy lever

The collateral framework, that is, eligible collateral and associated haircuts, is a monetary tool independent from interest rate policy and quantitative easing programmes. The collateral framework clearly plays an important, if under-researched, role in setting the cost of funding for commercial banks and shadow banks, and thus has significant implications for the cost and allocation of capital more widely throughout the financial sector.

The few empirical studies available have recently shown that eligible bonds face more favourable financing conditions compared to ineligible bonds and that higher haircuts are associated with higher bond yields, after controlling for company-level economic and financial factors.¹⁵ Moreover, a study published by the central bank of a Eurozone member – the Banque du France – has shown that firms whose loans are added to the ECB’s collateral framework enjoy lower interest rates compared to ineligible ones (after controlling for loan, firm and bank-level characteristics). The study also shows that newly eligible firms received a higher quantity of credit, when compared to ineligible ones.¹⁶

The ECB’s collateral rules affects the financial conditions of carbon-intensive and greener companies. This, in turn, impacts on how the former decarbonise their activities, and should be used as a test of the ECB’s commitment to green monetary policy operations.

In this report, we analyse how the ECB should tailor its collateral eligibility and haircuts decisions to the climate footprint of corporate bond issuers (i.e. the impact the issuers have on the climate crisis through their emissions). We focus on corporate bonds, as it is more straightforward to capture their climate footprint compared to debt instruments issued by credit institutions and governments.

To put the importance of the corporate bond market into perspective, one estimate suggests that the 2020 nominal value of European investment grade corporate bonds (i.e. the corporate debt that has relatively less risk of default) reached approximately EUR 5,650bn (which corresponds to about 47% of euro area 2019 GDP).¹⁷ Based on our estimations, the outstanding amount of the corporate bonds included in the ECB list of eligible collateral on 26 November 2020 was about EUR 1,680bn, i.e. 14% of the

euro area 2019 GDP. The eligible bonds are 4,605 out of 17,094 European investment grade corporate bonds (for more details, see Appendix A1).

3. HOW THE ECB'S COLLATERAL FRAMEWORK SUPPORTS FOSSIL FUEL COMPANIES

The ECB includes a significant number of bonds issued by fossil fuel companies in its collateral framework. It applies haircuts to those bonds without considering their climate footprint or climate risk. By doing so, it creates favourable financing conditions for the companies that have the highest responsibility for the climate crisis. As we explained in the previous section, the corporates that issue bonds that are deemed eligible in the collateral framework receive more credit and can benefit from cheaper borrowing costs simply as result of being included in the framework. To the extent that the bonds issued by fossil fuel companies are included in the collateral framework, a reasonable implication is that the Eurosystem collateral framework is actively creating favourable financing conditions – an implicit subsidy – for the companies engaging in the most climate damaging activities.

Identifying fossil fuel companies

To illustrate the support of the Eurosystem collateral framework to the fossil fuel sector, we specify fossil fuel companies in two steps. First, we identify four types of carbon-intensive activities and specify which issuers of the bonds included in the collateral framework have these activities as their primary ones. The carbon-intensive activities are as follows:¹⁸

- (a) Fossil fuel activities, like the extraction of natural gas, the mining of hard coal and the manufacture of refined petroleum products;
- (b) energy-intensive activities;
- (c) activities of non-renewable utilities;
- (d) carbon-intensive transportation activities related primarily to car, air and sea transportation.

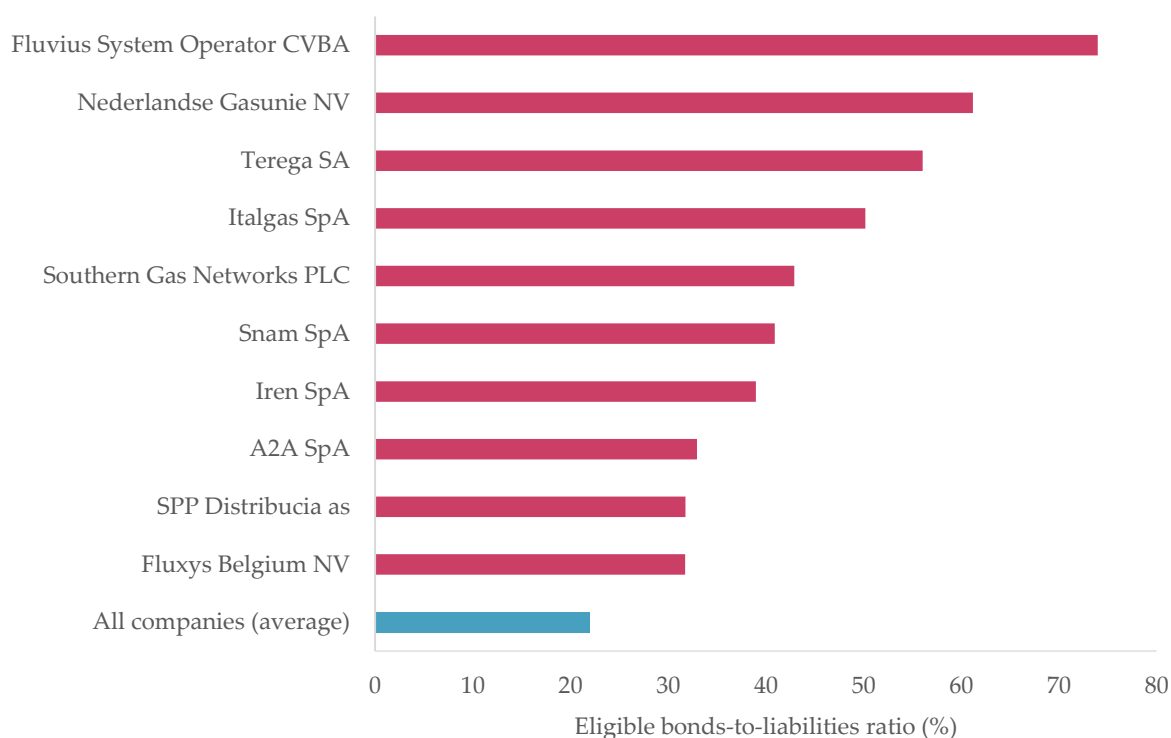
Although this classification allows us to identify companies whose primary activity is related to fossil fuels, it does not permit us to capture companies whose fossil fuel-

related activities are of secondary nature in their production process and further up the supply chain. But these companies are still important as they actively engage in fossil fuel-related activities.

Therefore, as a second step, we use the list of fossil fuel companies provided by Rainforest Action Network et al. (2020) and Urgewald (2019)¹⁹, whereby a broader set of criteria that move beyond the primary activities of companies are used (for more details, see Appendix A2). The fossil fuel companies analysed in this section should either have a fossil fuel primary activity or be included in the Rainforest Action Network et al. (2020) or Urgewald (2019) lists.

Collateral eligibility of fossil fuel companies

Using this broad definition of fossil fuel companies, we find that 61 fossil fuel companies have issued 756 corporate bonds (of about EUR 300bn outstanding amount) that the ECB accepted as eligible collateral on 26 November 2020 (the list of companies is reported in Appendix A3). For each fossil fuel company we estimate the ratio of eligible bonds to their total liabilities (using outstanding amounts). For example, if the eligible bonds-to-total liabilities ratio for a company is 50%, this means that 50% of its financing comes from bonds that the ECB accepts as collateral. The higher the ratio, the higher the implicit support that the ECB provides to a specific company. Strikingly, for 4 out of the 10 fossil fuel companies (mostly gas) with the highest eligible bonds to liabilities ratio, rely on bonds subsidised by the Eurosystem collateral framework for more than half of overall financing (Figure 2).

Figure 2: The 10 fossil fuel companies with the highest eligible bonds-to-total liabilities ratio (%)

Note: Since the latest available data for total liabilities are for 2019, we have excluded the bonds that are in the collateral framework and were issued in 2020. The fossil fuel companies for which the eligible bonds have been issued by their financial subsidiaries or their total liabilities were not available through Refinitiv Eikon have been excluded from the analysis.

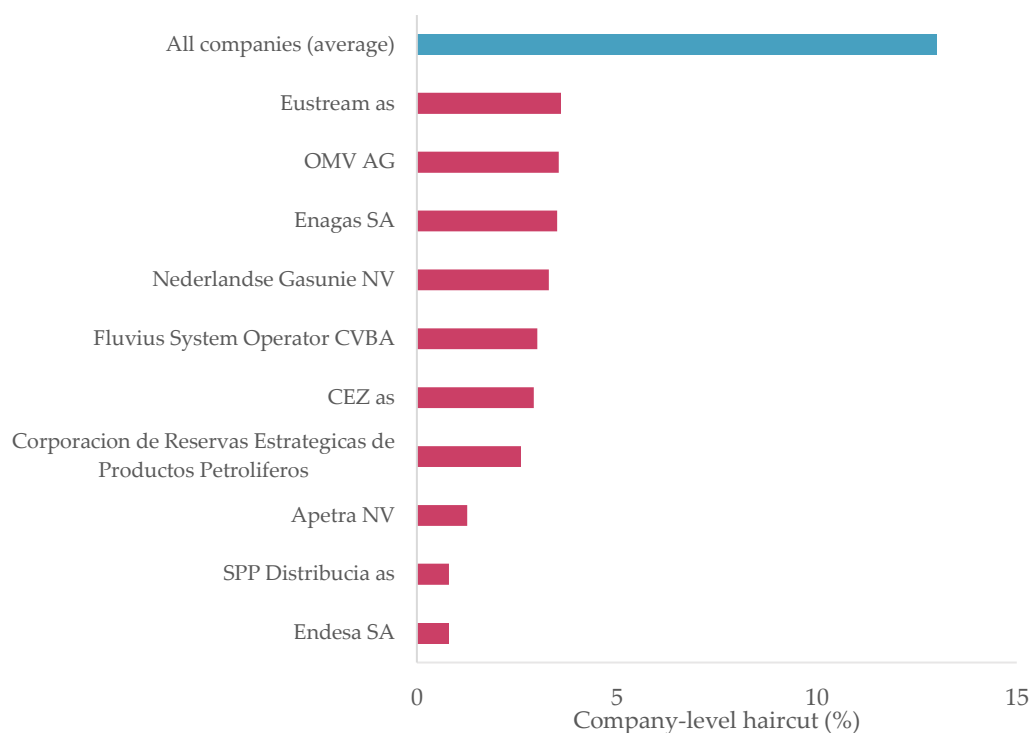
Sources: ECB (bond ISIN codes, 26 November 2020), Refinitiv Eikon (NACE 4-digit codes, Refinitiv TRBC codes and bond outstanding amount, November 2020; company-level total liabilities, 2019) and authors' calculations.

Haircuts for fossil fuel companies and supply-chain effects

Eligibility is not the only way through which the ECB supports fossil fuel companies: low haircuts also play an important role. As Figure 3 illustrates, there are many fossil fuel companies whose bonds enjoy very low ECB haircuts. This effectively signals to financial markets that assets carry very low risk, creating favourable financing conditions for the companies issuing them. Even on the terms of the ECB's haircut regime, which emphasises the exposure of the ECB to the credit risk of collateral issuer, this is problematic, as fossil fuel companies are very likely to suffer from climate transition risks.

Consider the case of SPP Distribucia as. According to the latest data available, over 30% of its outstanding financing came from issuing ECB eligible corporate bonds (see Figure 2). Furthermore, the ECB applied very low haircuts to those bonds, further easing financing conditions for the fossil fuel company.

Figure 3: The 10 fossil fuel companies with the lowest company-level haircuts (%) on their eligible bonds.



Note: The company-level haircuts are estimated as the average haircut of all the eligible bonds of each company, weighted by the outstanding amount of each eligible bond.

Sources: ECB (bond ISIN codes and haircuts, 26 November 2020), Refinitiv Eikon (NACE 4-digit, Refinitiv TRBC codes and bond outstanding amount, November 2020) and authors' calculations.

In evaluating the support that the ECB provides to fossil fuel companies we also need to consider supply chain effects. When the ECB includes fossil fuel companies' bonds in its collateral framework, it not only implicitly supports the financing of these companies; it also provides indirect support to those fossil fuel companies that supply inputs to eligible bond issuers.

Table 1: The 5 fossil-fuel eligible bond issuers with the highest number of fossil-fuel suppliers

Fossil fuel company name	Number of fossil fuel suppliers
Equinor ASA	40
Eni SpA	28
Total SE	11
Repsol SA	6
TechnipFMC PLC	5

Sources: ECB (bond ISIN codes, 26 November 2020), Refinitiv Eikon (NACE 4-digit codes, Refinitiv TRBC codes and suppliers, November 2020) and authors' calculations

Table 1 shows that Equinor ASA, Eni SpA and Total SE together have roughly 80 fossil fuel suppliers. Although the bonds of these suppliers are not necessarily included in the list of eligible bonds, the fact that customers of these fossil fuel suppliers have issued eligible bonds suggests that they are indirectly benefiting from the ECB's collateral rules.

4. THE WIDER CARBON BIAS IN THE EUROSISTEM COLLATERAL FRAMEWORK

Eligibility and carbon intensive companies

Besides fossil fuel companies, the Eurosystem collateral framework also supports other carbon-intensive companies, both via the eligibility criteria and haircuts. In Table 2, we show that three sectors account for 68.4% of EU-28 GHG emissions – ‘Manufacturing’, ‘Electricity, gas, steam and air conditioning supply’ and ‘Transportation and storage’. These sectors are clearly disproportionately represented in the list of eligible bonds when their contribution to EU-28 employment and GVA is taken into account. Collectively they contribute only 20.7% toward employment and 24.4% to GVA, but account for 61.8% of the outstanding amount (in EUR) in the ECB list.

Table 2: Sectoral breakdown of the ECB list of eligible corporate bonds in the collateral framework (outstanding amount), EU-28 greenhouse gas (GHG) emissions, EU-28 employment and EU-28 Gross Value Added (GVA)

NACE code	Sector	ECB list of eligible bonds - contribution to outstanding amount (%)	Contribution to EU-28 GHG emissions (%)	Contribution to EU-28 employment (%)	Contribution to EU-28 GVA (%)
A	Agriculture, forestry and fishing	0.05	15.06	4.56	1.62
B	Mining and quarrying	1.41	2.25	0.26	0.45
C	Manufacturing	38.81	24.96	14.65	17.29
D	Electricity, gas, steam and air conditioning supply	14.50	28.56	0.56	1.91
E	Water supply; sewerage, waste management and remediation activities	1.94	4.93	0.80	1.05
F	Construction	3.34	1.92	6.82	5.73
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	2.22	2.91	15.32	12.07
H	Transportation and storage	8.52	14.91	5.49	5.19
I	Accommodation and food service activities	0.47	0.56	5.62	2.97
J	Information and communication	10.27	0.25	3.25	5.70
K	Financial and insurance activities	7.53	0.18	2.61	5.42
L	Real estate activities	6.86	0.20	1.18	11.79
M	Professional, scientific and technical activities	1.12	0.61	6.77	7.36
N	Administrative and support service activities	2.19	0.65	7.20	4.99

P	Education	0.13	0.50	7.24	5.20
Q	Human health and social work activities	0.53	0.95	11.28	7.77
R	Arts, entertainment and recreation	0.00	0.25	1.92	1.43
S	Other service activities	0.09	0.34	2.86	1.70
T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	0.00	0.01	1.61	0.38
Total		100.00	100.00	100.00	100.00

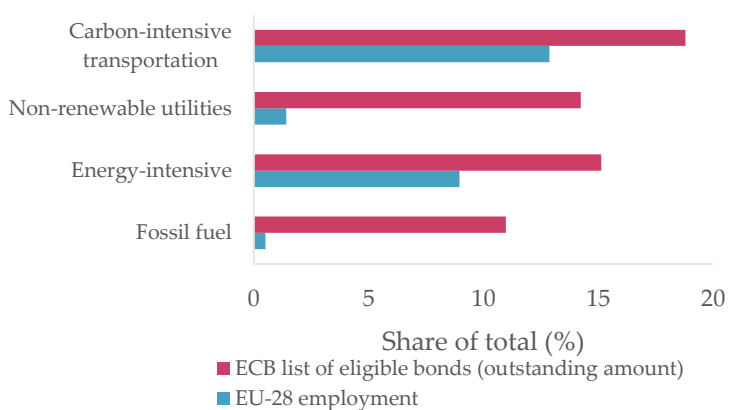
Note: The table does not include the sector 'O – Public administration and defense; compulsory social security' since bonds issued by this sector are not included in the list of eligible corporate bonds analysed in this report (see Appendix A1).

Sources: ECB (bond ISIN codes, 26 November 2020), Refinitiv Eikon (NACE 1-digit codes and bond outstanding amount, November 2020), Eurostat (employment, GVA and GHG emissions, 2018) and authors' calculations.

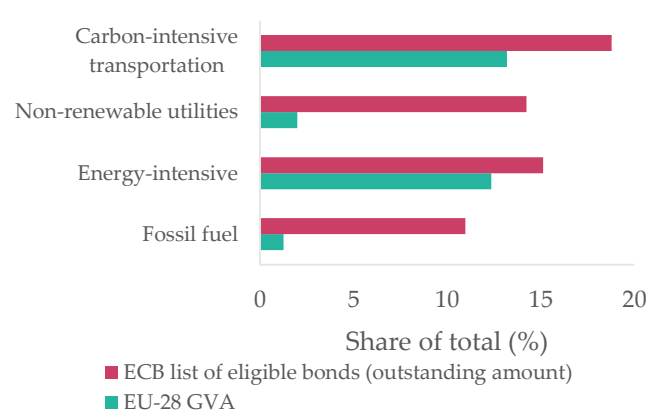
Figure 4 offers a more granular analysis that relies on the carbon-intensive activities described in Section 3. Overall, carbon-intensive companies represent 59% of the outstanding amount of the eligible corporate bonds, while their overall contribution to the EU employment and GVA is less than 24% and 29%, respectively. This suggests that the sectoral allocation underlying the eligibility of the Eurosystem's collateral framework does not mirror the sectoral make-up of the euro area when it comes to employment and GVA, and is considerably biased towards carbon intensive sectors. These results are broadly in line with those obtained in sectoral decomposition analyses of the ECB corporate QE programme.²⁰

Figure 4: Contribution of carbon-intensive sectors to the ECB list of eligible corporate bonds in the collateral framework (outstanding amount), EU-28 employment and EU-28 Gross Value Added (GVA)

Employment



Gross Value Added (GVA)



Note: In the case of non-renewable utilities and carbon-intensive transportation, bonds issued by companies that engage in green activities based on their TRBC codes (see Appendix A5) are not included in the carbon-intensive eligible bonds.

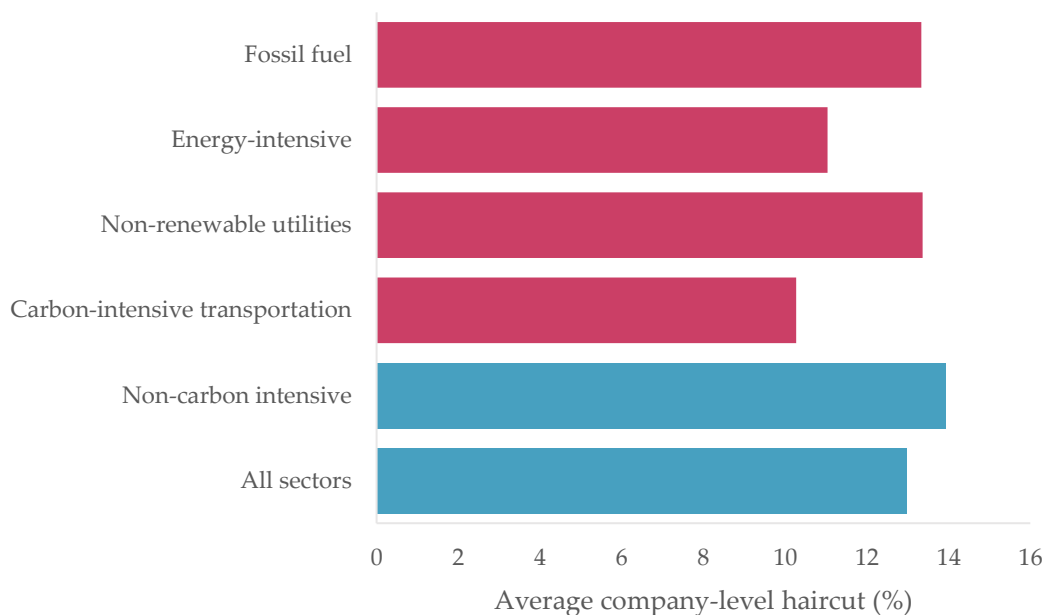
Sources: ECB (bond ISIN codes, 26 November 2020), Refinitiv Eikon (NACE 4-digit codes, Refinitiv TRBC codes and bond outstanding amount, November 2020), Eurostat, Annual detailed enterprise statistics for industry (employment and GVA, 2018) and authors' calculations.

Haircuts and carbon-intensive companies

It is well known that carbon-intensive companies are on average more exposed to transition risks; that is, the climate-related financial risks that arise from the processes of mitigation and adjustment towards a lower-carbon economy. However, the credit agencies that determine the ratings of bonds have not so far adequately accounted for these climate risks in their assessments.²¹ Since the ECB uses the ratings of credit agencies to evaluate the credit quality of bonds, it clearly underestimates the risks of bonds issued by carbon-intensive sectors.²²

This has significant implications for the haircuts of carbon-intensive companies given that the assessment of credit quality is the most important driver of the bond haircuts in the collateral framework. By failing to take into account climate transition risks, the ECB haircuts for carbon-intensive companies are on average lower than what they should actually be. Indeed, Figure 5 shows that the average haircuts of fossil fuel companies, energy-intensive companies, non-renewable utilities and companies that engage in carbon-intensive transportation are 13.33%, 11.03%, 13.36% and 10.27%, respectively – all lower than the average haircut of non-carbon intensive companies (which is 13.93%).²³

Figure 5: Average company-level haircut (%) of eligible bonds issued by carbon-intensive sectors, non-carbon-intensive sectors and all sectors



Note: The company-level haircuts are estimated as the average haircut of all the eligible bonds of each company, weighted by the outstanding amount of each eligible bond.

Sources: ECB (bond ISIN codes and haircuts, 26 November 2020), Refinitiv Eikon (NACE 4-digit codes, Refinitiv TRBC codes and bond outstanding amount, November 2020) and authors' calculations

The consideration of climate transition risks would most likely make the haircuts of these companies higher than the haircuts of the rest of the companies in the collateral framework. The same would also be the case if the collateral framework would be used as a means to support the transition to a low-carbon economy, as we show in the next section.

In sum, the Eurosystem collateral framework favours carbon-intensive companies both through the carbon bias in the list of eligible bonds and the non-consideration of climate issues in the determination of haircuts. The empirical analyses mentioned in Section 2 suggest that this favourable treatment of carbon-intensive companies results in better financing conditions for polluting companies compared to less polluting ones.

5. HOW TO GREEN THE COLLATERAL FRAMEWORK: THREE SCENARIOS

We consider three policy scenarios for the greening of the Eurosystem collateral framework. In all these scenarios we consider the climate footprint of each bond which is specified based on the following factors:

- (1) whether the bond has been issued by a company whose primary activity is carbon-intensive;
- (2) whether it has a 'green bond' label;²⁴
- (3) whether it has been issued by a company that its primary activity is (potentially) green;
- (4) the carbon intensity of the bond issuer compared to the intensity of the sector that the issuer belongs to;
- (5) the share of non-renewable energy in the total energy use of the bond issuer compared to its peers;
- (6) the decarbonisation that the bond issuer has achieved over the last years compared to its peers; and
- (7) how aligned the decarbonisation plans of the bond issuer are with scenarios that are consistent with the Paris Agreement.

Factors (1), (2) and (3) allow us to implement an activity/project-based distinction of bonds between 'carbon-intensive', 'green' and 'other', while factors (4), (5), (6) and (7) are used to construct our Company Climate Index (CCI) which allows us to implement a granular 'shades of dirty and green' perspective. All the details and formulas through which we identify the climate footprint of companies are described in Appendix A5.

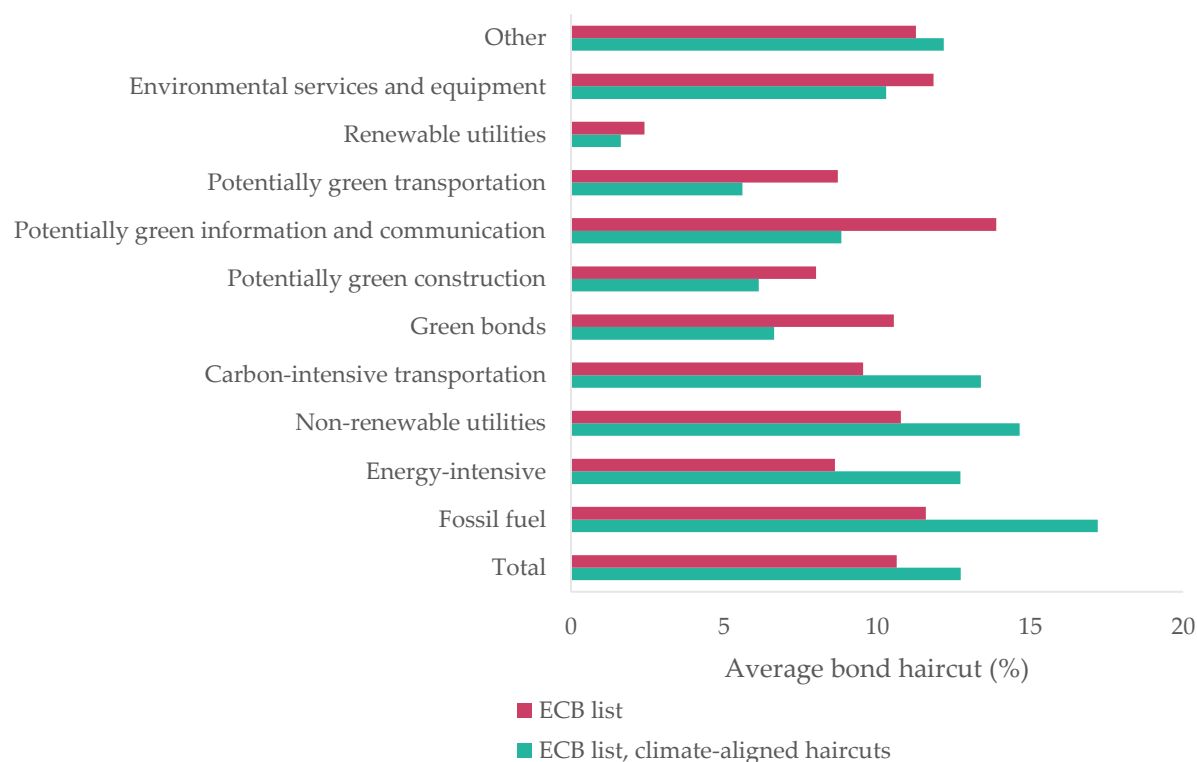
Scenario 1 – Climate-aligned haircuts

In the first scenario – *climate-aligned haircuts* – we keep the list of eligible bonds unchanged but adjust haircuts based on their climate footprint. In particular, we

increase the haircuts of carbon-intensive issuers. This increase is, however, lower for companies with a better climate performance, creating a clear incentive for companies to become more climate-aligned. Similarly, we lower haircuts on ‘green bonds’ and bonds issued by companies that engage in (potentially) green activities so that the reduction in haircuts is higher for the bond issuers that have a better climate performance. For the rest of the bonds, the haircuts increase or decrease depending solely on the company-level climate performance. The formula that we use for the adjustment in haircuts is presented in Appendix A6.²⁵

As shown in Figure 6, the climate-aligned haircuts are, on average, higher than the ECB ones for bonds issued by carbon-intensive companies and lower for bonds issued by companies that engage in (potentially) green activities, as well as for ‘green bonds’. For the remaining bonds, climate-aligned haircuts are slightly higher.²⁶

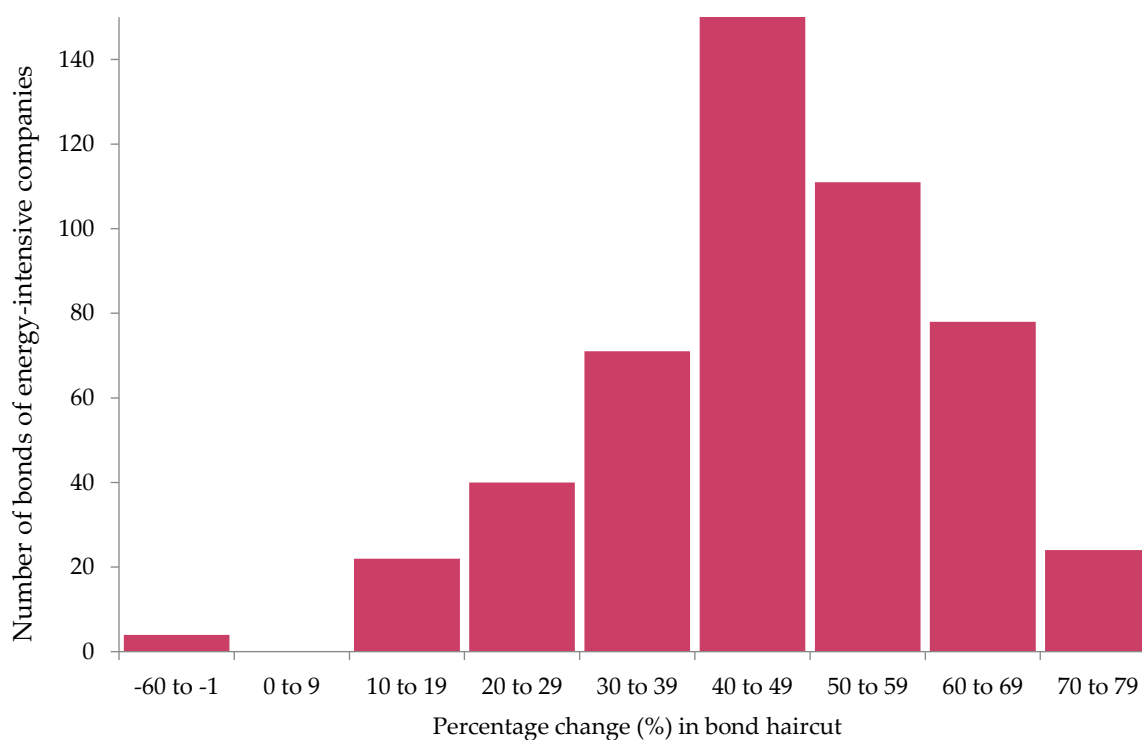
Figure 6: Average bond haircut, ECB list of eligible bonds with and without climate-aligned haircuts



Sources: ECB (bond ISIN codes and haircuts, 26 November 2020), Refinitiv Eikon (NACE 4-digit codes, Refinitiv TRBC codes, bond outstanding amount, November 2020; environmental variables) and authors' calculations.

However, within each set of activities there is high heterogeneity in the level of haircuts. We illustrate that in Figure 7, where we report the distribution in the bond haircuts for energy-intensive companies. On the one hand, ‘green bonds’ issued by these companies enjoy a decline in haircuts; on the other hand, bonds issued by companies that have a very poor climate performance exhibit an increase in haircuts that is close to 80%. Carbon-intensive companies that perform relatively well in the CCI experience only a mild increase in the haircuts of their bonds. This suggests that our climate-aligned haircuts can incentivise companies in carbon-intensive sectors to reduce their adverse climate impact.

Figure 7: Percentage change (%) in the haircuts of eligible bonds issued by energy-intensive companies

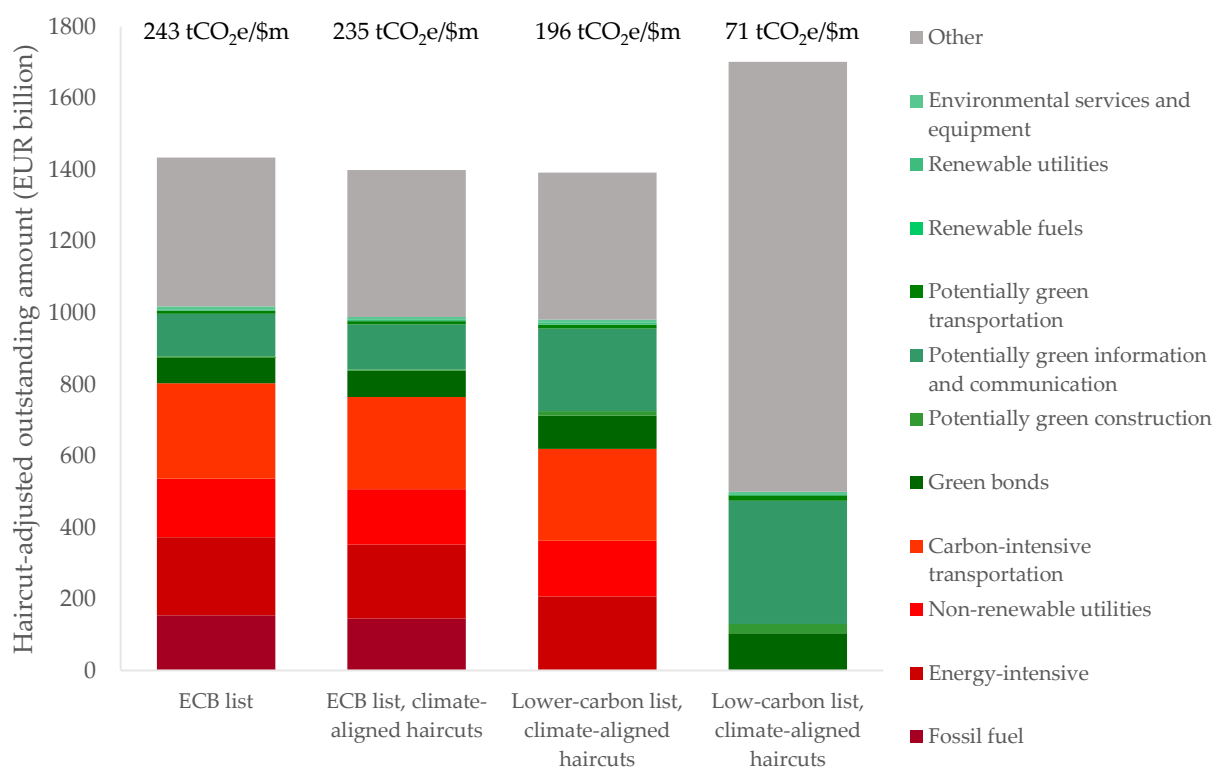


Sources: ECB (bond ISIN codes and haircuts, 26 November 2020), Refinitiv Eikon (NACE 4-digit codes, Refinitiv TRBC codes, bond outstanding amount, November 2020; environmental variables) and authors' calculations

By changing the haircuts applied to corporate bonds, the maximum funding that banks can obtain from the ECB also changes, which could have important implications for the stability of the banking sector. To proxy how the maximum level

of funding changes, we compare in Figure 8 the existing haircut-adjusted outstanding amount of bonds (first bar) and the climate-aligned one (second bar).²⁷ The haircut-adjusted amount declines only slightly when our proposed haircuts are imposed, suggesting that our climate-aligned haircut scenario is unlikely to affect the access to central bank funding for banks.²⁸ Moreover, the ECB would adjust haircuts without modifying the current bond eligibility criteria.

Figure 8: Haircut-adjusted outstanding amount of eligible corporate bonds (in EUR billion) and weighted average carbon intensity (WACI) (in tCO₂e/\$m), existing ECB list and low-carbon scenarios



Note: The figures above each bar show the WACI for each scenario.

Sources: ECB (bond ISIN codes and haircuts, 26 November 2020), Refinitiv Eikon (NACE 4-digit codes, Refinitiv TRBC codes, bond outstanding amount, November 2020; financial and environmental variables) and authors' calculations

Overall, from a climate perspective, our 'climate-aligned haircuts' scenario differs from the existing collateral framework in two key ways. Firstly, although collateral eligibility does not change, within each type of activity those companies with better climate performance face lower haircuts compared to their peers with poorer climate performance. Secondly, the weighted average carbon intensity (WACI) in this

scenario falls to 235 tCO_{2e}/\$m compared to 243 tCO_{2e}/\$m in the existing collateral framework.²⁹

Scenario 2 – Lower-carbon, climate-aligned haircuts

To support the low-carbon transition, a more effective approach would be to exclude all the dirty bonds issued by fossil fuel companies while adding other green bonds and bonds issued by (potentially) green sectors, which satisfy the eligibility criteria (third bar in Figure 8). In this second scenario, climate-aligned haircuts are used again.³⁰ It is also important to note that whilst our framework does preclude dirty bonds issued by fossil fuel companies, it gives the opportunity to these companies to remain eligible by issuing green bonds whose haircuts are adjusted accordingly.

Figure 8 shows that in our ‘lower-carbon list’ scenario, the haircut-adjusted outstanding amount of bonds would increase and the WACI of the list of eligible bonds would decline substantially. Moreover, the activity decomposition of the eligible bonds would change compared to the existing collateral framework.

Scenario 3 – Low-carbon, climate-aligned haircuts

In our last scenario (fourth bar in Figure 8), we exclude the bonds of all companies that engage in carbon-intensive activities (apart from green bonds) and we replace them with (i) green bonds and bonds issued by companies that engage in (potentially) green activities that satisfy all the eligibility criteria apart from the investment grade one and (ii) bonds of companies that engage in ‘other’ activities (i.e. activities that are neither green or dirty) which satisfy the eligibility criteria fully or partly.

The relaxation of the investment grade criterion allows us to avoid a decline in the haircut-adjusted outstanding amount. Although this relaxation might be seen as a limitation of this scenario from a traditional risk management perspective, a key advantage of this scenario is that it generates a very substantial decline in the WACI to 71 tCO_{2e}/\$m. Note also that all the non-investment grade bonds that are added have been assigned very high haircuts.

Overall, our proposed low-carbon collateral framework does not reduce the maximum collateralised liquidity that banks can obtain through the Eurosystem. It

changes, however, the types of bonds that banks need to hold in order to preserve their access to central bank liquidity. Under our scenarios, banks with 'dirtier' corporate bond portfolios would need to shift to 'greener' bonds and climate practices to ensure smooth access to central bank loans. Given the permanent nature of the Eurosystem collateral framework, and its signalling role for the secured funding markets, the implementation of our proposals could contribute to the decarbonisation of the European corporates.

6. CONCLUSION

The Eurosystem collateral framework is at the heart of the euro area financial system. Its current form favours bonds issued by carbon-intensive sectors, so it acts as a barrier to the decarbonisation of the EU economy. In this report, we have shown how the collateral framework could become climate-aligned, incentivising companies to decarbonise their production.

We have specified three policy scenarios for the greening of the collateral framework. In the first scenario, the list of eligible bonds remains the same, but the haircuts of the bonds are adjusted according to their climate footprint. Our climate-aligned haircuts have been designed to induce firms to issue green bonds, reduce their carbon intensity, increase the share of renewable energy use and set targets for absolute reductions in emissions. In the second scenario, we exclude fossil fuel companies' bonds from the list of eligible bonds (except for those that have a 'green' label) and add other bonds with relatively low climate footprints. In the third scenario, we exclude bonds issued by fossil fuel companies but also the bonds that are issued by the other carbon-intensive companies. We replace them with other bonds that are not carbon-intensive and satisfy fully or partly the eligibility criteria. In all of these scenarios, the weighted average carbon intensity of the eligible bond list declines. The higher decline in the second and third scenarios suggests that these scenarios are more consistent with tackling the climate emergency.

Oustry et al. (2020)³¹ have recently suggested that the Eurosystem collateral framework could address climate risks by encouraging banks to pledge more climate-aligned assets as collateral, without modifying the list of eligible bonds or their haircuts. They argue that this approach would allow the Eurosystem to factor climate risks into its collateral framework without violating the market neutrality principle.

Although the implementation of their proposal would definitely contribute to the decarbonisation of the euro area financial system, we think it does not go far enough. The urgency of the climate crisis calls for the ECB and the other euro area central banks to discard the obsolete market neutrality principle, and put in place more active interventions. The ECB needs to pick up the challenge of greening the

collateral framework through direct changes in haircuts and the list of eligible bonds, as we have recommended in this report. Leaving this issue to the market would only postpone the crucial support that the Eurosystem should provide to governments' decarbonisation plans.

APPENDIX

A1. THE ECB LIST OF ELIGIBLE CORPORATE BONDS

The marketable assets included in the Eurosystem collateral framework should satisfy the following criteria:³²

1. they should have been issued either (a) in euros by an institution established in the European Economic Area (EEA), Canada, Japan, the UK or the US, or (b) in USD, yen or sterling by an institution established in the EEA;
2. they should be rated investment grade.³³

In our analysis, the ECB list of eligible corporate bonds comprises all those bonds that are included in the list of bonds accepted as collateral in the Eurosystem whose: (i) issuer group is IG3 ('corporate and other issuers'), IG9 ('financial corporations other than credit institutions') or IG11 ('public corporation') and (ii) asset type is AT01 ('bond'), AT02 ('Medium-term note'), and AT03 ('Treasury) bill / commercial paper / certificate of deposit'). We exclude those bonds whose issuer belongs to the NACE 2-digit sector 84 ('public administration and defense; compulsory social security'). The data refer to 26 November 2020 and have been downloaded from the ECB website.³⁴

The number and outstanding amount of the bonds included in the ECB list of eligible bonds is 4,605 and EUR 1,680bn, respectively.³⁵ As explained in Appendix A5, our analysis requires the identification of the 4-digit NACE code and the Refinitiv Thomson Reuters Business Classification (TRBC) code of the bond issuer as well as the outstanding amount for each bond. For some bonds, the outstanding amount is not available from Refinitiv Eikon. Therefore, we exclude these bonds as well as those bonds for which the NACE or TRBC code is not available in Refinitiv Eikon. The ultimate number of bonds in the ECB list of eligible bonds analysed in this report is 4,099 (with an outstanding amount of EUR 1,620bn). The match between the bonds and the companies that have issued them is made by using the International Securities Identification Number (ISIN).

A2. FOSSIL FUEL COMPANIES IN URGEWALD (2019) AND RAINFOREST ACTION NETWORK ET AL. (2020)

Urgewald (2019) provides a list of coal companies, called the Global Coal Exit List (GCEL). For a company to be included in GCEL, it should satisfy at least one of the following three criteria:

1. it should belong to the mining, power, services or utility sector, and its coal-related power production or revenue should be at least 20% of its total production or revenue;
2. its annual thermal coal production should exceed or equal 10 million tonnes or its installed coal-fired power capacity generation should exceed or equal 5 GW;
3. it should have coal power, coal mining or coal infrastructure expansion plans.

Rainforest Action Network et al. (2020) identifies the following categories of top fossil fuel companies:

1. Fossil fuel expansion companies (they include GCEL companies)
2. Tar sand companies
3. Arctic oil and gas companies
4. Offshore oil and gas companies
5. Fracked oil and gas companies
6. Liquefied Natural Gas (LNG) companies
7. Coal mining and coal power companies (they include GCEL companies)

A3. FOSSIL FUEL COMPANIES: SHARE OF ELIGIBLE BONDS AND COMPANY-LEVEL HAIRCUTS

Company name	Eligible bonds-to-liabilities ratio (%)	Company-level haircut (%)
2I Rete Gas SpA	-	14.02
A2A SpA	32.97	12.62
Apetra NV	-	1.26
BP PLC	-	12.78
CDP Reti SpA	-	18.00
Centrica PLC	0.75	27.31
CEZ as	20.46	2.92
Corporacion de Reservas Estrategicas de Productos Petroliferos	-	2.60
E.ON SE	7.25	14.74
Enagas SA	-	3.51
EnBW Energie Baden Wuerttemberg AG	-	34.26
Endesa SA	-	0.80
Enel SpA	1.22	10.75
Engie SA	14.34	21.27
Eni SpA	14.42	6.17
EP Infrastructure as	-	13.91
Equinor ASA	12.44	7.16
Erdoel lager GmbH	-	5.51
Erdoelbevorratungsverband KdoeR	-	4.80
Eustream as	-	3.60
EVN AG	10.92	4.01
Fluvius System Operator CVBA	73.97	3.01
Fluxys Belgium NV	31.75	4.80
Fluxys SA	-	7.12
Gas Networks Ireland	-	3.70
Glencore PLC	-	24.80
Hera SpA	30.17	13.59
Iberdrola SA	-	7.53
Iren SpA	39.00	13.29
Italgas SpA	50.21	14.27
L'Air Liquide Societe Anonyme pour l'Etude et l'Exploitation des Procèdes Georges Claude SA	1.21	28.87
LafargeHolcim Ltd	-	23.96
Linde PLC	-	11.86
LyondellBasell Industries NV	-	24.80
MOL Magyar Olajes Gazipari Nyrt	8.32	9.60

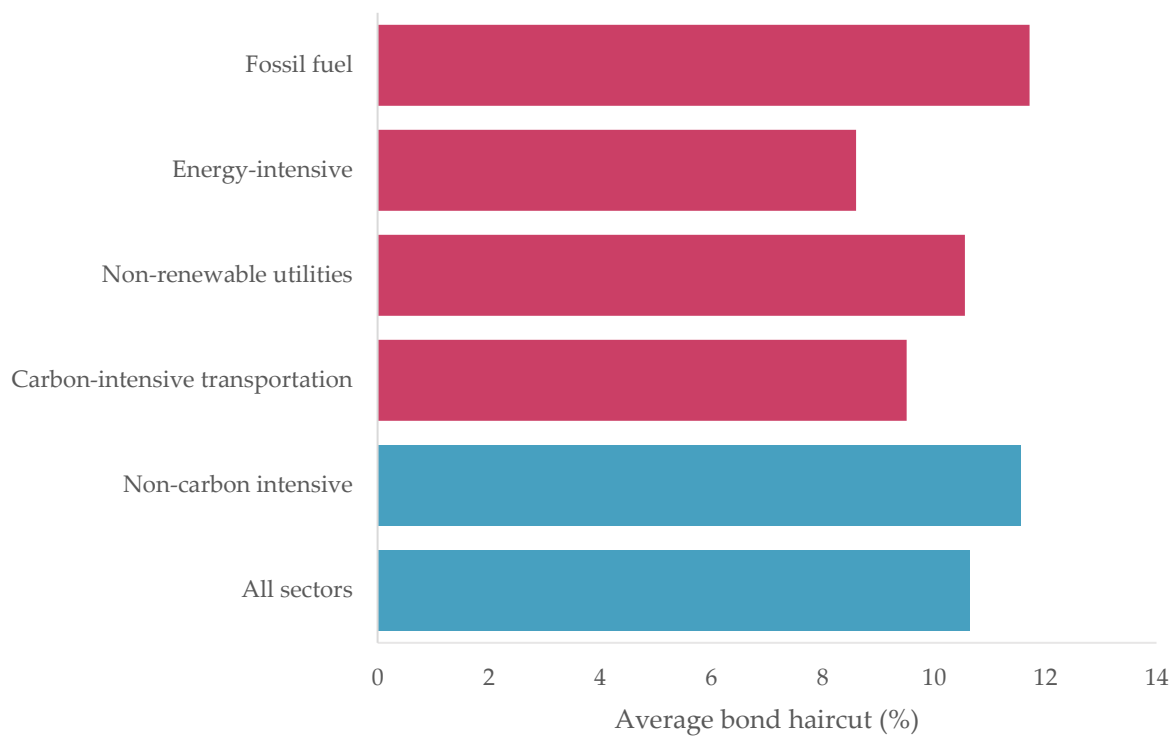
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National Grid Gas PLC	3.38	22.00
Naturgy Energy Group SA	-	20.89
Nederlandse Gasunie NV	61.19	3.30
Net4Gas sro	-	6.40
NK Lukoil PAO	-	31.10
Northern Gas Networks Holdings Ltd	-	36.95
OMV AG	19.37	3.55
Petrol dd Ljubljana	3.02	13.20
Polski Koncern Naftowy Orlen SA	-	16.79
Quadgas Holdings Topco Ltd	-	25.45
RAG Stiftung	-	18.93
Repsol SA	-	17.84
Rio Tinto PLC	-	19.51
Royal Dutch Shell PLC	-	12.95
Schlumberger NV	-	13.18
Scotland Gas Networks PLC	-	25.78
Snam SpA	40.93	11.20
Societa Metropolitana Acque Torino SpA	-	13.20
Southern Gas Networks PLC	42.91	25.44
SPP Distribucia as	31.76	0.80
Tauron Polska Energia SA	8.96	14.80
TechnipFMC PLC	3.89	9.90
Terega SA	56.04	11.65
Total SE	-	5.65
Veolia Environnement SA	23.63	12.47
Vier Gas Transport GmbH	-	3.80

Note: Since the latest available data for total liabilities are for 2019, we have excluded the bonds that are in the collateral framework and were issued in 2020. The fossil fuel companies for which the eligible bonds have been issued by their financial subsidiaries or their total liabilities were not available through Refinitiv Eikon have been excluded from the analysis of the eligible bonds-to-assets ratio. The company-level haircuts are estimated as the average haircut of all the eligible bonds of each company, weighted by the outstanding amount of each eligible bond.

Sources: ECB (bond ISIN codes and haircuts, 26 November 2020), Refinitiv Eikon (NACE 4-digit codes, Refinitiv TRBC codes, bond outstanding amount, November 2020; company-level total liabilities, 2019) and authors' calculations.

A4. AVERAGE HAIRCUT OF ELIGIBLE BONDS PER CARBON-INTENSIVE SECTOR



Sources: ECB (bond ISIN codes and haircuts, 26 November 2020), Refinitiv Eikon (NACE 4-digit codes, Refinitiv TRBC codes, November 2020) and authors' calculations.

A5. IDENTIFYING THE CLIMATE FOOTPRINT OF BONDS

We identify the climate footprint of each bond taking into account the following factors:

- (1) *Whether the principal activity of the bond issuer is classified as carbon-intensive based on the NACE 4-digit codes and Refinitiv TRBC codes:* We identify carbon-intensive activities drawing on Battiston and Monasterolo (2019)³⁶. The starting point is the Climate Policy Relevant Sectors (CPRS) classification, presented in Battiston et al. (2017)³⁷. This classification specifies sectors that can be affected by climate policies and are subject to climate transition risks. However, not all of these sectors are necessarily carbon-intensive. Battiston and Monasterolo (2019) have identified carbon-intensive sectors, which are a subset of CPRS. We have identified NACE 4-digit codes that correspond to carbon-intensive activities following the rationale of their classification. However, those companies that belong to these NACE 4-digit codes, but their Refinitiv Thomson Reuters Business Classification (TRBC) activity or industry is related to green activities, are not included in our carbon-intensive list. The list of green activities is reported below (see 2). We end up with bonds issuers that engage in the following carbon-intensive activities: (i) fossil fuel activities; (ii) energy-intensive activities; (iii) activities of non-renewable utilities and (iv) carbon-intensive transportation activities.
- (2) *Whether the NACE 4-digit code of the bond issuer corresponds to potentially green activities or the Refinitiv TRBC code corresponds to green activities:* We use the recently developed EU Taxonomy of sustainable activities³⁸ to specify what we call ‘potentially green’ activities. The EU Taxonomy identifies NACE 4-digit codes that capture activities that can contribute to climate mitigation because they (i) are already low-carbon, (ii) are not low-carbon but can contribute to the transition to a low-carbon economy by reducing emissions (transition activities), and/or (iii) enable other activities to achieve emissions reductions (enabling activities). A limitation of the EU classification is that it includes many carbon-intensive activities. These are primarily the transition activities undertaken by high-carbon companies. Although we acknowledge the need for promoting activities that reduce emissions in carbon-intensive sectors, we find it misleading

to call these activities ‘green’. It would be more accurate to argue that these are ‘dirty’ activities, whose degree of dirtiness can decline. Thus, in our ‘potentially green’ sectors we include all these NACE codes that are part of the EU Taxonomy for climate mitigation but are not carbon-intensive. We, however, make some exceptions, for example in the case of real estate activities and life insurance. Although these activities are included in the EU taxonomy and are not carbon-intensive, we think it is not accurate enough to call them ‘potentially green’, since their contribution to emission reduction is likely to be very small. We overall identify companies that engage in the following activities: ‘potentially green forestry’, ‘potentially green waste management and remediation’, ‘potentially green construction’, ‘potentially green transportation’, ‘potentially green information and communication’. The reason why these activities are called ‘potentially green’ is that we do not have sufficient information to decide if the activities conducted by these sectors are actually green. The EU Taxonomy has specified screening criteria that include thresholds for metrics related, for example, to emission and energy generation. However, we do not have access to such detailed information at a sufficiently granular level for all companies that are included in our analysis.

On top of the ‘potentially green’ activities, we identify some additional green activities taking into account the TRBC activity or industry of the companies. These are (i) ‘renewable utilities’ (which comprise the TRBC activities ‘renewable utilities’, ‘renewable independent power producers (IPPs)’, ‘power charging stations’, ‘alternative electric utilities’, ‘hydroelectric and tidal utilities’, ‘solar electric utilities’, ‘wind electric utilities’, ‘biomass and waste to energy electric utilities’ and ‘geothermal electric utilities’), (ii) ‘renewable fuels’, (iii) ‘renewable energy equipment and services’ and (iv) ‘environmental services and equipment’. We also include the TRBC activity ‘electric (alternative) vehicles’ in the ‘potentially green transportation’ category mentioned above.

- (3) *Whether the bond is classified as green:* We use the green bond flag provided by Refinitiv Eikon. Refinitiv Eikon defines green bonds as fixed income products that offer investors the opportunity to participate in the financing of large

sustainable energy green projects that help mitigate climate change and help countries adapt to the effects of climate change.

- (4) *The Relative Carbon Intensity (RCI) of the issuer*: This relies on the company-level carbon intensity provided by Refinitiv Eikon, which is equal to the sum of Scope 1 and Scope 2 CO₂ equivalent GHG emissions (in tonnes) over the company revenues in \$ million.³⁹ When reported data is missing, we use the estimated intensity from Refinitiv Eikon, if this is provided. The data that we use refers to 2019. The *RCI* of each company is given by:

$$RCI = \min\left(\frac{CI_{COMPANY}}{CI_{SECTOR}}, UPPER\right)$$

where $CI_{COMPANY}$ is the company-level carbon intensity and CI_{SECTOR} is the median carbon intensity in the TRBC business sector that the company belongs to (based on the available Refinitiv Eikon data for the companies of the European Economic Area (EEA), Canada, Japan, the UK and the US). The higher the *RCI* the worse the climate performance of the company. We set an upper limit for the ratio (*UPPER*) such that we prevent it from taking very high values. If Refinitiv Eikon does not provide any data for the carbon intensity (reported or estimated), we set the *RCI* equal to 1.

- (5) *The Relative Non-Renewable Share (RNRS) of the issuer*: This relies on the company-level renewable energy use ratio provided by Refinitiv Eikon, which is defined as the total energy purchased from primary renewable energy sources over company's total energy use. The data that we use refers to 2019. We define the non-renewable share as 1 minus the renewable energy use ratio. The *RNRS* of each company is given by:

$$RNRS = \min\left(\frac{NRS_{COMPANY}}{NRS_{SECTOR}}, UPPER\right)$$

where $NRS_{COMPANY}$ is the company-level non-renewable share and NRS_{SECTOR} is the median non-renewable share in the TRBC business sector that the company belongs to. The higher the *RNRS* the worse the climate performance of the company. We set an upper limit for the ratio (*UPPER*) such that we prevent it

from taking very high values. If Refinitiv Eikon does not provide data for the renewable energy use ratio, we set $RNRS$ equal to 1.

- (6) *The Relative Backward-looking Decarbonisation Rate (RBDR) of the issuer:* This is based on the percentage change in Scope 1 and Scope 2 emissions of the bond issuer over the period 2017-2019 provided by Refinitiv Eikon. We define the decarbonation rate as the annual compound percentage reduction in emissions. The $RBDR$ is given by:

$$RBDR = \min\left(\frac{BDR_{SECTOR}}{BDR_{COMPANY}}, UPPER\right) \text{ if } BDR_{COMPANY} > 0; \text{ otherwise } RBDR = UPPER$$

where $BDR_{COMPANY}$ is the company-level decarbonisation rate and BDR_{SECTOR} is either (i) the median decarbonisation rate in the TRBC business sector that the company belongs to (if this median is positive), or (ii) the mean of the median decarbonisation rates in the TRBS business sectors with positive median decarbonisation rates (if this median is negative). The higher the $RBDR$ the worse the climate performance of the company. We set an upper limit for the ratio ($UPPER$) such that we prevent it from taking very high values. If $BDR_{COMPANY} \leq 0$, we set $RBDR = UPPER$ to capture the fact that the company performance is completely at odds with the climate emergency since its emissions have not declined over the last years. If Refinitiv Eikon does not provide data for the growth rate of emissions, we set $RBDR$ equal to 1.

- (7) *The Relative Forward-looking Decarbonisation Rate (RFDR) of the issuer:* Refinitiv Eikon provides data about the target emission reduction percentage until a specific future year (the year differs between companies). We define the target decarbonisation rate as the annual compound targeted percentage reduction in emissions. The $RFDR$ is given by:

$$RFDR = \min\left(\frac{FDR_{ALIGNED}}{FDR_{COMPANY}}, UPPER\right)$$

where $FDR_{COMPANY}$ is the target decarbonisation rate of the company and $FDR_{ALIGNED}$ is the decarbonisation rate that is required in order for the company to be aligned with a specific climate scenario. In this report we set $FDR_{ALIGNED}$ equal to 7% which, according to the EU Technical Expert Group on Sustainable

Finance (2019)⁴⁰ is broadly in line with IPCC's 1.5°C scenario. If Refinitiv Eikon does not provide data for the target decarbonisation rate of a company, we interpret this as a lack of decarbonisation plans and we thus penalise the company by setting $RFDR$ equal to $UPPER$.

Based on factors (1), (2) and (3), we identify the following activity/project-based dummy variables for each bond j :

- (i) the variable CIA_j which equals 1 when the bond issuer has a primary carbon-intensive activity;
- (ii) the variable $GREEN_j$ which equals 1 if the bond issuer's primary activity is 'potentially green' or the bond has a 'green' label;
- (iii) the variable $OTHER_j$ which equals 1 when both CIA_j and $GREEN_j$ are equal to 0.

Using factors (4), (5), (6) and (7), we define the following Company Climate Index (CCI) for each issuer of bond j :

$$CCI_j = w_1 RCI_j + w_2 RNRS_j + w_3 RBDR_j + w_4 RFDR_j$$

where RCI_j is the relative carbon intensity of the issuer of bond j , $RNRS_j$ is the relative non-renewable share, $RBDR_j$ is the relative backward-looking decarbonisation rate of and $RFDR_j$ is the relative forward-looking decarbonisation rate. w_1, w_2, w_3 and w_4 are the weights that are applied to each component of the CCI . In the estimations of this report we have used $w_1 = 0.4$ and $w_2 = w_3 = w_4 = 0.2$. We have also used $UPPER=2$, which means that the CCI takes values between 0 and 2. The higher the CCI the worse the climate performance of a company.

Note that a large number of corporate bonds are issued by companies that engage in financial service and insurance activities (sectors K.64, K.65 and K.66). Following Battiston and Monasterolo (2019), for the bonds that have been issued by these companies, we use the NACE codes, the TRBC industry/activity and the company-level data of the ultimate parents.

A6. ESTIMATING CLIMATE-ALIGNED HAIRCUTS

The climate-aligned haircut of each bond j ($haircut_{CLj}$) is given by the following formula which combines that activity/project-based dummy variables and the Company Climate Index (CCI) defined in Appendix A5:

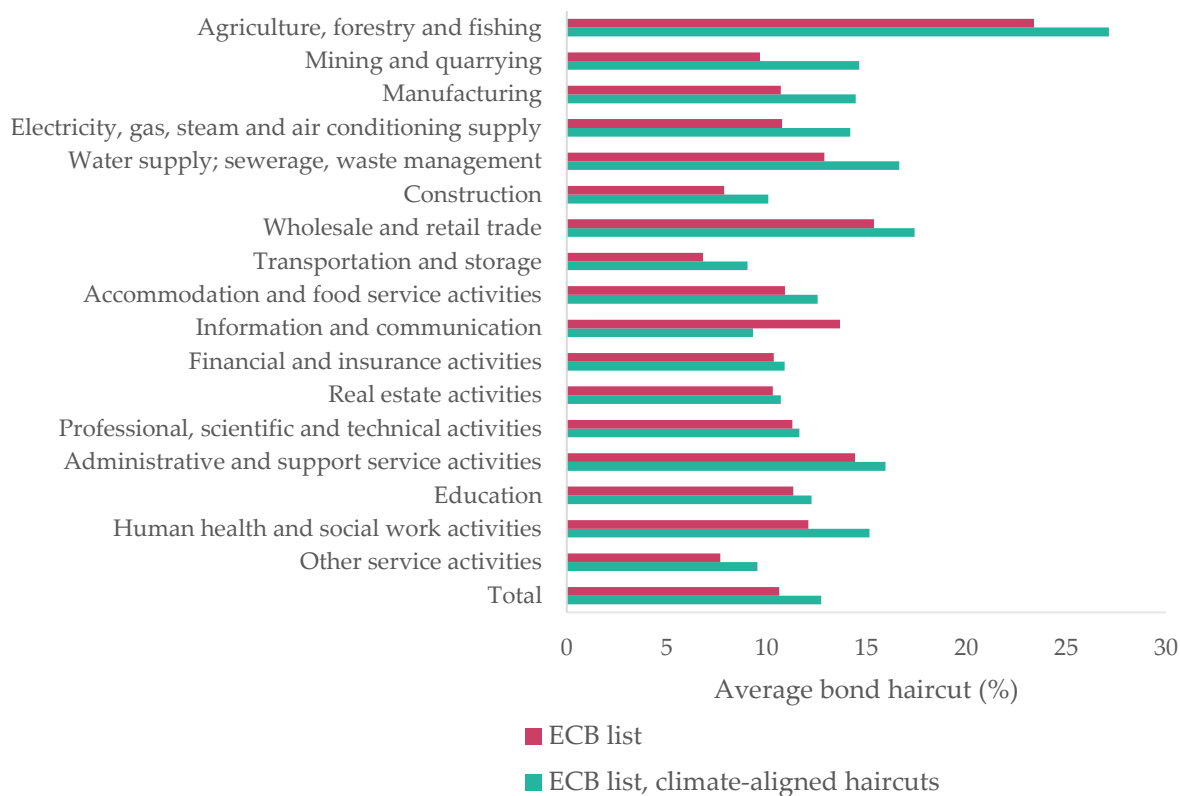
$$haircut_{CLj} = haircut_{CURj} \times [1 + \gamma_1 CIA_j \times [1 + (CCI_j - 1)] - \gamma_2 GREEN_j \times [1 + (1 - CCI_j)] + \gamma_3 OTHER_j \times (CCI_j - 1)]$$

where $haircut_{CURj}$ is the current haircut in the Eurosystem collateral framework and γ_1 , γ_2 and γ_3 parameters capturing the adjustment of the haircut for carbon-intensive, 'potentially green' sectors/green bonds and other sectors. In the estimations for this report we have used $\gamma_1 = \gamma_2 = \gamma_3 = 0.4$. Recall that a higher CCI_j reflects a poorer climate performance.

For the conventional bonds of carbon-intensive issuers, the haircut increases by $100 \times \gamma_1\%$ if $CCI_j = 1$ while for companies that engage in (potentially) green activities or issue green bonds the haircut declines by $100 \times \gamma_2\%$ if $CCI_j = 1$. For the rest of the bonds, the haircuts remain unchanged if $CCI_j = 1$. The formula has the following implications. First, the conventional bonds that are issued by carbon-intensive companies experience a lower penalty the better is the climate performance of the issuers. Second, carbon-intensive companies can avoid a penalty by issuing green bonds. Third, green bonds and bonds issued by companies engaging in (potentially) green activities experience a lower decline in their haircut the higher is their carbon footprint.

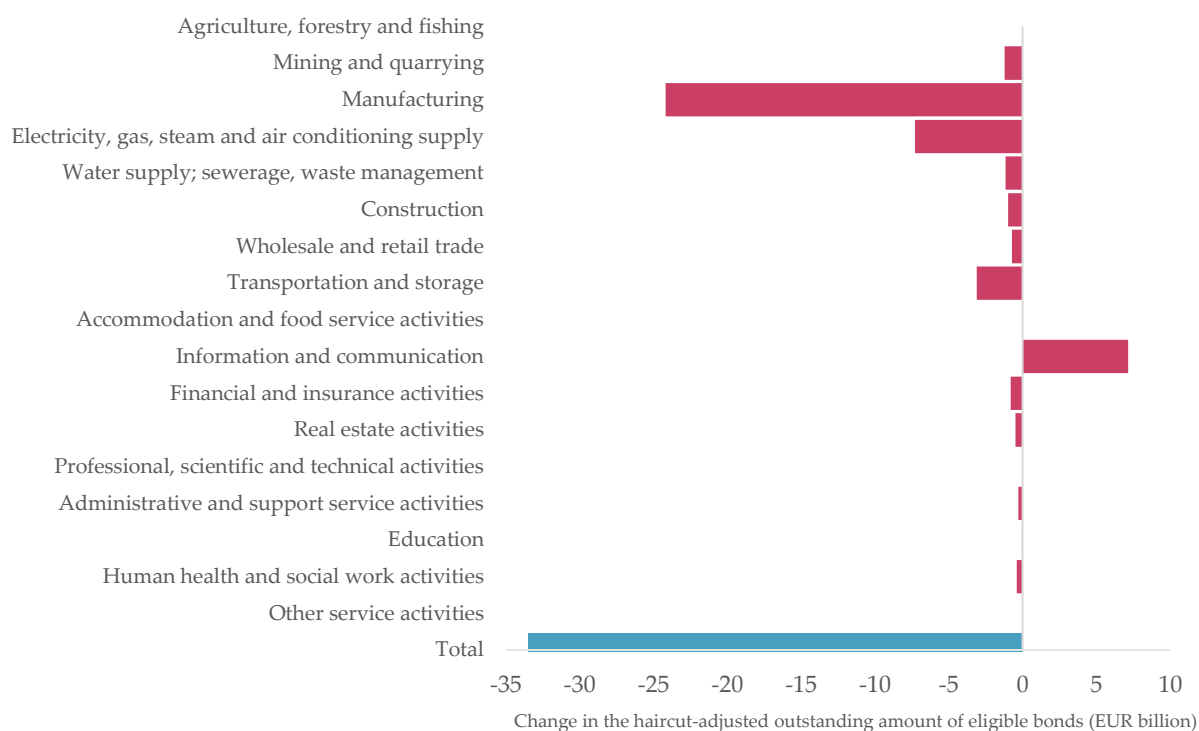
Overall, the formula takes into account that companies that engage in carbon-intensive activities have a higher responsibility for the climate crisis, but at the same time it provides the opportunity to these companies to experience lower haircuts by improving their climate performance or by issuing green bonds. Moreover, for the (potentially) green companies there is an incentive to improve their climate performance since this would allow them to experience an even higher decline in the haircuts of the bonds that they issue.

A7. AVERAGE BOND HAIRCUT PER NACE 1-DIGIT SECTOR, ECB LIST OF ELIGIBLE BONDS, CURRENT AND CLIMATE-ALIGNED HAIRCUTS



Sources: ECB (bond ISIN codes and haircuts, 26 November 2020), Refinitiv Eikon (NACE 1-digit and 4-digit codes, Refinitiv TRBC codes, November 2020; environmental variables) and authors' calculations

A8. CHANGE IN THE HAIRCUT-ADJUSTED OUTSTANDING AMOUNT OF ELIGIBLE BONDS PER NACE 1-DIGIT SECTOR



Note: The figure shows the difference between the outstanding amount in the 'ECB list' and the outstanding amount in the 'ECB list, climate-aligned haircuts'

Sources: ECB (bond ISIN codes and haircuts, 26 November 2020), Refinitiv Eikon (NACE 1-digit and 4-digit codes, Refinitiv TRBC codes, bond outstanding amount, November 2020; environmental variables) and authors' calculations

ENDNOTES

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- ³ See Senni, C.C. and Monnin, P. (2020). 'Central bank market neutrality is a myth', *Council of Economic Policies Blog*, 16 October, available at: <https://www.cepweb.org/central-bank-market-neutrality-is-a-myth/>
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- ⁵ See <https://www.bankofengland.co.uk/news/2021/march/mpc-remit-statement-and-letter-and-fpc-remit-letter>
- ⁶ See e.g. Dafermos, Y., Gabor, D., Nikolaidi, M., Pawloff, A. and van Lerven, F. (2020). 'Decarbonising is easy: Beyond market neutrality in the ECB's corporate QE', *New Economics Foundation*, October, available at: <https://neweconomics.org/2020/10/decarbonising-is-easy>
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- ⁹ See McLeay, M., Radia, A. and Thomas, R. (2014). 'Money creation in the modern economy: An introduction', *Bank of England Quarterly Bulletin*, 54 (1), 1-10.
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¹⁷ See ICMA (2020). 'The European investment grade corporate bond secondary market & the COVID-19 crisis: An ICMA Secondary Market Practices Committee (SMPC) market report', May, available at: <https://www.icmagroup.org/assets/documents/Regulatory/Secondary-markets/The-European-investment-grade-corporate-bond-secondary-market-and-the-COVID-19-crisis-280520.pdf>

¹⁸ For more details, see Appendix A5. We extend the approach developed by Dafermos, Y., Gabor, D., Nikolaidi, M. and van Lerven, F. (2020). 'Decarbonising the Bank of England's Pandemic QE: 'Perfectly Sensible'', New Economics Foundation, August, available at: <https://neweconomics.org/2020/08/decarbonising-the-bank-of-englands-pandemic-qe>. We draw on the Climate Policy Relevant Sectors (CPRS) classification developed by Battiston, S., Mandel, A., Monasterolo, I., Schütze, F. and Visentin, G. (2017). A climate stress-test of the financial system, *Nature Climate Change*, 7 (4), 283-290; see also Alessi, L., Battiston, S., Melo, A. and Roncoroni, A. (2019). 'The EU Sustainability Taxonomy: a Financial Impact Assessment', European Commission, available at: <https://ec.europa.eu/jrc/en/publication/eu-sustainability-taxonomy-financial-impact-assessment>. Carbon-intensive sectors are specified using the approach of Battiston, S. and Monasterolo, I. (2019). 'How could the ECB's monetary policy support the sustainable finance transition?', mimeo, University of Zurich, available at: <https://www.finexus.uzh.ch/dam/jcr:0103ed7b-71e9-4e81-9941-ee61feefd851/ECB%20sustainable%20finance%202022%20MarchIM.pdf>. For more details see Appendix A2.

¹⁹ Rainforest Action Network et al. (2020). 'Banking on climate change 2020', available at: <https://www.ran.org/bankingonclimatechange2020/>; Urgewald (2019). 'Global coal exit list', available at: <https://coalexit.org/database-full>.

²⁰ See Dafermos, Y., Gabor, D., Nikolaidi, M., Pawloff, A. and van Lerven, F. (2020). 'Decarbonising is easy: Beyond market neutrality in the ECB's corporate QE', New Economics Foundation, 20 October 2020, available at: <https://neweconomics.org/2020/10/decarbonising-is-easy>

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²² Actually, by doing so the ECB implicitly assumes that there will be no transition to a low-carbon economy or that the transition will be extremely smooth with no impact on the financial position of carbon-intensive companies.

²³ While the figure shows the average company-level haircut per carbon-intensive sector, the results are similar when the average bond haircut is used (see Appendix A4).

²⁴ We use the green bond flag provided by Refinitiv Eikon. Eikon defines green bonds as fixed income products that offer investors the opportunity to participate in the financing of large sustainable energy green projects that help mitigate climate change and help countries adapt to the effects of climate change.

²⁵ For a similar formula that relies solely on the carbon intensity of companies, see Schoenmaker, D. (2021). Greening monetary policy, *Climate Policy*, doi: 10.1080/14693062.2020.1868392

²⁶ Appendix A7 also shows how the bond haircuts change per NACE 1-digit sector.

²⁷ The haircut-adjusted outstanding amount of bonds is not the same as the maximum amount of funding that banks in the euro area can obtain since (1) only a proportion of the corporate bonds included in the ECB list are held by eurozone banks and (2) the amount of funding depends on the market value of bonds and not on their outstanding value. However, we have used the outstanding amount of bonds because of the lack of granular data for the holdings of banks and because the daily volatility in the bond prices would make our result reliant on the day that we would select to do our analysis.

²⁸ In Figure A8 we show that the outstanding amount of bonds issued by manufacturing sector are mostly affected by the change in haircuts. However, even in this sector the change in percentage terms is small.

²⁹ The WACI is calculated by taking the average carbon intensity that corresponds to each bond weighted by the proportion of the haircut-adjusted outstanding amount of the bond in the total outstanding amount for all eligible bonds.

³⁰ For the bonds that are added, we first estimate the haircuts that these bonds would have based on the existing collateral framework (the factors that affect these haircuts are maturity, the type of coupon, investment grade and security type) and we then make these haircuts climate-aligned using the formula provided in Appendix A6.

³¹ Oustry, A., Erkan, B., Svartzman, R. and Weber, P.F. (2020). Climate-related risks and central banks' collateral policy: a methodological experiment. Banque de France Working Paper 790.

³² See: <https://www.ecb.europa.eu/mopo/assets/standards/marketable/html/index.en.html>

³³ Refinitiv Eikon provides a specific variable about the grade of bonds. If a bond is not assigned as investment grade according to this variable, or the information is not available, we also check the ratings given by Standard & Poor's, Moody's and Fitch. If one of these rating agencies provides a rating of BBB or higher (in the case of the Standard & Poor's and Fitch) or Baa3 or higher (in the case of Moody's), we include it in the list.

³⁴ See: <https://www.ecb.europa.eu/paym/coll/assets/html/list-MID.en.html>

³⁵ For those bonds that were not issued in euro, we have transformed them into euro by using the exchange rates of the 26th of November 2020.

³⁶ Battiston, S. and Monasterolo, I. (2019). 'How could the ECB's monetary policy support the sustainable finance transition?', mimeo, University of Zurich, available at:

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³⁷ Battiston, S., Mandel, A., Monasterolo, I., Schütze, F. and Visentin, G. (2017). A climate stress-test of the financial system, *Nature Climate Change*, 7 (4), 283-290. See also:

<https://www.finexus.uzh.ch/en/projects/CPRS.html>

³⁸ See EU Technical Expert Group on Sustainable Finance (2020). 'Taxonomy: Final report of the Technical Expert Group on Sustainable Finance', Brussels, March 2020, available at:

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³⁹ For a discussion of the use of carbon intensity as a variable for assessing the climate performance of a company, see Ehlers, T., Mojon, B., and Packer, F. (2020). 'Green bonds and carbon emissions: exploring the case for a rating system at the firm level', *BIS Quarterly Review*, September, 31-47.

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