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Green or Greed? Examining the Nexus Between Sovereign Green Bonds and National Climate Targets

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Abstract

The fight against climate change has reached a critical point, requiring financial flows to align with climate-resilient pathways. This thesis investigates the alignment between sovereign green bonds and national climate targets. It expands the discussion from a corporate to a sovereign perspective, thus acknowledging the impact of sustainability disclosure practices by governments on the rest of society. The research question posed is: to what extent are sovereign issuers' climate targets linked to their sovereign green bond impact reports? The research is based on a qualitative desk review of impact reports published by the ten largest sovereign issuers in the EU as of 2021. The findings suggest a weak link between sovereign green bonds and national climate targets. There is a lack of climate target restatement. Diverse methodologies for calculating climate impact are prevalent, with no standardized approach. Reporting on green bond additionality is also lacking, hindering the quantifiable attribution of green value. Transparency and harmonization in disclosure practices emerge as key issues. This thesis rejects the concept that issuers proactively utilize green bonds to attain national climate targets. The presence of information asymmetries implies market underperformance. Additional research is needed to further understand the alignment, and policy intervention is necessary to facilitate more stringent, transparent, and universal standards for utilizing green bonds in the climate transition.

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1. Introduction

The urgency of combating climate change and environmental degradation has never been more apparent than in recent international climate conferences. These high-level meetings have underscored the critical role that financial systems will have to play in addressing these global challenges. Mobilizing investment for climate action has been emphasized as a key component in maintaining the 2°C temperature threshold outlined in the Paris Agreement. However, the scale of the challenge is substantial, as the UN Commission on Trade and Development estimates that meeting the Sustainable Development Goals (SDGs) will require between \$5 to \$7 trillion annually through 2030 (Tolliver et al, 2019). These figures demand a refocus of attention towards environmental finance instruments and innovative financing mechanisms that can help unlock the capital needed to address the urgent environmental challenges facing our planet.

Historical environmental finance innovations include instruments such as the Clean Development Mechanism (CDM) and the establishment of the Green Climate Fund (GCF). Both of these have been conducive to advancing the targets under the UN SDG framework and the Paris agreement. But an environmental financial instrument that has received particular attention in the last decade is the green bond. This instrument has been widely considered as one of the most important financial innovations to align financial flows with lowered greenhouse gas emissions and climate-resilient pathways. Although the market for green bonds only comprises a small fraction of the bond market overall, the recent exponential rise in green bond issuances has resulted in a handful of studies exploring its potential and effectiveness. The main advantage with the green bond is that it functions in the same way as conventional bonds. It is a fixed-income debt instrument allowing issuers to raise a certain amount of capital over a certain amount of time. The issuer of a green bond repays the debt through regular interest payments until maturity is reached (i.e., the end of the contract period), at which the initially borrowed principal amount is also repaid. What differentiates the green bond from the conventional bond is what type of projects they are eligible to finance. The use of green bond proceeds *must* exclusively be allocated towards the financing or re-financing of green projects (OECD, 2015). The terminology of the green bond raises the controversial, yet important question of what projects can truly be labelled green. The obscurity around the definition has resulted in a wide range of interpretations. This is the elephant in the room of green finance – a lack of standardization and harmonization.

Efforts have been made to address the issue of lacking standardization. In 2014, a consortium of investment banks came together and established a collection of voluntary best guidelines called the Green Bond Principles (GBP), in an effort to boost transparency, accuracy, and integrity of disclosed information by green bond issuers. The GBP are now monitored and reassessed by an independent secretariat under the International Capital Markets Association (ICMA), consisting of four key components: use of proceeds, selection and evaluation process, management of proceeds, and reporting (Climate Bonds Initiative, 2023). The World Bank and the International Finance Corporation (IFC) also have their own set of criteria and definitions for what projects qualify as green. The Climate Bonds Initiative (CBI) has also provided stakeholders with a list of green definitions under its taxonomy (Climate Bonds Initiative, 2023). The European Union (EU) is also expected to establish its own Green Bond Standard along with the implementation of the EU Taxonomy (European Parliament, 2023). The

main takeaway is that the market for green bonds is incredibly fragmented, which impedes the process of accurately assessing the role of green bonds in the climate transition.

The Paris Agreement was a groundbreaking legally binding international treaty in 2015, adopted by 196 countries. This treaty is held up by the requirement that countries must submit national climate action plans – also known as nationally determined contributions (NDC) – to reduce their greenhouse gas emissions. The Paris Agreement placed heavy emphasis on the role of climate finance, as large-scale investments are crucial for reducing emissions.

Many governments that ratified the Paris Agreement have since then begun to issue *sovereign green bonds* in an attempt to raise capital for climate-friendly projects. Sovereign green bonds are those issued exclusively by governments. Many of these sovereign green bond issuers have set ambitious national climate targets for themselves. However, there is little research on how these climate targets are addressed by their sovereign green bonds. And with a lack of legally binding and standardized frameworks on how green bonds ought to be managed, one cannot be entirely certain of the role that sovereign green bonds play in the climate transition.

1.1 Aim and scope

The purpose of this thesis is to analyze the connection between sovereign green bonds and sovereign national climate targets. More specifically, this thesis asks the following question: to what extent are sovereign issuers' green bond impact reports linked to their national climate targets? This question will be answered through a desk-review of impact reports and climate targets published by the ten largest sovereign issuers in the EU as of 2021. A synthesized list of core indicators is derived and utilized to systematically identify concepts and ideas related to climate-target alignment in the reports. The process of deriving the list of core indicators is guided by the following sub-questions:

- Are national climate targets explicitly restated?
- Is progress towards targets reported on?
- Are descriptions of impact indicators and impact methods provided?
- Is additionality of the sovereign green bond addressed?¹
- Are sovereign green bond impact reports externally verified by an independent party?

The EU was chosen due to the majority of worldwide issuances being issued within this region. EU's largest sovereign issuers include France, Germany, Italy, Netherlands, Belgium, Spain, Ireland, Poland, Sweden, and Hungary. It makes sense to look at these countries, because given these sovereigns' leadership in sovereign green debt finance, one would assume them to be leaders in disclosure as well. Any inconsistencies identified in this study could thus indicate a much larger problem with issuers not at the frontier of sovereign green debt finance.

A desk-review was chosen over a content analysis for a number of reasons. First, this thesis utilizes cross-country qualitative data containing disharmonized definitions and keywords, making a content analysis unsuitable given the considerable risk of overlooking valuable information. Second, the data consist of many graphs, tables, and images. The information provided by these visual aids would also be easily overlooked in a content analysis. Third, simply counting the frequency of keywords (e.g., restated national climate targets) in impact reports would ignore the importance of context. In order to fully understand the link between sovereign green bonds and national climate targets, one must also consider the context in which climate targets are mentioned, which is difficult to do in a content analysis.

The decision to solely focus on the climate aspect of green bonds was based on pure feasibility. Out of all the sustainability pillars, climate has received the most attention in international agreements. This

¹ Additionality refers to the additional environmental benefits that are in addition to what would have been achieved without the green bond. This concept is important in determining whether a green bond is used to refinance an existing project or to fund a new project that would not have happened in absence of the bond. Additionality also relates to the issuer's share of responsibility for reducing emissions if the project involves multiple parties (Tolliver et al, 2019; Tuhkanen & Vulturius, 2022).

focus on climate has led to an establishment of quantitative and tangible targets that are more feasible to study from an empirical lens than the vague objectives for biodiversity, water management, and adaptation.

The analysis will study a cross-section of primary governmental documents published through 2021, specifically looking at national climate targets and sovereign green bond allocation- and impact reports. This thesis builds on the work of Tolliver et al (2019) and Tuhkanen & Vulturius (2022). Tolliver et al (2019) studied the link between private sector green bond issuances and the objectives under the SDGs and respective NDCs. Tuhkanen & Vulturius (2022) took a similar route, studying the connection between corporate green bonds and company climate targets. These two studies took a corporate perspective to analyzing the role of green debt finance in advancing environmental objectives. This thesis aims to expand the debate by taking a sovereign perspective.

1.1.1. The role of the sovereign

The decision to focus on sovereign green bonds is based on a variety of factors. First, the potential of governments to address environmental problems by issuing green bonds has gained considerable traction over the past five years. The issuances of green bonds have increased significantly since 2018, further signaling the importance of governmental commitments to combat climate change and environmental degradation (Dell’Atti et al, 2022). Second, by promoting quantifiable, science-based green bonds at the governmental level, sovereigns possess the leverage to incentivize other entities such as corporations and financial institutions at lower levels (Dell’Atti et al, 2022; Torvanger et al, 2021). Lastly, empirical evidence suggests that governmental sustainability leadership and transparent disclosure practices of green bond activities have a positive and stimulating impact on the green bond market overall (Torvanger et al, 2021), thus highlighting the importance of governmental leadership in the realm of sustainable finance.

1.2. Outline of the thesis

The remainder of this thesis is structured as follows. First, some essential context on green bonds, international climate agreements, and disclosure policies is provided in chapter two. In chapter three, the research aim and question are supplemented by a literature review of relevant previous studies, along with a thorough description of applied theoretical concepts. Chapter four comprises a description of the data used in the empirical analysis. Thereafter, an overview of the applied method is given in chapter five. The empirical analysis is then executed in chapter six, with the aim to explain the findings and discuss them in the context of the broader research. Lastly, chapter seven provides a conclusion to the thesis through reflection of the main findings.

2. Context

2.1. Green bonds

Green bonds fundamentally function in the same way as conventional bonds. They differ on one aspect – the use and allocation of proceeds. The accumulated capital from a green bond can solely be used to finance or refinance green projects, assets, or operations with the aim to reduce climate change and environmental degradation, and contribute to sustainable development (Andersson et al, 2017). The result is a direct link between international capital markets and green investments, even if green bonds do not always generate new green investments.

2.1.1. History

The market for sustainable investments began emerging in the 1980s, with the debate and sanctions against South Africa’s apartheid regime serving as main contributors for its emergence. Awareness among investors and consumers grew significantly at the time, as they began to realize the potential impact of their investment decisions on the world around them. Environmental disasters such as Chernobyl in 1986 and Exxon Valdez in 1989 resulted in environmental issues gaining traction in the public debate (Andersson et al, 2017). The market for green bonds first emerged back in 2007, when the

European Investment Bank (EIB) issued its first *climate awareness bond* (CAB). The issuance volume constituted a total amount of 600 million euros, with a 5-year maturity. 83% of the issuance volume was allocated towards renewable energy projects, while the remaining 17% was allocated towards energy efficiency projects. The CAB was the first bond to exclusively earmark the raised capital for sustainable investments. It became EIB's most covered bond in media at the time, with more than 100 hundred articles written in 12 countries (Andersson et al, 2017). This issuance became a catalyst for bond markets whose accumulated capital would solely be earmarked towards sustainable investments. Up until this day, the EIB remains the largest issuer of green bonds. Andersson et al (2017) described the historical developments up until 2017, where EIB had issued more than 19 billion euros in green bonds.

The next development phase of the green bond occurred when the World Bank and Skandinaviska Enskilda Banken (SEB) joined forces to develop the first framework for green bond issuances. They also issued their first green bond in 2008. This bond was also the first to actually be given the label *green bond*, and this became the status-quo label for bonds whose accumulated capital is exclusively allocated towards green investments. The World Bank issued its green bond in Swedish krona, with the issuance volume constituting a total amount of 3.35 billion Swedish krona. The framework jointly developed by the World Bank and SEB describes the process of identifying eligible green expenditures, i.e., what projects can green bond proceeds be allocated towards. This framework was evaluated by a so-called *second party opinion*. This was the first instance this concept was introduced in the bond market. The framework was widely implemented among subsequent issuers and acted as an important predecessor for the standards in place today (Andersson et al, 2017).

The market for green bonds experienced a rather slow start after the breakthrough issuances by EIB and the World Bank in 2007 and 2008 respectively. Despite the overall success and widespread attention surrounding the green bond issuances, the market growth was minimal. Annual issuance volumes were modest, not constituting more than a couple of billion dollars a year. The relative newness of the debt instrument acted as an obstacle for rapid expansion, as there is always a learning curve associated with adoption rates. Another potential explanation for the stagnant market growth in the initial stages relates to the financial crisis in 2008. Sustainability initiatives are less prioritized during times of financial struggle (Andersson et al, 2017; Torvanger et al, 2021). Financial markets instead focused on dampening the effects of the crisis. Political resources were also mainly focused towards mitigating the crisis and boosting the economy.

Annual issuances increased by a factor of almost four in 2013, going from \$3.1 billion in 2012 to \$11 billion in 2013. The reason for this significant market widening was due to the market entry of several new sectors. Both corporate and municipal green bonds were introduced to the market. The significant upswing in issuances in 2013 was accompanied by joint efforts to develop a standard for green bond issuance. The World Bank took the reins by hosting a conference allowing for conversation between investors, issuers, and financial institutions, to develop a set of criteria that would foster continued growth for the green bond market. The trend of rapid growth continued throughout the remainder of the decade, with issuances passing \$1 trillion in 2020. Despite the positive trajectory, cumulative green bond issuances only amount to approximately 0.8% of the total outstanding global bond market (Torvanger et al, 2021).

2.1.2. Economic theory

Understanding the motives and incentives to enter the green bond market can help us gain a better understanding of the intentions of market participants – both on the demand and supply side. The underlying motives behind issuing and investing in green bonds will determine the trajectory of the market as well as its participants' intentions to proactively address science-based, quantitative targets. It is therefore useful to incorporate economic theory into the discussion for contextual purposes.

The demand side of the market for green bonds consists of investors. To better understand market participation among investors, we must address the question of why investors choose to invest in green bonds. The incentives for investing in green bonds provides us with useful knowledge on the very existence of the market itself. Why rational profit-seeking investors decide to pursue sustainability in

their investment strategy is a critical question to ask in order to understand sovereign sustainable bonds (Lupo-Pasini, 2022). The skeptics of sustainable finance push the argument of investors' needs to maximize profits. They argue that this primary goal of profit maximization will always be prioritized over non-financial objectives such as sustainability issues. Green bond markets are thus limited by this notion of investors primarily pursuing investments that guarantee targeted financial returns rather than investments providing public goods with lower returns. Portfolio managers deciding on a fund's investment strategy have a fiduciary duty to be in compliance with the mandates approved by the fund's board, and these mandates primarily relate to making financial profit for the investors. Sustainability objectives are always subordinate to the main financial goal of maximizing profit, which is the underlying reason for the fund's existence in the first place (Lupo-Pasini, 2022).

Given this primary focus on financial returns, it is necessary to understand whether these financial incentives are rooted in additional profits or reduced risk. Literature suggests that investors would receive financial returns in the form of lower default risk from the issuer (Lupo-Pasini, 2022). Lowered risk can relate to both financial risk and climate risk. Financial risks consist of risks such as credit risk, liquidity risk, operational risk, historical risk, and market risk (Andersson et al, 2017). Credit risk – mostly relevant to the green bond market – is the risk of incurring financial losses resulting from declining credit quality. The Paris agreement has granted a more favorable position to sustainable sectors, as they are better equipped with dealing with the required transition. These sectors will thus face lower costs and have a higher probability of staying in the market, ultimately resulting in lower credit risk. Climate risks typically consist of transition risk and physical risk. Transition risk involves the risk of transitioning to a sustainable society, which could relate to political decisions or technological advances. Physical risk involves the depreciation of certain assets resulting from climate change (Andersson et al, 2017). Sustainable sectors are associated with lower risk, which is an attractive characteristic for many investors.

The financial incentives on the demand side rarely relate to the attainment of environmental, social, and governance objectives (ESG). As long as primary payment obligations are fulfilled by the borrower, the investor's primary objective is met. The achievement of ESG objectives does thus not have an immediate impact on these financial returns (Lupo-Pasini, 2022). The sole financial beneficiary of the attainment of these objectives is the borrower itself, which is discussed further in detail below. The reality is that meaningful sustainability achievements are public goods. They are positive externalities generating benefits for all of society to enjoy (Andersson et al, 2017). The issue with public goods is the difficulty of internalizing them as private profit, so these benefits are oftentimes overlooked and marginalized in the internal calculus.

The supply side consists of issuers. The general idea behind green bonds is based on the notion that this debt instrument is able to provide financial incentives encouraging issuers to implement sustainable change. As mentioned earlier, there are several economic motives for issuing a green bond. Issuing a green bond could represent an effort to lower climate risk and credit risk, placing the issuer in a more favorable position in the aftermath of the Paris agreement, as costs are lowered and the prospects for future funding are increased (Flammer, 2013; Lupo-Pasini, 2022). Some studies have also pointed to the possibility that issuers issue green bonds to obtain cheaper financing (Zerbib, 2019; Cicchiello et al, 2022). These findings suggest that issuers with higher environmental performance can reap financial benefits through lower costs of capital. The bond yields are lower for those with higher environmental performance, indicating lower costs of borrowing which ultimately represents a significant economic motive for issuing green bonds. This premium is widely referred to as a "greenium" (Zerbib, 2019). The "greenium" also pertains to the demand side, as investors are more likely to accept lower bond yields from green bonds. This could be explained by investor mandates to reduce climate risk. The Paris Agreement, and climate change itself, have substantially increased the risks of investing in "brown sectors", i.e., heavily emitting sectors. The "greenium" might thus be a result of increased risk aversity on the demand side. The findings on the "greenium" are largely debated, however, and there is no current consensus on the topic. Zerbib (2019) found green bonds to display a negative premium of around 2 basis points relative to conventional bonds, while Larcker & Watts (2020) found the premium to be zero.

The economic motives for attaining ESG commitments among issuers is less clear. The fundamental constraint that hinders issuers from committing to specific ESG targets relates to policy. Political interference is inevitable. Many of the ESG targets require policy change, which poses a significant barrier to achieving the policy change essential to the debt agreement. This could thus act as a disincentive to committing to meaningful sustainability objectives (Lupo-Pasini, 2022).

A widely considered question in the realm of sustainable finance is whether capital allocation for sustainable investments could successfully result in less non-sustainable investments. Andersson et al (2017) argue that investments in brown sectors will not decline until the expected demand for their products declines. This could occur either from the emergence of more profitable sustainable substitutes, or through government policies that reduce demand and increase the risk of holding non-sustainable assets. Should large amounts of non-sustainable bonds be sold while demand remains unchanged, expected revenues for those bonds increase (Andersson et al, 2017). And given investors' incentives to maximize profits, this drastic increase in expected revenues would attract a lot of attention.

2.2. Initiatives and international agreements

As is seen above, the mobilization of capital in capital markets is determined by several economic factors. But capital mobilization is also influenced by numerous initiatives and international agreements set throughout the years. Below is a description of relevant initiatives and agreements taken to mobilize capital towards sustainable investments.

2.2.1. Principles for Responsible Investments

The Principles for Responsible Investments (PRI) was launched in 2006 by the United Nations (UN) Global Compact and the UN Environment Programme Finance Initiative. The main objective of this initiative is to foster consideration of environmental, social, and governance (ESG) factors by institutional investors (Gond & Piani, 2012). Since the initial launch, the PRI has drawn more than 2,000 signatories globally (Kim & Yoon, 2022). Due to its considerable size, significance, and the fact that it was a first mover, the PRI is plausibly the most important responsible investment initiative in existence. The PRI and its cumulative impact have facilitated a niche-to-mainstream shift for responsible investment (Majoch et al, 2017).

Signatories of the PRI are obliged to submit annual reports describing their efforts towards achieving the six principles. The framework for reporting is overarching, mainly oriented towards three specific areas: responsibility, transparency, and assessment (Andersson et al, 2017).

2.2.2. Green Bond Principles

A majority of green bond labels cohere with the Green Bond Principles (GBP). The GBP were initially developed by the private sector, first introduced in January 2014 by a consortium of major financial institutions under the aegis of the International Capital Markets Association (ICMA). The establishment of these Principles served as a major catalyst for the green bond market as a whole, as confidence grew in the debt instrument (Ehlers & Packer, 2017; Ehlers et al, 2020). GBP provide issuers with a set of voluntary process guidelines that cover the key components of green bond issuance. These guidelines have been widely accepted as a market standard and have become the basis for actors operating within the market for green bonds. It is important to note that compliance with these process guidelines under the GBP is not mandatory. The GBP are merely for assessing the credentials of green bonds, thereby providing industry with more safety (Nanayakkara & Colombage, 2021). Green labelling thus lies primarily in the hands of the issuers, allowing the "greenness" of projects to take on many different values and interpretations. The level of compliance with the GBP by green bond issuers is then assessed by the Climate Bonds Initiative (CBI), where CBI issues a certificate over the "greenness" of the bond (Nanayakkara & Colombage, 2021). By adhering to the GBP, the issuer complies with the following process guidelines:

Use of Proceeds	Process for Project Evaluation and Selection	Management of Proceeds	Reporting
<ul style="list-style-type: none"> • Describe the utilization of proceeds towards eligible projects 	<ul style="list-style-type: none"> • Communicate environmental objectives of projects • Communicate selection process • Provide complementary information on social and environmental risks 	<ul style="list-style-type: none"> • Describe the management and temporary placement of unallocated net proceeds 	<ul style="list-style-type: none"> • Report on allocated proceeds and expected impact from allocation.

Figure 1. Green Bond Principles. Source: Green Bond Principles (2021).

Several non-exclusive broad categories of eligible green projects are recognized under the GBP. These include renewable energy, energy efficiency, pollution prevention and control, climate change adaptation, green buildings, and sustainable water and wastewater management (Forsbacka & Vulturius, 2020). A definition of a green bond is not included in the GBP, nor a classification system that clearly outlines eligible green projects. The purpose of the GBP is merely to provide structured process guidelines that facilitate the defining of green eligible projects based on the issuer’s green bond framework. Additionally, the Principles enable for transparency between issuer and investor through the green bond framework and subsequent impact reports (Forsbacka & Vulturius, 2020).

2.2.4. EU Commission’s High-Level Expert Group

Following the Paris agreement, the EU Commission established a High-Level Expert Group (HLEG) on sustainable finance. HLEG was assigned with the objective to develop recommendations for promoting sustainable investments within the EU. The group laid a solid foundation for the comprehensive action plan on sustainable finance proposed in 2018 by the European Commission – with the aim to achieve emissions reductions, resource efficiency, and sustainable economies (Saab & Sadik, 2018; Andersson et al, 2017).

The most relevant proposals (in the context of this thesis) brought forth by the HLEG include the development of a classification system for sustainable assets along with an EU-standard for green bonds (Andersson et al, 2017). The classification system is known as the EU Taxonomy, clearly defining what activities can be considered sustainable. The EU Green Bond Standard is of voluntary nature and was published in 2021 to increase harmonization and transparency in the green bond market. The Standard was developed to be in line with the Taxonomy, with the aim to address the current fragmentation around the definition of sustainability.

2.2.5. The Paris Agreement

The Paris Agreement is by far the most ambitious international climate agreement to date. This Agreement is a legally binding treaty, adopted by 196 Parties at UN’s Climate Change Conference in Paris in 2015, entering into force in 2016. The overarching goal of the Paris Agreement is “to hold the increase in the global average temperature to well below 2°C above pre-industrial levels” while also pursuing efforts “to limit the temperature increase to 1.5°C above pre-industrial levels.” (UNFCCC, n.d.). Each ratifying Party was tasked with developing climate-focused commitments, also known as Nationally Determined Contributions (NDCs). These NDCs require countries to communicate the climate actions they will take to reduce emissions in order to reach the goals of the Paris agreement. This includes communicating specific emissions reductions targets.

COP21 in Paris was also particularly adamant in emphasizing the role of climate finance in meeting these emissions reductions targets. Significant financial resources are needed to mitigate climate change and adapt to the adverse consequences already underway (UNFCCC, n.d.). The International Energy

Agency (IEA) estimated that maintaining the 2°C threshold stated in the Paris agreement would require \$53 trillion in energy-related investments by 2035 (Tolliver et al, 2019). There is thereby a significant amount of pressure to mobilize substantial volumes of capital in pursuit of the ambitious climate targets set under the Paris agreement. COP21 in Paris was the first international climate agreement to explicitly address the finance sector, establishing that financial flows should be made consistent with a climate-resilient pathway towards low greenhouse gas emissions (Forsbacka & Vulturius, 2020). Green bonds have been widely acknowledged as an advantageous instrument to finance the attainment of these targets. And since the ratification of the Agreement, many countries have experienced rapid growth in green bond markets in attempts to curb emissions.

2.3. EU's largest sovereign green bond issuers

The ten largest issuers in the EU as of December 31st, 2021, were France, Germany, Italy, Netherlands, Belgium, Spain, Ireland, Sweden, and Hungary (Statista, 2022). As mentioned earlier, studying the largest issuers in the EU makes sense given the EU's leading position in sovereign green bond issuances worldwide. This is based off the rationale that leadership in sovereign green bond issuance would be somewhat indicative of leadership in disclosure practices as well. Any shortcomings identified among these top issuers could thus potentially indicate a much more widespread problem among issuers not at the frontier of sovereign green debt finance. In order to understand the link between these countries' sovereign green bond impact reports and respective climate targets, it is useful to provide some context on the targets the countries have set for themselves, along with the sovereign green bonds they have issued.

Table I provides an overview of two things: the national climate targets each sample country has set for itself, and the sovereign green bonds issued by each sample country. The targets were obtained from each sample country's national energy and climate plan (NECP). These plans were introduced by the EU's *Regulation on the governance of the energy union and climate action* (European Commission, n.d.). The government regulation imposed by the EU required all Member States to submit national long-term strategies looking forward to 2050, thereby providing relevant climate targets aligning with the EU objectives under the Paris agreement (European Commission, n.d.).

<i>Country</i>	<i>Climate Targets</i>	<i>Issued Sovereign Green Bonds</i>
<i>France</i>	<ul style="list-style-type: none"> • 37% by 2030 <ul style="list-style-type: none"> ◦ 2005 benchmark • Carbon neutral by 2050 	<ul style="list-style-type: none"> • Green OAT 2039 <ul style="list-style-type: none"> ◦ Issued in 2017 • Green OAT 2044 <ul style="list-style-type: none"> ◦ Issued in 2021
<i>Germany</i>	<ul style="list-style-type: none"> • At least 55% by 2030 <ul style="list-style-type: none"> ◦ 1990 benchmark • Carbon neutral by 2050 	<ul style="list-style-type: none"> • Green Federal Bond <ul style="list-style-type: none"> ◦ Issued in September 2020 • Green Federal Note <ul style="list-style-type: none"> ◦ Issued in November 2020
<i>Italy</i>	<ul style="list-style-type: none"> • 33% by 2030 <ul style="list-style-type: none"> ◦ 2005 benchmark • Carbon neutral by 2050 	<ul style="list-style-type: none"> • BTP Green 2045 <ul style="list-style-type: none"> ◦ Issued in 2021
<i>Netherlands</i>	<ul style="list-style-type: none"> • 49% by 2030 <ul style="list-style-type: none"> ◦ 1990 benchmark • 95% by 2050 <ul style="list-style-type: none"> ◦ 1990 benchmark 	<ul style="list-style-type: none"> • DSL Green Bond <ul style="list-style-type: none"> ◦ Issued in 2019 • DSL Green Bond <ul style="list-style-type: none"> ◦ Expected issuance 2023
<i>Belgium</i>	<ul style="list-style-type: none"> • 30% by 2020 in Wallonia <ul style="list-style-type: none"> ◦ 1990 benchmark • 80-95% by 2050 in Wallonia <ul style="list-style-type: none"> ◦ 1990 benchmark • 35% by 2030 in Flanders <ul style="list-style-type: none"> ◦ 1990 benchmark • 80% by 2050 in Flanders <ul style="list-style-type: none"> ◦ 1990 benchmark 	<ul style="list-style-type: none"> • Green OLO86 <ul style="list-style-type: none"> ◦ Issued in 2018

<i>Spain</i>	<ul style="list-style-type: none"> • At least 20% by 2030 <ul style="list-style-type: none"> ◦ 1990 benchmark • Carbon neutral by 2050 	<ul style="list-style-type: none"> • SPGB Green Bond 2042 <ul style="list-style-type: none"> ◦ Issued in 2021
<i>Ireland</i>	<ul style="list-style-type: none"> • 30% by 2030 <ul style="list-style-type: none"> ◦ 2005 benchmark • Carbon neutral by 2050 	<ul style="list-style-type: none"> • ISGB 2031 <ul style="list-style-type: none"> ◦ Issued in 2018 • ISGB 2043 <ul style="list-style-type: none"> ◦ Issued in 2023
<i>Poland</i>	<ul style="list-style-type: none"> • 7% by 2030 <ul style="list-style-type: none"> ◦ 2005 benchmark • Carbon neutral by 2050 	<ul style="list-style-type: none"> • Poland Sovereign Green Bond <ul style="list-style-type: none"> ◦ Issued in 2016, 2018, and 2019
<i>Sweden</i>	<ul style="list-style-type: none"> • 63% by 2030 <ul style="list-style-type: none"> ◦ 1990 benchmark • Carbon neutral by 2045 	<ul style="list-style-type: none"> • Sweden Sovereign Green Bond <ul style="list-style-type: none"> ◦ Issued in 2020
<i>Hungary</i>	<ul style="list-style-type: none"> • 40% by 2030 <ul style="list-style-type: none"> ◦ 1990 benchmark • Carbon neutral by 2050 	<ul style="list-style-type: none"> • Hungary Sovereign Green Bond <ul style="list-style-type: none"> ◦ Issued in 2020

Table 1. Climate Targets and Sovereign Green Bond Issuances. Source: NECP (2020).

3. Theory and Previous Research

Although considerable scholarly attention has been directed towards the green bond and its potential to address climate change and environmental degradation, little research has been conducted to gain an empirical understanding of *how* green bonds are proactively funding the climate transition. A majority of the previous literature have focused on the financial aspects of the green bond, placing large emphasis on the financial details and incentives behind issuing a green bond (Zerbib, 2019; Partridge & Medda, 2020; MacAskill et al, 2021; Hyun et al, 2020). Several studies have explored whether issuers of green bonds borrow capital at a premium (also called “greenium”), implying that issuers of green bonds would borrow at a lower cost relative to issuers of conventional bonds (Zerbib, 2019; Ehlers & Packer, 2019). Understanding the financial aspects of green bonds is undoubtedly important, but we must also ask ourselves whether green bonds are consistent with the climate targets that issuers have set for themselves. The main purpose of the green bond is to signify a commitment to exclusively allocate raised funds towards financing or re-financing green projects (OECD, 2015). If this purpose is not fulfilled in a meaningful way, i.e., if green bonds do not work proactively towards meeting the climate targets and environmental objectives set by the issuer, research on the financial characteristics of green bonds loses its significance.

Conceptual and theoretical framework

This thesis will incorporate the conceptual framework developed by Tuhkanen & Vulturius (2022), stating that issuers adopt climate targets to manage climate risk and will thus utilize green bonds to achieve them. The designated conceptual framework was originally applied to a corporate perspective, but this thesis aims extrapolate it to fit a sovereign perspective. Fundamentally, the conceptual framework remains unchanged – sovereign issuers adopt climate targets in accordance with international climate agreements and will utilize sovereign green bonds to achieve them. Should this study identify a disconnect between sovereign green bonds and national climate targets, it may imply that the sovereign green bond market is insufficiently designed for attaining the climate targets that market participants have set for themselves.

Additionally, this thesis will incorporate Akerlof's (1970) theory of information asymmetries, stating that markets with more information asymmetries will perform worse than markets with less information asymmetries. Akerlof's (1970) theory will serve as a guiding framework for the discussion of results and subsequent implications for the overall performance of the sovereign green bond market. More details on the theory are provided further down in Section 3.3.

3.1. Sovereign green bonds

The sovereign green bond is a fairly new instrument, which has resulted in there being limited research on the topic. Sustainable finance has progressively become more important for governments from an international economic law perspective, as many financial investors in sustainable finance have begun to shift their attention towards governments (Lupo-Pasini, 2022).

The demand for sovereign green bonds reached US\$1 trillion in 2021, and the market is expected to grow significantly larger by the end of 2021. Sangiorgi & Schopohl (2021) studied the demand for green bonds and found particularly sovereign green bonds to exhibit unmet investor demand. This implies that sovereign green bonds are currently under-issued, thus suggesting that governments should focus more on green bond investment channels in their transition financing strategy. Sovereign green bonds namely allow states to borrow capital at a relatively low cost. Wiśniewski & Zieliński (2019) were among the first to study the sovereign green bond market and its characteristics, specifically looking at the case of France and Poland. They argue that the demand for sovereign green bonds is substantial, as the instrument has gained considerable attention from market participants over the past decade (Wiśniewski & Zieliński, 2019). The cost of issuing a green bond does not differ significantly from that of a conventional bond, and the authors strongly advocate for continued development of the sovereign green bond market (Wiśniewski & Zieliński, 2019). However, the authors do not incorporate a critical discussion on whether this financial instrument actually contributes to addressing meaningful climate objectives.

Lupo-Pasini (2022) studied the efficiency of sovereign green debt finance, taking an international law perspective to address the question of whether sovereign green debt contracts actually have the power to achieve true sustainable change. Sovereign sustainable finance is based on the notion that international financial investors are able to leverage their position as capital suppliers to incentivize sustainable investments among sovereign borrowers. The debate on sustainable finance has circulated around the assumption that sustainable investors can coerce borrowers to implement ESG policies as a condition for their lending, potentially acting as a helping hand for governments seeking to promote difficult political reforms. Financial markets' shift in attention towards sovereign debt markets could thus trigger a positive regulatory change and induce more sustainable domestic policies. Lupo-Pasini (2022) argues against this assumption, finding little evidence that financial investors can incentivize the allocation of expenditures towards sustainable policies. His findings suggest that the market for sovereign sustainable bonds is solely designed to increase the aesthetic appeal of those financial instruments to retail investors but has little prospect of promoting true sustainable change (Lupo-Pasini, 2022).

Sovereign debt contracts also lack tangible consequences of violating stated ESG commitments. This minimizes the incentives for sustainable change. The lack of contractual incentives in sovereign debt finance negatively impacts the overall credibility of the sovereign issuer, as sovereigns are not contractually obliged to commit to meaningful ESG objectives (Lupo-Pasini, 2022). Baldi & Pandimiglio (2022) studied the greenwashing risk of issuing green bonds. They developed a conceptual framework, partially built around the notion that sovereigns are more prone to greenwashing practices due to them being less proximate to their respective constituencies. Monitoring activity is inefficient, since the projects covered by the sovereign green bond are typically nationwide. Baldi & Pandimiglio (2022) argued that it is therefore easier for sovereign issuers to deceive investors by carrying out less sustainable and impactful activities. Sovereign issuers are less likely to incorporate meaningful control processes in their framework, making it difficult to assess the true sustainability impact of the sovereign green bond as it increases the risk of greenwashing. The reported greenwashing risk thus negatively impacts the overall credibility of sovereign green bonds.

Conclusively, the lack of accountability in sovereign debt contracts regarding the attainment of meaningful ESG commitments, combined with the high exposure to greenwashing risk highlight the importance of studying whether or not sovereign-issued green bonds are proactively contributing to the achievement of national climate targets.

3.2. Green bonds and climate targets

This thesis builds on the previous work of Tolliver et al (2019) and Tuhkanen & Vulturius (2022), who studied the link between green debt financing and climate targets on the corporate/organizational level. Tolliver et al (2019) studied the extent to which green bond proceeds were allocated to activities aligned with the SDGs and NDCs. By thoroughly analyzing green bond issuer documents, they identified many inconsistencies between green bond use of proceeds and relevant targets. International financial institutions provided the most consistent post-issuance assessments on environmental outcomes stated in the SDGs and NDCs, but the remainder of issuers were lacking in the disclosure of relevant environmental impact estimates. The marginal impact of green bond proceeds becomes more obscure as a result, ultimately creating an undesirable information gap that undermines investor confidence and overall credibility of the financial instrument (Tolliver et al, 2019).

Tuhkanen & Vulturius (2022) took a similar route by studying the link between corporate issuers' climate targets, their green bond programs, and post-issuance impact reports. The authors developed a conceptual framework which this thesis aims to incorporate into the discussion – stating that *issuers adopt climate targets to manage transition risk and utilizes green bonds to achieve them*. Climate targets are used to identify and communicate where an entity aspires its greenhouse gas emissions to be at a certain point in the future. These targets must be science-based in order to ensure stakeholders that they are truly consistent with sustainable change. Tuhkanen & Vulturius (2022) found there to be a significant disconnect between corporate issuers' climate targets, their green bond frameworks, and impact reports. This is a consequence of lacking external pressure to use proceeds for achieving ambitious and aspirational science-based targets. The authors draw the conclusion that issuers do not use their green bond frameworks and impact reports to demonstrate connections between their green debt financing and official climate targets.

Andersson et al (2017) reach similar findings, stating that a direct link between green bonds and climate targets is not easily identified. The authors also bring up an important but rather controversial point when discussing the green bond market. Technically, investments could be allocated towards boosting energy efficiency in the fossil fuel industry. Such investments could potentially result in more emissions reductions than allocating the same amount of capital towards a renewable energy facility. In the short run, investments into fossil fuel efficiency could thus reduce emissions more than investments into sustainable wind farms. The long-run result would be an increase in the life span of fossil fuel facilities, ultimately prolonging the transition towards a sustainable economy (Andersson et al, 2017). This long-run perspective has generated widespread viewpoint that green bonds financing fossil fuel efficiency should be excluded from the major indices for Western green bonds (Andersson et al, 2017). The issue with excluding these fossil fuel efficiency projects, according to Andersson et al (2017), is that although capital will be allocated towards more sustainable investments, there is little to no indication nor insurance that these investments are more sustainable from a 2°C threshold scenario. Emissions will decline, but the question remains whether these emissions reductions will occur at a level necessary for the achievement of the goals set under the Paris agreement (Andersson et al, 2017). Ehlers et al (2020) build on this by questioning the efficiency of the green bond market. They find green bond projects to have had limited effect on emissions reductions, and that aspirational environmental impacts are rarely achieved. A key aspect of this study – relating to the arguments laid out by Andersson et al (2017) – is that large polluters rarely issue green bonds. There are two plausible reasons for this. First, these polluters might be disincentivized by the concern of being accused of greenwashing. Second, there is the high probability that these green bonds issued by large polluters are excluded from existing green funds (Ehlers et al, 2020). Issuers take a large reputational risk when issuing a green bond, as the bond might not qualify as *green* by investors (Forsbacka & Vulturius, 2020). This reputational risk has led to an undersupply of green bond issuances among large polluters, posing a serious issue since these large polluters have a substantial impact on whether national climate targets are achieved or not.

There is also the important aspect of *additionality* – i.e., whether there has been any added green value or if the project still would have happened in absence of the green bond. Tuhkanen & Vulturius (2022) found that issuers fail to provide vital information on this matter. This is also addressed by Tolliver et al (2019), who emphasize the fact that although proceeds are exclusively earmarked towards green projects, green bonds are oftentimes mistakenly credited for generating additional environmental benefits from the assets they finance. In reality, green bonds are primarily issued to refinance existing projects rather than finance new projects (Tolliver et al, 2019). Also, green bond issuers are seldom the sole financiers of green projects. These projects are oftentimes co-managed, which is seldom stated in impact reports. Therefore, environmental benefits derived from green bonds are not necessarily additional, as capital could be allocated to projects using other financial mechanisms.

3.3. Harmonized disclosure, standardization, and information asymmetries

A reoccurring concern with the green bond arises from the definition itself: a green bond signals a commitment to use the proceeds to finance or re-finance “green” projects, assets, or business activities exclusively (OECD, 2015). Many scholars have attempted to address the question of what projects, assets, or activities can be considered as “green,” and the interpretations vary. The fundamental reason for this variation is rooted in the absence of standardization. Forsbacka & Vulturius (2019) emphasized the need for more standardized, transparent, and comparable formatting for green bond impact reporting. The GBP is widely accepted by the market for how green bonds ought to be managed, including voluntary guidelines for issuing green bonds. These principles recognize a variety of non-exclusive broad categories of eligibility of green projects contributing to a range of environmental objectives. The GBP does not include a standard definition of a green bond and lacks a comprehensive classification system for eligible projects and activities. There are four key components in the GBP: i) use of proceeds; ii) process for evaluation and selection of eligible projects; iii) management of proceeds; and iv) impact reporting. Forsbacka & Vulturius (2019) highlighted the fragmented nature of these voluntary guidelines, finding significant variation in both detail and complexity in issuers’ green bond frameworks and reporting methods. Additionally, there is no harmonized and coordinated process used by third-party verifiers when certifying the green bond documents.

The GBP only comprises a fraction of the voluntary standards in the sphere of sustainability disclosure practices. Climate Bonds Initiative (CBI) has their own standard for how green bonds ought to be managed. Additionally, the EU has recently developed their own Green Bond Standard, in line with the EU Taxonomy. This builds on the GBP, but also includes additional characteristics and guidelines to address the obstacles to development. Forsbacka & Vulturius (2019) argue that the fundamental contribution of the green bond to climate finance lies in both the procedure and infrastructure for disclosure practices regarding climate-related information and sustainability performance. According to the EU Commission, the most concerning challenge for continued growth of the market for green bonds is the lack of a universal standardized framework for how green bonds ought to be defined (Andersson et al, 2017).

Given the substantial variety of standards and definitions, disclosure practices lose much of their power and the market for green bonds loses much of its potential to address meaningful climate objectives. This ties into the theory developed by Akerlof (1970). His work on information asymmetries has facilitated a fundamental understanding of market phenomena. His theory – widely known as the Lemon Theory – suggests that a market with information asymmetries, i.e., imperfect information, will be less productive than its counterpart market with less information asymmetries. An inability to distinguish good quality from bad quality results in low-quality products selling on the market for high quality. Akerlof (1970) uses the automobile market as an example of how information asymmetries can affect the market. Participants of this market buy a car without knowing whether the car they bought is a good car or a bad car. The bad cars, i.e., the lemons, drive out the good since it is impossible for buyers to tell the difference between good and bad cars. Only the seller knows.

The Lemon Theory is theoretically applicable to the market for green bonds, where green bonds with weak sustainability become indistinguishable from green bonds with strong sustainability. Possessing a green bond with strong sustainability is undoubtedly advantageous given its association with lowered climate risk. If climate impact is disclosed in a transparent and science-based manner in green bond

impact reports, assessment of climate risk becomes more accurate. Should an asymmetry of available information exist, i.e., a scenario where only the issuer knows the true green value of the sovereign bond, green bonds of weak and strong sustainability will trade at the same price. Ultimately, “weak” and greenwashed green bonds would potentially drive the “strong” green bonds out of the market, as the owners of “weak” green bonds will tend to trade at a higher frequency than that of “strong” green bonds given the higher potential returns (Akerlof, 1970). Forsbacka & Vulturius (2019) emphasize the important role of environmental performance transparency in addressing information symmetries, also stating that bridging the issuer-investor informational gap is one of the most important issues for the green bond market. Applying Akerlof’s (1970) Lemon Theory can help us make sense of the results we are seeing – i.e., the transparency of green bond impact reports related to climate target alignment – and the implications it has for the sovereign green bond market as a whole. Should sovereign issuers not disclose information on the alignment between their green bonds and climate targets in a science-based and satisfactory manner, we can draw the conclusion that the market is *underperforming* from an overtrade of green bonds of weak sustainability with minimal contribution towards climate targets.

Previous research suggests that green bonds have been priced at a premium relative to conventional bonds (Zerbib, 2019; Ehlers & Packer, 2017; Bauer & Hann, 2010; Oikonomou et al, 2014). This can be linked to pro-environmental preferences among investors – a theory suggesting that investors are willing to accept lower bond yields in return for environmental performance (Zerbib, 2019). Potential explanatory factors are lower perceived risks, intangible asset creation, or pure philanthropic mechanisms (Zerbib, 2019). Bauer & Hann (2010) also find that firms with proactive environmental management benefit from lower costs of debt financing. Oikonomou et al (2014) build on this and find that higher corporate social performance is associated with lower bond yields. However, given the lack of international harmonization of disclosure policies, domestic differences leap the risk of compromising the value of green bond issuances (Ehlers & Packer, 2017). Disharmony in disclosure on climate-related information and sustainability performance create information asymmetries, potentially turning the green bond market into a market for “lemons” as described by Akerlof (1970). Owners of green bonds with strong sustainability will tend to lock in, as they have no incentive to trade their high-quality bonds in a market where information asymmetries are prevalent. As mentioned earlier, high-quality bonds are associated with reduced climate risk, and are thus advantageous to possess. On the contrary, owners of green bonds with weak sustainability, with high climate risk, might trade more frequently in the market given the presence of the “greenium” (Zerbib, 2019, Ehlers & Packer, 2017; Bauer & Hann, 2010; Oikonomou et al, 2014). The risk for information asymmetries in the green bond market creates a strong case for conducting a thorough assessment of the quality of green bonds, specifically analyzing their alignment with climate targets.

3.4. The role of governmental leadership

Building confidence in the green bond market requires transparency and disclosure of green bond activities and impacts. Governments play an important role in establishing requirements on disclosure practices relevant to sustainability. Torvanger et al (2021) conducted a comparative analysis on Norway and Sweden to determine the success factors of green bond markets. They found *governmental leadership* to be one of the main stimulants of the green bond market, suggesting that governments proactively demonstrating meaningful commitments to sustainability have a large impact on the green bond market overall. This indicates that there might be a presence of legitimacy- and institutional-oriented incentives in explaining green bond market success (Maltais & Nykvist, 2020; Torvanger et al, 2021). Sun et al (2019) also look at the role of governmental leadership, utilizing institutional theory to explain how institutional environments shape corporate behavior and strategy. These authors study the effect of government environmental information disclosure on corporate environmentalism and find a positive association between the two (Sun et al, 2019). Government environmental information disclosures are found to promote corporate environmentalism through the following channels: providing support for governmental decision-making regarding environmental governance, building agency among environmental nongovernmental organizations, and promoting participation of civil society in environmental issues (Sun et al, 2019). Access to information on public sector activities comprises the very essence of public sector transparency. If governments are to ensure the efficiency of systems, then

the actors bound by those systems must be made aware of what they entail (OECD, 2003). The most important benefits of public sector transparency are not only associated with attracting foreign investments, but also with enhancing the credibility and accountability of both the corporate and governmental sectors (OECD, 2003).

China has become a widely studied case when it comes to the role of information disclosure in environmental governance (Zhang et al, 2016; Sun et al, 2019; He et al, 2012). In 2008, the policy scheme Environmental Information Disclosure Measures (EIDM) came into force, with the aim to alleviate information asymmetries between actors, gain political credit from the enhancement of governmental transparency, and to improve overall administrative performance (Zhang et al, 2016). Environmental information disclosure on the governmental level has been found to promote green innovation, civil society engagement, and corporate environmentalism (Tan et al, 2022; Zhang et al, 2016; Sun et al, 2019). However, governmental disclosures of environmental information are still lacking in terms of quality, reliability, credibility, and usefulness. It is argued that more verifiable information disclosed by government would advance informational governance on all levels (Zhang et al, 2016). Petrie (2018) expands the debate to a different context, arguing that greater government environmental transparency and accountability in New Zealand would yield better environmental outcomes through the augmentation of ex post national-level environment reporting requirements and implementation of new requirements for ex ante transparency of key environmental goals and targets (Petrie, 2018).

Governmental transparency has a substantial impact on the rest of society. It is therefore important to ensure that governments disclose information in an explicit manner, as it results in enhanced corporate environmentalism, public participation, and green innovations (Sun et al, 2019; Zhang et al, 2016; Tan et al, 2022). The government sets the standard for how other markets behave. The governmental management of sovereign green bonds would thus have a plausible effect on the management of green bonds in other green bond markets downstream. Should sovereign green bonds not be credibly aligned with national climate targets in a transparent manner, then one might expect a similar misalignment in other green bond markets.

4. Data

This study looks at the ten largest sovereign green bond issuers in the EU as of December 31st, 2021. These countries include France, Germany, Italy, Netherlands, Belgium, Spain, Ireland, Poland, Sweden, and Hungary (Statista, 2022). The data on amount issued was compiled by the Climate Bonds Initiative (CBI) for their report “Sustainable Debt: Global State of the Market 2021.” (Climate Bonds Initiative, 2021).

EU countries were chosen due to the fact that sovereign green bond issuances in the EU make up the majority of worldwide issuances. This makes sense because if governments at the frontier of sovereign green bond issuance do not display significant leadership in disclosure practices, it might indicate a more widespread problem in the sovereign green bond market overall. Additionally, solely studying sovereign issuances within the EU facilitates the comparability between the data. The sample size of ten was chosen from a feasibility standpoint, but also due to the sovereign green bond being a fairly new financial instrument resulting in adoption rates still being relatively low.

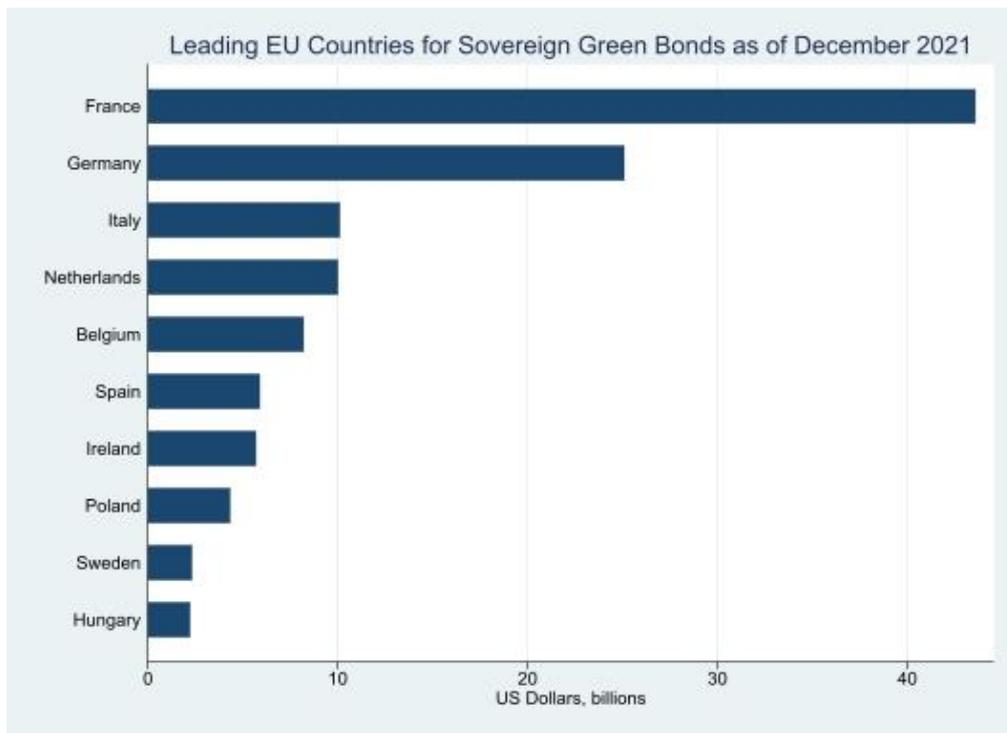


Figure 2. Leading Sovereign Green Bond Issuers in the EU. Source: Statista (2022) and Climate Bonds Initiative (2021).

4.1. Impact reports

The data on impact reports are extracted from primary governmental sources, where the latest available impact report up until 2021 is extracted. Reporting is listed as a core component under the GBP. The reporting component under the GBP state that issuers should make and keep readily up-to-date information on the use of proceeds. It is recommended for these reports to be renewed annually until full allocation (ICMA, 2021). All but one impact report was available for extraction. The sovereign issuer that failed to make their impact report publicly available was Spain. However, Spain is still included in the analysis because failing to make impact reporting publicly available serves as an indication for lacking disclosure, which is a result in itself.

The main advantage with these data is that they are extracted from primary governmental sources. The data thus contain raw information and first-hand evidence open for interpretation. These official documents are issued by national treasuries and ministries, thus enhancing the overall credibility of the data. The sovereign green bond impact reports provide first-hand evidence on the climate impact from the use of proceeds. Validity is thus ensured as the data are deemed appropriate for answering the research question in a satisfactory manner. Given the primary nature of the governmental documents, reliability is also ensured as the data allow for a systematic capturing of the climate-target alignment over time. However, concerns for reliability arise with the desk review applied for this thesis given the prevalent bias of human error. I discuss this further in the method section.

4.2. National climate targets

The national climate targets are obtained from two sources. The first source is each sample issuer's National Energy and Climate Plan (NECP). These plans were introduced by the EU's *Regulation on the governance of the energy union and climate action* (European Commission, n.d.). The government regulation imposed by the EU required all Member States to submit national long-term strategies looking forward to 2050, thereby providing relevant climate targets aligning with the EU objectives under the Paris agreement (European Commission, n.d.). These are thus primary governmental documents with high levels of reliability, as the data allow for a systematic and reproducible extraction of national climate targets over time. The validity of the data is also satisfactory, as the targets stated in the NECP are those subsequently searched for in the sovereign green impact reports.

The second source used for this thesis is the EU's updated submission on its first NDC under the Paris Agreement. These updated submissions are found in the Nationally Determined Contributions Registry, created by the United Nations Framework Convention on Climate Change (UNFCCC). This is in accordance with Article 4, paragraph 12 of the Paris Agreement, where NDCs communicated by Parties are recorded in a public registry supported by the secretariat (UNFCCC, n.d.). EU's updated submission is the second version of its initial NDC, consisting of three parts: the introduction, the updated and enhanced NDC, and the information provided to facilitate clarity and transparency of the NDC. All of the relevant countries' targets can be located in UNFCCC's NDC registry.

The NECP submitted by each sample country is used as the main source for extracting sovereign climate targets, as many national climate targets differ from that of the EU's NDC. For example, Sweden has set 2045 as the target year for achieving carbon neutrality, in contrast to EU's target year of 2050 (Swedish Ministry of Climate and Enterprise, 2021; European Commission, 2020). In this case, Sweden's self-stated targets will be considered. Should no diverging national climate targets be identified, they are instead assumed to be in line with those of the EU NDC.

5. Method

This paper takes a qualitative approach to analyzing the link between sovereign green bonds and respective national climate targets. Specifically, this study is conducted through desk review. Desk-based research is a research method conditional on the material published in reports and other type of documents. The desk review in this study is conducted by thoroughly analyzing sovereign green bond post-issuance impact reports published through 2021. Data on national climate targets are also gathered in a desk-based manner through the processing of NECPs and UNFCCC's NDC Registry, as these data are necessary for the sake of answering the research question.

5.1. Conceptual and theoretical framework

The empirical analysis is guided and facilitated by the conceptual framework on green bonds developed by Tuhkanen & Vulturius (2022), along with the theory of information asymmetries developed by Akerlof (1970).

Tuhkanen & Vulturius (2022) developed and tested their conceptual framework linking green bonds to climate targets, in the context of polycentric climate governance and climate risk management on the corporate level. This conceptual framework builds on the notion that if green bonds are used for demonstrating and signaling commitments to climate change mitigation targets, then green bond frameworks and impact reporting should be linked to climate targets. This thesis aims to apply this conceptual framework to the sovereign level, slightly modified to fit a governmental perspective while also being limited to impact reporting. The modified conceptual framework suggests that if governments issue sovereign green bonds to demonstrate efforts to achieve national climate targets and the 1.5°C goal under the Paris Agreement, then sovereign green bond impact reports should be closely linked to these climate targets. This framework will facilitate and guide the interpretational part of the empirical analysis.

The theory of information asymmetries, i.e., the Lemon Theory, developed by Akerlof (1970) will also facilitate the empirical analysis, particularly in the discussion of results. His theory encapsulates the role of information asymmetries in explaining market performance. It suggests that markets with uncontrolled information asymmetries will perform inferiorly to markets with less information asymmetries, either by becoming illiquid or collapsing altogether. The end result is a market primarily trading lower quality goods. This theory can be applied to the market for green bonds. Should information be asymmetrical, i.e., if climate-target alignment is not disclosed in a transparent manner in the sovereign green bond impact reports, the market will ultimately consist of lower quality sovereign green bonds. Through the application of Akerlof's (1970) Lemon Theory on asymmetrical information, we are better able to draw conclusions from the results obtained in the empirical analysis and understand its implications for the sovereign green bond market overall.

5.2. Qualitative analysis: A desk review

A desk review is applied for this study. The desk review aims to identify core indicators (related to climate-target alignment) in textual data. In a way, it resembles the fundamental ideas behind a content analysis, although not entirely the same. Content analysis has often been used in previous studies to assess information from environmental reports (Landrum & Ohsowski, 2017; Pamoshika et al, 2021). Through conducting content analysis, the researcher takes a qualitative and quantitative approach to examine sources with varying information. This allows for a *systematic* capturing of various themes, concepts, and patterns in qualitative sources, such as written reports. In that sense, the desk-based method utilized for this thesis shares a lot in common with content analysis, since it aims to identify themes and concepts related to climate-target alignment.

5.2.1. Delimitations

However, there are some shortcomings with content analysis which resulted in the desk-based method being deemed superior for the scope of this thesis. Many of the previous studies using content analysis have done so in an automated fashion, using particular software to count the frequency of various keywords (Gill et al, 2008; Landrum & Ohsowski, 2017; Dade & Hassenzahl, 2013). Although these automated content analyses can be useful in assessing the prevalence of particular concepts and ideas in a text by counting the frequency of keywords, they also leap the risk of overlooking valuable information presented in graphs, tables, and images. Another risk with automated content analyses is its limitations in analyzing cross-country data. The green bond impact reports analyzed in this study originate from different countries, posing a significant challenge to systematically identify harmonized definitions and keywords, given the cross-country differences in interpretations. Additionally, given the prevalence of visual aids (graphs, tables, images, etc.) in green bond documents, content analysis was ruled out it tends to overlook this type of information. Lastly, applying automated content analysis and counting the frequency of particular keywords presents considerable challenges to answering the research question in a satisfying manner. Solely extracting the number of times that national climate targets are referred to in sovereign green bond impact reports would be misleading since it ignores the importance of context. Restating national climate targets does not necessarily signal any meaningful alignment between sovereign green bonds and national climate targets. By conducting a more thorough desk review, one is able to take context into consideration while also ensuring that no information was overlooked due to the misspecification or inconsistency of keywords. Context is essential for this study, as the frequency of climate targets alone tells us very little about their link to green bonds. To assess the alignment of sovereign green bonds with national climate targets, other aspects must be considered, such as impact reporting methods, choices of impact indicators, and green bond additionality.

Based on the arguments listed above, a desk review was deemed superior for the scope of this thesis, as it better incorporates the important aspects of context, tables and graphs, cross-country differences in reporting. By deriving a list of core indicators, this desk review aims to identify the connection between sovereign green bond impact reports and national climate targets.

5.2.2. Deriving the core indicators

The analytical desk-based method follows a similar structure to that of Tuhkanen & Vulturius (2022), where core indicators were produced and subsequently identified through a desk review of green bond documents. Incorporating relevant indicators is vital for ensuring efficient communication among stakeholders (Mazzi et al, 2012). For this study, core indicators relevant to the *sovereign* context were derived and subsequently searched for in the sovereign green bond impact reports. These core indicators were derived from a synthesis of sources. The ICMA has published a complementary Climate Transition Finance Handbook, providing guidance on disclosure and climate transition strategies for issuers who wish to finance projects towards the implementation of net zero emissions strategies, aligned with the targets under the Paris Agreement (ICMA, 2020). This Handbook includes suggested information and indicators for ensuring alignment with the climate targets, developed to provide guidance and expectations for participants of debt markets aiming to raise funds for climate-transition related purposes particularly aligning with the attainment of climate targets. Climate Bonds Initiative (CBI) has also

published a set of *transition principles* for issuers wishing to align their bonds with an ambitious, science-based, climate transition (Climate Bonds Initiative, 2021).

Table 2 displays the core indicators which will be utilized for the analysis. These core indicators were primarily derived from the synthesis of ICMA’s Climate Transition Finance Handbook (ICMA, 2020), CBI’s transition principles (Climate Bonds Initiative, 2021), and from the papers by Tuhkanen & Vulturius (2022) and Tolliver et al (2019). This synthesized list of core indicators, listed in Table 2, thus represents a best-practices approach to utilizing green bonds for climate transition finance purposes. Together, they facilitate the operationalization of the main variable essential for this paper – i.e., the alignment of national climate targets and sovereign green bonds.

Basing the analysis on these core indicators allows for a systematic assessment of how sovereign green bonds are proactively utilized for the attainment of national climate targets. Not only is this study attempting to identify national climate targets in green bond impact reports, but it is also attempting to uncover the various courses of action sovereign issuers are taking to achieve those targets. These courses of action ultimately determine the credibility of an issuer’s climate change-related commitments. This is why other core indicators – such as choice of impact indicators, applied method, and share of green bonds financing – are important to incorporate into the analysis, as they provide vital information indicating whether or not a sovereign issuer is credibly positioned to finance the attainment of its national climate targets.

CORE INDICATORS	DESCRIPTION
Long-term target	<p>Long-term target aligned with the goals of the Paris Agreement.</p> <ul style="list-style-type: none"> • e.g., the objective of limiting global warming to 1.5°C and, at the very least, to well below 2°C. • Alternatively, the EU’s NDC for 2050 or own national climate target for 2050.

Interim target	<p>Demonstrating the trajectory towards the long-term target, by setting milestone targets.</p> <ul style="list-style-type: none"> e.g., 2030 targets or similar.
Progress towards target	<p>Quantifiable contribution of green bonds to sovereign issuers' climate targets.</p> <ul style="list-style-type: none"> Informs how sovereign green bond strategy is specifically aimed at achieving national climate targets.
Impact indicators	<p>Disclosure of relevant indicators and units used to measure climate impact of the sovereign green bond.</p> <ul style="list-style-type: none"> e.g., GHG emissions avoided as recommended by the GBP.
Applied method	<p>Disclosed method applied in quantitative determination.</p> <ul style="list-style-type: none"> e.g., disclosure of how an issuer calculates the climate impact of the sovereign green bond.
Share of green bonds financing	<p>Disclosure of how much a particular investment is financed through the sovereign green bond.</p> <ul style="list-style-type: none"> Significantly influences the impact calculations.
Share of refinancing	<p>Disclosure of refinancing schemes.</p> <ul style="list-style-type: none"> i.e., already existing projects versus new projects.
Independent verification	<p>Independent technical review of sovereign issuers' green bond impact reports.</p> <ul style="list-style-type: none"> Verifies the internal tracking and allocation of funds to eligible projects.

Table 2. Core Indicators of Climate Target Alignment.

The desk review consists of assessing each sovereign green bond impact report in the sample of EU countries, by systematically identifying the presence of concepts entailed by each core indicator listed in Table 2. This allows us to determine whether sovereign issuers are proactively using green bonds as a tool for attaining their national climate targets, or if this sovereign debt instrument solely represents an additional risk for greenwashing. The core indicators in Table 2 comprise the following: long-term target, interim target, progress towards target, choice of impact indicators, applied method, share of

green bonds financing, share of refinancing, and independent verification. The synthesis of these indicators represents a proxy for the alignment between management of sovereign green bond proceeds and national climate targets.

The restating of sovereign issuer's long-term target and interim targets demonstrates a sense of proactive awareness of the targets and the issuer's commitment to attain them. All targets and pathways should align with achieving net zero emissions by 2050 and nearly halving the emissions by 2030 if the goals outlined in the Paris Agreement are to be met (Climate Bonds Initiative, 2021). The "progress towards target" indicator looks at whether the issuer reports quantitatively on its use of proceeds in the context of the climate target. For instance – reporting on the quantitative contribution of the proceeds towards the climate target. This is an essential core indicator, as it represents a proactive management of the green bond specifically tailored to attaining the climate targets the issuer has set for itself.

The choice of impact indicators in the measurement of climate impact is also of great importance, as it helps reveal whether or not issuers are reporting in a standardized and science-based manner. If there is a large spread in the use of impact indicators, the marginal contribution of sovereign green bonds to climate targets is then obfuscated and ultimately less meaningful. Additionally, scrutinizing the applied method among issuers and whether it is properly disclosed is important for similar reasons, as it helps us identify whether the climate impact of sovereign green bond proceeds is measured and quantified in a standardized manner. A credible transition is namely characterized by comparable operating metrics, highlighting the importance of disclosed and standardized methods (Climate Bonds Initiative, 2021; Tuhkanen & Vulturius, 2021). If the methods for measuring climate impact differ from one another, or are not disclosed in a satisfactory manner, the ability to interpret impact is marginalized.

Disclosing the share of green bonds financing and the share of refinancing is also essential for accurately assessing the marginal contribution of sovereign green bonds towards the attainment of national climate targets. Reporting on the share of green bonds in total investment is necessary to avoid a scenario where two or more financiers take ownership of the same emissions reductions (Tuhkanen & Vulturius, 2022). Reporting on the share of refinancing is necessary to determine the share of proceeds flowing towards existing projects versus new projects, ultimately allowing for an assessment of the additionality of the green bond. Both these indicators help determine whether or not the sovereign green bonds yield any additional green value to society.

Lastly, the independent verification is an important indicator for assuring harmonized reporting between issuers while also reducing bias.

5.3. Limitations

The reliability of the data could potentially be compromised by the biases arising from conducting desk-based research. These biases mainly relate to human error, i.e., cognitive bias. All researchers are prone to errors and biases, especially in desk-based research relying on judgment and reasoning. Alleviating this bias would require additional inputs and analyses from third-party independent researchers, which lies beyond the scope of this thesis. Instead, the thesis addressed the reliability issue through deriving a synthesized list of simple and unambiguous core indicators, obtained from numerous diverse sources in the climate transition spectrum. These synthesized core indicators facilitate consistency, ensuring a satisfactory level of scientific reproducibility under the same conditions.

This synthesis of core indicators also contributes to enhancing the validity of the data, as they comprise measures that have been produced by a consortium of sources. These include Tuhkanen & Vulturius (2022), ICMA's Climate Transition Finance Handbook (2020), and CBI's transition principles (Climate Bonds Initiative, 2021). The synthesis will produce results that accurately represent what they are supposed to measure, i.e., the alignment between sovereign green bond impact reports and national climate targets. Analyzing the link between impact reporting and national climate targets requires looking at several different aspects. Solely identifying the presence of restated climate targets in impact reports ignores the importance of context, which would negatively affect the validity of this data. In order to answer the broader research question of climate-target alignment, we also need to look at whether the issuer reports on progress towards targets, impact indicators, applied method, share of green

bonds financing, share of refinancing, and independent verification. All these aspects are important to incorporate into the analysis, as they facilitate an understanding of whether sovereign issuers are taking proactive initiatives to utilize green bonds for attaining their national climate targets. They help us answer the question of whether the climate impact from green bond proceeds have been accurately measured, and whether these measures can be used for subsequently assessing the quantitative contribution of sovereign green bonds towards attainment of national climate targets. This in turn will answer the main question of the extent of alignment between sovereign issuers’ climate targets and green bond impact reports. If climate impact is accurately measured and disclosed in impact reports, then we can assume climate-target alignment.

Another limitation relates to the data, and the fact that the issuers in the sample are at the very forefront of sovereign green debt finance. The results could potentially tell us very little about the market as a whole, should the sovereign issuers demonstrate perfect alignment between their impact reporting and climate targets. This thesis is solely guided by the findings of previous studies suggesting significant levels of misalignment between the green bonds and climate targets among leading issuers in the private sector (Tuhkanen & Vulturius, 2022; Tolliver et al, 2019). While perfect alignment is also a result, it would be difficult to extrapolate this finding to the broader market for sovereign green bonds, as selection bias might arise from sampling the top issuers in the EU. On the other hand, given that the sovereign issuances in the EU comprise the majority of worldwide issuances, a considerable share of the sovereign green bond market is thus covered through this sampling decision.

6. Empirical Analysis

6.1. Results

The following section describes and analyzes the findings of the study, with the aim to gain valuable insight into the alignment of climate targets in sovereign green bond impact reporting procedures. The main results are presented in Figure 3 and Table 3. These display the prevalence of core indicators identified in the sovereign green bond impact reports published by each sample issuer. Figure 3 presents the results quantitatively, without specifying issuer-specific details. Table 3 provides more detailed issuer-specific findings.

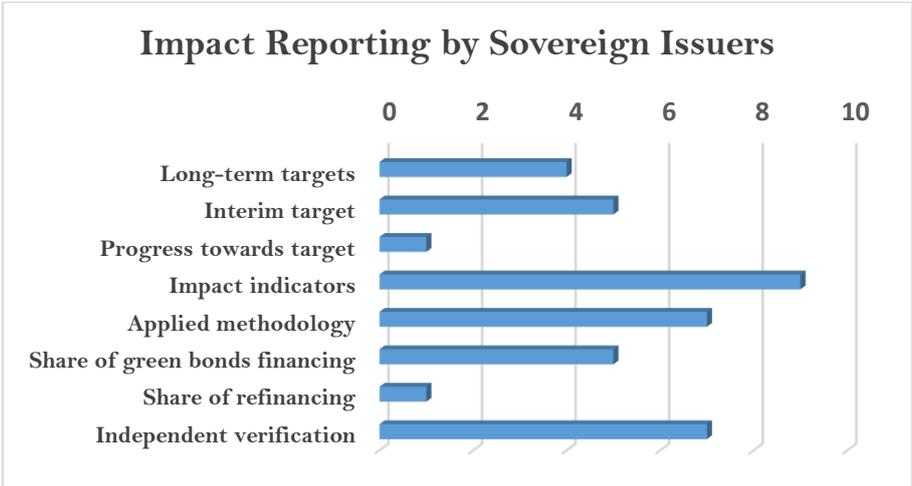


Figure 3. Analysis of Core Indicators in Sovereign Green Bond Impact Reports.

6.1.2. Climate targets in impact reports

First, the impact reports were examined to identify evidence of links to the national targets. This was done by assessing whether targets were explicitly restated by the sovereign issuer in the report. Figure 3 and Table 3 show that only four out of ten sovereign issuers explicitly restated their long-term targets

in their impact reports. These issuers include France, Germany, Sweden, and Hungary. The long-term targets explicitly restated in the reports all involve carbon neutrality, either by 2045 or 2050.

Interim targets were only restated by five issuers. These include France, Germany, Netherlands, Belgium, and Sweden. A majority of these interim targets were milestone targets for 2030. Some of the issuers solely restated a 2030 target, while others restated additional interim targets for 2020, 2035, and 2040. As is also seen in Table 1 in the context section, the sovereign issuers use different benchmarks when restating their targets in the impact reports, ranging from 1990 to 2015.

Only one sovereign issuer – Sweden – reported on progress towards its target, stating the quantifiable contribution of its sovereign green bond proceeds with respect to the overarching national climate target. Specifically, Sweden reported on the emissions reductions impact of a project funded by the green bond in the context of broader national emissions levels, thus demonstrating a quantifiable marginal contribution of green bond proceeds towards the attainment of its national climate targets.

“The annual reduction in emissions corresponds to around 4 per cent of Sweden’s total emissions.” – (Swedish National Debt Office, 2021, pp. 12)

6.1.3. Impact indicators and applied method

The impact reports were then examined to identify the use of relevant impact indicators and the disclosure of impact methods. Figure 3 and Table 3 show that nine out of the ten sovereign issuers provided relevant impact indicators to measure climate impact. Impact indicators relevant to climate targets are mainly stated in tonnes of CO₂ equivalents avoided or GWh of renewable energy produced, as recommended by the GBP (2020). The issuer that failed to provide relevant impact indicators was Spain. As mentioned earlier, Spain has not made its impact report publicly available. This sovereign issuer is still included in the sample, however, and is thus assumed to disclose *none* of the core indicators.

The results presented in Figure 3 and Table 3 also show that solely seven out of the ten sovereign issuers disclosed the applied method they used to calculate climate impact. Most of the issuers that disclosed information about their applied method had used a counterfactual scenario to calculate avoided emissions. The three issuers that did not disclose their method to their impact assessment include Germany, Spain, and Ireland. Germany solely referred to external links when discussing the method for deriving the emissions avoided. Ireland referred to a specific software used to calculate emissions for one project only, without going further into detail. There is also significant variation in the methods that sovereign issuers utilize when measuring avoided greenhouse gas emissions. Many of these methods were developed internally by each sovereign issuer.

6.1.4. Share of green bond financing and refinancing

The presence of core indicators relating to share of green bond financing and refinancing were then analyzed in the impact reports. Figure 3 and Table 3 show that solely five out of the ten sovereign issuers to incorporate the share of green bond financing into their impact assessment. This indicator essentially analyzes whether the issuer is considering the share of green bond financing in relation to total investment when calculating the avoided greenhouse gas emissions. This clarifies the green value attribution and additionality of emissions reductions to green bond financing in cases where projects are partly owned by other investors. The issuers that successfully incorporated this into their impact assessment were Germany, Netherlands, Belgium, Ireland, and Hungary. For instance, Germany addressed this issue of shared financing by reporting the emissions avoided *weighted* by its relative share of the project. The rest of the sovereign issuers that reported on the share of green bond financing had done so in a similar fashion.

Of the ten sovereign issuers, only one reported on the share of refinancing, i.e., the share of funding towards new versus existing projects. The sole issuer that addressed this important aspect was Poland,

explicitly stating the percentage of proceeds spent on refinancing projects versus the percentage spent on newly launched projects.

“About 34% of the proceeds was spent on refinancing projects initiated in 2018. The remaining 66% was allocated to new projects launched in 2019.” – (Polish Ministry of Finance, 2019, pp. 4)

6.1.5. Independent verification

Lastly, the prevalence of independent verification of the impact reports was examined. Figure 3 and Table 3 reveal that seven out of the ten sovereign issuers had their impact reports externally reviewed by an independent verifier. These independent verifications are mandated by the CBI and recommended by the GBP, allowing for a technical review of the internal tracking, allocation of funds, and impact assessments, with the aim to ensure minimal bias in the impact calculations. Table 3 shows the names of the independent verifiers. The issuers that failed to provide evidence of independent verification were Spain, Poland, and Hungary. These impact reports provided no assurance that they had been externally reviewed by an independent entity to ensure that impact assessments, such as calculating avoided emissions, were executed in an unbiased manner. Additionally, Sweden and Belgium go into minimal level of detail when describing how their impact assessments were reviewed by a third party. Sweden solely states an independent verifier for their green bond framework, and mention SEB as a strategic advisor for the reporting. Belgium solely states that an Independent Committee gave independent advice and reviewed its impact methods, without going further into detail.

Sovereign Issuer	Long-term target	Interim target	Progress towards target	Impact indicators	Applied method	Share of green bonds financing	Share of refinancing	Independent verification
France	Carbon neutral by 2050	33% by 2030*	N/A	tCO ₂ -e avoided	Counterfactual scenario + emissions factors***	N/A	N/A	Moody's ESG Solutions
Germany	Carbon neutral by 2045	65% by 2030**	N/A	tCO ₂ -e avoided per annum	N/A	Yes	N/A	Deloitte
Italy	N/A	N/A	N/A	tCO ₂ -e avoided per annum	Counterfactual scenario + internal emissions factors***	N/A	N/A	ISS ESG
Netherlands	N/A	49% by 2030**	N/A	mtCO ₂ -e avoided	Conversion of generated energy to avoided emissions***	Yes	N/A	Sustainalytics
Belgium	N/A	40% by 2030**	N/A	ktCO ₂ -e avoided	Counterfactual scenario + internal emissions factors***	Yes	N/A	Independent Committee
Spain	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ireland	N/A	N/A	N/A	ktCO ₂ -e avoided per annum	DEAP 4.2 Software (N/A)***	Yes	N/A	Sustainalytics
Poland	N/A	N/A	N/A	ktCO ₂ -e avoided per annum	Basic hypothetical assumptions***	N/A	Yes	N/A
Sweden	Climate neutral by 2045	63% by 2030**	Yes	tCO ₂ -e avoided per annum	Counterfactual scenario + emissions factors***	N/A	N/A	CICERO
Hungary	Climate neutral by 2050	N/A	N/A	ktCO ₂ -e avoided	Counterfactual scenario + emissions factors***	Yes	N/A	N/A

Table 3. Issuer-Specific Analysis of Core Indicators in Impact Reports.

*2015 benchmark

**1990 benchmark

***using internal calculations

7. Discussion

7.1. Dissonance between national climate targets and sovereign impact reports

The conceptual framework, modified for this study, states the following: if governments issue sovereign green bonds to demonstrate efforts to attain their national climate targets and the 1.5°C goal under the Paris Agreement, then sovereign green bond impact reports should be closely aligned with these climate targets. Should sovereign green debt financing be utilized as a strategic tool for achieving national climate targets, then those targets would be heavily represented in impact reporting. As is implied by the results, only four out of ten issuers have restated their long-term targets, five out of ten have restated their interim targets, and a staggering one out of ten has attempted to quantitatively assess the marginal contribution and progress of its sovereign green bond towards attaining its national climate targets. 50% or less of the issuers restated their long-term and interim climate targets and solely 10% of the issuers report on progress *in the context* of their overall climate targets.

The results thus suggest there to be a limited connection between sovereign green bonds and national climate targets. Although a majority of the proceeds from the sovereign green bonds are allocated towards emissions-reducing projects and activities, sovereign issuers do not use their green bond impact reports to disclose *explicit* connections between green debt financing and national climate targets. These findings are in line with those of Tuhkanen & Vulturius (2022) and Tolliver et al (2019), who studied the role of corporate green bonds in advancing the sustainability transition. The fact that governments do not demonstrate a clear connection between their sovereign green bonds and national climate targets could potentially explain the findings of Tuhkanen & Vulturius (2022) and Tolliver et al (2019), given the substantial impact of governmental environmental transparency on the rest of society (Sun et al, 2019; Zhang et al, 2016; Tan et al, 2022).

7.2. Lack of transparent and harmonized impact methods

Almost all the sovereign green bond issuers used relevant impact indicators to assess the climate impact of the proceeds. These impact indicators all comprised some units of avoided greenhouse gas emissions. However, the methods for deriving these figures differ significantly among the issuers. This particular shortcoming is also identified in previous studies, suggesting the need for green bond markets to initiate a common language in order to become a financial catalyst for systemic change (Tuhkanen & Vulturius, 2022; Tolliver et al, 2019). The methods disclosed by the sovereign issuers in the sample were developed internally within each country, using nationally determined emissions factors to calculate avoided emissions relative to a counterfactual scenario. This heterogeneity in impact methods raises some concern for transparency and comparability between sovereign green bond impact reports. Literature suggests that the fundamental contribution from green bonds lies in the procedure of disclosure practices regarding climate-related information, and that the lack of standardized and comparable formatting poses the biggest challenge for future success of the green bond market (Forsbacka & Vulturius, 2019; Andersson et al, 2017).

A lack of comparability implies a lack of credibility. Information asymmetries become inevitable as long as methods for calculating climate impact remain heterogeneous. This poses a risk for the credibility of the sovereign green bond market as a whole. By applying Akerlof's (1970) Lemon Theory, we assume that green bonds of weaker sustainability are traded more frequently, i.e., those whose climate impact have been calculated in an unscientific manner. As long as the market allows for information asymmetries, resulting from disharmonized methods, there are no sufficient incentives for issuers to incur the additional costs of undertaking complex, standardized, and science-based methods. Returning to the literature on governmental transparency in fostering corporate environmentalism and public participation (Sun et al, 2019; Zhang et al), the results in Table 3 suggest that a lack of harmonized impact methods among sovereign issuers leads to minimal incentives for adopting responsible disclosure practices at the corporate level as well. The lack of transparent and comparable reporting, as implied by Table 3, ultimately fails to minimize the risk of greenwashing, thus hindering future scaling of the sovereign green bond market (Forsbacka & Vulturius, 2019).

7.3. The additionality of green bonds

Given that only five out of ten issuers addressed the share of green bond financing, and only one out of ten issuers addressed the share of refinancing, it becomes extremely difficult to attribute an *additional* green value to sovereign green bond financing. The lack of reporting on project co-ownership, and share of financing towards new versus existing projects, poses a challenge for accurately assessing and calculating direct climate impact of sovereign green bonds. It is therefore important for issuers to differentiate between projects that would have happened either way and those that would not have happened in absence of the sovereign green bond. Issuers in this study's sample suffer from the same shortcoming, in the sense that differentiation does not take place among a majority of the sample. This is in line with the findings of Tolliver et al (2019) and Tuhkanen & Vulturius (2022), who also found issuers to fall short in providing vital information on additional versus non-additional impacts. The lack of harmonized impact methods mentioned earlier also presents an obstacle to attributing reported avoided emissions to sovereign green bond financing.

Once again, this is a case of information asymmetry, where the issuer sits on more information than the investor regarding additional climate impact. The ability to distinguish high quality from low is thus marginalized, ultimately causing the market to underperform as sovereign issuers of low-quality green bonds are able to trade on the market for high quality (Akerlof, 1970).

7.4. Leadership in issuance is not indicative of leadership in disclosure

The results displayed in Figure 3 and Table 3 suggest a weak link between sovereign green bonds and national climate targets. The issuers selected for this study are at the forefront of sovereign green debt finance (Statista, 2022; Climate Bonds Initiative, 2021). Intuitively, one would assume leadership in sovereign green bond issuance to translate into high levels of climate ambition. The shortcomings in disclosure practices, relating to inconsistent restatements of climate targets, disharmonized impact methods, and the opaque disclosures of green bond additionalities, suggest that leadership in sovereign green debt finance does not go hand-in-hand with responsible reporting practices. Sovereign green bond issuances in the EU make up a majority of worldwide issuances. The results thus imply that a majority of worldwide issuances are lacking in their alignment with national climate targets and the objectives under the Paris Agreement.

7.5. Implications for the market and policy recommendation

The green bond is considered as one of the most important financial innovations to align financial flows with lowered greenhouse gas emissions. The findings from this study identify considerable shortcomings in the sovereign green bond's potential to align financial flows with the attainment of national climate targets. The main issue arises from the lack of harmonized reporting – issuers do not meaningfully communicate the true impact of investments. This poses a serious obstacle for future market potential. Given that four out of ten state their long-term targets, five out of ten state their interim targets, and one out of ten stated its progress towards the target, there is little evidence suggesting that sovereign issuers are proactively utilizing their green bonds for attaining these targets. Comparability and harmonization are further aggravated by the lack of standardized methods, and the lack of reporting on share of refinancing and green bond financing. The EU is making strides to ensure a higher level of comparability and harmonization in the green bond market through its Green Bond Standard (GBS) proposal (European Parliament, 2023). Tuhkanen & Vulturius (2022) view this as a crucial step for ensuring future green bond market success as the GBS aims to establish a system of metrics and thresholds fully aligned with the new EU taxonomy of sustainable economic activities. The proposed GBS would also be key component in alleviating information asymmetries, which according to Akerlof's (1970) Lemon Theory would result in a stronger market with higher-quality products being traded, i.e., sovereign green bonds with strong sustainability. It is particularly important for sovereign issuers to be at the forefront of this change, given the vital role of governmental leadership in ensuring future green bond market success (Tolliver et al, 2019, Maltais & Nykvist, 2020).

The evidence derived from this study calls for some policy recommendations. Sovereign issuers, as well as all other issuers, should be forced to disclose information on how their proceeds explicitly finance the attainment of climate targets. This policy recommendation involves establishing a stringent set of harmonized and comparable impact methods to minimize the risks of greenwashing. This is in line with the findings of Baldi & Pandimiglio (2022), who found sovereign issuers to be especially prone to greenwashing given the lack of science-based monitoring practices. By compelling issuers to report explicitly on the contribution of green bonds to attaining climate targets, this set of stringent policies can also reduce information asymmetries between issuers and investors, ultimately ensuring that higher-quality green bonds are being traded on the market. These policies would most likely raise the transactional costs of issuing sovereign green bonds, representing another significant problem that unfortunately lies beyond the scope of this study.

8. Conclusion

The fight against climate change has reached a critical point, and to meet the ambitious climate targets we have set for ourselves, financial flows must align with reduced greenhouse gas emissions and climate-resilient pathways. This thesis sheds light on this alignment, specifically examining the connection between sovereign green bonds and national climate targets. While previous research has approached this issue from a corporate perspective, this paper expands the discussion by taking a sovereign perspective. This is justified by evidence suggesting that sustainability disclosure practices by governments have a significant impact on society as a whole.

This thesis asked the following research question: to what extent are sovereign issuers' climate targets linked to their sovereign green bond impact reports? This is a broad question, hence the need to break it down into a series of sub-questions, relating to restatement of climate targets, reporting on progress towards target, use of impact indicators, applied method, green bond additionality, and independent verification. These sub-questions were essential to answer the research question in a holistic and satisfactory manner. In conclusion, my findings suggest a weak link between sovereign green bonds and national climate targets. The conclusion drawn is based on a number of factors. First, there is a lack of climate target restatements in sovereign issuers' impact reports, and close to zero reporting on progress towards target. Second, the applied methods for calculating climate impact vary significantly among issuers, as all the methods have been internally developed in each country. Third, there is a lack of reporting on green bond additionality, i.e., whether the sovereign green bonds can be quantifiably attributed to any added green value. The overarching issue common to all findings relate to the lack of transparency and harmonization in disclosure practices.

These findings thus reject Tuhkanen & Vulturius' (2022) conceptual framework modified for this thesis, suggesting that sovereign green bond impact reports should closely align with national climate targets if governments issue sovereign green bonds to demonstrate efforts to attain their targets and the 1.5°C goal under the Paris Agreement. These findings also suggest a prevalence of information asymmetries in the sovereign green bond market. And through applying Akerlof's (1970) Lemon Theory on information asymmetries, we can conclude that the market is underperforming as bonds of weaker sustainability will be traded more frequently than those of stronger sustainability.

More research is undoubtedly needed to further understand the alignment between green bonds and their contribution to the attainment of climate targets. If financial flows are to be aligned with climate-neutral pathways, international capital markets must accelerate efforts to develop a more stringent, transparent, and universal standard on how debt instruments such as the green bond ought to be utilized for the climate transition.

9. Reference List

- Agence France Trésor. (2021). Green OATs: Allocation and Performance Report [pdf], *Agence France Trésor*, Available online: https://www.aft.gouv.fr/files/medias-aft/3_Dette/3.2_OATMLT/3.2.2_OATVerte/OAT_2021_FINAL_WEB_ENG.pdf, [Accessed 21 April, 2023].
- Agence France Trésor. (2021). Investments for the Future Programme (PIA) [pdf], *Agence France Trésor*, Available online: https://www.aft.gouv.fr/files/medias-aft/3_Dette/3.2_OATMLT/3.2.2_OATVerte/Invest%20for%20the%20Future%20-%20FULL_Impact%20evaluation%20report.pdf, [Accessed 21 April, 2023].
- Agence France Trésor. (n.d.). Green OATs, *Agence France Trésor*, Available online: <https://www.aft.gouv.fr/en/green-oat>, [Accessed 17 April, 2023].
- Akerlof, G.A. (1970). The Market for “Lemons”: Quality Uncertainty and the Market Mechanism, *The Quarterly Journal of Economics*, vol. 84, no. 3, pp. 488-500.
- Államadósság Kezelő Központ. (2021). Hungary Green Bond Impact Report 2020 [pdf], *Államadósság Kezelő Központ*, Available online: <https://www.akk.hu/download?path=21dcb526-74eb-40c9-914a-9119b8e1d8e1.pdf>, [Accessed 21 April, 2023].
- Államadósság Kezelő Központ. (2021). Recognition for Hungary’s Green Bonds, *Államadósság Kezelő Központ*, Available online: <https://akk.hu/content/path=CBIaward21>, [Accessed 17 April, 2023].
- Andersson, M., Fast, D., Johansson, N., Larsson Klevhill, M. (2017). Att främja gröna obligationer [pdf], Available online: <https://www.regeringen.se/contentassets/7768eb2b8d7c45eb9d8d36bd85a0b293/att-framja-grona-obligationer-hela-dokumentet-sou-2017115.pdf.pdf>, [Accessed 3 February, 2023].
- Baldi, F., Pandimiglio, A. (2022). The role of ESG scoring and greenwashing risk in explaining the yields of green bonds: A conceptual framework and an econometric analysis, *Global Finance Journal*, vol. 52.
- Bauer, R., Hann, D. (2010). Corporate Environmental Management and Credit Risk [pdf], *European Centre for Corporate Engagement (ECCE)*, Available online: <https://haas.berkeley.edu/wp-content/uploads/BauerHaan.pdf>, [Accessed 5 April, 2023].
- Belgian Debt Agency. (n.d.). Green OLO, *Belgian Debt Agency*, Available online: <https://www.debtagency.be/en/green-olo>, [Accessed 17 April, 2023].
- Belgian Debt Agency. (2018). Green OLO Impact Report 2018 [pdf], *Belgian Debt Agency*, Available online: https://www.debtagency.be/sites/default/files/content/download/files/green_olo_-_impact_report_2018_0.pdf, [Accessed 21 April, 2023].
- Belgian Consultation Committee. (2020). Belgian Integrated National Energy and Climate Plan 2021-2030: Section A [pdf], Available online: https://energy.ec.europa.eu/system/files/2020-09/be_final_necp_parta_en_0.pdf, [Accessed 14 April, 2023].
- Belgian Consultation Committee. (2020). Belgian Integrated National Energy and Climate Plan 2021-2030: Section B [pdf], Available online: https://energy.ec.europa.eu/system/files/2020-09/be_final_necp_parta_en_0.pdf, [Accessed 14 April, 2023].
- Climate Bonds Initiative. (2023). Green Bond Principles & Climate Bond Standard, *Climate Bonds Initiative*, Available online: <https://www.climatebonds.net/market/best-practice-guidelines#:~:text=Voluntary%20best%20practice%20guidelines%20called,%2C%20HSBC%2C%20Mizuho%20Securities%2C%20Morgan>, [Accessed 3 January, 2023].

- Climate Bonds Initiative. (n.d.). Netherlands Sovereign Green Bond, *Climate Bonds Initiative*, https://www.climatebonds.net/certification/netherlands_sovereign, [Accessed 17 April, 2023].
- Crédit Agricole. (2021). Spain Launches Its First Ever Green Bond, *Crédit Agricole*, Available online: <https://www.ca-cib.com/pressroom/news/spain-launches-its-first-ever-green-bond>, [Accessed 17 April, 2023].
- Dell'Atti, S., Di Tommaso, C., Pacelli, V. (2022). Sovereign green bond and country value and risk: Evidence from European Union countries, *Journal of International Financial Management & Accounting*, vol. 33, no. 3, pp. 505-521.
- Department of Communications, Climate Action & Environment. (2020). National Energy & Climate Plan: 2021-2030 [pdf], *European Commission*, Available online: https://energy.ec.europa.eu/system/files/2020-08/ie_final_necp_main_en_0.pdf, [Accessed 14 April, 2023].
- Dutch State Treasury Agency. (2022). State of the Netherlands: Green Bond Report [pdf], *Ministry of Finance*, Available online: <https://english.dsta.nl/subjects/green-bonds/documents/publication/2022/05/27/green-bond-report>, [Accessed 21 April, 2023].
- Ehlers, T., Mojon, B., Packer, F. (2020). Green bonds and carbon emissions: exploring the case for a rating system at the firm level, *BIS Quarterly Review*, pp. 31-45.
- Ehlers, T., Packer, F. (2017). Green bond finance and certification, *BIS Quarterly Review*, pp. 89-101.
- Federal Ministry for Economic Affairs and Climate Action. (2020). Integrated National Energy and Climate Plan [pdf], *European Commission*, Available online: https://energy.ec.europa.eu/system/files/2022-08/de_final_necp_main_en.pdf, [Accessed 14 April, 2023].
- Federal Ministry of Finance. (2023). Green federal securities, Available online: <https://www.bundesfinanzministerium.de/Content/EN/Standardartikel/Topics/Priority-Issues/Climate-Action/green-german-federal-securities-restricted/green-german-federal-securities.html>, [Accessed 17 April, 2023].
- Federal Ministry of Finance. (2020). Green bond impact report [pdf], Available online: https://www.bundesfinanzministerium.de/Content/EN/Standardartikel/Topics/Priority-Issues/Climate-Action/green-german-federal-securities-restricted/green-bond-impact-report-2020.pdf?__blob=publicationFile&v=2, [Accessed 21 April, 2023].
- Flammer, C. (2013). Corporate Social Responsibility and Shareholder Reaction: The Environmental Awareness of Investors, *Academy of Management Journal*, vol. 56, no. 3, pp. 758-781.
- Forsbacka, K., Vulturius, G. (2019). A Legal Analysis of Terms and Conditions for Green Bonds: Focus on the Financial Markets in the Nordics, *Europarättslig Tidskrift*, vol. 3, pp. 397-442.
- Gill, D., Dickinson, S., Scharl, A. (2008). Communicating Sustainability: A Web Content Analysis of North American, European and Asian Firms, *Journal of Communication Management*, vol. 12, no. 3, pp. 243-262.
- Gond, J.P., Piani, V. (2012). Enabling Institutional Investors' Collective Action: The Role of the Principles for Responsible Investment Initiative, *Business & Society*, vol. 52, no. 1, pp. 64-104.
- Government of France. (2020). Integrated National Energy and Climate Plan for France [pdf], *European Commission*, Available online: https://energy.ec.europa.eu/system/files/2022-08/fr_final_necp_main_en.pdf, [Accessed 14 April, 2023].
- Government of Spain. (2020). Integrated National Energy and Climate Plan 2021-2030 [pdf], *European Commission*, Available online: https://energy.ec.europa.eu/system/files/2020-06/es_final_necp_main_en_0.pdf, [Accessed 14 April, 2023].
- Hyun, S., Park, D., Tian, S. (2020). The price of going green: The role of greenness in green bond markets, *Accounting and Finance*, vol. 60, pp. 73-95.

- ICMA. (2020). Climate Transition Finance Handbook: Guidance for Issuers [pdf], *ICMA*, Available online: <https://www.icmagroup.org/assets/documents/Regulatory/Green-Bonds/Climate-Transition-Finance-Handbook-December-2020-091220.pdf>, [Accessed 11 April, 2023].
- ICMA. (2021). Green Bond Principles: Voluntary Process Guidelines for Issuing Green Bonds [pdf], *ICMA*, Available online: https://www.icmagroup.org/assets/documents/Sustainable-finance/2022-updates/Green-Bond-Principles_June-2022-280622.pdf, [Accessed 10 April, 2023].
- ISGB Working Group. (2020). Eligible Green Projects Impact Report 2020 [pdf], *Government of Ireland*, Available online: <https://www.ntma.ie/uploads/publication-articles/ISGB-EligibleGreenProjects-Impact-Report-2020-Final.pdf>, [Accessed 21 April, 2023].
- Kim, S., Yoon, A. (2022). Analyzing Active Fund Managers' Commitment to ESG: Evidence from the United Nations Principles for Responsible Investment, vol. 69, no. 2, pp. 741-758.
- Landrum, N.E., Ohsowski, B. (2017). Identifying Worldviews on Corporate Sustainability: A Content Analysis of Corporate Sustainability Reports, *Business Strategy and the Environment*, vol. 27, no. 1, pp. 128-151.
- Lupo-Pasini, F. (2022). Sustainable Finance and Sovereign Debt: The Illusion to Govern by Contract, *Journal of International Economic Law*, vol. 25, no. 4, pp. 680-698.
- MacAskill, S., Roca, E., Liu, B., Stewart, R. (2021). Is there a green premium in the green bond market? Systematic literature review revealing premium determinants, *Journal of Cleaner Production*, vol. 280.
- Majoch, A.A.A., Hoepner, A.G.F., Hebb, T. (2017). Sources of Stakeholder Salience in the Responsible Investment Movement: Why Do Investors Sign the Principles for Responsible Investment? *Journal of Business Ethics*, vol. 140, pp. 723-741.
- Mazzi, A., Mason, C., Mason, M., Scipioni, A. (2012). Is it possible to compare environmental performance indicators reported by public administrations? Results from an Italian survey, *Ecological Indicators*, vol. 23, pp. 653-659.
- Minister Aktywów Państwowych. (2020). Executive Summary of Poland's National Energy and Climate Plan for the Years 2021-2030 [pdf], *European Commission*, Available online: https://energy.ec.europa.eu/system/files/2020-01/pl_final_necp_summary_en_0.pdf, [Accessed 14 April, 2023].
- Ministry of Economic Affairs and Climate Policy. (2020). Integrated National Energy and Climate Plan 2021-2030: The Netherlands [pdf], *European Commission*, Available online: https://energy.ec.europa.eu/system/files/2020-03/nl_final_necp_main_en_0.pdf, [Accessed 14 April, 2023].
- Ministry of Economic Development, Ministry of the Environment and Protection of Natural Resources and the Sea, Ministry of Infrastructure and Transport. (2020). Integrated National Energy and Climate Plan [pdf], *European Commission*, Available online: https://energy.ec.europa.eu/system/files/2020-02/it_final_necp_main_en_0.pdf, [Accessed 14 April, 2023].
- Ministry of Economy and Finance. (2022). 2022 BTP Green Allocation and Impact Report [pdf], Available online: https://www.mef.gov.it/ufficio-stampa/comunicati/2022/documenti/2022-Allocation-Impact-Report-Italy-Sov-Green-Bond-12_05_2022_ENG_FINAL_....pdf/, [Accessed 21 April, 2023].
- Ministry of Economy and Finance. (2021). Btp Green, the new sovereign bond to finance Italy's ecological transition, Available online: <https://www.mef.gov.it/en/focus/Btp-Green-the-new-sovereign-bond-to-finance-Italys-ecological-transition-00001/>, [Accessed 17 April, 2023].
- Ministry of Finance. (2020). Green Bond Report on the Use of Proceeds [pdf], *Polish Ministry of Finance*, Available online: <https://www.gov.pl/web/finance/issues-international-bonds>, [Accessed 21 April, 2023].

- Ministry of Finance. (n.d.). Issues, *Polish Ministry of Finance*, Available online: <https://www.gov.pl/web/finance/issues-international-bonds>, [Accessed 17 April, 2023].
- Ministry of Infrastructure. (2020). Sweden's Integrated National Energy and Climate Plan [pdf], *European Commission*, Available online: https://energy.ec.europa.eu/system/files/2020-03/se_final_necp_main_en_0.pdf, [Accessed 14 April, 2023].
- Ministry of Innovation and Technology. (2020). National Energy and Climate Plan [pdf], *Hungarian European Commission*, Available online: https://energy.ec.europa.eu/system/files/2022-08/hu_final_necp_main_en.pdf, [Accessed 14 April, 2023].
- Nanayakkara, K.G.M., Colombage, S. (2020). Does compliance with Green Bond Principles bring any benefit to make G20's 'Green economy plan' a reality? *Accounting & Finance*, vol. 61, no. 3, pp. 4257-4285.
- National Treasury Management Agency. (2023). Ireland raises €3.5 billion from the sale of a new 20-year green bond, *National Treasury Management Agency*, Available online: <https://www.ntma.ie/news/ireland-raises-3-5-billion-from-the-sale-of-a-new-20-year-green-bond>, [Accessed 17 April, 2023].
- OECD. (2015). Green bonds: Mobilising the debt capital markets for a low-carbon transition [pdf], *Bloomberg Philanthropies*, Available online: <https://www.oecd.org/environment/cc/Green%20bonds%20PP%20%5Bf3%5D%20%5Blr%5D.pdf>, [Accessed 14 January, 2023].
- OECD. (2003). Public Sector Transparency and the International Investor [pdf], *OECD Committee on International Investment and Multinational Enterprises*, Available online: <https://www.oecd.org/investment/investment-policy/18546790.pdf>, [Accessed 13 April, 2023].
- Oikonomou, I., Brooks, C., Pavelin, S. (2014). The Effects of Corporate Social Performance on the Cost of Corporate Debt and Credit Ratings, *The Financial Review*, vol. 49, no. 1, pp. 49-75.
- Partridge, C.; Medda, F.R. (2020) The evolution of pricing performance of green municipal bonds. *Journal of Sustainable Finance and Investment*, vol. 10, no. 1, pp. 44–64.
- Sangiorgi, I., Schopohl, L. (2021). Why do institutional investors buy green bonds: Evidence from a survey of European asset managers, *International Review of Financial Analysis*, vol. 75.
- Spinaci, S. (2023). Establishment of an EU Green Bond Standard In "An Economy that Works for People," *European Parliament*, Available online: <https://www.europarl.europa.eu/legislative-train/theme-an-economy-that-works-for-people/file-eu-green-bond-standard#:~:text=The%20EU%20GBS%20will%20set,and%20protecting%20investors%20from%20greenwashing>, [Accessed 14 January, 2023].
- Statista Research Department. (2022). Leading countries for sovereign green bonds worldwide 2021, *Statista*, Available online: <https://www.statista.com/statistics/1292595/leading-countries-for-sovereign-green-bonds-worldwide/#:~:text=As%20of%20December%2031%2C%202021,approximately%2043.6%20billion%20U.S.%20dollars>, [Accessed 26 December, 2022].
- Sun, D., Zeng, S., Chen, H., Meng, X., Jin, Z. (2019). Monitoring the effect of transparency: How does government environmental disclosure facilitate corporate environmentalism? *Business Strategy and the Environment*, vol. 28, no. 8, pp. 1594-1607.
- Swedish National Debt Office. (2021). Debt Office publishes report on Sweden's sovereign green bond, *Swedish National Debt Office*, Available online: <https://www.riksgalden.se/en/press-and-publications/press-releases-and-news/press-releases/2021/debt-office-publishes-report-on-swedens-sovereign-green-bond/#:~:text=In%20June%202020%2C%20the%20Government,%2C%20selected%2C%20presented%20and%20reported>, [Accessed 17 April, 2023].
- Swedish National Debt Office. (2021). Green Bond Investor Report 2021 [pdf], *Swedish National Debt Office*, Available online:

<https://www.riksgalden.se/contentassets/c17362da31174c27b662ba9290b6827a/green-bond-investor-report-2021.pdf> [Accessed 21 April, 2023].

- Tan, X., Peng, M., Yin, J., Xiu, Z. (2022). Does Local Governments' Environmental Information Disclosure Promote Corporate Green Innovations, *Emerging Markets Finance and Trade*, vol. 58, no. 11, pp. 3164-3176.
- Tolliver, C., Ryota Keeley, A., Managi, S. (2019). Green bonds for the Paris agreement and sustainable development goals, *Environmental Research Letters*, vol. 14.
- Torvanger, A., Maltais, A., Marginean, I. (2021). Green bonds in Sweden and Norway: What are the success factors? *Journal of Cleaner Production*, vol. 324, no. 15.
- Tuhkanen, H., Vulturius, G. (2022). Are green bonds funding the transition? Investigating the link between companies' climate targets and green debt financing, *Journal of Sustainable Finance and Investment*, vol. 12, no. 4, pp. 1194-1216.
- United Nations Framework Convention on Climate Change. (n.d.). The Paris Agreement, *UNFCCC*, Available online: <https://unfccc.int/process-and-meetings/the-paris-agreement>, [Accessed 4 April, 2023].
- United Nations Framework Convention on Climate Change. (n.d.). NDC Registry, *UNFCCC*, Available online: <https://unfccc.int/NDCREG>, [Accessed 1 April, 2023].
- Wiśniewski, M., Zieliński, J. (2019). Green bonds as an innovative sovereign financial instrument, *Ekonomia i Prawo*, vol. 18, no. 1, pp. 83-96.
- Zerbib, O.D. (2019). The effect of pro-environmental preferences on bond prices: Evidence from green bonds, *Journal of Banking and Finance*, vol. 98, no. C, pp. 39–60.
- Zhang, L., Mol, A.P.J., He, G. (2016). Transparency and information disclosure in China's environmental governance, *Current Opinion in Environmental Sustainability*, vol. 18, pp. 17-24.