A novel database for green bonds
to support investment analysis and decision making, research, and regulatory decisions:
The Green Bond Transparency Platform

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I. INTRODUCTION

The past decade has seen a rapid increase in the empirical literature investigating green bonds and their links to investment decisions. This is not surprising given that since 2007, an aggregate of USD 2 trillion in green bonds was issued globally to finance low-carbon investments (BNEF, 2022). Green bonds are debt obligations issued in a public or private offering by a private company or a governmental entity, which at the time of issuance commits to invest the resources raised exclusively in green project categories for instance renewables, low-carbon transport or agriculture. Additionally, these bonds also commit to report the environmental impacts of the projects funded, such as tons of greenhouse gases avoided, renewable energy generated, or the number of electric vehicles financed.

The credibility of the green bond market depends on the ability to verify the greenness of bond issuances. Thus, the public availability of data becomes essential to verify the bonds' greenness. In general, it can be assumed that more transparency leads to more informed investment and regulatory decisions.

This paper presents the Green Bond Transparency Platform (GBTP) as a novel, user-driven, free of charge database.[2] Its objective is to promote the harmonization and standardization of green bond reporting, support investors in making well-informed decisions based on granular impact and use of proceeds data (henceforth called green bond data), facilitate research on the linkages between green bond data and investor behavior and the materiality of data, and support regulatory decisions. The GBTP is currently focused on Latin America and the Caribbean and can be replicated in other jurisdictions and active markets such as Asia, Europe, and the United States.

The paper presents the justification of the need for such a platform and the information challenges it seeks to overcome, its functionalities and technical choices made in the design, alternative evolving data sources, and discuss potential applications for research, investment decision-making, and policy making.

The remainder of the paper proceeds as follows. The introductory section continues with a short literature review to illustrate the importance of data to verify the greenness of a bond for the bond's pricing. Section II describes the construction of the database and its characteristics in detail. Section III reviews and discusses evolving databases for green bonds. Section IV provides some descriptive statistics and illustrates high-level links between green bonds and their environmental characteristics. Section V discusses challenges, and potential applications of the data for investors, researchers, regulators, and prospective new issuers. Section VI concludes. The paper contains three appendices that highlight additional information. Appendix I contains the data schema of the Green Bond Transparency Platform. Appendix II provides an overview of the variables and Appendix III provides a sample of screenshots from the Platform and definitions of downloadable data.

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[2] The Green Bond Transparency Platform is available at https://www.greenbondtransparency.com/. All templates and data mentioned in the paper can be found and downloaded here: https://www.greenbondtransparency.com/support/resources/

Empirical literature

The empirical literature on green bonds is at a young stage and renders some interesting initial results. First, green bonds tend to be subjected to a green premium or "greenium" as some studies have called it, meaning that green bonds achieve lower yields for their issuers due to information and reporting requirements of their use of proceeds, which demand more sophisticated reporting procedures (MacAskill et al, 2021). Second, investors interested in expanding their green portfolios and complying with ESG commitments, care about the ability to verify greenness and the adequate use of funds of bonds (Ehlers & Packer, 2017; Kakeu, 2017, Lambooy et al, 2018). Finally, most empirical research has been conducted primarily on developed capital markets, which highlights the challenge to enhance the understanding of green investment and their capacity to support development in emerging economies (Banga, 2019).

Regarding the literature related to the so called "greenium", most up to date empirical research has been conducted in developed markets and interesting conclusions can be drawn from them. For instance, Kapraun et al (2021) find that while green and conventional bonds trade at similar yields on average, there is a substantial variation of the Green premium across currencies and issuer types. Investors have accepted 5 to 18 bps lower yields (e.g. a greenium which make it interest rate payments cheaper for the bond issuers) when the bond was issued by governments, local governments or supranationals, or the issuance has been in a Euro. While for corporate green issuers no significant greenium emerges for bonds issued in another currency than Euro. The authors suggest that investors in green bonds issued by countries with rather low sustainability reputation might trust and value the label of Green bonds denominated in major currencies (EUR, USD) more than of those denominated in their local currency.

Similarly, Baker et al. (2018) analyze the green bond premium of US municipal bonds in the primary market utilizing the green certification of the bond by an external party. The authors find a significant green premium average of 6 basis points for bonds complying with the Green Bond Principles and a 14 basis points average when the green bond received a Climate Bond Initiative certificate. Moreover, constructing a Green Disclosure Integrity Score to assess the secondary market behavior of green bond investors, Geerlings (2019) finds a significant 23 basis point difference between green and conventional bonds.

Furthermore, MacAskill et al (2021) in their systematic literature review on premium determinants published between 2007 and 2019 confirm the existence of a green premium within 56% of primary and 70% of secondary market studies. These premiums are concentrated among green bonds that are government issued, investment grade, and that follow defined green bond governance and reporting procedures. Although there is a larger range of premia in the primary market, the authors find an average "greenium" of 1 to 9 basis points on the secondary market. Interestingly, their findings highlight the importance of strengthening environmental preferences amongst bond market participants, both issuers and investors.[3]

The literature is pointing to the fact that investors value the green credentials of a bond and are willing to accept lower yields. Studies like the one carried out by Kakeu (2017) show that environmentally conscious investors incorporate both their environmental externalities concerns and environmental risks on their portfolio management and their expected rate of return. Similarly, Ehlers & Packer (2017) identify that a relatively large share of green bonds is concentrated in sectors subject to environmentally related credit risks. Finally, Lambooy et al (2018) review how asset managers and fund managers exert influence on the companies' efforts to reduce their negative and improve their positive environmental

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[3]

impacts. The authors found that biodiversity and natural capital are considered material by investors, employing available legal options in their engagement strategies and using the information disclosed by investee companies pursuant to mandatory reporting law. However, the authors also mentioned that investors tend to be interested in biodiversity and natural capital only when these are clearly and directly linked to reducing financial risks.

However, the research on this topic in emerging markets is sparse possibly due to the low numbers of issuances and data availability in those economies. For example, Latin America and the Caribbean commands about 2% of the total USD 2 trillion global green bond market, even though issuers have issued already around 280 issuances in the past 7 years.[4] Banga (2019) highlights the potential of green bonds in mobilizing adaptation and mitigation finance for developing countries. The author identifies the lack of appropriate institutional arrangements for green bond management, the issue of minimum size, and high transactions costs associated with green bond issuance, as the key barriers for the development of green bonds in developing countries. To overcome these challenges, the author suggests multilateral and national development banks as intermediary institutions for local green bond management, and for local governments to cover the transaction costs associated with green bond issuance for local green bond issuers. Banga (2019) thereby points to both the capacity issue in green bonds issuance, management and reporting, as well as a cost issue of issuing and reporting on green bonds.

On this matter, green bonds gain particular interest from pension funds and large institutional investors to achieve the needed financing for climate mitigation and adaptation due to the lower risk exposure they represent, providing a steady, inflation adjusted income stream. A recent study on pension fund portfolios show that bonds represent on average 50% of the total composition (OECD, 2021a), which enables the mobilization of large amounts towards "green initiatives". Nevertheless, on a 2011 study (Della Croce, R. et al., 2011) these types of assets only represented 1% of the total portfolio composition. One of the main barriers was the uncertainty about the risk return of these instruments and the transparency on the use of proceeds of green bonds guarantee the usage of the funds on green investments.

Shilov et al (2016) identifies three challenges to the growth of the green bond market 1) inconsistency in standardization of procedures and clarification of expectations to define greenness of a bond, 2) reducing the cost of capital through the securitization of smaller projects (see also the discussion on covered bonds and credit enhancement guarantees in Ketterer et al., 2019), and 3) targeting support of green bond issuances which are in line with a low-carbon transition. To achieve these, monitoring and evaluation procedures would need to be established and a broad dialogue among public and private market actors to safeguard the integrity of the market. The availability of transparent, consistent data pre- and post-issuance together with the respective methodologies utilized to calculate the data could be a first step towards what Shishlov et al (2016) suggested. Such granular green bond data, if available, would allow to compare data resulting from bonds issuers that utilized different standards and methodologies, and indeed bring out more prominently discussions between private and public actors on the relevance of this data. In particular, data on the green label can lower the cost of capital, as Dorfleitner et al. (2021) found for a global sample of green bonds that investors reward green bonds that are reviewed by external reviews. Indeed, Simeth (2022) finds a yield spread of six to nine basis points lower if a green bond has a pre-issuance Second Party Opinion, as these external reviews signal the credibility and quality of greenness information, available at pre-issuance.

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[4] Data calculated by the authors utilizing public information, press releases, Bloomberg New Energy Finance, Climate Bond Initiative, and Sitawi/NINT data (for Brazilian issuances).

The aforementioned literature indicates the importance of being able to validate the greenness of a bond issuance over time. However, surprisingly the data required to conduct this validation is not readily available in a standardized and consistent manner and costly to piece together.

Climate Bonds Initiative (CBI) conducted three post-issuance disclosure reviews on the reporting practices of green bond issuers and the availability of impact and use-of proceed reports at the global scale and for Latin America and the Caribbean. The latest report, CBI (2021) illustrates that utilizing a sample of globally issued bonds between Q4 2017 and Q1 2019, i) 77% of issuers sampled representing 88% of the amount issued provided use-of-proceeds (UoP) reporting, 59% of issuers representing 74% of the amount issued provided impact reporting, and 57% of issuers representing 73% of the amount issued provided both UoP and impact reporting. The analysis points to larger issuers being more likely to report and that the reporting share has increased over time relative to early stages of the market especially regarding reporting on impacts. Larger bond issuances being more likely to report can be a signal that reporting is more challenging for smaller issuers and that there is potentially a justification for standardization and simplification of reporting procedures, without compromising quality.

The CBI studies were based on samples and required the authors to find all the reports of each issuer. Furthermore, the sample of resulting reports were analyzed for the key performance indicators utilized for reporting. The research work that the CBI team has conducted is time intensive as it is impressive which could also explain that the post-issuance disclosure report series is published every two years. To replicate the data series and provide timely data, a database would require to be updated more frequently. The challenge is on how to ensure 1) a larger sample, and 2) more accurate data on impact reports and use of proceeds reports (which are sometimes difficult to find online) and 3) more detailed and standardized data on greenness which could render more nuanced results.

On the latter, for instance, currently planned and actual project categories, planned and realized performance indicators and project narratives, are reported in a non-standardized way if at all. Issuers utilize their own report formats, usually non-machine-readable pdf files, and the cost of analyzing and comparing between different bond issuances is externalized to third parties. Thus, green bond investors, their analysts, regulators, new green bond issuers, and non-governmental institutions interested in the status and credibility of the green bond market face the same challenge, considering that the development of a consistent dataset takes many hours and small decisions can render different results.

A higher data granularity would allow researchers and investment professionals to dedicate more time to analyze the data and make more informed inferences decisions, respectively. The next section provides an overview of the main characteristics of the GBTP.

II.   CONSTRUCTION OF THE DATABASE

The Platform is a user-driven, reporting database, which can be used free of charge by everybody. All data uploaded to the GBTP is uploaded by two types of so-called qualified users: issuers of green bonds and external reviewers. External reviewers are firms that are hired by the issuers to provide and publish an independent review confirming the alignment of their bond to international standards (ICMA, 2021).[5] Unregistered users are all other interested parties in the platform including investors, asset managers, stock exchanges, researchers, civil society, investment banks, standard setters, regulators.

The decision to develop a platform with detailed green bond market data can be traced to outcomes of the CBI (2019) post-issuance disclosure report and subsequent discussions with the about 30 of the aforementioned market actors on the usefulness of such a platform. The following elements enabled the decision in favor of a platform: 1) the results of the second CBI post-issuance disclosure survey (CBI, 2019) illustrated considerable heterogeneity in reporting practices and depth at the global level, 2) the surprising absence of a freely fully publicly accessible complete database to analyze green bonds' environmental performance and the evolution of reporting practices over time, 3) the importance for detailed data to provide technical support for green bond issuers (see Shishlov, 2016), 4) the challenges faced by issuers worldwide to report in a standardized and comparative manner, 5) the cost of analysis for investors of the greenness (Reed, P. et al., 2019), and 6) the emergence of potentially more mandatory rather than voluntary disclosure requirements e.g. EU Green Bond Standard considered the requirement of mandatory assurance reports over the lifetime of the bond.

The public data in the platform can answer the following illustrative sample questions. A complete overview of data inputs by issuers and external reviewers is provided in sub-section II.2 and all standardized data categories can be found in Appendix II:

- Basic Bond Data:
    - o   Which bonds were issued by which issuer, when, in which currency, and for which tenor and maturity date?
    - o   What type of issuers have issued bonds e.g. sovereigns, local governments, development banks, financial corporates, and non-financial corporates?
    - o   What is the jurisdiction of the issuer?
    - o   What is the equivalent of the volume issued in another currency in USD Dollars?
    - o   Which bonds have matured?
    - o   Which bonds are labelled bonds, i.e. have at least one external review?
- Use of Proceeds:
    - o   In which types of projects and project types were the proceeds of the bond invested?
    - o   Where are the projects located?
    - o   How much of each project was financed by the proceeds of the bonds compared to other

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[5] Issuers can hire an independent external reviewer to provide an opinion on the alignment with international standards, like the ICMA Green Bond Principles, EU Green Bond Standards and CBI taxonomy of the eligible projects. Issuers can obtain several types of reviews with several levels of scope, depending on the bond status (pre-issuance and post-issuance) as described by (CBI, 2021)

external capital providers including the issuer's other funding sources?

- o Was the project re-financed i.e. do the proceeds of the bond re-finance an existing project or a new so-called greenfield project?

- Impact metrics:

  - o What type of environmental impact such as GHG emission reductions did individual projects or groups of projects achieve in each year?

  - o In which time period was the particular indicator achieved (e.g. between June and December of a particular year)?

  - o Which impact methodology was applied to measure or calculate the respective impact metric? Is the reported value pro-rated, i.e. is the co-financing share of the bond issuance considered in the reported data?

  - o How does the realized value (e.g. GHG emissions) compare with the planned value?

- External reviews:

  - o Which green bonds have received an external review pre- and/or post-issuance?

  - o What data was reviewed by an external reviewer pre- and/or post-issuance?

  - o Which external reviewer conducted the review and which methodology did the external reviewer utilize to conduct the review?

  - o What is the conclusion of the respective external review?

Inclusive Participatory Development Process

The platform creation by the Inter-American Development Bank started in mid-2019 to address several market challenges.[6] The platform development was guided from the beginning by an inclusive participatory feedback process with the main market stakeholders: issuers, external reviewers, standard setters and certification bodies, investors and asset managers, investment banks, stock exchanges and market associations.[7]

Stakeholders provided feedback since the concept stage in July 2019 onwards till the present. The result of this ongoing feedback dialogue is that the following key principles guided the platform development and are explained in the following:

1. **First-hand data, Taxonomy Neutrality, Free Access and No data assumptions**

2. **User Support**

3. **User-friendliness**

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[6] At that time, the IDB had provided technical assistance support to about one-fifth of all green bond issuances in terms of volume in Latin America and the Caribbean. For a good overview of the barriers to scaling green and thematic bond markets in emerging bond markets see also OECD (2021b).

[7] For a full list of official GBTP supporters please see https://www.greenbondtransparency.com/support/about-us/ In addition to these organizations, the platform was presented bilaterally as well as in free-of-charge online events to issuers, investor groups, academics and other experts in the US, Europe and Asia to gather feedback and enhance the functionalities of the platform. This is an ongoing process to ensure the GBTP remains useful in the market in the long-term.

4. Issuer reporting needs, commitments, and support

Principle 1: First-hand data, Taxonomy Neutrality, Free Access, and No data interpretation

The data is directly procured from the original source, i.e. the issuer and external reviewer provides first-hand data, ensuring that no interpretation or calculation of an individual bonds data is applied by the platform system. That means that only data uploaded by the issuer and external reviewer is shown on and downloadable from the platform. The platform provides the necessary tools for reporting of use of proceeds and indicators at the bonds program, bond and project level.

The platform is taxonomy-neutral and allows the inclusion of all green bonds, both labelled and unlabeled green bonds. As mentioned by Hyun S., et al. (2021) labelled green bonds are those which have received at least one external review most often regarding the green bond framework. Unlabeled or sometimes called self-labelled bonds are those, which do not utilize an external review due to the clear-cut greenness of the project.

All relevant variables: issuer types, project categories, key performance indicators, level and scope of external reviews pre- and post-issuance are standardized utilizing existing and forthcoming international guidelines and practices, such as the Green Bond Principles by the International Capital Markets Association (ICMA), Climate Bonds Standard by the Climate Bonds Initiative, the European Union Green Bond Standard (EU GBS), and guidance forthcoming from ISO 14030. All standardized coded elements can be found in Appendix II Table II.3.

The data access is public and does not require any login nor payment to view, analyze, or download the data in excel format (see Appendix III Figure I.10 for definitions of data points). To achieve this, the following Data Procurement format was developed for use by the issuers and external reviewers pre- and post-issuance (see also Principles User Support and User-friendliness).

Application Data procurement

User: Issuer and external reviewer

A. Sign-in creation.

Issuers or external reviewer register as users in the platform in two steps. In Step 1, the prospective registered user enters its email address and creates a password. In Step 2, the prospective registered user requests access to the upload functionalities in the role of an issuer or external reviewer, respectively. The GBTP User Support Team (UST) verifies these requests before granting any user access to upload data as an issuer or external reviewer, respectively.[8]

User: Issuer

B. Input Webform (Basic data)

- **Bond Creation** The platform requests information related to the bond issuance.
    - Upload Green Bond Framework pdf document.[9]
    - Add project categories proposed to be financed by the proceeds.

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[8] Issuers and external reviewers can sign-up for several login credentials under the same organizational entity. i.e. an issuer entity can have several logins to the issuer profile. The platform records which login account makes which data changes on the platform (see Appendix I on Blockchain).

[9] Where no framework is available, this step can be skipped.

- Add key performance indicators (KPIs) to be reported against.
- Add methodology used to calculate KPIs.

C. **Input Excel Sheets (Granular data)**

- **Projects excel upload**: Compiles descriptive data of the eligible projects categories under the CBI and ICMA standards, with the potential to include evolving taxonomies like the European Union Green Bond Standard. Location of the project, models and options of financing is also requested. The specific input covers:

  - Name of the eligible project with allocated resources and a brief description.
  - Host Organization - Organization or entity receiving the allocated resources.
  - Country where the project is executed and currency in which the project is financed.
  - Project geo-location.
  - Eligible project categories under the Climate Bonds Initiative (CBI) taxonomy and Green Bond Principles (GBP) by ICMA.
  - Type of financing (refinancing/greenfield and co-financing share).
  - Represented Projects - Number of subprojects in the project, in case an issuer wants to report an aggregated group of projects e.g. 12 Wind farms reported together rather than each wind project reported individually.

- **Disbursements and Allocation excel:** Compiles each project's allocation and disbursement data, for different time periods.

  o Name of the eligible project (as in the Project excel) with allocated amount of proceeds and a brief project description.

  o Allocation & Disbursement dates. Dates on which the issuer allocated and disbursed the proceeds to the project.

  o Allocation currency. Currency in which the proceeds are allocated.

  o Allocated amount indicated in the allocation currency.

  o Disbursed amount in the following currencies: allocation currency reported, the issuance currency, and USD.

- **Key Performance Indicators excel:** Compiles data on the environmental key performance indicators the issuer committed to report against in its green bond framework.

  o Name of the eligible project (as in the Project excel).

  o Performance period of the indicator (from- to dates).

  o Indicator name and the unit.

  o Planned value (estimated value to be achieved) and measured (realized) value of the indicator.

  o Benchmark value, where applicable.

  o Methodology used to measure or calculate the KPI.

User: External Reviewer

Definitions of Standardized Pre- and Post-issuance products

Pre-issuance

- Second Party Opinions (SPO) are used to provide an assessment on the alignment of the green bond framework with Green Bond Principles or equivalent taxonomy.

- Certification are used to certify pre- and post-issuance the bond, the green bond framework, the intended use of proceeds by project categories, and the KPIs (ICMA, Feb 2021). Certification occurs against a recognized external green standard such as the Climate Bond Standard or the EU Green Bond Standard (or any other local or regional standards e.g. ASEAN).

- Ratings, as an assessment of bond's alignment with the Green Bond Principles and the integrity of its green credentials according to an established scoring.

Post-issuance

- Assurance reports, stating whether the use of proceeds has actually occurred.

- Verification of impact reporting, quantifying the climate or environmental impact of a project/asset numerically and methodologically. In some cases, alignment is assessed against a standard.

D. Input Webform

- Upload External Review pdf document.

E. Input Excel Sheets

- **External Review form excel.** The standardized excel sheet is modelled after the ICMA external review form.[10] The external review form is used by external reviewers to summarize the conclusions of the review. It asks responses to a mix of multiple-choice questions, and includes open free-write sections for summarizing each section and the conclusion. The data uploaded by the external review, can be downloaded in excel format by any user to facilitate comparisons between different bonds and their green credentials based on the conclusions of the external reviews. The external review form includes the following four categories, which represent the corresponding four pillars of the Green Bond Principles, and the executive summary: i) Executive summary, ii) Use of Proceeds, iii) Process for Project Evaluation and Selection, iv) Management of Proceeds, and v) Reporting.

Principle 2: User Support

The GBTP provides free technical assistance through the User Support Team (UST). The support functions of the team are conducted via individualized online person-to person calls and the development of manuals and videos. In particular, the UST is responsible to

- Support all Qualified Users linked to LAC issuances to upload their data to the platform.

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[10] Current versions of the ICMA external review form can be found here https://www.icmagroup.org/sustainable-finance/sustainable-bonds-database/#Templatesforissuers

- Present the functionalities of the platform to users and engage them to utilize the platform for impact and use of proceeds reporting and as a key resource to learn from available green bond impact and data of other users.

- Inquire about the needs of each individual issuer and external reviewer and guides them to facilitate their participation in the GBTP.

- Conduct completeness checks of each of the issuances uploaded and inform the issuer on the findings. The completeness check following the procedures illustrated in Appendix II Figure I.5.

- Maintain the list of KPIs up-to-date and provides recommendations where KPIs can be harmonized to simplify aggregation and analysis.

- Inform the market on best reporting practices and existing and evolving green bonds definitions.

- Develop digital media such as manuals and short videos to facilitate independent data upload.

- In particular, to support the scalability of the platform, independent upload and user appropriation of the platform is incentivized through the development and promotion of easily understandable guidance material that presents the GBTP purpose, functionalities, step-by-step use and requested data. All supporting documents are accessible through the Resources Page, where all the material, documents, presentation, and videos are available for interested stakeholders.[11]

Principle 3 User friendliness

A key principle of the platform is user friendliness. For instance, during the concept phase, issuers and external reviewers had asked about the time involved of reporting on the GBTP. Furthermore, a key challenge to be addressed was access to comparable data. Addressing these aspects became essential to facilitate user participation. Thus, user friendliness is essential to motivate i) issuers to report their data through the GBTP, ii) external reviewers to validate their reviews' conclusions, iii) investors and any interested stakeholder including regulators and academics to utilize the data. Thus, the data upload and download process were designed to reduce the transaction costs for the aforementioned parties.

The GBTP development team took the following decisions on the data upload functionality:

1) Issuers shall be able to report within their own reporting commitments based on their green bond framework. Only if they decide to, can issuers go beyond their commitments and add voluntarily more data (e.g. location data of projects using Global Positioning System coordinates). This ensures that the responsibility for reporting and incentives to do so in a timely manner remains with the issuer;

2) The platform shall utilize standard software tools, such as standardized excel sheets, which issuers and external reviewers can be expected to already utilize with a high likelihood.[12]

3) The compilation of the data for issuer and external reviewers should be possible anachronously i.e. parallel compilation of data should be possible. Separating the respective excel sheets allows issuers

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[11] See GBTP Resources page - https://www.greenbondtransparency.com/support/resources/

[12] A key choice was to reduce any additional real or perceived barrier to reporting through the platform. One option discussed was the development and installation of proprietary or open-source software on issuers' and external reviewer' IT systems. However, given the multitude of IT systems involved and potential security concerns on the issuers' and external reviewers' side, this option was discarded in favor of available tools: webform entry and excel sheets, the latter had also often been used already by issuers and external reviewers in the preparation of their reporting.

to separate and delegate the work internally, for instance to finance and sustainability departments, and also work offline before the upload occurs on the platform.

4) This latter aspect, the ability to work offline, allows more senior members of the issuer's organization to review the data before the upload furthermore, and reduces the probability of fat finger errors, i.e. erroneous inputs more associated with the webform entry. The excel sheet variant simplifies the compilation of data and subsequent internal review of the excel sheets before they get uploaded. The use of any webform entries have been thus reduced where possible.

The GBTP development team took the following decisions for the data download functionality:

1) The complete dataset uploaded by the issuers and external reviewers is available for download without login and for free.

2) While there could be tangible benefits to allow download of data only with a login, and thereby recognizing the identity and possibly the type of user, the perception of the GBTP development team was that the platform can convey more trust to its users, if the amount of data captured on each individual identified user is minimized.

3) The download of the data can happen at the following levels:

   i) Individual bond downloads – provides the data described under the data upload such as ticker codes (e.g. ISIN, FIGI), issuance volume and currency, issuer name and country, issuance date eligible project categories, use of proceeds, key performance indicators, the project location, the methodology applied to calculate indicators, and the results of the external reviews and the methodology applied to conduct the external review,

   ii) Program bond downloads – same as under individual bonds with the exception that direct links between bonds and projects cannot be made under this modality,

   iii) list of bonds and their basic characteristics such as ticker, issuance volume and currency, issuer name and location, issuance and maturity date,

   iv) Bulk download of all the data for analysis by investors and researchers.

Principle 4 Issuer reporting needs and commitments

The platform allows issuers to report according to their own reporting needs and commitments. An issuer which finances exclusively one project with one bond issuance can arguably provide more granular data than an issuer financing 100 projects through the issuance of a bond program. Therefore, the commitments by issuers to report are different and dependent on their particular context and cost-assessment of providing the data for each project.[13] Correspondingly, the issuer can utilize the following two modalities to report i) Individual Bonds, and ii) Bond Program reporting.

Bond structure for individual bond reporting

Used for debt securities issued to rise capital to fund projects that have positive environmental and/or climate benefits, including, simple bonds, multi-tranche bonds and multi-series bonds reporting the

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[13] The aforementioned excel sheets under Principle 3 facilitate the inclusion of more data voluntarily, where available.

impact indicators and projects financed only by the respective bond's proceeds.

Bond-Program structure

Multiple bonds may be used by issuers as funding sources for programs of projects. The individual bonds may have completely different parameters (e.g. volume, tranches, markets, currencies, issuance dates) yet their proceeds are accumulated in one "pot" or fund which is then used to finance projects. Because it is not possible to distinguish between the bonds once their proceeds are added to the fund, per-bond reporting of allocations and KPIs no longer makes sense for such bonds. The reporting is then made to the Program-level and the impact reporting is calculated as a pro rata value (see also Discussion Section for methodological challenges).

III. EVOLVING DATABASES

Due to the rapid increase of the green bond market globally and the growing demand for consistent, reliable and transparent data on the use of proceeds and performance metrics, different data providers have emerged in parallel to provide reliable information for investment decisions. ICMA (2021) has recently finalized guidelines on how to develop data platforms and databases considering harmonization needs and reducing the burden for issuers and investors. Furthermore, as part of the guidelines, ICMA (2021) conducted a mapping for databases.[14] The mapping requested information by all data providers and platforms on the services offered, its market coverage, level of impact reporting, and data sources.

A key challenge for data providers is the heterogeneity of the data, nomenclatures and classification systems used. While achieving data harmonization will make it easier for issuers to report consistently as mentioned by the green bonds OECD study (2015), it will also enable data platforms to share data among themselves, and investors to combine datasets from different data providers where required in the absence of a global standard.[15]

In the following, some differentiating aspects applied by different databases are discussed: Cost, Data Procurement, Granularity, Geography, Integrity, Collaboration and Replicability.

1. **Cost:** In principle, there are currently two models: a commercial model, where data providers charge a fee for the use of the data, and a free of fee model, where the data provider shoulders the cost.[16] The public nature of the GBTP data, allows commercial data providers to use the data in their platforms and thereby improve data coverage.

2. **Data procurement:** Data providers use two main sources to collect impact data: First-person data and Third-person data. Most stock exchanges databases, such as Luxembourg Stock Exchange (LGX) use a third-person approach, collecting impact data from multiple sources including public issuer reports. Given the existing heterogeneity in the methodology of different document sources, stock exchanges and analytics trading platforms like Bloomberg LP (BBG), Nasdaq Sustainable Bond Network (NSBN), ICE Data Services (ICE) and the Green Asset Wallet (GAW) usually combine this data, with the one provided directly from the issuer. The Green Bond Transparency Platform (GBTP) approach focuses exclusively on data provided by issuers, and is thus free of interpretation decisions. This approach aims to motivate issuers to be fully responsible for their reporting. Initial discussions with issuers have revealed a large motivation and enthusiasm to provide reporting through the GBTP. The inclusion of external reviewers as Qualified users provides further credibility, as a tag reflecting an external review only appears after the confirmation of the external reviewer. By focusing on first-hand data and not interpreting it (Principle 1), a platform can become a neutral tool for reflecting the environmental impact of debt-securities and support discussions on harmonization and regulation (see Discussion section). Nevertheless, green bond data from the GBTP can be combined with existing databases which offer financial data such as yields and investor holding patterns.

3. **Data granularity:** Data granularity considers both the data provided by issuers and external reviewers. Most databases focus on issuer data (project categories, KPIs) and illustrate the presence of an external review. The GBTP goes further for both issuers and external reviewers. For issuers it

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[14] The IDB GBTP development team is a member of the ICMA Database Working Group.

[15] The IDB GBTP development team is collaborating with two commercial data providers Luxembourg Stock Exchange and Nasdaq Sustainable Bond Network on data structure harmonization and data-sharing agreements, with a view to facilitate harmonization.

[16] In the case of the GBTP, bilateral donor resources allow for the implementation.

allows the inclusion of calculation methodologies and GPS project location data and project narratives. Regarding external reviewers data, it captures the scope and level of the review, the reviewer organisation, the review methodology, the conclusions of the review and the summary ICMA external review form. Table II.2 in Appendix II illustrates the data granularity that issuers can report with.

4. **Data geography:** Data services like BBG, ICE and NSBN provide a wide scope of impact reporting for products other than bonds as ESG data providers. These databases cover the global green bond market and provide analytics based on impact reporting, while the GBTP focus in green bonds issued in Latin America and the Caribbean, providing depth in the impact and use of proceeds data at the project level and consequently, the project-category level per country.

5. **Data integrity:** The platform assures data integrity by incentivizing the updated reporting of green bonds' use of proceeds and impact metrics, supporting annual reports of green bonds and providing an analysis tool to investors, enabling a free and simple access to the green bond data. The interaction between the three key players of the platform issuers, external reviewers and investors, motivates issuers to disclose transparent information and improve the reporting, by labeling the green bonds and reporting under the international standards.

The role of the external reviewers in the green bond market has increased over the years, along with the increase of the products offered to verify the impact. Few data providers, like the GBTP, GAW and NSBN have included the services of external review impact assessment and offer the data services to external reviewers, thus enhancing the transparency and consistency of the data provided. Investors play a key role in motivating issuers and external reviewers to provide the platform with their data and to improve their reporting practices. One approach is the indirect interest investors show for the platform through promotional events and the platform supporters. However, investors themselves can request issuers to participate in the platform, and external reviewers to verify the information published, creating an active reporting and investment ecosystem. Furthermore, the integrity of the data is enhanced through the application of a Blockchain ledger, which makes transparent the data upload transaction by issuers and external reviewers (see Appendix I).

6. **Collaboration and Replicability to other regions and type of bonds:** On the global outlook, current data providers present multiple closed systems databases gathering different kind of relevant information as input, resulting in a limited access to information upon a log-in/fee. The GBTP with its free of charge structure, eases the access of stakeholders to the data and the process for extracting it, promoting the usage of the data as widely as possible also by other platforms. Furthermore, an open accessible system allows for simpler replication in other jurisdictions. For instance, by market actors in other regions, such as Asia, Europe, and the US, or other thematic bonds such as sustainable bonds.

IV. DESCRIPTIVE STATISTICS

The GBTP covers currently green and sustainability bonds issued by Latin American and Caribbean issuers between 2014 and 2022. In this period, a total equivalent of USD 31 billion in labelled green and sustainable bonds with green proceeds have been issued by 80 different issuers and in 160 different issuances within the region. The largest share, 47%, was issued by non-financial corporates, followed by sovereigns (Chile and Colombia) with 25%, development banks for 14%, financial corporates for 13% making up 99% of the regional market.

Brazil, Chile, and Mexico make up 82% of the market. About 71% was issued in USD and EUR (56% for USD and 15% for Euro), and Brazilian Reals being the dominant local currency with a weight of 18%.

Table 2 illustrates the data included in the GBTP since its launch on April, 27 2021. The GBTP covers currently USD 31 billion in green and sustainability bonds.

The average issuance included in the GBTP has a size of USD 220 Million, while the smallest is USD 256,000 and the largest more than USD 2.3 billion. Local currency bonds in the GBTP total USD 5.3 billion, and their mean is considerably smaller at USD 80 Million with the largest issuance USD 390 Million and the smallest as above. The average tenor is 10.2 years with the minimum at 9 months and the longest at 60 years. Most bonds finance on average between 2-3 project categories, with the maximum being 12-13 project categories. A total of 54 different Key Performance Indicators are reported against by issuers, with 5 indicators used on average per bond issuance, the maximum KPIs reported against being 62 by Klabin.
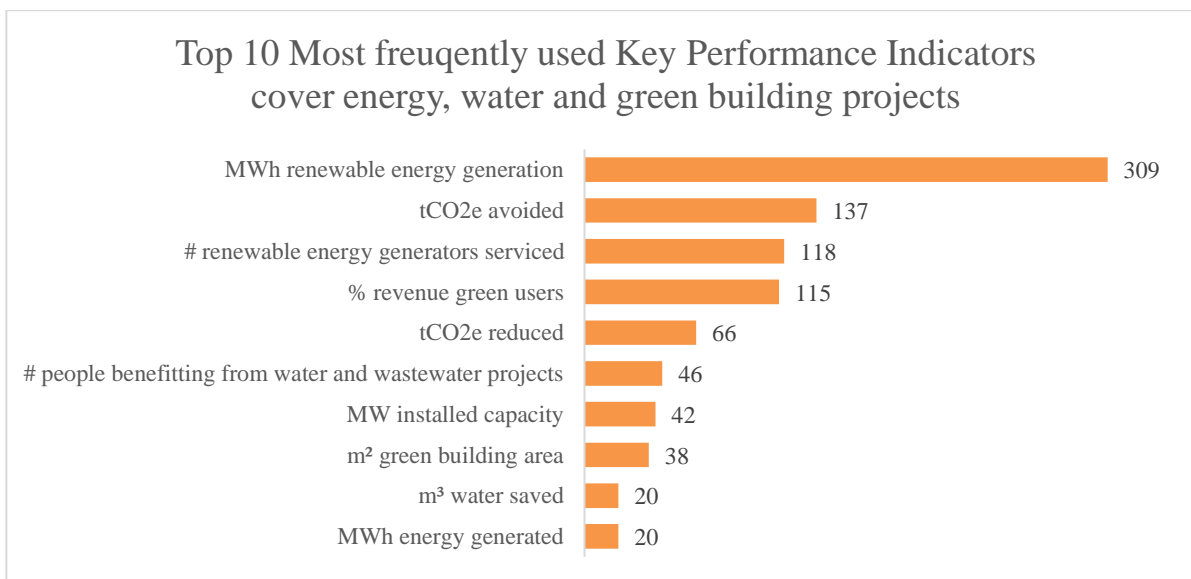
Table 1. Summary Statistics GBTP

	Total	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
Volume issued in USD in Billion	23.8	107	0.22	0.40	0.000256	2.32
Volume issued in local currencies (other than USD, EUR or CHF) in Billion	5.3	64	0.08	0.08	0.000256	0.39
Tenor in Years Total	-	107	10.2	8.8	0.8	60.0
Number of Project Sub-Categories financed CBI (49 Sub-Categories)	-	58	2.4	2.3	1	12
Number of Project Categories financed GBP (48 Sub-Categories)	-	58	2.2	2.2	1	13
Number of KPIs reported against	137	54	4.7	8.7	1	62

Status April 2022. Based on 107 issuances in GBTP
and 58 bonds reporting use of proceeds

Category CBI	#	$ US in Million	Category GBP	#	$ US in Million
Energy	253	5,300	Renewable Energy	242	5,100
Land-use	66	2,100	Environmental Management	61	2,100
Transport	46	1,800	Clean Transportation	46	1,800
Water	165	1,300	Water and wastewater	145	1,300
Buildings	104	488.4	Green Buildings	88	414.3

Other	18	98.5	**Energy Efficiency**	34	206.8
Social	201	81.3	**Other**	2	99.4
ICT	3	57.0	**Pollution**	15	85.3
Waste	4	24.3	**Social**	201	81.3
			Eco-Efficient economy	4	46.7
			Climate Change Adaptation	22	26.9

Regarding the use of proceeds, most of the volume issued finances energy projects and land-use projects, such as forestry and agriculture. These types of projects show the main sectors used by issuers to finance the transition to a green economy.

Top 10 Most freuqently used Key Performance Indicators cover energy, water and green building projects

- MWh renewable energy generation: 309
- tCO2e avoided: 137
- # renewable energy generators serviced: 118
- % revenue green users: 115
- tCO2e reduced: 66
- # people benefitting from water and wastewater projects: 46
- MW installed capacity: 42
- m² green building area: 38
- m³ water saved: 20
- MWh energy generated: 20

One key result obtained using the GBTP data is the high frequency of energy, water and green buildings indicators used in the impact reports. Most issuers report indicators related to emissions avoided/reduced and energy generated, which is in line with the Energy project category being the most financed in volume and number of bonds and the land-use project category, which related to water usage.

V. DISCUSSION

This section discusses different challenges and opportunities to employ the data by different users such as investors, researchers, regulators, and prospective new issuers.

Challenges

- **Aggregation.** Due to the Principle that issuers need to be able to report according to their commitments, over the short-term there is a high variety of key performance indicators and different calculation methodologies involved. Without ensuring that calculation methodologies are equivalent, aggregation of two KPIs with the same name pose a risk that aggregate impacts are overestimated. In the longer-term this can be mitigated as methodologies become standard tools to be identified as early as possibly, where applicable, for both issuers and external reviewers to facilitate post-issuance reporting. According to ICMA (2021), there is no harmonized method for collecting and presenting impact data and the limited consistency, accuracy, depth and scope in the data and reporting provided. Data from platforms such as the GBTP and collaborations with other platforms can provide an input to the discussion of harmonized approaches.

- **Timeliness.** Issuers decide the moment of data upload. This moment might coincide with the yearly anniversary of the issuance date or issuers might chose a different date and frequency for instance anytime any allocation or disbursement to a project is updated or performance indicators change. Issuance dates of issuances vary between the issuances; thus, the platform data is dynamic and changes as issuers upload their data on different dates. Any data analysis, needs to take the dynamic nature of the platform into account. This also means that the platform might not at each moment in time be updated or complete. It is the objective of the UST to support issuers in the upload and it is expected that over time the GBTP becomes a benchmark for reporting which maintains intrinsic incentives to participate.

- **Replication.** The GBTP has been created utilizing a technical structure which can be expanded easily to new taxonomies, jurisdictions, thematic bond types, and new external review types. One of the core advantages of the platform, its dedicated user support, which provides individual support to each issuer, is not trivial to replicate. However, through the development of short educational videos, the support needs can be substantially reduced. For instance, the GBTP welcomed recently an issuer, which uploaded its data independently and without any support from the UST.

The data of the GBTP can be utilized by different actors. For illustrative purposes, the role data can have for each of these actors is sketched in the following illustrative applications.

Investors. Data from the GBTP can support investment analysis and decision making. Investors and asset managers have mandates to buy and hold green bonds and to report on their impact. The GBTP provides a simple virtual portfolio tool to calculate the impact of a portfolio of bonds, without the need to login for the investor. More sophisticated calculations and investor-side assumptions can be made with the downloaded excel sheets. Usually decisions to buy the bonds are taken in the primary market utilizing pre-issuance information. Through the platform, investors can benchmark bonds against each other and also against the bonds of the same issuer based on the investors definition of greenness and sector focus e.g. renewable energy vs low-carbon transport vs avoided deforestation. Investors can utilize the data to deepen the discussion with issuers and become active stakeholders. Granular green

bond data could also facilitate decision-making by those central banks who decide to include green bonds in their reserve management decision (see Fender et al, 2019 for a discussion on including the environmental dimension in reserve management decisions).

Researchers. The GBTP data could allow researchers to deepen their understanding of the links between greenness of a bond, investor holding behavior and pricing in the primary and secondary market. So far, the depth of greenness has not been extensively researched and research on the materiality of green bond characteristics in emerging economies is scarce. The GBTP can provide an important contribution to fill this gap.

Regulators and policy makers. The GBTP data can provide a benchmark about the status of a particular market. The data allows regulatory authorities to do their own investigations on the value and use of external reviews, the stringency of the application of standards, and allow researchers to deepen their understanding of the links between greenness of a bond, investor holding behavior and pricing in the primary and secondary market. So far, the depth of greenness has not been extensively researched and research on the materiality of green bond characteristics in emerging economies is scarce. The GBTP can provide an important contribution to fill this gap. Value and potential risks derived from changes. Currently, reporting procedures are voluntary, however, new standards such as the EU GBS are considering the application of mandatory reporting elements. Emerging market economies who want to participate in a global market might have to comply with these extra-jurisdictional requirements. The GBTP data can provide regulators with an overview of the status and the potential distance between existing and evolving standards.

New prospective issuers. Issuing a green bond is non-trivial and often requires the technical support of external parties such as multilateral institutions, advisors and consultants. The GBTP can provide a simple first stop shop to understand what other issuers have done with the proceeds and how they reported. This can provide a motivation for the issuer to participate in a race to the top in both reporting and application of the bond proceeds over time.

VI. CONCLUSIONS

There is a wide consensus about the importance of the green bond market to support low-carbon development and transitions, especially in developing countries. Different studies have found evidence that greater and deeper financial sector has a positive impact on development and completion of projects with positive environmental impacts. What is less clear from existing research, however, is the information and the level of granularity required to expand the green bond market in emerging countries and provide capital to support low-carbon investments.

The Green Bond Transparency Platform seeks to promote the harmonization and standardization of green bond reporting in Latin America and the Caribbean, as well as support investors and regulators to make well-informed decisions utilizing also green bond data. The GBTP has been developed to provide issuers and external reviewer with a user-friendly, taxonomy neutral and free platform, where the users can utilize standardized templates and access a dedicated user support team. The GBTP facilitates comparisons and compliance with different green bond taxonomies. The ultimate goal of the platform is to offers a detailed and comprehensive source of information about green bonds, in order to support the development of the market and increase the inflow of long-term green investment.

References

Banga, J. (2019). The green bond market: A potential source of climate finance for developing countries. Journal of Sustainable Finance & Investment, 9(1), 17–32. https://doi.org/10.1080/20430795.2018.1498617

Bloomberg New Energy Finance (BNEF). (2022). Sustainability data.

Climate Bonds Initiative (2020). $1 Trillion Mark Reached in Global Cumulative Green Issuance. Available Online: https://www.climatebonds.net/2020/12/1trillion-mark-reached-global-cumulative-green-issuance-climate-bonds-data-intelligence

CBI (2020). Bonds are labelled green by the issuer and should be qualified as green by an independent party. External Review. https://www.climatebonds.net/market/second-opinion

CBI (2021). Post-Issuance Reporting. https://www.climatebonds.net/resources/reports/post-issuance-reporting-green-bond-market-2021

Croce, R. della, Kaminker, C., & Stewart, F. (2011). The Role of Pension Funds in Financing Green Growth. OECD Publishing. www.oecd.org/daf/fin/wp

Dorfleitner, G., Utz, S. & Zhang, R. The pricing of green bonds: external reviews and the shades of green. *Rev Manag Sci* (2021). https://doi.org/10.1007/s11846-021-00458-9

Ehlers, T., & Packer, F. (2017a). Green bond finance and certification. BIS Quarterly Review September. https://www.bis.org/publ/qtrpdf/r_qt1709h.pdf

Environmental Finance & IFC (2020). Green Bond Funds Impact Reporting Practices 2020. Available Online: https://www.environmental-finance.com/content/focus/creating-green-bond-markets/publications/green-bond-funds-impact-reporting-practices-2020.html

Fender, I., McMorrow, M. Sahakyan, V., and Zulaica, O. (2019). Green Bonds: The Reserve Management Perspective. BIS Quarterly Review. https://www.bis.org/publ/qtrpdf/r_qt1909f.pdf

Hyun, S., Park, D., & Tian, S. (2021). Pricing of Green Labeling: A Comparison of Labeled and Unlabeled Green Bonds. Finance Research Letters, 41, 101816. https://doi.org/10.1016/J.FRL.2020.101816

ICMA (2021). The Green Bond Principles. https://www.icmagroup.org/sustainable-finance/the-principles-guidelines-and-handbooks/green-bond-principles-gbp/

ICMA (2021). Impact Reporting Databases. Impact Reporting Metrics and Databases. https://www.icmagroup.org/sustainable-finance/impact-reporting/

ICMA (2021). External Reviews. https://www.icmagroup.org/assets/documents/Sustainable-finance/Guidelines-for-GreenSocialSustainability-and-Sustainability-Linked-Bonds-External-Reviews-February-2021-170221.pdf

Kakeu, J. (2017). Environmentally conscious investors and portfolio choice decisions. Journal of Sustainable Finance & Investment, 7(4), 360–378. https://doi.org/10.1080/20430795.2017.1326454

Ketterer, J. A., Andrade, G., Netto, M., & Haro, M. I. (2019). Transforming Green Bond Markets: Using Financial Innovation and Technology to Expand Green Bond Issuance in Latin America and the Caribbean. Inter-American Development Bank. https://doi.org/10.18235/0001900

Lambooy, T. E., Maas, K. E. H., Foort, S. van 't, & Tilburg, R. van. (2018). Biodiversity and

natural capital: Investor influence on company reporting and performance. Journal of Sustainable Finance & Investment, 8(2), 158–184. https://doi.org/10.1080/20430795.2017.1409524

MacAskill, S., Roca, E., Liu, B., Stewart, R. A., & Sahin, O. (2021). Is there a green premium in the green bond market? Systematic literature review revealing premium determinants. *Journal of Cleaner Production*, *280*, 124491. https://doi.org/10.1016/j.jclepro.2020.124491

OECD, & Bloomberg Philanthropies. (2015). Green bonds: Mobilising the debt capital markets for a low-carbon transition. https://www.oecd.org/environment/cc/Green%20bonds%20PP%20%5Bf3%5D%20%5Blr%5D.pdf

OECD. (2021a). Pension Funds in Figures. https://www.oecd.org/daf/fin/private-pensions/Pension-Funds-in-Figures-2021.pdf

OECD. (2021b). Scaling up Green, Social, Sustainability and Sustainability-linked Bond Issuances in Developing Countries https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DCD(2021)20&docLanguage=En

Reed, P., Cort, T., & Yonavjak, L. (2019). Data-Driven Green Bond Ratings as a Market Catalyst. The Journal of Investing, 28(2), 66–76. https://doi.org/10.3905/JOI.2019.28.2.066

Simeth, Nagihan. (2022). The Value of External Reviews in the Secondary Green Bond Market. Finance Research Letters 46: 102306. https://doi.org/10.1016/j.frl.2021.102306.

APPENDIX I. Technical platform

Database

Financial data is highly relational in nature and relational databases are commonly selected to store, transact in, analyze such data. The platform is not an exception: PostgreSQL was selected as the database backend for its rich capabilities, proven track record, suitability for the project scale and the permissive license. The main entities stored in the database, apart from bonds, are frameworks, projects, disbursements, KPI measurements, as well as various support entities such as the ones to keep users, organisations and jurisdictions.
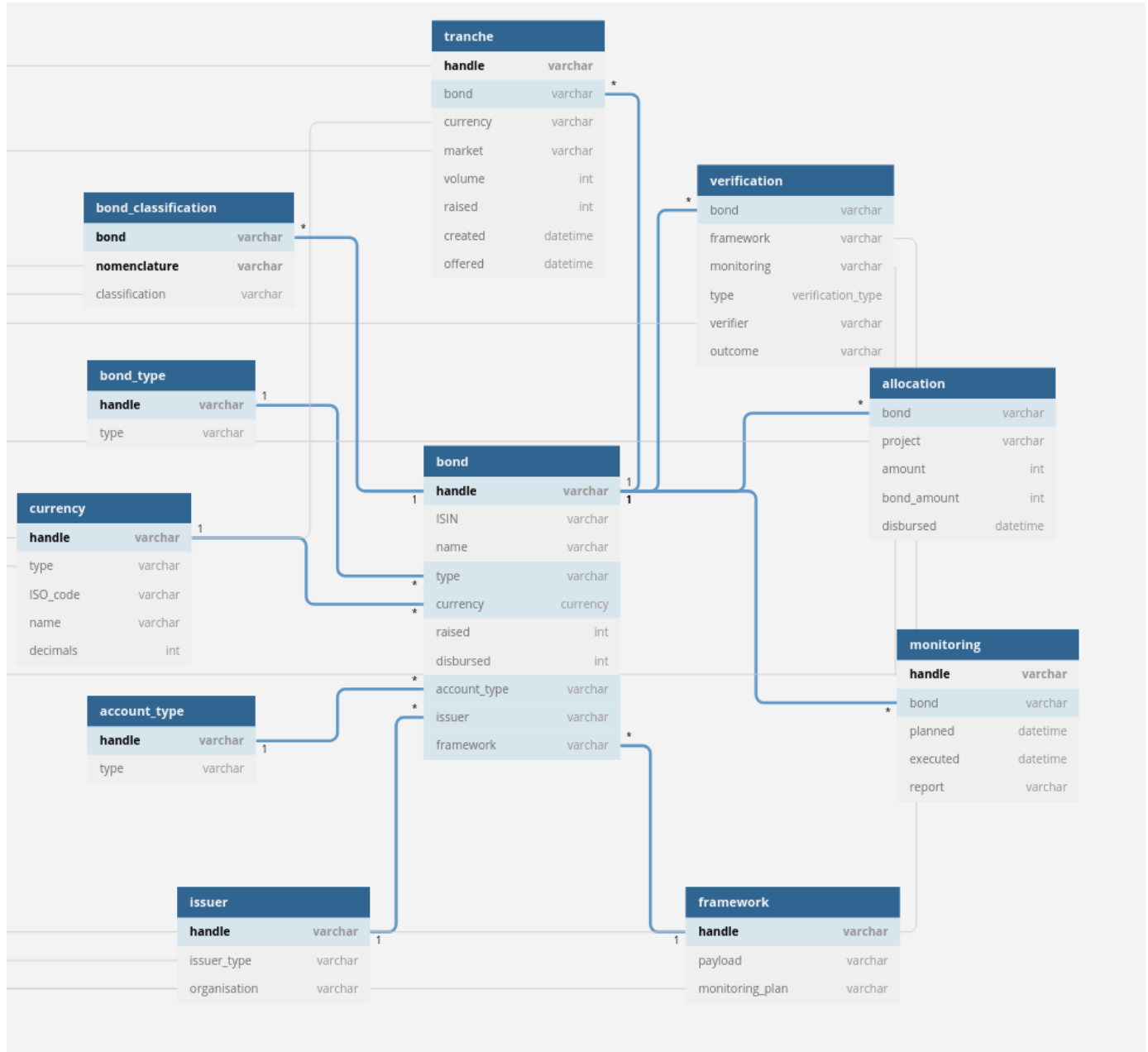
Figure I.1: Bond entity and direct links
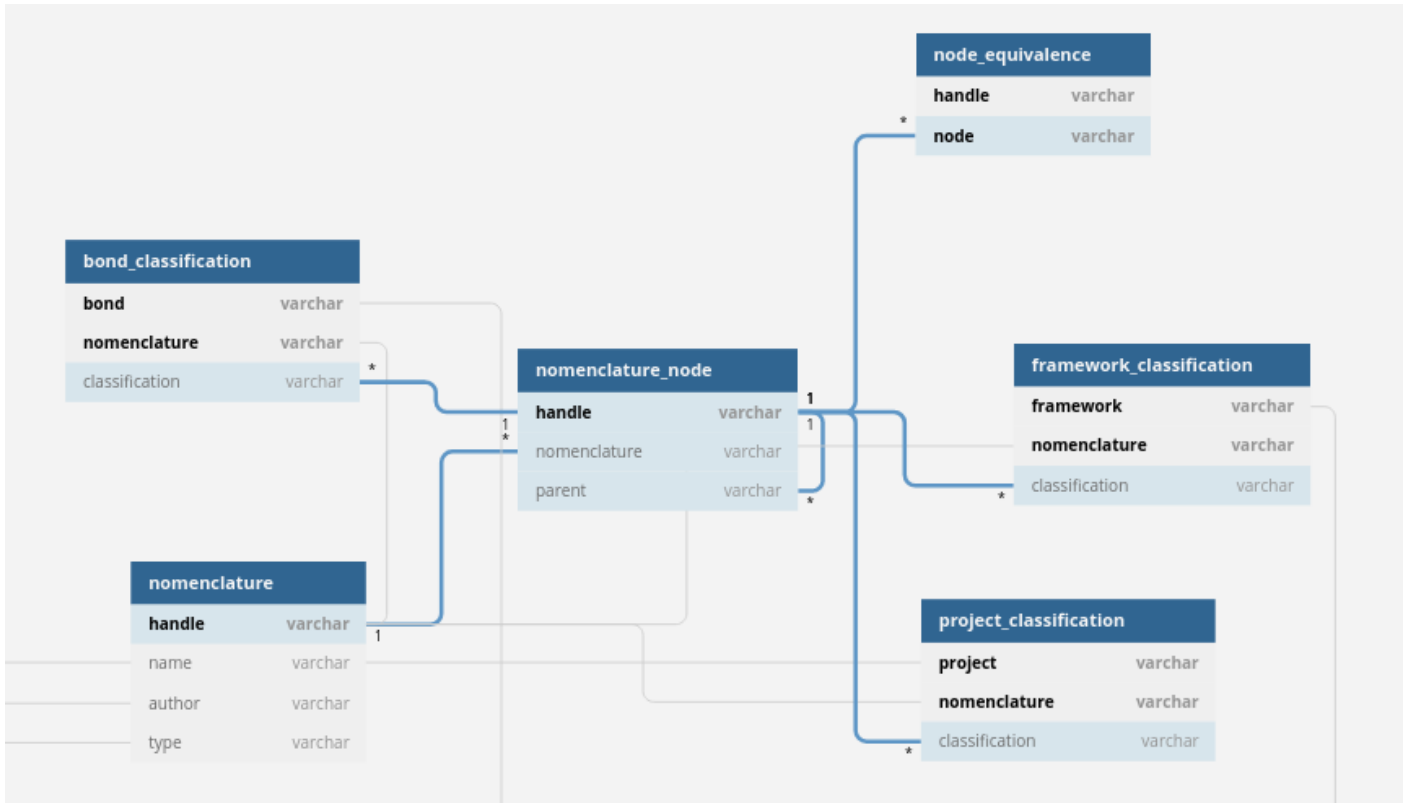
Figure I.2: A tree-like nomenclature structure, node equivalence and direct links

Each nomenclature has a tree-like structure. A concept of "node equivalence" was added in order to make connections between nodes of different nomenclature trees, thus laying a foundation for being able to infer classification under one nomenclature when classification under another one is known. Deeper analysis of existing nomenclatures showed that equivalence sometimes has a very complex nature or not possible at all, so this concept is presently not used in the platform.

The business realities further show that projects may be funded by multiple bonds so projects do not "belong" to a specific bond. There are two ways in which a project may be connected to a bond:

1. It has received funding from the bond proceeds
2. The bond has reported a KPI related to the project
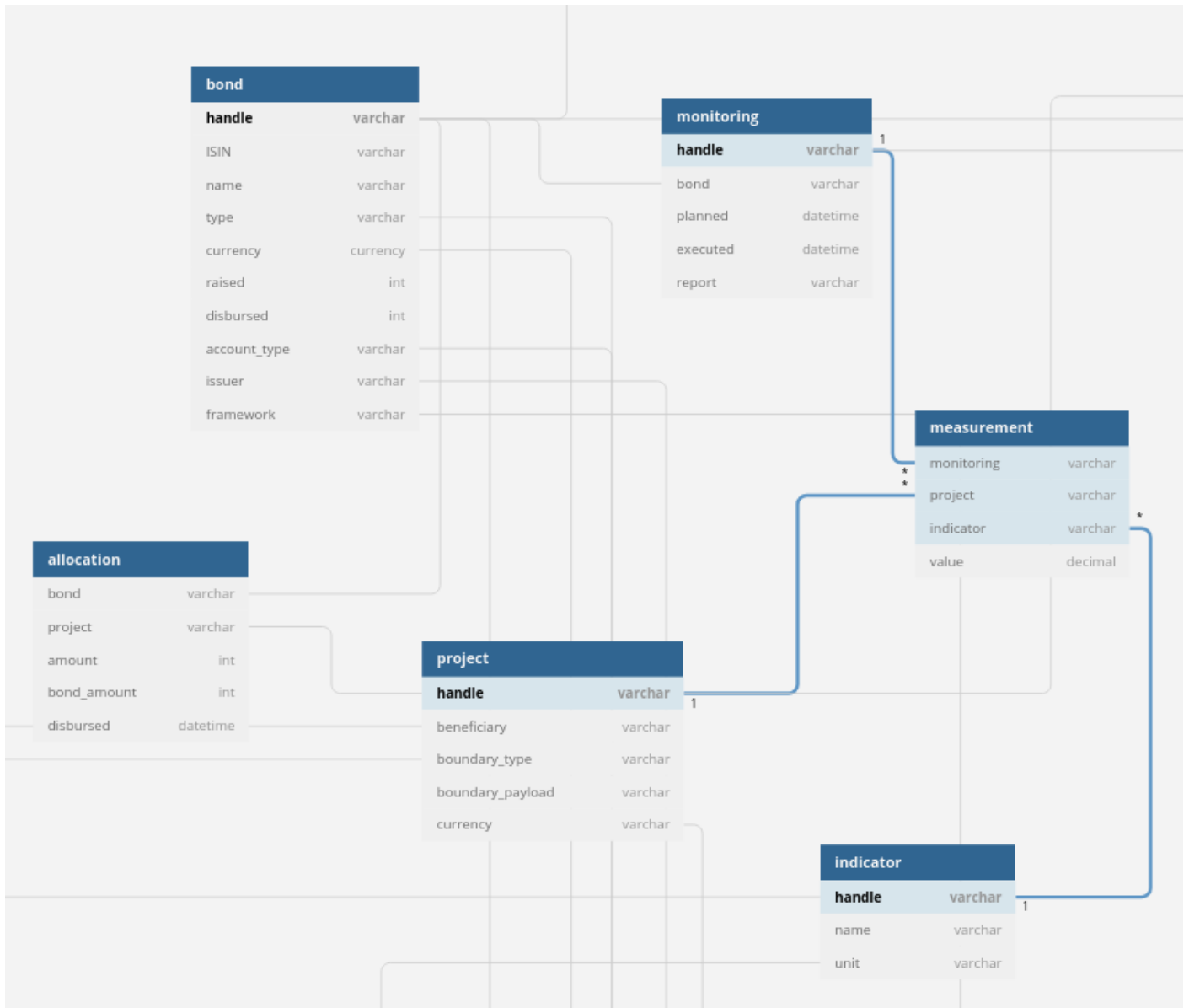
Figure I.3: The link between the bond and the project lies through allocations and measurements

Working with various currencies presents a specific challenge for the platform:

- The bond is denominated in a specific currency but its tranches on different markets may have different currencies

- The projects may receive funds in a currency which is different from either the bond or any of its tranches' currencies

- Allocations and disbursements are made in the project currency but should be accounted for in bond statistics i.e. have numbers reported in the bond currency as well

Currency is therefore prominent in many of the business entities throughout the database. The common practice here, in order to avoid the need to work with exchange rates, which are seen as an attempt at data interpretation, to require reporting in multiple currencies. In the case of allocations and disbursements, a

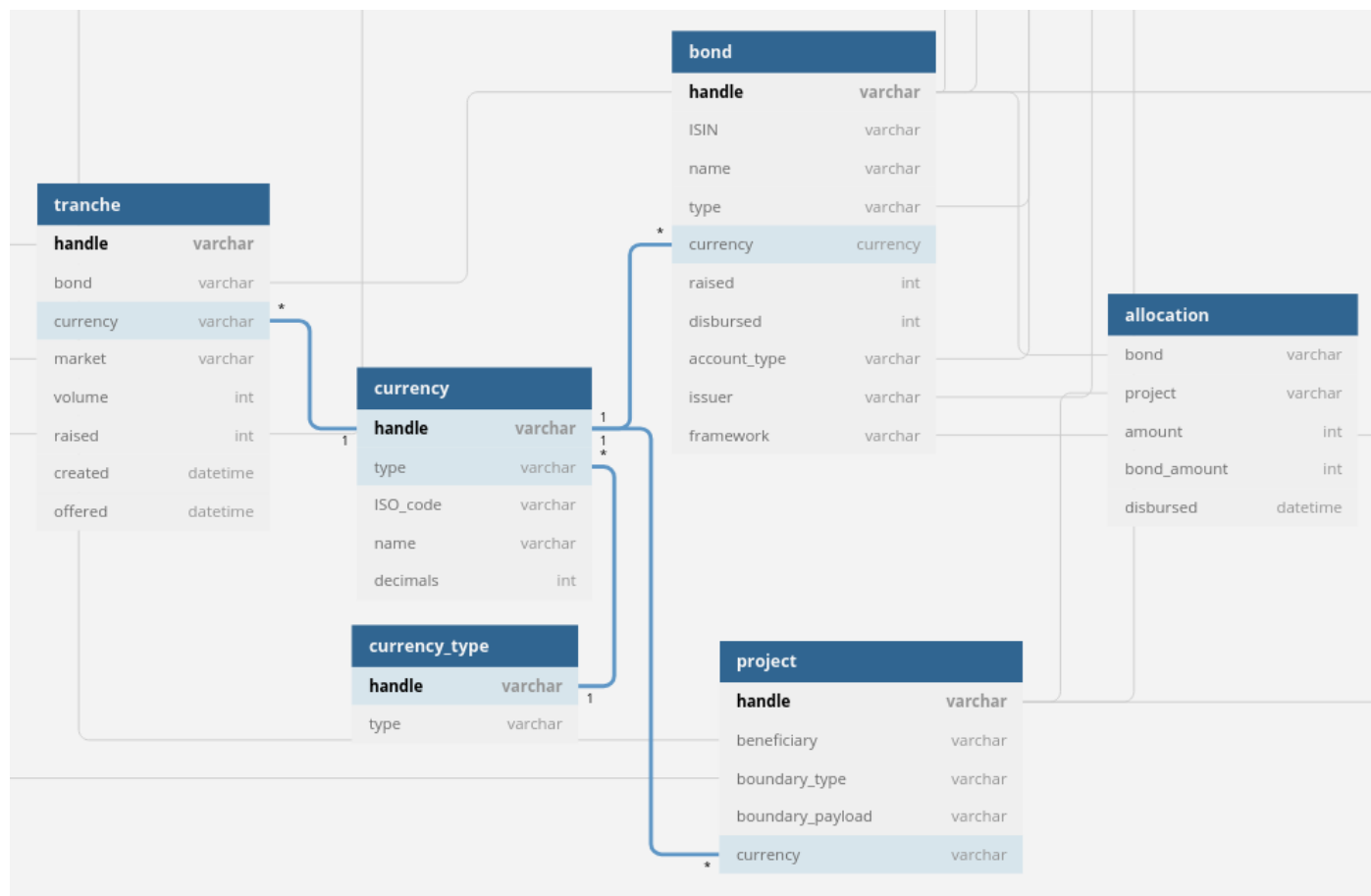maximum of three currencies are involved: the bond currency, the project currency, and US dollar.

Figure I.4: Bonds, projects and tranches use potentially different currencies

The entire schema consists of close to 50 tables and is unlikely to be of interest to the reader.

Application

The application back end is programmed in the Python language. The back end is stateless, which adds a number of benefits in terms of its hosting scenario. All state is recorded exclusively in the database.

Identity management is outsourced to Auth0, a SaaS identity service. Users are identified by their email address which is also used by the notification system to send notification emails. GraphQL was used to maintain flexibility in querying data from the front end. The use of GraphQL allowed to keep the back end very simple. In some cases, however, automated brokering of GraphQL requests generated suboptimal database queries or cursors which were too large to transport to the front end over a potentially slow connection. In such cases (e.g. the generation of the interactive map on the main page) custom SQL queries were developed and used.

The Lektor CMS was bundled with the platform to provide its content management functionalities - FAQ, About us, Resources and similar pages. The Lektor CMS uses a file-based data storage which makes it difficult to make its backups consistent with the backups of the data which resides in the PostgreSQL database. Although strong consistency is not critical in this case, the issue was partially mitigated by co-

locating the database and the CMS file storage and using volume snapshotting for backup.

Blockchain

Various approaches were considered for the use of DLT / blockchain in the platform (see Table below) according to the following criteria: energy/emission intensity, speed, cost, likelihood of business continuity in the medium-term, and the availability of smart contracts and add-on services. It proved impractical to store all data provided by issuers on-chain due to their size, so it was decided to store hashes of bond states on chain each time a bond is published. Engaging issuers and verifiers in working with a blockchain solution presented a potentially major challenge: working with cryptographic keys in the browser was considered too cumbersome for the user and presented a major risk to key safety, while issuing an desktop application to users was not possible due to the locked down PC environments and IT policies of issuers. Presently, all blockchain transactions are initiated and signed for by the platform itself; they currently prove that there was a version of the bond with the given hash at a certain point in time and thus provides some degree of non-repudiation for an issuer or verifier who would like to entertain changing the past.

Blockchain Platform Selection
The usage profile of blockchain favored the usage of a public blockchain. Private blockchain platforms, such as Hyperledger Foundation, either self-hosted or offered as cloud service, were thus not considered.
None of the public blockchains in use currently have been created with the GBTP use in mind. It is therefore recommended not to look at existing platforms from the "intended purpose" viewpoint: some of them come with a strong intended use message, some are more generic, but the GBTP was developed with a new use case with unique constellation of technical and business requirements and it is the match between its business requirements and the capabilities of the blockchain, not the intended purpose of the blockchain, that needs to be the decisive factor in blockchain selection.

Criterion	Bitcoin	Ethereum	Ripple	Stellar
Low emissions	No: proof of work only	Proof of work (now), ongoing work to switch to proof of stake	Yes: probabilistic voting	Yes: voting
Has smart contracts?	No	Yes	No	Yes
Is sufficiently fast?	No	Costly	Yes	Yes
Has add-on integrated services, such as secure data exchange?	No	No	No	Yes
Likely to survive in the next seven years	Yes	Yes	Yes	Yes

Table I.1 Blockchain Selection

APPENDIX II. Variables, Standardized Categories, and Completeness Check Procedure

Table II.1. Issuer jurisdictions

Jurisdiction name		
Argentina	Costa Rica	Panama
Barbados	Dominican Republic	Peru
Brazil	Ecuador	Uruguay
Chile	Guatemala	Paraguay
Colombia	Mexico	Supranational

Table II.2: Overview of data points uploaded by issuer via Excel Sheets

Bond Projects	Bond Allocation	Bond KPIs
Project name - Name of the project to which resources are allocated and for which environmental impacts are measured.	Project name - Name of the project to which resources are allocated and for which environmental impacts are measured.	Project name - Name of the project to which resources are allocated and for which environmental impacts are measured.
Host Organization - Organization or entity that receives project resources.	Allocation date - Date the issuer agrees to allocate X amount of resources to project Y. For some issuers this may be the issue date of the bond and for other issuers that allocate funds over time, it may be the date on which the same disbursement is made for the project.	Performance Period Since - Enter the start date from which the indicator measurement in column D. started to be measured. If there are no metrics yet, please enter an estimated date
Represented Projects - Number of subprojects that can be covered by the project specified in column A.	Allocation currency - select the currency in which the resources were allocated to the project from the drop-down list.	Performance Period To - Enter the start date from which measurement of the indicator started to be measured in column D. If there are no metrics yet, indicate an estimated date.
Country - Select the country where the project is running from the drop-down list	Allocation amount in allocation currency - Amount assigned or committed to the project in the allocation currency selected in column C.	Indicator - select the impact indicator. Consult the extensive list in the "KPI List" spreadsheet, where in column C you find all KPIs available for upload to the platform. It is suggested to search by sector for the indicator closest to your impact metric, copy and paste it into the "KPIs" spreadsheet in column D.

Bond Projects	Bond Allocation	Bond KPIs
Region, Latitude, Longitude and Google Maps Link - Optional information to know the exact location of the project and have an interactive visualization on the platform.	Disbursement date - Date on which the issuer disburses X amount of funds for project Y. In some cases, disbursement is made on different dates or only one for the same project.	Planned value - Indicate the estimated value of the impact generated by the project before the measurement. It is optional.
Currency in which the project is financed from the drop-down list.	Disbursement Amount Reported - Indicate the amount that was disbursed for the project on the date defined in column E, in the currency in which the report was made.	Measured Value - indicates the actual measured value of the impact generated by the project.
CBI project type - Select the most appropriate project category from the drop-down list according to the Climate Bonds Initiative (CBI) categories	Disbursement Amount in Bond Currency - Indicate the amount that was disbursed for the project on the date defined in column E, in the currency of issuance of the bond.	Unit - Impact indicator unit (eg t -> for tons, kg -> for kilograms, etc.). To select your indicator, consult the "KPI List" worksheet in column B.
GBP Project Type - Select from the drop-down list the most appropriate project category according to the Green Bond Principles (GBP) categories established by ICMA.	Disbursement Amount in US Dollars - Indicate the amount that was disbursed to the project on the date defined in column E, in US Dollars.	Methodology – Include the Methodology which was used to calculate the KPI
Refinancing - Select "Yes" if the project is to be refinanced by the title resources or "No" if it is not refinanced.		
Refinancing: A project may have had previous disbursements prior to the issuance of the green bond. With the issuance of the title and meeting the eligibility criteria, the project is reimbursed with the amount invested in the past with the title's resources.		
Co-Funding - Indicate the percentage (%) of the total		

Bond Projects	Bond Allocation	Bond KPIs
project value that the title funds.		
Project Description - Space to write a brief narrative about the project and data of interest to the public and investors.		
Overall Project - If you have an overall project listed in column A that includes other subprojects presented in the template, indicate your name in this column for each subproject that is split from the overall project.		

Table A3 Standardized Project Categories and KPIs

Sector	Water	Land-use	Energy	Buildings	Other	Transport	Waste	ICT
# of KPIs	54	40	30	20	20	10	9	7

Green Bond Principles Project Categories	Climate Bond Initiative Project Categories
Biodiversity conservation - Marine	Buildings - Commercial
Biodiversity conservation - Watershed	Buildings - Products & Systems for Efficiency
Clean transportation - Electric	Buildings - Residential
Clean transportation - Hybrid	Buildings - Urban Development
Clean transportation - Multi-modal	Energy - Bioenergy
Clean transportation - Non-motorised	Energy - Geothermal
Clean transportation - Public	Energy - Grid
Clean transportation - Rail	Energy - Hydro
Clean transportation - Vehicle infrastructure	Energy - Marine Renewables
Climate change adaptation - Climate observation	Energy - Nuclear
Climate change adaptation - Early warning systems	Energy - Solar
Climate change adaptation - Information systems	Energy - Storage
Eco-efficient economy - Distribution	Energy - Transmission
Eco-efficient economy - Eco-label	Energy - Wind
Eco-efficient economy - Packaging	ICT - Broadband Networks
Eco-efficient economy - Products	ICT - Data hubs
Energy efficiency - Appliances	ICT - Power Management
Energy efficiency - District heating	ICT - Telecommuting
Energy efficiency - Energy storage	Industry - Cement
Energy efficiency - New buildings	Industry - Cement, Iron and Aluminium
Energy efficiency - Products	Industry - Chemicals

Energy efficiency - Refurbished buildings	Industry - Fuel
Energy efficiency - Smart grids	Industry - Glass
Environmental management - Afforestation	Land-use - Agriculture
Environmental management - Agriculture	Land-use - Commercial Forestry
Environmental management - Animal husbandry	Land-use - Ecosystem Conservation & Restoration
Environmental management - Climate smart farm	Land-use - Fisheries and Aquaculture
Environmental management - Fishery and aquaculture	Land-use - Supply Chain Management
Environmental management - Forestry	Other - Unspecified
Environmental management - Natural landscapes	Transport - Aviation
Environmental management - Reforestation	Transport - Freight Rail
Green buildings - Commercial	Transport - Public
Green buildings - Residential	Transport - Rail
Other - Unspecified	Transport - Water-borne
Pollution - Greenhouse gas control	Waste - Biological Treatment
Pollution - Reduction of local emissions	Waste - Landfill
Pollution - Soil remediation	Waste - Preparation
Pollution - Waste prevention	Waste - Radioactive Waste Management
Pollution - Waste recycling	Waste - Recycling
Pollution - Waste reduction	Waste - Reuse
Pollution - Waste to energy	Waste - Waste to energy
Renewable energy - Appliances	Transport - Low Carbon Buses
Renewable energy - Products	Water - Distribution
Renewable energy - Transmission	Transport - Private
Water and wastewater - Flooding mitigation	Water - Flood defence
Water and wastewater - Infrastructure	Water - Monitoring
Water and wastewater - Urban drainage	Water - Nature-based Solutions
Water and wastewater - Wastewater treatment	Water - Storage
	Water - Treatment

Completeness Check

This procedure is utilized by the User Support Team (UST) to assess the consistency of the information published on the platform. The procedure is not expected to substitute the bonds' external reviews, instead, it represents the main and traditional completeness and sense check of a bond's information.

- The process consists of evaluating some key points and reporting the findings and discrepancies in a particular data field. The UST informs the issuer or external reviewer.

- First, the UST will identify new bonds published, then the team evaluates the coherence of the bond's issuance data after the bond is published and the alignment of the project categories and project description with the framework and external review (when available).

- Regarding the use of proceeds reporting, on one hand, the team will check disbursements' and allocations' information to avoid discrepancies.

- On the other hand, the KPIs' information will be checked, to seek alignment with the impact report published by the issuer and evaluate the historical track of the indicator to identify coherence and continuity between the data reported.

- Regarding the external review data, the UST will verify if the information reported by the external reviewer is referring to the correct project and mentioning the same key values reported in: allocation, disbursement and KPI.

- Finally, the UST will look at all notes made on the Completeness Check procedure in the "GBTP Completeness Check Form" and if any topic for Adjustment Required by issuer is identified, the UST sends in an email to the issuer.

- If the issuer agrees to correct the information on GBTP, the UST will "Unpublish" the bond and ask the issuer to correct the report in 5 working days. As a final stage, the team will notify the issuer that Completeness Check procedure is finalized and there are no concerns on the report.
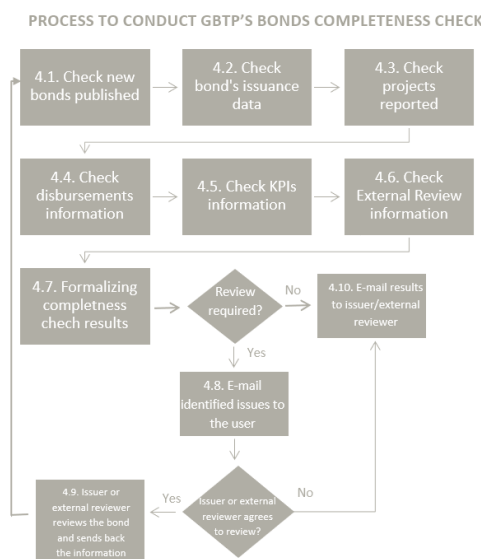
Figure I.5: Process for the GBTP Completeness Check

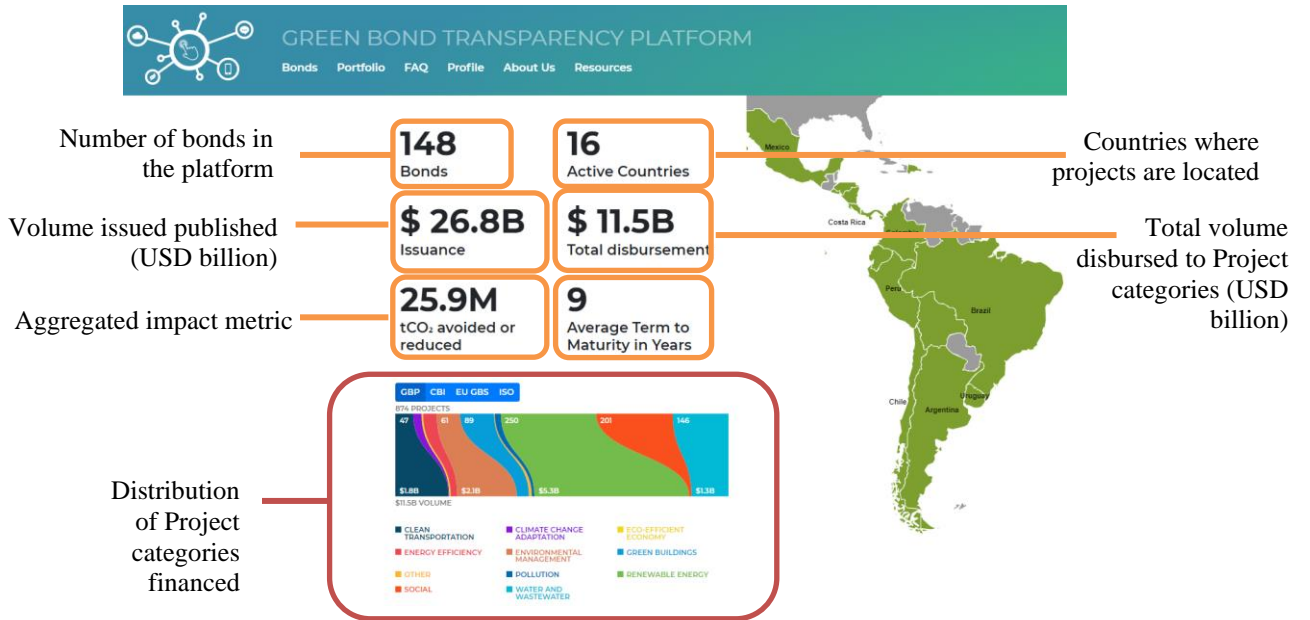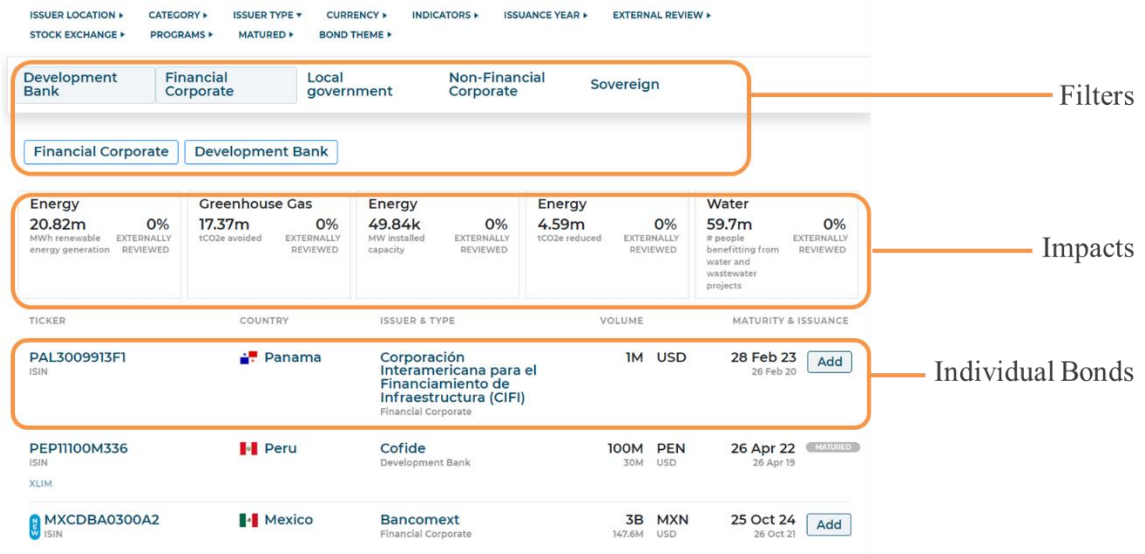**APPENDIX III. Sample Screenshots GBTP**

Number of bonds in the platform

Volume issued published (USD billion)

Aggregated impact metric

Distribution of Project categories financed

Countries where projects are located

Total volume disbursed to Project categories (USD billion)

Figure I.6: GBTP landing page

Filters

Impacts

Individual Bonds

Figure I.7: GBTP Search page

CBI Certified Portfolio

🏛 CBI_CHILE
TICKER

Green Bonds issued by the Republic of Chile, certified by CBI
ISSUER

Ministry of Finance of the Republic of Chile
Sovereign

ISSUANCE VOLUME	LOCATION	TOTAL AMOUNT DISBURSED
USD 7.4B USD 3.8B EUR 3.2B	🇨🇱 Chile	**USD 935.1M** USD 935.1M

Bonds in program:
US168863DL94: Chile - USD 2050
US168863DN50: Chile - USD 2032
XS1843433639: Chile -EUR 2031
XS2108987517: Chile - EUR 2040

`GBP` `CBI` `EU GBS` `ISO` `USD`

Disbursement KPI Blockchain

CATEGORY	SUBCATEGORY	2018	2019	2020	2021	2022
Clean transportation	⊞ Rail	318.4M	244.1M	300.1M	—	—
	⊞ Electric	0.2M	5.2M	20.1M	—	—
Energy efficiency	Appliances	0.1M	0.1M	—	—	—
Renewable energy	⊞ Generation	1.3M	0.5M	0.1M	—	—
Green buildings	Commercial	0.3M	10.5M	14.9M	—	—
Climate change adaptation	Climate observation	4.9M	6.5M	7.8M	—	—

Figure I.8: Bond program view displaying general data and disbursements

`GBP` `CBI` `EU GBS` `ISO`

Disbursement KPI Blockchain

Energy % energy saving	Forest % audit carried	Water % water studies completed	Greenhouse Gas % hydrometeorological station on operation on total station		Greenhouse Gas tCO2e avoided
Energy MWh renewable energy generation		Greenhouse Gas km metro new tracks	Greenhouse Gas # passenger	Energy tCO2e reduced	Local Gases t PM2.5 avoided	Transport # buses replaced

CATEGORY	SUBCATEGORY	2018	2019	2020
Energy efficiency	Appliances		981	1,957
Renewable energy	⊟ Generation	58	62	58
	Construction of Photovoltaic System	58	62	58

Figure I.9: Bond program view displaying impact metrics on a year-by-year basis
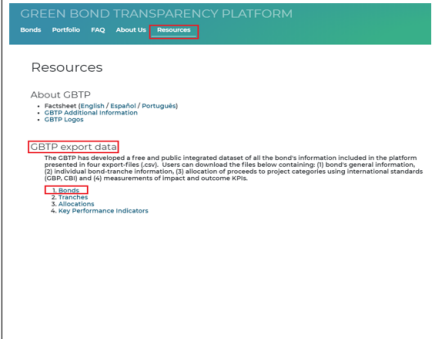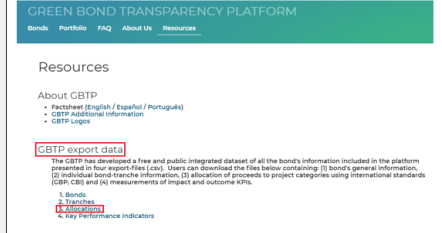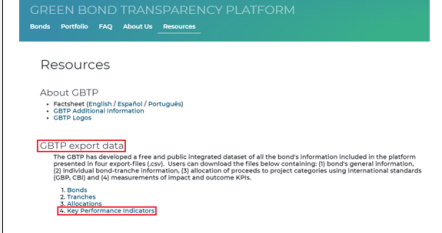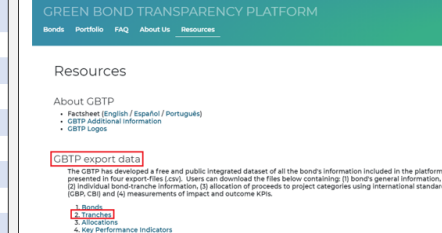
Sheet	Public	Ref. No	Name	Full name	Description	See where to download this information from GBTP here
bond	External	1.01	link	Bond link	Unique link to the bond data in the Green Bond Transparency Platform website.	
		1.02	handle	Link handle	Unique code of the bond registered in the Green Bond Transparency Platform showed in the bond link.	
		1.03	ISIN	ISIN code	International Securities Identification Number (ISIN) uniquely identifies a security.	
		1.04	CUSIP	CUSIP code	A CUSIP number is a unique identification number assigned to stocks and registered bonds in the United States and Canada.	
		1.05	FIGI	FIGI code	The FIGI code a is global identification based on Bloomberg's Open Symbology.	
		1.06	ticker	Ticker code	A stock symbol is an arrangement of characters—usually letters—representing publicly-traded securities on an exchange	
		1.07	name	Bond name	Name of the bond in the platform created by the issuer.	
		1.08	issuer_name	Issuer name	Name of the issuer reporting for the use of proceeds and KPIs of the bond	
		1.09	issuer_type	Issuer type	Type of issuer from the categories: Development bank, Financial corporate, Non-financial corporate, Local Government, Sovereign.	
		1.1	issuer_jurisdiction	Issuer jurisdiction	Country of the SPV issuer reporting.	
		1.11	fund	Fund structure	Indicates if one of the entries has a "fund-structure". "f" means that the entry does not have a fund structure and is not used as a base for a group of bonds reporting allocations and KPIs at the program level. "t" means that the entry has a fund-structure.	
		1.12	issuance_date	Issuance date	mm/dd/yyyy when the bond was issued.	
		1.13	maturity_date	Maturity date	mm/dd/yyyy when the bond matures. Moment in time when the principal of a bond must be repaid to an investor.	
		1.14	volume_usd	Volume issued in USD	USD equivalent of the face value issued.	
		1.15	volume_bond_currency	Volume issued in bond currency	Amount issued in denominated currency.	
		1.16	bond_currency	Bond currency	The denominated currency of the bond.	
allocations	External	2.01	bond_handle	Link handle	Unique code of the bond registered in the Green Bond Transparency Platform showed in the bond link.	
		2.02	bond_name	Bond name	Name of the bond in the platform created by the issuer.	
		2.03	nomenclature	Standard for project category	Standard/taxonomy: used to define project categories: Climate Bonds Initiative Project Classification, ICMA Green Bonds Principles Project Categories, EU Taxonomy Green Bonds, ISO Standard.	
		2.04	category	Project category	Project category under the specified project category standard.	
		2.05	subcategory	Project sub-category	Project sub-category under the specified project category standard.	
		2.06	project	Project name	Project name.	
		2.07	location	Project location	Location of the project.	
		2.08	latitude	Latitude	Latitude in plane coordinates.	
		2.09	longitude	Longitude	Longitude in plane coordinates.	
		2.1	date_allocation	Allocation date	mm/dd/yyyy when the proceeds were allocated/ assigned to the project.	
		2.11	date_disbursement	Disbursement date	mm/dd/yyyy when the proceeds were disbursed to the project.	
		2.12	allocation_currency	Allocation currency	The currency used to allocate the proceeds of the bond to the project.	
		2.13	allocated_allocation_currency	Allocated amount in allocation curre	Allocated amount to the project reported in allocation currency.	
		2.14	disbursed_allocation_currency	Disbursed amount in allocation curre	Disbursed amount to the project reported in allocation currency.	
		2.15	bond_currency	Bond currency	The denominated currency of the bond.	
		2.16	disbursed_bond_currency	Disbursed amount in bond currency	Disbursed amount to the project reported in bond currency.	
		2.17	disbursed_usd	Disbursed amount in USD	USD equivalent of the disbursed amount.	
		2.18	refinancing	Refinancing	Indicated if a project was or not refinanced.	
		2.19	cofinancing_percentage	Co-finance percentage	Share of the total value of the project that was co-finance using the bond proceeds.	
measurements	External	3.01	bond_handle	Link handle	Unique code of the bond registered in the Green Bond Transparency Platform showed in the bond link.	
		3.02	bond_name	Bond name	Name of the bond in the platform created by the issuer.	
		3.03	nomenclature	Standard for project category	Standard/taxonomy: used to define project categories: Climate Bonds Initiative Project Classification, ICMA Green Bonds Principles Project Categories, EU Taxonomy Green Bonds, ISO Standard.	
		3.04	category	Project category	Project category under the specified project category standard.	
		3.05	subcategory	Project sub-category	Project sub-category under the specified project category standard.	
		3.06	project	Project name	Project name.	
		3.07	location	Project location	Location of the project.	
		3.08	latitude	Latitude	Latitude in plane coordinates.	
		3.09	longitude	Longitude	Longitude in plane coordinates.	
		3.10	indicator	Indicator	Name of the key performance indicator.	
		3.11	unit	KPI unit	International measure unit for the KPI.	
		3.12	planned_value	Planned value	Estimated KPI value for the project pre-project execution.	
		3.13	measured_value	Measured value	Real KPI value for the project post-project execution.	
		3.14	can_be_aggregated	KPI aggregated	Indicates if its possible to aggregate a KPI.	
		3.15	methodology_code	Methodology code	Specific code for a given methodology used to measure the KPI.	
		3.16	measurement_period_start	KPI measurement starting period	mm/dd/yyyy when ends the measuring KPI period.	
		3.17	measurement_period_end	KPI measurement ending period	mm/dd/yyyy when starts the measuring KPI period.	
tranches	External	4.01	bond_handle	Link handle	Unique code of the bond registered in the Green Bond Transparency Platform showed in the bond link.	
		4.02	bond_name	Bond name	Name of the bond in the platform created by the issuer.	
		4.03	market	Issuance market	Issuance market: National or International.	
		4.04	stock_exchange	Stock exchange	Bond's listing stock exchange.	
		4.05	tranche_currency	Tranche currency	The denominated currency of the tranche.	
		4.06	volume_offered_tranche_currency	Volume offered in tranche currency	Tranche's offered amount in tranche currency.	
		4.07	volume_raised_tranche_currency	Volume raised in tranche currency	Tranche's raised amount in tranche currency.	
		4.08	bond_currency	Bond currency	The denominated currency of the bond.	
		4.09	volume_raised_bond_currency	Volume raised in bond currency	Raised amount in bond's issuance in bond currency.	
		4.1	volume_raised_usd	Volume raised in USD	USD equivalent of the volume raised.	

Figure I.10: Downloadable data and Definitions of data fields