Do financial investors need non-financial data?

Infrastructure ESG Data Investor Survey
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Executive Summary

In this EDHECinfra survey, we asked a large sample of investors in infrastructure why they need to have access to ESG data i.e., non-financial data, for the assets they hold or want to hold. We examine three main questions:

1. What is the main purpose or use-case of non-financial (ESG) data for investors in infrastructure?
2. What risks most require non-financial data to make better investment decisions in infrastructure?
3. What kind of data is the most useful and relevant to make such decisions?

Prima facie, the answer to the first question might be expected to be the reporting of ESG performance and the characteristics of infrastructure investments. In our survey, we find that reporting to regulators and stakeholders is indeed high on investors' list of reasons for requiring non-financial data to be disclosed. However, the main driver of this demand everywhere is *portfolio risk management*.

Climate risks are the most important, and they are not priced

This finding suggests that ESG risks are not fully reflected in asset prices today. Indeed, if these risks were fully priced, investors could in large part manage them through the prism of asset prices. Climate risks are extreme risks and require going beyond standard measures of risk like volatility and correlation metrics. However, not only is there a lack of robust data on tail events, but climate-related tail events are all in the future. There is no time series of realised price information in the event of significant shifts in the climate.

Assuming (weak) market efficiency, by which all information available at one point in time is incorporated into asset prices. It follows that if investors express a strong demand for non-financial (ESG) data about their assets and portfolio for the specific purpose of risk management, it must be because information about such risks is not found in asset prices. If that were the case, investors today would first demand ESG data for reporting purposes. Instead, while regulatory reporting remains an important motivation for accessing ESG data, it is not the primary one. ESG data is also considered useful for different regulatory and stakeholder reporting between regions. Some investors are more interested in reporting to their stakeholders while others are more focused on reporting to regulators, reflecting a combination of regulatory and societal differences. For instance, European investors are more concerned with regulators and American ones with private stakeholders including civil society.

The survey also finds that of all the ESG risks, investors in infrastructure are overwhelmingly concerned about only one class of risks: climate risks (physical and transition risks) which are ranked first or second by almost 80% of respondents. In comparison, environmental impacts and risks are reported to be the main concern of a few investors, while social acceptability and governance issues have received little attention so far.

Investors need non-financial benchmarks

Finally, it transpires from survey responses that while infrastructure investors typically have access to the asset-level non-financial data for their own assets and portfolio, they lack standardised data that can be compared to a benchmark. In effect, the amount of data to

which they have currently have access to is too limited for them to have a view on ESG for the purpose of risk management or reporting performance on a relative basis.

With robust cross-sectional data on the factors that are related to ESG and climate risks, Investors could also ensure that they diversify any concentrated exposures in certain types of risks and hope to preempt some of the risks associated with climate change: asset prices are relative, hence knowing how much certain assets are exposed to a known hazard relative to all other comparable assets held in the market can be a first filter to assess the amount of ESG risk exposure in a portfolio.

For instance, many digital infrastructure assets are responsible for large contributions to greenhouse gases because of their high energy consumption, hence they are liable to pay a theoretical carbon tax. But not all data centres have the same scope 2 profile. With enough data, investors could ensure they hold only top quartile assets in terms of energy efficiency, thus partly protecting themselves from the drawdown that the introduction of carbon taxes would create. The same rational applies to many transport assets, which not only have significant scope 3 scores but also a range of carbon efficiency levels.

Such applications and more can be conceived as ways for investor to manage their risk beyond the current level of asset prices precisely because the later do not integrate these risks, even though they are notionally understood by investors.

Regulatory reporting is also risk management

Some of these risks are created by regulatory interventions, especially transition risks. The introduction of a carbon tax for example, however orderly, would be a shock to asset prices.

While the survey found that investors differ a lot regarding the role of ESG regulation as a driver of the need for non-financial data, such disparities can be attributed to the fact that ESG regulations are still emerging and evolving globally. For example, in the EU, the European Commission on Sustainable Finance has put forth an EU taxonomy. The Corporate Sustainability Reporting Directive (CSRD) requires companies to report the taxonomy aligned sustainability of their activities. At the same time, the Sustainable Finance Disclosures Regulation (SFDR) imposes mandatory (EU taxonomy aligned) ESG disclosure obligations for asset managers and other financial market participants. In the US, conversely, there are no regulations at the federal level.

As ESG regulations evolve globally, infrastructure investors will need data to meet compliance requirements, and regulatory reporting may become an important driver of ESG data demand in the future. As climate regulation and climate change itself begin to have an impact on businesses, the use of non-financial data will thus become a more permanent input in an asset and risk management process that used to rely almost entirely on asset prices. Markets will of course integrate as much of this new information into prices as possible. But the continued evolution of the climate and its impact on human and economic life, as well as the choices made by regulators to try to control and mitigate this evolution, create a form of uncertainty that investors are only beginning to learn to live with, but have also clearly understood.

In the end, the creation of robust benchmarks to assess risks on the basis of non-financial data, especially climate risks, is a necessary evolution for the infrastructure investment sector. EDHECinfra intends to contribute to this evolution with the development of several benchmarks of climate risk exposures and their impact on asset value for thousands of infrastructure assets globally.

1. Do financial investors (in infrastructure) need non-financial data?

Non-financial data has increasingly become an input in investment decisions in many asset classes, including infrastructure equity and debt. For the past decade this type of information has often been bundled together as 'ESG' data i.e. the disclosure and reporting of data about the environmental, social and governance characteristics of firms and investments.

In effect, the requirement by investors to disclose and report non-financial information can be traced back to what the economic literature calls a "demand for monitoring" that characterises long-term investments in general, and private and illiquid markets in particular.

In public markets, investors have a choice between monitoring and trading (Shleifer and Vishny, 1986): choosing to be a long-term owner creates incentives to engage in corporate monitoring and to specialise more in monitoring than in trading. For example, Chidambaran and John (1998) argue that a long-term investment horizon creates incentives to improve shareholder value by imposing disciplinary mechanisms on managers. Indeed, Chen et al. (2007), Elyasiani and Jia (2008), Elyasiani and Jia (2010); Elyasiani et al. (2010) and Attig et al. (2012) among others, find that concentrated holdings by independent institutional investors with a long-term horizon leads to increased monitoring and is related to better public firm performance.

Since investors' demand for monitoring is an increasing function of their investment horizon, greater demand for ESG data disclosure and reporting by infrastructure investors reflects their belief that monitoring and managing the ESG characteristics of the firm can contributes to value creation or preservation. For instance, measuring, monitoring and reducing a firm's carbon footprint can be expected to have an impact on its exposure to so-called transition risks e.g., a future carbon tax.

Another reason why ESG monitoring may be necessary to supplement information revealed by trading (asset prices) is the level of disagreement in markets about the materiality of certain ESG risks. When market participants agree on the nature and quantity of the risks being priced, the bid-ask spread of financial assets is small because market prices carry all the information available to investors at that time. But investors can also disagree on what drives expected returns and asset values because of gradual information flow, limited attention or heterogeneous priors (see Hong and Stein, 2007).

Climate change is a good example of a family of risks about which investors hold heterogeneous views, including about the scope, timing and severity of the associated risks. Indeed, climate risks are notoriously hard to model and integrate into economic models (see for example Weitzman, 2009). Heterogeneous investment beliefs and varying levels of attention to climate risks amongst investors can be expected to lead to disagreement. This wedge between bid and asking prices makes non-financial data valuable to investors who need to document and validate their investment tastes and preferences beyond what market prices can reveal today.

In this paper, we examine the reasons why investors demand non-financial or ESG data. We use survey data collected by EDHEC*infra* from amongst a large global sample of investors in

infrastructure equity and debt (see appendix for details) to examine three main questions:

1. What is the main purpose or use-case of non-financial (ESG) data for investors in infrastructure?
2. What risks most require non-financial data to make better investment decisions in infrastructure?
3. What kind of data is the most useful and relevant to make such decisions?

Prima facie, the answer to the first question on **why investors need ESG data** might well be expected to be ESG reporting and regulatory requirements. In our survey, we find that reporting to regulators and stakeholders is indeed high on investors' list of reasons for requiring non-financial data to be disclosed. However, *the main driver of this demand everywhere is portfolio risk management*.

Consistent with the notion of disagreement between investors about the value of assets exposed to certain risks, this finding suggests that ESG risks are not fully reflected in asset prices today (see also Manocha and Blanc-Brude, 2021). Indeed, if ESG risks were fully priced, investors could in large part manage such risks through the prism of asset return volatility and correlations. Moreover, beyond standard measures of risk like volatility and correlation metrics, extreme risks are harder to price given the lack of robust data on tail events. In effect, climate related risks not only include tail events, but these are all in the future; hence there is no time series of realised price information in the event of significant shifts in the climate.

Assuming (weak) market efficiency, by which all information available at one point in time is incorporated into asset prices. It follows that if investors express a strong demand for non-financial (ESG) data about their assets and portfolio **for the specific purpose of risk management**, it must be because information about such risks is not found in market prices. If that was the case, investors today would primarily demand ESG data for reporting purposes.

Moreover, one might argue that the recent regulatory push for reporting and monitoring ESG data is also motivated by risk-management concerns on the part of the regulator, especially when it comes to climate risks. Macro-prudential regulators are concerned with systemic risks (system-wide shocks) and economic stability. If all the information that is necessary to understand these risks was priced by markets, prudential regulators would not increasingly require the disclosure of non-financial information either.

Consistent with the notion that regulation partly drives ESG data demand, our survey finds that investor demand for ESG data for the purpose of regulatory and stakeholder reporting differs between regions. Some investors are more interested in reporting to their stakeholders while others are more focused on reporting to regulators, reflecting a combination of regulatory and societal differences between regions. For instance, European investors are more concerned with regulators and American ones with private stakeholders including civil society.

The answer to second question about **which ESG risks require infrastructure investors' attention the most** is *climate risks*. Investors in infrastructure overwhelmingly worry about both transition and physical risks ahead of any other ESG considerations. Of course, other environmental and social considerations are also very important to some investors, which also supports the hypothesis that investors disagree on what is the most material element in the ESG profile of their investment. Still, climate risks dwarf all other concerns for infrastructure investors. This is consistent with the notion that non-financial data is the most needed where risks are the least well-documented and create tail risks that are not easily diversified, insured or hedged against.

Finally, **the type of non-financial data** that investors say they need to best take into account ESG characteristics when making investment decisions matches their preferred use cases. However, it also points to a number of gaps in the availability and reliability of the information they need, in particular the potential to create robust benchmarks using contributed data. Indeed, to engage in risk management in particular but also stakeholder and regulatory reporting, ESG data must be robust enough to allow meaningful comparisons and rankings in the cross-section of assets. We return to this point in the paper.

The rest of this paper is organised thus: the next section (2) examines the answers to the first line of questioning on the drivers of ESG data demand. The following section (3) reports in more details which ESG risks and impacts infrastructure investors are the most focused on, and section 4 looks at the type of ESG data that investors demand and need to meet their objectives. Section 5 discusses the results and concludes.

2. The Primacy of Risk Management

In the survey, respondents were asked to rank the following five reasons for requiring ESG data disclosure and reporting:

- Reporting to regulators
- Reporting to stakeholders and society
- Identifying and managing risks to their investments
- Identifying new investments
- Other reasons

Figure 1 shows the most important (Ranked first) driver of ESG data demand while table 1 shows the ranking received by each proposed driver of demand.

Globally, 37% of the respondents ranked "Identifying and managing risks" as their main reason for demanding ESG data and indeed only 5% considered this reason to be irrelevant. *Identifying and managing risks* was ranked 1st by more than a third of respondents in all regions, the second most important in close to one quarter and the third most important reason in close to 20% of cases. This is true for both fund managers and asset owners: both groups stated that the identification and management of risks is their main reason for needing ESG data - even in Europe where the pressure for regulatory reporting is the greatest (see below) and where 60% of survey respondents originate (see Appendix).

Stakeholder reporting is the second most important reason given by infrastructure investors for requiring ESG data. It is considered the most important by 27% of cases globally, and in North America and Australia it is considered to be as important as risk management. It is then ranked as the 2nd most important reason to need ESG data in 28% of cases, and the 3rd most important reason in 27% of cases.

In the EU, it is ranked as the most important by about a quarter of respondents, in third place behind reporting to regulators, a voting pattern which is unique to European investors. Stakeholder reporting is then ranked 2nd or 3rd most important by about a third of European respondents.

In the US, stakeholder reporting is consistently given as one of the important reasons (Ranked first 42% of the time) for requiring ESG data disclosure and reporting, and it is the second most important reason in North America overall (including Canada), Asia, and Australia. Organisation-wise, stakeholder reporting is more important to asset managers than to asset owners: 26% of managers ranked it as their top reason as opposed to 22% of asset owners.

On aggregate, *Regulatory Reporting* ranks third as the most important reason for demanding ESG data: it is the most important in 21% of cases, the 2nd most important in 16% of cases, and the third most important in 21% of cases. There are significant geographic differences in these responses: for EU-based respondents, even though identifying and managing risks is the most important reason for needing ESG data, regulatory reporting is a close second. In effect, EU respondents are the only ones who most frequently assign reporting to regulators the highest rank, in contrast with North American respondents who often rank regulatory reporting amongst the least important reasons, while Asian and Australian investors tend to rank it in third place. As a result of this geographic disparity, there is no clear pattern of preferences between asset owners and asset managers when it comes to regulatory reporting and the demand for ESG data. We return to the importance of geography when it comes to

Figure 1: Top Ranked Reasons by Infrastructure Investors for Requiring ESG Data Disclosure and Reporting

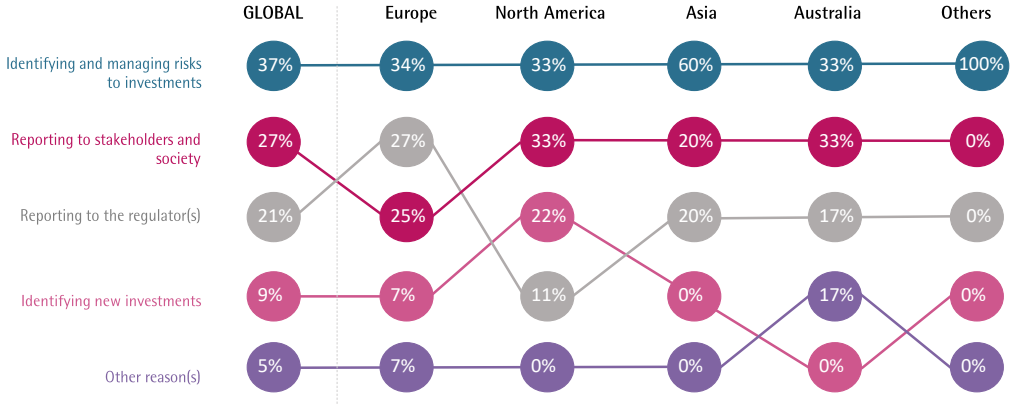


Table 1: Ranking of Drivers of demand of ESG data by survey respondents

Driver	Rank 1 (%)	Rank 2 (%)	Rank 3 (%)	Rank 4 (%)	Rank 5 (%)	Not relevant
Reporting to your regulator(s)	21	16	21	23	3	16
Reporting to your stakeholders and society	27	28	27	16	0	3
Identifying and managing risks to your investments	37	25	21	9	1	5
Identifying new investments	9	24	27	29	1	9
Other reason(s)	5	5	0	7	56	27

regulatory drivers of the demand for ESG data below.

Identifying new investments is given as the main reason for wanting ESG data in only 9% of cases globally and is most often rated as the 4th (29%) or 3rd (27%) most important reason. Asian and Australian investors do not seem to require ESG data for the identification of new investments at all.

Finally, "other reasons" for wabting ESG data are either non-existent (over a quarter of cases) or most often it is ranked as the least most important reason (56% of cases) suggesting that the first four reasons proposed in the survey cover the key factors of ESG data demand in the infrastructure investment sector.

These findings have several important implications for investing in infrastructure and the role of non-financial data reporting and disclosure.

1. **ESG risks are not fully priced**: the dominance of risk management as investors key reason for wanting ESG or non-financial data points to an important part of the debate on ESG in general and climate risks in particular: whether or not these characteristics are already included in asset prices.
If this information was fully priced by markets today, it should be reflected in the firm's cost of capital (which, in equilibrium, is equivalent to expected returns) and investors could use the firm's weighted average costs of capital (WACC) as a proxy of the riskiness of the investment, including ESG risks. Instead, the requirement by a pension plan invested in private assets via a managed fund to know about the carbon footprint of the fund's assets reflects the reality of transition risk today: investors do not know - for wxample - when and if a carbon tax will be created and how much it would impact a business' value. Transition risk is thus not so much a factor of the volatility of returns observed today than of a possible future state of the world, the likelihood of which is very

hard to predict, and about which there is widespread disagreement amongst market participants. Monitoring asset- and portfolio-level emissions is thus a way of anticipating and potentially managing transition risks in a way that cannot be achieved by simply looking at valuations.

Without financial information on ESG risks being fully embodied in asset prices, investors in infrastructure can, in principle, use non-financial data to select, diversify, hedge and sometimes insure their risks. Extreme flood or social acceptability risks, for example, can be diversified by ensuring that such exposures are not too concentrated in the portfolio. Likewise, given the potential substitution between transport modes, investing in transport assets relying on different technologies e.g., road vs rail, can provide a hedge against sector-specific regulations. For example a higher tax on petrol should decrease road traffic but increase rail usage. In other words, non-financial data allows investors to manage financial risks that otherwise would not be taken into account.

To be able to engage in risk management in this way, investors in infrastructure need data that captures the characteristics of assets and investment in robust manner in the cross-section i.e., data that passes a scientific test of robustness. We return to this point below and in the conclusion.

2. **Non-financial objectives are increasingly important**: After risk management, the relative importance of reporting non-financial information to stakeholders and society at large is an important finding. ESG data provides information on the environmental and social impacts or risks of the activities of certain investments (see below on the ESG Taxonomy).

   When reporting to their stakeholders, be they limited partners or plan members, investors are expected to inform their clients or owners about their risk-adjusted performance as an investment scheme or product. Hence, financial reporting, which covers the question of risk management, could include non-financial information for the reasons outlined above such as the carbon footprint of investments.

   However, the same investors may also wish to report information to their stakeholders about their impact i.e., in response to a demand for monitoring that emanates from clients, members and society. For instance, investors may want to report that they are investing in companies that contribute to the decarbonisation of the economy, or invest in aligning their emissions with national targets. They may also want to report that their portfolios exclude certain activities considered harmful or undesirable, etc.

   The demand for non-financial data for the purpose of reporting to stakeholders and society is thus an expression of the increasing importance of non-financial objectives for investors in infrastructure. These are effectively constraints on asset selection and portfolio construction decision and thus not only a matter of reporting but also an input in investment decisions. In order to report a desirable non-financial outcome or impact to stakeholders (whatever that may be) investors need to know what the non-financial characteristics of assets are, preferably relative to a scientifically defined benchmark.

   As with risk management, their need to identify and later demonstrate the effectiveness of the impact of their investment puts the onus on the availability of robust data that is scientifically collected and validated.

3. **Regulation is not leading the demand for non-financial data** but will standardise it. On aggregate, reporting to regulators in the third most frequent top reason for wanting to have access to ESG data for infrastructure investments. This finding shows that regulation on the disclosure and reporting of ESG data lags market practices. Indeed, the

main regulatory frameworks remain incomplete and sometimes unclear; this is consistent with investors ranking the use of non-financial data for other purposes more highly.

- For instance, even the more advanced framework found in the **EU** is not yet precise or accomplished enough to define exactly what non-financial data is needed. The European Commission on Sustainable Finance aims to make sustainability considerations an integral part of its financial policy in order to support the European green deal (European Commission, 2020). In order to do this, the Commission has developed a framework that includes numerous components [1] But while the EU regulatory landscape is well structured and among the most advanced globally, it is still subject to debate e.g., on inclusion of certain activities in the taxonomy (see Amenc et al., 2022, on the includion of natural gas), amendments, and delays.[2] Under the EU taxonomy, any activity is considered green if it substantially contributes to one of the six objectives of the taxonomy and does not harm the other five. The documentation published by mid 2022 is incomplete and defines substantial contributions only for the first two objectives. This is a source of confusion and implementation challenges: compliance requirements are sometimes incoherent, e.g. the distinction between Article 8 and Article 9 funds. Disclosures have to be aligned with multiple regulations, different requirements apply to different types of products, disclosures differ at the firm and product level and the information flow can be complex i.e., information important to compliance is presented in multiple legislative acts.

- In the **UK**, new regulatory requirements (GOV.UK, 2022) mandate companies and financial services to report ESG metrics in line with the Task Force on Climate-related Financial Disclosures (TCFD). Given that TCFD alignment metrics will only cover climate change, UK regulators are proposing a UK taxonomy and aligned mandatory Sustainability Disclosure Requirements (SDR) that will effectively expand the scope of regulatory reporting. The actual metrics and coverage of the SDR will be defined over the course of 2022, meaning that associated reporting requirements will also firm up from 2022 onwards. As of mid-2022, there is no documentation defining individual disclosures.

- In the **US**, ESG regulations are still lacking at the federal level but financial regulators have begun to take non-financial data into account. The US Securities and Exchange Commission (SEC) made public statements in 2021 (see SEC, 2021c,d) indicating its intention to adopt ESG disclosure requirements (Harrington and Garzon, 2020). In March 2022, the SEC requested public comments on required climate disclosures, a majority of which were in support of a (TCFD aligned) mandatory standardised reporting framework (see SEC, 2022, for details). The SEC regulatory agenda for now includes the development of rules for disclosure relating to climate risk, human capital, including workforce diversity and corporate board diversity, and cybersecurity risk (SEC, 2021a). Details of these requirements were expected to be available in 2021, but were delayed until 2022 and are currently expected to come into effect in 2023. A Climate and ESG Task Force to identify ESG related misconduct

1 - The EU taxonomy of sustainable activities; A European green bond standard; Mandatory corporate disclosures of climate-related information (The Corporate Sustainability Reporting Directive (CSRD) requires companies to report the taxonomy aligned sustainability of their activities), EU (climate, ESG) labels and benchmarks of ESG disclosures; Mandatory sustainability-related disclosures in the financial services sector (The Sustainable Finance Disclosures Regulation (SFDR) imposes mandatory and suggests voluntary ESG disclosure obligations for asset managers and other financial markets participants); An International Platform on Sustainable Finance.

2 - In November 2021, the Commission announced the delay of the application of the Regulatory Technical Standards (RTS) under the SFDR to 1 January 2023.

was also created in 2021 (SEC, 2021b). Given the lack of clarity on the contents of the planned disclosures, investors can only look at frameworks such as TCFD until the exact requirements of future disclosures are defined, and companies cannot put into place/do not need process that enable the collection/production of ESG data.

- In **Asia**, a number of different voluntary and mandatory reporting requirements exist in different countries, with a focus on governance-related topics (Petraki, 2022; Takamatsu, 2021), but environmental disclosures are now gaining popularity. For example, the Singapore Exchange has a road-map for listed companies to provide mandatory climate-related disclosures based on recommendations of TCFD starting from 2022 (SGX, 2021). Japan, Hong-Kong and Taiwan are promoting companies to voluntarily disclosure information inline with TCFD. The Hong Kong Stock Exchange (HKEX) also has a broader mandatory reporting requirement for listed companies. (HKEX, 2021) Because the Asian ESG regulatory reporting framework is still developing (Singhania and Saini, 2021), it is unclear if and when a consistent reporting framework can be adopted across nations (such as TCFD for environmental disclosures) or if different countries will have individual mandatory/voluntary reporting requirements.

- **Australia** currently has no national ESG regulations (Asten et al., 2020; Julvez, 2022) but there are fragmented state and territory level requirements to report some ESG data. For example, the Corporations Act is primarily focused on the governance of companies, requires companies to disclose ESG risks faces by the company where they could affect the entity's achievement of its financial performance. Other ESG related acts also require reporting of individual ESG aspects. Examples include the Modern Slavery Act 2018, The Commonwealth Criminal Code Act 1995 (which is focused on anti-bribery and corruption laws), the Fair Work 2009 (which protects workers rights and proposes labour laws), and the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act, which ensures environmental compliance on multiple fronts). In addition to this, the Australian Prudential Regulation Authority (APRA) and the Australian Securities Exchange (ASX) do provide guidance for banks, insurers, pension funds and listed companies on how to manage environmental and social risk. Companies listed on the ASX have to 'comply or explain', acording to these issued guidelines, in an annual Corporate Governance Statement. Further, the Australian Securities and Investment Commission (ASIC), recommends that all listed companies report along the lines of the TCFD framework (ASIC, 2021a)). While Australian regulators recognise the need for nationwide standardisation (see IMF, 2021; Chalmers, 2021), there is also a preference for promoting voluntary disclosures (ASIC, 2021b; Wynn-Pope et al., 2021).

Existing mandatory ESG disclosures thus remains incomplete everywhere in the world and have been universally slow to develop. As these frameworks develop they will increasingly standardise the type of non-financial data that needs reporting. Still, our results show that market participants do not focus on non-financial data primarily for the purpose of regulatory reporting; this is the most frequently cited use case for which investors either do not know what data is required or do not need ESG data. This problem is more evident at the portfolio level than at the asset level. Figure 9 in the appendix shows that, 27% of respondents do not know or do not need asset level ESG data, while 32% of respondents

do not know or do not need portfolio level ESG data, for regulatory reporting. Conversely, results show that investors largely know what ESG data they need for risk management. For risk management only 4% respondents at the asset level and 13% respondents at the portfolio level do not know or need ESG data sets.

Thus, key infrastructure investor use cases for ESG or non-financial data are to identify and manage risk and report to stakeholders before reporting to regulators. While this is consistent with the state of the regulation, it is also important to note that investors are not waiting for the regulator to access and make use of non-financial data. This is because, as we argued in the introduction, there is a clear economic and financial use case for increasing non-financial monitoring in illiquid long-term assets that are exposed to hard-to-quantify risks like climate change.

In the next section, we consider which of these risks are priorities for investors in infrastructure.

3. The Importance of Climate Risks

To understand which material ESG risks and impacts are needed to conduct risk management, the survey asked respondents to rank ESG risks and impacts in the order of their perceived importance.

ESG risks and impacts are identified using an infrastructure-specific taxonomy described in Manocha and Blanc-Brude (2021). The taxonomy itself also available in the appendix. This taxonomy differentiates between a firm's impacts (*on* the environment or society), which can also be potential sources of risk to the firm itself, and the risks to which the firm is directly exposed to (*from* the environment or the society).

This taxonomy creates an exhaustive but parsimonious set of super classes, classes and subclasses of risks and impacts that are relevant to the activities of infrastructure companies as defined under the second pillar of the TICCS taxonomy[1]. In our survey 95% of respondents agree that structuring ESG data clearly into classes of impacts and risks is well suited in order to understand and measure ESG aspects for the infrastructure sector.

In terms of the impact of the infrastructure investments, survey respondents were asked to rank the the following superclasses by order of importance:

- Impact of assets/companies on natural resources (e.g., biodiversity loss/restoration/conservation, water pollution/diversion/restoration, land pollution/degradation/restoration)
- Impact of assets/companies on climate change (Scope 1, 2, and 3 emissions)
- Impact of assets/companies on human well-being (collective and workforce well-being e.g., human rights, public health, and safety, workforce health and safety, employment conditions)
- Impact of assets/companies on economic development (human development e.g., living standard, human capital, assets value e.g., on land/real estate/business/ value)
- Governance impacts on organisations (e.g., company effectiveness, risk management) and on external relationships (e.g., transparency, CSR, stakeholder engagement)

Likewise, in terms of risk superclasses, they were asked to rank the following ESG risks by order of importance to them as investors in infrastructure:

- Physical risks (geophysical –e.g., earthquakes, volcanoes; hydrological events e.g., floods; climatological –e.g., extreme temperatures, wildfires; meteorological e.g., storms)
- Access to natural resources risk (i.e., risks associated with the reduction in the quantity or deterioration of quality of natural resources)
- Social acceptability risks (e.g., customers/public/regulators acceptability risks)
- Workforce availability risks (i.e., availability of a sufficient workforce - e.g., strikes/slowdown/lockout risks)
- Organisation risks (e.g., process failure, absence of processes)
- Staff quality risks (e.g., risks associated with staff competency and integrity)

Figures 2 and 3 show the results for impacts and risks respectively.[2] The results show very clearly

1 - a classification system of infrastructure companies. See docs.edhecinfra.com

2 - Note that this ranking was done individually i.e the risks and impacts were ranked in order of importance separately. Which means that while we can analyse which risks/impact is more important, we cannot say if any given risk is more important than any given impact.

Figure 2: Ranking of material ESG impacts for infrastructure investors

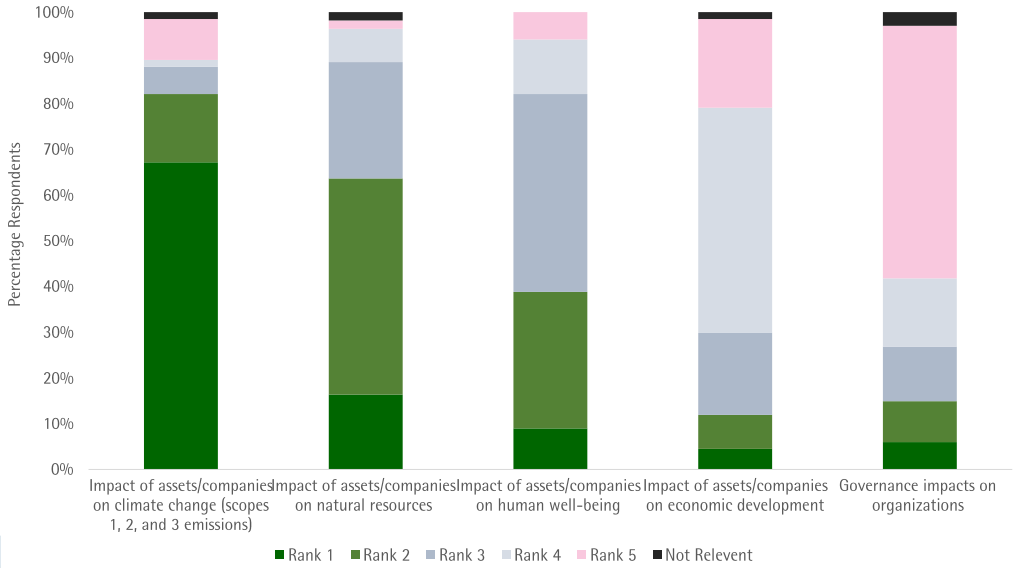


Figure 3: Ranking of material ESG risks for infrastructure investors

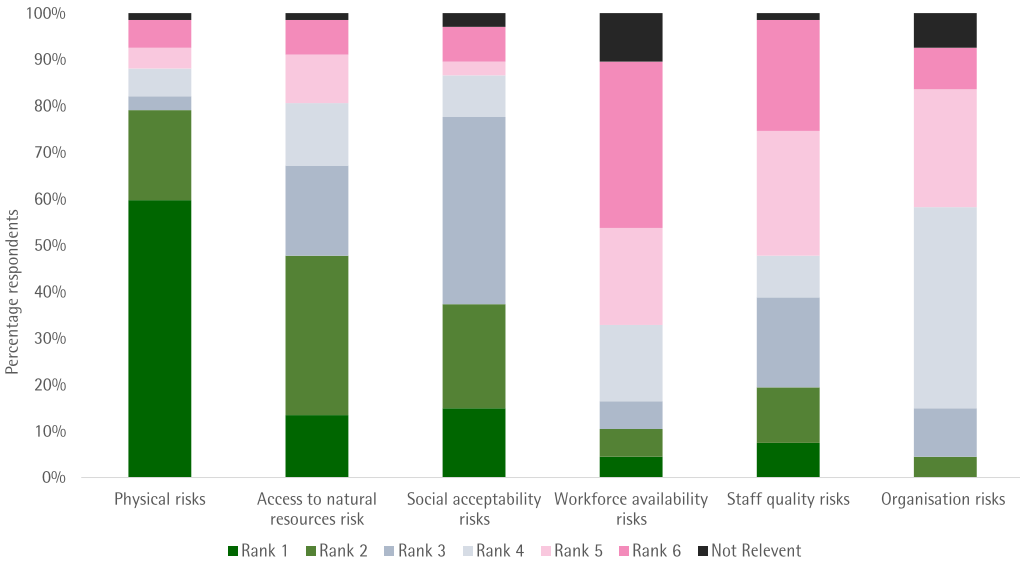


Table 2: Ranking of material ESG risks and impacts by infrastructure investors

Rank	ESG Risk	ESG Impact
1	Physical risks (geophysical –e.g., earthquakes, volcanoes; hydrological events –e.g., floods; climatological –e.g., extreme heat)	Impact of assets/companies on climate change (scopes 1, 2, and 3 emissions)
2	Access to natural resources risk (i.e., risks associated with the reduction in the quantity or deterioration of quality of natural resources	Impact of assets/companies on natural resources (e.g., biodiversity loss/ restoration/ conservation, water pollution/ diversion/ restoration, land pollution/ degradation/ restoration)
3	Social acceptability risks (e.g., customers/ public/ regulators acceptability risks)	Impact of assets/companies on human well-being (collective and workforce well-being –e.g., human rights, public health and safety, workforce health and safety, employment conditions)
4	Workforce availability risks (i.e., availability of a sufficient workforce –e.g., strikes/ slowdown/ lockout risks)	Impact of assets/companies on economic development (human development –e.g., living standard, human capital, assets value –e.g., on land/real estate/business/ value)
5	Organisation risks (e.g., process failure, absence of processes)	Governance impacts on organizations (e.g., company effectiveness, risk management) and on external relationships (e.g., transparency, CSR, stakeholder engagement)

that investors in infrastructure care mostly about their climate impact i.e., their transition risks and the physical risks that climate changes poses to their assets.

The construction, operation and maintenance of infrastructure has ESG impacts, which in turn create risks. For example, the noise pollution generated by traffic on urban roads can cause social acceptability risks by impacting the health and well-being of surrounding local communities. A community may convince authorities to impose construction of expensive noise barriers or levy an environmental tax. Thus, impacts of a firm are often direct or indirect drivers of the risks faced by the firm (see Manocha and Blanc-Brude, 2021, for a detailed discussion).

Chief amongst these impacts are carbon and other greenhouse gas emissions, which not only impact the climate but also create transition risks. Chalmers and Basu (2020) argue that transition risks are particularly significant for infrastructure assets, which face unexpected dynamics that can be regulatory, legal, market or technological in nature, as well as reputation risks generated by the transition risks. In the face of such risks, asset owners and managers may decide to shift to lower carbon technologies, reduce their emissions, etc. to manage the risks created by their climate impact.

Figure 2 shows that a majority investors in infrastructure rank the impact of climate change of infrastructure companies as most important – highlighting their focus on transition risk. There is no difference between asset owners and managers in this respect, but fund managers rank climate change as the most important impact more often (72% of the time vs 56% of the time for asset owners).

The impact of assets on natural resources (biodiversity and the environment) are the second most important (ranked second by about 40% of the respondents), followed by risks associated with impacts on human well-being (ranked third by 40% of respondents).

In terms of ESG risk, physical risk is ranked first by almost 60% of respondents, followed by access to natural resources risk (ranked second by almost 34% of respondents) closely followed by social acceptability risks (ranked third by 40% of respondents). Workforce availability risk, organisation risks and staff quality risks are seen as less important and are ranked first by less than 10% of respondents. Indeed, exposure to climate-driven physical risks such as floods, hurricanes, droughts, wildfires etc. poses the threat of asset damage and operational disruption and these damages are not only substantial today[3] but also expected to increase.

This result is consistent across asset owners and managers, who all rank physical risk as the most relevant category. However, asset managers rank physical risk as their top concern 64% of the time, whereas asset owners do so 33% of the time. For asset owners, access to natural resources risk such as water is considered as important a factor as climate-driven physical risks.

Figure 4 confirms that physical risk are almost universally at the top of the agenda expect in Australia, where organisational risk and social acceptability are considered more relevant by investors in infrastructure.

Even though respondents were asked to rank impacts and risks independently, these results indicate that investors rank them consistently: for example, the most relevant ESG risk is climate-driven physical risk and the most important ESG impact is climate impact (defined as Scope 1,2,3 of GHG emissions), which is a known driver of physical risk (MassonDelmotte et al., 2021) as well as transition risk. Likewise, the second most prominent risk is *access to natural resources* and the corresponding impact of infrastructure

3 - A study by the World Bank (Hallegatte et al., 2019) estimates that the cost of damage to infrastructure from natural hazards is USD18 billion, annually

Figure 4: Ranking of ESG risks by Geography

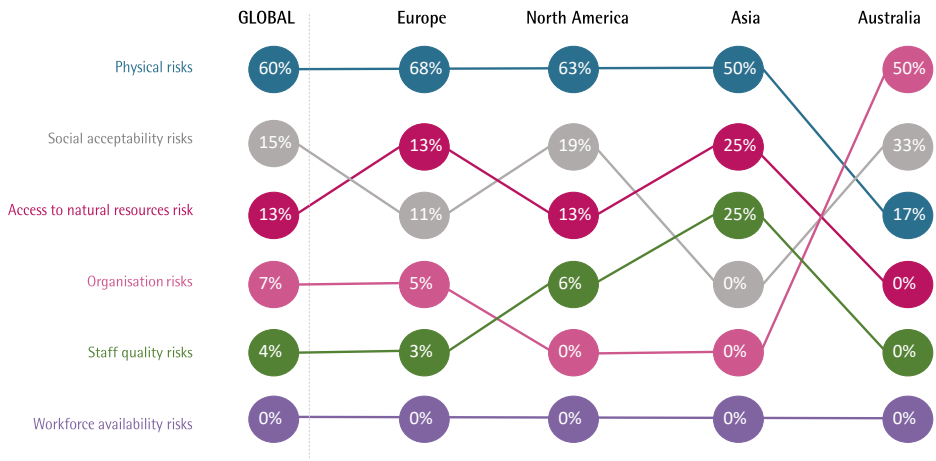
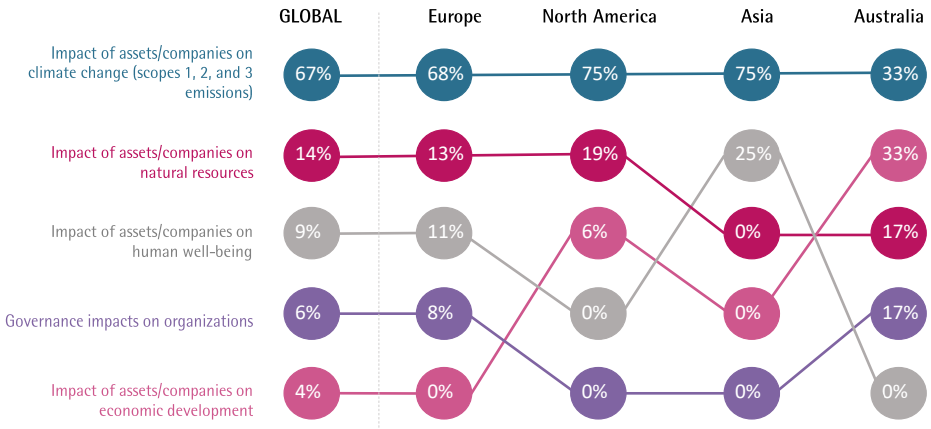


Figure 5: Ranking of ESG risks by Geography



investments on natural resources was ranked as the second most important as well (see table 2). In these two cases, for each risk, a corresponding rank is assigned to the related impact. Impacts are understood to be risk drivers or mitigators.

These results are consistent with our earlier finding that investors require non-financial data to manage their risks, and climate risks clearly are much more relevant to them than any other dimension of ESG.

In the next section, we turn to our third finding on the type of non-financial data that investors require to achieve their objectives, including the most important: managing climate risks.

4. ESG Data is also for Benchmarking

To collect non-financial data that is comparable and useable for the purpose of risk management and reporting, a minimum level of standardisation is necessary. Ad minima, an ESG reporting frameworks should include of three components (Petraki, 2022):

- Taxonomies to define classes of assets, risks and impacts and what is considered sustainable;
- Company or asset level disclosures that serve to provide financially material information to investors;
- Product or portfolio level disclosures to help investors identify whether capital is allocated towards sustainability objectives.

These requirements fit the need for investors to identify relevant ESG issues and assets, to be in a position to use them as a filter and monitor the non-financial performance of investments, and to design portfolios that have the non-financial characteristics that they desire, whether this should be for risk management, stakeholder or regulatory reporting purposes.

Yet, despite their clearneed for ESG data for risk management, the standards currently used by infrastructure investors to measure and report ESG performance are not always focused on the type of data that would be needed to fulfil their main use case of identifying and managing risks. Manocha and Blanc-Brude (2021) presented the findings of a comprehensive review and quantitative comparison of existing ESG standards for infrastructure investors currently in use. They categorised 1,661 indicators used by 17 ESG schemes into the dimensions of impacts and risks following the EDHEC*infra* ESG taxonomy and found that 88% of reviewed disclosures focused on impacts while only 12% aim to capture direct risks. The 2021 survey found that about 60% of the respondents agreed that current ESG schemes for infrastructure investors are currently not focused on measuring what would constitute "sustainability risks" under a TCFD inspired framework. Manocha and Blanc-Brude (2021) also found that ESG reporting schemes diverge considerably in terms of scope and measurement, which is consistent with the findings of other research on ESG scores created for capital market instruments.

Survey respondents were asked to describe what type of data they actuall wanted in the context of the four use cases mentioned above: risk management, stakeholder reporting, regulatory reporting and identifying of new investments. Answers were collected about the usefulness of ESG data at the asset level, the (investor's) portfolio and the market. Table 3 summarises these preferred responses.

Respondents were given the choice of prioritising raw data, benchmark metrics, alignment information and ESG scores and ratings. The responses were very concentrated on the first two kinds of data points: At the asset level, ESG impacts and risks metrics and raw data about own assets are most widely required data types. At the portfolio level, ESG impacts and risk metrics are the most in demand and, at the market level, the most demanded ESG data type is ESG metrics by market segment.

Most investors (70%) indicated that they want access to *raw* non-financial information about their assets i.e., absolute values about greenhouse gas emissions or avoided emissions, the number of jobs created, etc. but also relative values (ESG impacts and risk metrics) that would allow them to make sense of the data reported for their own assets (also 70% of responses at the asset level,

Figure 6: Number of data point available and ability to benchmark ESG metrics using normal data

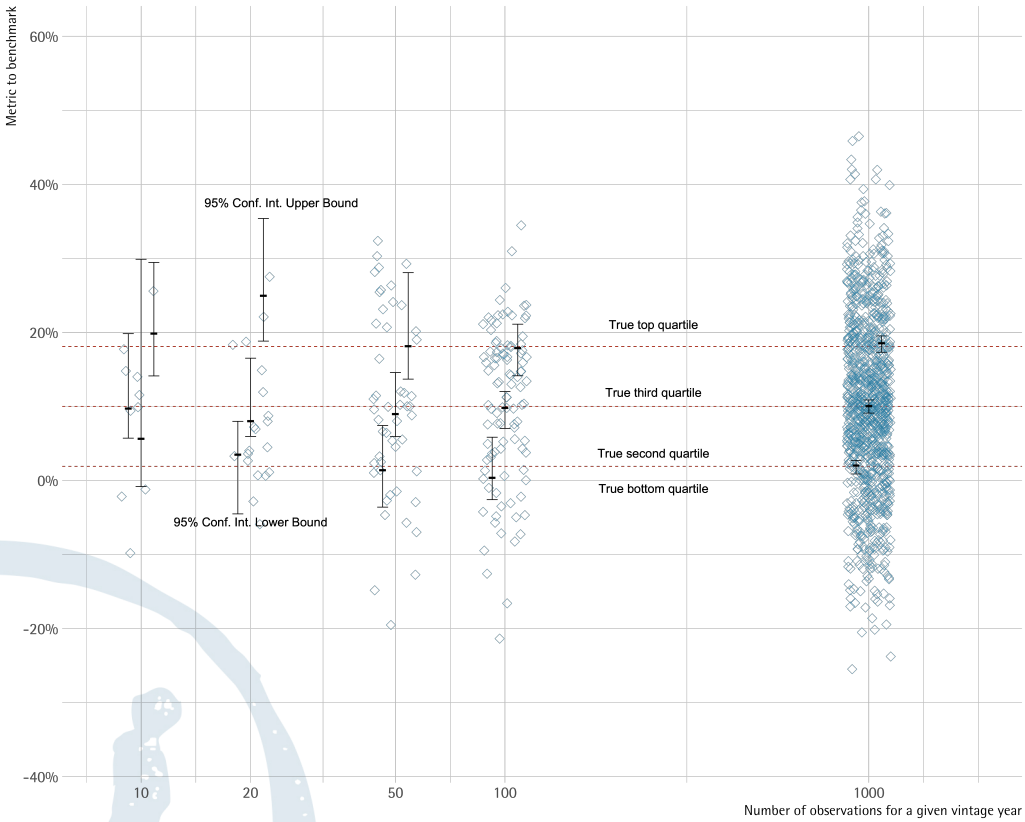


Table 3: Prefered data types required by infrastructure investors for different use cases

Use case	Asset level	Portfolio level	Market level
Risk management	ESG impacts and risks metrics, raw data about own assets	ESG impacts and risks metrics	ESG impacts and risks metrics by market segments
Stakeholder reporting	Measures of ESG impacts and risks, ESG ratings/ scores	ESG impacts and risks metrics, ESG scores/ ratings	ESG impacts and risks metrics by market segments, ESG scores or rating benchmarks/ ranges by market segment
Regulatory reporting	Raw ESG data about own assets	ESG impacts and risks metrics	ESG impacts and risks metrics by market segments
Investment identification	ESG impacts and risks metrics	ESG impacts and risks metrics	ESG impacts and risks metrics by market segments

78% of time at the portfolio level, and 74% of the time at the market level).

Fund managers and direct investors can be expected to have access to the non-financial information of their own investments. However, for the purpose of risk management, they need broader ESG metrics that provide them with a relative view of the exposures found in their portfolios. For instance, if a certain infrastructure asset (say, a road) is involved in the production of a certain amount of CO2 emissions, investor would want to benchmark this against other assets including the ones that are not in their portfolio. Indeed, investors can always decide to arbitrage between assets including in terms of their non-financial characteristics, if these are understood to represent exposures to material risk factors.

In order to diversify exposures to, say, flooding risk for some types of infrastructure, investors need not only know the likelihood of extreme rain events or the number of metres of water that would accumulate during a 100-year flood for assets in the portfolio. They also need to know how these metrics compare to other exposures found in similar assets and whether

they are average, extreme or, by contrast, limited compared with most other such assets. This requires ESG metrics that investors can rely on statistically (we return to this below).

Indirect investors-like fund LPs require both raw data about individual assets (as part of the reporting of GPs to integrate this information at the broader portfolio level where they may need it for regulatory reporting) but also on a relative scale to assess the investment choices made by fund managers in terms of non-financial characteristics. For example, fund investors may want to invest in an infrastructure fund that is committed to the decarbonisation of airports, but also expect the funds assets to be in the top quartile of this sector in terms of CO2 emitted per million passengers.

Likewise, reporting to stakeholders requires demonstrating that the impact of the investments made compares favourably to the average. Hence stakeholder reporting requires benchmarking of ESG data as well.

Investors know that regulatory reporting requires raw data. Indeed, reporting schemes like the ones being created in the EU or the US require the direct reporting of the amount of CO2 (Scope 1, 2 and 3) produced by a given investment. However, from a macro-prudential perpesctive this is not sufficient: for instance a central bank stress testing the impact of transition risks on the financial system would need to know the relative exposure of any given bank. This requires benchmarking financial actors relative to each other to understand how climate related losses might propagate through the financial system.

Thus, investors demand non-financial data which is very consistent with their prefered use case: risk management. They need to understand the exposures of their assets and portfolio to ESG Risks. To do this they need two bits of information: 1/ the value of the relevant metrics e.g., emissions, for their own assets and portfolio and 2/ a benchmark for that same metric in order to rank their assets relative to others available in the market.[1]

This conclusion points to two different issues with regards to investors access to non-financial data:

1. Asset-level data is needed to rank, monitor and possible filter individual investments. Today this information is not fully defined or easily comparable due to the emerging nature of the various voluntary reporting schemes used and the creation of new regulatory frameworks. However, as argued in Manocha and Blanc-Brude (2021), such standards can only converge and consolidate.; indeed 84% of the respondents to our survey agree that ESG standards should and will consolidate. There is indeed some evidence of a transition towards consolidation: at the COP26 conference, the International Financial Reporting Standards (IFRS) Foundation announced the creation of the International Sustainability Standards Board (ISSB) to help provide non-financial reporting (Daubeney, 2022). As taxonomies are clarified and definitions converge, reporting individual data point for specific investments will become standardised. Just like financial accounting became sufficiently standardised for the EBITDA or Total Assets of most firms in the world to be comparable, non-financial accounting can be expected to follow a similar path.

2. However, this tackles only half of the data that investors (and regulators) need to fullfil their preferred use cases, be they risk management, stakeholder reporting or regulatory reporting. Indeed, as argued above, they also need to

1 - Of course, the individual metrics required to measure/report the different aspects at different levels (asset, portfolio, market) can differ widely. For example, data on carbon emissions is required to understand the climate impact of an asset or firm, the amount of pollution generated by assets may contribute to the impacts of assets on human health, the disposal of waste in rivers can help understand the impacts on the biodiversity in rivers, the climate adaptation strategies may inform how companies are preparing for risks from floods, hurricanes etc. When translating these impacts and risks to estimates of profits and loss, other metrics such as the share of investments in renewable sector, Energy consumption in GWh per million of revenue of invested companies etc. are also required.

benchmark this information against a robust dataset in order to assess, beyond absolute metrics, how their assets and portfolios fare relative to the rest of the market in terms of non-financial metrics. Hence, the availability of large dataset presenting a representative range of outcomes in the cross-section is imperative as well.

This points to a more fundamental problem in terms of how the data about the ESG characteristics of infrastructure companies is compiled and aggregated. Most ESG metrics about unlisted infrastructure investments are either self-reported using data from current portfolio companies produced (81% of respondents) or using so-called contributed data i.e., data provided by investors and fund managers for the purpose of building scores and reports (74% of cases). As is also the case with financial performance data for similar infrastructure investments, such information is typically characterised by reporting and survivorship biases which make it less reliable to benchmark against. More importantly, these datasets are typically small, especially in the unlisted infrastructure space.

When it comes to benchmarking assets, the estimation of the distribution of this data, which is used to rank performance of individual assets or portfolio, requires a lot of data to be robust. Figure 6 illustrates this matter: with less then 1,000 data points per period, even with normally distributed data, the ability of investors to know even the quartiles of the data with reasonable certainty is very limited. It becomes difficult and sometimes impossible to create reliable benchmarks when only a few hundred projects have reported data, often without regard to representativeness of the underlying universe.

This last point calls for innovation in the area of non-financial data. Relying on contributed data only creates a strong limitation in the use of ESG data by investors in the infrastructure space. Contributed data will allow some reporting in absolute terms but is unlikely to support the more fundamental question of benchmarking the non-financial performance of firms.

A number of technologies exist and are being developed to 'augment' available data and go beyond simply aggregating contributed information but using it as an input in models that address much larger part of the universe. This is something that investors are increasingly willing to consider. In our survey, we asked respondents if they would accept ESG data that is AI generated: 40% of respondents said that they would accept using ESG data that is at most 50% AI-generated. However, only a fraction (3%) of respondents would trust data that is 100% AI generated.

The combination of better reporting standards and advanced data technologies will allow the creation of proper ESG data that can respond to investors preferred use cases, as documented above.

5. Conclusions

In summary, with this survey we have shown that investors in infrastructure have clear priorities and preferences when it comes to non-financial or ESG data. First, they require this type of information so they can engage in asset and portfolio risk management, which suggests that only a limited amount, if any, of ESG information is currently reflected in asset prices. Indeed, if the opposite was true then the most important use case for non-financial information would not be risk management. This conclusion has important implications in terms of the type of ESG information that investors need, in particular whether this data allows the relative benchmarking of assets on a non-financial basis, since such data are taken to be risk factor proxies. Investors thus aim to document and manage their exposures to certain risks via their access to ESG data.

The second most important reason that investors want non-financial data is to respond to a monitoring demand on the part of their stakeholders. Here again, investors say they need asset level raw data but also the ability to compare any such impact metric against a reliable sector or market benchmark.

Finally, the third most important reason for wanting ESG data is the regulator. While this may be surprising to some, we argue that this is consistent with the state of development of mandatory ESG reporting frameworks, which are very much still in development. While such frameworks require reporting of raw asset-level data like CO2 emissions, we argue that macroprudential regulation is also ultimately about managing risks and benchmarking the exposures of certain institutions relative to others and the market as a whole.

The need for non-financial data benchmarks in order to make risk management or reporting truly possible for infrastructure investors thus points to a fundamental issue: where does the data come from and is it representative and robust. We argue that even with well-behaved distribution the minimum number of observations per period or vintage is at least 1,000 data points. Below this threshold the robustness of the rankings and selection of investments on a comparative basis becomes statistically unreliable. We note that most infrastructure investors usually have access to data about their own portfolio only, or a pool a few hundred investments in the best of cases.

We conclude that technological innovations that allow processing and aggregating much larger datasets, including thanks to machine learning processes and techniques, are likely to support a much better use of non-financial data for the purposes that investors require, as documented in the survey.

Finally, the other key finding presented in this paper is the relative importance given to climate risks by investors in infrastructure. Consistent with the role of infrastructure in the economy and its contribution to energy production, storage, transportation and consumption, investors in infrastructure report that climate risks are more important to them than any other ESG considerations (with the exception of other environmental risks in some cases) by several order of magnitude.

The requirement by investors to access data on the climate risks of their infrastructure portfolio is also a confirmation of the conclusion that such risks are not priced in full if at all today.

A. Appendix

A.1 Data Sources

The data used in this study comes from the responses of 2 ESG surveys carried out by EDHEC*infra* between April 2021 and January 2022. This chapter provides the rational for conducting the surveys, describes the respondents of each survey and lists the questions, whose responses serve as the data set of this study.

A.1.1 2021 Survey

In March 2021, EDHECinfra published a research paper entitled "Towards A Scientific Approach to Measuring ESG in Infrastructure (Manocha and Blanc-Brude, 2021). The paper explored the role of ESG issues in an investment context, namely how institutional investors should incorporate ESG elements into the financial management of their portfolios. It presented findings of a comprehensive review and comparison of 17 ESG standards currently used by infrastructure investors. The paper also presented a taxonomy of ESG impacts and risks, in other words, a detailed typology of the ESG impacts and risks associated with different categories of infrastructure assets. This taxonomy is available in the Appendix of this paper.

The paper explored the role of environmental, social and governance (ESG) issues in an investment context, namely how institutional investors should incorporate ESG elements into the financial management of their portfolios. It presented findings of comprehensive review and quantitative comparison of 17 ESG standards (over 4000 associated disclosures) currently used by infrastructure investors. The paper also proposed a taxonomy of ESG impacts and risks always relevant to all infrastructure companies.

In 2021, EDHEC*infra* conducted a survey shortly after this study was published. The survey aimed to understand if the market agreed with the main conclusions of the paper. By July 2021, it was answered by 58 Asset Managers (AMs), Asset Owners (AOs), and institutional investors globally.

The 2021 survey asked the the following questions:

- A growing number of investors pursue ESG objectives to improve environmental and social outcomes directly and while this is important, ESG also remains a risk management and asset pricing question beyond the addition of constraints to the investments universe. Do you agree with this view?
- The paper proposes to address the matter of double materiality (impact of ESG on asset value and on society, the economy and the environment) by differentiating between the firm's impacts that are potential sources of risk and can influence asset values and those impacts that are expected to remain pure unpriced externalities. Do you agree with this approach?
- This paper shows that ESG schemes for infrastructure investors have been proliferating for a decade, and argues that a degree of consolidation is inevitable, with one or two 'salient' schemes emerging in the coming years and others bound to be absorbed or abandoned. Do you agree?
- The paper argues that ESG schemes for infrastructure investors are not focused on measuring what would constitute "sustainability risks" under a Task Force on Climate Disclosures (TFCD) inspired framework. Do you agree?
- The paper proposes a taxonomy of ESG impacts and risks that can be related to the

Figure 7: Distribution of 2022 survey respondents by respondent type

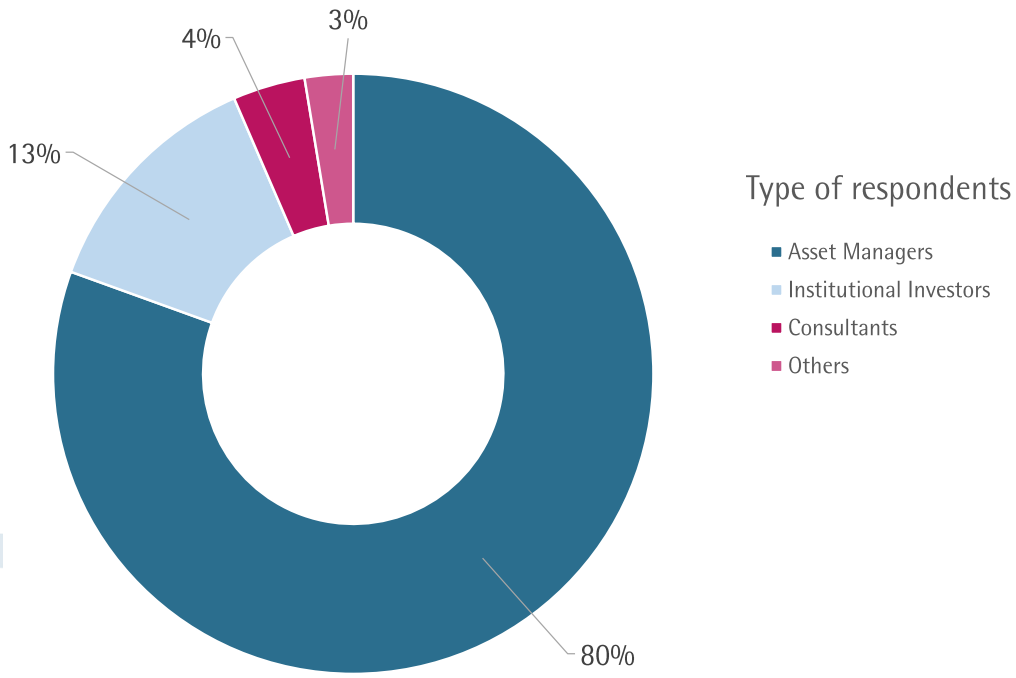
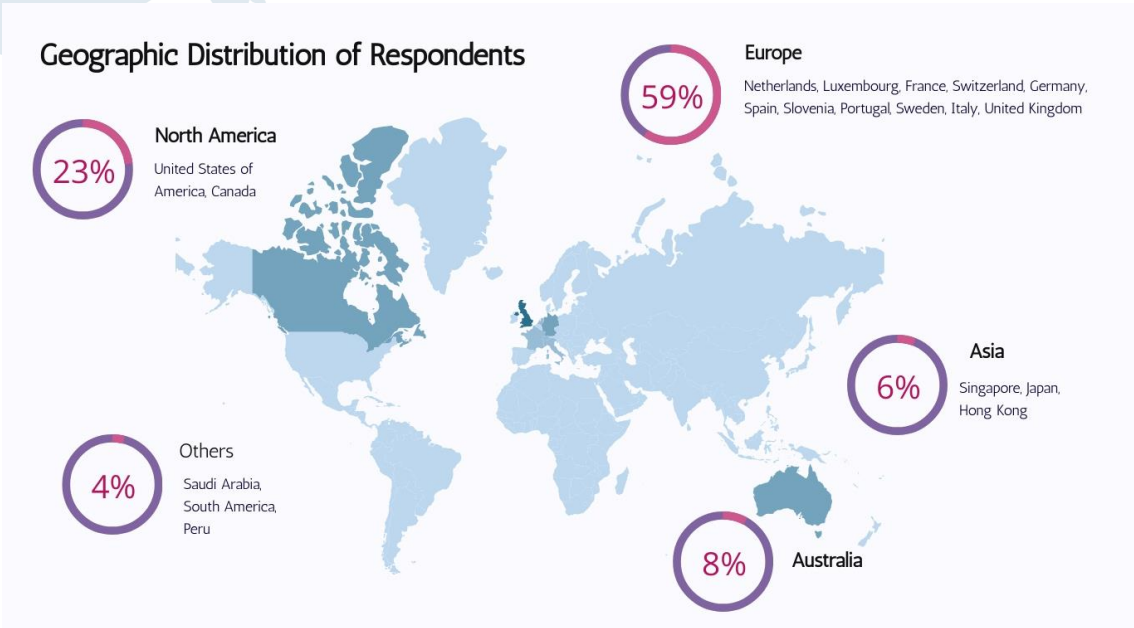


Figure 8: Distribution of 2022 survey respondents by geography



TICCS® classification standard of infrastructure companies and used to create universal risks and impact measures of infrastructure investments using asset-specific materiality profiles. Do you find this proposal useful?

A.1.2 2022 survey

The second ESG survey aimed to understand the drivers of demand of ESG data, the most relevant classes of ESG impacts and ESG risks for investors, the type of ESG data required by Asset Managers (AMs) and Asset Owners (AOs), and the current manner in which ESG data is collected at created.

The respondents of the survey were mainly from the infrastructure sector. They were either infrastructure specialists working in firms that invest in infrastructure among other sectors or were owners/managers of infrastructure assets.

The 2022 survey asked investors the following questions:

- Why does do your organisation need ESG data today?
- What kind of ESG data do you need at the asset level?
- What kind of ESG data do you need at the portfolio level?
- What kind of ESG data do you need at the market level?
- Rank the ESG impacts super-classes of the EDHECinfra taxonomy by order of importance
- Rank the ESG risk super-classes of the EDHECinfra taxonomy by order of importance
- Do you currently work with an ESG data provider?
- What is the main purpose of your collaboration with an ESG data provider?
- Where does the ESG data about your own investments come from?
- Where do your ESG market analytics come from?
- Between contributed data (e.g., from asset owners and managers) and AI-generated data (e.g., using satellite imagery, media reviews, etc.), what data do you accept?

77 respondents answered this survey by January 2022. Figure 7 shows that 80% of these were Asset Managers, 12% were Asset Owners while only 5% and 3% were consultants and others each. As shown on figure 8, in terms of geographic distribution, 59% of respondents are from Europe, 23% are from North America, 8% from Australia, 6% from Asia and 4% from other regions.

A.2 The Infrastuture ESG Taxonomy

The ESG taxonomy is an exhaustive list of all types of ESG impacts and risks that are relevant for all infrastructure companies. **It has three pillars- Environmental, Social and Governance and two dimensions- Impacts and Risks.**

The ESG taxonomy is built following **classification theory**, over three levels of a superclass, a class and a sub-class.

The EDHECinfra ESG taxonomy, is presented in table 4 through to table 9. For additional details on how the taxonomy was built, please refer to Manocha and Blanc-Brude (2021).

Figure 9: Geographic distribution of respondents who do not need or do not know what data is required regulatory reporting at the asset and portfolio level

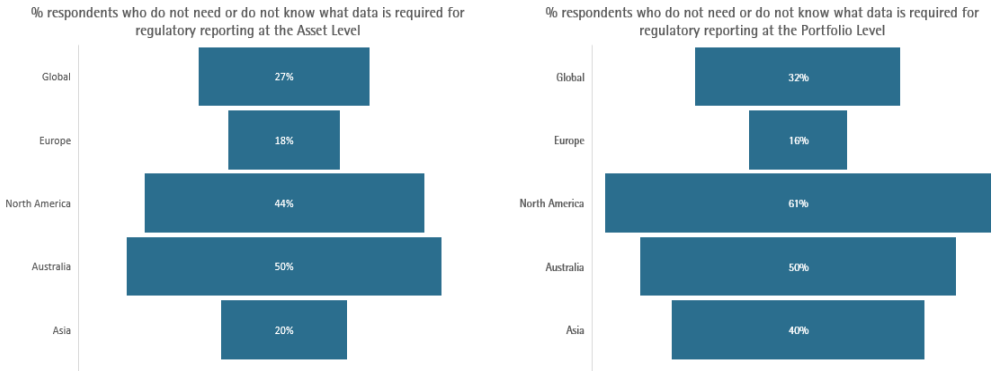


Table 4: Environmental Pillar Impact Classes

Identifier	Class Name	Class Definition
EI 1	**Natural resources**	The world's stock of naturally occurring assets (including geology, soil, air, water and all living things) that can be used for economic production or consumption.
EI 1.1	*Biodiversity*	The variety and variability of life on Earth at the genetic, species, and ecosystem level.
EI 1.1.1	Loss	The decline in number, genetic variability, variety of species, and the biological communities in a given area.
EI 1.1.2	Disturbance	A temporary and localised change in environmental conditions that causes a pronounced change in an ecosystem.
EI 1.1.3	Restoration	The process of assisting in the recovery of habitats and establishing the ecological processes necessary to make terrestrial and aquatic ecosystems sustainable, resilient, and healthy under current and future conditions.
EI 1.1.4	Conservation	The practice of protecting and preserving the wealth and variety of the biodiversity and maintaining the function of the natural ecosystems of a given region.
EI 1.1.5	Enhancement	The process of improving the organisms and habitats of a given region.
EI 1.2	*Water resources*	Natural sources of water that that are useful for human activities.
EI 1.2.1	Pollution	Discharge of harmful substances or contaminants that cause degradation of the water quality of a given resource.
EI 1.2.2	Depletion	The consumption of a water resource faster than it can be replenished.
EI 1.2.3	Diversion	Mass movement of water of water temporarily or permanently.
EI 1.2.4	Preservation and protection	Protecting the quality, quantity and integrity of water resources.
EI 1.2.5	Restoration	The process of restoring the quality, quantity and integrity of the water bodies that have been subject to pollution or depletion.
EI 1.3	*Land*	Land resources refers to the soil geographic land (soil) and all the naturally occurring resources such as rocks, minerals and ores present under the surface of the land.
EI 1.3.1	Pollution	The deposition of waste materials on land or underground in a manner that can contaminate the soil.
EI 1.3.2	Change in land use	Human induced transforming of the landscape of a piece of land.
EI 1.3.3	Degradation	Decrease in the quality or integrity of soil that causes the economic or biological productivity of a given piece of land to fall.
EI 1.3.4	Preservation and protection	Protect the quality, quantity and integrity of land resources.
EI 1.3.5	Restoration	The process of restoring the quality, quantity and integrity of land resources that have been subject to pollution or degradation.
EI 1.4	*Atmosphere*	The blanket of gases that surrounds the earth.
EI 1.4.1	Air pollution	Release of gaseous and particulate contaminants into the air.
EI 1.4.2	Climate change	The abnormal variations and the significant long-term change in the expected patterns of the average weather of the Earth's local, regional and global climates.
EI 1.4.3	Air quality improvement	Reducing the concentration of contaminants present in the air.

Table 5: Environmental Pillar Risk Classes

Identifier	Class Name	Class Definition
ER 1	**Physical risk**	The risks that infrastructure assets face from physical events or natural disasters.
ER 1.1	*Geophysical events*	Events originating from solid earth.
ER 1.1.1	Earthquake risk	The physical risk stemming from the shaking and displacement of the ground due to seismic waves.
ER 1.1.2	Volcanic risk	The physical risk stemming from volcanic activity such as rock falls, ash falls, lava streams, gases etc.
ER 1.1.3	Mass movement (dry) risk	The physical risk stemming from the displacement caused by the physical movement of the earth.
ER 1.2	*Hydrological events*	Events associated with water occurrence, movement and distribution.
ER 1.2.1	Flood risk	The physical risk stemming from a significant rise in water levels.
ER 1.2.2	Mass movement (wet) risk	The physical risk stemming from the displacement caused by the physical movement of the earth caused by a change in hydrological conditions.
ER 1.3	*Climatological events*	Events caused by long-lived/meso to macro scale processes (in the spectrum of intra-seasonal or multi-decadal climatic variability).
ER 1.3.1	Extreme temperature risk	The physical risk stemming from a variation in temperature above or below normal conditions.
ER 1.3.2	Drought risk	The physical risk stemming from a long-term event triggered by a lack of precipitation.
ER 1.3.3	Wildfire risk	The physical risk stemming from an uncontrolled burning fire, usually in wild lands.
ER 1.4	*Meteorological Events*	Events caused by long-lived/meso to macro scale atmospheric processes (in the spectrum of minutes or days)
ER 1.4.1	Storm risk	The physical risk stemming from the disturbance of the atmosphere marked by wind and one or more of rain, snow, hail, sleet or thunder and lightning.
ER 2	**Access to natural resources**	Access to natural resources can be understood as the opportunity and the ability to make use of the natural resources required for the activities of the infrastructure company.
ER 2.1	*Resource loss risk*	The risks associated with the reduction in the quantity or deterioration of quality of natural resources in a given geographic region.
ER 2.1.1	Quality risk	The deterioration of quality of natural resources in a given geographic region, associated with the human activities.
ER 2.1.2	Availability risk	The depletion in the stock of a natural resource in a given geographic region, associated with the human activities.

Table 6: Social Pillar Impact Classes

Identifier	Class Name	Class Definition
SI 1	**Human wellbeing**	The state of health, happiness and/or prosperity.
SI 1.1	*Collective wellbeing*	The positive and impacts of infrastructure companies on the wellbeing of a given community.
SI 1.1.1	Human rights	Rights inherent to all human beings, regardless of race, sex, nationality, ethnicity, language, religion, or any other status.
SI 1.1.2	Public health and safety	The anticipation, recognition, evaluation and control of hazards arising in or from the workplace that could impair the health and wellbeing of the public.
SI 1.1.3	Public disturbance	The state in which the comfort or peace of members of the public is disrupted.
SI 1.1.4	Heritage and culture	The legacy of physical artifacts and intangible attributes of the community.
SI 1.2	*Workforce wellbeing*	Employee wellbeing refers to the state of employees' health, happiness and/or prosperity.
SI 1.2.1	Workforce health and safety	The anticipation, recognition, evaluation and control of hazards arising in or from the workplace that could impair the health and wellbeing of the workforce.
SI 1.2.2	Working conditions	Working conditions to encompass a broad range of topics and issues, from working time to physical conditions and mental demands that exist in the workplace.
SI 1.2.3	Benefits	Benefits are any perks offered to employees in addition to salary.
SI 2	**Economic development**	The process by which the economic wellbeing and quality of life of a nation, region, or local community are improved.
SI 2.1	*Human development*	Enabling people to lead a long and healthy life, to be educated, to enjoy a decent standard of living, as well as political freedom, other guaranteed human rights and various ingredients of self-respect.
SI 2.1.1	Standard of living	The level of wealth, comfort, material goods, and necessities available to a certain socioeconomic class or geographic area.
SI 2.1.2	Human capital	The stock of habits, knowledge, social and personality attributes (including creativity) embodied in the ability to perform labor so as to produce economic value.
SI 2.1.3	Healthy life	A long life, free from diseases and acute and chronic health conditions
SI 2.2	*Assets Values*	The market value of all assets that can be impacted by infrastructure.
SI 2.2.1	Related land value	The value of a piece of property including both the value of the land itself as well as any improvements that have been made to it.
SI 2.2.2	Related real estate value	The worth of a piece of real estate.
SI 2.2.3	Related business value	The entire value of the business; the total sum of all tangible and intangible elements.
SI 2.2.4	Related infrastructure asset value	The market value of any given infrastructure asset as a function of the availability of infrastructure networks connected physically or digitally.

Table 7: Social Pillar Risk Classes

Identifier	Class Name	Class Definition
SR 1	**Social Acceptability**	The outcome of a collective judgment or collective opinion of a project or company.
SR 1.1	*Customer*	The group of individuals that use the service provided by the infrastructure company.
SR 1.1.1	Quality of service	The description or measurement of the overall performance of a service as seen by users.
SR 1.1.2	Affordability of service	The ability of a large proportion of society (at least the top of the bottom quartile) to pay for a service.
SR 1.1.3	Accessibility of service	The degree to which a service is available and physically accessible to as many users as possible.
SR 1.2	*General Public*	The individuals in a given population.
SR 1.2.1	Sector reputation	The social acceptance of a whole infrastructure sector by the general public.
SR 1.2.2	Privatisation perception	The social acceptance of privately owned infrastructure by the general public.
SR 1.2.3	Company reputation	The overall estimation in which an organisation is held by its internal and external stakeholders.
SR 1.3	*Regulators*	Bodies that are tasked with regulation of infrastructure.
SR 1.3.1	Ideology	A set of opinions or beliefs of a group or an individual, the regulators in this case.
SR 1.3.2	Politics	The acceptability, or lack of it, of an infrastructure company or an infrastructure sector by the general public can lead to the government promoting or barring specific companies or types of infrastructure.
SR 2	**Workforce Availability**	The availability of a sufficient workforce to carry out all the activities of an infrastructure company.
SR 2.1	*Industrial action*	Action by workers as a protest and means of forcing compliance with demands.
SR 2.1.1	Strikes and slowdowns	The mass refusal of employees to work.
SR 2.2	*Labor Market*	Refers to the supply of and demand for labor, in which employees provide the supply and employers provide the demand.
SR 2.2.1	Skill drought	The unavailability of trained, educated, or experienced segments of the workforce.

Table 8: Governance Pillar Impact Classes

Identifier	Class Name	Class Definition
GI 1	**Organization quality**	The ability of an infrastructure company to govern itself.
GI 1.1	*Company management*	The organisation and coordination of a company's activities in order to achieve company goals.
GI 1.1.1	Effectiveness	The capability of management to achieve the company's desired targets in a specified time.
GI 1.1.2	Impact and risk management	The ability of an infrastructure company to manage all impacts and risks resulting from its activities and external actors.
GI 1.2	*External relationships*	The process of maintaining healthy relationships with the internal and external stakeholders of the company.
GI 1.2.1	Transparency	The extent to which a corporation's actions are observable by outsiders.
GI 1.2.2	Corporate accountability and responsibility	The degree to which a company accepts responsibility for the impact of its actions on society and the environment.
GI 1.2.3	Stakeholder engagement	The process of involving all parties who may be affected by the company's decisions or can influence the company's business.
GI 1.2.4	Contractor and supplier engagement	The identification, selection, and management of relevant contractors and suppliers.

Table 9: Governance Pillar Risk Classes

Identifier	Class Name	Class Definition
GR 1	**Organisation Failure**	The failure of a company to govern itself.
GR 1.1	*Process failure*	A failure of organisation processes, either due to the process being difficult to use, poorly designed or poorly implemented, can pose a risk to the governance of the company.
GR 1.1.1	Reporting failure	The inability to partially or completely report mandatory and/or voluntary disclosures as a result of a process failure.
GR 1.1.2	Compliance failure	The failure of internal management systems designed to prevent and detect violations of applicable law, regulations, rules, international guideline and ethical standards by the company.
GR 1.2	*Absence of processes*	The absence of core and other organisation processes.
GR 1.2.1	Mandatory processes	The process required to ensure that companies comply with all applicable rules and regulations and adhere to all mandatory standards.
GR 1.2.2	Other processes	The processes that enable smooth running of the company but are not mandated by law or industrial standards.
GR 2	**Staff failure**	The inability of the team as a whole to successfully or efficiently complete company activities.
GR 2.1	*Competency*	The specific demonstrable or measurable skills required to complete a specific company activity.
GR 2.1.1	Core competency	The specific skills required to complete the core business activities of a company.
GR 2.1.2	Non-core competency	The specific skills required to complete the non-core business activities of a company.
GR 2.2	*Integrity*	The quality of the company workforce having strong ethical and moral principles.
GR 2.2.1	Criminal activity	Dishonest behaviour on part of its employees and can cause a company to be part of criminal activities.
GR 2.2.2	Non-criminal activity	Dishonest behaviour which is not criminal in nature, but can hamper internal processes, thus creating issues for company management.

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