

Role of Data in the Building of Legitimacy for Green Bonds — Capturing, Contextualizing, and Communicating

Olgerta Tona
Department of Applied
IT, University of
Gothenburg
olgerta.tona@ait.gu.se

Yixin Zhang
Department of Applied
IT, University of
Gothenburg
yixin.zhang@ait.gu.se

Aleksandre Asatiani
Department of Applied IT,
University of Gothenburg
aleksandre.asatiani@ait.gu.se

Juho Lindman
Department of Applied
IT, University of
Gothenburg
juho.lindman@ait.gu.se

Abstract

Green bond markets promise to fight climate change by encouraging green investments. Yet, the real-world complexity of quantifying the green impact of sustainable initiatives might be exploited for greenwashing, thus threatening the entire market's credibility. Advances in business analytics research and practice hold the potential to untangle this complexity. This study aims to explore how one can engage with data to build the legitimacy of green bonds. In particular, we detail data-related needs, requirements, and challenges that are critical to take into account for designing relevant and effective information system artifacts that will support green bond markets. Through focus groups, interviews, and secondary data analysis, we identify capturing, contextualizing, and communicating green impact as core activities for bond issuers toward ensuring legitimacy for their green bonds. Based on these findings, we outline future research avenues and propose an initial set of research questions for the business analytics and, more broadly, information systems community.

Keywords: data, role of data, green legitimacy, green finance, green bonds.

1. Introduction

The European Union (EU) has adopted a vision to achieve net-zero carbon emissions by 2050—a vision that centers on the transition to a sustainable economy (https://ec.europa.eu/clima/policies/strategies/2050_en). Encouraging green investments is one form of efforts geared toward transitioning to a sustainable economy. The idea behind such investments is to offer investors financial instruments, such as green bonds, to fund investments with a positive environmental impact (Banga, 2019). These instruments are

becoming attractive. Currently, we are witnessing high demand for green investment products: Sustainable funds grew from US\$10.4 billion in 2020 to US\$21.5 billion in net inflows in the first quarter of 2021 (Stankiewicz, 2021). The demand is in part driven by investors' moral values and a desire for a positive image and reputation as well as the low risk and future potential of green investment. Bond issuers, such as banks, are motivated to issue green bonds to attract such investors and meet the regulations and recommendations set by bodies such as the EU. Borrowers are interested in receiving green loans and mortgages because of the low interest rates and the desire to adopt an environmentally friendly lifestyle.

However, if the environmental contribution of green bonds is uncertain, “the entire regulatory fabric of the green bond market may suffer from systemic legitimacy deficits in the eyes of investors, stakeholders, and regulators” (Park, 2018, p.7). To illustrate, in 2014, French multinational electric utility company GDF Suez issued its first green bond. It was the largest ever green bond (EUR 2.5 billion) at that time to finance projects on “renewable energy and energy efficiency” (Bouille, 2014). However, one of the projects—the Jirau mega-dam in Brazil—led to environmental disaster. Research shows that the dam projects led not only to deforestation, but also to labor and human rights violations, with the highest impact on indigenous people. GDF Suez's green bond presents a controversial case as to whether green bonds are indeed green, which adds even more fuel to an already-ongoing discussion on greenwashing in the context of sustainability.

Unfortunately, as the example illustrates, companies may engage in greenwashing behaviors—“the practice of directing proceeds from green bonds towards projects having negligible or negative environmental benefits” (Dev, 2020). Behaviors that claim greater green impact (without data backup) than what a project actually achieves erode the credibility

of the green market. Greenwashing can seriously undermine the reputation of green bonds and inhibit the development of a green finance market. Furthermore, green investments may be hampered by information asymmetry and data fragmentation as they lead to a lack of awareness about financial resources for green investment and uncertainties regarding the true impact of green investments (Baker McKenzie, 2019).

To counteract these concerns, the quantification of the environmental impact is a step toward building green legitimacy (Park, 2018). As such, data and analytics take on prominent roles. Business Intelligence and Analytics (BI&A) solutions that aim to generate actionable insights for organizations through data (Chen et al., 2012; Davenport et al., 2012; Phillips-Wren et al., 2015) can equip bond issuers with tools to prove the green impact of their bonds to stakeholders. Given the BI&A capabilities and the wide areas of application (Chen et al., 2012), bond issuers would not only have the possibility to produce reports on green impact, but also track it in the future.

Despite the calls for information systems (IS) researchers to stay abreast of grand challenges, such as environmental sustainability (Gholami et al., 2016; Zhang, 2012), most of the BI&A-related research streams focus primarily on enhancing organizational performance such as improving decision-making performance (Ghasemaghaei et al., 2018), creating strategic value (Grover et al., 2018), enabling service innovation (Lehrer et al., 2018), and driving process innovation capabilities (Mikalef & Krogstie, 2020).

We argue that to support the green initiative (European Commission, 2020) and design relevant and effective BI&A solutions, we should *first* understand the data-related needs, challenges, and activities from an economic sustainability perspective. Motivated by (1) the urgency of addressing the legitimacy of green bonds to ensure the healthy development of a sustainable financial ecosystem (Park, 2018); and (2) the potential of data to make the flow of financial resources to sustainable projects transparent, this study explores the role of data in building the legitimacy of green bonds. Through this study, we also set forward an agenda for IS scholars to join the debate on green bonds and the role of IS in green investments.

This paper is structured as follows. We first discuss green bonds – a type of sustainable financial instrument – and their legitimacy. We then describe the methodology used in this study. Next, we present the main findings. We conclude by outlining three major directions for future research.

2. The legitimacy of green bonds

Green financing and green bonds are receiving increasing attention from practitioners and researchers. According to the International Capital Market Association (ICMA), “Green Bonds are any type of bond instrument where the proceeds or an equivalent amount will be exclusively applied to finance or re-finance, in part or in full, new and/or existing eligible Green Projects and which are aligned with the four core components of the GBP (i.e. Green Bond Principles)” (International Capital Market Association, 2021). Interestingly, there is no legal definition of green bonds. Instead, green bonds are “labeled” by their issuers (Park, 2018). The idea behind green bonds is to offer investors financial instruments for funding initiatives with a positive environmental impact (Banga, 2019).

To facilitate transparency and disclosure for the development of the green bond market, the green bond process is framed by the following four guiding principles: the use of proceeds, the process for project evaluation and selection, the management of proceeds, and reporting. These guidelines aim to increase the transparency of financial resources’ flow among a variety of stakeholders (i.e., “those groups and individuals who can affect or be affected” [Freeman et al., 2010, p. 9]), such as green bond issuers, investors, and borrowers. GBP are considered critical to the healthy development of the green bond market (Park, 2018). Moreover, the EU Green Bond Standard is also based on the ICMA’s GBP, composed of the alignment of use of proceeds with the EU Taxonomy, a green bond framework, allocation and impact reporting, and external verification (EU Technical Expert Group on Sustainable Finance, 2020c). GBP are crucial to the green bond market, and the four principles of GBP offer voluntary process guidelines and emphasize transparency, disclosure, accuracy, and integrity (International Capital Market Association, 2021).

In reality, identifying and categorizing projects that fall into green categories is non-trivial. For example the Mexico City Airport Trust issued the USD 6 billion green bond in 2016 and 2017 to finance the construction of the new Mexico City International Airport — an ambiguous project within the category of green projects (Baker McKenzie, 2019). “Green” bonds can finance projects that claim to promote sustainability, while having minimal to no positive environmental impact (Rajwanshi, 2019). To minimize these risks, data collection and reporting on the use of proceeds and the actual environmental impacts of green projects supported by green bonds

are critical for all stakeholders and for the healthy development of the green bond market.

Another example of hard-to-evaluate green bonds is connected to building renovations. The aim of these types of projects is to improve energy efficiency in buildings. They may involve a considerable number of small- to medium-scale projects and not only businesses but also thousands of homeowners. This further increases the complexity of assessing projects' environmental impacts, keeping track of the use of proceeds, and reporting.

To understand how bond issuers legitimize their green bonds and attract investors, we draw upon the legitimacy theory (for a review, see Suddaby et al., 2017). In this study, we perceive building the green legitimacy of green bonds as a process that “starts from the ground and is built over time” (Suddaby et al., 2017, p. 459). Legitimacy emerges during a non-static and interactive process where different actors negotiate its interpretation and thereby engage in meaning-making (Neilsen & Rao, 1987; Suddaby, 2010; Suddaby et al., 2017). From the process perspective, “legitimation is understood to be a structured set or sets of formal or emergent activities that describe how an actor acquires affiliation with an existing social order or category” (Suddaby et al.,

2017, p. 13). This definition highlights a set of activities related to building legitimacy, such as the use of persuasive language and communication where different audiences are provided with a “narrative structure” (Suddaby et al., 2017). Furthermore, organizations that aim to become sustainable may decide to comply with regulations, set up environmental groups and committees, reach out to external assessment groups, and imitate successful competitors, among others (Bansal & Roth, 2000). To understand the role of data when building legitimacy, we focus on identifying data-related activities that emerge when bond issuers aim to affiliate their bond products with green impact.

3. Research method

We collected four types of primary and secondary qualitative data: focus group discussions, an interview, reviewed regulatory reports, and EU webinars on green finance. Primary data was gathered from organizations located in Northern Europe. An overview of the empirical research material is provided in Table 1.

Table 1. Overview of empirical data materials

Type of data/ Method	Participants	Organizations	Length
Primary/Focus group 1	1. A project coordinator 2. Head of research and innovation 3. Business developer 4. Debt manager	1. Region in Northern Europe 2. Startup company 3. Financial institution A 4. Financial institution A	120 min.
Primary/Focus group 2	1. Head of research and innovation 2. Head of developed capital markets of sustainable bonds	1. Startup company 2. Financial institution B	30 min.
Primary/Focus group 3	1. Head of research and innovation 2. Sustainability officer	1. Startup company 2. Financial institution C	60 min.
Primary/Interview 4	1. Head of sustainability	1. Financial institution A	35 min.
Primary/Focus group 5	1. Head of research and innovation 2. Representatives of bond issuers	1. Startup company 2. Financial institutions A, B, and C	90 min.
Secondary/Expert reports	<ul style="list-style-type: none"> - <i>Final report on the technical expert group on sustainable finance (March 2020) (EU Technical Expert Group on Sustainable Finance, 2020a);</i> - <i>Taxonomy report: Technical annex (March 2020)(EU Technical Expert Group on Sustainable Finance, 2020b);</i> - <i>A renovation wave for Europe—Greening our buildings, creating jobs, improving lives (October 2020) (European Commission, 2020);</i> 		
Secondary/EU webinar series	<ul style="list-style-type: none"> - <i>Series of webinars on the EU Taxonomy—Discussion on future developments with the platform on sustainable finance (February 2021) (European Commission, 2021).</i> 		

The focus group participants were selected based on their experience and interest related to the focus of this study. After identifying and reaching out to key

actors in the green bonds area, focus groups were formed. The discussions in the focus groups shifted from personal experience handling green bonds to

problems with the customer journey engaging with the building renovation to current and future regulations to potential technical solutions. The composition of the groups was diverse to obtain discussion from different perspectives. The participants were a project manager who is managing and coordinating an international research project on building renovation, different representatives of different groups in financial institutions (primarily banks), and a consultant practitioner interested in designing technical solutions. Each of the focus groups was attended by either one or three authors from the team. All focus group discussions were recorded with the consent of the participants and were further transcribed and made ready for analysis. During these sessions, we were introduced to the EU Taxonomy, whose aim is to guide organizations and individuals in transitioning to a sustainable economy. We conducted

an additional interview to clarify certain aspects of green bonds discussed by financial institutions during focus groups. After the focus groups, we immersed ourselves in reading and analyzing the EU regulations regarding green finance. Furthermore, we participated in a series of webinars organized by the European Commission to understand the discussion about future policy solutions, the long-term goal of the EU Taxonomy, and the EU vision for transitioning to a green economy. We took notes during the webinars, which we analyzed against the EU Taxonomy documents. The secondary data provided insights when we analyzed the focus group interviews and created regulatory boundaries around the problem area being explored. Combining regulatory knowledge with practitioner experience provided a better picture of the challenges faced in the green bond market.

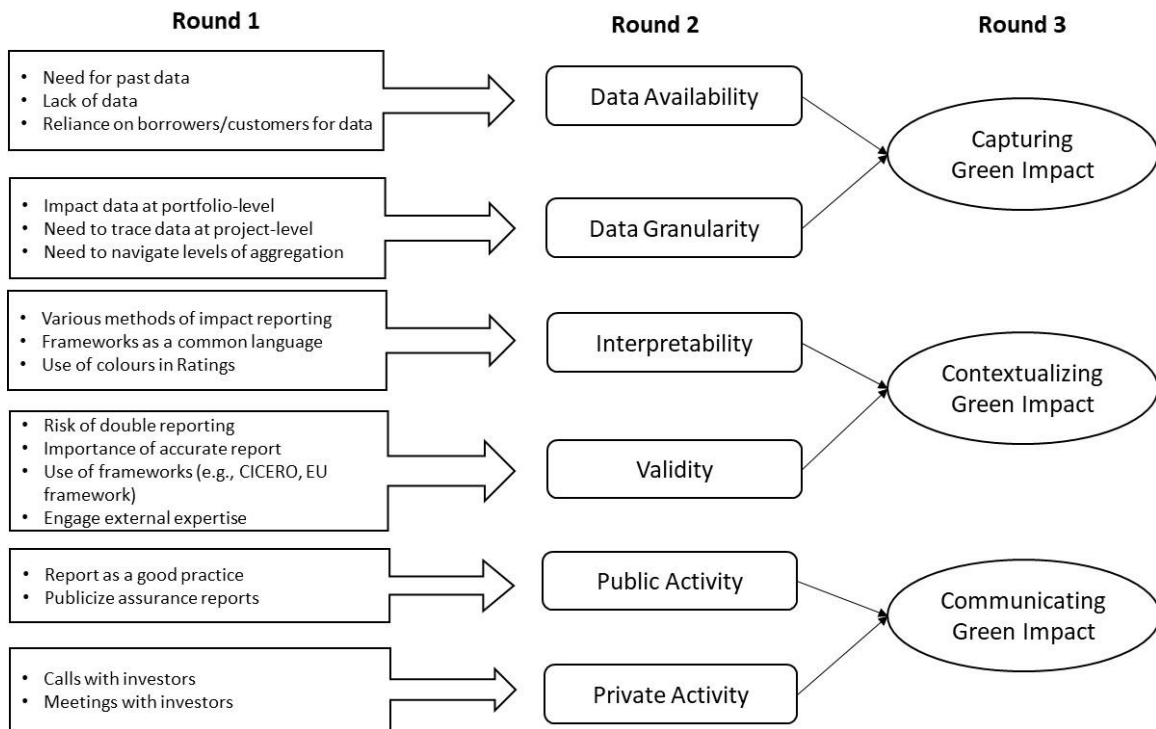


Figure 1. Qualitative data structure

To analyze our data, we borrowed three-stage coding technique from the grounded theory (Charmaz, 2006), starting with open coding. At this stage, the codes were fully data-driven. During the second round, we identified and connected categories informed by open codes. In the third round, we grouped the categories from round 2 with a particular focus on identifying the data-driven processes enacted to assess the green impact (see Figure 1).

4. Findings

Our analysis suggests that bond issuers need to capture, contextualize, and communicate green impact to external actors toward building green legitimacy. For each of these activities, we detail the data-related needs, requirements, and challenges to ensure the positive legitimation of green bonds.

4.1. Capturing green impact

Capturing green impact entails the efforts of bond issuers to extract and store the data that are necessary to provide evidence of the positive environmental impact of their bonds. Our findings highlight data availability and data granularity as key parts of these efforts.

Data availability refers to the extent data can be obtained and used for measurement purposes. Comparing data across different points in time requires access to past, present, and future data:

And this is our vision for bonds: in order to assess the impact of improved energy operations between two points, we would need to know what was the energy efficiencies in these points in time. (Respondent, Focus group 2)

That's the starting point, you know, comparing the before to the after, or the alternative to the after, which gives you a clue on the reduction in for instance kilowatt hours used. And then that has to be translated into CO₂, using emission factors for CO₂. (Respondent, Interview 4)

Often, in the absence of data, assumptions are made to provide a rough estimate of what a particular type of data would look like: *“And we also know the expected or actual energy usage in that building. So, the climate or the impact is calculated by comparing the actual or expected energy usage of the building that we finance, compared with an alternative scenario, where the alternative scenario is the energy performance if that building had been built according to the building code”* (Respondent, Interview 4).

While data are the core asset of the reporting pillar of green bonds, some of our respondents argued that often they are faced with a lack of data related to green impact: *“... you need to report in your sustainability efforts and the outcomes. Of course, data is missing part in everything we do currently”* (Respondent, Focus group 3). Also reported was an inability to capture data at the house renovation level, that is, lower levels: *“The data could be collected on the level the different renovation categories, but not for specific renovations”* (Respondent, Focus group 2).

Precise measurements of the energy efficiency impact of a building renovation are essential for the accurate reporting of a green bond. Given the difficulty of finding that type of information, some bond issuers might be forced to rely heavily on their customers (i.e., borrowers) to self-report the required data. Two respondents said the following:

I mean, we need that [the CO₂ or the KPIs] from the borrower to be able to, you know, pass it through to the investors. (Respondent, Focus group 1)

Up until now, we have been, and by we, I mean the whole banking sector [in a Nordic country], we have created a green loan product that is basically already end-user reliant. The homeowner will give the bank an energy certificate saying that this is really energy efficient house. (Respondent, Focus group 2)

A low level of data availability negatively impacts not only the green impact measure but also the knowledge required to design and construct good measures. Hence, one of the minimum requirements for bond issuers is to be able to provide evidence of a bond's positive impact is to have the capabilities and capacities to connect to the necessary data sources across time.

Data granularity refers to the level of detail of the data captured for the purpose of measuring climate impact. As a bond can be used to finance different portfolios, projects, or activities, analyzing data at different levels is necessary to provide detailed reports to regulatory bodies, investors, and customers:

We report on a portfolio basis. When we issue green bonds, the impact from each specific green bond is associated to the total portfolio impact [...] But we issue bonds on a portfolio level, so any specific green bond, it's associated with all the projects in the portfolio, so we don't do a bond-by-bond approach, connecting a specific bond to a specific project. (Respondent, Interview 4)

Other respondents described challenges in tracking down the climate impact on a project basis, such as the following: *“We should actually for every single project that we have—being a mortgage, being a large loan to a large company, we should be able to address the climate risks and the climate impacts. ... So, we tried to do that for sectors as for now, but going forward, we will need to do that on project by project”* (Respondent, Focus group 3).

But it will be interesting also to then process, what's the environmental, what's the emission reduction impact of these small projects together. (Respondent, Focus group 1).

Granular data enable the traceability of environmental impacts at different levels (i.e., the project, investor, and bond level, among others), which contributes to the transparency of green bonds for all stakeholders. One respondent stated, *“We would need to track the money that we borrow in the financial markets, and make sure that it's invested according to our framework”* (Respondent, Focus group 1). Yet, navigating the data's level of detail (e.g., through drilling down and rolling up operations) is considered an issue: *“I also say that there are two aggregations we need to solve. One is the aggregation of lenders and another one is the aggregation of impact”* (Respondent, Focus group 1).

Through the focus group discussions, we also noted that the need to aggregate smaller loans into large enough green bond products to offer liquidity to attract investors further complicates the abovementioned issues. A respondent said the following:

... Size attracts investors. Investors don't want to be active in trades which are small, because then they don't feel that there's liquidity, meaning that they don't feel that if they go into a bond, they might want to switch out of it at some time. (Respondent, Focus group 1)

Solving the challenges related to data granularity matters not only for setting up appropriate measures in place but also to be able to highlight individual projects that can be problematic from a climate change perspective. We notice a close relation between data availability and granularity in that data availability will suffer if bond issuers are not able to capture data at different levels.

4.2. Contextualizing green impact

Contextualizing green impact entails the activities bond issuers enact to facilitate the meaning-making process of their green measure. They do so by enhancing the investors' and customers' interpretability of the "greenness" and improving data validity through third-party verifications.

Interpretability requires the green impact number to be presented comprehensively for other stakeholders to interpret and act upon. However, making a green investment choice can be difficult given the variety of impact measurement methods employed by bond issuers, which often can lead to inconsistencies across different impact reports of green bonds:

But what you can say about reporting itself is that first of all one thing that we acknowledged from the investor meetings that we had was that it's fairly tricky for investors to get the full picture of an [issuer of green bond] because every issuer [report it] in different ways. They have different baseline scenarios, they have different calculation methods, etc. (Respondent, Focus group 1)

One way through which bond issuers aim to enhance interpretability is using frameworks. Frameworks act as a "common language" between bond issuers and investors. One respondent states,

And then we have a framework in the industry and this is really important in dialogue with our investors. Within the framework we have energy efficient activities and criteria that make the loans green. (Respondent, Focus group 2)

Another way through which bond issuers signal the greenness of a bond is by using colors and badges. A respondent gave the following example:

Obviously, we have this second opinion from Cicero [<https://cicero.green>], that sort of confirms that an external firm have confirmed that what our ambition is very high, it's very good. And they awarded us (...), with a dark, the majority of color that they give us is dark green, which is the best possible shade of green that you can receive for this... the rating itself is good, but there's always room for improvements. And it's all a matter of how much time and money do you want to invest in getting a high rating. There are demands from some investors that you need to have a rating from XYZ rating agency and it needs to be higher than this. (Respondent, Focus group 1)

Transparency does not necessarily lead to interpretability. Interpretability is important for decision makers to make sense of different scenarios and make informed choices in line with their values.

Validity includes the regulatory and organizational practices that review and establish the accuracy of green bonds—meaning that bonds reported as green are actually green. One factor that diminishes the accuracy of the impact assessment is the risk of double reporting for each activity funded by the same bond. Double reporting leads to inflation of the impact, where the sum of reported impacts from different green investments is more than that from real-life green activities—hence diminishing the transparency of how bonds are used and their specific environmental impacts:

All projects impact is quantified based on the share of the investment cost that's been financed by [name of bond issuer] and on agreed loans dispersed and outstanding. I know that some issuers, they can have a project, which has been financed by a lot of different institutes, but they sort of say that we financed the whole. So, they report on a whole basis, instead of just the part they finance. (Respondent, Focus group 1)

Indeed, reporting accurate measurements is important to maintain the transparency and level of trust among stakeholders: *"We currently have a third-party end-of-year review and we also do impact reporting for the investors. Thus, we report those and there is even a mortgage part and we list CO2 emission impact and try to be very transparent with those. The more information we provide to the market, the better the investors like those efforts"* (Respondent, Focus group 3).

Frameworks are an important tool to classify activities that are eligible for a green bond. For instance, one of the respondents described their

framework as follows: “*So, what we did was that, first of all, we work together with one of the biggest [...] banks at the time, on green bonds, to help us compose this kind of framework. They worked quite closely with Cicero, I don’t know if you’re familiar with Cicero, it’s the Center for International climate and environmental research. It’s a Norwegian Institute. And they provide a second opinion on this framework that we have. The framework itself adhere to the four pillars of the green bond principles, where we stay to use or proceeds product evaluation and selection, management or proceeds and reporting*” (Respondent, Focus group 1). Another respondent points to the importance of EU frameworks: “*Also, investors if you invest in anything, and you, shares, stocks, bonds, what have you, you need, if you call it a sustainable fund, or you have a sustainable label to it, you will need to also address this question of how much is good in the EU taxonomy*” (Respondent, Focus group 3).

Some bond issuers go even further by setting up expert groups in order to enhance the validity of their green bond: “*So, one of the one of the first things we did was actually to organize an environmental committee. And I think we were one of the first ones in the world-ish, especially related to green bonds, who had this environmental commitment, this type of external expertise*” (Respondent, Focus group 1).

Overall, bond issuers need to contextualize their green impact measures through the use of frameworks and back up their measures through third-party verifications in order to enhance legitimacy and attract investors. These activities are key to facilitate meaning-making across a number of actors during this legitimation process.

4.3. Communicating green impact

When the impact of a green bond is captured and contextualized, bond issuers use a variety of communication forms to make it available to other actors in an effort to create a space where legitimacy is negotiated among actors. Our data show that bond issuers initiate public and private activities to communicate their green measures.

Public activity is characterized by the publication of official impact reports. While it is not legally required, it is considered good practice to increase transparency and reach out to the public: “*Yeah, so there is not a legal requirement to publish the impact report. It’s however recommended good practice according to the ICMA Green Bond Principles. So, we try to effectively voluntarily process guidelines for issuing green bonds. So, it’s considered good practice to publish an impact report and most green bond issuers do that as well*” (Respondent, Interview 4).

Furthermore, some bond issuers go even further and make public their financial assurance reports: “*we publish annually what we call an issuance report, and that is a report undertaken by our external auditors, basically verifying the allocation of bonds proceeds. This means that the auditor checks that the amounts that we have raised from green bonds have been allocated to the green loans and their associated green projects*” (Respondent, Interview 4).

Reporting is an important public activity to increase transparency and signal seriousness regarding the way bond issuers handle climate change issues and concerns.

Private activity refers to the communication practices with external parties, such as investors, that are not open to the public. Quantifying the impact of a green bond in terms of decreased carbon emissions and increased energy efficiency indicates the extent to which a bond is green. However, during the focus groups, we found that often the information provided to investors through different published reports was insufficient to build a complete picture. So, bond issuers interact with investors through different channels, as indicated by our respondents:

We do have regular calls with investors, where we have to explain our story, whether there are questions when it comes to the US and dollars. They can be very thorough when it comes to the analysis. And they can ask extremely tricky questions. (Respondent, Focus group 1)

So, when we issued the first bond it was very necessary to meet up with a few investors or with a lot of investors and explain the story, especially since the framework is very broad... (Respondent, Focus group 1)

Even in contexts where investors receive a great deal of data, the interpretability of this information, from the investors’ perspective, is not always certain. The lack of interpretability in the reports forces financial institutions to reach out to investors through other communication channels, such as meetings and phone calls, to make their case of green impact. At the same time, this practice enhances trust between investors and bond issuers regarding the green activities funded by a bond.

5. Discussion and future research

The IS field is lagging behind in the discussion of contemporary challenges of sustainability, and particularly green finance. Specifically, we believe that BI&A stream of research holds the potential to support the building of legitimacy of green bonds in the finance market. Yet, before designing a BI&A solution, one needs to understand the role of data in building the legitimacy of the green bond.

Our foremost contribution is detailing the main activities (i.e., capturing, contextualizing, and communicating the green impact) that bond issuers engage with when negotiating with other actors as to the extent to which their bonds are green. We name these activities the *three Cs of green bond legitimacy*. Although we discuss the three Cs separately, they are undoubtedly interlinked. We argue that data are often fragmented, which undermines the efficiency of investment allocation to impactful green projects. The resulting lack of transparency could easily lead to mistrust in green bonds. Even when the required green impact data are captured properly, they are not always contextualized and narrated properly, leading to poor interpretability.

While the data-related challenges entailed in the three Cs are increasingly discussed in the IS discipline, we argue that the context of green finance and sustainability increases their relevancy and creates research opportunities for IS scholars to meaningfully contribute to combating one of the biggest challenges of our time—by advancing academic discussion and informing practice. In this section, we propose directions for future research that build on our three Cs of building green bond legitimacy. We also discuss some examples of how such future research can be shaped. The list is not exhaustive and was tailored to illustrate the way IS research can contribute to identifying and solving these challenges. We call not only on the BI&A researchers but also on the larger IS community to dedicate its attention to the challenges.

Capturing. Our findings reveal that bond issuers face challenges capturing data to be able to calculate the green impact of their bonds. These data, as a form of language, are important for the emergence of collective meaning-making (Suddaby, 2010; Suddaby et al., 2017). For external stakeholders, the deficiencies in data capturing ultimately manifest as poor data availability and granularity. As a result, potential investors may remain skeptical of the true green impact of the bonds as they find the data either insufficient or untrustworthy. To mitigate these challenges, we suggest that future research consider the following research question: *How can the green impact data capturing be designed in such a way as to ensure the availability of granular and trustworthy data?* BI&A research areas could contribute to answering this research question by focusing on developing business/big data analytics capabilities in the context of green bonds. This research could shed light on how bond issuers could redesign, plan, and orchestrate the necessary resources to leverage data for capturing green impact (e.g., Mikalef et al 2018).

A second promising research area is blockchain, which has emerged as the underlying decentralized

data infrastructure that is exemplified by early use cases in cryptocurrency bitcoin, land registry, supply chains, and identity management (for more use cases, see Lindman et al., 2020). The main promise of the technology is to question decades of the centralized practice of computing in IS (Lindman et al., 2017; Sørensen, 2016). Blockchain technologies relying on a network of decentralized database could offer solutions to data granularity, transparency, and trustworthiness. Potential research efforts in this area could be, for example, related to novel designs for the immutable storage of green project data (especially bonds), decentralized governance infrastructures for impact measurement, or novel, more transparent green data consent management systems based on blockchain.

Contextualizing. Data without their context can be of limited use. In a negotiation process, part of legitimation construction, data and text are interpreted and re-interpreted by a variety of actors (Suddaby et al., 2017). Our findings suggest that data were mapped against a variety of frameworks and dimensions in an attempt to align different actors in the same negotiation space. Scholars emphasize the need to tailor explanations of data and IS actions to each stakeholder, and emergent technologies such as machine learning and artificial intelligence in IS research have reinvigorated the discussion of the interpretability and explainability of IS outputs (Asatiani et al., 2021). While in this context we do not necessarily deal with a black-box algorithm, if the green impact measures come without the necessary context, they become uninterpretable for the potential investors. To tackle this challenge, we propose studying the following research question: *How can green impact data be contextualized to generate actionable insights for actors involved when building green legitimacy?* Examples of research areas that can investigate this question are data science and BI&A. Currently, the IS discipline is heeding calls for more IS-oriented data science research to solve contemporary grand challenges (Saar-Tsechansky, 2015), and we believe that the context of green bonds and their impact on the environment represents a fertile area for data science and BI&A applications. Data science might advance the information challenges by developing new constructs, measurements, and artifacts based on the design science perspective (Hevner et al., 2004), which might manifest into statistical techniques and measurement approaches. Similarly, BI&A might shed light on how to make sense of data and generate actionable insights (Chen et al., 2012; Mikalef & Krogstie, 2020). Given the risk of a tradeoff between accuracy and interpretability, it is important to consider that in this

particular context, the generated insights should be highly interpretable by decision makers who need to make informed decisions, such as funding green activities or investing in green bonds.

Communicating. To establish legitimacy, contextualized green impact data need to be communicated to the external stakeholders effectively. Indeed, one of the key activities of building legitimacy is communication and the use of persuasive language (Suddaby et al., 2017). While there are standardized (or sometimes mandated) procedures for the public reporting of green impacts, some stakeholders, such as bigger institutional investors, require a more personalized and direct approach. Research on establishing legitimacy through the communication of corporate social responsibility suggests that in addition to standard communication activities (e.g., promotion, rhetoric), creating stakeholder value through collaboration and engagement is highly important (Nielsen & Thomsen, 2018). Modern IS and communication platforms offer a broad portfolio of tools to communicate green impact data and directly engage a wide range of stakeholders. Here we propose a further research question: *How can bond issuers create communication strategies aimed at increasing actors' participation in constructing green legitimacy?* To study this question, researchers could build upon an emerging area of ethics for big data analytics, dignity, data transparency, and social inclusion. Given that data are expected to be shared among stakeholders, it is critical to explore ways of increasing awareness among all stakeholders across levels about data collection, data sharing, and data use to minimize the risk of breaching confidentiality and privacy (Martin, 2020). From the perspective of big data and analytics, new codes of ethics could be developed to protect against unwanted and destructive behavior (O'Leary, 2016). These issues are especially salient for green bonds connected with building renovation projects and individual homeowners.

Furthermore, no or limited information democratization threatens human dignity (Leidner & Tona, 2021). To protect it, IS researchers should pursue research on how to enable easy access to information resources, especially those that are necessary for an eco-friendly life. Facilitating information democratization supports not only the dignity of those who care about the environment and want to engage in green choices, but also enhances social inclusion to unite against climate change.

7. Conclusions

In this exploratory qualitative study, we explore the role of data when building the legitimacy of green

bonds. While green bonds hold the potential to reduce carbon emissions, ensuring their greenness is complex. The complexity stems from the involvement of diverse stakeholders, lack of data, low data aggregation levels, different bond assessment frameworks, and various reporting methods, among others. We strongly believe that the IS field and, in particular, BI&A and big data analytics researchers should take on a more active role in combating climate change by advancing the knowledge and tools needed to address these major challenges.

Acknowledgments

Authors want to thank Interreg North Sea Region Program (2014-2020) project STRONGHOUSE for supporting this research effort.

7. References

- Asatiani, A., Malo, P., Nagbøl, P. R., Penttinen, E., Rinta-Kahila, T., & Salovaara, A. (2021). Sociotechnical Envelopment of Artificial Intelligence: An Approach to Organizational Deployment of Inscrutable Artificial Intelligence Systems. *Journal of the Association for Information Systems*, 22(2), 325–352.
- Baker McKenzie. (2019). *Critical challenges facing the green bond market*. [https://www.bakermckenzie.com/-/media/files/insight/publications/2019/09/iflr--green-bonds-\(002\).pdf?la=en](https://www.bakermckenzie.com/-/media/files/insight/publications/2019/09/iflr--green-bonds-(002).pdf?la=en)
- Banga, J. (2019). The green bond market: a potential source of climate finance for developing countries. *Journal of Sustainable Finance and Investment*, 9(1), 17–32.
- Bansal, P., & Roth, K. (2000). Why Companies Go Green: A Model of Ecological Responsiveness. *Academy of Management Journal*, 43(4), 717–736.
- Bouille, B. (2014). *Whoaa! GDF Suez goes BIG with largest ever RE/EE green bond at EUR2.5bn (\$3.5bn)*. <https://www.climatebonds.net/2014/05/whoaa-gdf-suez-goes-big-largest-ever-reee-green-bond-eur25bn-35bn-and-still-3x-times>
- Charmaz, K. (2006). *Constructing Grounded Theory: A Practical Guide Through Qualitative Analysis*. SAGE Publications.
- Chen, H., Chiang, R. H. L., & Storey, V. C. (2012). *Business intelligence and analytics: From big data to big impact*. 36(4), 1165–1188.
- Davenport, T. H., Barth, P., & Bean, R. (2012). How “Big Data” is Different. *MIT Sloan Management Review*, 54(1), 22–24.
- Dev, M. (2020). *How Green Are Green Bonds?* <https://dhaaramagazine.in/2020/12/06/how-green-are-green-bonds/>
- EU Technical Expert Group on Sustainable Finance. (2020a). *Sustainable finance: TEG final report on*

- the EU taxonomy.
https://ec.europa.eu/info/sites/default/files/business_economy_euro/banking_and_finance/documents/200309-sustainable-finance-teg-final-report-taxonomy_en.pdf
- EU Technical Expert Group on Sustainable Finance. (2020b). *Taxonomy report: Technical Annex*.
https://ec.europa.eu/info/sites/default/files/business_economy_euro/banking_and_finance/documents/200309-sustainable-finance-teg-final-report-taxonomy-annexes_en.pdf
- EU Technical Expert Group on Sustainable Finance. (2020c). *Usability Guide: TEG Proposal for an EU Green Bond Standard*.
https://ec.europa.eu/info/sites/default/files/business_economy_euro/banking_and_finance/documents/200309-sustainable-finance-teg-green-bond-standard-usability-guide_en.pdf
- European Commission. (2020). *A Renovation Wave for Europe - greening our buildings, creating jobs, improving lives*.
https://ec.europa.eu/energy/sites/ener/files/eu_renovation_wave_strategy.pdf
- European Commission. (2021, February). *Series of webinars on the EU taxonomy – Discussion on future developments with the platform on sustainable finance*. https://ec.europa.eu/info/events/finance-210224-sustainable-finance-platform-webinars_en
- Freeman, R. E., Harrison, J. S., Wicks, A. C., Parmar, B. L., & de Colle, S. (2010). *Stakeholder theory: The state of the art*. Cambridge University Press.
- Ghasemaghaei, M., Ebrahimi, S., & Hassanein, K. (2018). Data analytics competency for improving firm decision making performance. *The Journal of Strategic Information Systems*, 27(1), 101–113.
- Gholami, R., Watson, R. T., Molla, A., Hasan, H., & Bjørn-Andersen, N. (2016). Information systems solutions for environmental sustainability: How can we do more? *Journal of the Association for Information Systems*, 17(8), 521–536.
- Grover, V., Chiang, R. H. L., Liang, T. P., & Zhang, D. (2018). Creating Strategic Business Value from Big Data Analytics: A Research Framework. *Journal of Management Information Systems*, 35(2), 388–423.
- Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. *MIS Quarterly*, 28(1), 75–105.
- International Capital Market Association. (2021). *Green Bond Principles - Voluntary Process Guidelines for Issuing Green Bonds*.
<https://www.icmagroup.org/assets/documents/Sustainable-finance/2021-updates/Green-Bond-Principles-June-2021-140621.pdf>
- Lehrer, C., Wieneke, A., vom Brocke, J., Jung, R., & Seidel, S. (2018). How Big Data Analytics Enables Service Innovation: Materiality, Affordance, and the Individualization of Service. *Journal of Management Information Systems*, 35(2), 424–460.
- Leidner, D. E., & Tona, O. (2021). The CARE Theory of Dignity Amid Personal Data Digitalization. *MIS Quarterly*, 45(1), 343–370.
- Lindman, J., Berryhill, J., Welby, B., & Barbieri, M. P. (2020). *The uncertain promise of blockchain for government* (OECD Working Papers on Public Governance 43).
- Lindman, J., Tuunainen, V. K., & Rossi, M. (2017). Opportunities and Risks of Blockchain Technologies – A Research Agenda. *Hawaii International Conference on System Sciences*.
- Martin, K. E. (2020). Ethical issues in the big data industry. In K. E. Martin (Ed.), *Strategic Information Management* (5th ed., Issue 2, pp. 450–471).
- Mikalef, P., & Krogstie, J. (2020). Examining the interplay between big data analytics and contextual factors in driving process innovation capabilities. *European Journal of Information Systems*, 29(3), 260–287.
- Neilsen, E. H., & Rao, M. V. H. (1987). The Strategy-Legitimacy Nexus: A Thick Description. *The Academy of Management Review*, 12(3), 523–533.
- Nielsen, A. E., & Thomsen, C. (2018). Reviewing corporate social responsibility communication: a legitimacy perspective. *Corporate Communications: An International Journal*, 23(4), 492–511.
- O’Leary, D. E. (2016). Ethics for Big Data and Analytics. *IEEE Intelligent Systems*, 31(4), 81–84.
- Park, S. K. (2018). Investors as Regulators: Green Bonds and the Governance Challenges of the Sustainable Finance Revolution. *Stanford Journal of International Law*, 54(1), 1–47.
- Phillips-Wren, G., Iyer, L. S., Kulkarni, U., & Ariyachandra, T. (2015). Business Analytics in the Context of Big Data: A Roadmap for Research. *Communications of the Association for Information Systems*, 37(1), 23.
- Rajwanshi, Y. (2019). *Are Green Bonds as Good as They Sound?* Berkeley Economic Review.
<https://econreview.berkeley.edu/are-green-bonds-as-good-as-they-sound/>
- Saar-Tsechansky, M. (2015). Editor’s comments: the business of business data science in IS journals. *MIS Quarterly*, 39(4), iii–vi.
- Sørensen, C. (2016). The curse of the smart machine? digitalisation and the children of the mainframe - LSE Research Online. *Scandinavian Journal of Information Systems*, 28(2), 57–68.
- Stankiewicz, A. (2021). *Sustainable Fund Flows Reach New Heights in 2021’s First Quarter*.
<https://www.morningstar.com/articles/1035554/sustainable-fund-flows-reach-new-heights-in-2021s-first-quarter>
- Suddaby, R. (2010). Challenges for Institutional Theory. *Journal of Management Inquiry*, 19(1), 14–20.
- Suddaby, R., Bitektine, A., & Haack, P. (2017). Legitimacy. *Academy of Management Annals*, 11(1), 451–478.
- Zhang, Y. (2012). IT Enabled Environmentally Friendly Consumption: IT Features Addressing Challenges In Consumer Decision Making. *European Conference on Information Systems*, 233.