

Green Bond Impact Report as an Essential Next Step in Market Development*

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The measurement of the environmental impact of green bonds, its reliability and the publication of measurement results are crucial for the transparent functioning of the market and supporting investor decisions. However, this segment of the financial markets is still at an early stage of maturity, and the lack of adequate data and methodologies is a common problem that can only be solved by the development of single-market best practices and regulations. The essay reviews the trends, characteristics and current regulation of existing green bond impact reports and describes the challenges of evaluating impact reports, based on the literature and our own practical experience. In our view, the market has already moved past its “virtue-signalling PR” stage, but there is still a long way to go before impact data become as standardised as traditional financial data.

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1. Introduction

We live in an era of rapid change, and one of the most significant areas of this change is the transformation of climate conditions. This is one of the biggest socio-economic challenges of our day and age, both globally and domestically, and one that may largely determine our future as well. Ensuring environmental sustainability will require huge financial resources: according to the World Bank’s estimate, between 2015 and 2030, USD 90 trillion in global infrastructure investment would be needed to meet climate targets (*UN 2021*). OECD calculations also project a significant investment need of USD 6,900 billion annually to meet the climate targets of the Paris Agreement (*OECD 2020*).

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

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Today, an increasing number of countries are embarking on the path of the green economic transformation, and many businesses are striving to achieve sustainable operations. A key factor in the success of the green transition is strategic cooperation with the financial system, as financial intermediation brings banks and other financial service providers into contact with the economy as a whole. The role of the financial sector is also underpinned by the fact that the green transition of the economy presupposes that the financial system can finance green investments to an adequate extent, but for this it will need to undergo a significant transformation (*Carney 2021*). By the second decade of the 21st century, the role and responsibilities of central banks have also changed, and as prominent actors in economic policy they cannot afford not to address the issue of the transition to a carbon-neutral economic model (*Matolcsy 2022*).

One precondition for a successful green transition of the economy is that financial markets take into account and appropriately assess climate risks¹ and are able to monitor the expected or realised positive environmental impacts of their investments. This requires a suitable methodology, but there are major challenges in the field, both in terms of the content and comparability of the available data, as well as in terms of methodologies and models.

Transparency rests on data, the evaluation and analysis of which requires an appropriate methodology. While the traditional securities market offers decades of data and experience, green markets are only 5–10 years old (*Climate Policy Institute 2021*), and they are also tiny compared to the entire bond market, amounting to approximately 1–2 per cent (*ICMA 2020; CBI² 2022b*). Regulation should solidify on the market, best practices should emerge in disclosure and models, and data transparency should meet the demands of investors. All of this takes time. An appropriate attitude on the part of regulators and financial sector supervisors is essential for the development of green markets and transparency.

1.1. Green bond issuances

The European Investment Bank was a pioneer with its Climate Awareness Bond in 2007, the world's first green bond issue, but the market only started to develop dynamically from 2014–2015 (*EU 2022*). Over the past 3–4 years, the volume of green bond issuance has grown significantly: while annual global issuance in 2018

¹ The risks that summarise the impacts of the climate change and the resulting vulnerability of the financial markets, current and future climate variability and extreme events, and the implications for sustainable development. There are several types of impacts that can result from these risks, some with a lingering process (e.g. changes in temperature and precipitation) and others with a sudden onset (e.g. tropical storms and floods) (*UNFCCC 2007*).

² CBI: Climate Bonds Initiative – International green bond market development organisation with its own quality scoring system and taxonomy.

was less than EUR 200 billion, it already approached EUR 500 billion in 2021 (*CBI 2022a*), with total outstanding marketable stock of EUR 1,300–1,400 billion by the first quarter of 2022 (*IIF 2022*). Developed markets account for the largest share of this stock, at around EUR 1,000 billion, but the share of developing markets is growing (around EUR 200 billion, with the remainder mainly attributable to supranational issuers).

In addition to green bonds, the number and volume of green investment funds in international financial markets has been steadily growing since 2017–2018. According to a CBI summary, 13 green bond ETFs (Exchange Traded Funds) in EUR or USD were available in the first half of 2022, with a total market value of nearly USD 1.7 billion (*CBI 2022c*). More and more financial institutions are launching ESG-rated funds in Hungary, but dedicated green bond index-tracking funds are not yet available. As with the green ETFs, the volume of other bonds with a positive social and environmental impact has also shown a dynamic increase (in 2021, the outstanding stock of these securities was also around EUR 500 billion).

Several studies have already been carried out on the basic parameters of green bonds, their qualification methods, the types of green projects financed and their markets in general (greenium, volumes, types of issuers, etc.) (see for example one of the first analyses on the subject: *Mihálovits – Tapaszti 2018*), so it is not the purpose of this essay to discuss these characteristics.

The significant expansion of the market for green products has brought green bonds into the mainstream rather quickly, but while the structure itself is rapidly moving towards maturity, the standardisation, availability and reliability of impact reports is still at an early stage. All of the major frameworks require some form of annual reporting (supplemented with an allocation report), and thus it is unavoidable for issuers to produce better and better quality reports if they wish to meet market expectations.

The focus of this paper is therefore on the challenges around green impact reporting and a brief overview of current practices and regulations. Without well-functioning impact reporting mechanisms, the integrity of the green bond market could be compromised, and we believe that the most important area for development in the near future will be to ensure the credibility of environmental impact data.

2. Impact report

2.1. Current regulation

The impact report summarises the environmental impact of the projects that have been implemented with the funds generated by green bond issuances. The report is primarily intended to inform investors that the utilisation of the resource is in alignment with the predetermined financial and environmental framework. Its credibility is based on continuous measurement, the reliability and regular publication of data, and their integration into the company's reporting structure. The international Green Bond Standards (*Table 1*) are designed to ensure the comparability of sustainability targets, the transparency of appropriate use of resources and the investor expectations of sustainability. Within the framework of the international standards, taxonomies have been established, defining all of the economic activities that are acceptable under the sustainability objectives of the Green Bond Standards. First, the Climate Bond Initiative developed a taxonomy to identify the activities and projects needed to achieve a low-carbon economy, in line with the goals of the Paris Agreement. The regulation is based on the latest climate science, including research from the Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency (IEA). The taxonomy is regularly updated based on the latest climate science findings, the emergence of new technologies and sector-specific criteria (*CBI 2021*).

In 2015, the International Financial Institutions (IFI) proposed a harmonised framework for impact reporting with associated metrics in the renewable energy sector and for cross-sectoral energy efficiency projects (IFI Harmonised Framework). Subsequently, the International Capital Markets Association (ICMA) published further documents, building on the work of the International Financial Institutions, and this collaboration resulted in the ICMA Harmonised Framework. Likewise, these documents outline proposed impact reporting metrics for the water and wastewater, waste and resource efficiency, and low-carbon transport sectors (*ICMA 2021b*).

In order to properly identify sustainable financing opportunities, in June 2021 the European Union adopted the first major piece of the detailed EU taxonomy regulation for sustainable economic activities, the Climate Delegated Act on climate change mitigation and adaptation, which provides the basis for sustainable financing in a broader sense (including debt and other forms of financing in addition to bonds) (*EU 2020*).

Table 1			
Comparison of green bond standards			
	ICMA GBP*	CBI Standard	EU GBS** (planned)
Green Bond Framework/ European Green Bond Factsheet	Use of proceeds Project evaluation and selection process Management of proceeds Reporting commitments	Use of proceeds Project evaluation and selection process Management of proceeds Reporting commitments	Use of proceeds Project evaluation and selection process Management of proceeds Reporting commitments
Reporting	Allocation Report (mandatory) Environmental Impact Report (mandatory)	Allocation Report (mandatory) Compliance Report (mandatory) Environmental Impact Report (mandatory)	Allocation Report (mandatory) Environmental Impact Report (mandatory)
External authentication	Green Framework (recommended) Allocation Report (recommended) Environmental Impact Report (recommended)	Green Framework (mandatory) Allocation Report (mandatory) Compliance Report (mandatory) Environmental Impact Report (recommended)	Green Framework (mandatory) Allocation Report (mandatory) Environmental Impact Report (recommended)
Accreditation/ supervision of external certifiers	-	CBI	ESMA

*Note: The content of the reports requested by each organisation may differ. For example, an Allocation Report deemed compliant with an ICMA standard may not be compliant with the other two standards. * ICMA: The International Capital Market Association – is an international non-profit organisation of financial institutions that shapes market frameworks in a self-regulatory manner and represents them to regulators. / ICMA Green Bonds Standard: It forms the basis of the green bond market standards, which seeks to provide guidance for the market on key aspects. ** European Green Bonds Standard: An EU-wide green bond standard, which will be voluntary for issuers, but if they issue a bond under this framework, they will have to comply with binding standards.*

Source: MNB (2022a)

With regard to *Table 1*, it is important to underline that, with the exception of the EU GBS, in the designation of recommended/obligatory categories in the reporting section a voluntary commitment was understood not as an explicit legal obligation, but as an integral part of the framework and expected by the market (*MNB 2022a*).

In addition to the standards and taxonomies above, it is worth mentioning the comprehensive guidance document for preparing impact reports developed by a group of Nordic public issuers (Nordic Public Sector Issuers Position Paper). The document aims to complement the work of the International Financial Institutions. It includes reporting requirements on climate-related physical risks and the Sustainable Development Goals (SDGs) (*NPSI 2020*).

Reporting is becoming more widespread as the green bond market expands, but it also raises a number of concerns, particularly because of the lack of detailed, binding, accountable standards and consistency. Currently, post-issuance reporting is fragmented, and without a common framework it is up to the issuers to decide which metrics to report. The accuracy and reliability of impact measurement and monitoring also has great potential for improvement, as verification and evidence of impacts are often lacking (*CBI 2021*).

A significant proportion of green bond issuers see the use of frameworks as useful, but many market players see impact reporting commitments as a barrier to further green bond issuance. This may be because perceptions of difficulty and costliness are associated with an initially steep learning curve, which is expected to flatten over time as issuers gain reporting experience. The already existing and future initiatives can certainly help this learning process (*CBI 2021*).

2.2. Characteristics of impact reports, related trends

The design of impact reports is significantly influenced not only by regulatory requirements but also by the needs of market participants and the capabilities of issuers, and therefore the market environment should also be considered when analysing the current structure of impact reports. On the whole, there is a positive trend, with more and more issuers preparing impact reports but in a significantly different structure, while investors, supported by regulatory initiatives, expect a gradual improvement in their coverage, quality and comparability.

In the normal decision-making process, investors increasingly consider impact reports as crucial to their financial decisions. Both investors and issuers have highlighted as an advantage of green bonds that the investment can be linked to a specific and verified project. Metrics such as emissions avoided or improved water efficiency allow the investor to demonstrate to its partners how the capital received is being used to achieve sustainability (*Maltais – Nykvist 2020*). As the Green Bond Principles (GBP)³ require issuers to report annually on the use of bond proceeds and the environmental impacts achieved, it is expected that similar requirements will be imposed on green bond funds as well (*ICMA 2021a*). Two main types of report may be distinguished in relation to green bonds: the allocation report describes the use of the proceeds at the specific project level, and it is also the first step towards the other type, the impact report, and, for the time being, is more common than the latter.

³ Green Bond Principles. The Green Bond Principles are a set of voluntary frameworks motivated and aimed at promoting the role of global securities markets in financing progress towards environmental and social sustainability (*ICMA 2021a*).

An increasing part of the market is producing impact reports, although full market coverage is still a long way off. Based on the responses of market participants surveyed by the CBI, 77 per cent of issuers prepared allocation reports on the use of proceeds, while only 59 per cent reported on environmental impacts (*Table 2*) (*CBI 2021*). According to a survey by Environmental Finance, for 2021, 72 per cent of issuers produced impact reports, meaning that the majority of “green” projects already have environmental impacts reports, making it a common market practice, but coverage needs to be improved (*Environmental Finance 2021*).

There may be several types of issuers representing themselves on green or sustainability bond market. They have different backgrounds and motivations for preparing impact reports. Issuance by financial institutions is common, but sovereign, non-financial or government-backed entities also play a significant role among issuers. The utilities and the energy sector are the largest contributors to corporate sector issuance, with more than 30 per cent of issuance stemming from these two sectors (*Environmental Finance 2021*). In general, large issuers are more likely to publish their environmental impact measurements and data. The main reason for this is that larger companies have more resources and are thus better able to cope with the increased burden of disclosure. In addition, such companies tend to be more stable issuers in the green securities markets, so their long-term strategies are better suited to the development of a proper reporting framework. Furthermore, the regulations often set expectations and more stringent principles for larger companies in the first place. Financial institutions are the top reporters, with more than 90 per cent of them producing at least allocation reports, but development banks and local governments are not far behind (*Environmental Finance 2021*).

The issuers are dominated by European and North American entities (*CBI 2021*). These regions have the most developed financial and, to a certain extent, climate protection cultures, where proactive regulation and strong investor (and public) pressure can support the development of reporting.

Table 2**Prevalence of reporting structures**

	Report types			
	Allocation report	Impact report	Both	At least one of them
Proportion of reporting issuers, %	77	59	57	79
Proportion of bonds issued by reporting issuers, %	77	63	62	78
Proportion of issued volume by reporting issuers (billion USD), %	88	74	73	88

Note: The reporting coverage is the stock of green bonds issued between November 2017 and March 2019 and included in the Climate Bond Green Bond Database. The total universe is made up of 694 bonds from 408 issuers, amounting to approximately USD 212 billion. Loans and securitised assets are not included.

Source: Based on Climate Bond Initiative (2021)

Green projects in different sectors have different environmental impacts, which has an effect on the design of the relevant impact reports. In emerging markets, the energy sector dominates the use of green bond proceeds. Nearly two thirds of the resources acquired in these markets are used in the energy and transport sectors, but there are also significant uses in water, property and waste management (*Environmental Finance 2021*).

The financial backgrounds, resources and needs of the users of impact reports also vary widely. Issuer impact reports are currently used mainly by large green investors, central banks and fund managers. They can also optimise their investments on an impact basis and provide information to their end investors. There is strong demand from large investors for adequate, comparable impact reporting and they can put considerable pressure on the issuers to do so. Substantial human resources are also allocated to the analysis of impact reports.

2.3. Existing challenges and development points

The Central Bank of Hungary (Magyar Nemzeti Bank, MNB) is also present as an investor in the green bond market, and so we have tried to summarise the difficulties and challenges that investors currently face in this segment of the securities market, based on the MNB's experience. The MNB has produced impact reports in a number of ways and on a number of occasions in recent years, such as the impact analysis of the green bond portfolio within the foreign exchange reserve, published in 2021 (*Elek et al. 2021*) and 2022 (*Paulik – Tapaszti 2022*).⁴

⁴ In addition, in 2022, the MNB published its climate-related financial disclosure, based on the recommendations of the Task Force on Climate Change Financial Disclosures (TCFD) (*MNB 2022b*).

The primary purpose of impact reports is to provide investors with the right information to help them allocate resources between issuers and projects, i.e. they are prepared ultimately for investors, to convince them and support their work, so that optimal investment decisions can be made from a green perspective. To do this, the investors need to have ex ante and, where possible, ex post impact reports available in a comparable, standardised format for a possibly large proportion of issuers and projects at regular intervals.

According to the 2021 research of Environmental Finance, more than 90 per cent of the investors surveyed said they consider the impact reports of bond issuers and green bond funds to be “crucial”, and more than half of them said they are deterred from further investment in bonds that are characterised by poor impact data and the impact reports that such data lead to (*Environmental Finance 2021*).

2.3.1. The environmental impacts of green bonds are building blocks in the green strategies for transition

Projects financed by green bonds are ideally “building blocks” of the environmental objectives explicitly defined in the issuing entity’s green strategy, i.e. the green investments are part of a larger strategy. However, our experience so far suggests that the green strategies of the majority of issuers are not yet sufficiently developed to enable investors to judge the usefulness of individual green projects within this higher-level framework.

Of course, most of the large issuers already have some kind of strategy supporting net-zero/emissions reduction/transition in place, but the level of detail varies. The desired green strategic status would be an emissions reduction plan explicitly supporting compliance with the 1.5/2 degrees Celsius targets, in a form validated and benchmarked by an external body (i.e. showing the deviation from the emissions reduction pathway calculated from the “sub-division” of the major targets committed to in the Paris Agreement).

The organisations supporting and monitoring the development of the green strategy include TPI (Transition Pathway Initiative), SBTi (Science Based Target initiative), GFANZ (the Glasgow Financial Alliance for Net Zero) and CA100+ (Climate Action 100+). There are many differences in the methodologies and assessment systems of these organisations, but their objective is broadly the same: to provide a framework within which the credibility of the climate commitments of these entities can be assessed, alongside the ability to identify and manage the financial and environmental risks/opportunities inherent in the transition to low emissions. In short: Is the climate plan undertaken by the company sufficient to meet the Paris targets, and does the company have the commitment, financial, technological and human resources required to realise it?

From the perspective of the main topic of this paper, it is therefore worth highlighting that while green bond impact reports are valid on their own and may even show the adequacy and quality of the projects, it is desirable to assess environmental impacts at a higher level, in order to maintain the integrity of the green bond market, in the interest of a more holistic perspective.

The following section looks in detail at the main challenges related to impact reporting.

2.3.2. Regulations

As already discussed, identically to the Hungarian market, there is currently no explicit international regulation on the obligation and form of an allocation report or impact analysis for green bonds. This may change in the near future with the adoption of the EU Green Bond Standards (EU-GBS), where certain conditions are already legally required⁵ (*EC 2019*). For the time being, however, the reporting of impacts is somewhat based on self-reporting and defined by standards voluntarily undertaken by the issuers. It is important to underline that the current standards are voluntary for the issuers, but still represent some level of commitment, so the recommended points they contain are not completely arbitrary. At the same time, the degree of freedom of feasibility of the points contained in the standards is high, affecting the time interval, structure, etc.

2.3.3. Challenges in relation to the data appearing in the impact reports

The shortcomings of green impact reports, the lack of standards, the difficulty of comparability and other technical problems have already been mentioned several times in this essay. It is important to stress that this is far from always being the fault of the issuers, as the publication of impact reports at this level of detail is a new phenomenon in the capital markets, and thus it takes time to develop, understand and implement protocols and quality assurance.

One of the weaknesses of sustainable finance concepts, whether we are talking about impact investing or other forms of ESG, is the challenges related to data: sometimes there is even no data, or often it is not collected and published in a systematic way; there are no data providers or widely accepted estimation methods.

There is an old adage that can be applied to sustainable finance as well: you can only manage what you can measure. However, it should also be borne in mind that if the measurement is wrong or deliberately biased, the decisions based on it are less likely to achieve their real purpose. Accordingly, it is one thing to accept

⁵ However, in the first instance, the issuers will not be obliged to issue green bonds in this format, even within the EU.

exactly what needs to be measured, but another equally important question is how to measure it and ultimately how to arrive at the desired value of the given green indicator. The latter should also be presented transparently to avoid greenwashing (Alogoskoufis *et al.* 2021). Greenwashing is the term used to describe activities that risk making unsubstantiated and misleading claims of environmental benefits, i.e. the practice where a company communicates positively about its environmental performance, but its actual environmental performance has negative impacts (Delmas – Burbano 2011).

Looking at the user side of the reports prepared by issuers, the impact reports to be prepared by fund managers may also involve several technical difficulties. Investors often have to collect the reports related to the green bonds in their portfolio individually, for example from the issuers' websites. This is a very time- and resource-consuming process for a large portfolio with many securities. One solution to this problem can be for example the service provided by the company of Green Assets Wallet, which collects published impact reports in a common database; however, if there are uncertainties in the input data, the resulting databases will also not be perfect. In the following, we focus on methodological issues related to data and other technical factors.

How impacts are reported depends, of course, in the first place on the type of project: different indicators may be expected for a renewables project than for a waste management or adaptation project, for example. For example, *Table 3* highlights some important indicators per project (NPSI 2020).

Table 3
Key indicators for each green project

Renewable projects:

Energy production capacity	MW (megawatts)
Annual renewable energy production	MWh (megawatt hours) or GWh (gigawatt hours)
Annual GHG emissions avoidance/reduction	CO ₂ equivalent* in tonnes

Green buildings:

Annual energy use avoided – compared to national average standards	kWh/m ² or percentage (%)
Annual energy use reduction compared to the pre-investment status (in the case of renovation)	MWh (megawatt hours) or GWh (gigawatt hours)
Annual GHG emissions avoidance/reduction	CO ₂ equivalent in tonnes

Table 3
Key indicators for each green project

Transportation:

Annual GHG emissions reduction/avoidance	CO ₂ equivalent in tonnes
New railway lines, cycle paths, etc.	km
Estimated car use reduction	km

Adaptation projects – investments to help adapt to inevitable negative impacts of climate change:

Protection against heat waves (protected area)	m ² or number of protective devices
Protection against storms (protected area)	m ² or number of protective devices
Resilience projects against other elements	capacity (for example water diverters, etc.)

*Note: GHG – greenhouse gasses, * Based on the strength and persistence of the greenhouse effect, the effect of each gas can be “converted” into a carbon dioxide effect.*

It is important to note that these indicators are only examples; as the sophistication of the impact reports increases, the number of relevant indicators may also increase somewhat by project type. It is essential that not all material environmental impacts can be quantified with sufficient precision, so a qualitative presentation of projects can also deepen the knowledge needed to evaluate projects, but in general, issuers should aim for a quantitative presentation.

As shown in *Table 3*, there are indicators that are interpreted in absolute terms, such as energy production or the commissioning of energy production capacity. These indicators are characterised by their relative accuracy, although in the case of intermittent renewables the ex ante determination of energy production is always based on baseline assumptions due to the year-to-year variability of the weather (number of sunny/windy hours in a given area). This is why it would be also beneficial to publish ex-post reports, where the issuer can report on the energy production already achieved. In the case of capacity indicators, this is not a problem in most cases, as the peak capacity can be explicitly determined. However, the resulting production naturally varies from one geographical location to another, e.g. solar panels in Germany produce on average around 10 per cent efficiency per year compared to the peak capacity, while in Spain this can be more than double on average (*Aszódi et al 2021*).

Currently, one of the least funded areas is adaptation projects, partly due to the difficulties in directly defining technological solutions and the less explicit nature in terms of environmental impacts. However, their role may increase in the coming decades, as in the absence of a significant global emissions turnaround, the pace and magnitude of climate change may become increasingly drastic even within a few years, making adaptation, even at high costs, inevitable. In the worst-case

scenario, warming could reach a level where mitigation projects may be sidelined for rational reasons (“race to the bottom” scenario).

2.3.4. Indicators interpreted against an emissions benchmark

In addition to absolute indicators, indicators describing the environmental impact relative to the emissions baseline scenario are very popular. In the vast majority of cases, these are the most prominent indicators in issuer/investor impact reports, as they are the most publicly relevant on the one hand and they are the financial impact that is “translated” into relevant environmental indicators on the other.

In the examples shown in *Table 3*, this is the so-called “avoidance or reduction of carbon dioxide equivalent per tonne”. As the name suggests, we are talking about emissions avoidance/reduction relative to some benchmark emissions, which has two basic cases: when the *emissions reduction* can be directly identified in the case of the operation of the entity (for example, in the case of a property renovation project, the reduction relative to the carbon emissions from last year’s consumption); and when we are talking about *emissions avoidance* relative to some reference baseline or benchmark. The reference emissions are therefore what the emissions level would have been if and when the green project had *not* materialised, i.e. if the traditional, fossil-based technological solutions of the past had not been *substituted*. A fundamental question is which fossil energy sources will be substituted and in what order.

It is therefore easy to understand that the impact of the avoidance/reduction demonstrated by the issuer is influenced not only by the impact of green projects, but also by the definition of the reference pathway (substitution parameter). The lack of standardisation is perhaps most pronounced in the definition of baselines, which can be reflected in the very different values across regions. It is important to stress that this can be seen as natural to some extent, as the energy mix varies from country to country (for example, France has a high share of near-zero emissions nuclear energy), the quality of existing real estate assets (the EU’s northern part already has a better energy efficiency of buildings), the current energy efficiency of different sectors, and so on. Obviously, the relative emissions avoidance impact of a new renewable project in a region that is already fundamentally greener will be smaller than that of a green project in a predominantly fossil region (e.g. Poland due to coal dominance). In the former, for example, gas-fired power plants could be substituted, while in the latter, the most polluting coal-fired power plants could be slowly phased out of the energy market.

This phenomenon also points to the need for global coordination at a higher level of abstraction, since, assuming that developing countries rely more on cheaper fossil energy, it makes a difference in terms of emissions reduction efficiency in which region a green investment to substitute existing energy production is implemented

(not to mention that the cost of green projects may be even lower in developing countries). Unfortunately, there is currently only little global coordination – realised mainly through large global development banks and UN initiatives.

As already stressed, the determination of baseline reference emissions is rather hypothetical and based on scenario analysis. In most cases, a fossil power plant is not taken off the grid when a renewable project starts to generate power, all the more so because, for example, the European electricity market is integrated to some extent (depending on cross-border capacities), so it would be difficult to clearly identify the incoming and the ceasing energy generation. Not to mention the fact that energy consumption (electricity) may even rise in the EU under the green strategy, so it is not even certain that fossil production units can be phased out at all. In such cases, the calculation becomes even more difficult and complex, especially as a green project once implemented will run for many years. In other words, the positive impact may be higher at the beginning, while later on it may decrease year by year due to the greener overall operation.

Hence, the differences in the relative emissions impact of green projects in different regions with almost identical technical parameters are not only due to the existing, fully justifiable parameters (e.g. the existing energy mix) but also to the calculation methods of the baseline/substitution parameter itself.

2.3.5 Other methodological issues

In addition to the aspects outlined above, there are still a number of questions regarding the reporting methodology, which we believe are also key to the further development of the market:

- *Data published at different levels:* Some issuers disclose environmental impacts at the individual bond level, but most of them only disclose portfolio-level data for the entire project. So, while some issuers directly disclose the impact share attributable to green bond financing, which makes the life of the investors much easier, others disclose the total impact of projects, preferably showing the corresponding shares (green bonds vs. normal bonds in the project) separately. Publication at the bond level can be more complicated for large issuers that finance many projects in parallel, making it more difficult to track the source of funds raised from each bond. This can sometimes result in a flawed methodology, whereby the reported impacts cover a wider range of projects than those financed by the green bond(s), and the impact of the part financed by green bonds is not clearly defined. At the other extreme, the impact is presented on a loan-by-loan basis where it is not possible to aggregate these impacts. In the absence of methodological background documents, it is also questionable whether the projection basis is the loan granted or the loan disbursed in such cases.

For investors, of course, the ideal solution would be to report on a per bond basis, with impacts even per unit of invested resources (e.g.: 400 tonnes of CO₂ avoided/1 million euro invested, etc.), but this would understandably place too heavy a burden on issuers, and in extreme cases could discourage them from issuing green bonds. Finding a good balance is therefore an important task for the future.

- *GHG dominance*: The most widely used indicator among issuers is GHG impact/avoidance. However, in many projects, GHG is not the indicator that best captures the environmental impact of the project. Water projects, which have a negligible GHG impact, are a good example, but they are also valuable and indispensable for the green transformation as well.
- *Time*: This refers both to ensuring comparability over time period, and to the time required for the impacts of the implemented green projects to “manifest” in the impact report. Investors currently face serious challenges in this respect: in some reports, it is not possible to properly separate the green projects already underway from the impact of the projects financed by the funds newly raised. In addition, the reports are not produced at the same time, nor do they cover the same period.
- *Regional differences*: As already indicated, similar projects in different regions have very different impacts. This may be partly due to the intuitive approach that the impact of projects in less developed regions is greater than in developed economies. On the other hand, the different calculation methodology or the entity/service provider performing the calculation may also be an explanation. Without detailed knowledge of the methodologies, it is difficult to decide whether the discrepancy is based on a legitimate methodology or greenwashing.
- *Transparency*: The methodological details and the data published in reports are often not well supported by data sources and methodological descriptions. Among the data published with high dispersion, it is therefore difficult to decide which are outliers and which are realistic effects. This can be helped by transparency, which is particularly true for developments related to environmental sustainability, for which this is an essential condition, either at the starting point or in measuring the impact of the steps taken (Kolozsi et al. 2022).
- *Separation*: Green financial instruments are often used by issuers for refinancing. This may cause further difficulties if one project cannot be sufficiently separated from the other, as it will be difficult to aggregate data across different reports and projects.

On the whole it can be said that the challenges outlined above create considerable uncertainty for investors. This can take the form of questions such as: Why has the portfolio's climate impact improved compared to the past period or to a benchmark? Is this due to a re-weighting, some kind of data error or simply a coincidence? It is not yet possible to answer these questions in all cases, so the changes in the climate-related risk performance of investments are often difficult to explain.

2.3.6 Risks of greenwashing

With the shift in investor attention or “shifting” by the regulations towards sustainability and the potential easier/cheaper source of financing that this may bring, the question may arise as to whether issuing entities may be implementing projects that are green only on the surface. Or the project is truly green, but the company is not making any effort to make the transition, and it is just a PR project, giving a false impression or misleading information about how environmentally friendly the company's products and operations are on a higher level. As for green bonds, research by the *CBI (2021)* suggests that the vast majority of issuers have now made at least their allocation report available – and mostly within the GBP recommended timeframe. Based on the environmental reports on the issues, no transactions have been excluded from their green bond database, suggesting that the issuers are indeed financing green projects/assets in a proper and promised way.

2.4. Impact reports in practice

2.4.1. Case study: avoided GHG emissions calculation for a large German bank

The bank included in our study is one of the most important agricultural development banks in Germany (*Rentenbank*), which invests the funds raised from green bonds mainly in renewable green projects (wind energy installations, photovoltaic panels on agricultural sites). The green bond impact report was prepared by the Center of Solar Energy and Hydrogen Research Baden-Württemberg and was based on the columns of installed power and electricity generation (*Table 4*). As already indicated, these numbers form the fully objective categories of the reports, while the numbers in the last column are based on the reference emissions figures against which the emissions avoidance is achieved (*Rentenbank 2021*).

Table 4			
Excerpt from Rentenbank's impact report			
	Installed power (MW)	Electricity production (GWh)	GHG emissions avoided (t CO₂eq)
Photovoltaic installations	1,670.8	1,464.7	1,003,900.0
Wind energy installations	3,502.8	6,390.5	4,820,700.0

Source: Rentenbank (2021)

Based on *Table 4*, the GHG avoidance per GWh is 685 tonnes for photovoltaic and 754 tonnes for wind energy installations. Given that the average German CO₂ emissions per GWh of production are currently in the range of 350–400 tonnes⁶ (with some year-to-year dispersion due to some fluctuations in renewable generation), these figures may even seem a bit high, so it is worth looking at the methodology more closely.

In Germany, the key parameter for carbon dioxide avoidance calculations is the so-called “substitution factor” (SF in per cent, *Umweltbundesamt 2020*). As can be seen from the formula below, which quantifies gross carbon dioxide avoidance, the other parameters can be considered relatively objective, and the estimation error is therefore minimal. In the formula that gives the gross⁷ carbon emissions avoidance for a given volume of renewable energy production, the numbers that can be well calculated are:

RE: Renewable energy production / *FE_d* and *FE_{id}*: Direct and indirect, entire value chain carbon emissions from fossil energy production / *fee* (%): fossil energy efficiency, i.e. what percentage of the primary energy is utilised.

$$E_{a,gross}[t] = RE[GWh] * \sum SF[\%] * \frac{FE_d[g/kWh] + FE_{id}[g/kWh]}{fee[\%]}$$

This formula therefore captures the proportion of green-fossil substitution: the energy (GWh) produced by renewable projects that substituted for each and each fossil energy production method in a determined proportion and, as a consequence, the avoidance of carbon dioxide produced by the given fossil production method. The key is therefore to define the SFs, i.e. the proportion and extent to which the projects in question substitutes for fossil-based production. The general approach to substitution by solar power in Germany is shown in *Table 5*.

⁶ <https://ourworldindata.org/grapher/carbon-intensity-electricity?tab=chart&country=~DEU>

⁷ Gross value because the production of renewable capacity also generates carbon emissions.

Table 5**Substitution factor for photovoltaic installations in Germany**

%	Nuclear energy	Lignite	Hard coal	Natural gas	Oil
Photovoltaic panels	0.5	17.5	49.4	32.6	0.0

Source: Umweltbundesamt (2020)

Accordingly, the incoming renewable energy generation replaces 0.5 per cent of nuclear energy production, 17.5 per cent is lignite based energy production, and so on. This is, of course, an expert estimate, since, as detailed above, exact figures are not available due to the complexity, size and dynamic nature of the system. Of course, the higher the proportion of lignite and hard coal in the parameter estimate, the higher the avoided carbon dioxide emissions, as these are the most emissions-intensive energy production modes. Naturally, individual issuers can still adjust this general estimate if they believe it is justified.

The calculation of gross carbon avoidance also needs to be adjusted for the embedded full-life-cycle carbon emissions of renewable energy production, as the production, installation, etc. of photovoltaic and wind energy installations also come with CO₂ emissions. This can also be seen as a relatively objective calculation, although there are still many challenges, for example in the large-scale recycling of photovoltaic panels. Currently in Germany these figures are 56 g CO₂/kWh in the case of solar and 17 g CO₂/kWh in the case of wind energy installations (without adding any energy storage capacity), which are far below, for example, the emissions of up to 1,000 g CO₂/kWh from coal-fired power plants.

2.4.2. Defining the Nordic reference pathway for impact reports

The *NPSI (2020)*, which describes the proposed calculation procedure for specific green bond impact reports, adopts a somewhat different “big picture” approach from the German example, with the clear advantage of simplicity. Accordingly, green projects in the region can use the following reference pathway (baseline emission) to calculate avoided emissions (*NPSI 2020*): CM (combined margin) = $OM + BM$.

OM (operating margin) is the emissions of the current generating capacity for which the substitution for the generation is likely to occur in the current dispatch hierarchy. (That is, the order in which fossil production methods are replaced.) BM (build margin), on the other hand, is intended to capture a future state, namely the future emissions that will accompany the operation of energy production. Of course, the model (which is based on countries’ commitments) assumes that energy production will become greener and greener, so that the “impact” of substitution

will decrease steadily over the life cycle of green projects. The key in this model lies in the weighting of the two factors, which as currently proposed looks like this:

$$CM (315g CO_2/kWh) = 0.5*OM (476g CO_2/kWh) + 0.5*BM (154g CO_2/kWh)$$

On the whole, therefore, there is a distinction between indicators in terms of the objectivity of reporting, some indicators are more specific, while others have more significant estimation assumptions. This is of course not a problem, but the investors need to be aware of these parameters, as in many cases it can be difficult to compare the impacts of green projects on a one-to-one basis.

2.5. Experiences with Hungarian green mortgage bonds

The Hungarian green bond market is still at a relatively early stage of development, and thus the available impact reports are also characterised by the challenges of the learning phase (Bécsi *et al.* 2022). Accordingly, in Hungary (in line with the EU), there is currently no legal requirement for reporting; it is based on self-declaration, so no uniform best practice has been established. Allocation and impact analyses are typically a few pages in length, describing the characteristics and impacts of a given project. In terms of indicators, they are dominated by data on carbon dioxide emissions, but indicators linked to the Sustainable Development Goals (SDGs) have also started to appear.

The challenges are thus fully in line with those faced by international issuers, but the lack of stronger energy efficiency data and reference pathways forces issuers to use even more estimation parameters. As the report by OTP Jelzálogbank⁸ notes, “...there is, among other things, a lack of data; where data exists, the reliability of data quality is low, additionally, given the lack of experience and established good practices there is no consensus related to the share of the client – financed by the financial institutions – emissions that the banks are responsible for” (OTP Jelzálogbank 2021).

In the following, we would like to highlight some important aspects from the green mortgage bond reports of OTP (OTP-J 2021), Takarékszövetkezet (TJ 2021) and UniCredit (UniCredit-J 2022) (Table 6). In the first instance, even the selection process for green loans differs, as the surveyed banks apply differently strict criteria to determine what they consider to be eligible for green real estate financing. This will of course affect the extent of the published impacts – banks that are “more lenient” in the green aspects are likely to publish lower impacts. However, as we have already indicated, the question of “energy efficiency improvement, but relative to what”, i.e. the definition of the reference pathway, is at least as important: while OTP, for example, considers the energy consumption/environmental impact of all non-green

⁸ mortgage bank

projects in its own loan portfolio as the baseline, the other two issuers use a less precisely defined national building stock benchmark (*Mihálovits – Paulik 2022*). The OTP report can be considered much more detailed in this respect; they try to provide more data points (indicating estimation difficulties), which is positive, as it makes a step towards transparency.

	Green mortgage bond financing (HUF billion)	Avoided energy consumption (GWh)	GHG emissions avoided (t CO ₂ eq/year)	Tonnes of GHG avoided per HUF 1 bn/year	Tonnes of GHG avoided per EUR 1 mn/year
OTP Jelzálogbank	95	45	10,059	105	41
Takarék Jelzálogbank	97	102	18,761	193	75
UniCredit Jelzálogbank	22	18	3,411	155	60

Source: OTP-J (2021); TJ (2021); UniCredit-J (2022)

As shown in *Table 6*, the impacts per HUF 1 billion of financing show a significant dispersion, which is the result of the two effects already explained – different energy efficiency properties are considered green by each issuer, and the reference pathways differ as well. From an investor perspective, the problem is that it is difficult to compare the results and optimise the environmental impacts.

The conversion of avoided energy consumption to GHG avoidance is not uniform. The GHG avoidance calculated from the GWh avoided also shows a dispersion (183–223 GHG avoidance/GWh), even though the reference pathway roughly represents the domestic housing stock in all cases. This indicator is the unit GWh,⁹ which reflects the average emissions load of energy use, which preferably could be estimated with a lower standard dispersion. It is clear, also from this, that standards are the cornerstone of market development.

If we compare the above values with those published by international, mainly Western European covered bond issuers – where the GHG avoidance per EUR 1 million typically ranges from 10–40 tonnes/year – the main difference is mainly in the definition of baseline scenarios: a green loan even with more stringent characteristics can only achieve a lower impact considering the baseline scenario includes buildings with much better average efficiency.

⁹ The main driver here is the type of heating.

It is worth highlighting the important aspect that the impact of each green bond is highly dispersive (10–800/900 tonnes CO₂ avoided/year/1 million euro invested), which is mainly explained by the different impact of the green projects financed: while renewable projects have a positive impact of several hundred tonnes per unit of the amount invested, the covered bond (mortgage bond) market analysed represents the lower end of the range. In other words, if in the management of green bond portfolios only a narrow-minded optimisation of the impacts were to take place, it could induce the sale of covered bonds, even though the upgrading of the housing stock is a key area for the green transition (*see also Baranyai – Banai 2022*). On the whole, therefore, the situation is much more complex than can be captured by a single indicator (*Elek et al. 2021*).

3. Future opportunities and conclusions

The impact of regulatory decisions and the consolidation of market best practices is realistic in the medium to long term, but in the meantime, investors need data and procedures to support their decisions. Larger groups of investors, who often have a dedicated “green department” to deal with these investments, often contact emitters directly and discuss the data, requesting any additional information they may have, in an attempt to bypass difficult-to-interpret data and inadequately detailed methodologies. Small investors are in a much more difficult position, as they do not have the resources or the right channels to reach the issuers.

Due to the resource-intensive processing and preparation of the reports and the often inconsistent reporting of the impacts of similar projects, we believe that in general, the areas that need to be improved most in the future are transparency and standardisation of impact assessments. In the long term, only the homogenisation of reports, the creation of a common reporting structure and a centralised platform can provide a solution. In addition, the responsibility of issuers and rating agencies in the process should be increased (“skin in the game”). In addition, reporting and external rating should be made explicitly mandatory, which would strengthen the reliability of the information provided and the confidence of customers. In addition to improving data quality and developing methodologies, issuers and fund managers should be required to meet standards that do not entail excessive costs. A standardised reporting structure and the creation of a common database could help also in this.

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