SUSTAINABLE FINANCE LAB

A GREEN INTEREST RATE FOR THE EUROZONE

Evaluating the design choices

In this paper

The current high interest rates slow down the energy transition, making the Eurozone more vulnerable to fossilflation. With a green interest rate programme, the ECB can offset this effect.

In this paper we analyse the most relevant design choices for such a green interest rate programme, like how to define 'green' and the structure and size of such a programme.

Using data from the 2023 Taxonomy-alignment reports of banks we find that a green rate can accelerate the energy transition throughout the Eurozone against modest costs.

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POLICY PAPER

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The Sustainable Finance Lab (SFL) is an academic think tank whose members are mostly professors from different universities in the Netherlands. The aim of the SFL is a stable and robust financial sector that contributes to an economy that serves humanity without depleting its environment. To this end the SFL develops ideas and provides a platform to discuss them, thus bridging science and practice.

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Policy Paper

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CONTENT

SUMMARY

The EU's quest for strategic autonomy and energy decarbonation requires a more rapid transition away from fossil fuels and massive investments in renewable energy sources, energy efficiency, grid interconnectivity and storage. On the upside, the energy transition would also benefit price stability prospects, as a clean energy mix will likely result in lower and more stable energy prices. Under its primary and secondary objective, the ECB has the mandate to support these EU priorities.

The current high interest rate environment has slowed down the transition. As a result of their cost structure, green investments are more sensitive to interest rate changes than fossil fuel ones. They are, therefore, disproportionately hit by the ECB's high interest rate policy. This policy contradiction slows down the green transition in the EU, which ultimately poses risks to price stability.

To address this contradiction, the ECB could introduce a green interest rate, in the form of a green targeted longer term refinancing operation (Green TLTROs). A Green TLTROs would provide banks with a lower green interest rate under conditions that incentivizes them to extend more green loans at cheaper rate.

The obstacles against the introduction of a Green TLTROs identified by the ECB during its 2020-2021 Strategy review are currently being overcome. As banks and corporations are starting to report on their alignment with the EU Taxonomy, reliable data on green lending is now available for central banks. Moreover, the ECB has announced that it will consider climate change when introducing new structural refinancing operations in the next few years.

Coincidentally, as the ECB's monetary policy stance is expected to become more accommodative in the coming months, the ECB should seize this momentum to introduce a separate interest rate for green

activities. Such initiative would also come at a timely moment to support the delivery of the EU's climate targets for 2030.

Designing a Green TLTRO is a delicate exercise. Such a policy should be created to stimulate green lending, while not jeopardizing the conduct of monetary policy. It should also be operationally feasible and preserve the level playing field between banks. This paper aims to clarify the design choices to be made in the Eurosystem context.
The EU Taxonomy of sustainable activities provides a broad and robust definition of green lending, and the related mandatory disclosure for banks and corporations will greatly facilitates the implementation of Green TLTROs. In addition, the ECB could decide to adopt a more "selective" Taxonomy approach that could help to prioritize specific segments of the EU Taxonomy that are more relevant for the conduct of price stability.

The ECB could design the green rate in two complementary ways. First, participating banks could benefit from an initial "basic" interest rate reduction on the amount of newly originated Taxonomy-aligned lending during the previous year. An additional "bonus" rate reduction could be granted for banks reaching pre-determined lending targets, for instance based on the Green Asset Ratio. We advise against introducing a penalty rate on dirty lending at this stage. Based on the literature, we find that a green spread of 100 to 200bps would already have tangible effects in stimulating renewable investments.

We built a dataset based on the Taxonomy-alignment reports of 73 banks for 2023 representing 80% of Eurozone banking assets. This dataset enables us to estimate the amount of Taxonomy-aligned assets stock of €400-500 billion. If banks had to increase their Green Asset Ratios by 2 pp per year in order to qualify for the green bonus rate, the size of the Green TLTRO could reach an annual size of between €317-378 billion. This order of magnitude is in line with estimations of the size of the green investment gap in Europe, and falls within the possible envelope of the ECB's future structural operations.

We identify several options enabling the ECB to control the size of the Green TLTRO programme to fit its monetary policy stance. If needed,

the ECB could reduce the borrowing allowances of banks, for instance by taking a selective approach in defining which EU Taxonomy activities would be eligible under the programme. In the extreme case the ECB can put a cap on the size of the whole programme.

Due to negative difference between the green interest rate and the ECB's deposit facility rate, a Green TLTRO would bear a cost on the Eurosystem's balance sheet. Under conservative assumptions, we estimate these losses at around €5 billion per year on the Eurosystem's balance sheet. In comparison, the Eurosystem is expected to make more than €160 billion of losses in 2022-2027.

GLOSSARY

APP	Asset Purchase Programmes
CERF	Carbon Emission Reduction Facility
CSRD	Corporate Sustainability Reporting Directive
DFR	Deposit Facility Rate
DNB	*De Nederlandsche Bank* (Dutch central bank)
DNSH	Do No Significant Harm
EBA	European Banking Authority
ECB	European Central Bank
EONIA	Euro OverNight Index Average
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Certificate
ESCB	European System of Central Banks
ESG	Environmental, Social and Governance
GAR	Green Asset Ratio
GDP	Gross Domestic Product
HICP	Harmonised Index of Consumer Prices
IEA	International Energy Agency
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
KPI	Key Performance Indicator
LCOE	Levelized Cost of Electricity
LTRO	Long-Term Refinancing Operation
MRO	Main Refinancing Operation
NACE	*Nomenclature statistique des activités économiques dans la Communauté européenne* (Statistical classification of economic activities in the European Community)
NFRD	Non-Financial Reporting Directive
NGFS	Network for Greening the Financial System
NVDE	*Nederlandse Vereniging Duurzame Energie* (Netherlands Association for Renewable Energy)
NSFR	Net Stable Funding Ratio
PBOC	People's Bank of China
RED	Renewable Energy Directive
SAFE	Survey on the Access to Finance of Enterprises
SSM	Single Supervisory Mechanism
TFEU	Treaty on the Functioning of the European Union
TLTRO	Targeted Long-Term Refinancing Operation

1. INTRODUCTION

The unprecedented inflationary crisis of 2021-2024, resulting from the economic restart after the Covid19 pandemic and the Russian invasion in Ukraine, has unveiled the dangerous dependency of the EU economy on imported fossil fuels. "Fossilflation" emerged as a term for the inflation driven primarily by increased prices of imported fossil energy like oil and gas in the Eurozone (Schnabel, 2022). In response to the spike of inflation, the European Central Bank (ECB) intervened by raising interest rates in 2022.

As pointed out in the recent report by Mario Draghi, the best solution against fossilflation would be to accelerate the energy transition, by boosting investments into energy decarbonation such as renewable energy sources, energy efficiency, grid interconnectivity and storage (Draghi, 2024). A rapid energy transition would result in cheaper and more stable energy prices, which would also improve price stability.

However, the ECB's monetary tightening simultaneously slows down the energy transition, as it worsens the financing conditions for specific sectors such as renewable energy investments, energy efficiency of buildings and other industries that are more capital intensive than the fossil fuel sector. Thus, the ECB's monetary policy is arguably working against the EU's economic priorities, like strategic autonomy and the implementation of the EU's Green Deal.

A wide range of academics, business organisations and think tanks have suggested a green interest rate (also referred to as "dual rates" or "green targeted longer term refinancing operation" (Green TLTROs)) in order to support the financing of transition investments. Unlike Japan and China, the ECB has so far rejected this concept, in particular due to operational feasibility challenges, such as the lack of reliable data on green lending. Moreover, the ECB was reluctant to

envisage the introduction dual rates under a restrictive policy environment as it was concerned it could blur its monetary policy stance.

However, the ECB started to cut interest rates in June 2024 and is expected to continue doing so in coming months, as inflation recedes in the Eurozone. Moreover, significant progress in the use of the EU Taxonomy by banks and corporates may facilitate the implementation of a green interest rate policy. Thus, the time may have come to revisit how a Green TLTRO programme could be introduced in practice. The goal of this paper is to evaluate the design options for a green interest rate in the Eurosystem policy framework. The paper does not intend to propose one way to introduce a green interest rate, but rather to guide policymakers and other stakeholders in their own thinking and develop more detailed proposals.

The report is structured as follows. Chapter 2 starts with an explanation of the two-way relationship between the ECB's monetary policy and the EU's energy transition. Chapter 3 reviews the recent policy discussion on the idea of a green interest rate. Chapter 4 discusses to what extent the implementation of the EU Taxonomy regulation can address the need for a clear and robust definition of green lending, and whether reliable data is sufficiently available. Chapter 5 describes how the level of green interest rate could be calculated. Chapter 6 discusses other policy parameters such as collateral requirements and the maturity of loans. In Chapter 7, we compare the advantages and disadvantages of the various policy parameters discussed and f highlight some of the policy trade-offs involved. For illustrative purposes, in chapter 8 we analyse the potential scenario of a green interest rate of up to 150 basis points lower than the ECB's key rate from 2025 until 2030. Based on a unique dataset of EU Taxonomy-alignment from a sample of European banks, we provide a preliminary assessment of the potential size and implications of this programme on the Eurosystem's balance sheet.in the long term.

2. HOW THE ECB'S MONETARY POLICY WORKS AGAINST PRICE STABILITY AND EU ENERGY TRANSITION

This section discusses the two-way relationship between the ECB's monetary policy and the green transition. On the one hand, a high interest rate environment negatively impacts the renewables sector disproportionally. Simultaneously, the delay in the renewables buildout leaves the European economy exposed to the negative effect of fossilflation, which may pose further risks for the conduct of price stability. This strongly intertwined relationship demonstrates the relevance of a successful energy transition for the ECB's mandate

Box 1: The relevance of climate change for the ECB's primary and secondary mandate

The primary mandate of the ECB is to preserve price stability in the euro area by steering the short-term interest rate of the banking sector (ECB, 2021c).

In this context, the ECB has recognised already in 2018 that climate change would have an impact on price stability, given the increased frequency of extreme weather events and their implications in terms of climate-related physical and transition risks on households and corporates, as well as the greater volatility and uncertainty induced on relative prices and inflation expectations (Coeuré, 2018).

This understanding was only reinforced in the recent years. For instance, the ECB made climate change a central part of its previous Strategy review and its recently revised operational framework (ECB, 2021b, 2024a). The relevance of climate change for price stability has been reiterated throughout the year by various ECB officials(see for example Elderson, 2021; Schnabel, 2022), as well as by the academic literature (Bremus, Dany-Knedlik and Schlaak, 2020; Beirne *et al.*, 2024).

Moreover, Article 127 of the TFEU stipulates: "Without prejudice to the objective of price stability, the ESCB shall support the general economic policies in the Union with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union. This so-called "secondary mandate", or perhaps more accurately "supportive objective", has often been neglected by the ECB (van Tilburg and Simić, 2021; Van't Klooster and De Boer, 2021). However, in recent years, it has made a resurgence. For instance, the ECB Executive Board Member Frank Elderson stressed that observing the secondary objective was "a duty, not an option" (Elderson, 2021).

Whether and how the ECB can prioritise the fight against climate change under its secondary mandate crucially depends on the degree of prioritisation of this issue by the EU's political institutions, and the existence of clear policies in this regard (Ioannidis, Hlásková and Zilioli, 2021; van Tilburg and Simić, 2021).

With the adoption of the Fit for 55 package under the previous legislature, the European Union has set itself high ambitions to accelerate the transition towards a low carbon economy. For instance, the EU adopted a Renewable Energy Directive (RED) which sets a target to reach 42.5% of renewable energy production in the EU by 2030 (*EU Directive 2023/2413 on the Promotion of Renewable Energy*, 2023). The Energy Performance of Buildings Directive (EPBD) also set a binding target to increase the average energy performance of the national residential building stock by 16% by 2030 (*EU Directive 2024/1275 on the energy performance of buildings (EPBD recast)*, 2024), in order to reduce energy consumption. Moreover, the RepowerEU strategy supplemented the EU green Deal by reinforcing the EU's ambition to decrease its dependence on Russian gas.

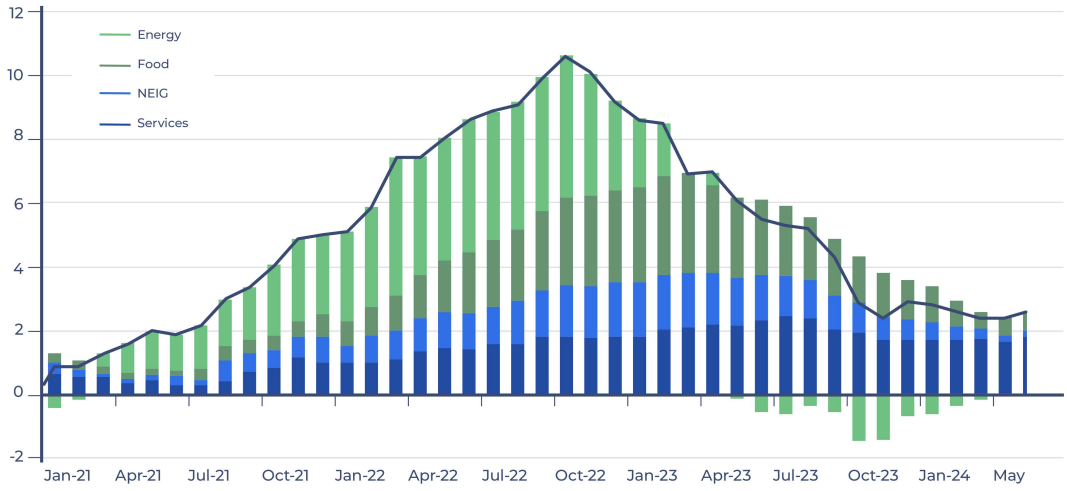
Successful implementation of these policies will unambiguously require important investment needs, to the tune of €400 to 500 billion per years (Andersson *et al.*, 2024). It is also clear that the bulk of these investments will require a greater input from the banking sector.

In the last few years, climate change mitigation has thus been on the top of the EU's agenda, with the adoption of the EU Green Deal and Climate Law. Moreover, the EU's goal of strategic autonomy, against the backdrop of the war in Ukraine and wider geopolitical tensions, also loudly speak in favour of accelerating the shift in the EU's energy mix towards more domestically produced green energy. Supporting these objectives could thus be interpreted to fall under the ECB's secondary mandate of "contributing to the achievement of the objectives of the Union", as indicated in the Article 127.

Impact of higher interest rates on renewable energy investments

In the summer of 2021, energy prices started to rise globally, due to the geopolitical tensions running up to the outbreak of the war in Ukraine, in combination with the opening up of economies after Covid. Due to the rise of energy prices, inflation in the Eurozone rose to 10.2% at its peak in October 2022 (see Figure 1 below). The ECB's Governing Council responded to this by raising interest rates in July 2022 up to 4.5% – their highest point since the creation of the ECB – and by phasing out its asset purchase programme (see Figure 3 in section 3.1).

Figure 1. Inflation contributors and total inflation in the Eurozone between 2021 and 2024



Source: ECB (2024)

The ECB's strategy to combat energy-driven inflation faced criticism, as interest rates changes have been described by many as inadequate to address a supply shock, like in this case energy-driven inflation (Krahé and Heilmann, 2023; Van 'T Klooster and Weber, 2024).

Changes in interest rate apply to the overall economy. However, the impact of these higher rates is not homogenous across sectors, as some sectors are more sensitive to interest rates changes than others, due to their higher reliance on debt financing costs. Renewable energy, for instance, is a very capital-intensive sector (IEA, 2023; Kleintop, 2023). This is because the cost of generating renewable energy is predominantly falling on the high upfront investment costs to build and install the required infrastructure. The further input costs of wind or solar radiation are basically nil: the sun shines and the wind blows for free. The opposite is true for fossil fuel energy, whose infrastructure have already been largely built, but whose running costs are very dependent on its input cost, which are the cost of

commodities required to run oil and gas power plants. This difference in the cost structure has deep implications on the cost-sensitivity of each energy technologies to changes of interest rates.

Empirical findings on the interest rate sensitivity of renewable projects

Multiple empirical studies confirm that renewable energies are more sensitive to changes in interest rates (Monnin, 2015; Schmidt *et al.*, 2019; Polzin *et al.*, 2021; Đukan *et al.*, 2023; Aguila and Wullweber, 2024). For instance, IEA finds that an interest rate hike from 3% to 7% would entail an increase of the Levelized cost of Electricity (LCOE) of more than 30% for offshore wind and solar PV (IEA, 2020). In contrast, the LCOE of gas-fired power would only increase by 4% (IEA, 2020).

Similarly, Voldsgaard et al. (2022) find that an increase of the cost of capital by 5 to 10% would lead to an increase of the cost of electricity from offshore wind, large-scale PV, and rooftop PV by 47%, 52-54% and 60% respectively. In contrast, the cost of capital hike would increase the cost of gas-fired electricity by only 8% (Voldsgaard, Egli and Pollitt, 2022). Anecdotally, a survey by the Netherlands Association for Renewable Energy found that a third of its members reported that an increased interest rate environment has negative impact on their financing options (NVDE, 2023a).

In a recent paper, ECB researchers found a different, but not contradicting conclusion. They found that green firms generally benefitted from interest rates 14 basis points lower than high-emission firms in the period 2018-2022. Moreover, high carbon firms were hit more aggressively (by 1bps) after a 25bps hike in the ECB key rate (Altavilla *et al.*, 2023). However, the study does not capture the structural disadvantage of renewable investments as aforementioned. A relatively smaller increase in costs of capital (as found by Altavilla and colleagues) may therefore still translate into larger total costs (i.e. LCOE) for renewables than fossil fuel projects.

At the same time, the ECB's own Survey on the Access to Finance of Enterprises (SAFE), finds that more than half of Eurozone companies indicate that high interest rates present very important obstacles to obtaining climate investments (Ferrando, Groß and Rariga, 2023).

Overall, the literature clearly establishes that interest rate hikes the ECB are increasing the cost of capital for renewable projects, which can appear to be in a strong contradiction with the ECB's mandate to support the above-mentioned economic policies of the EU.

Unfortunately, this policy contradiction is likely to occur again, as geopolitical risks remain high. After its unprecedented peak in 2022, inflation has significantly come down, enabling the ECB to cut rates by 25 basis points in June 2024 (ECB, 2024d). However, the geopolitical risks factors that led to the fossilflation of 2021-2023 are still very much present. When trying to escape its dependency on Russian gas, the EU has led itself to diversify its energy supply to other external sources of gas, like Qatar and the US. But the underlying risk of energy price shocks remain generally similar, as exemplified by the disruptions in supply chains due to terrorist attacks in the Red Sea or technical difficulties in the Norwegian gas pipeline facilities (Buli, 2024; Gwyn Jones, 2024; Partington, 2024). In addition, the next US administration may be less favourable to EU trade conditions (Moens and Gijs, 2023; Milligan, 2024). Although such geopolitical risks have always been possible, their probability, intensity, and potential gravity, have arguably never been higher than today.

As we will see in the next section, the risk of a policy mismatch between monetary policy and the green transition may also undermine the pursuit of price stability by the ECB itself.

More renewable energy will benefit the price stability

An important aspect of the debate on whether central banks should support the green transition is linked with the question as to whether the energy transition will lead to overall higher or lower levels of inflation. The so-called “greenflation” defines the hypothesis where it would lead to higher inflation (Schnabel, 2022). However, the opposite hypothesis also exists, as illustrated by the unexpected decline in solar PV costs by 89% between 2010 and 2022 (IRENA, 2023). As Christine Lagarde stated: “investment in renewables, grids and storage will lead to lower and more stable energy prices” (Lagarde, 2024). If the President of the ECB is correct, then price stability would greatly benefit from a speedy energy transition. As the share of clean energy production increases, inflation overall will reduce. In this section, we will explore the empirical evidence underpinning this statement.

Preliminary evidence of this negative relationship between the share of renewable energy sources in the energy mix and inflation was found in Spain, where an increase of 1 GWh of electricity production with renewables or cogeneration reduced electricity prices by almost 2€/MWh during the period from 2005 until 2011 (Gelabert, Labandeira and Linares, 2011)[1]. Moreover, Bank of Spain researchers recently found that a larger share of renewable energy could lead to a 50% reduction of wholesale energy prices in Spain by 2030 (Quintana, 2024).

1 This represents a price reduction of around 3.7% given the average wholesale electricity price of 50 € per MWh for the period analysed by the authors.

Using data from all Eurozone countries, Bednář and associates find a similarly strong correlation between energy prices and inflation, especially since 2009. They find that for each percentage increase in the electricity contribution in the HICP correlates with an increase in the HICP by six percentage points, and that the share of renewable electricity consumption is negatively associated with inflation. (Bednář *et al.*, 2022). Analysis by the International Energy Agency arrives at a similar conclusion, finding that "without PV and wind capacity growth in 2021-2023, average wholesale electricity prices would be higher by about 3% in 2021, 8% in 2022 and 15% in 2023" (International Energy Agency, 2023).

One exception in the literature is a recent IMF working paper, in which the authors try to identify correlation between renewable energy production and lower inflation, using data from 75 countries over the 1973-2022 period (Millischer *et al.*, 2024). However, the authors only find evidence of such correlation for the few EU countries with more than 85% of green renewable electricity production in their domestic supply mix, and not for other countries. As the authors explain, this is largely due to the specificities of the marginal energy pricing model that is being used in the EU energy market, where gas-powered electricity cost de facto determines the price of renewable energy[2]. This echoes the analysis of the EU's Joint Research Centre, which concludes that the benefit of renewable energy in terms of lower wholesale prices will take longer to materialise, due in part to limited storage capacity and system flexibility (Gasparella, Koolen and Zucker, 2023). In the EU's marginal price system, any linear increase in the share of renewables will not lead to an immediate and linear decrease to the whole wholesale energy price. There is instead a tipping point in the energy mix after which this correlation will fully come to effect.

All these findings tend to minimize the perceived risks of "greenflation". It is possible that higher prices of certain materials will increase, while the overall cost of production of green energy will also continue to decrease with technological advances and scaling up effects. Moreover, to reiterate, the cost of capital plays an important role in the output electricity cost, as we discussed in the previous section. Given that the cost of capital is partly a consequence of central bank's interest rate policies, there can be a feedback loop between central bank policies and energy inflation. Even if the greenflation hypothesis turned out to be true, it would still be counter-productive if central bank policies continue to increase the capital cost for renewables, since this would lead to higher production costs for green energy, ultimately translating into energy-driven inflation.

2 The wholesale electricity price in the EU is determined by the production cost of the energy technology which has to be switched on the last in order to meet new demand. Hence, once renewables and nuclear production is fully consumed, gas-powered plants are usually switched on to meet the EU demand. Given this, the price of gas most often determines the wholesale price of electricity, including when generated by renewables (Zakeri et al., 2023).

Against this background it appears that raising interest rates has an unfortunate side-effect of negatively impacting the sectors – in this case renewables – that could help reducing the inflationary pressure in the future. From that point of view, although raising interest rates could be necessary on the short term, it could simultaneously be counterproductive policy for long-term price stability. In the next section we will review the recent policy discussion on the possibility of introducing a green interest rate into the ECB's monetary policy framework, in order to situate how this concept could be practically implemented, and the various constraints already identified.

3. BACKGROUND AND POLICY DISCUSSION

In this chapter, we will review the recent policy developments around longer term refinancing operations (LTROs) and the subsequent debate on the possibility to adopt green refinancing operations. This background will prove useful in understanding the policy constraints and concerns that the policy idea has generated so far, and which will guide our thinking when designing a Green TLTRO.

Short history of ECB's refinancing operations

Before diving into the policy discussion on the greening of central bank refinancing operations, we first briefly summarize the recent history of ECB refinancing operations. This may be a good basis for understanding how these operations work, and therefore how they could be "greened".

The early history

Before the great financial crisis of 2008-2009, there was an active interbank lending market and banks would usually lend to each other. The role for the central bank was to steer the interbank lending rate within a certain corridor defined by the key interest rates.

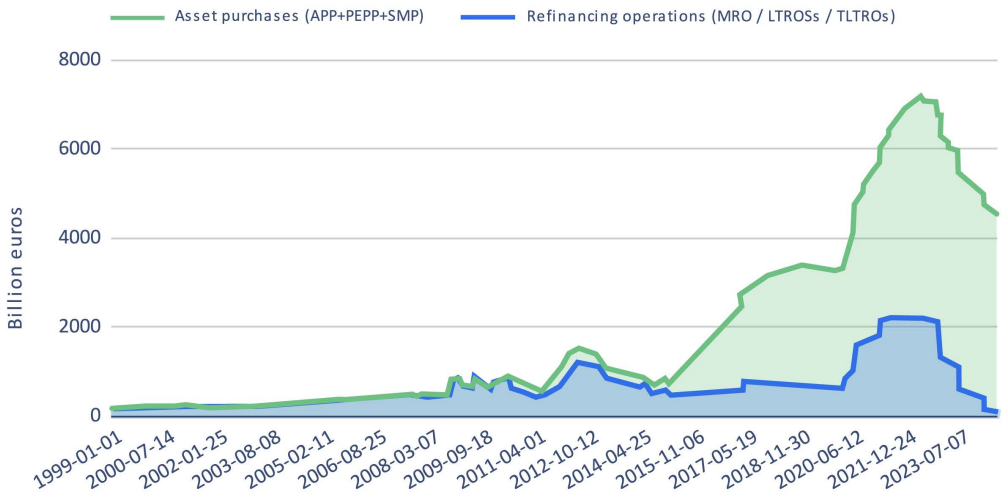
The provision of liquidity to banks was thus more limited and indirect. Banks had to compete to receive a portion of this limited liquidity by submitting bids, specifying both the amount of lending they want and the interest rate they are willing to pay. The central bank then ranked the bids by the level of interest rate offered and provided liquidity starting from the highest bids until the predetermined total amount was exhausted (Linzert, Nautz and Bindseil, 2006; Eisenschmidt, Hirsch and Linzert, 2009).

The post-crisis new normal

With the outbreak of the great financial crisis in 2008, the interbank market collapsed, leaving no choice to the central bank but to fill the gap by providing ample liquidity to the banking sector. This was done with the deployment of large-scale asset purchases programmes ("quantitative easing") and extension of already existing long-term lending operations (LTROs) beyond the usual 3 months maturity. To further support the banking sector during this turmoil, the central bank started offering loans against fixed rate and full allotment. In such a regime, banks do not have to compete anymore to receive liquidity: all bids submitted by banks are satisfied, up to a borrowing allowance. In 2014 the ECB introduced targeted LTROs (TLTROs) in order to strengthen the lending effects of the program (see Box 2 below).

The amount of these operations reached historically high levels, culminating at around 7 trillion of total outstanding liquidity injected in May 2021, including 2.2 trillion under TLTROs (see Figure 2 below).

Figure 2. Volume of ECB refinancing operations 1999-2024



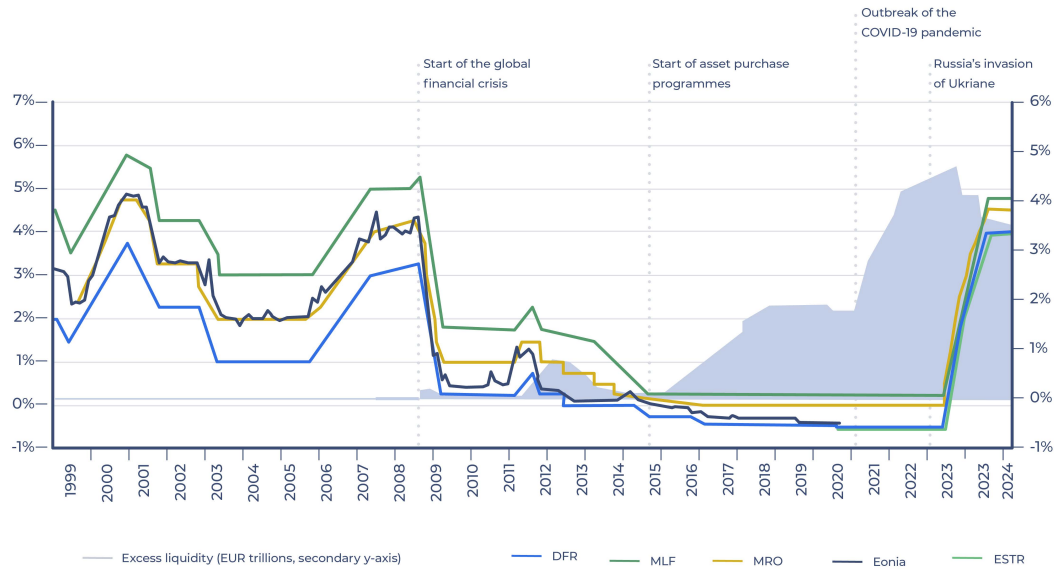
Source: ECB (2024f, 2024c).

As the central bank injected more reserves into the banking sector, the central bank's deposit rate played a more powerful role than the refinancing rate, and the whole system shifted from a corridor regime to a so-called floor regime[3]. As Figure 3 below shows, the interbank lending rate (EONIA, in blue) used to fluctuate between the Deposit Rate (DFR, in orange) and the Main Refinancing rate of the

3 For more details see (NBB, 2024).

ECB (MRO) until 2012. After that, the EONIA rate closely follows the ECB's deposit facility rate.

Figure 3. History of the of the ECB's monetary policy interest rates and instruments



Source; National Bank of Belgium (2024).

In response to the Covid-19 pandemic crisis, the ECB crossed another Rubicon. The ECB lowered the interest rate under TLTRO III to as low as -1%, well below its -0.5% deposit rate, and with 4 years maturity (ECB, 2020). In this setting, banks borrowing from the ECB could actually make money: they pay less in interest rate than they receive from interest payments on their deposit accounts at the central bank. There was, however, one condition: that banks meet a "lending performance threshold" over a specific period – namely to increase their (non-mortgage) lending to households and non-financial corporations (ECB, 2019).

Box 2: Findings on the performance of (T)LTROs

The LTRO operations, the precursor to TLTROs, were suspected to lead to carry trades by recipient banks. This means that these banks could use the discounted central bank lending to purchase government bonds (or other financial instruments) with a higher yield to benefit from the interest rate difference. The literature confirmed that carry trades were indeed taking place (see for example Crosignani, Faria-e-Castro and Fonseca, 2015; Acharya, Pierret and Steffen, 2016).

As a result, the ECB assigned firmer conditionalities to long-term lending in 2014 with the introduction of TLTRO-I – hence the update to the name of the program to *targeted* LTROs. The stated goal of this shift was strengthening the lending to the real economy and improving the monetary policy mechanism (ECB, 2014). The academic studies showed that this targeting was effective: there was little evidence of carry trade taking place, and the lending to the real economy improved in TLTRO programmes compared to earlier LTROs (de Haan, Holton and van den End, 2019; Laine, 2019; Benetton and Fantino, 2021; Castillo Lozoya, García-Escudero and Pérez Ortiz, 2022).

The TLTROs programme had positive effects across multiple other dimensions. For example, research has shown that banks that participated in the TLTRO-I program reduced the interest rates by 20 basis points and increased lending volume by 17% compared to non-participating banks (Benetton and Fantino, 2021). TLTRO-II was found to increase lending to the non-financial corporations by 20% (Laine, 2019). Vulnerable economies[4] of the Eurozone were found to have especially benefitted from the TLTRO programme, at least in 2016 and 2017 in terms of the amount of credit extended to the real economy (Afonso and Sousa-Leite, 2019). Moreover, certain studies find that TLTROs positively impacted macroeconomic variables such as GDP and inflation (Laine and Nelimarkka, 2023).

TLTROs are important examples of the way in which the ECB went beyond the conventional constraints of monetary policy. The innovative features of TLTROs inspired further creative suggestions as to repurpose refinancing operations to facilitate the green transition, as we will see in the following section.

Emergence of Green TLTROs proposals

At the end of 2019, the newly elected ECB President announced her intention to investigate the possible role of the ECB to support the fight against climate change, which by that time had become a pressing demand from a range of non-profit organisations and think tanks (Arnold, 2019).

Henceforth, the ECB embarked itself into a 18-month long strategy review process, which pave the ground for a wider public debate on how the ECB could address climate change. Inspired by Eric Lonergan[5], the idea of designing TLTROs targeted specifically towards green lending emerged. “Green TLTROs” were defined as

4 In the study defined as: Cypress, Spain, Greece, Ireland, Italy, Portugal and Slovenia.

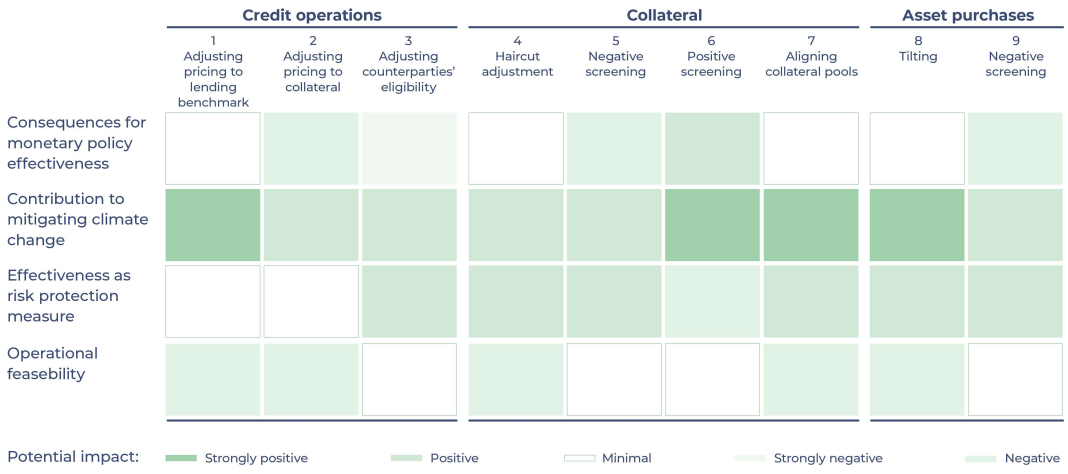
5 Eric Lonergan was the first to describe “dual rates” as the possibility for the central bank to offer a lending interest rate lower than the deposit facility rate (Lonergan, 2016, 2019, 2020).

"refinancing operations where the interest rate that banks pay depends on their volume of lending that complies with the EU's Green Taxonomy" (Van't Klooster and Van Tilburg, 2020).

Hubert Kempf had also imagined the implementation of a "climate spread" on the interest rate applicable to the ECB's refinancing operations (Kempf, 2020). This interest rate differentiation would be based on a climate scoring of commercial banks, serving as either an incentive or a penalty for less environmentally friendly banks.[6]

The idea was also reviewed by the Network for Greening the Financial System (NGFS), and identified as one of the potentially most effective ways to mitigate climate change while also pointing out to the difficult operational feasibility (NGFS, 2021).

Figure 4. The NGFS identified green refinancing operations as one of the potentially most impactful measures central banks could take



Source: NGFS (2021)

ECB's reaction to Green TLTROs

ECB President Lagarde initially welcomed the Green TLTROs proposal.[7] But in spite of her openness, the ECB did not end up introducing a differentiated green interest rate in the final conclusions of its strategic review. The Governing Council

6 We also acknowledge that Nikolas Z. Muller might have been the first who theorized the "green interest rate". However his approach differs from ours, as he defines the green interest rate as the equivalent of the natural interest rate which optimises consumption over the cycle depending on the expected path of pollution intensity of the economy. In his model, a green interest rate should therefore be higher than the normal rate, in order to decelerate consumption in a pollution-intensive economy (Muller, 2021).

7 At a hearing at the European Parliament on 28 September 2020, Christine Lagarde said: "you are asking me whether we would be prepared to consider this proposal as part of our strategy review, and the answer is yes." (European Parliament, 200).

deemed it "premature to concretely envisage targeted green operations at the current juncture." (Drudi et al., 2021) Several obstacles were identified, the first being the lack of reliable data on the green lending, since indeed, until very recently, commercial banks were not yet obliged to assess the Taxonomy-alignment of their loan books (Várhelyi, 2020). Another concern was ensuring that the policy would provide a level playing field for banks, as certain banks might be in a better position than others to achieve the green lending target (ECB, 2021a). Other concerns related to whether Green TLTROs do really fall within the mandate of the central bank, or whether it constitutes de facto a substitute for existing fiscal policies (Villeroy de Galhau, 2023).

Beyond these technical concerns, a more fundamental reason has been advanced to rule out the introduction of Green TLTROs. The ECB's strategy review led to the recognition of the importance of climate change for monetary policy under a "protective" or risk-based agenda, centred around the mitigation of climate-related risks and its implications for financial stability. By contrast, the introduction of differentiated rates is being seen as a more "proactive" or "allocative" approach where the central bank acts more directly in support of a reallocation of resources towards the low carbon transition. An proactive or allocative approach is often perceived as blurring the lines between monetary and fiscal policy (Boneva, Ferrucci and Mongelli, 2021; Kedward, Gabor and Ryan-Collins, 2022; Lane, 2024).

Resurgence of dual rates as a response to fossilflation

While the concept of dual rates was put aside for a while, it re-emerged in the discussion during the energy-led inflationary crisis following the war in Ukraine in 2022. While the ECB responded to this inflationary pressure by raising rates, critics of the ECB have argued that the "one size fits all" policy might not be sophisticated enough to address acute supply-shock stemming from imported fossil fuel energy prices. Indeed, while interest rate hikes may work when inflation is predominantly stemming from demand factors such as excessive wage growth, consumption or public budgets spending, the impact may be more limited when addressing supply shocks.

As we have seen in section 2, raising interest rates has an unfortunate side-effect of negatively impacting certain supply factors that could play a dis-inflationary role. From that point of view, although raising interest rates could be necessary on the short term, it could simultaneously be counterproductive policy for long-term price stability.

To overcome this trade-off, various voices from the banking sector and think tanks called once again on the ECB's governing council to adopt instead a "green dual rate" approach (Lonergan *et al.*, 2022; Monnet and Klooster, 2023; Van Doorslaer and Vermeiren, 2023). Green business leaders from France and the Netherlands

have also supported the idea at various occasions (NVDE, 2023b; Grandjean *et al.*, 2024), alerting about the impact of higher capital costs on their business model and on the levelized cost of energy (LCOE).

Going further, Van't Klooster and Weber have conceptualized a new inflation governance framework that would coordinate a broad range of stakeholders and policy areas including competition, fiscal, monetary policy, but also statistical authorities (Van 'T Klooster and Weber, 2024). Improving the governance of macro-financial policy would go a long way to improve economic efficiency and crisis management in the European Monetary Union. A differentiated green interest rate as described in this report could be one of the instruments at the service of a more coordinated and optimal policy mix. A green interest rate would enable the central bank to act simultaneously on demand and supply factors. With a dual rate regime, the central bank could raise rates to reduce aggregate demand, while at the same time lowering the green interest rate to preserve specific supply side factors from undue tightening.

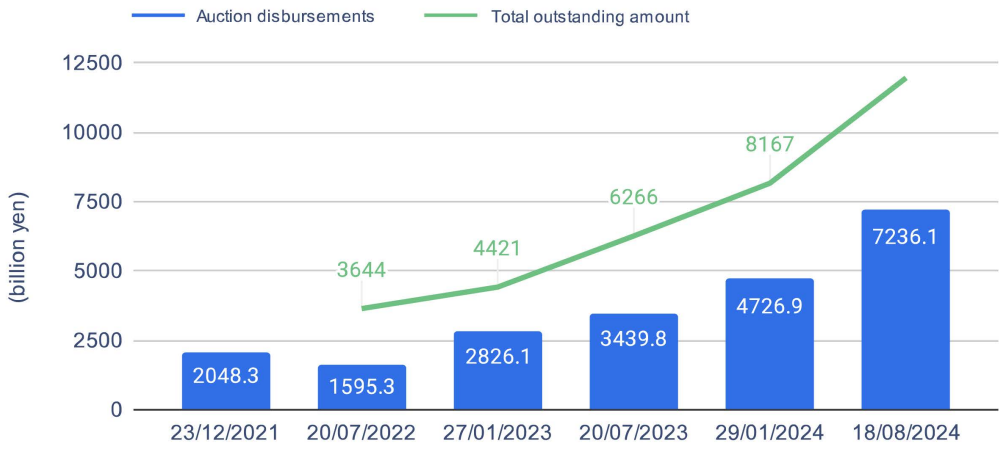
New research analysis also emerged showing that that the "additional lending from banks participating to the TLTRO III programme is mainly directed to more polluting sectors" (Colesanti-Senni, Pagliari and Van't Klooster, 2023). This advanced the case for a greener approach for the next period of monetary policy loosening. This argument was recognised by ECB Board member Frank Elderson: "whenever there is a monetary policy need in the future to reconsider targeted longer-term refinancing operations for banks, there are compelling reasons to seriously consider greening them" (Elderson, 2023).

Meanwhile, several central banks in Asia have recently introduced similar green lending schemes. In 2021, the People's Bank of China (PBOC) introduced a Carbon Emission Reduction Facility (CERF) enabling banks to borrow at a preferential rate of 1.75% for an amount corresponding to 60% of their volume of loans issued to support to the low-carbon transition (PBOC, 2021). The Bank of Japan followed suit in January 2022 by launching a new programme called "Transactions for Climate Response Financing Operations" under which banks can borrow at 0% from the Bank of Japan (Clarke, 2022). As of July 2024, Japanese banks were able to borrow 11,963 billion yen (€76 billion), following an almost constantly growing take-up (See Figure 5). Under both programmes, banks can self-identify the green loans eligible to the facility, but ex-post verifications are carried by the central bank.

In October 2021, the Hungarian central bank also launched a similar programme, targeted to a specific sector: green housing. Under the "Green Home Programme" initiative, the Magyar Nemzeti Bank provided 300 billion HUF (around €761 million) to credit institutions at a 0% interest rate under condition that these funds be used

for loans to households seeking to build or purchase new, homes with an energy performance certificate label higher than "BB" (80 kWh/m²/year) (NGFS, 2024).

Figure 5: Lending to Japanese banks under the Bank of Japan's Funds-Supplying Operations to Support Financing for Climate Change Responses



Source: Bank of Japan (2024).

Current state of discussion at the ECB

As we have seen so far, three major reasons prevented the ECB to decide on the implementation of Green TLTRO until now. First a definition of green lending, and availability of reliable data was missing. Second, a Green TLTRO framework should not interfere with the ECB's monetary policy and comply with the ECB's mandate. And third, the implementation of a dual rate strategy during a tightening period seemed complex and risky. We argue it is time for the ECB to re-evaluate the possibility of introducing a green interest rate.

Firstly, significant progress has been made in the provision of a reliable definition of green lending, and the availability of reliable data from the banking sector. In particular, progress in the adoption and early implementation of the EU Taxonomy represent a promising development which deserve to be taken into account, alongside other options.

Secondly, the ECB itself have now opened the path for reconsidering green dual rates when it announced in March 2024 its new operational framework, a plan for the ongoing reduction in excess reserves in the financial system (as discussed in section 3.1). Under this new framework, the ECB said it will continue to have structural refinancing operations alongside structural asset purchases. Importantly, for both these instruments, the ECB said it "will aim to incorporate climate change-

related considerations" (ECB, 2024a). Thus, the establishment of the new structural refinancing operations could provide a basis to deploy in the coming years some form of interest rate differentiation based on climate criteria. However, the ECB's new framework is only expected to come into place in the horizon of 2026-2027 (Schnabel, 2024).

Thirdly, the ECB expressed concerns against the introduction of a green interest rate policy under a restrictive monetary policy stance. For instance, ECB Board member Isabel Schnabel rejected the possibility of introducing dual rates, stating: "Green targeted lending operations, for example, could be an instrument worth considering in the future when policy needs to become expansionary again (...) But they are not an option for the immediate future given the current need for a restrictive monetary policy" (Schnabel, 2023).

Since June 2024, the ECB started to pivot its monetary policy strategy by cutting interest rates. If inflation continues to recede and the ECB continues to move towards a more accommodative stance, this will thus open the political space for differentiated rate.

In the following sections we will discuss the design choices for such a green differentiated rate program. Sections 4 to 6 will investigate key policy parameters of a green interest rate, with a view of addressing concerns that have been identified so far. Section 7 will summarise the policy trade-offs entailed in the implementation of a green interest rate, and provide provisional conclusions.

4. DEFINITION OF 'GREEN': USE OF THE EU TAXONOMY

As discussed, one of the main obstacles to the design of the green refinancing operations that the ECB foresaw originally was the lack of the good definition of a green asset and the lack of systematic data collection by banks (ECB, 2021a). Providing a definition of green lending is difficult for independent central banks, since they do not have the expertise nor the political legitimacy to specify which lending is green (Tamez, Weenink and Yoshinaga, 2024). Fortunately, the EU has recently adopted a framework that does just this: the EU Taxonomy of sustainable activities. In this section we will analyse to what extent can the EU Taxonomy be used for the purpose of implementing a green interest rate.

Introduction to the EU green Taxonomy

The EU Taxonomy was adopted in 2021 by the EU institutions in order to help investors, companies and policymakers to identify activities that are environmentally sustainable, aiming to facilitate the transition towards a greener economy and avoid greenwashing (European Commission, 2023).

As it stands, the EU Taxonomy covers economic activities including energy, manufacturing, transport, waste management, water, and buildings, among others. Importantly, it does not cover agriculture nor activities that are generally neutral in terms of carbon emission, like most services. The Taxonomy framework provides precise technical screening criteria, which are science-based thresholds and performance requirements that are tailored for each economic activity, and which must be met to qualify as environmentally sustainable. These criteria can be either positive or negative. For instance, a minimum energy-efficiency level for buildings represents a "Significant contribution criteria" while usage threshold of toxic material or water may constitute "Do No Significant Harm", or DNSH) criteria (European Commission, 2024).

Data availability and Green Asset Ratio

The EU Taxonomy applies to a broad range of actors, from corporations to financial institutions. Under Article 8 of the EU Taxonomy regulation, banks and insurers are required to disclose the Taxonomy-alignment of their EU-based loan books (European Union, 2020). Taxonomy-related disclosure requirements have been incorporated into banks pillar 3 disclosure requirements, with a harmonized reporting template[8]. Since 2024, all banks in the EU have to disclose annually their Taxonomy-alignment levels.

The most prominent KPI that banks have to disclose is the "green asset ratio" (GAR), i.e. the share of Taxonomy-aligned assets upon their total eligible assets. The GAR is accompanied by a GAR "Flow" which is meant to provide transparency on the institution's progress towards sustainable investment goals. The GAR Flow covers exclusively the share of new assets (originated or acquired during the reporting year) that are Taxonomy-aligned. However, for this first reporting cycle, many banks have not fully reported on their GAR Flow KPI[9].

To calculate their GAR, banks must rely on the provision of climate related data by their customers. For loans to households, in particular mortgages, auto loans and renovation loans, the ESG relevant data can be relatively easily collected through Energy Performance Certificates (EPCs) which companies and individuals are increasingly obliged to obtain under EU and national law. While EPCs are sufficient to assess the alignment of loans with the Taxonomy's "significant contribution" criteria, banks often struggle to assess the compliance with the "Do Not Significant Harm" (DNSH) criteria[10].

The situation is more complex for corporate loans, as data collection is contingent upon the implementation of the Corporate Sustainability Reporting Directive (CSRD). Under CSRD, corporates will be obliged to declare their own Taxonomy-alignment, and such data will be exploited by banks in the calculation of their GAR. However, the CSRD implementation is gradual. It is only mandatory in 2025 for the largest firms, and in 2026 and 2027 for middle-size companies. Overall, 50,000 firms will ultimately have to comply with the CSRD, compared to 11,000 under the current NFRD rules. While the CSRD represents a huge step forward, it is not

8 The Pillar 3 ESG reporting templates can be accessed here: https://www.eba.europa.eu/activities/single-rulebook/regulatory-activities/transparency-and-pillar-3/implementing-technical-standards-its-prudential-disclosures-esg-risks-accordance-article-449a-crr

9 For the reporting year 2023, only 70% of banks in our sample reported their GAR Flow. They justified this due to the lack of referential data for 2022. Banks which reported the GAR Flow often did not provide the nominal amount of new lending originated or acquired during the reporting period, which would be required for Green TLTRO.

10 For example, several banks interviewed mentioned difficulties with the DNSH technical screening criteria for building renovation activity which requires a "full flush volume of a maximum of 6 litres and a maximum average flush volume of 3,5 litres" (European Union, 2023).

foreseen to expand the CSRD scope to small companies[11], although these entities can decide to voluntarily disclose their Taxonomy-alignment as well.

A key aspect of the GAR calculation formula is that certain assets are excluded from the numerator but not from the denominator. These are assets related to activities not classified by the Taxonomy (such as agriculture) or issued by SMEs not subject to reporting requirements under the NFRD or CSRD directive. By contrast, some assets (such as exposures to central banks, or cash) are excluded from both the numerator and the denominator. Therefore, there is an asymmetry in the way the ratio is calculated. This implies that, counter-intuitively, it is not possible for a bank to reach a green asset ratio of 100%. According to the EBA, the maximum GAR for the whole EU banking sector could be at most around 60% (European Banking Authority, 2021). This asymmetry is meant to ensure that the GAR level would not go down when more activities and/or counterparties will eventually be included in the EU Taxonomy (since this would increase the denominator).

Data sample from the banking sector

Since Taxonomy data is only available since early 2024, we have collected data for a number of banks in order to see by ourselves what data is now available. In section 8.2 we provide an overview of a sample of this newly available data. The most striking finding is that the GAR level of banks is rather low (2.23% on average) with a total amount of Taxonomy-aligned lending of €401 billion. We also observe high heterogeneity between the levels and quality of banks' green asset ratios. This is linked to their varying capacity to obtain the relevant data from their counterparts[12], but also due to diverging practices in the assessment of the Taxonomy criteria[13].

We also find that around 77% of Taxonomy-aligned lending (€310 billion) are based on mortgages associated with energy efficient buildings. This dominance of real estate in the data may have important implications for the design of Green TLTRO, as we will discuss later. Unfortunately, outside of mortgages, renovations loans and car loans, the Taxonomy reporting templates for financial institutions do not require banks to provide granular information about the particular NACE sector codes or Taxonomy activities (although some banks do it on a voluntary basis).

11 Due to the size criteria of CSRD, SPVs are most often outside of the CSRD scope. As SPVs are often used for renewable projects, this effectively excludes them from the GAR calculation. To remedy this issue, the EBA has proposed an additional voluntary-based KPI: the BTAR. The main difference with the GAR is that BTAR includes non-CSRD companies. However, banks do not yet report this indicator.

12 For instance, collecting EPCs from mortgages is easier in countries where a national EPC database has been established.

13 Due to the late communication of a clarification notice by the EU Commission on 21 December 2023, some banks have decided to apply a strict approach following the new EC guidelines, while other have not implemented them for the 2023 reporting cycle.

Instead, banks have to report on the volume of Taxonomy lending by type of asset or counterparty, which strongly limit the possibility to obtain sectoral breakdown of Taxonomy-aligned corporate lending flows.

Implications for implementing a Green TLTRO programme

Overall, the first reporting cycle of the Green Asset Ratio reveals that the quality of these disclosures are still very much at the infancy stage, with high discrepancy in how these data are calculated by banks. Banks's Green Asset Ratios are particularly low. In this section, we will discuss to what extent these difficulties complicate the implementation of a green intertest rate by the ECB, and the possible ways to remedy these issues.

First of all, the fact that Green Asset Ratios are currently low would significantly limit the borrowing allowances of banks if Green TLTRO was implemented as of 2024. However, while banks' GAR are low, the total aggregate volume of Taxonomy-aligned lending was in 2023 already significant from a macroeconomic perspective (around €300-400 billion). And in any case, with the gradual implementation of CSRD and banks' ongoing efforts in improving their ESG data collection systems, it is almost certain that Taxonomy-alignment levels will increase rapidly in the coming years. The complexity and administrative cost to collect Taxonomy-relevant data will remain high in the early phase. However, the financial incentives provided by the green interest rate would partly compensate for it. The European Commission is expected to review the Taxonomy regulation in 2025[14], which will be a window of opportunity to simplify the reporting rules as well as refine screening criteria. Complementary solutions could be envisaged as well. For example, the EBA has proposed the introduction of green labels for certain retail products, with potentially more flexible rules and criteria than the EU Taxonomy (European Banking Authority, 2023). Assets compliant with such EU label specifications could also be made eligible to Green TLTRO when such additional labelling system in place.

We also see a risk of data inconsistencies, or even greenwashing, especially since Taxonomy disclosures are not fully audited (yet). Certain banks could also be tempted to tweak their balance sheet composition (by reducing their non-Taxonomy-aligned lending, or selling these assets to other entities) in order to fictively improve their GAR. Banks could be tempted to do that especially near the end of the reference period, in order to artificially boost the figures that will eventually be formally reported in their annual reports. To cope with these two issues, Várhelyi (2020) suggested that independent third parties (e.g. audit companies) should be mandated by national central banks to verify the

14 Article 19(5) of the EU Taxonomy regulation anticipates that Taxonomy's screening criteria should be reviewed every 3 years (European Union, 2020).

compliance of banks' reporting with the Taxonomy framework. This could be done in practice by carrying out sample-based verifications of individual assets (for example by verifying the energy performance certificates associated with mortgages and renovations loans). If a certain threshold of errors is detected, the auditing company could then proceed with even more granular verifications. The percentage of errors detected could be subtracted (including retroactively) from the ECB's preferential Green TLTRO rate. Significant and/or repeated misreporting should be subject to further sanctions, or even provoke the exclusion of banks from the programme.

A perhaps more complex issue relates to the conceptual nature of the EU Taxonomy, which takes a focus on economic activities that may be considered as "sustainable". For this reason not all activities are covered: for example agriculture and services are missing. Most SMEs are also not covered since they are not falling under the CSRD. As a result, banks specialized in financing SMEs and agriculture could be disadvantaged by a green interest rate based on the European Taxonomy.

At the same time, introducing a green interest rate could also precisely provoke a catalysing effect for banks, corporates and policy makers to overcome these issues. With the promise of having a lower green interest rate from the ECB, banks and their counterparts will have much stronger incentives to make the reporting efforts. Even companies not covered by CSRD (such as SPVs) might find it cost-worthy to produce voluntary-based reporting if they can obtain cheaper funding in return. The resulting improvement in the quality and quantity of Taxonomy data reports will ultimately help improve the management of climate-related risks by banking supervisors and central banks.

Broad or selective Taxonomy approach?

The EU Taxonomy is very broad, covering a wide variety of activities falling under six climate and environmental objectives. This comprehensiveness may lead to two issues.

First, there is a risk that as the use of the EU Taxonomy scales up in the coming years and the Green TLTRO-eligible lending expands as a result, the programme could become oversized and jeopardize the conduct of monetary policy. In section 5.3 we discuss the various ways in which the ECB could mitigate the issue.

Second, it is not immediately clear that all the EU Taxonomy activities equally need to be supported by a Green TLTRO programme in order to achieve the ECB's primary and secondary objectives. Indeed, from a monetary policy lens, not all the economic activities covered by the EU Taxonomy contribute directly to the reduction of fossil fuel dependency. In addition, not all activities may suffer from

particularly high investment needs. For illustrative purposes, consider 3 concrete examples:

- Afforestation makes laudable contribution to reducing carbon emission, but does not immediately help reducing energy consumption or increase clean energy production, and thus contribute to shielding the Eurozone against fossilflation.
- Conversely, investments in hydropower plants, while valuable for the energy transition, have a relatively low investment gap (Pellerin-Carlin, Calipel and Bizien, 2024). Thus, decreasing the cost of these investments may not be absolutely needed.
- Another striking example is the ownership or acquisition of real estate properties with an already high energy performance, which dominates by far the amount of Taxonomy-aligned lending disclosed by banks thus far (see section 4.2). From a climate perspective however, the effect of incentivizing the purchase of already well-insulated homes through green mortgages with a green interest rate policy can be negligible. Indeed, while energy-efficient buildings consume less energy, and by extension, less fossil fuel, home purchase transactions do not per se reduce carbon emissions[15] – it is the investment into energy-efficient renovations which does so.

For these reasons, the ECB could instead select a subset of the Taxonomy activities that would more effectively help fulfil its mandate. An obvious move in this direction would start by excluding the Taxonomy activity "Acquisition and ownership of real estate" from the Green TLTRO programme. Indeed, as pointed above, the green lending stimulus from a Green TLTRO would be better targeted towards funding for renovation as opposed to mortgage transactions for the purchase of already high energy efficient real estate.[16]

From a monetary policy standpoint, targeting Green TLTRO to specific sectors that have likely a more positive contribution to price stability, such as investments in renewables energy infrastructures, electrical grid interconnection, storage, and energy-efficient renovation, would likely address fossilflation risks more effectively. Moreover, a selective approach would also mechanically reduce the potential size of the Green TLTRO programme, which would conveniently limit potential interference with the overall monetary policy stance on the short-term. We will return to this question in section 5.2.

15 Actually, the inclusion of real estate into Green TLTRO risks fuelling housing prices for well-insulated dwellings, and thus may represent a risk for financial stability. For this reason, the ECB already excluded loans for house purchase under TLTRO III.

16 In the case of "green mortgages" whose proceed cover both the purchase and the renovation of the property, the segment of the loan dedicated to the renovation should be eligible to Green TLTRO.

Going towards a selective approach would require more detailed Taxonomy reporting by banks – as NACE sectoral or Taxonomy activity breakdowns are not currently required in Pillar 3 disclosures. It would also require having a robust analysis of the inflationary contribution of each of the activities represented in the EU green Taxonomy. To our knowledge, such exercise has not yet been undertaken by the Eurosystem.[17] Yet, without such strong evidence-based analysis, it might be more complicated to justify the choice of excluding certain activities from the Taxonomy. The inclusion or exclusion of certain activities such as gas and nuclear energy, could also prove quite controversial and compromise the reputation of the ECB. To mitigate such risks, the formal (but advisory) involvement of other EU agencies with more sectorial expertise in this exercise could prove useful to provide political legitimacy for the ECB.

We will further summarize the trade-offs of choosing a broad or a selective Taxonomy approach, as well as their policy implications in the section 7. In the following section we will discuss the possible mechanisms underpinning the green interest rate policy.

17 See for instance the letter by Christine Lagarde to MEP Ville Niinistö (Lagarde, 2022).

5. STRUCTURE AND SIZE OF A GREEN TLTRO

The defining feature of the Green TLTRO is that is provides commercial banks with a lower interest rate offered by the central bank. There are various ways to determine how much lower should the green interest rate be (the "green spread"). Another key feature is the quantity of lending that should be extended to banks under a Green TLTRO policy. We will discuss in this section how the ECB could calibrate the optimal volume of the programme.

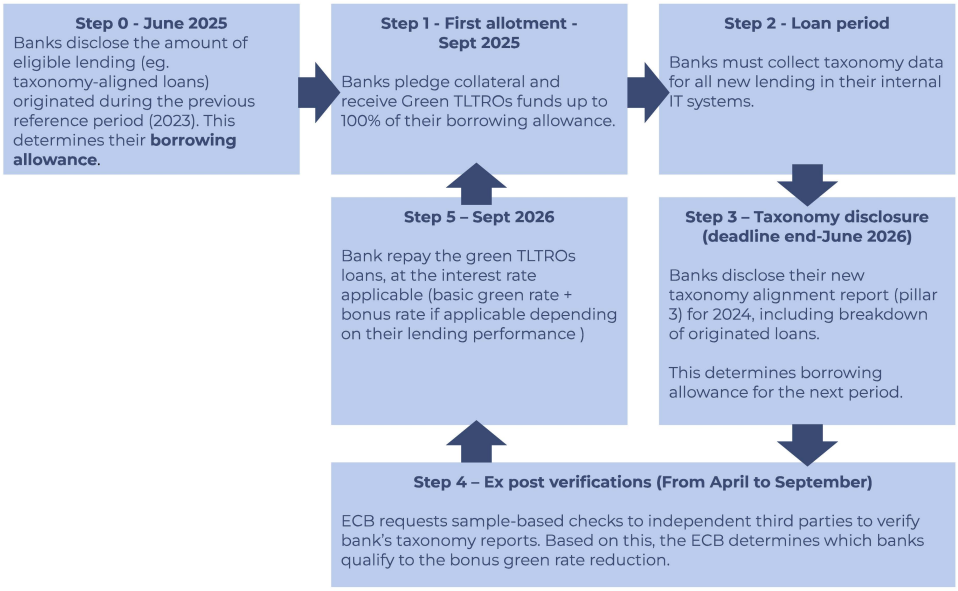
Box 3: Understanding the Green TLTRO mechanism step by step

To illustrate concretely how the Green TLTRO programme would work, here is a simplified diagram describing the step-by-step process of a Green TLTRO operation, if implemented as soon as 2025 (See Figure 6 below). For the sake of simplicity, we assume the ECB would use a broad Taxonomy and Green TLTRO operations have a maturity of one year.

The fact that borrowing allowances are determined based on the lending of the previous reference period implies that banks receive Green TLTROs funding after having actually originated new green lending. This may seem counter-intuitive if one thinks of Green TLTRO as a "funding for lending scheme" in a literal sense, where banks would technically pre-require the TLTRO funding before they can start lending to their customers. However this does not reflect the functioning of credit and money creation in today's economic system (Jakab and Kumhof, 2015). Moreover, from a practical perspective, it would be impossible for banks and central banks to predict *ex ante* (at the date of the allotment) the amount of green lending that will be originated by banks in the future – and which should correspond to the

borrowing allowance. As a consequence, the borrowing allowance and green interest rate incentive can only be calculated *ex-post*. However in practice banks will anticipate the opportunities offered by the Green TLTRO mechanism and optimize their lending behaviour accordingly.

Figure 6. Simplified description of the proposed mechanism underlying Green Long-Term Refinancing Operations with 1 year maturity



Source: authors.

Determining the green interest rate

The green interest rate mechanism could be determined by three components. These three mechanisms can be implemented on their own or combined:

- Banks would benefit from a "basic" green interest rate on their amount of Green TLTRO borrowing based on their previous green lending. This is the mechanism adopted by the Chinese and Japanese central banks.
- A "bonus" green rate would be applied to banks, but under condition that banks reach a predefined lending target. This was the mechanism of the ECB's TLTRO III.
- A penalty rate could be applied for banks with underwhelming green lending performance.

These three mechanisms offer different advantages and disadvantages, which we discuss below.

Basic green interest rate

Under a simple green interest rate rule, the preferential rate would be granted on the basis of the green lending issued by the bank. This green interest rate would in fact be expressed as a "spread" between the key ECB interest rate (for example, -100bps of the average MRO rate during the reference period[18]). This way, the green interest rate would automatically be adjusted upward or downward whenever the ECB's Governing Council decides to change its key interest rates.

The advantage of this option is that banks are guaranteed to receive a lower interest rate, and therefore they can confidently transmit this lower interest rate onto their new green loans. This contrasts with the mechanism of the TLTRO III, where the preferential rate was only granted to banks which reached their "lending performance threshold" – and thus correspond to the green bonus rate which we present in the next section. The risk of this option is that only banks that are certain to reach the target will tend to participate to the programme, or if they do, they will not immediately transmit the lower rate to their customers until they are certain to qualify for the bonus rate.

However, if implemented alone, a basic green interest rate would not necessarily encourage banks to "walk the next mile" and scale up their lending towards the levels needed to fill the EU's investments gaps. For this reason, the next section discusses the possibility to introduce a "green bonus rate" subject to a volume-based lending target.

Bonus green rate

The bonus interest rate is a similar mechanism than the ECB's TLTRO III programme. Under TLTRO III, banks would get an interest rate of 50 bps below the deposit facility rate if they managed to increase their outstanding lending to households (excluding loans for house purchase) and non-financial corporations by 1% (this threshold was reduced at 0% during the pandemic crisis). Banks that did not achieve the target had to pay the usual interest rate.

The key advantage of a target-based approach is that Green TLTRO would not just reduce the cost of lending, but also motivate banks to be more ambitious and aim for a higher volume of loan origination. This mechanism could thus be exploited to steer the whole banking sector towards filling climate investment gaps.

18 In the recent past, the ECB's deposit facility rate (DFR) was the main key interest rate. However as of September 2024, the ECB has narrowed the difference between the MRO and the DFR from 50 to 15bps, signalling the ECB's intention to re-establish a corridor regime where the MRO play once again an important role. For this reason, and for clarity, we use the MRO as referential for the green interest rate.

How to set the bonus rate lending targets

Defining lending targets under the EU Taxonomy approach is a delicate exercise, since the EU Taxonomy in itself does not provide transition pathways against which banks should be evaluated upon. In principle, the forthcoming transition plans foreseen in the CSRD could provide a robust tool for this, however the design of such plans are still at the infancy stage.

A more immediate and practical and generic approach would consist in using the Green Asset Ratio as a key performance metric[19]. For example, a bank with a current GAR of 4% would need to reach 6% the following year, while a bank with a GAR of 10% would need to reach 12%.

To define the "speed" of the GAR target, one could start by evaluating the GAR level that the whole banking sector should reach by 2030 or 2050 in order to help the economy meet its transition goals. From there, one can calculate retroactively the speed at which the GAR has to increase on average yearly to reach this level. For the purpose of illustration, let us assume that the banking sector should reach a GAR of 50% in 2050. In such a scenario, then banks would need to continuously increase their GAR by 2 percentage points every year. Hence, the ECB could set as a target for banks to increase their GAR by 2 percentage points every year.

Under a preliminary calculation, two percentage points of GAR increase would represent around €300-400 billion per year (see section 8.3). Although this volume is very tentative at this point, it is interesting to note that it is within the range of the various estimates of public and private annual climate investments need, which are comprised between 300-800 billion for the whole EU (Andersson *et al.*, 2024; Draghi, 2024).

To reiterate, banks can increase GAR by increasing the numerator (originating new lending or screening preexisting assets as green) but also by reducing the denominator i.e. reducing their holding of non-Taxonomy-aligned assets (which happens naturally as loans reach maturity, or when a bank sells off these assets). Thus, each bank has multiple leverages and possible strategies to reach the GAR target. In the short run, banks will likely mechanically increase their GAR as they roll-out their capacity to collect and analyse ESG data. Furthermore, as companies start complying with the CSRD, pre-existing loans may subsequently become Taxonomy-aligned.

The effects of different targets on bank lending can be hard to predict. If targets are too ambitious and difficult to achieve, it risks demotivating banks to even participate in a Green TLTRO. Moreover, uncertainty as to whether the bank will

19 In principle the BTAR could also be used, however it is not being used yet by banks, so we have put this option aside for now.

qualify to the bonus rate at the end of the period may generate reluctancy to pass-over the lower rate to their customers, at least until the GAR target is within reach. Conversely, if the targets are too low and easy, banks simply receive a windfall profit and may not "walk the extra mile" as intended by this policy design choice. To mitigate this issue, the ECB could offer multiple-tier interest rates, with even more generous interest rate reduction in case the bank surpasses the basic lending target, or for the top-tier of banks that have the best green lending performance.

Overall, a combination of both mechanisms could be a powerful mix to ensure a broad participation of banks while also effectively pushing banks to scale up their green lending towards the volumes needed to achieve the transition.

Penalty rate

In addition to a (lower) green interest rate, a penalty rate could be established to penalize banks whose lending continues to fund the most polluting and carbon-intensive projects.

In principle, such penalty rate could reinforce the incentives for banks to support the transition and avoid situations where banks benefitting from a lower green interest rate simultaneously continue to fund activities that are negative for the transition. Theoretically, the penalty rate could also play a reinforcing role during monetary tightening periods. Incidentally, such a penalty rate would reduce the cost of the policy on the Eurosystem's balance sheet (as discussed in section 8.5).

However, the operational feasibility of this option is rather complicated, given the absence of a well-developed "red" Taxonomy that negatively screens out activities that are not Paris-aligned. Moreover, the establishment of a penalty rate could discourage certain banks from taking part in the Green TLTRO programme. It would perhaps be more prudent to envisage introducing a penalty rate in a second stage, and only if such counter-productive lending behaviors are observed empirically.

Size of the "green spread"

The "green spread" should be big enough to motivate banks to develop new strategies to increase green lending, and to transmit in lower rates for green projects and consumers.

As the cost of funding reduces, banks will be able to offer lower rates for renewable projects. On top of that, the lower rate will reduce the costs of green projects and hence increase their profitability, which is likely to motivate or attract more project developers (or households willing to invest in home green energy), and thus help scale up green investments.

Theoretically, the bigger the green spread, the stronger its impact will be. But how large should green spread be in order to materially help close the EU's green investment gap? Previous research showed that 100bps differentiation would help achieve 5 to 12% of the needed emission reductions EU goals (Altaghlibi, van Tilburg and Sanders, 2022). A more recent analysis found that a green rate that is 200bps lower would improve by 24% to 53% the profitability of most renewable technologies for solar and wind (onshore and offshore) for Germany, France, Italy, the Netherlands and Spain (Altaghlibi, van Tilburg and Bronstering, 2024). These results however widely differ depending on the future path of energy prices.

In his report for the European Commission published in September 2024, Mario Draghi estimates that a reduction of 250 bps of the cost of capital would be required to reach a level of private investment of around 4% of GDP – as required to bridge the EU's green investments (Draghi, 2024).

On the other hand, a too big green spread will increase the cost of the Green TLTRO on the balance sheet of the Eurozone central banks. We discuss and quantify this implication in section 8.5.

Borrowing allowance and size of Green TLTRO portfolio

Under the ECB's TLTROs III, lending was limited by a borrowing allowance set for each bank as 55% of their total of eligible lending (loans to non-financial corporations and households excluding mortgages). However, this rule was designed under a vastly accommodative monetary policy stance, where the issuance of abundant liquidity was an integral part of the ECB's strategy. But as we have seen in section 3.5, the ECB intends to move away from the abundant liquidity regime, and move towards a hybrid regime where the size of structural refinancing operations will be calibrated to correspond to the liquidity needs of the financial system (Schnabel, 2024). Various academics have generally estimated that such liquidity needs will be ranging from €1 trillion to €1.7 trillion (Gotti and Papadia, 2024). The ECB will therefore need to carefully calibrate the programme in order to avoid a situation where the Green TLTRO becomes bigger than its liquidity target. There are four ways in which the ECB can do that.

Reducing the scope of eligible lending

First, we should note that the decision to follow either a broad or selective approach as described in section 4.3 greatly determines the borrowing allowance of each bank. With a selective scope of eligible green lending the central bank would automatically limit the borrowing allowance, and therefore the potential size and growth of Green TLTROs. For example, excluding mortgages from the scope of Green TLTRO would reduce the size of the programme by four times according to our estimates (see section 8.3). Theoretically, the ECB could initially choose a "broad" eligible green lending scope, and decide later to switch to a more

selective approach by narrowing down the scope of eligible green lending to a fewer number of economic activities that are the most relevant for price stability.

Reducing the borrowing allowance ratio

If the ECB does not choose a selective approach, then one option to limit the size of Green TLTRO is to reduce the borrowing allowance ratio for each bank. Instead of borrowing up to 100% of the green lending originated during the previous reference period, the exact borrowing allowance ratio could be calibrated over time. This adjustment could ensure that the total amount of is aligned with the central bank's monetary policy stance and liquidity forecasts. For example, if the ECB needs to reduce liquidity provision in the banking system, it could reduce the borrowing allowance for each bank, say to 80% instead of 100%, thus automatically reducing the volume of the whole programme. The People's Bank of China for example applies a borrowing allowance of 60% of green lending (PBoC, 2021).

Setting a hard limit on Green TLTRO size with competitive bidding.

The ECB could also pre-determine a maximum Green TLTRO benchmark allotment for the whole banking sector, thus creating a hard limit on the size of the programme. This approach would thus depart from the "full-allotment" policy that has become standard in the post financial crisis regime, although partial-allotment refinancing lines could perfectly coexist with (non-green) full-allotment structural refinancing operations. In this case, the ECB would pre-announce how much lending it intends to allocate to under Green TLTRO (the benchmark allotment). If the total bid amount exceeds the maximum benchmark allotment, banks would then have to compete to receive the liquidity.

In a first scenario, banks would have to compete by bidding on the interest rate through an auction, as was the case under LTROs until 2009. In this case the ECB would set a minimum green rate and banks would submit bids for green refinancing they are willing to take at smaller green spreads. The banks offering the highest rate would get their Green TLTRO allotment first until all accepted bids exhaust the maximum lending amount set by the ECB.

This option, however, would risk excluding certain banks completely from the operation. In addition, it might counteract the spirit of the Green TLTRO programme itself, as its goal is to reduce the interest rates in the first place. Decreasing the green spread by bidding in the auctions might then decrease the attractiveness of the programme for the participants.

Borrowing allowance limitation based on GAR

A more complex variant would work by reducing the relative borrowing allowance of each bank according to their past green performance. The ECB could apply a reduction of the borrowing allowance, based on for instance their share in the

outstanding green lending of all banks participating in the auction. For example, a bank whose green lending stock represents 10% of the sum of bids from banks participating in the auction would only be able to receive up to 10% of the maximum lending amount. Thus, unlike the previous option, all banks' bids would be at least partly satisfied.

The (yet unconfirmed) assumption underlying this allocation is that banks with a high green lending level would be more likely to make an effective use of the liquidity to issue even more green lending in the future, given their greater experience and capacity to extend green lending.

However, if the ECB chooses to reduce the size of the programme, it is worth noting that this would eventually reduce the impact of the policy, as the lower interest rate would be offered against a smaller volume of new lending. The ECB could mitigate that by increasing the green spread. At the same time, as the amount of lending grows, it could also signify that the programme is reaching its goal to scale up green lending in the economy, and that the incentive may not be necessary anymore.

The magnitude of the 'green' spread and the determination of the programme size are one of the main considerations for the introduction of a Green TLTRO. In the following sections we discuss further design choices and overview some of their main trade-offs.

6. OTHER IMPLEMENTATION ASPECTS

Next to the determination of interest rates and volume size, ECB's lending programs are defined by several other parameters. In this section we review some of them. We first discuss which collateral rules the Green TLTRO program could follow. We then examine the maturity of the loans (the period after which the loan has to be repaid), the frequency of auctions, and the programme duration. We finish the section with considerations on communication of the launch of such programme.

Collateral policy

All refinancing operations from central banks usually require that banks pledge appropriate assets as collateral in exchange from central banks liquidity. The ECB's collateral framework determines which assets are eligible to be pledged as collateral for these operations (ECB, 2023). Several proposals have discussed limiting eligibility of assets issued by fossil fuel companies and promoting the securities by green ones (Oustry *et al.*, 2020; Dafermos *et al.*, 2021; Reclaim Finance, 2023). This would improve the financing conditions of green companies and penalize the polluting ones. In 2024, the ECB considered the possibility of implementing pool-limitations on intensive carbon assets but concluded in July 2024 that such option was too complicated (ECB, 2024b).

Theoretically it is possible to constrain the provision of Green TLTRO liquidity against the provision of green collateral (such as green bonds). However, the pool of green collateral is likely too small and regulatory green standards are not available for all types of assets, especially securitized assets (EBA *et al.*, 2013). As a result, such an approach would drastically reduce the potential borrowing available for banks.

Overall, maintaining the standard collateral policy rules might add to the simplicity of the program, as well as alleviate concerns around the disruptions of monetary policy transmission. In other words, while Green TLTRO liquidity would only be provided under condition that banks issue green lending it is not necessary that banks pledge "green collateral" in order take part in Green TLTRO. However, if or when new green rules are eventually introduced in the Eurosystem collateral framework, extending these rules to apply to Green TLTRO might be reasonable, given the climate orientation of both policies.

Maturity

Central bank refinancing operations have typically a shorter maturity, given that these policies are designed to influence the short-term interbank market rate. While certain TLTROs operations had a maturity of up to 4 years, the ECB's current refinancing operations (LTROs) have a maximum duration of only 3 months (ECB, 2024e).

If the maturity of Green TLTROs is shorter than the maturity of the eligible green lending, this reduces the attractiveness of the Green TLTRO, since the reduction in the cost of capital will only apply for a shorter period after which the green lending has to be refinanced by the bank.

For instance, the maturity of loans for energy efficient renovations is typically around 10 years, or more. If the Green TLTRO maturity is only one year, this means that the underlying cost of funding for the renovation loan is not reduced during the 9 remaining years[20].

Thus, the longer the maturity, the stronger the incentive for banks to issue green loans. Ideally, the maturity of the Green TLTRO loans should correspond approximately to the maturity of the green lending that such programme is designed to incentivize.

However, providing long maturities also implies that the central bank commits to maintaining the programme for a longer time span, which can raise difficulties for the conduct of its monetary policy. In particular, this makes the policy less easily reversible, although the ECB can always propose early repayments options for banks. Moreover, if the central bank offers important long-term liquidity provision, it may result in a weaker transmission of its policy on the short-term repo market rate. In addition, central bank funding operations with a residual maturity shorter

20 Although, as bank loans are usually amortizable with gradually diminishing principal repayments, the major part of the interest rate cost comes in the first few years. In contrast, the principal of a bond is usually repaid in a lump sum at maturity date.

than one year do not qualify for the net stable funding ratio (NSFR) under prudential rules and are therefore much less attractive for banks (EBA, 2015). A mid-way solution can be to have a short maturity combined with the possibility of rolling over. For example, the Bank of Japan's climate transaction programme offers loans with a one-year maturity, which can be rolled-over (Bank of Japan, 2024). This programme enables banks to receive cheaper funding for longer, while preserving the ability for the central bank to phase out the programme more quickly if it would ever be needed.

Allotment Frequency

The next questions relate to how often the ECB should enable banks to borrow more money from the Green TLTRO programme.

In general, banks might prefer more frequent allotments, as this allows them greater ability and flexibility to obtain liquidity they need. For this reason, the ECB's Main Refinancing Operations are made on a weekly basis. However, a green LTRO is not designed to provide short term liquidity to banks. The objective would be lowering the cost of green lending and increasing lending volumes on the medium term.

Moreover, experience from previous TLTRO operations has shown that such a programme can be complex to administer – both for central and commercial banks. To minimize the complexity, cost and administrative burden of Green TLTRO, the frequency of the allotments could be reduced to an annual basis (instead of quarterly under TLTRO III). Furthermore, for the sake of simplicity, the operation schedule should be aligned with the Taxonomy report and Pillar III disclosure deadlines (usually end-June) in order to streamline the work of the banks' reporting teams.

Programme duration and communication

To stimulate new lending, a Green TLTRO program should run for a substantial period to send a strong signal to banks and allow them to integrate the incentives into their business strategies. If the ECB starts this programme in 2025, a duration of five years could be appropriate. As the programme would conclude in 2030, this would also enable a meaningful evaluation of the program's impact in supporting the EU's green transition toward the 2030 targets.

Although the ECB could theoretically extend the program beyond 2030, or even make it open-ended, having a set end date could incentivize investors and banks to expedite project management planning before the end of 2030 to maximize the benefits of the Green TLTRO programme while it is available.

In any case, the sooner the ECB announces this programme, the sooner banks can start incorporating this in their business strategy and at the operational level. The ECB should announce this programme at least one year earlier than the first Green TLTRO transaction, in order to allow every bank to speed up the process of identification of eligible loans in their loan books, in order to optimize their initial borrowing allowance.

7. DESIGN CHOICES AND POLICY TRADE-OFFS

In the previous chapter we have discussed in details the various policy design choices that the ECB should take into account when designing a green refinancing programme. This section intends to clarify the multitude of options for each parameter and their combinations. To this effect, we formulate four general guiding principles relevant for the success of the programme, before assessing each policy option according to these principles.

General Principles

Taking into consideration the ECB mandate and policy discussion, we identify four general principles. These are the conditions that a Green TLTRO should meet and hence the criteria that any design could be assessed upon.

Monetary policy compatibility

A differentiated rate approach should be operational regardless of whether the central bank is conducting a restrictive or expansionary policy stance. To ensure this is the case, the Green TLTRO should not interfere or contradict the overall monetary policy strategy or blur its communication. Moreover, the ECB should preserve sufficient flexibility and discretion to adjust the parameters of the programme in order to adapt to the evolving economic outlook and monetary policy stance.

Broad participation

Since the goal of this programme is to reduce the cost of investments into clean energy production and energy efficiency in the whole Eurozone, it should be open to all banks from all size across all Eurozone member states and that a sufficiently large number of them do participate. This way, the policy will transmit its effect to all corners of the Eurozone economy. It is thus crucial that the program offers a level playing field to all banks.

Stimulate new lending

The goal of this programme is to stimulate banks to develop robust strategies to effectively increase their financing to the green transition in the coming years. Hence, the green spread should be large enough to significantly reduce the cost of borrowing for corporates and households, and the green lending scope should be adequately defined to areas that have financing needs.

Operational feasibility

Last but not least, the programme's rulebook and administrative burden should be made as simple as possible for banks, but also for the central banks that will administer it.

Comparative assessment of design choices

While all options are technically feasible, some poses specific advantages and downsides regarding the general principles we outlined in the introduction to this section. Table 1 below summarizes our findings.

Table 1. Comparison of Green TLTRO design features against four defined principles

Darker green options indicate stronger preference. Lighter greens options indicate potential concerns.

Principles	Monetary policy compatibility	Broad participation	Green lending stimulus	Operational feasibility
Green lending definition				
Broad Taxonomy	A broad Taxonomy scope could stimulate activities unrelated to fossilflation and thus not directly contribute to price stability (e.g. adaptation, water, circularity...). In the case of real estate, it could even create financial stability risks.	All banks are obliged to use the EU Taxonomy, so they should be capable to onboard the programme and develop their own strategies.	Incentivizes all types of Taxonomy-aligned lending, including those that may not be so relevant for the energy transition (e.g. adaptation, biodiversity, water).	All banks and regulators have already started using the EU Taxonomy, as are a growing number of companies. Reporting frame-works are in place.

Principles	Monetary policy compatibility	Broad participation	Green lending stimulus	Operational feasibility
Selective Taxonomy	Can be effectively targeted to stimulate dis-inflationary sectors.	Depending on which sectors are chosen, certain banks could be disfavoured due to their lending portfolios or business models.	The effect of green interest can be better targeted to the most critically needed activities, and therefore stimulate these stronger.	A selective approach would require additional ad-hoc reporting from existing Pillar 3 templates. Central banks might also be reluctant to make sectoral allocation decisions.
Green interest rate mechanism				
Basic green interest rate (only)	The level of green spread can be pegged to the ECB key interest rate in order to adjust automatically with the overall monetary policy stance.	Creates a positive incentive for all banks to participate regardless of their expected lending growth.	The effect might be more limited since banks can benefit from a windfall effect (they receive a lower rate for loans they would have issued anyway).	Easy to implement
Bonus green interest rate (only)	The level of green spread can be pegged to the ECB key interest rate in order to adjust automatically with the overall monetary policy stance	Could limit the participation to banks that are already certain to reach the target.	Lending targets create a strong incentive for banks to aim for higher quantity of green loans, however, the green interest rate might not transmit auto-matically to final consumers until the bank is certain to have reach the target.	Relatively more complex to imple-ment than the basic green interest rate.
Combination of lending-based and bonus rate	The level of green spread can be pegged to the ECB key interest rate in order to adjust automatically with the overall monetary policy stance	All banks are certain to benefit from the incentives of Green TLTRO	Quantitative targets create a strong incentive for banks to develop more ambitious, volume-based strategies	Relatively more complex to implement than using only one mechanism.

Principles	Monetary policy compatibility	Broad participation	Green lending stimulus	Operational feasibility
Penalty rate	The penalty rate would play a marginal role, unlikely to interfere with the monetary policy stance.	Will likely discourage banks to participate, especially if a penalty rate is established in the early phase.	Will likely reinforce incentives for banks to focus in green lending	Complex to implement, especially due to the lack of Taxonomy for dirty assets.
Limiting size of the programme				
Borrowing allowance with full-allotment	Risk that Green TLTRO overshoots its intended size (especially if a broad Taxonomy scope is chosen), although the central bank can always limit the % of borrowing allowance to reduce the size of Green TLTRO liquidity in line with monetary policy stance.	Enables all banks to participate.	Borrowing allowance rule provides guarantee that banks can access Green TLTRO if they issue more green lending. However, the impact would be reduced in case the ECB reduces the borrowing allowance ratio over time.	Simple, follows the current practice of full-allotment operations.
Hard limit with auction based on interest rate bids	Hard limit on the size of Green TLTRO minimizes risk of injecting excess liquidity, maintaining? monetary policy stance.	The competitive auction risks excluding banks whose bids are not selected due to their low legacy green lending issuance.	The competitive auction will result in a higher green interest rate.	This used to be the standard design of refinancing operations.
Hard limit based on relative share of GAR level among participating banks	Hard limit on the size of Green TLTRO minimizes risk of injecting excess liquidity, preserving the monetary policy stance.	The auctioning scheme will limit the borrowing allowance of each bank, however all banks will be able to participate to some degree.	Hard limit may result in suboptimal amount of Green TLTRO green lending to accommodate investment needs	Relatively more complex to implement

Principles	Monetary policy compatibility	Broad participation	Green lending stimulus	Operational feasibility
Collateral policy				
Standard collateral rules	In line with current monetary policy framework.	Enables all banks to participate.	No particular difference	In line with the current design of refinancing operations.
Green collateral requirement	Shortage of green assets in the current collateral pool of banks will reduce the provision of Green TLTRO liquidity.	Risk to drastically reduce how much eligible green lending banks can pledge from Green TLTRO due to shortage of green assets.	This will possibly limit the borrowing allowance of banks that have more eligible lending than green collateral eligible assets. Although in the long run, this could reinforce incentives for banks to issue more green collateral-eligible assets.	Requires making important changes to the existing Eurosystem collateral framework, which would delay the programme implementation.
Maturity				
Short (<1 year)	Aligned with current monetary policy instrument geared at steering short-term interest rate.	Less attractive for banks since the Green TLTRO funding would not qualify for Net Stable Funding.	The Green TLTRO incentive is less significant if the maturity is shorter, (unless if the Green TLTRO can be rolled over).	Shorter maturity implies more frequency (see point below).
Long (>1 year)		Long maturity operations are attractive for banks to acquire stable funding.	The Green TLTRO incentive is stronger with a longer maturity	Longer maturity requires less frequent operations, which reduces the administrative burden for banks and central banks

Principles	Monetary policy compatibility	Broad participation	Green lending stimulus	Operational feasibility
Frequency				
Quarterly	Enables ECB to adjust the policy parameters more often, for example to match to the liquidity analysis for monetary policy.	No particular difference	No particular difference	Creates more complexity and administrative burden for banks and central banks
Yearly	Induces more rigidity in the ECB's liquidity management.	No particular difference	No particular difference	Less complexity and administrative burden for banks and central banks

As the table shows, the list of policy parameters identified could enable a multitude of design choices and combinations. We note the following key points:
First and foremost, the choice of the green lending scope is a critical one, as it tends to have important consequences in deciding on other parameters. Typically, a broader Taxonomy approach could lead to a larger size of the programme, so it could necessitate additional action to limit the size of it. On the other hand, choosing a selective approach would, by design, limit the size of the Green TLTRO and thus avoid having to resort to hard measures to contain the size of the programme. A middle way between the two would be to decide whether to start small with a selective approach while possibly extending to other activities in the medium run, or whether to take a broader approach in the first phase, while being ready to narrow down the scope of the programme on the longer run.

When choosing the interest rate mechanism, a combination of both a basic green interest rate and a target-based bonus rate reduction could provide the most optimal and complementary mix: while a lending-based green interest rate cannot steer banks towards ambitious volumes of green lending, a target-based bonus rate does. Vice-versa, a green bonus rate only can refrain banks from participating and have a lower transmission to the real economy, whereas a basic lending rate does not have that disadvantage.

When it comes to managing the size of the Green TLTRO programme, a scheme based on standard borrowing allowance could be the most effective, except in the case where a broad Taxonomy scope is chosen. As more sectors are by definition covered by the broad than the selective approach, this could risk making the programme too big in the medium run. To be on the safe side, the ECB would have to be prepared to adjust downward the borrowing allowance ratio (or other discussed policy parameters) in case the Green TLTRO size grows bigger than

intended. If the ECB assesses that keeping the rules unchanged during the whole programme duration is preferable, then setting a “hard limit” would be the second best.

In general, there is a potential trade-off between stimulating green lending on the longer term and the conduct of monetary policy. In particular, more generous conditions in terms of longer maturity and programme duration would clearly maximise the potential impact of this programme. On the other hand, this could also create constraints for the conduct of monetary policy, as Green TLTRO could interfere with the contracting policy stance on the short term. However, as already indicated, there are effective instruments for central banks to reduce this risk.

As already discussed, constraining the Green TLTRO to green collateral rules would be both complex and counterproductive, at least on the very immediate future. However, a Green TLTRO programme could still be coupled with other type of climate-related adjustments to the collateral framework if such changes were decided in the future by the ECB.

We also note that having only yearly Green TLTRO auctions (compared to quarterly TLTROs) could be an important way to reduce the complexity and administrative cost of the programme, assuming the ECB’s liquidity management can still operate in this context.

8. PRELIMINARY PROGRAMME SIMULATIONS

To get an impression of the quantitative implications of a Green TLTRO at the current stage of Taxonomy implementation, we built a unique dataset Taxonomy-alignment of the biggest European banks, based on their disclosure reports for 2023 – the very first reporting cycle for the GAR. This database allows us to run some basic simulations for illustrating the magnitude of the impact of a Green TLTRO on the overall lending of banks, and the impact on the profit and losses of the central banks of the Eurosystem. This section presents the database and its implications.

The dataset

For the purpose of this analysis, we have compiled a dataset of Taxonomy-alignment disclosure of more than 73 banks established in the Eurozone, among the 110 banks supervised by the ECB-SSM. We excluded banks not headquartered in EU20 Eurozone countries, and most importantly, Eurozone banks who have not yet fulfilled their obligation to disclose their Taxonomy reports by the cut-off date of our sample (July 2024)[21]. Our sample thus covers 80.7% of banking assets in the Eurozone. We analysed the annual report (or separate pillar 3 or sustainability reports) of these banks in order to extract selected data points on their Taxonomy-alignment.

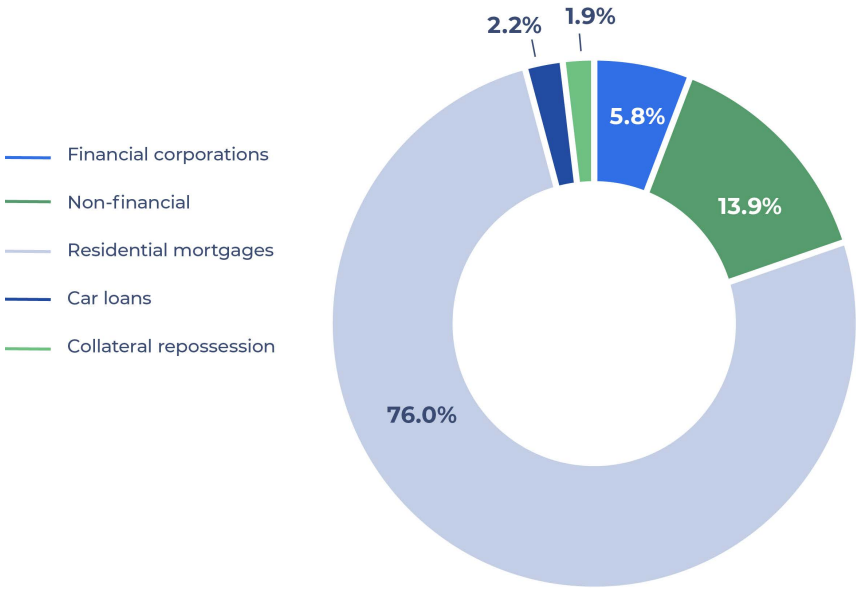
Based on this sample, we calculate the weighted-average GAR (based on turnover) for the Eurozone banking sector at around 2.53%, the average GAR is 2.23% and the median GAR at 1.42%. 11% of banks in our sample have a GAR smaller than 0.1% and around a quarter (24.5%; 18 banks) have a GAR comprised between 0.1 and 1%. The banks with the highest GAR level in our sample are the 10 banks have a GAR higher than 5%, among which only three have a GAR higher than 10% (see

21 For this reason, our sample might have a bias towards greener banks.

Figure in Annex). The complete list of banks' green asset ratio is available in the Annex.
In total, the nominal outstanding volume of Taxonomy-aligned banking asset is €398 billion. Unfortunately, a breakdown of Taxonomy-aligned asset per NACE sector or Taxonomy activity is not available under the current reporting requirements. This limitation implies, for instance, that it is not possible to identify how much Taxonomy-aligned lending has been extended towards renewable energy generation.

The vast majority (77,4%, 310 billion) of Taxonomy-aligned lending corresponds to mortgages whose underlying real estate asset has a high energy efficiency. Meanwhile, loans to financial corporations represent nearly 6% of assets, and 14% for non-financial corporations subject to the NFRD. However, renovation loans represent a minuscule amount with nearly €446 million of assets (0.11% - so small it does not appear in the chart below), at an equal level than loans to local government. Loans for vehicles are slightly more visible with €9 billion (2.3%). Loans for renewable energy infrastructure are included in financial or non-financial corporations.

Figure 7. Type of Taxonomy-aligned assets held by a sample of Eurozone banks.



Source: authors' own work, based on annual reports of 73 EU banks.

Policy parameters

For this exercise, we decide to opt for a broad Taxonomy approach. This choice is primarily motivated by the fact that data on Taxonomy-alignment of banking assets have become available since early 2024. To run a similar exercise with a

"selective" approach, a more detailed breakdown of bank Taxonomy disclosures per NACE sector or Taxonomy activity would be necessary. We then use the following parameters:

Policy parameter	Design choice
Green interest rate	100 bps below the MRO[22]
Green bonus rate	50 bps reduction in addition to the green interest rate
Eligible green lending	Broad Taxonomy
Collateral policy	Standard
Borrowing allowance	100% of new Taxonomy-aligned lending at the end of the previous year
Lending target	GAR +2pp
Reference period	Previous reporting year
Maturity	One year, no rollover
Programme duration	Five years

Potential size of Green TLTRO

As discussed in section 5.3, the size of the programme will be an important consideration for the overall design of Green TLTRO and its compatibility with the ECB's monetary policy strategy.

Under a simple borrowing allowance rule, the size of the programme will be directly proportional to the amount of eligible Taxonomy-aligned lending issued by banks during the previous period. Our database enables us to have some preliminary idea about the potential size of a Green TLTRO programme. We find that in 2023 the banks in our sample held €401 billion of Taxonomy-aligned assets[23]. However, this amount corresponds to a stock of loans, and not to the flow of new lending originated in 2023. Given that 2023 was the very first reporting cycle, we have no reference data for 2022, and therefore data on green lending flows are not systematically available yet via Pillar 3 disclosure reports.

As a proxy, we use our dataset to simulate how much new green lending banks should theoretically extend in order to increase their GAR to the target of 2 percentages points in 2024. All things equal, we find that banks in our dataset would have to originate €317 billion of new eligible lending (including real estate) for the next reference period in order to reach the GAR target. Extrapolating beyond our sample, this would result in a rough estimate of €378 billion for the whole Euro area banks. For each individual bank, this represents a lending target

22 All simulations in this section use ECB key interest rates levels as of 18 September 2024 (Deposit facility rate: 3.5%; Main refinancing operations: 3.65%).

23 Our sample covers 80.7% of Eurozone banking assets. A simple extrapolation of our sample would result in a theoretical total volume of Taxonomy-aligned assets of 479 billion euros for the entire Euro area banks.

of around €4 billion on average per bank (median: €1.8 billion) (see Figure in Annex).

As already pointed out, in practice banks can also increase their GAR by reducing their holding of non-Taxonomy-aligned assets (which happens naturally as loans reach maturity, or when a bank sells off these assets). In the short run, it is also very likely that the GAR will increase mechanically as banks roll-out their capacity to collect and analyse ESG data, and as companies start complying with the CSRD. Under a selective Taxonomy approach, the simple exclusion of loans to households collateralized by real estate assets from the Green TLTRO scope would shrink the programme to around €90-108 billion.

For comparison, since 1999 the ECB lent on average €674 billion to the banking sector throughout open market operations (MRO, LTROs, TLTROs). TLTROs alone peaked at €2200 billion in 2021. The Green TLTRO therefore could be relatively small compared to its predecessors.

Incentives from the green interest rate: case studies

Given the incompleteness of data on the GAR Flow, we are unable to simulate the (retroactive) effect of Green TLTRO on our sample of banks. For illustrative purposes, we compare the outcome of the abovementioned interest rate rules on a sample of fictive and simplified banks with a balance sheet of €100 billion, with various growth levels of eligible lending (see Table 2 below).

We then calculate the interest rate that would be applicable for each bank depending on whether this bank qualifies for the target-based bonus interest rate. We also show the incentive for the bank against the counterfactual case where such bank would have borrowed the same amount at the MRO rate. Under this simulation, we take the simplistic assumption that all banks achieve their GAR growth by issuing more green lending – and not throughout changes in their loan book composition. We do this over 5 years to ensure the simulation shows the long run effect.

Although these are simplified examples, these allow us to identify patterns in the way a Green TLTRO programme would incentivize banks.

First, we notice that all banks have an incentive to take part in the Green TLTRO, albeit at different scale and speed. Accordingly, bank C, the Laggard, with the highest yearly growth rate is the one that will benefit from the highest interest rate deduction within the period despite its lower starting GAR level. However, this was not the case for the whole period: during year 1, this bank was the one benefiting less from the incentive, given its low starting point.

Table 2. Cumulative interest rate gain over 5 years

€ Millions	Starting level of GAR	GAR growth per year	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Bank A Normal bank, high growth	2.5%	2.5%	56	56	58	59	61	**290**
Bank B Normal bank, slow growth	2.5%	1.0%	44	18	18	18	18	**115**
Bank C Laggard, catching up	0.5%	3.0%	11	90	94	97	101	**393**
Bank D Green pioneer, slow growth	5.0%	1.0%	88	18	18	18	18	**159**
Bank E Pioneer, steady growth	5.0%	2.5%	113	56	58	59	61	**346**

Inversely, the “green pioneer” banks both win the most in the first year given their higher GAR growth in year 0. However, the incentive quickly reduces for the bank with a slow growth rate of 1%, just like bank B. This illustrates that over time “green banks” do not have a superior advantage under the proposed rules. Only banks with a constantly high GAR growth level benefit the most from Green TLTRO.

The cost for the Eurosystem

One concern regarding this proposal is the cost of the proposal for a Green TLTRO on the central bank balance sheet. This problem is particularly acute at the moment, given the historically big losses made by Eurosystem central banks since 2022, due to the higher interest rate paid on the large amount of excess reserves in the post-pandemic period (Arnold, 2024). Depending on calculations, it is estimated that Eurosystem central banks made losses to the tune of €55 billion to €160 billion between 2022-2024, and will continue in the coming years until around 2027. (Belhocine, Vir Bhatia and Frie, 2023; De Grauwe and Ji, 2024; Fitch Ratings, 2024).

The mechanism behind these losses is the following. When the central bank lends money to banks, this mechanically creates additional reserves that commercial banks unavoidably deposit back to the central bank, at the deposit facility. Although it was not always historically the case (Monnet, Humann and Mitchener, 2024), the central bank usually remunerates commercial banks deposits at the central bank. For this reason, lending operations can bear a cost for the central bank in case the central bank lends money at a lower interest rate than the money it pays on the deposit facility, as would be the case under Green TLTRO.

However, the losses made from a Green TLTRO programme are likely to be notably smaller than these, given the smaller size of the Green TLTRO compared to the addition of TLTROs and the APP. We ran a simple simulation to approximate the potential cost of a Green TLTRO programme on the Eurosystem's balance sheet.

As in the previous section, we first assume that all banks increase their GAR by 2 percentage points, which would (by simplification) entitle them to a total borrowing allowance of €317 billion. As we discussed above, this number gives a generous estimate for the early phase of Green TLTRO, but is within the range of the possible size of the programme if banks were to successfully increase their GAR by 2 percentage points per year in the next few years.

Such injection of central bank reserves via Green TLTRO would increase deposits held by banks at the ECB's deposit facility, resulting in around €11 billion of interest rates payments from the Eurosystem to banks[24]. Meanwhile, as all banks would qualify for the bonus green interest rate they would all qualify to a green spread reduction of 150bps below the MRO, thus having to pay an interest rate of 2.15% (MRO 3.65% – 150bps), resulting in an income of €6.8 billion for the ECB. The difference between the two operations constitutes 4.2 billion in losses for the Eurosystem. This cost rises to 4.7 billion when considering the opportunity cost due to the loss of income that would have been generated by the central bank if it lends money at the MRO rate instead of the Green TLTRO rate[25]. If we extrapolate this amount to the whole Euro Area banking sector (and not just the 73 banks in our sample), the losses would amount to €5.7 billion. If the Green TLTRO maturity was longer than one year, this number would have to be multiplied accordingly.

Although this simulation is taking overly simplistic (but generous) assumptions, they allow us to conclude that such annual losses would be substantially lower than the losses made by the Eurosystem in recent years, and should therefore not

24 For the sake of simplicity, we ignore the effects of the non-remuneration of minimum reserves requirements and of the heterogenous distribution of bank reserves across banks and member states.

25 This is also a conservative assumption. In the absence of a Green TLTRO scheme, banks could also seek funding on financial markets instead of the ECB's MRO.

be a major concern or obstacle to considering the introduction of a Green TLTRO policy. Moreover, technical solutions such as tiered reserves mechanisms are available to reduce the magnitude of this cost. For example, the ECB could expand further the scope of its unremunerated reserves by revising upward the level of minimum reserves requirements, as proposed by Paul de Grauwe and others (De Grauwe and Ji, 2024). This would effectively reduce the base amount to which the ECB is remunerating banks through its DFR, reducing its outflows and thus total losses.

In theory, a simple solution to completely avoid any losses would be to set the lowest possible green interest rate at the same level as the ECB's deposit facility rate. In such a situation, both rates neutralize each other. However, this solution would abruptly limit the incentive offered to banks, especially given that since September 2024, the spread between the MRO and the DFR has been reduced to 15bps (instead of 50bps before). In such a setup, the ECB would need to compensate such tiny green spread by making other policy parameters more attractive, for example by extend further the maturity of Green TLTROs.
Another more radical solution would be to apply a "penalty rate" (higher than the MRO) against banks that continue to extend lending towards the dirtiest companies in parallel to their issuance of green lending (as discussed in section 5.1). In doing so, the ECB would generate more income from certain banks, which could offset – at least partly – the losses incurred by other banks. However, as discussed already such solution is technically difficult and could be counterproductive.

9. CONCLUSION

Since 2020, there has been a rich discussion on the possibility of introducing a green interest rate in the Eurosystem's policy framework. Since then, the economic rationale for moving in this direction seem even stronger in the context of high and volatile energy prices, growing geopolitical and geo-economic tensions, and a recurring risk of fossilflation. As outlined in the recent report by Mario Draghi, the EU's ambitions to increase its strategic autonomy and accelerate the decarbonation of the energy requires a massive increase in public and private investments in the transition. At this stage, it is not clear whether future development of the Capital Markets Union agenda will be sufficient to unlock new funding in the short term. Against this background the deployment of more proactive green monetary policy tools in support of the EU's strategic priorities and the implementation of the EU Green Deal could be justified under both the primary and secondary mandate of the ECB.

The technical obstacles and justifications advanced previously by the ECB for not introducing Green TLTROs do no longer seem valid. With the development of Taxonomy-related mandatory disclosure for banks and corporations, it is now possible to evaluate the volumes of green lending within a bank's balance sheet. Although the EU Taxonomy reporting framework could be improved, the EU Taxonomy can already greatly facilitate the implementation of a Green TLTRO programme in the near future. Moreover, a commitment to introduce Green TLTRO in the future would likely produce a catalysing effect in the banking and corporate sectors to accelerate the ongoing efforts to comply with the Taxonomy and CSRD requirements and thus increase their green asset ratio more rapidly. The design of a green interest rate policy remains a delicate exercise. Fortunately, policymakers have a variety of design choices at their disposal. A critically important parameter will be to choose between a broad or selective approach to the EU Taxonomy. Typically, a broader Taxonomy approach could be simpler to implement. However, it could also lead the programme to overshoot in size, which

would necessitate careful and more complex calibration of other parameters. A selective approach would, by design, limit the size of the Green TLTRO and could more precisely target sectors relevant for fighting the fossilflation. On the other hand, the selective approach might require more "allocational" decision making that some central banks may not be willing to undertake in isolation from political authorities. Either way, it would be conceptually possible to start small with a selective approach while possibly extending to other activities in the medium run, or conversely to take a broader approach in the first phase, while being ready to narrow down the scope of the programme on the longer run. On the very short-run, adopting strict green collateral requirements would be both complex and counterproductive.

When it comes to the calculation method of the green interest rate, a basic interest rate on all green lending might offer simplicity, but a bonus green rate could increase banks' origination of new lending, as evidenced under previous TLTROs. Overall, a combination of both mechanisms could be a powerful mix, where banks with persistent GAR growth emerge as clear winners. A penalty rate could theoretically further reinforce the transmission mechanism, but would probably be best introduced in a later stage, for example once a 'red' Taxonomy becomes available in the EU.

In general, there is a potential trade-off between stimulating green lending on the longer term and the conduct of monetary policy. In particular, more generous conditions in terms of longer maturity and programme duration would clearly maximise the potential impact of this programme. On the other hand, this could also create constraints for the conduct of monetary policy, as Green TLTRO could interfere with the contracting policy stance on the short term.

Using a unique dataset of Taxonomy-alignment of Euro area commercial banks, we find that the existing stock of Taxonomy-aligned assets in the Euro area banking sector was comprised between €400-500 billion at end 2023. On the basis that banks would have to increase their Green Asset Ratios by 2 pp per year in order to qualify for the green bonus rate, the size of the Green TLTRO would reach an annual size comprised between €317-378 billion (€4 billion on average for each bank). This order of magnitude is in line with the range of investment gaps being discussed in the literature. Moreover, this falls within the possible envelope of liquidity that the ECB envisages to supply to banks under its future operational framework.

Overall, it appears that the risk that a Green TLTRO overgrows to the point of interfering with the ECB's monetary policy would be manageable. The ECB can easily limit the programme's growth by reducing the scope of eligible lending (i.e. excluding certain Taxonomy activities) or reducing the borrowing allowance

ratio (i.e. banks can receive less liquidity than their past green lending). The most extreme, but administratively simple policy would be putting a hard cap on the size of the Green TLTRO programme and have banks compete to receive liquidity from this limited amount. An important design choice will be to decide whether to start small with a selective approach while possibly extending to other activities in the medium run, or whether to take a broader approach in the first place, while being ready to narrow down the scope of the programme later on.

Based on the literature, we find that a green spread of 100 to 200bps would already have tangible effects in stimulating renewable investments. However further research is needed to calibrate the green spread from a monetary policy perspective, and to evaluate the possible spill-over effects.

Due to negative cash-flow, resulting from the difference between the newly introduced green interest rate and the ECB's deposit facility rate, a Green TLTRO would bear a cost on the Eurosystem's balance sheet. Using conservative assumptions, we estimate that an interest rate reduction of 150bps on €317 billion of Green TLTRO lending would imply a yearly cost of around €5 billion on the Eurosystem. This is a much smaller amount than the recent losses made by the Eurosystem, and should therefore not constitute a primary concern when considering the adoption of such policy.

The ECB's forthcoming operational framework offers a roadmap for introducing climate-friendly structural refinancing operations in the coming years. This represents progress since the Strategy Review in 2020-2021, when the ECB rejected the idea. However, these greener structural operations might come too little and be of relatively small size to address the issues of fossilflation and supporting the EU political objectives related to climate change. As the ECB's monetary policy stance is expected to become more accommodative in the coming months, the ECB should seize this momentum to introduce a separate interest rate for green activities. Such initiative would also come at a timely moment to support the delivery of the EU's climate targets for 2030.

ANNEX I: FIGURES FROM THE DATASET

Figure 8. Green Asset Ratio levels of 73 EU banks (based on data reported by banks)

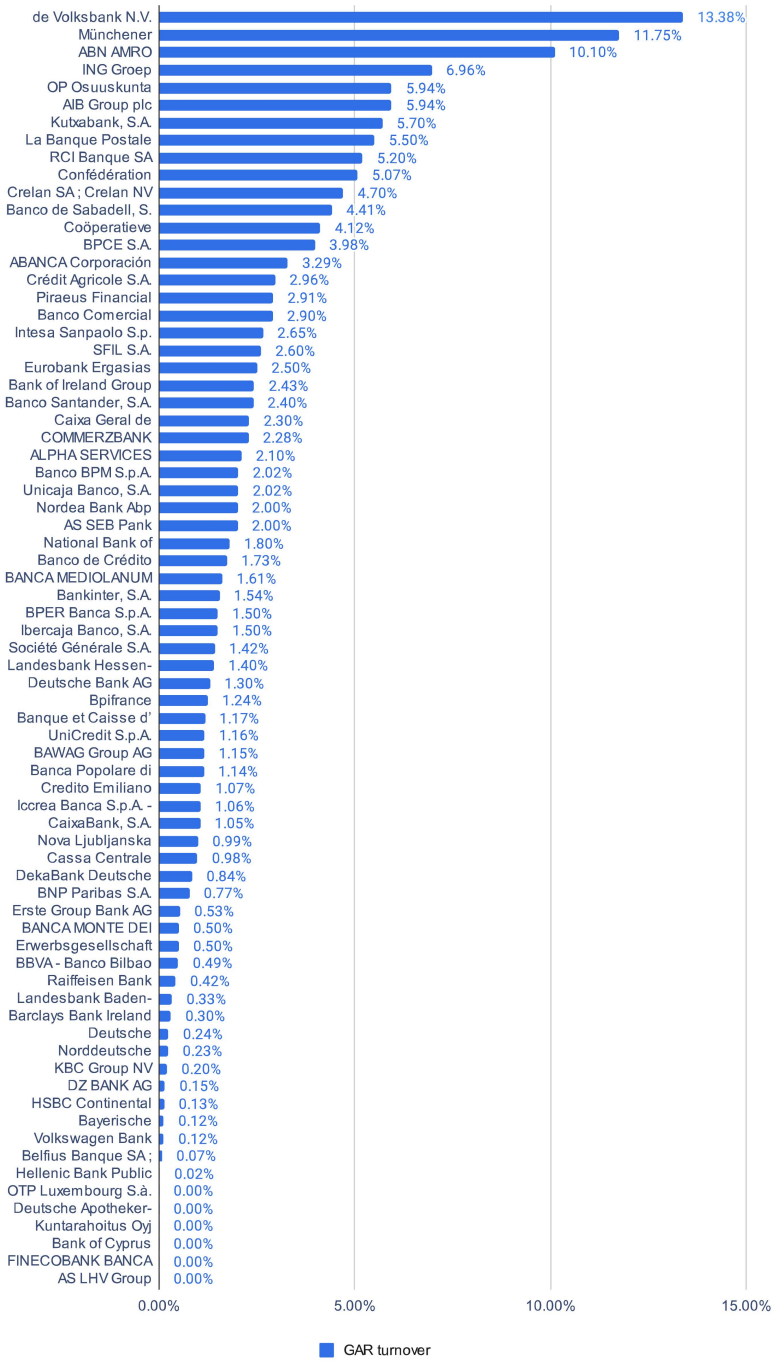
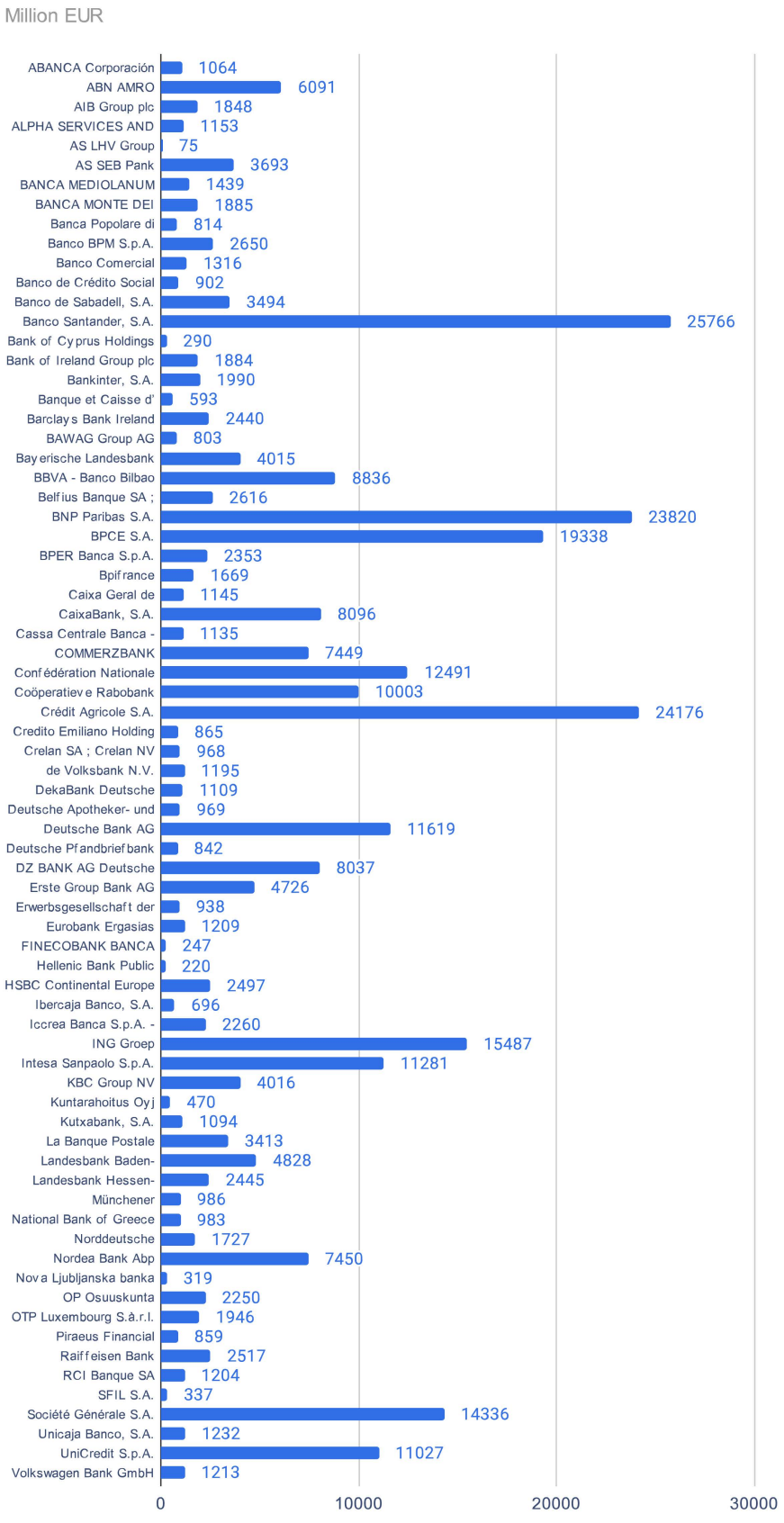


Figure 9. Volume of new lending required per bank to reach a 2 pp target under Green TLTRO programme (own calculations)



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