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Innovative score-based approach to GRI Standards: case study on waste management companies

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ABSTRACT

The importance of companies disclosing information that goes beyond their mere financial performance is more and more recognized. Following the European Non-financial Disclosure Directive, companies started measuring and reporting their environmental, social, and governance information.

To disclose their data, most organizations around the world use the Global Reporting Initiative (GRI) Standards as guidelines. These show many benefits that are hard to dispute, like transparency and homogenization between companies.

However, sustainability reporting through these standards also carries some weaknesses and limits. One is the lack of a score-based approach. As a result, these reports fail to provide a comprehensive view of a company's sustainability performance, making comparisons between companies a challenge. This, in turn, limits stakeholders' ability to understand the true commitment of reporting companies toward environmental sustainability.

To address this gap, the thesis turns its attention to existing sustainability scoring systems, aiming to draw inspiration from them to create an innovative solution. Indeed, it focuses on developing a methodology for assigning a GRI Environmental Score to reporting companies. A framework is presented, designed to evaluate a company's environmental performance, with applicability across diverse industry sectors.

The method is then applied to a real-world case study involving three companies in the waste management sector. This case study aims to assess the method's effectiveness by analyzing actual corporate data, providing insights into companies' environmental performance and the viability of the proposed approach.

LIST OF ACRONYMS

CDSB	Climate Disclosure Standards Board
CSA	Corporate Sustainability Assessment
CSR	Corporate Social Responsibility
CSRD	Corporate Social Responsibility Directive
C&D	Construction and Demolition
EFRAG	European Financial Reporting Advisory Group
EMAS	Eco-Management and Audit Scheme
ESAP	European Single Access Point
ESRS	European Sustainability Reporting Standards
ESG	Environmental, Social, Governance
EU	European Union
FSB	Financial Stability Board
GHG	Greenhouse Gases
GRI	Global Reporting Initiative
KPI	Key Performance Indicators
IIRC	International Integrated Reporting Council
MS	Member States
MSCI	Morgan Stanley Capital International
NFD	Non-Financial Disclosure
NFRD	Non-Financial Reporting Directive
PIE	Public Interest Entities
SASB	Sustainability Accounting Standards Board
SDG	Sustainable Development Goals
SME	Small and Medium-Sized Enterprises
TCFD	Task Force on Climate-related Financial Disclosures
UN	United Nations

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Chapter 1. Introduction and aim of the thesis

1.1 Scope and significance of the thesis

This thesis explores the world of non-financial disclosures and sustainability reports through the use of Global Reporting Initiative (GRI) Standards. It investigates the legal aspects and reporting process related to the disclosure of information related to sustainability by companies.

The work highlights the problems encountered during the analysis of non-financial disclosures. In particular, the fact that reporting information through the use of GRI Standards, since they are not score-based, give no insights on the reporting company's sustainability performance and easy comparison between companies is not possible. Hence, it is hard for stakeholders and readers to understand the actual commitment of reporting companies for what concerns environmental sustainability.

Therefore, in the thesis, existing scoring systems are presented and analyzed to draw inspiration from in order to create an innovative one. Indeed, this thesis focuses on finding an innovative way to assign a GRI Environmental Score to reporting companies. It presents a framework to evaluate a company's environmental performance which can be applied to different sectors.

A case study is presented, applying the framework to three companies working in the waste management sector. The goal is to test the method on real corporate data in order to evaluate the companies' environmental performance and investigate whether the method is successful in doing so.

1.2 Thesis development context

The thesis development took place after an immersive six-months internship at a prominent consulting company. During that time, detailed reviews of sustainability reports were carried out as the role of revisor for external assurance. The process of external assurance consisted in getting to know the company, investigate their way of gathering the disclosed data, and check for correct compliance with the reporting requirements of the GRI Standards.

The first-hand experience of revising sustainability reports provided clear insights into the complexities and challenges occurring in reporting data according to the GRI Standards. It contributed to the formulation of research questions, hypotheses, and

methodologies which will be discussed in the thesis. Therefore, the content and direction of the thesis reflect the practical experience of the internship.

Moreover, the case study on which the thesis focuses is companies which underwent the process of revision for external assurance during the internship period. The familiarity gained from critically assessing the sustainability reports of these waste management entities forms a key basis for the thesis development and application of the proposed score-base methodology.

1.3 The structure of the thesis

The second chapter of this work covers the state of the art of non-financial disclosures. It examines the legal framework in which non-financial information are reported. The Non-Financial Disclosure Directive 2014/95/EU, the European directive about ESG statements, as well as the Legislative Decree No. 254/16, the transposition of the Directive in Italy, are presented in the chapter. Then, it explains the sustainability reporting practice. Chapter 2 then proceeds to investigate the GRI Standards, which are the focus of the thesis work. The chapter ends with a brief explanation of the legal development of non-financial disclosures in the European Union.

Chapter 3 identifies the challenges and weaknesses of using GRI Standards for non-financial disclosures. It aims to investigate the possible changes the Standards could undergo to better disclose the reporting company's sustainability performance. The main one being the need for a scoring system able to assign a sustainability value to the company for a better understanding of the sustainability and an easier comparison with companies working in the same sector. Then, the chapter proceeds to examine the state of the art of existing ESG rating methodologies, which are score-based, for assessing companies' sustainability practices: MSCI ESG Rating and S&P Global ESG Score. An innovative scoring system to be applied to GRI Standards, which draws inspiration from the ones previously discussed, is then formulated.

Chapter 4 presents a case study, involving three companies working in the waste management sector. The chapter describes the companies' characteristics, as well as presenting their disclosed data published in their non-financial disclosures. It also explains the context of the GRI disclosure requirements for the Standards selected for the case study.

In chapter 5 the scoring system is applied to the companies previously presented to study its way of working. It presents the measurements and outcomes of the case study.

It provides the result and discussion of the application of the innovative score-based system for certain GRI Standards to the companies of the case study.

Chapter 6 provides a concise summary of the key findings of the thesis, its limits, and its possible further developments. It discusses the potential directions for future research that have emerged from the study and offers suggestions for how the work could be further extended.

Chapter 2. State of the art

ESG is a term used to refer to Environmental, Social, and Governance sustainability of companies and organizations. Each dimension of ESG corresponds to a distinct aspect of the entity's operations and practices:

- Environmental considerations (E) encompass climate change mitigation and adaptation, as well as a broader focus on the environment and related risks.
- Social considerations (S) encompass topics such as inequality, inclusivity, labor relations, investment in human capital, and community engagement.
- Governance (G) of both public and private institutions, including management structures, employee relations, and executive compensation, plays a key role in ensuring that environmental and social considerations are integrated into decision-making processes.

Some advantages of prioritizing ESG management for organizations include (World Economic Forum, 2022):

- Improving reputation and competitiveness.
- Providing a deeper understanding of the company’s sustainability for a more informed decision-making process by stakeholders.
- Meeting the growing information needs of stakeholders, including customers, suppliers, investors, shareholders, and regulators, concerning ESG matters.
- Minimizing or preventing potential conflicts with consumers concerning products or services.
- Enhancing employee loyalty, commitment, participation, and motivation.

Furthermore, a variety of stakeholders show interest in the management of ESG topics. Institutional investors are increasingly incorporating ESG considerations into their decision-making processes. This growth is driven by three main factors (Eccles et. al, 2017): changes in policies, academic evidence supporting the positive correlation between ESG factors and financial performance, and the establishment of ESG performance and reporting standards by organizations like the Sustainability Accounting Standards Board (SASB) and the International Integrated Reporting Council (IIRC) (Eccles et. al, 2017). Prior to making investment decisions, private equity funds conduct ESG due diligence and evaluate ad hoc actions for portfolio companies with weak ESG profiles (Zeisberger, 2014). This focus on ESG considerations stems from investors' growing recognition of the impact that non-financial factors can have on value creation,

long-term company performance, and the well-being of society as a whole (Zeisberger, 2014). ESG ratings provide an overall score or grade that positions a company on a specific rating scale. These scores, based on predefined sustainability criteria and weighted by importance, reflect a company's sustainability performance (Laermann et. al, 2016). As a result, ESG ratings enable capital providers to distinguish companies that excel in risk management and corporate governance compared to their peers (Laermann et. al, 2016). Furthermore, customers have shown a willingness to pay a premium price for products or brands that adhere to sustainable and ethical practices (McKinsey, 2023).

2.1 Legal framework

Companies' actions have significant influence on the EU and global society. EU citizens expect companies to understand and address their positive and negative societal and environmental impacts, taking responsibility through Corporate Social Responsibility (CSR) (European Parliament Research Service, 2021).

In line with the European Green Deal[1], funding economic activities that support environmental, social, and governance objectives plays a key role in fostering sustainable growth and financing the green transition to achieve the EU's 2050 climate neutrality goal. In order to improve data availability and disclosure of non-financial information by companies and financial institutions, it is essential to direct capital flows towards sustainable investment. By doing this, better measurement, monitoring, and management of companies' societal impact and performance would be enabled (European Parliament Research Service, 2021).

In this context, the Directive 2014/95/EU, referred as Non-Financial Reporting Directive (NFRD), which is an amendment to the Accounting Directive (Directive 2013/34/EU), was adopted in 2014. The directive aims to promote greater business transparency and accountability concerning social and environmental issues. Under the NFRD, large public interest entities, including listed companies, banks, and insurance companies with over 500 employees, are mandated to publish reports on ESG dimensions. For example, policies they implement in relation to social responsibility and treatment of employees; respect for human rights; anti-corruption and bribery; and diversity on company boards (in terms of age, gender, educational and professional background)

[1] The EU Green Deal (European Commission, 2019, December 11) is a comprehensive and ambitious policy framework introduced by the European Commission, the executive branch of the European Union, on December 11, 2019, representing a roadmap for achieving climate neutrality by 2050.

(Directive 2014/95/EU). The disclosure must encompass information about business models, policies, outcomes, risks, risk management, and key performance indicators (KPIs) relevant to the business. At present, around 6000 of the largest EU companies are required to disclose non-financial information under the NFRD (European Commission, 2014).

Nonetheless, according to the NFRD, a company should report at least on this information:

- Employment of energy resources, differentiating between those derived from renewable versus non-renewable origins.
- Use of water resources.
- Greenhouse gases emissions and discharge of pollutants into the atmosphere.
- Impact, even in the medium term, on the environment, health and safety, associated with risk factors.
- Societal components linked to workforce management, initiatives for ensuring gender parity, the execution of global agreements, and the manner of communication with societal partners.
- Respect for human rights, steps taken to prevent their violation, measures to preclude prejudiced attitudes or behaviors.
- Combating against both active and passive misconduct, with an indication of the mechanisms adopted to do so.

In cases where companies do not disclose details concerning the matters mentioned above, the Directive grants them the opportunity to offer a clear and reasoned explanation for such abstention, also called "comply-or-explain" (European Parliament Research Service, 2021).

In Italy, after two consultations held by the Ministry of Economy and Finance, the Legislative Decree No. 254/16 (D. Lgs n. 254/16) was submitted to the competent commissions of the Chamber and Senate. The Legislative Decree, which implements Directive 2014/95/EU, on the communication of non-financial information in Italy was passed on 30 December 2016[2]. Member States' transposition deadline for the NFRD was

[2] In the European Union, the legislative process requires cooperation between EU institutions and individual Member States. Upon introduction, an EU directive delineates specific aims that all member states are expected to achieve within a predefined timeframe. However, each member state has the autonomy to determine the approach by which they will incorporate the directive's requirements into their national legislation.

6 December 2016 (European Parliament Research Service, 2021). Undertakings covered by the Directive had to report for the first time in 2018 (for the 2017 financial year).

Article 2 of the Legislative Decree No. 254/16 defines its scope, clarifying the parameters to be classified as large undertakings. These include Public Interest Entities (PIE) which had, on average, more than 500 employees during the financial year and which exceeded one of the following dimensional limits on the date of the financial statements closing:

1. Total balance sheet: Euro 20M.
2. Total net sales and revenues: Euro 40M.

Article 3 establishes the content of non-financial statement. It must contain information to the extent necessary for an understanding of the undertaking's development, performance, position, and impact of its activity, relating to these matters:

- Environmental
- Social
- Personnel-related issues
- Respect for human rights
- The fight against active and passive corruption.

The statement should include in particular undertaking's business model, description of the policies pursued by the undertaking in relation to those matters/results achieved, and the principal risks related to those matters linked to the undertaking's operations. Then, the non-financial statement can either be integrated into the management report or be a separate report, for example called Sustainability Report or Non-Financial Declaration Report. In case of a separate report, after its approval by the Board of Directors, it must be published in the Company Register together with the Management Report.

Furthermore, Article 4 provides for regulation of consolidated non-financial statement, required to be submitted by public-interest entities which are parent undertakings of a large group. In case of groups of companies, a consolidated statement shall be drawn up, the scope of which shall include the data of the parent company and its subsidiaries consolidated.

2.2 Reporting practices for Non-Financial Disclosures

According to the Non-Financial Reporting Directive, a company is required to disclose information on environmental, social and employee matters, respect for human

rights, and bribery and corruption. This information should be shared to the extent required for comprehension of the company's advancement, accomplishments, performance and impacts of its operations (UNGP Reporting, 2017).

The Non-Financial Reporting Directive leaves flexibility in enacting its provisions. It, in fact, does not stipulate the utilization of a particular non-financial reporting norm or structure, nor does it impose elaborate disclosure prerequisites, such as a catalog of metrics per sector (European Parliament Research Service, 2021). Thus, companies have the liberty to decide how they wish to present pertinent information in the most practical manner, as they consider more suitable.

In 2015 the Task Force on Climate-related Financial Disclosures (TCFD) was set up by the Financial Stability Board (FSB), an international body that monitors and makes recommendations about the global financial system to promote stability and protect against systemic risks. The TCFD's purpose is to support entities in disclosing coherent, and comparable information about fiscal risks linked to climate change. The purpose was accomplished by creating recommendations for communicating these risks and opportunities, meeting investors' expectations and needs (Task Force on Climate-related Financial Disclosures, 2023).

In June 2017, the TCFD released a Final Report (Task Force on Climate-related Financial Disclosures, 2017) containing the recommendations to motivate financial institutions and non-financial corporations to disclose data concerning climate-related risks and opportunities that climate shifts could bring upon business performance. The Task Force structured its recommendations around four thematic areas that represent core elements of how organizations operate: governance, strategy, risk management, and metrics and targets. These four overarching suggestions are supported by key climate-related financial disclosures, denoted as recommended disclosures, which enhance the framework with insights that will help investors and other stakeholders in understanding the thought processes and assessments regarding climate-associated risks and opportunities.

In 2019, the European Commission crafted a document under the umbrella of the NFRD, titled "Guidelines on non-financial reporting: Supplement on reporting climate-related information" (European Commission, 2019). This document was prepared with the intent of aiding concerned companies in disclosing non-financial data in a pertinent, effective, uniform, and more comparable manner. It serves as an extension to the instructions established by the Commission back in 2017 (European

Commission, 2017), which are non-binding and are released in accordance with Article 2 of the NFRD[3]. It should be noted that this supplement does not constitute a universally followed standard for corporations. Rather, it offers counsel to businesses that aligns with the Non-Financial Reporting Directive and integrates the recommendations of the TCFD. The main goal of these guidelines is to facilitate companies in disclosing high quality, pertinent, valuable, uniform, and more comparable non-financial (environmental, social, and governance-related) data in a manner that fosters resilient and sustainable growth and employment while also ensuring clarity and transparency for stakeholders. These guidelines are primarily intended for corporations mandated by the Directive to disclose non-financial data in their managerial reports. Nevertheless, these non-compulsory guidelines could serve as a benchmark for all entities disclosing non-financial data, including those beyond the Directive's scope (Sustainability Reporting)[4].

According to the European Commission Guidelines on non-financial reporting (European Commission, 2019), one key principle to follow when reporting sustainability information is to "disclose material information". Therefore, the first step when writing these reports is to conduct a materiality analysis.

Materiality entails the importance or relevance of information within a specific context, decision-making process, or scenario. It stands as a foundational concept employed to determine what data should be disclosed, reported, or considered when making choices. Evaluating material topics in non-financial reporting enables companies to comprehend which ESG issues are most important to their business activities and stakeholders, offering guidance for their reporting and strategic decision-making. Indeed, the non-financial statement is expected to reflect a company's fair view of the information needed by relevant stakeholders. Issues to be considered for inclusion in the non-financial statement are specific to the company's circumstances, considering concrete situations and sectoral considerations. Indeed, information that may be material in one context may not be in another. Companies within an industry are likely to share similar environmental, social and governance challenges, for instance because of the resources they may rely

[3] Article 2 of the Non-Financial Reporting Directive (Directive 2014/95/EU) refers to “guidance on reporting” and sets out that “the Commission shall prepare non-binding guidelines on methodology for reporting non-financial information, including non-financial KPIs, general and sectoral, with a view to facilitating relevant, useful and comparable disclosure of non-financial information by undertakings”.

[4] Typically, documents disclosing ESG information of companies that do not fall in the scope of the NFRD are called Sustainability Reports and are voluntary.

upon to produce goods and services, or the effects they may have on people, society, and the environment. It may therefore be appropriate to directly compare relevant non-financial disclosures among companies in the same sector.

According to the 2017 guidelines (European Commission, 2017), multiple considerations might come into play when evaluating the materiality of information. These encompass:

- Business model, strategy, and principal risks: a firm's aspirations, tactical maneuvers, administrative methodologies and systems, principles, tangible and intangible assets, value creation process, and chief uncertainties constitute pertinent factors.
- Main sectoral issues: entities within comparable fields may confront similar concerns that bear relevance, particularly if said subjects have been acknowledged by competitors, customers, or suppliers.
- Interests and expectations of relevant stakeholders: corporations are expected to interact with stakeholders and cultivate a good understanding of their areas of concern and preoccupations.
- Impact of the activities: corporations ought to reflect on the actual and potential severity and recurrence of impacts. This includes the impacts originating from their products, services, and their corporate relations (encompassing aspects of the supply chain).
- Public policy and regulatory drivers: public strategies and regulations could potentially impact a corporation's distinct circumstances and shape the materiality.

In materiality assessment, first of all, the organization must define which categories to involve and at what scale, identifying a representative sample of stakeholders for each category selected. Stakeholders contribute to identifying material topics. These stakeholders will take part in the materiality analysis through stakeholder engagement activities. Stakeholders can partake in either a single multi-stakeholder event or, alternatively, it is possible to provide a session focused on sustainability within engagement activities already foreseen by the organization with one or more categories of stakeholders (such as consultations with investors and shareholders, meetings or site visits with suppliers, or internal climate analyses). Among all the categories of stakeholders, the organization can identify the most relevant ones according to criteria such as strategy and number: when consolidating the results of all stakeholder

engagement activities, the assessments emerged from the different stakeholder categories can be weighted based on the relative relevance assigned to each stakeholder category.

Through engagement of the stakeholder and the understanding of their expectations and needs, it is possible to identify strategic ideas of interest in order to undertake paths of stakeholder-oriented development in the field of sustainability. Undertakings involving stakeholder interactions activities improve the bond between them and the organization, cultivating mutual trust and transparency. When an organization defines its relevant topics, it must subject them to vote and validation from the perspective of both the organization and its stakeholders, in order to identify the material topics. From a list of relevant topics, material topics are identified on the basis of two dimensions:

- The significance of these topics in relation to their economic, environmental, and social impacts.
- The ability of these topics to influence stakeholder assessments and decisions.

However, not all significant subjects carry the same weight, and reporting must mirror their corresponding relevance. Once the list of topics relevant to the organization and its stakeholders has been defined, they must be evaluated by the organization and its stakeholders, in order to identify and prioritize the material topics that will be the subject of non-financial reporting. A quantitative judgement of the relevant topics identified is required, so participants will be asked to express their opinion on how much each of the topics identified is able to influence Group's ability to create value in the short, medium, and long term and to influence stakeholders' decision making, using for example a scale from 1 to 5.

It is important to acknowledge that material topics can vary widely based on the nature of the company's operations, industry, and stakeholder expectations. Indeed, organizations should identify and prioritize the most relevant and significant topics that align with their business strategy and have a meaningful impact on sustainability performance and stakeholder trust.

Below, a few examples of recurring material topics for non-financial disclosure:

- Greenhouse Gas Emissions: Reporting on the company's emissions of greenhouse gases, such as carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O), and efforts to reduce these emissions.
- Energy Consumption: Disclosing energy consumption patterns, renewable energy use, and energy efficiency initiatives.

- Water Usage and Management: Reporting on water consumption, water sourcing, and efforts to reduce water usage and manage water-related risks.
- Waste Management: Providing information on waste generation, recycling rates, waste reduction initiatives, and hazardous waste handling.
- Employee Diversity and Inclusion: Reporting on workforce demographics, gender and ethnic diversity, inclusion programs, and equal opportunity efforts.
- Health and Safety: Providing information on workplace safety measures, employee health and wellness programs, and efforts to prevent accidents and incidents.
- Biodiversity and Ecosystem Protection: Reporting on efforts to protect and conserve biodiversity, habitat preservation, and initiatives to minimize negative impacts on ecosystems.

After the materiality assessment, knowing the material topics for the company in question, there is the step of identification of reporting standards to use and the preparation and sending of sheets for the collection of sustainability data and information. This step is usually done through the use of Standards which explain the type of information to disclose and the way to do so. Indeed, sustainability reporting standards provide a structured framework for collecting, measuring, and reporting data on various aspects of a company's operations that relate to sustainability. This includes information about environmental impacts (such as carbon emissions, water usage, and waste management), social practices (like employee well-being, diversity, and human rights), and governance (such as ethical practices, board structure, and executive compensation). In general, reporting standards are issued by authoritative supranational, international, or national bodies (public or private in nature) that are functional, in whole or in part, to meet non-financial reporting requirements. According to the 2019 Guidelines (European Commission, 2019), companies are advised to disclose data in alignment with universally acknowledged reporting standards and frameworks, aiming to enhance comparability among the stakeholders. Indeed, to contribute to harmonization on both EU and global scales, the guidelines refer to various established reporting frameworks and standards.

In addition to the TCFD, which are integrated in the guidelines, the European Commission (European Commission, 2019) also takes particular account of the standards and frameworks developed by the:

- Global Reporting Initiative (GRI)
- Climate Disclosure Standards Board (CDSB)

- Sustainability Accounting Standards Board (SASB)
- International Integrated Reporting Council (IIRC)
- EU Eco-Management and Audit Scheme (EMAS)

It is important to acknowledge that in this particular context, the European Commission, in July 2020, mandated the European Financial Reporting Advisory Group (EFRAG) to draft suggestions for a conceivable forthcoming European standard for non-financial reporting. This matter will be further discussed in the last paragraph of this chapter.

Regardless of the many frameworks recognized by the European Commission, according to KMPG (2022), the GRI Standards are the most widely adopted and internationally recognized. For this reason, the thesis focuses on these standards.

2.3 Global Reporting Initiative Standards

The "Global Reporting Initiative Sustainability Reporting Standards" (GRI Standards) are an international reporting standard defined by the Global Reporting Initiative for Non-Financial Reporting and constitute a universally accepted reporting model, guided by the purpose of facilitating the comparability, reliability, and verifiability of information. These guidelines provide standards that companies can follow to measure and report their economic, environmental, social, and governance performance. Indeed, GRI's main purpose is to help companies and other entities communicate their sustainability efforts and impacts in a transparent and consistent manner.

GRI was founded in 1997 following an environmental damage involving an oil spill (Global Reporting Initiative, 2023). Initially, the aim was to create an accountability mechanism to ensure that companies would adhere to responsible environmental conduct principles, including social, economic and governance issues. The first version of the guidelines was published in 2000, providing the first global framework for sustainability reporting. It is important to note that GRI regularly updates its reporting standards to reflect evolving best practices and stakeholder expectations in the field of sustainability reporting. Indeed, from the first publication, GRI Guidelines were updated or revised various times, as it is shown in Figure 1. In 2016, GRI transitioned from providing guidelines to setting the first global standards for sustainability reporting: the GRI Standards. From there, the Standards continued to be updated until a major update in 2021 with the revision of the Universal Standards and the introduction of the Sector Standards.

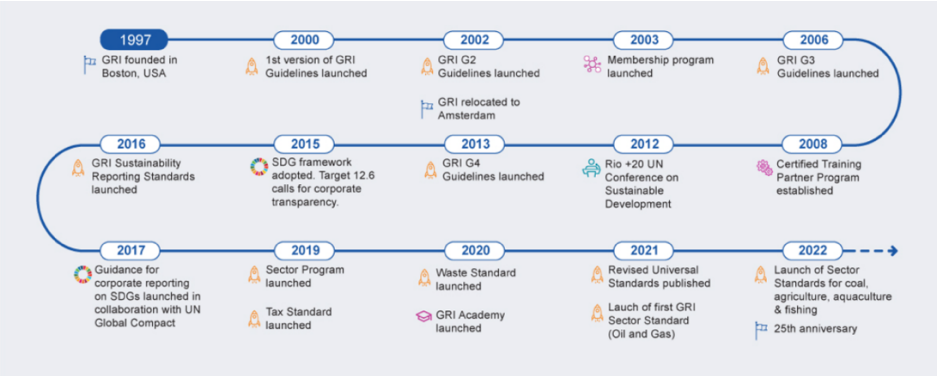

Figure 1 Timeline of GRI's history (Global Reporting Initiative, 2023).

The GRI Standards, 2021 update, are structured as a system of interrelated standards that are organized into three series: GRI Universal Standards, GRI Sector Standards, and GRI Topic Standards. Figure 2 shows the division of the different Standards found in the GRI 1 document. The Universal Standards GRI 1, 2 and 3 must be used by all organizations reporting in accordance with the GRI Standards. An organization begins the reporting practice by consulting GRI 1: Foundation 2021, which introduces the purpose and system of the Standards explaining key concepts for the reporting. It specifies the requirements and reporting principles that the organization must comply with to report in accordance with the GRI Standards. The GRI 2: General Disclosure 2021 contains disclosures that the organization uses to provide information about its reporting practices and other organizational details, such as its activities, governance, and policies. GRI 3: Material Topics 2021 provides guidance on how to define the reporting company's material topics, also explaining how to disclose the information about the process of determination of the topics. Sector Standards are applied based on the sectors in which the company reporting information operates. They are made based on the typical material topics related to specific sectors. The Topic Standards are the ones used according to the material topics for the reporting company. The company will have certain Standards to report based on the material topics identified with the materiality assessment using GRI 3 and through stakeholder engagement.

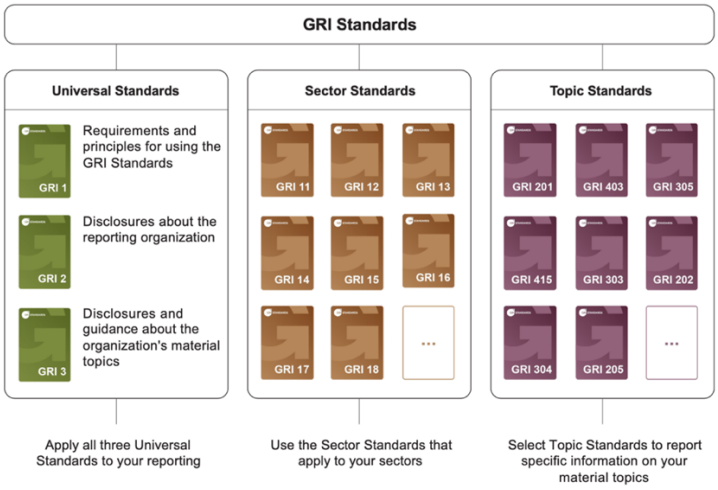

Figure 2 GRI Standards: Universal, Sector and Topic.

All disclosures in the Standards have requirements which provide information to be reported and instructions on how to do so by companies involved in reporting ESG information. Indeed, requirements can be followed by guidance, including background information, explanations, and examples to help the organization better understand the requirements. The organization is not required to comply with the guidance. The Standards may also include recommendations. These are cases where a particular course of action is encouraged but not required for the specific Standard to be considered as correctly disclosed. As mentioned in the paragraph 2.2, if the company is not able to comply with the requirements of a Standard they are supposed to report, then the company is required to specify the reasons for omission or the requirements the company does not meet (European Parliament Research Service, 2021).

There are two ways a company can disclose ESG information following GRI Standards: “in accordance” or “with reference” to the GRI Standards. The “in accordance” way is the one which provides a more comprehensive picture of the sustainability of the reporting company. According to GRI 1, it means reporting ESG information in compliance with the following nine requirements:

1. Apply the reporting principles
2. Report the disclosure in GRI 2: General Disclosures 2021
3. Determine material topics
4. Report the disclosure in GRI 3: Material topics 2021
5. Report disclosures from the GRI Topic Standards for each material topic
6. Provide reasons for omission for disclosures and requirements that the organization cannot comply with

7. Publish a GRI content index[5]
8. Provide a statement of use
9. Notify GRI

If the company does not comply with these requirements, then it cannot claim to have reported information in accordance with the GRI Standards. Therefore, the company will have to declare to have prepared the reported information with the methodology "with reference" to the GRI Standards, provided it complies with the requirements of that way of reporting. If the company reports "with reference" to the GRI Standards, it means that it uses just some selected Standards, or parts of their content, to report specific topics for specific purposes. According to GRI 1, the requirements to meet when reporting with reference are the following three:

1. Publish a GRI content index
2. Provide a statement of use
3. Notify GRI

Reporting principles are a set of eight principles that must be used simultaneously to define the contents of the report and achieve a sustainability report in accordance with GRI Standards. Each principle includes tests to enable the organization to verify that each principle has been correctly applied.

- Accuracy: The reporting information must be accurate and detailed enough to allow stakeholders to assess the performance of the organization.
- Balance: The data reported should reflect negative and positive aspects of the organization's performance in order to enable a weighted assessment of overall performance.
- Clarity: The organization must make the data available in such a way that it is understandable and accessible to stakeholders who use it.
- Comparability: The organization must select, fill in, and report information consistently. The reporting information should be presented in such a way that stakeholders can analyze changes in the organization's performance over time and that could support analysis for other organizations.
- Completeness: The report should cover material topics and their perimeters sufficiently to reflect significant economic, environmental, and social impacts and

[5] Content index generally refers to a structured list or table included in a company's non-financial disclosure or sustainability report. This index provides readers with a clear guide to where specific information can be found within the report. The purpose of the content index is to enhance transparency, ease of navigation, and accountability in reporting.

allow stakeholders to assess the organization's performance during the reporting period.

- Sustainability context: The report should present the organization's performance in the broader context of sustainability.
- Timeliness: The organization must publish reports on a periodic basis so that the data is available in the time required to enable stakeholders to make informed decisions.
- Verifiability: The reporting information must be able to be checked and verified.

As mentioned before, companies report Topic Specific Standards based on the material topics identified through the materiality assessment. There are three series of Topic Specific Standards:

- Series 200: Economic disclosure. The series include standards for economic topics in an organization (economic performance, anti-corruption, etc.).
- Series 300: Environmental disclosure. The series include standards relating to environmental topics of an organization (energy consumption, water consumption, greenhouse gas emissions, etc.).
- Series 400: Social disclosures. The series include standards on social topics in an organization (employment, child labor, public policies, etc.).

For each material topic, organizations are required to report:

- Management approach disclosures, using the components provided in GRI 3-3: Management of material topics.
- Topic-specific disclosures for the corresponding GRI Standard if the material topic is reconcilable with an existing GRI Standard. If the material topic cannot be reconciled with a GRI Standard instead, the organization must still report the management approach and may consider reporting any appropriate information and KPIs.

Below, in Figure 3, there is an example of GRI Standard related to the waste generated by the reporting company. It belongs to the 300 series (environment) and in particular it is a 306 GRI, meaning that it gives information on how to disclose information about the waste of the reporting company. The GRI is 306-3: Waste generated. The picture, taken from the GRI Guidelines on the GRI 306, shows the requirements for disclosing the Standard in accordance and guidance for the disclosure of the different points found in the requirements. For example, this GRI Topic Specific

Standard will be disclosed when there is a material topic relating to the waste generation of the company, which is very recurring as already seen in the previous paragraph.

Disclosure 306-3 Waste generated

REQUIREMENTS

The reporting organization shall report the following information:

a. Total weight of waste generated in metric tons, and a breakdown of this total by composition of the waste.

b. Contextual information necessary to understand the data and how the data has been compiled.

Compilation requirements

2.1 When compiling the information specified in Disclosure 306-3-a, the reporting organization shall:

2.1.1 exclude effluent, unless required by national legislation to be reported under total waste;

2.1.2 use 1000 kilograms as the measure for a metric ton.

GUIDANCE

Background

The total weight of waste generated, when contrasted with the weight of waste that the organization directs to recovery and disposal, can show the extent to which the organization manages its waste-related impacts.

The composition of the waste generated can help identify recovery or disposal operations appropriate to the type of waste and to the specific materials present in the waste.

Guidance for Disclosure 306-3

This disclosure covers waste generated in the organization's own activities. The organization can separately report waste generated upstream and downstream in its value chain, if this information is available.

Guidance for Disclosure 306-3-a

When reporting composition of the waste, the organization can describe:

- the type of waste, such as hazardous waste or non-hazardous waste;
- the waste streams, relevant to its sector or activities (e.g., tailings for an organization in the mining sector, electronic waste for an organization in the consumer electronics sector, or food waste for an organization in the agriculture or in the hospitality sector);
- the materials that are present in the waste (e.g., biomass, metals, non-metallic minerals, plastics, textiles).

Templates for how to present information under this disclosure can be found in the Appendix Tables.

Guidance for Disclosure 306-3-b

To help understand the data, the organization can explain the reasons for the difference between the weight of waste generated and the weight of waste directed to recovery or disposal. This difference can be a result of precipitation or evaporation, leaks or losses, or other modifications to the waste. In the context of this Standard, leaks result from physical or technical failures (e.g., a trail of waste from a waste collection truck), while losses result from inadequate security measures or administrative failures (e.g., theft or lost records).

To help understand how the data has been compiled, the organization can specify whether the data has been modeled or sourced from direct measurements, such as waste transfer notes from contracted waste collectors, external assurance, or audits of waste-related data.

See references [1], [4], [10], and [11] in the Bibliography.

Figure 3 GRI Standard 306-3: Waste generated.

The Standard shows the information to be disclosed in the report and how to do so. There are compilation requirements which include the unit of measure and what to include in the data acquisition. The guidance points are meant to help reporting companies to get a better understanding on what the Standard requires.

2.4 Legal development

In April 2021, a proposal known as the Corporate Sustainability Reporting Directive (CSRD) Proposal (European Commission, 2021) was put forth by the European Commission with the intention to enhance and revise the existing Non-Financial Reporting Directive by making changes to the present requirements. The CSRD (Directive (EU) 2022/2462) officially entered into force on January 5th, 2023. This new directive has a wider scope; indeed, a broader range of companies is involved, including listed small and medium-sized enterprises (SMEs).

The CSRD represents an important step towards improving transparency and accountability within companies concerning their sustainability performance. The aim is to promote sustainable business practices across the EU by providing investors, stakeholders, and the general public with enhanced information that enables a comprehensive assessment of a company's ecological and societal impact. According to the European Commission (European Parliament Research Service, 2021), the implementation of these new requirements will ensure that stakeholders are supplied with the necessary information to understand the potential investment risks coming from factors such as climate change and other sustainability-related concerns. Additionally, it will create a culture of transparency about the impact of companies on people and the environment. The initial application of this new directive is expected to commence during the financial year of 2024, for reports published in 2025.

The key Highlights of the CSRD Include:

- Purpose: The central objective of the CSRD is to elevate the quality, uniformity, and comparability of sustainability reporting among companies within the confines of the European Union.
- Scope: The CSRD is designed to apply to large companies, including listed companies, credit institutions, and insurance companies, operating within the EU. The reporting requirements are extended to more companies than the ones covered under the NFRD. Starting from Fiscal Year 2024 the scope will be large European Companies listed that meet at least two of the following criteria:
  (i) Net revenues over EUR 40M
  (ii) Assets under the balance sheet over EUR 20M
  (iii) Employees over 250

  Instead, according to the Directive, from Fiscal Year 2025 all major European companies, listed and non-listed will be required to disclose a

non-financial statement. From Fiscal Year 2028 also non-EU companies generating turnover in the EU of at least Euro 150M and having at least one subsidiary or branch in the EU will be required to do so.

- Reporting Requirements: The Directive introduces mandatory sustainability reporting, expanding on the previous non-financial reporting requirements. Companies subject to the CSRD will have to report according to European Sustainability Reporting Standards (ESRS). The draft standards are developed by the EFRAG, known as the European Financial Reporting Advisory Group, an independent body bringing together various different stakeholders. More on this matter will be discussed at the end of the current paragraph.
- Digital Reporting: An accentuation on digitalization is evident within the CSRD, stipulating that companies must present their sustainability reports in a digital, machine-readable, and interactive format. This aims at improving accessibility and facilitating data analysis. The format will be XHTML. Furthermore, the sustainability report can no longer be published separately, but sustainability information must be included in the management report.
- Assurance: To enhance the credibility and reliability of the provided sustainability information, the CSRD introduces a stipulation for external assurance. Companies will have to engage independent auditors to verify the accuracy of their reports. Consequently, at the EU level, limited assurance becomes a legal requirement.
- European Single Access Point: The proposal envisions the creation of a European Single Access Point (ESAP) that would serve as a central repository for all publicly disclosed company information, including sustainability reports. This would make sustainability information easily accessible for comparing data.

The final text of the Directive was officially published within the Official Journal of the EU subsequent to its ratification by the European Parliament and Council, with its enforcement taking effect on the 5th of January 2023. However, it is required upon Member States to transpose the directive into their domestic legislation within a span of 18 months following its publication. Consequently, the regulations delineated by the NFRD will continue to be effective until the point of transition to the new CSRD rules, allowing companies the necessary time to gradually adapt to the fresh reporting requirements.

As previously mentioned, the Directive entails that companies subject to the CSRD will have to report according to European Sustainability Reporting Standards. These standards are developed by the EFRAG, known as the European Financial Reporting Advisory Group, an independent body, non-profit association that serves the public interest by providing advice to the Commission on the endorsement of international financial reporting standards.

As required by the CSRD, the CSRS take a “double materiality” perspective. The concept of Double Materiality has two perspectives. The first perspective refers to issues that reflect the actual or potential significant social and environmental impacts linked to an organization and its value chain. The second perspective includes all risks and opportunities of sustainability that can positively or negatively affect the development, performance, and positioning of an organization (in the short, medium or long term) and thus create or erode its business value.

The ESRS are 12 which cover many sustainability issues (European Commission, 2023):

Group	Number	Subject
Cross-cutting	ESRS 1	General Requirements
Cross-cutting	ESRS 2	General Disclosures
Environment	ESRS E1	Climate
Environment	ESRS E2	Pollution
Environment	ESRS E3	Water and marine resources
Environment	ESRS E4	Biodiversity and ecosystems
Environment	ESRS E5	Resource use and circular economy
Social	ESRS S1	Own workforce
Social	ESRS S2	Workers in the value chain
Social	ESRS S3	Affected communities
Social	ESRS S4	Consumers and end users
Governance	ESRS G1	Business conduct

Figure 4 Group, number, and subject of the 12 ESRS (European Commission, 2023).

ESRS 1, titled "General Requirements," outline fundamental principles for reporting under ESRS. It does not establish specific disclosure mandates on its own. ESRS 2, labeled "General Disclosures," gives essential information that must be disclosed

regardless of the particular sustainability aspect being addressed. Indeed, ESRS 2 is mandatory for all companies falling within the scope of CSRD. All remaining standards and their corresponding disclosure criteria, including specific data points, undergo a scrutiny of materiality. This means that companies will report only pertinent information, and they may omit irrelevant details that are not "material" to their business operations and model. Materiality-bound disclosure requirements are mandatory, and if information qualifies as material, it must be disclosed. In line with the provisions of the Accounting Directive, the process of the company's materiality assessment is externally verified. The standards necessitate companies to conduct a robust materiality assessment to ensure comprehensive disclosure of all sustainability information required to meet the objectives and mandates of the CSRD. For instance, if a company determines that climate change lacks material significance and consequently doesn't report according to that standard, it must furnish a comprehensive explanation of the conclusions drawn from its materiality assessment pertaining to climate change.

It is important to underline the fact that EFRAG is collaborating with global organizations to harmonize the ESRS with international benchmarks, with the aim to alleviate the reporting complexities for businesses by integrating standards like TCFD, UN Guiding Principles on Business and Human Rights, and GRI (European Financial Reporting Advisory Group, 2021).

Chapter 3. Materials and methods

3.1 Identification of the limits of GRI Standards

As explained in the previous chapter, GRI Standards are standards for sustainability reporting to meet non-financial reporting requirements and for comprehensive and effective representation of companies. Indeed, they are recognized by the European Commission to meet the requirements of the Non-Financial Reporting Directive.

The GRI Standards offer several advantages and strengths that make them the most widely adopted and internationally recognized framework for sustainability reporting (KPMG, 2022). Some advantages of using these Standards include:

- They enable reporting companies to communicate and report on the commitment to sustainable development by integration of all dimensions of sustainability.
- They provide guidance on the type of information to be included in the report in order to respond to the expectations and needs of the different categories of stakeholders.
- They define specific indicators for measuring the organization’s performance in ESG matters.
- They ensure transparency enhancing stakeholders' accountability in terms of sustainability.
- They are flexible and can be applied to different industries, sectors, and types of organizations.

These benefits are hard to be disputed, however, GRI Standards' application for sustainability reporting also carries some weaknesses and limits. This thesis focuses on one of them.

GRI Standards provide guidance on how to report many indicators relating all dimensions of sustainability, however, a notable weakness persists: the absence of a standardized scoring system that integrates these multifaceted metrics into a coherent index of sustainability performance. While the GRI Standards offer invaluable guidance on how to report different ESG indicators, they remain silent on the critical matter of how to assign relative weights and values to these indicators. As a consequence, the true sustainability prowess of businesses often remains elusive, hidden behind a veil of unweighted data points. This deficiency in a standardized scoring approach detracts from the GRI Standards the potential to provide a clear, comparable, and concise representation of a company's commitment to sustainability.

This lack of a standardized scoring system gives rise to a lack of consistency in how companies measure and portray their sustainability endeavors. Thus, what should be a common language of sustainability reporting becomes a polyglot of divergent dialects, complicating the task of benchmarking and assessment.

Moreover, the many topics covered by the GRI Standards, while undeniably comprehensive, create a way for companies seeking to distill their most salient sustainability priorities. The absence of a method to weigh and prioritize issues relative to the materiality to the company and stakeholders may result in reporting that inadvertently misrepresents a company's most significant sustainability aspects. This raises a critical question: in the absence of a structured scoring mechanism, how can we be sure that businesses are actually communicating their most critical sustainability achievements? Or worse, their poor sustainability performance?

While the GRI Standards provide transparency in non-financial disclosure, they may fail in painting a comprehensive portrait of a company's actual sustainability performance. Adhering to reporting requirements, after all, is not a synonym for driving meaningful change in sustainability terms. The lack of a standardized scoring system means that companies can fulfill reporting obligations without necessarily making progress in advancing their sustainability ambitions and accomplishments. The result is a narrative text which may be rich in detail but lacks a definitive statement on the sustainability of the company, easy to read, understand and compare with others. Non-financial reports generally range between 100-200 pages of information, from which an actual idea of the company’s sustainability performance is hard to understand.

Indeed, this lack of standardized scoring system makes it challenging for investors, consumers, and other stakeholders seeking to align their decisions with sustainability face challenges in evaluating and comparing diverse companies' efforts. The presence of a benchmarking tool would give the ability to stakeholders to make informed decisions and would make companies actually improve their sustainability performance.

Below, in Figure 5, there is an example of the same GRI Standards (305-1, 305-2) correctly reported by two companies working in the same industry. The table were taken from their sustainability reports. Although they both disclose the same kind of information about themselves, it is hard to understand which one of them is more sustainable. If the GRI were accompanied by a score-based indicator in relation to the company’s size and operations for example, it would be easier for stakeholders to understand the company’s efforts or bad performance. Furthermore, a comparison

between the different years in which the sustainability information was reported is hard to make, it is not immediate to understand if the company has improved their performance over time. This because an understanding of the performance is hard to detect just by looking at the disclosed data. Again, if a score-based indicator was related to the GRI, then this comparison would be easier to make. In the case in which score-based indicator were present in a report like this, companies would be incentivized to better their sustainability performance. This because the needed information would be easily accessible and clear, rather than spread along 100 pages.

GHG emissions[15]	2022	2021
Direct GHG emissions - Scope 1 (tCO_{2eq})	275,392	285,991
Indirect GHG emissions from energy consumption - Scope 2 Location based (tCO_2)	340,017	327,806
Indirect GHG emissions from energy consumption – Scope 2 Market based (tCO_2)	510,082	461,814

Greenhouse gas emissions into the atmosphere (t)	June 30, 2022	June 30, 2021
GRI 305-1		
Scope 1 CO_2 direct emissions	285,694	294,061
GRI 305-2		
Location-based Scope 2 CO_2 indirect emissions	368,436	356,428
Market-based Scope 2 CO_2 indirect emissions	520,394	473,683

Figure 5 GRI 305-1 and 305-2 reported by two companies working in the same industry.

As sustainability becomes more and more important and center of decision-making within the stakeholders, the need for a comprehensive scoring system within the GRI Standards becomes increasingly urgent. It is necessary to bridge the existing gap between extensive data collection and a clear, concise representation of reporting companies' sustainability performance. In the pages that follow, two score-based systems are investigated and then a standardized scoring system is conceptualized and formulated, with the intention to create a comprehensive final GRI Environmental Score to easy compare and identify a company's sustainability performance.

3.2 State of the art of ESG rating and ranking systems

The GRI, in an article published in March 2022 (Global Reporting Initiative, 2022), states that there is misinformation around the differences between standards, frameworks, ratings and ranking. Their difference in purpose and approach is hardly recognized. In the article, the sustainability framework is divided in three dimensions: organizations that set up standards, the ones that issue frameworks and principles meant for guiding companies, and the ones that rate the ESG reporting of companies. In the Figure 6, there is the distinction between standards and framework. It shows the different existing organizations which work in one dimension as well as the other. While there are many

frameworks that deal with the topic of ESG, currently, on a global scale there only two reporting standards: GRI and SASB each with a different audience and scope. The scope of the other standards depicted in the figure is indeed not global.

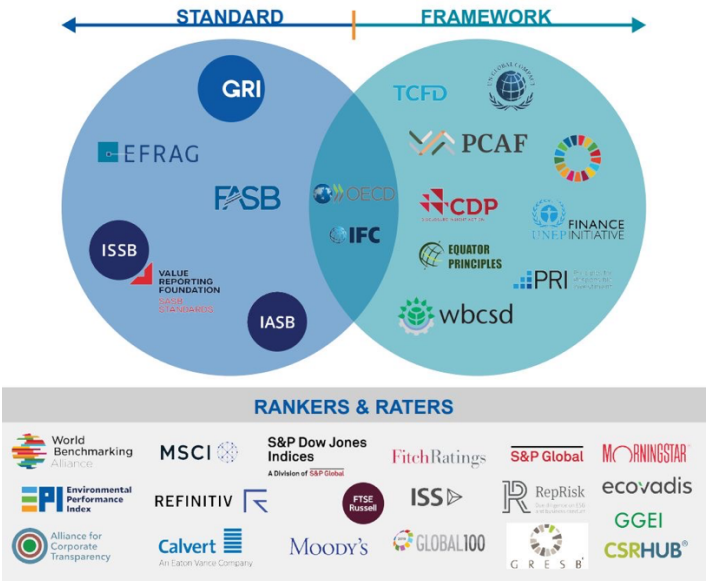

Figure 6 ESG standards, frameworks, rankers, and raters (Global Reporting Initiative, 2022).

As clarified by the GRI article (Global Reporting Initiative, 2022), standards represent the established benchmark of quality expectations, considered satisfactory for reporting entities to fulfill. A standard can be conceptualized as encompassing distinct and precise criteria or metrics that outline the specifics of 'what' should be reported concerning each subject. Broadly speaking, corporate reporting standards share key attributes, including a focus on the public interest, impartiality, a rigorous procedural framework, and engagement with the public through consultation.

However, frameworks serve as the structural backbone for contextualizing information. These frameworks are typically employed when precise standards are lacking. While offering an approach to follow, frameworks do not dictate the specific method to use. Essentially, a framework can be thought of as a collection of guiding principles that influence and mold individuals' perspectives regarding a particular topic, yet it falls short of imposing a well-defined reporting obligation.

Ratings and ranking depict the level of organizational maturity or proficiency in ESG matters. An ESG rating for a corporation is constructed from a numerical evaluation and an associated risk classification. The data disclosed in accordance with established reporting criteria and frameworks constitutes a vital resource for ranking and rating

entities. Nonetheless, the precise composition of the final rating frequently remains opaque. Nevertheless, the significance of these rankings and assessments, particularly in terms of securing financial resources, is on the rise.

Regarding ratings and ranking, according to an article published by the GRI (Global Reporting Initiative, 2022 July 26), the perception about them is not always positive, since some critics argue that the methods used by ESG rankers and raters to evaluate companies' sustainability practices are not always objective or consistent. This is reasonable since many organizations manage their sustainability ratings obtained by different agencies. This is because the ratings influence their financial flows, particularly investments and funding. Ratings are used to benchmark, inform shareholder decisions, and assess supply chain information. However, they can also improve information disclosure, attract capital investment, and manage the company's image (Global Reporting Initiative, 2022 July 26).

It is important to underline that, broadly speaking, ESG ratings only investigate on the company's "sustainability risk" and therefore the focus is on financial materiality. ESG ratings measure the exposure of the company to a risk and how well it manages this situation. Therefore, ESG ratings do not necessarily measure whether a company reduces its impact and contribute to a more sustainable world. This is a problem recognized by agencies themselves, which are moving towards considering also ESG impact in their methods.

The Global Reporting Initiative is the provider of the world's most used sustainability reporting standards. For this reason, it is not in the ranking and rating business. Anyway, the GRI works together with these organizations (Global Reporting Initiative, 2022 July 26) since the metrics and information obtained from the GRI Standards offer essential data which these agencies use to build their rating methodologies.

Two scoring-ranking systems which are able to evaluate the sustainability performance of companies and a very simplified explanation of their methodologies are presented below. The innovative scoring system presented in the next paragraph draws inspiration from them. The systems presented, previously mentioned, are: MSCI ESG Rating and S&P Global.

MSCI stands for Morgan Stanley Capital International. It is an investment research firm which provides analytics tools, investment indexes, ESG and climate ratings. The aim of this organization is to provide clear information on company's risk to investors to

allow better investment decisions. MSCI's rankings are based on information publicly published, like financial and non-financial disclosures (MSCI ESG Research LLC, 2023).

Concerning MSCI ESG Rating, its aim is to measure entities' management of environmental, social and governance risks and opportunities. Risks can impact financial performance because of operational costs or cots of litigation. They are industry-relative measures, since there are very different risks and opportunities related on the sector a company works in.

Each company investigated by the MSCI ESG Rating is evaluated on a selection from two to seven Environmental and Social Key Issues. The research process begins with an in-depth assessment of the ESG risks and opportunities that are relevant to each industry.

Indeed, the Environmental and Social Key Issues relevant for a given company are selected out of 27 Key Issues based on the company's exposure to potentially important ESG risks, which are driven by industry-specific and market-specific factors. To be consistent with the previous terms used in the document, the key issues chosen to be investigated are "material". The key issues are aggregated in ten themes and three pillars (the sustainability dimensions), as shown in Figure 7. All companies are evaluated on the Governance Pillar.

3 Pillars	10 Themes	33 ESG Key Issues
Environmental	Climate Change	Carbon Emissions
		Climate Change Vulnerability
		Financing Environmental Impact
		Product Carbon Footprint
	Natural Capital	Biodiversity & Land Use
		Raw Material Sourcing
		Water Stress
	Pollution & Waste	Electronic Waste
		Packaging Material & Waste
		Toxic Emissions & Waste
	Environmental Opportunities	Opportunities in Clean Tech
		Opportunities in Green Building
		Opportunities in Renewable Energy
Social	Human Capital	Health & Safety
		Human Capital Development
		Labor Management
		Supply Chain Labor Standards
	Product Liability	Chemical Safety
		Consumer Financial Protection
		Privacy & Data Security
		Product Safety & Quality
		Responsible Investment
	Stakeholder Opposition	Community Relations
		Controversial Sourcing
	Social Opportunities	Access to Finance
		Access to Health Care
		Opportunities in Nutrition & Health
Governance	Corporate Governance	Board
		Pay
		Ownership & Control
		Accounting
	Corporate Behavior	Business Ethics
		Tax Transparency

Figure 7 The 33 ESG Key Issues and relative aggregation in themes and pillars (MSCI ESG Research LLC, 2023).

MSCI ESG Rating looks at the company's exposure to industry-specific risks, based on its business activities, size of its operations, and where it operates. Then it looks at how the company manages the industry-specific risks. It does this by determining a Business Exposure Score and a Management Score.

Putting it in a very simplified way, to derive the Company ESG Rating, scores are given to different information. To begin with, scores are given to Environmental and Social Key Issues (Key issues scores): each company receives a score from 0 to 10 on the selected key issues. In the Environmental and Social Pillars, the scores evaluate the company's exposure to risks or opportunities and its ability to manage that exposure. These are calculated using the Key Issue Exposure Score and Key Issue Management Score, considering the company's risk exposure or risk management. An example of the measuring of a Key Issue Score provided in the report of MSCI ESG Rating methodology is the measure of the impacts for the Health and Safety Key Issue based on the extent to which companies' business segments are more oriented to injuries and fatalities. Underground coal mines have an average fatality rate per 1.000 employees of 0,45. This metric will be converted into 0-100 score based on the relative ranking of industry intensities.

Then, a score is given to the governance pillar, which ranges from 0 to 10 and assesses of a company's overall governance. Furthermore, a Weighted Average Key Issue Score is calculated based on the weighted average of the scores received on all the individual Environmental and Social Key Issues and the Governance Pillar Score. The Environmental Weight represents the sum of the weights of all Key Issues that fall under the Environmental Pillar. The Social Weight represents the sum of the weights of all Key Issues that fall under the Social Pillar. The Governance Weight is a standalone calculation and determined as the sum of the weights of the Corporate Governance themes. Lastly, the Industry-Adjusted Company Score is calculated by normalizing this last score and the Company ESG Rating is derived.

These assessments of company performance are not absolute but are explicitly intended to be relative to the standards and performance of a company's industry peers. MSCI ESG Ratings are based on a seven- point scale from 'AAA' to 'CCC', indicating how an entity manages relevant key issues relative to industry peers.

Letter Rating	Leader/Laggard	Final Industry-Adjusted Company Score
AAA	Leader	8.571* - 10.0
AA	Leader	7.143 – 8.571
A	Average	5.714 – 7.143
BBB	Average	4.286 – 5.714
BB	Average	2.857 – 4.286
B	Laggard	1.429 – 2.857
CCC	Laggard	0.0 – 1.429

Figure 8 Relation between rating and Final Industry-Adjusted Company Score (MSCI ESG Research LLC, 2023).

Concerning the weighting process, MSCI uses a proprietary scoring methodology to assess a company's performance on each factor. The scores are typically on a numerical scale, with higher scores indicating better ESG performance. MSCI may assign different weights to ESG factors based on their materiality and relevance within specific industries. Factors that are more critical to a particular industry's ESG performance may be given higher weights. For example, carbon emissions might carry greater weight for a company in the energy sector compared to a technology company.

At the end, the rating score is able to provide information on the company's commitment to reduce its carbon emissions, whether the company's emissions goals are enough to keep global warming below 1,5°C, how well the company is managing ESG issues, whether the company has been accused of any controversial behavior related to ESG issues, whether the company is aligned with any of the UN Sustainable Development Goals (SDG).

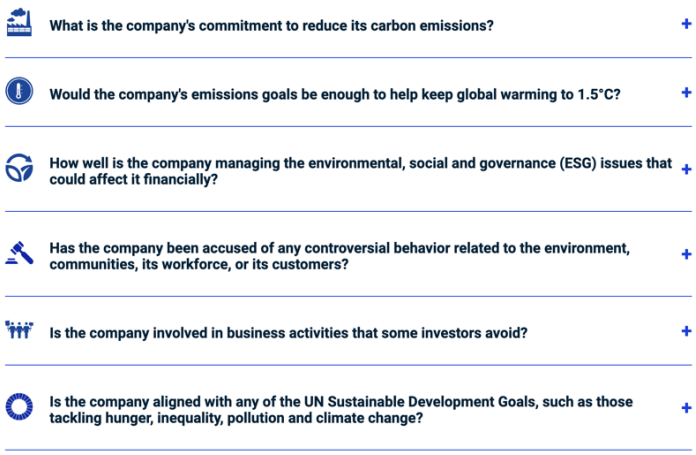

Figure 9 The information MSCI ESG Rating provides at the end of the score measuring process.

Concerning the third point shown in Figure 9[6], MSCI ESG Rating can measure the company's resilience to financially material environmental, societal and governance (ESG) risks. The rating assesses how well companies manage risk compared with their peers. Below, there is an example to show the kind of information which are possible to obtain from this method. It is the rating of two companies working in the same industry (software and service industry): Oracle Corporation and Microsoft Corporation.

Figure 10, on the left, shows the rating of Oracle Corporation. With the rating of A, it is positioned average among other 113 companies in the same industry. Figure 10, on the right, shows the rating of Microsoft Corporation. With the rating of AAA, it is leader in the industry.

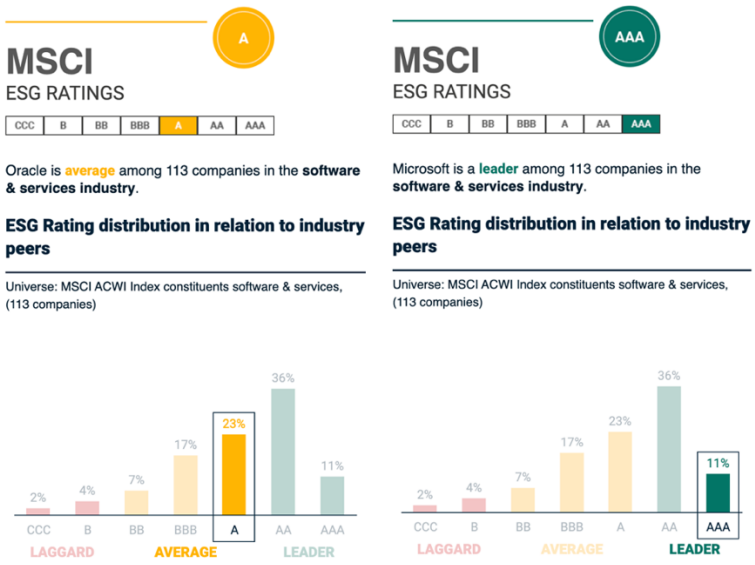

Figure 10 MSCI ESG Rating of Oracle Corporation (on the left) and Microsoft Corporation (on the right).

This type of rating can also show the rating history of the company, which is very convenient when wanting to assess the performance of a company in time, over the last five years or since the records began. Below, in Figure 11 on the left, the rating history of Oracle Corporation. It has upgraded in the last year. While Figure 11 on the right, shows the rating history of Microsoft Corporation, which remained intact over time.

[6] The figures shown are print screens of the ESG Score of the company available by inserting the company's name at https://www.msci.com/our-solutions/esg-investing/esg-ratings-climate-search-tool?creative=628277388697&keyword=msci%20esg%20scores&matchtype=b&network=g&device=c&gclid=EAIaIQobChMIjOWslOfogAMVpVFBAh3Z-gCVEAAYASABEgKmj_D_BwE&gclsrc=aw.ds

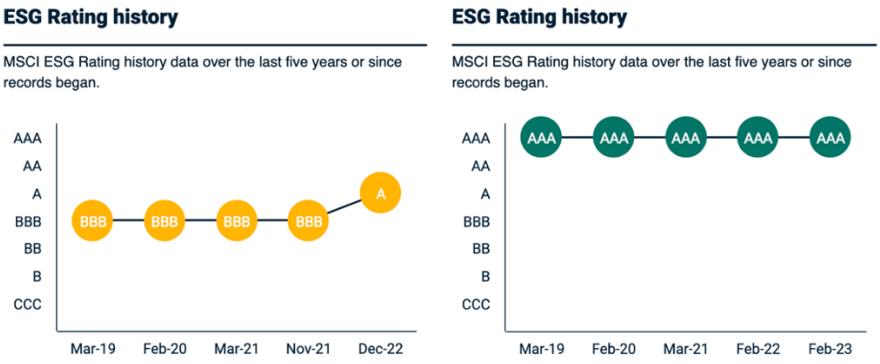

Figure 11 MSCI ESG Rating history over time of Oracle Corporation (on the left) and Microsoft Corporation (on the right).

Another existing scoring systems, able to evaluate the sustainability of a company, is the S&P Global Corporate Sustainability Assessment (CSA). It is widely used and covers thousands of companies in the world. This assessment enables to measure sustainability performance and compare it with competitors (S&P Global, 2021). The CSA is based on submitting an industry-specific questionnaire, of about 100-130 questions, to companies. At the end, the CSA generates a score on the ESG of the assessed company, as well as an individual score for each of the sustainability dimension, where 100 is the best score (S&P Global, 2021). An advantage of the CSA is that in the case in which companies do not answer to the questionnaire provided, S&P Global analysts can assess them anyway by using publicly available information.

Calculating a company's S&P Global ESG Score means following a process of sub-level scores progressively weighted and summed up until reaching a final aggregation. The process starts with single questions, the values are weighted, summed up and aggregated into areas called criteria. Then, the criteria's scores undergo the same process, aggregating them into areas called dimensions: economic, social, environmental. In the same way, dimensions' scores are weighted and summed in order to reach the final sustainability score of the company in question. For what concerns the weights, they are industry-specific to reflect on the industry-specific issues. In the Figure 12 below, the relative weights of the three sustainability dimensions are shown for the Multi and Water Utilities industry. It is evident that the environmental factors are considered more relevant in this sector and therefore appropriate weight is given to that dimension.

	Weight in % of total Score	Change from 2022
Governance & Economic Dimension	29	1
Transparency & Reporting	2	New
Corporate Governance	6	0
Materiality	2	0
Risk & Crisis Management	3	0
Business Ethics	3	0
Policy Influence	2	0
Supply Chain Management	2	0
Information Security/ Cybersecurity & System Availability	2	0
Innovation Management	2	0
Market Opportunities	5	-1
Environmental Dimension	44	3
Environmental Policy & Management Systems	3	0
Emissions	7	New
Resource Efficiency & Circularity	4	New
Waste	3	New
Water	7	New
Climate Strategy	8	1
Biodiversity	3	1
Electricity Generation	9	1
Social Dimension	27	-4
Labor Practice Indicators	4	1
Human Rights	3	1
Human Capital Development	3	0
Talent Attraction & Retention	5	0
Occupational Health & Safety	5	1
Customer Relationship Management	1	-1
Privacy Protection	2	0
Stakeholder Engagement	4	-2

Figure 12 Relative weights attributed to the three sustainability dimensions for the Multi and Water Utilities Industry.

By taking for example the weights applied to banks shown in Figure 13, it is evident that the Governance and Economic dimension is more relevant. It is important to notice that also the criterion of the two industries taken as example are different. Therefore, set of questions asked to the companies will also be different. Indeed, for 61 industries evaluated through CSA, there are different sets of questionnaires based on the evaluated company's sector.

	Weight in % of total Score	Change from 2022
Governance & Economic Dimension	51	2
Transparency & Reporting	2	New
Corporate Governance	9	0
Materiality	3	0
Risk & Crisis Management	7	1
Business Ethics	9	2
Policy Influence	3	0
Tax Strategy	3	0
Information Security/ Cybersecurity & System Availability	4	1
Sustainable Finance	9	0
Financial Stability & Systemic Risk	2	0
Environmental Dimension	16	-2
Emissions	2	New
Climate Strategy	8	1
Decarbonization Strategy	6	0
Social Dimension	33	0
Labor Practice Indicators	6	2
Human Rights	4	1
Human Capital Development	4	-2
Talent Attraction & Retention	5	-1
Occupational Health & Safety	3	0
Financial Inclusion	5	2
Customer Relationship Management	2	0
Privacy Protection	4	2

Figure 13 Relative weights attributed to the three sustainability dimensions for Banks.

CSA analyst look, within each criterion, for evidence of the company's awareness on sustainability matters and their commitment to address them. Some factors investigated by CSA are:

- Whether the company has implemented strategies to manage sustainability risks related to their sector.
- Whether the company gives transparent and clear information about its sustainability.
- Whether the information provided are validated by external assurance.

Concerning the way in which the score is given, each question of the questionnaire is designed to be objective and to be assigned a number between 0 and 100. Some of the questions are qualitative. In this case, the CSA analysts codify the answer in order to give it a quantitative score. Furthermore, many of the questions companies have to answer to ask them to provide documentation to support their answers. The final question score is given by multiplying the number of points received with the answer (0-100), the weight of the question within the criterion (predefined: add up to 100) and the criterion weight within the questionnaire (predefined: add up to the total dimension weight).

After calculating the question scores for each of the questionnaire's questions, the S&P Global ESG Score can be obtained by summing up all the question scores (0-100).

Below, there is an example to show what information is obtained from using this method[7]. It is the rating of the same two companies working in the same industry (software industry): Oracle Corporation and Microsoft Corporation. The example covers the same companies as the previous method in order to see the similarities. As Figure 14 shows, a benchmark for the overall score, as well as for each dimension is shown. The overall ESG score was calculated as previously explained after the completion of the questionnaire by the company. The weights were relative to the software industry. Oracle Corporation, on the top, has a lower ESG Score than Microsoft Corporation. This is in line with the MSCI rating. Microsoft Corporation, on the bottom, seems to perform better in all three dimensions of sustainability. Beside the possibility to easily compare one company to another and to the whole industry, this score gives relevant information also about the performance of the company in time. Indeed, since the sustainability

[7] The figures shown are print screens of the ESG Score of the company available by inserting the company's name at https://www.spglobal.com/esg/solutions/data-intelligence-esg-scores?utm_source=google&utm_medium=cpc&utm_campaign=Brand_ESG_Search&utm_term=s%26p%20global%20esg%20scores&utm_content=534418150272&gclid=EAIaIQobChMI3tbIlubogAMVRQcGAB234QtrEAAYAiAAEgLvhvD_BwE

performance is identified by a number, the data is easily accessible and usable to compare. Oracle has upgraded in the last years, while Microsoft remains constant in its score over time.

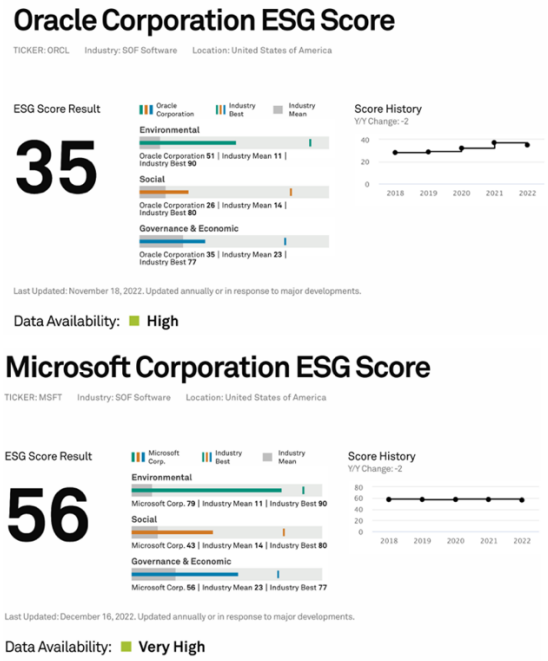

Figure 14 S&P Global ESG Score of Oracle Corporation (on the top) and of Microsoft Corporation (on the bottom).

The scoring system presented in the next pages draws inspiration from these ESG ratings and ranking systems.

3.3 Development of an innovative GRI Environmental Score

In response to the growing importance of assessing corporate environmental performance, a comprehensive scoring framework has been formulated. It draws inspiration from the established systems discussed in the previous section. This framework is designed to be applied specifically to the GRI Standards. Designing a scoring system for GRI Standards can be a complex task since they cover a variety of indicators belonging to different sustainability dimensions. For the purpose of this thesis, the indicators considered for the proposed scoring system are exclusively environmental (300 Series).

Furthermore, qualitative indicators are not part of the scoring system. Only quantitative indicators are considered in the framework. Indeed, the goal of the scoring system is to end up with an informative cumulative GRI Environmental Score. The score is intended to be used as a tool to enable a quantitative evaluation of companies' environmental sustainability performance relatively to the performance of competitors.

Moreover, the score is intended to be used for comparative analysis of the same company over time in relation to its peers, in order to understand whether its environmental performance has increased with time.

This paragraph presents an overview of the proposed framework. It lays the groundwork for the subsequent application of the system to companies within the same sector. Indeed, the next chapters will investigate the use of the framework in a case study involving companies working in the waste management sector. The framework is composed of seven steps. Below, each subparagraph generally explains one of the framework's steps.

3.3.1 Selection of relevant GRI Standards

The process of developing the GRI Environmental Score begins with the identification of specific GRI environmental indicators on which to base the study of the companies under scrutiny. The selection is based on the relevance to the sector in which the reporting companies that are being evaluated work in. Indeed, the chosen indicators should represent material information to be disclosed based on the characteristics and demands of the sector under scrutiny.

Since only environmental indicators are considered, these certainly belong to the 300 Series of the GRI Standards. This series cover:

- Resource usage
- Energy consumption
- Greenhouse gas emissions
- Water usage
- Waste management

which are almost always considered material topics for every reporting company.

The selection of relevant Standards can be accomplished through a straightforward benchmark analysis. This entails and investigation into indicators disclosed by companies operating within the same sector. This benchmark analysis can be performed with the reporting companies in question. A table can be formulated in which the possible GRI Standards as well as the benchmarking companies are shown. In the table, the GRI Standards disclosed by the companies, divided for areas of interest (materials, energy, emissions, waste), are marked. Then, the GRI Standards on which to focus the next step of the framework are chosen. In the table, there should also be an indication of whether

the GRI Standard is qualitative or quantitative since the framework considers only quantitative ones. The selected GRI Standards are going to be the ones disclosed by all the companies chosen for the benchmark analysis.

3.3.2 Collection of data

The next step in developing a GRI Environmental Score is to collect the quantitative data disclosed in the chosen standards and the data needed for the standardization.

The environmental data of the selected GRI Standards and the data for standardization needs to be collected from the public non-financial disclosures of the companies under scrutiny. For the purpose of the discussion and interpretation of the companies' environmental performance, data must be collected for more than one year in order to investigate the sustainability trend. In order to find the information needed, it is necessary to consult the GRI Content Index found at the end of non-financial disclosures, to understand where they are found inside the text.

It is important to underline that, in this method, only the totals of the requirements of each GRI Standard are considered. For example, if the GRI asks to disclose the energy consumption from renewable and non-renewable sources, and the total of energy consumption, only this last one is considered.

3.3.3 Assignment of relative weights to selected GRI Standards

A relative weight should be assigned to each of the selected indicators selected based on their importance to sustainability within the sector in which the companies under scrutiny work.

It is important to underline the fact that the scoring system is sector specific. This means that the ultimate GRI Environmental Score cannot be compared for companies working in different sectors. This is due to different sectors having different characteristics and demands; the chosen material indicators would be different too, as well as the relative weights assigned to each of them.

In order to assign weights correctly, underscoring the importance within the specific industry's sustainability landscape, collaborative consultations with experts, stakeholders, and industry practitioners can take place.

The weighting assignment process involves giving a number ranging from 0 to 1[8] to each of the selected indicators based on their importance.

For example, let's assume to have selected the following GRI Standards for organizations belonging to the construction and demolition (C&D) sector:

- GRI 301-1 Materials used by weight or volume.
- GRI 302-1 Energy consumption within the organization.
- GRI 303-3 Water withdrawal.
- GRI 305-1 Direct (Scope 1) GHG emissions.
- 306-3 Waste generated.

Considering the characteristics of the C&D sector and the factors that are commonly associated with this industry's environmental impact, it is possible to assign coherent weights to each of the selected indicators.

GRI 301-1 Materials used by weight or volume: In the C&D sector, materials used retain a considerable environmental impact. The construction industry is the largest global consumer of resources (Solìs-Guzmán et. al, 2014). For this reason, the relative weight assigned for this GRI Standard is: 0,15. It represents the moderate importance of the material usage factor.

GRI 302-1 Energy consumption within the organization: The C&D sector is known for its high energy intensity. This high consumption is due to activities such as site preparation, equipment operation, transportation, and material manufacturing, which take up 40% of the global energy consumption (Solìs-Guzmán et. al, 2014). This justifies a relatively higher weight for energy consumption to address the sector's significant environmental impact. Indeed, the relative weight assigned for this GRI Standard is: 0,25. It represents the high importance of the energy factor.

GRI 303-3 Water withdrawal: Some construction activities may have limited water usage. Water is used in applications like mixing for the production of cement. However, water represents only 5% in the composition of cement (Saloma et. al, 2015). This explains the relatively lower weight assigned to this GRI compared to the previous two indicators. The relative weight assigned for this GRI Standard is: 0,10. It represents the low importance of the water usage factor.

[8] In the context of assigning weights, a number closer to 1 signifies greater importance, while a number closer to 0 signifies lesser importance. The sum of the assigned weights must be equal to 1.

GRI 305-1 Direct (Scope 1) GHG emissions: Consequently to the use of energy, the C&D sector contributes significantly to GHG emissions. Globally, in developed and developing countries, buildings contribute to 33% of the greenhouse gas (GHG) emissions (Solìs-Guzmán et. al, 2014). As a result, direct GHG emissions (GRI 305-1) were assigned a substantial weight to reflect the industry's environmental impact. The relative weight assigned for this GRI Standard is: 0,30, representing the very high importance of this factor.

GRI 306-3 Waste generated: Waste generation is a concern in the C&D industry stemming from demolition and construction activities. In the European Union it generates 40% of the total UE waste annually (Solìs-Guzmán et. al, 2014). Given its significance, waste generation received a moderate weight in the assessment. The relative weight assigned for this GRI Standard is: 0,20.

3.3.4 Standardization of GRI data

After the data collection, a standardization has to take place. This is fundamental since even though competing companies have the same operations, products, and material topics, they have different characteristics in terms of dimension, number of clients, number of products, number of sites. Indeed, they need to be put onto a common scale in order to treat each of them equally in the scoring system. The common way to harmonize the data into a common scale is to standardize it by diving it for multiple variables. These can be the company's dimension, number of clients, number of products produced, number of sites, or others based on the companies' characteristics and the industry they operate in. This information is also usually available in the public non-financial disclosures of companies but needs more effort to be found. The formula shows how to standardize the GRI data.

$$Standardized\ GRI\ data = \frac{GRI\ data}{Standardization\ factor} \quad (1)$$

The data for each selected GRI Standard is standardized using more than one standardizing factor. Therefore, there are as many standardized data for each GRI as the chosen factors. For example, if 4 GRI Standards are selected in step 1 and 3 standardization factors are chosen to characterize the companies, there will be 12 standardized GRI data.

Then, the standardized data needs to be interpreted for a discussion to take place. This is important to understand the relations between the data disclosed in the GRI and the characteristics of the companies.

3.3.5 Assignment of scores to the standardized GRI data

In this step, each of these standardizations are assigned a score. It is important to note that the GRI Environmental Score is designed to be used as a comparative tool, so these scores are assigned based on how the companies compare to each other within the same industry. These scores are not absolute, but relative to other companies in the same sector.

The scores are attributed as a ranking between the selected companies to which the method is applied, where the highest rank/score means better environmental performance, since the final GRI Environmental Score indicates better performance the higher its value. For example, if selecting 5 companies, there will be 5 scores to attribute to the standardized GRI data for each company. The score 5 would be assigned to the standardized data referring to the company with the lowest standardized value, while 1 to the data referring to the company with the highest value. This is done to indicate that a better environmental performance is indicated by lower energy consumption, emissions, water withdrawal, and waste generated, per unit of standardization factor.

Taking for example the data of 4 companies (A, B, C, and D): their GRI 302-1 standardized data (energy consumption within the organization) with two standardization factors, employees, and revenues.

Table 1 Example of assignment of scores to standardized GRI data.

	Company A	Company B	Company C	Company D
Employees standardization	250	300	360	190
Ranking	3	2	1	4
Revenues standardization	2300	2000	3400	2700
Ranking	3	4	1	2

Employees standardization shows the value of the energy consumption within the company per unit of employee, while revenues standardization shows the value of energy consumption within the company per unit of revenue. These values are compared with every company under study and the scores are attributed relatively to them. In the example, score 4 is given to the company with the lowest values, meaning that it is the company which uses the least energy per unit of employee and revenue. While score 1 is

given to the company with the highest value, meaning that it is the company which uses more energy per unit of employee and revenue.

Once the scores for each standardized GRI data have been assigned, an aggregation of them takes place. This is done by summing up all the scores given for each standardized data. In this way, each GRI Standard now have a score.

$$Scores\ aggregation = \Sigma\ Standardized\ GRI\ Data\ Score \quad (2)$$

3.3.6 Calculation of GRI Data Scores and GRI Weighted Scores

The GRI data score for each indicator is the score aggregation for that standard divided by the number of standardization factors used, as shown in formula 3. This corresponds to the average score obtained in each standardization for every GRI Standard.

$$GRI\ Data\ Score = \frac{Scores\ aggregation}{Number\ of\ standardization\ factors} \quad (3)$$

At this point, every single selected GRI Standard has a score based on the companies' performances compared to one another and an assigned weight based on the GRI's importance in the sector. Therefore, the calculation of each GRI weighted score can take place. This is done by multiplying the GRI data score of each indicator with the relative weight of the indicator, as shown in formula number 4.

$$GRI\ Weighted\ Score = GRI\ Data\ Score * GRI\ Weight \quad (4)$$

3.3.7 Calculation of GRI Environmental Score

In order to get the final GRI Environmental Score, the aggregation of the single GRI Weighted Scores is necessary. This is done by summing up all the Weighted GRI Scores for each of the selected GRI Standards.

$$GRI\ Environmental\ Score = \Sigma\ (Weighted\ GRI\ Score) \quad (5)$$

At this point, the GRI Environmental Score will be on the scale of the number of companies under study, since as many scores as those are attributed in step 5, as explained in subparagraph 3.3.5. Therefore, for easier comprehension, the score is converted into a

scale ranging between 0 and 10, where 10 represents the best performance and 0 the poorest. After the calculation, an interpretation of the results between companies and between the same company over time is necessary.

Chapter 4. Case study

The framework previously explained for the development of the GRI Environmental Score is now applied to three Italian companies working in the waste management sector. A wide range of activities are included in this industry. Principally, electricity generation, transmission, and distribution; gas utilities and distribution; water management and water services; waste management; public lighting. This chapter dives into the analysis of their sustainability reports and their disclosed data, with a focus on the environmental dimension, for the development of the GRI Environmental Score for each of them in order to interpret their environmental sustainability performance over time. It presents the characteristics of the companies included in the case study and the first two steps of the method. The information stated in this chapter are taken from the public non-financial disclosures of the companies.

4.1 Characteristics of the companies

The selected company for the case study are Veritas S.p.A., Tea S.p.A., and Etra S.p.A., which are all Italian waste management companies working at the regional level. In this paragraph their characteristics are presented in order to show their similarities and to explain the reason for their selection.

Veritas S.p.A. (which stands for "*Veneziana Energia Risorse Idriche Territorio Ambiente Servizi*") is an Italian multiutility company working in the metropolitan area of Venice and the Treviso province. Its main activities are waste management, water management, cemetery services, municipality heat distribution, and public lighting. The company serves 51 municipalities in the Veneto region of Italy, with a territorial extension of 2.625 km^2.

The municipalities covered by the waste management service are 34, while for the water management are 36. The residents served by the company's services are 918.000. However, this does not consider the tourism phenomena which strikes the covered geographical area every year. This is a very important feature to consider about this company. It is estimated that the presence of tourists is around 50 million people every year. Figure 15 shows the tourist attendance in some of the most frequented municipalities served by Veritas S.p.A. in the years from 2019 to 2021.

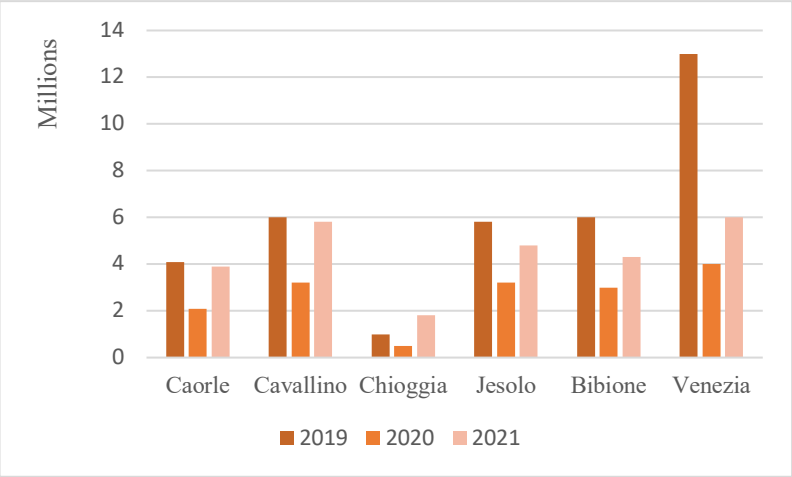

Figure 15 Tourist attendance in some municipalities served by Veritas S.p.A. in 2019-2021.

The company counts 3.396 employees and its revenues amount to 455,2 million euros. Veritas S.p.A. is the consolidation of different subsidiaries companies. Indeed, it is composed of eight companies, Veritas S.p.A. being the parent company. The subsidiaries are: Asvo S.p.A., Coprogetto Venezia S.r.l., Eco-ricicli Veritas S.p.A., Metalrecycling Venice S.r.l., Depuracque Servizi S.r.l., Lecher Richerche e Analisi S.r.l., and R.I.V.E. S.r.l. The data shown in the next paragraph refer to the Group Veritas S.p.A., therefore considers all the companies just listed. Below, an explanation of the activities in which each company is involved in:

- Veritas S.p.A. is the parent company of the Group. It does the waste and water management. It collects around 500 million tons of urban waste and treats around 95 million cubic meter of water every year. Its water network adds up to 5.345 km, while the sewage network to 2.768 km. Furthermore, it also manages the heat and public lighting in three municipalities (Chioggia, Fiesso d'Artico, Fossalta di Portogruaro). For the Venice municipality, it manages the wholesale fish market, public bathrooms, and the fire prevention.
- Asvo S.p.A. manages urban waste services in 11 municipalities, and cemetery services in 5 (Portogruaro, San Michele al Tagliamento, San Stino di Livenza, Fossalta di Portogruaro e Cinto Caomaggiore).
- Coprogetto Venezia S.r.l. deals with selection and treatment of residual municipal solid waste and the waste coming from waste treatment activities. The company's mission is to value waste through the extraction of recyclable material present in the residual waste of the separate collection and the transformation of non-recyclable waste in fuel for energy recovery in order to minimize the amount of

material ending up in the landfills. For its operations, the company uses two production lines of RDF (Refused Derived Fuel), which is then used in its own power plant to produce electricity.

- Eco-ricicli Veritas S.p.A. deals with selection and treatment of municipal solid waste coming from separate collection. In particular it treats glass, plastic, metals, paper, and wood for the production of secondary raw materials.
- Metalrecycling Venice S.r.l. deals with selection, treatment and enhancement of ferrous scrap. The company acquires the material from demolitions and municipalities' waste collections and prepares them in different combinations to obtain different alloys.
- Depuracque Servizi S.r.l. deals with recovery and disposal of special and hazardous waste on behalf of third parties. With its activities, Depuracque provides companies with the treatment service of liquid waste deriving from their processes and which, due to the concentrations of polluting substances contained in them, are not suitable for direct discharge into the sewer.
- Lecher Richerche e Analisi S.r.l is a research laboratory. It carries out withdrawals and samplings in all environmental matrices including analysis and characterization of waste; sampling and chemical-physical and microbiological analyzes on water; analysis of fuels, oils and derivatives; sampling and analysis of the forms of asbestos and evaluation of the state of degradation of materials containing asbestos; sampling and analysis of emissions into the atmosphere and workplaces, remediation of contaminated sites.
- R.I.V.E. S.r.l. deals with the recovery of special waste on behalf of the parent company.

Tea S.p.A. (which stands for "*Territorio Energia Ambiente*") is an italian multiutility company working in the province of Mantova and Milano. Its main activities are waste management, water management, cemetery services, municipality heat distribution, energy production and sale, and public lighting. The company serves 57 municipalities in the Lombardia region of Italy, with a territorial extension of 2.341 km^2. The residents served by the company's waste management service are 315.000, while the ones served by the water management service are 309.215.

The company counts 623 employees and its revenues amount to 357 million euros. Tea S.p.A. is the consolidation of different seven subsidiaries companies. Indeed, it is

composed of eight companies, Tea S.p.A. being the parent company. The subsidiaries are: Mantova Ambiente S.r.l, AqA S.r.l., SEI S.r.l., Tea Servizi Funerari S.r.l., Tea Energia S.r.l.,Tea Reteluce S.r.l., and Depura S.r.l.

The data shown in the next paragraph refer to the Group Tea S.p.A., therefore considers all the companies just listed. Below, an explanation of the activities in which each subsidiary company is involved in:

- Mantova Ambiente S.r.l, deals with transportation, selection, and treatment of municipal solid waste coming from separate collection. The company owns a mechanical biological treatment plant, a landfill for municipal solid waste and special non-hazardous waste, and a composting plant for biomethane production.
- AqA S.r.l. deals with the water management of municipalities. It manages the resource supply, through 67 wells, its purification, through 14 purifiers, its distribution, through a network 1.772 km long, the collection and treatment of wastewater, through 76 water treatment plants.
- SEI S.r.l. deals with the production of energy. It owns two hydroelectric plants, one natural gas cogenerator, two animal oil cogenerators, one biogas plant from landfill, several PV plants, and thermal power plants for heat management.
- Tea Servizi Funerari S.r.l. supplies cemetery services to private individuals.
- Tea Energia S.r.l. takes care of the electric energy and gas sale to the market, included domestic clients and big enterprizes.
- Tea Reteluce S.r.l. designs and builds public lighting systems and traffic light systems, taking care of energy efficiency and using smart technologies.
- Depura S.r.l. deals with the management of road maintenance services, street furniture and road signs and maintenance services for gas distribution networks. Furthermore, the Company manages the special non-hazardous liquid waste treatment plant (D8, D9, D15, R13).

Etra S.p.A. (which stands for "*Energia Territorio Risorse Ambientali*") is an Italian multiutility company working along the Brenta river basin. Its main activities are urban waste management, water management, cemetery services, municipality heat distribution, and public lighting. The company serves 69 municipalities in the Veneto region of Italy, with a territorial extension of 1.709 km^2. The residents served by the company's waste management services are 545.523, while for the water management service they are

594.712. The company counts 999 employees and its revenues amount to 177,6 million euros.

For what concerns the water management, the activities of Etra S.p.A. involve the resource supply, through 113 wells, its purification, through 4 purifiers, its distribution, through a network 5.434 km long, the collection and treatment of wastewater, through 31 water treatment plants. The sewage network is 2.616 km long. Etra S.p.A. also deals with the design, construction and maintenance of wells and water plants, new pipelines for the aqueduct and sewers and purification plants. The service also includes quality control of the water withdrawn, supplied, and purified. A very important activity in the field of water resources is represented by the search for leaks in the distribution network determined by various factors such as the age of the networks, the length of the pipelines, the imperfections of the structures and the level of pressures. In parallel with the technical activities, the management of the Integrated Water Service also provides for the performance of administrative activities such as the activation of new users, the calculation of billing and the collection of tariffs. The company treats around 40 million cubic meter of water per year.

For what concerns the waste management, the municipalities covered by Etra S.p.A. are 64. There, the company deals with the planning, management and control of the separate waste collection service, urban waste treatment, identification of final destination plants, monitoring of individual flows, street sweeping, design, adaptation, control, and monitoring of collection centers. The company collects around 227.000 tons of urban waste per year.

The plants for the selection and treatment of solid waste are:

- A waste hub in Bassano del Grappa, consisting of a large wet waste treatment plant, a dry waste pre-treatment plant and an inter-municipal temporary storage center for recyclable, special and hazardous waste.
- A paper and cardboard waste sorting plant in Campodarsego.
- A selection plant in San Giorgio delle Pertiche.
- A Biotreatment Center in Camposampiero for the treatment of organic waste.
- A sand recovery plant from street sweeping in Limena.
- Two landfills, an exhausted one in Bassano del Grappa and the post-mortem management of the landfill in Campodarsego.

Table 2 Summary of the characteristics of the company of the case study.

Companies	**Veritas S.p.A.**	**Tea S.p.A.**	**Etra S.p.A.**
General characteristics			
Activities	Multiutility: waste management, water management, cemetery services, municipality heat distribution, and public lighting. Waste collection, sorting and treatment. Treatment of liquid hazardous waste. Water treatment and distribution.	Multiutility: waste management, water management, cemetery services, municipality heat distribution, gas distribution, energy sale, and public lighting. Waste collection, sorting and treatment. Treatment of liquid hazardous waste. Water treatment and distribution.	Multiutility: waste management, water management, cemetery services, municipality heat distribution, and public lighting. Waste collection, sorting and treatment. Treatment of liquid hazardous waste. Water treatment and distribution.
Location	Metropolitan area of Venice and Treviso province (Italy, Veneto).	Mantova and Milano province (Italy, Lombardia).	Brenta river basin (Italy, Veneto).
Municipalities	51	57	69
Territorial extension [km^2]	2.625	2.341	1.709
Employees	3.396	623	999
Revenues [Meuro]	455,2	357	177,6
Waste management			
Users served	879.405	315.000	545.523
Waste collected [t]	510.067	153.000	227.718
Collection centers	39	38	44
Landfills	4	1	2
Selection and treatment plants	3	2	6
% separate collection	72,9	87	74,2
Water management			
Users served	798.146	309.215	594.712
Water treated [Mm^3]	97,1	26,2	41,7
Water treatment plants	36	76	31
Water purifiers	4	14	4
Wells	66	67	113

Table 2 shows a summary of the characteristics of each company. It is divided between general characteristics, waste management facilities and information, and water management facilities and information. These waste management companies were chosen carefully. As just explained, they work in specific areas at the regional level and their

operations involve the same activities. This gives the opportunity to compare them and find important patterns in the waste management sector along different regions and provinces. For example. Initially other two companies (A2A S.p.A. and Hera S.p.A.) besides these three were selected, but their operations were slightly different, therefore their disclosed GRI data would have not been comparable even after standardization.

4.2 Selection of relevant GRI Standards

The first step in the process of developing the GRI Environmental Score begins with the selection of specific GRI environmental indicators. It is based on their relevance to the waste management sector. In this case, the Standards to scrutinize are selected after a simple benchmark with competing companies in the same sector.

Table 3 The GRI Standard benchmark analysis of the companies.

GRI Standards	Quantitative	Veritas	Tea	Etra	Selected sector-specific indicators
Materials					
301-1	Yes				
301-2	Yes				
301-3	Yes				
Energy					
302-1	Yes	x	x	x	x
302-2	Yes				
302-3	Yes		x		
302-4	Yes		x		
302-5	Yes				
Water					
303-1	No	x	x	x	
303-2	No	x	x	x	
303-3	Yes	x	x	x	x
303-4	Yes	x	x		
303-5	Yes	x	x		
Emissions					
305-1	Yes	x	x	x	x
305-2	Yes	x	x	x	x
305-3	Yes		x		
305-4	Yes		x		
305-5	Yes		x	x	
305-6	Yes				
305-7	Yes		x		
Waste					
306-1	No	x	x	x	
306-2	No	x	x	x	
306-3	Yes	x	x	x	x
306-4	Yes		x	x	
306-5	Yes		x	x	

Table 3 was formulated to undergo this analysis. In the table, there is the distinction between quantitative and qualitative indicators, since only quantitative ones are considered in the method. Through the consultation of the content index of their non-financial disclosures, the GRI Standards disclosed by the three companies were identified and marked with an "x" in the matrix. The selected indicators were the ones that all companies disclosed. This is shown in Table 3. From the analysis it emerged that the GRI Standards identified to be scrutinized in the next steps are five:

- GRI 302-1 Energy consumption within the organization.
- GRI 303-3 Water withdrawal.
- GRI 305-1 Direct (Scope 1) GHG emissions.
- GRI 305-2 Indirect (Scope 2) GHG emission.
- GRI 306-3 Waste generated.

4.3 Collection of data

This paragraph shows the data collected from the public non-financial disclosures of the three companies for each of the GRI Standards selected in the previous step. Each subparagraph presents the data collected for each of the previously selected GRI Standards for every company and explains the disclosure requirements of the indicators. The last subparagraph shows the data collected which was used for the standardizations in the next step of the framework presented in the next chapter. The information was collected for three years: 2021, 2020, and 2019 in order to further investigate the companies' trend in environmental performance. In the next chapter, this data is interpreted. A hypothesis was made during the collection of the data: each company disclosed the information accordingly to the GRI Standards' requirements; the information refers to the same perimeters and, therefore, are to some extent comparable with each other.

4.3.1 GRI 302-1 Energy consumption within the organization

GRI 302-1 requires disclosing the company's energy consumption within the organization in Joules (or multiples) throughout the reporting year. This involves the energy consumption for the correct functioning of the company's operations and activities. It considers the disclosure of fuel types used and the distinction between the non-renewable and renewable fuel consumed. It requires disclosure of the total electricity, heating, cooling, and steam purchased for consumption, the self-generated electricity,

heating, cooling, and steam consumed. As well as the one sold to third parties. In order to avoid double-counting of fuel consumption, the self-generated energy consumed by the organization is reported in fuel consumption. Furthermore, the energy consumed disclosed by this GRI considers energy consumed by entities owned or controlled by the organization. Finally, the total energy consumption within the organization in Joules or multiples is calculated using the formula shown in Figure 16.

Total energy consumption within the organization

=

Non-renewable fuel consumed

+

Renewable fuel consumed

+

Electricity, heating, cooling, and steam purchased for consumption

-

Self-generated electricity, heating, cooling, and steam, which are not consumed

-

Electricity, heating, cooling, and steam sold

Figure 16 Formula to calculate the total energy consumption within the organization.

The tables show the disclosed information about energy consumption for each of the companies under scrutiny in the case study. Each information is reported for every year.

Table 4 GRI 302-1 disclosed by the case study's companies in 2021.

2021	Veritas	Tea	Etra
Total consumption non-renewable sources [GJ]	841.979	217.944	369.696
Total consumption renewable sources [GJ]	100.070	30.526	33.012
Total consumption within the organization [GJ]	942.049	248.470	402.708
% renewables	11%	12%	8%

Table 5 GRI 302-1 disclosed by the case study's companies in 2020.

2020	Veritas	Tea	Etra
Total consumption non-renewable sources [GJ]	788.574	214.982	349.562
Total consumption renewable sources [GJ]	46.677	16.073	38.390
Total consumption within the organization [GJ]	835.251	231.055	387.952
% renewables	6%	7%	10%

Table 6 GRI 302-1 disclosed by the case study's companies in 2019.

2019	Veritas	Tea	Etra
Total consumption non-renewable sources [GJ]	798.168	231.781	344.959
Total consumption renewable sources [GJ]	38.115	986	39.636
Total consumption within the organization [GJ]	836.283	232.767	384.595
% renewables	5%	0%	10%

The companies reported the information correctly. However, for the purpose of the method to calculate the GRI Environmental Score, only the total consumption and the distinction between renewable and non-renewable sources is reported here.

4.3.2 GRI 303-3 Water withdrawal

GRI 303-3 requires disclosing the company's total water withdrawal in ML with the breakdown of withdrawals by different sources. These are surface water, groundwater, seawater, produced water, and third-party water, if possible. Then, the company is required to report on the withdrawal from areas which are subject to water stress with the breakdown of the same sources presented before. The tables show the disclosed information about water withdrawal for each of the companies under scrutiny in the case study. Each information is reported for every year.

Table 7 GRI 303-3 disclosed by the case study's companies in 2021.

2021	Veritas	Tea	Etra
Total water withdrawal [ML]	112.429	27.590	63.621
Of which from areas with water stress [ML]	0	2.561	63.621
% areas with stress	0%	9%	100%

Table 8 GRI 303-3 disclosed by the case study's companies in 2020.

2020	Veritas	Tea	Etra
Total water withdrawal [ML]	114.000	29.120	64.907
Of which from areas with water stress [ML]	0	2.580	64.907
% areas with stress	0%	9%	100%

Table 9 GRI 303-3 disclosed by the case study's companies in 2019.

2019	Veritas	Tea	Etra
Total water withdrawal [ML]	120.104	28.940	65.869
Of which from areas with water stress [ML]	0	2.580	65.869
% areas with stress	0%	9%	100%

The companies reported the information correctly. However, for the purpose of the method to calculate the GRI Environmental Score, only the total water withdrawal and the withdrawal from areas with water stress is reported here.

4.3.3 GRI 305-1 Direct (Scope 1) GHG emission

GRI 305-1 requires disclosing the company's direct GHG emissions in metric tons of CO_2 equivalent. Scope 1 emissions refer to direct greenhouse gas emissions that occur from sources that are owned or controlled by the organization. These emissions result from activities that are under the organization's operational control and typically involve the combustion of fossil fuels or other processes that directly release greenhouse gases into the atmosphere. The company should also report which gases are included in the calculation: CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3, or all. In the compilation of the information specified in the GRI 305-1, reporting companies should exclude any GHG trades from the calculation. Furthermore, biogenic emissions of CO_2, from the combustion or biodegradation of biomass, should not be reported in the Scope 1 emissions, but separately from them. The tables show the disclosed information about the direct GHG emissions for each of the companies under scrutiny in the case study. Each information is reported for every year.

Table 10 GRI 305-1 disclosed by the case study's companies in 2021.

2021	Veritas	Tea	Etra
Scope 1 emissions [Co2eq]	28.412	21.251	9.626

Table 11 GRI 305-1 disclosed by the case study's companies in 2020.

2020	Veritas	Tea	Etra
Scope 1 emissions [Co2eq]	25.594	19.893	8.059

Table 12 GRI 305-1 disclosed by the case study's companies in 2019.

2019	Veritas	Tea	Etra
Scope 1 emissions [Co2eq]	23.971	23.583	7.704

4.3.4 GRI 305-2 Indirect (Scope 2) GHG emission

GRI 305-1 requires disclosing the company's indirect GHG emissions in metric tons of CO_2 equivalent. Scope 2 emissions refer to indirect greenhouse gas emissions that are associated with the consumption of purchased electricity, heat, or steam by the organization. These emissions are not generated on-site but are linked to the electricity or energy that an organization uses, often from external sources like power grids. Scope 2 emissions are considered indirect because the organization doesn't directly control the generation of the energy it consumes. Instead, it is responsible for the emissions associated with the energy it purchases and uses. The company should also report which gases are included in the calculation: CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3, or all. In the compilation of the information specified in the GRI 305-2, reporting companies should exclude any GHG trades from the calculation. Furthermore, the calculation should be based in the location-based method if the reporting company has operations in markets without product or supplier-specific data. Instead, it should use both location and market-based method if it has any operations in markets providing product or supplier-specific data in the form of contractual instruments. According to the GHG Protocol (2022), location-based method calculation represents the average emissions intensity of grids where the energy consumption occurs (therefore, the geographical area in which the company operates). While a market-based method calculation represents emissions from the actual electricity that companies have decided to choose from (or their lack of choice). It derives the emission factors from contractual instruments, which include any type of contract between two parties for the sale and purchase of energy bundled with attributes about the energy generation, or for unbundled attribute claims. The tables show the disclosed information about the indirect GHG emissions for each of the companies under scrutiny in the case study. Each information is reported for every year.

Table 13 GRI 305-2 disclosed by the case study's companies in 2021.

2021	Veritas	Tea	Etra
Scope 2 emissions *Market based* [Co2eq]	53.973	15.407	16.605
Scope 2 emissions *Location based* [Co2eq]	37.074	20.927	29.338

Table 14 GRI 305-2 disclosed by the case study's companies in 2020.

2020	Veritas	Tea	Etra
Scope 2 emissions *Market based* [Co2eq]	59.597	16.685	30.158
Scope 2 emissions *Location based* [Co2eq]	42.981	22.419	17.965

Table 15 GRI 305-2 disclosed by the case study's companies in 2019.

2019	Veritas	Tea	Etra
Scope 2 emissions *Market based* [Co2eq]	64.650	17.225	23.884
Scope 2 emissions *Location based* [Co2eq]	48.013	36.227	22.087

4.3.5 GRI 306-3 Waste generated

GRI 305-1 requires disclosing the company's waste generated in metric tons, and a breakdown of this total by composition of the waste. This involves the waste generated during the company's activities. It requires to disclose the breakage between hazardous and non-hazardous waste generated. The tables show the disclosed information about the waste generated for each of the companies under scrutiny in the case study. Each information is reported for every year.

Table 16 GRI 306-3 disclosed by the case study's companies in 2021.

2021	Veritas	Tea	Etra
Total waste generated [t]	522.447	100.854	74.984
Of which hazardous [t]	4.278	20	54
% hazardous	0,82%	0,02%	0,07%

Table 17 GRI 306-3 disclosed by the case study's companies in 2020.

2020	Veritas	Tea	Etra
Total waste generated [t]	611.354	88.715	77.151
Of which hazardous [t]	3.899	133	112
% hazardous	0,64%	0,15%	0,15%

Table 18 GRI 306-3 disclosed by the case study's companies in 2019.

2019	Veritas	Tea	Etra
Total waste generated [t]	555.424	75.143	84.275
Of which hazardous [t]	6.424	69	100
% hazardous	1,16%	0,09%	0,12%

4.3.6 Data for standardization

The relevant standardization factors selected and collected for the subsequent standardization of each GRI Standard for each company are:

- Number of employees: this factor is relevant when evaluating resource consumption, as larger companies may naturally have higher absolute consumption. It allows for a fair comparison of resource efficiency among companies of different sizes.
- Users served by the company's services[9]: this factor is relevant because it reflects the scale of the company's operations and its impact on the community.
- Collected waste: this factor is relevant for assessing efficiency in waste management operations. It helps determine how effectively a company handles waste, promotes recycling, and minimizes waste generation. A lower standardized value may indicate better waste management practices.
- Treated water: this factor helps evaluate water efficiency in operations. It is essential in industries like waste management, where water is used for various purposes, including treatment processes.

In the next chapter, these hypotheses will be studied and discussed.

The tables show the disclosed information for each of these standardization factors in the companies' non-financial disclosures.

Table 19 Data for subsequent standardization of GRI data of the case study's companies in 2021.

2021	Veritas	Tea	Etra
Employees	3.396	623	999
Users served	918.000	315.000	570.000
Collected waste [t]	510.000	153.000	227.000
Treated water [km^3]	97.100	26.200	41.700

Table 20 Data for subsequent standardization of GRI data of the case study's companies in 2020.

2020	Veritas	Tea	Etra
Employees	3.386	604	947
Users served	918.000	315.000	570.000
Collected waste [t]	480.000	163.000	223.000
Treated water [km^3]	96.800	31.500	43.600

[9] With users served is intended the residents in the area covered by the company. Therefore, the tourists present in the area covered by Veritas S.p.A. are not counted in that number. This was considered in the interpretation of the results obtained through the standardization of the GRI data. A hypothesis made with the data of users served is that the number does not change in time.

Table 21 Data for subsequent standardization of GRI data of the case study's companies in 2019.

2019	Veritas	Tea	Etra
Employees	3.294	572	944
Users served	918.000	315.000	570.000
Collected waste [t]	548.000	174.000	221.000
Treated water [km^3]	103.400	32.100	45.910

Chapter 5. Results and discussion

5.1 Assignment of relative weights to selected GRI Standards

Considering the characteristics of the waste management sector and the factors that are commonly associated within this industry's environmental impact, coherent weights to each of the selected indicators were assigned. In the waste management sector, which involves the generation, distribution, and management of essential resources like energy and water, certain environmental aspects hold more significance due to the nature of the industry. The weights were assigned also by drawing inspiration from the weights previously shown in the S&P Global Ranking system in paragraph 3.3.

GRI 302-1 Energy consumption within the organization: The waste management sector is known for its high energy intensity. This high consumption is due to activities such as the equipment used for the waste and water management activities. This justifies a relatively higher weight for energy consumption to address the sector's significant environmental impact. Indeed, the relative weight assigned for this GRI Standard is: 0,20. It represents the high importance of the energy factor.

GRI 303-3 Water withdrawal: Water is a key resource for waste management companies, especially in contexts where water scarcity is a concern. While not as central as energy, water withdrawal is still significant and deserves attention. The relative weight assigned for this GRI Standard is: 0,15. It represents the moderate importance of the water usage factor.

GRI 305-1 Direct (Scope 1) GHG emissions: Consequently to the use of energy, the utilities sector contributes significantly to GHG emissions. As a result, direct GHG emissions were assigned a substantial weight to reflect the industry's environmental impact. The relative weight assigned for this GRI Standard is: 0,25, representing the very high importance of this factor.

GRI 305-2 Indirect (Scope 2) GHG emissions: Indirect GHG emissions related to energy consumption are an important factor. It is relevant as these emissions reflect the impact of the energy sources the company uses. The relative weight assigned for this GRI Standard is: 0,25, representing the very high importance of this factor.

306-3 Waste generated: Waste generation is a concern in the waste management sector. The waste generated by these companies usually comes from the waste management operations, reflecting on the operational efficiency of these. Therefore, higher waste generation is also correlated to higher environmental impact. Given its

significance, waste generation received a moderate weight in the assessment. The relative weight assigned for this GRI Standard is: 0,15.

5.2 Standardization of GRI data

After the data collection of the GRI data, they were standardized using the standardization factors collected and shown in the tables in subparagraph 4.3.6. This step was fundamental to be put the three waste management companies onto a common scale in order to treat each of them equally in the scoring system and in the subsequent aggregation considering the weights assigned to each indicator. The standardization took place by dividing the different data by every standardization factor, as previously shown in formula 1 in subparagraph 3.3.3. Therefore, for each GRI data collected, four standardized data were calculated, since four standardization factors were chosen to characterize the companies. Below, each subparagraph shows the tables representing the standardization for each GRI Standard (302-1, 303-3, 305-1, 305-2, 306-3), company (Veritas S.p.A., Tea S.p.A., Etra S.p.A.), year (2021, 2020, 2019), and standardization factors (employees, users, collected waste, treated water). Furthermore, an interpretation of the GRI data for each company throughout the years is presented, as well as one of the standardized data between companies over the years.

5.2.1 Standardization of GRI 302-1

The tables show the standardization of the data disclosed in GRI 302-1 by the three companies of the case study. They also show the ranking of the standardized data, which is going to be discussed in the next paragraph. The data disclosed by them was divided by the standardization factors. In the tables, there are the values for the standardization of each factor for every company and year. For the purpose of applying this method, even though the GRI requires disclosure of multiple information, in the collection of the data, only the totals are considered. For this GRI, only the total consumption of energy within the organization is taken into account.

Table 22 Standardized data and ranking for GRI 302-1 in 2021.

2021	Veritas	Ranking	Tea	Ranking	Etra	Ranking
Employees standardization	277,40	3	398,83	2	403,11	1
Users standardization	1,03	1	0,79	2	0,71	3
Collected waste standardization	1,85	1	1,62	3	1,77	2
Treated water standardization	9,70	1	9,48	3	9,66	2
Score	6		10		8	

Table 23 Standardized data and ranking for GRI 302-1 in 2020.

2020	Veritas	Ranking	Tea	Ranking	Etra	Ranking
Employees standardization	246,68	3	382,54	2	409,66	1
Users standardization	0,91	1	0,73	2	0,68	3
Collected waste standardization	1,74	1	1,42	3	1,74	2
Treated water standardization	8,63	2	7,34	3	8,90	1
Score	7		10		7	

Table 24 Standardized data and ranking for GRI 302-1 in 2019.

2019	Veritas	Ranking	Tea	Ranking	Etra	Ranking
Employees standardization	253,88	3	406,94	2	407,41	1
Users standardization	0,91	1	0,74	2	0,67	3
Collected waste standardization	1,53	2	1,34	3	1,74	1
Treated water standardization	8,09	2	7,25	3	8,38	1
Score	8		10		6	

Before looking at the standardized data, an interpretation of the disclosed absolute information is given. This is done in order to see how and if the standardization of data makes this interpretation take another way.

As illustrated in Figure 17, Veritas S.p.A.'s energy consumption has undergone notable changes over the years. In 2019 and 2020, the energy consumption levels were relatively stable. In 2019, the company consumed 836.283 to 835.251 GJ, followed by a marginal increase in 2020. However, a significant shift occurred in 2021 when the energy consumption spiked to 942.049 GJ.

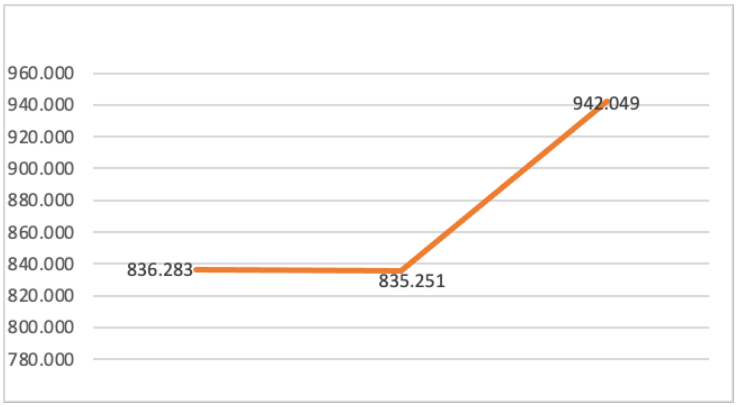

Figure 17 Veritas S.p.A.'s trend over the years in energy consumption.

Several factors contribute to the fluctuations in energy consumption. One crucial factor to consider is the impact of the COVID-19 pandemic. According to the non-

financial statements of Veritas S.p.A. of 2020, the pandemic led to a milder tourism phenomenon, resulting in a 55% reduction in tourist visits compared to 2019. Fewer visitors to the area meant reduced water and waste treatment requirements. However, the pandemic also brought about changes in other aspects of Veritas' operations. The company provides cemetery services, which include crematories. During the COVID-19 pandemic, there was an increase in the use of crematories, due to the circumstances surrounding the pandemic. This increased activity cemetery services could have offset the decline in other areas, such as tourism-related services, resulting in energy consumption levels remaining relatively steady between 2019 and 2020.

In contrast, 2021 presented a different set of challenges. Veritas S.p.A. attributed the higher energy consumption in this year to several factors:

- Natural gas consumption: the company reported increased consumption of it, primarily driven by the activation of the sludge dryer at Fusina. This additional energy demand is associated with wastewater treatment processes.
- Continued pandemic effects: despite the milder tourism conditions, the lingering effects of the COVID-19 pandemic continued to influence energy consumption. Cemetery service, including cremations, remained in demand, contributing to energy usage.
- Transportation: Veritas indicated that energy consumption also rose due to the use of fuel for transportation. As a response, the company initiated the purchase of electric cars that will be powered by energy generated through PV panels, a move toward more sustainable transport practices.
- Waste disposal: during the pandemic, there was a surge in the use of individual protection devices such as masks, which were disposed of through incineration and waste-to-energy processes. Veritas S.p.A. owns one of these facilities, which played a role in accommodating the disposal of these items, contributing to higher energy consumption in 2021.

These multifaced factors collectively explain the fluctuations in Veritas S.p.A.'s energy consumption trends. While the pandemic influenced tourism-related services, it also brought about changes in other areas of operation, highlighting the complexity of managing energy consumption in a dynamic environment. Veritas' proactive approach, including the adoption of electric cars and PV panels, indicates a commitment to addressing environmental challenges and optimizing energy usage.

By looking at Figure 18, Tea S.p.A.'s energy consumption trends exhibit a pattern similar to Veritas, the consumption levels slightly decrease in 2020 and then rise in 2021. According to Tea S.p.A.'s non-financial statement, the 7% increase in energy consumption in 2021 can be attributed to various factors:

- Higher natural gas consumption: the company reported increased natural gas consumption, likely driven by its use in various operation processes.
- Thermic energy for public heating: this service provided by Tea likely saw an increased demand in response to the lockdown measures taken by the Italian government.
- Fuel for transportation: the energy consumption also rose due to the use of fuel for transportation for the waste management collection activities.
- Cemetery services: similarly to Veritas, Tea provided cemetery services which continued to experience demand due to the ongoing COVID-19 pandemic. This added to the energy usage for the company.

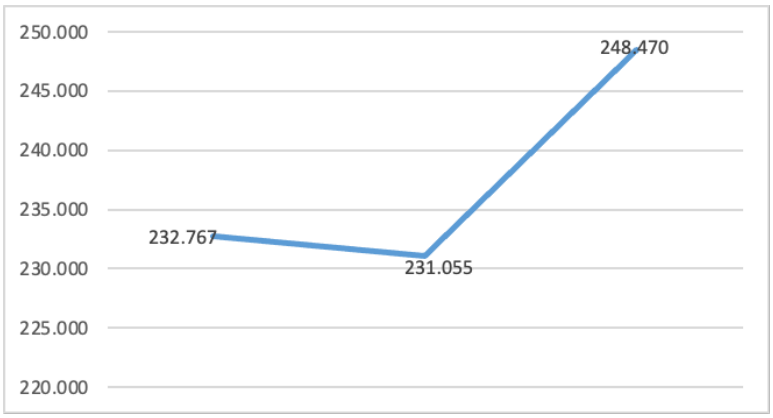

Figure 18 Tea S.p.A.'s trend over the years in energy consumption.

Etra's energy consumption trend aligns with those of the other two companies in the case study. It too witnessed an increase in energy consumption in 2021 compared to previous years. The role in this was played by the same factors as the other two companies, however other factors are:

- Internalization of processes: the company mentioned, in its non-financial disclosure, that it internalized certain processes of the waste management service that were previously outsourced. This change in operational structure may have influenced the energy consumption patterns.

- Increase in waste treatment: it treated more waste in 2021 compared to 2019. The volume of waste being processed can significantly impact energy consumption, as more waste required more energy for collection, sorting, and treatment.

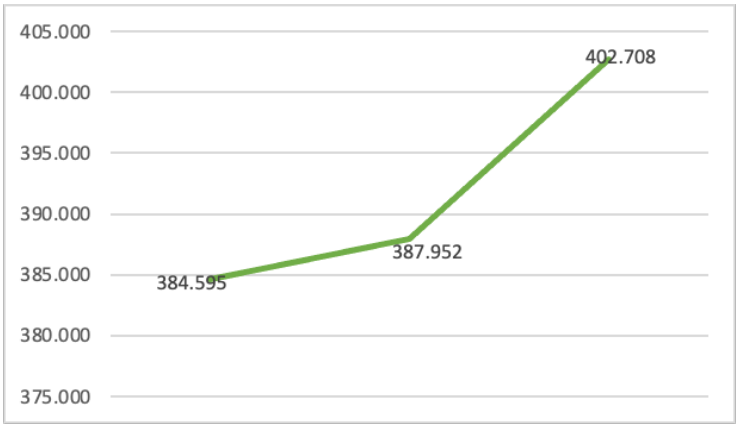

Figure 19 Etra S.p.A.'s trend over the years in energy consumption

By looking at the total consumption of energy by the three companies over the years, without any standardization, Veritas S.p.A. consumes two to three times more energy compared to the other two. Etra S.p.A. also consumes more than Tea S.p.A.

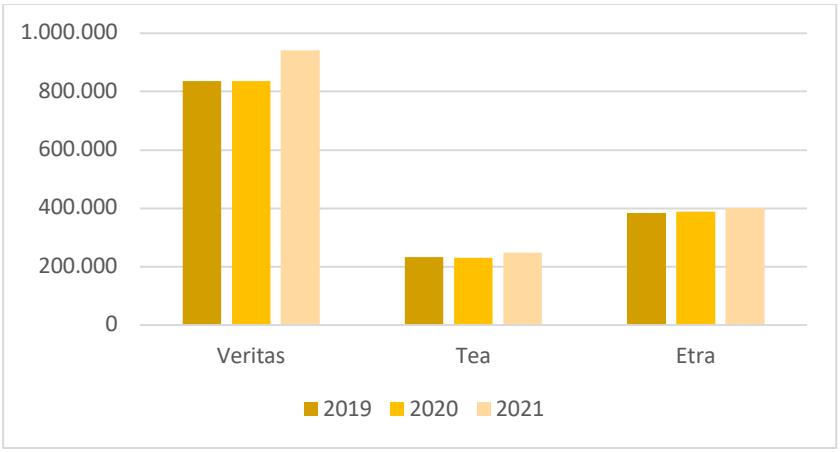

Figure 20 Energy consumption of case study's companies over the years.

However, the perspective changes when analyzing the total energy consumption standardized for their characteristics. The two factors selected to comment the relation between GRI data and standardized GRI data are users served and waste collected by the companies. By dividing the energy consumption by these standardization factors, we gain insights into how efficiently energy is utilized relative to the scale and scope of their operations.

Starting with the relationship between users served and energy consumption, it is critical to understand that the standardization data for energy consumption per unit of users served [GJ/user] is similar for all three companies. This implies that, in relation to the number of users served, each company consumes a roughly equivalent amount of energy. This insight is obscured when solely examining the total energy consumption of these companies. Moreover, it is important to underline that Veritas serves a substantial number of users, which include residents in its service areas. Notably, this number does not account for the significant influx of tourists who visit the region. As a result, the standardization value for Veritas appears higher compared to the other companies. If tourists were factored into the calculation, the standardization data would likely be lower. When presenting the collected data in the previous chapter, a hypothesis was made about the users served: they do not change over time. Therefore, the standardization data shows the trend in energy consumption of the companies over time. Indeed, Veritas S.p.A. and Tea S.p.A. show a slight decrease and then an increase in energy consumption, while Etra S.p.A. shows stable consumption in 2019 and 2020, and then a slight increase in 2021. These standardizations not only facilitate fair comparisons across companies with varying scales but also reveal meaningful trends in energy efficiency. They show that while Veritas may consume more total energy due to its extensive user base, it manages to provide services efficiently in relation to the number of users served.

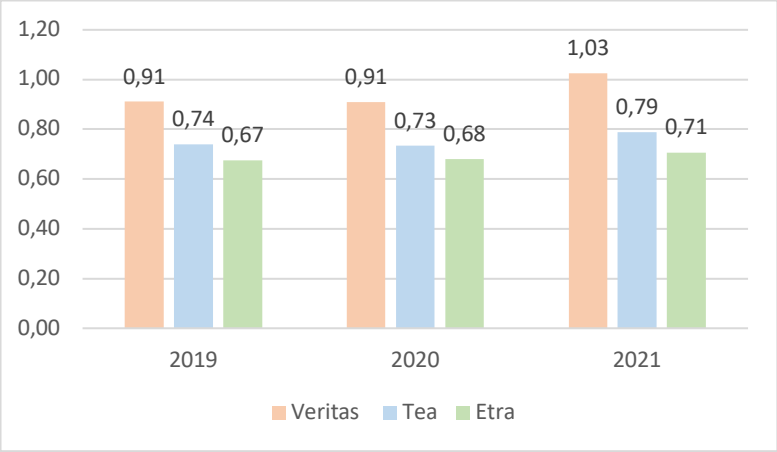

Figure 21 GRI 302-1 standardization by users served.

The same argument can also be done using the waste collected by the companies as standardization factor. This standardization factor not only reflects the scope of the waste management activities of these companies, but also captures the influence of tourism phenomena, which was not considered in the previous standardization factor based on

users served. Over the years, the data reveal that the order of magnitude of waste collected by each company remains consistent. Veritas S.p.A., due to the expansive scope of its operations, extensive territorial coverage, and the influx of tourists in the municipalities it serves, consistently collects a significant amount of waste compared to the two companies. In 2021 alone, Veritas collected 510.000 tons of waste from its waste management activities, while Tea S.p.A. collected 153.000 tons, and Etra S.p.A. collected 227.000 tons. The patterns in waste collection are quite similar in previous years, thereby ensuring that the standardization factors remain relatively stable. At first glance, it might seem that Veritas S.p.A. is the most energy-consuming company and therefore potentially most impactful on the environment. However, this perception shifts when considering energy consumption in relation to the amount of waste collected by each company. Indeed, as shown in Figure 22, the standardized data reveals that all three companies consume a similar amount of energy per unit of waste collected [GJ/tons]. The standardized data suggests that Etra S.p.A. is the company which uses relatively more energy in relation to the amount of waste it collects and subsequently treats. On the other hand, Veritas S.p.A.'s energy consumption appears justified by the significant quantity of waste it manages. This underscores a fundamental reality: the more waste a company is responsible for collecting and treating, the greater its energy requirements. This includes energy used for transportation, as well as the energy consumed during recycling and other waste treatment operations. Furthermore, the trends in energy consumption by the companies over the years are reflected in the standardization data. Notably, the standardization values are higher for each company in 2021, coinciding with the year when all three companies experienced increased energy consumption, as previously explained.

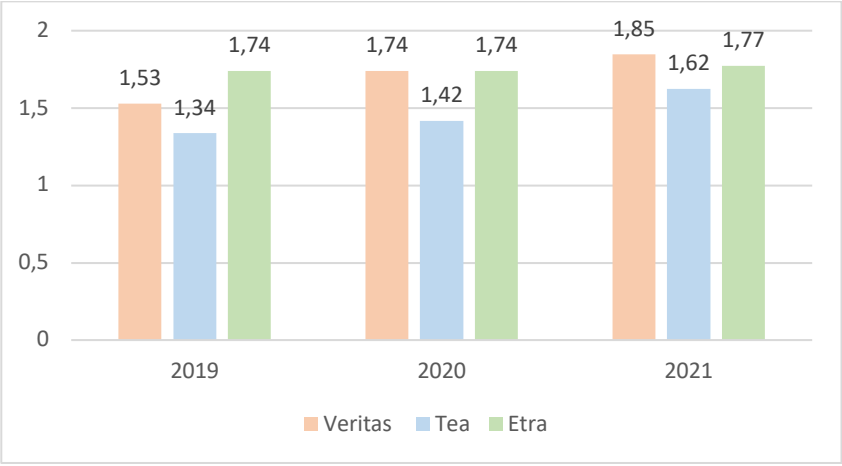

Figure 22 GRI 302-1 standardization by collected waste.

In summary, by standardizing energy consumption with respect to waste collected, we gain valuable insights into the efficiency of each company's operations. It becomes evident that Veritas S.p.A.'s energy consumption aligns with the magnitude of waste it handles, highlighting the necessity of energy-intensive waste collection and management processes. This perspective underscores the importance of considering standardization factors when assessing the environmental impact of waste management companies.

5.2.2 Standardization of GRI 303-3

The tables show the standardization of the data disclosed in GRI 303-3 by the three companies of the case study. They also show the ranking of the standardized data, which is going to be discussed in the next paragraph. The data disclosed by them was divided by the standardization factors. In the tables, there are the values for the standardization of each factor for every company and year. For the purpose of applying this method, even though the GRI requires disclosure of multiple information (like the distinction between areas under stress, types of source), as shown in chapter 4 in the collection of the data, only the totals are considered. For this GRI, only the total water withdrawal is taken into account.

Table 25 Standardized data and ranking for GRI 303-3 in 2021.

2021	Veritas	Ranking	Tea	Ranking	Etra	Ranking
Employees standardization	33,11	3	44,29	2	63,68	1
Users standardization	0,12	1	0,09	3	0,11	2
Collected waste standardization	0,22	2	0,18	3	0,28	1
Treated water standardization	1,16	2	1,05	3	1,53	1
Score	8		11		5	

Table 26 Standardized data and ranking for GRI 303-3 in 2020.

2020	Veritas	Ranking	Tea	Ranking	Etra	Ranking
Employees standardization	33,67	3	48,21	2	68,54	1
Users standardization	0,12	1	0,09	3	0,11	2
Collected waste standardization	0,24	2	0,18	3	0,29	1
Treated water standardization	1,18	1	0,92	3	1,49	2
Score	7		11		6	

Table 27 Standardized data and ranking for GRI 303-3 in 2019.

2019	Veritas		Tea		Etra	
Employees standardization	36,46	3	50,59	2	69,78	1
Users standardization	0,13	1	0,09	3	0,12	2
Collected waste standardization	0,22	2	0,17	3	0,30	1
Treated water standardization	1,16	2	0,90	3	1,43	1
Score	8		11		5	

Before looking at the standardized data, an interpretation of the disclosed absolute information is given. This is done in order to see how and if the standardization of data makes this interpretation take another way. The analysis of water withdrawal data for the three waste management companies reveals interesting insights into their water usage patterns over the years. The figures below depict these trends. As it is shown in Figure 23, Veritas S.p.A.'s water withdrawal experienced a decrease over the years. The withdrawal decreased from 2019 to 2021 by 8 ML. Instead, Tea S.p.A. shows a slight increase in 2020 for then decrease again. Etra S.p.A., shows a decrease slightly over the years, but the ML withdrawn are on the same line. For each company, this is caused mainly due to actions taken over the years for the reduction of water losses along the water network and the recycling and reuse of water already in the processes.

Figure 23 Veritas S.p.A.'s trend in water withdrawal over the years.

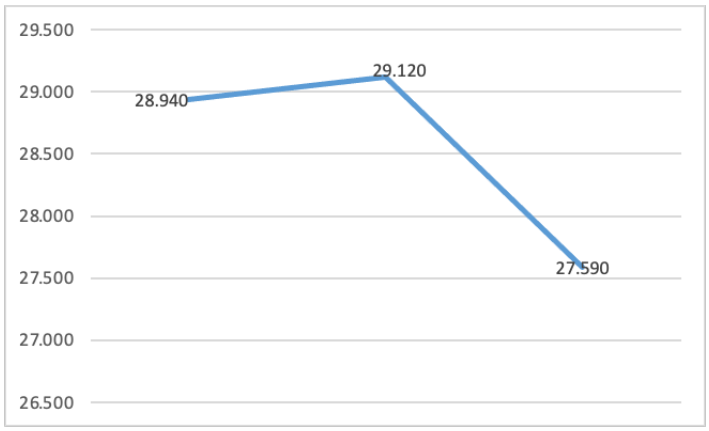

Figure 24 Tea S.p.A.'s trend in water withdrawal over the years.

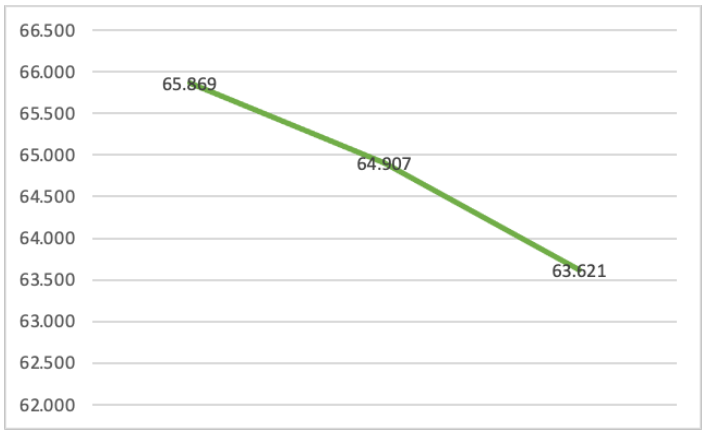

Figure 25 Etra S.p.A.'s trend in water withdrawal over the years.

Initially, without standardization, it appears that Veritas S.p.A: withdraws a significantly larger volume of water compared to the other two companies. Veritas' water withdrawal surpasses that of Tea and Etra by two to four times. This observation might lead one to assume that Veritas has a more substantial environmental impact due to its higher water usage.

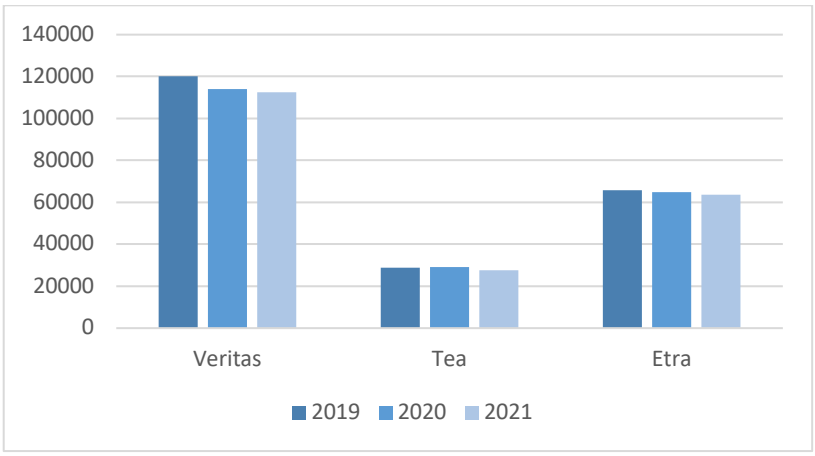

Figure 26 Water withdrawals of case study's companies over the years.

To provide a more equitable bases for comparison and allow a common scale assessment, the number of employees is selected as the standardization factor. This factor represents the company's dimension, permitting an evaluation of water withdrawal per unit of employee. It is vital to consider the number of employees in this context. Veritas has a notably larger workforce, employing 3.396 individuals, while Tea had 623 employees, and Etra 999. This employee count remained relatively stable over the years for all three companies, as previously noted. Consequently, when water withdrawal is divided by the number of employees, discerns that Veritas' high water usage aligns with its larger dimension and operational reach. In essence, the size of Veritas justifies its substantial water withdrawal. In contrast, Etra stands out by showcasing a relatively higher water withdrawal per employee. This indicates that the volume of water they withdraw may be excessive for their organizational scale and activities.

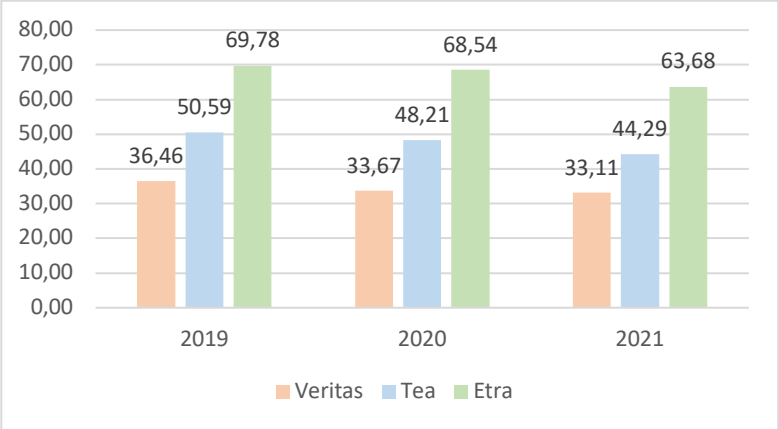

Figure 27 GRI 303-3 standardization by employees.

In summary, standardizing water withdrawal by the number of employees provides a more balanced perspective on how efficiently these companies utilize water resources. It clarifies that Veritas S.p.A.'s substantial water usage aligns with its larger dimension. Conversely, Etra S.p.A.'s relatively high water withdrawal per employee suggests room for optimization in their water management practices. These standardization insights underscore the importance of assessing environmental data relative to the specific characteristics and size of each organization.

5.2.1 Standardization of GRI 305-1

The tables show the standardization of the data disclosed in GRI 305-1 by the three companies of the case study. They also show the ranking of the standardized data, which is going to be discussed in the next paragraph. The data disclosed by them was divided

by the standardization factors. In the tables, there are the values for the standardization of each factor for every company and year.

Table 28 Standardized data and ranking for GRI 305-1 in 2021.

2021	Veritas	Ranking	Tea	Ranking	Etra	Ranking
Employees standardization	8,37	3	34,11	1	9,64	2
Users standardization	0,03	2	0,07	1	0,02	3
Collected waste standardization	0,06	2	0,14	1	0,04	3
Treated water standardization	0,29	2	0,81	1	0,23	3
Score	9		4		11	

Table 29 Standardized data and ranking for GRI 305-1 in 2020.

2020	Veritas	Ranking	Tea	Ranking	Etra	Ranking
Employees standardization	7,56	2	32,94	1	8,51	3
Users standardization	0,03	2	0,06	1	0,01	3
Collected waste standardization	0,05	2	0,12	1	0,04	3
Treated water standardization	0,26	2	0,63	1	0,18	3
Score	8		4		12	

Table 30 Standardized data and ranking for GRI 305-1 in 2019.

2019	Veritas	Ranking	Tea	Ranking	Etra	Ranking
Employees standardization	7,28	3	41,23	2	8,16	1
Users standardization	0,03	2	0,07	1	0,01	3
Collected waste standardization	0,04	2	0,14	1	0,03	3
Treated water standardization	0,23	2	0,73	1	0,17	3
Score	9		4		11	

Before looking at the standardized data, an interpretation of the disclosed absolute information is given. This is done in order to see how and if the standardization of data makes this interpretation take another way. The trends in direct GHG emissions closely align with the energy consumption patterns of the waste management companies. These emissions originate from sources owned or controlled by the respective companies, making their trends and the reasons behind them intimately connected. As illustrated in Figure 28, Veritas S.p.A.'s direct GHG emissions have witnessed an increase over the years, much like its energy consumption trends. The reason behind this surge echo those outlined for energy consumption. In particular, the inclusion of cemetery services in 2020 and 2021, driven by the COVID-19 pandemic, contributed to elevated emissions. Additionally, the 2021 increase is attributed to higher natural gas consumption due to the

sludge dryer in Fusina, transportation for waste management, and the incineration of individual protection devices during the pandemic in waste-to-energy plant owned by Veritas S.p.A. These factors collectively account for the rise in Vertias' direct GHG emissions.

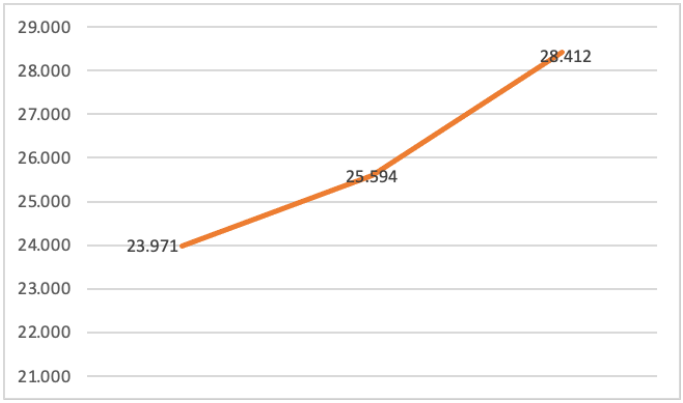

Figure 28 Veritas S.p.A.'s trend in direct GHG emissions over the years.

Figure 29 depicts Tea's direct GHG emissions trend, mirroring its energy consumption patterns. A slight decrease in emissions is observed in 2020, followed by an increase in 2021. The reason aligns with those for energy consumption, as outlined in the non-financial statement of Tea. The 7% increase in GHG emissions in 2020 is attributed to higher natural gas consumption, thermic energy for public heating, fuel for transportation, and electricity for operations. Similar to Veritas, also provided cemetery services in response to the ongoing COVID-19 pandemic, contributing to the emission rise.

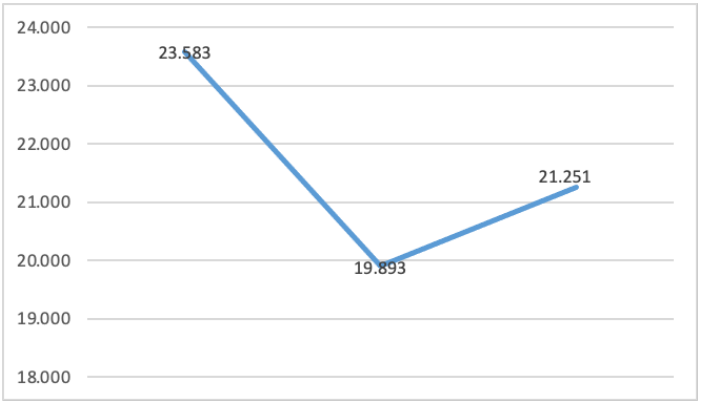

Figure 29 Tea S.p.A.'s trend in direct GHG emissions over the years.

Etra's direct GHG emissions trend follow a similar trajectory to the other two companies. In 2021, like its counterparts, Etra experienced increased energy consumption, resulting in higher GHG emissions. A significant portion of Etra's direct

emissions stems from transportation activities within the waste management service. Notably, the company internalized previously outsourced waste management processes, further contributing to the emission increase in 2020-2021.

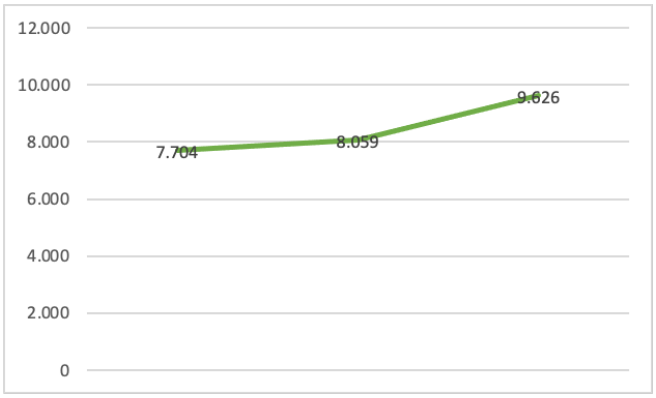

Figure 30 Etra S.p.A.'s trend in direct GHG emissions over the years.

Looking at the total direct GHG emissions without standardization, Veritas appears to emit more than the other two companies, as shown in Figure 31.

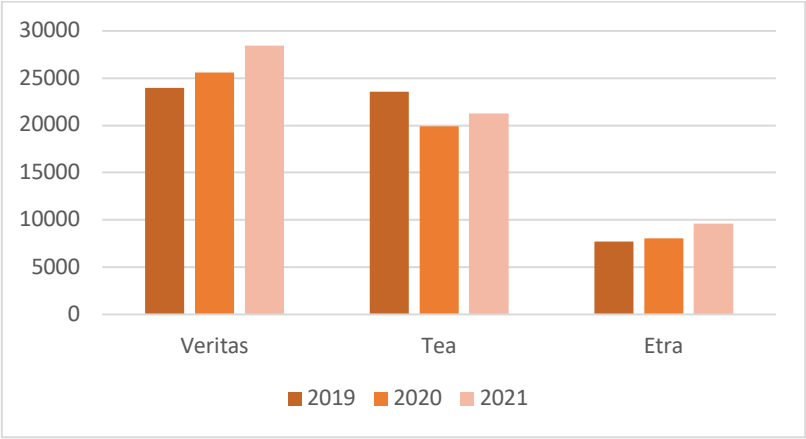

Figure 31 Direct GHG emissions of case study's companies over the years.

To gain a more comprehensive understanding and enable fair comparisons, two standardization factors are employed: users served and waste collected by the companies.

Using the number of employees as a standardization factor, the data reveals intriguing insights, as depicted in Figure 32. Contrary to initial perceptions, Veritas' direct emissions per employee are similar to Etra, underscoring that they both manage emissions efficiently given their workforce size. However, Tea emerges as the company emitting significantly more GHGs per employee, indicating a relatively higher environmental impact considering its dimension.

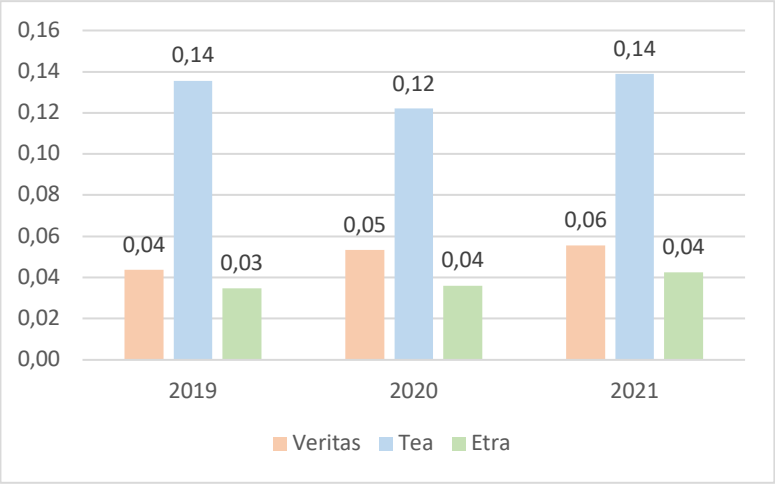

Figure 32 GRI 305-1 standardization by employees.

The same argument can also be done using the waste collected by the companies as standardization factor. Despite Veritas S.p.A. emitting the most without standardization, when considering waste collected, its emissions per unit of waste collected are comparable to Etra's, as shown in Figure 33. This standardization highlights that Veritas' elevated emissions align with its extensive waste collection and treatment activities. Notably, Tea stands out as the company emitting the most in relation to the waste it collects, suggesting potential areas for emission reduction efforts.

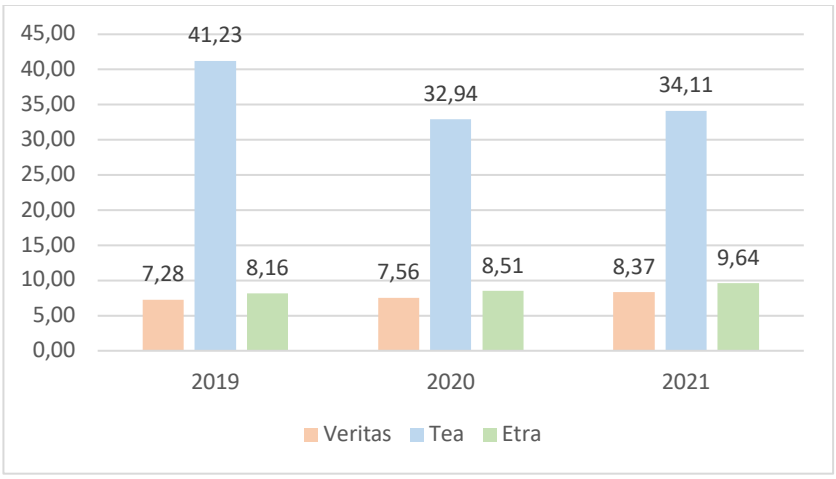

Figure 33 GRI 305-1 standardization by waste collected.

In summary, standardizing direct GHG emissions data using different factors provides a more nuanced understanding of the environmental impact of these waste management companies. While Veritas' emissions align with its extensive operations, Tea's relatively high emissions per employee and waste collected highlight areas for potential improvement. These standardization insights emphasize the importance of

evaluating environmental data in context and relative to specific company characteristics and operations.

5.2.1 Standardization of GRI 305-2

The tables show the standardization of the data disclosed in GRI 305-2 by the three companies of the case study. They also show the ranking of the standardized data, which is going to be discussed in the next paragraph. The data disclosed by them was divided by the standardization factors. In the tables, there are the values for the standardization of each factor for every company and year.

Table 31 Standardized data and ranking for GRI 305-2 in 2021.

2021	Veritas	Ranking	Tea	Ranking	Etra	Ranking
Employees standardization	15,89	3	24,73	1	16,62	2
Users standardization	0,06	1	0,05	2	0,03	3
Collected waste standardization	0,11	1	0,10	2	0,07	3
Treated water standardization	0,56	2	0,59	1	0,40	3
Score	7		6		11	

Table 32 Standardized data and ranking for GRI 305-2 in 2020.

2020	Veritas	Ranking	Tea	Ranking	Etra	Ranking
Employees standardization	17,60	3	27,62	2	31,85	1
Users standardization	0,06	1	0,05	2	0,05	3
Collected waste standardization	0,12	2	0,10	3	0,14	1
Treated water standardization	0,62	2	0,53	3	0,69	1
Score	8		10		6	

Table 33 Standardized data and ranking for GRI 305-2 in 2019.

2019	Veritas	Ranking	Tea	Ranking	Etra	Ranking
Employees standardization	19,63	3	30,11	1	25,30	2
Users standardization	0,07	1	0,05	2	0,04	3
Collected waste standardization	0,12	1	0,10	3	0,11	2
Treated water standardization	0,63	1	0,54	2	0,52	3
Score	6		8		10	

Before delving into the standardized data, it is important to first interpret the disclosed absolute information regarding the market-based scope 2 emissions of the three waste management companies. These emissions reflect the companies' decision on where to source their electricity, making it a significant indicator of their environmental

commitment. Market-based scope 2 emissions represent emissions associated with electricity the companies have chosen to purchase or not purchase. These emissions are influenced by the contractual arrangements and sources of energy chosen by the companies. 2020. This decline signifies that the companies have actively invested in procuring cleaner and renewable energy from third-party sources to power their operations. Lower market-based scope 2 emission suggest reduced direct emissions at the facilities where the purchased energy is generated, indicating a preference for renewable energy sources.

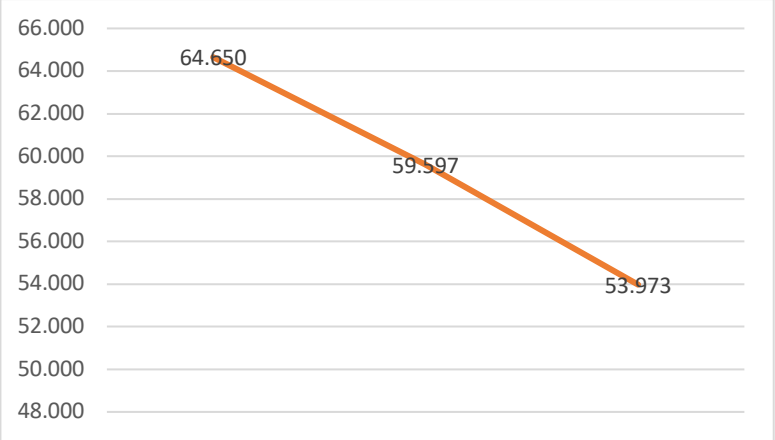

Figure 34 Veritas S.p.A.'s trend in indirect GHG emissions over the years.

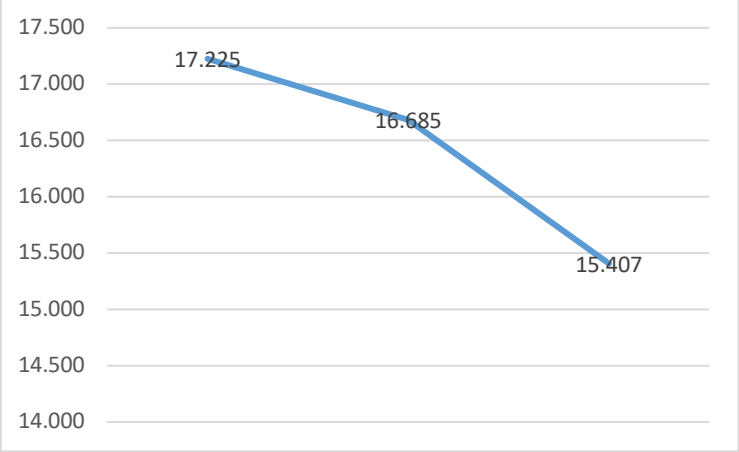

Figure 35 Tea S.p.A.'s trend in indirect GHG emissions over the years.

Figure 36 Etra S.p.A.'s trend in indirect GHG emissions over the years.

When considering the total market-based scope 2 indirect GHG emissions without standardization, it appears that Veritas has the highest emissions compared to the other two companies, as mentioned.

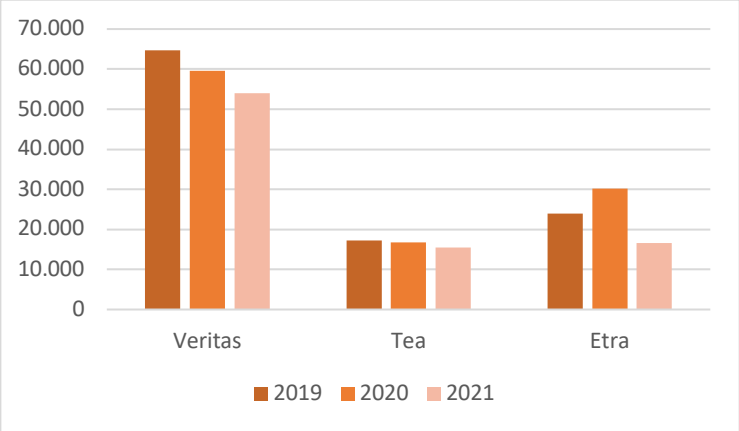

Figure 37 Indirect GHG emissions of case study's companies over the years.

To offer a more equitable basis for comparison, users served by the companies are used as a standardization factor. This allows for a common scale to assess the market-based scope 2 emissions per unit of users served, providing insights into each company's environmental performance relative to their reach. Upon standardization further highlights that the emissions of the three companies are quite similar when normalized for users served. The standardized emissions data indicated that Etra's higher scope 2 emissions, compared to Tea, are justified by its larger user base, serving 570.000 users, compared to the Tea's 315.000. Moreover, the trends in scope 2 emissions for the three companies become apparent through the standardized data, offering valuable insights into their commitment to cleaner energy source over time.

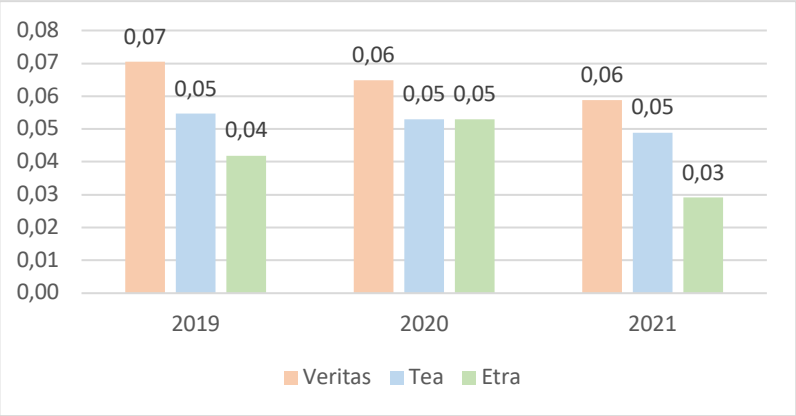

Figure 38 GRI 305-2 standardization by users served.

In summary, standardizing market-based scope 2 emissions data using users served as a factor provides a fair basis for comparison, revealing that Veritas' emissions are justified when accounting for the scale of their operations. This standardization also emphasizes the importance of considering specific operational and contextual factors when evaluating a company's environmental impact.

5.2.1 Standardization of GRI 306-3

The tables show the standardization of the data disclosed in GRI 306-3 by the three companies of the case study. They also show the ranking of the standardized data, which is going to be discussed in the next paragraph. The data disclosed by them was divided by the standardization factors. In the tables, there are the values for the standardization of each factor for every company and year. For the purpose of applying this method, even though the GRI requires disclosure of multiple information (like the distinction between hazardous and non-hazardous, or the composition of waste), as shown in chapter 4 in the collection of the data, only the totals are considered. For this GRI, only the total waste generated by the organization is taken into account.

Table 34 Standardized data and ranking for GRI 306-3 in 2021.

2021	Veritas	Ranking	Tea	Ranking	Etra	Ranking
Employees standardization	153,84	2	161,88	1	75,06	3
Users standardization	0,57	1	0,32	2	0,13	3
Collected waste standardization	1,02	1	0,66	2	0,33	3
Treated water standardization	5,38	1	3,85	2	1,80	3
Score	5		7		12	

Table 35 Standardized data and ranking for GRI 306-3 in 2020.

2020	Veritas	Ranking	Tea	Ranking	Etra	Ranking
Employees standardization	180,55	1	146,88	2	81,47	3
Users standardization	0,67	1	0,28	2	0,14	3
Collected waste standardization	1,27	1	0,54	2	0,35	3
Treated water standardization	6,32	1	2,82	2	1,77	3
Score	4		8		12	

Table 36 Standardized data and ranking for GRI 306-3 in 2019.

2019	Veritas	Ranking	Tea	Ranking	Etra	Ranking
Employees standardization	168,62	1	131,37	2	89,27	3
Users standardization	0,61	1	0,24	2	0,15	3
Collected waste standardization	1,01	1	0,43	2	0,38	3
Treated water standardization	5,37	1	2,34	2	1,84	3
Score	4		8		12	

Before delving into the standardized data, it is important to first interpret the disclosed absolute information regarding waste generation by Veritas, Tea and Etra. This data provides insights into each company's handling of waste over the years. The trend in waste generation by Veritas reveals a notable increase in waste generated in 2020. This surge can be attributed to the disposal of personal protective equipment, such as masks, which had to be incinerated due to non-recyclability. However, in 2021, despite an increase in tourism as the lockdown period ended, waste generation decreased, indicating a more efficient waste management and recycling processes. Additionally, Veritas cited increased activities at their Metalrecycling plant as a contributing factor to the rise in waste generation. Notably, a significant portion of this waste is classified as "End of waste", intended to become secondary raw material.

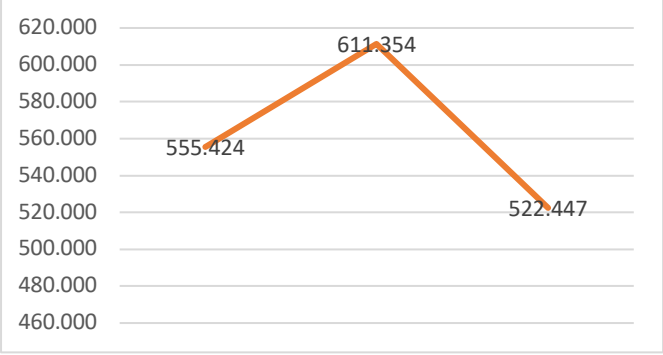

Figure 39 Veritas S.p.A.'s trend in waste generation over the years.

In contrast to Veritas, Tea's trend in waste generation shows a continuous increase over the years. This growth is primarily attributed to recycling activities, including mechanical recycling and composting, as well as wastewater treatment. However, a decline in collected waste by Tea over the years suggests inefficiencies in their recycling operations, leading to increased waste generation.

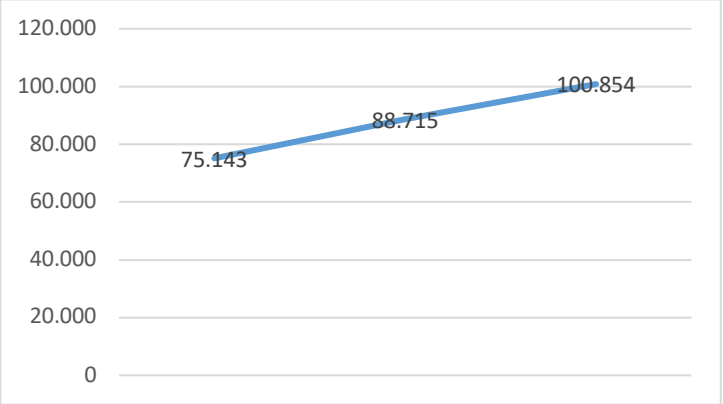

Figure 40 Tea S.p.A.'s trend in waste generation over the years.

Etra's trend in waste generation also differs from the other two companies, with a noticeable decrease over the years. This decrease is particularly noteworthy given that Etra collected more waste each year, reflecting increased recycling efficiency in their operations. Recycling activities, leachate from landfills, and dried sewage contribute to Etra's waste generation, with recycling accounting for 39% of the total waste generated.

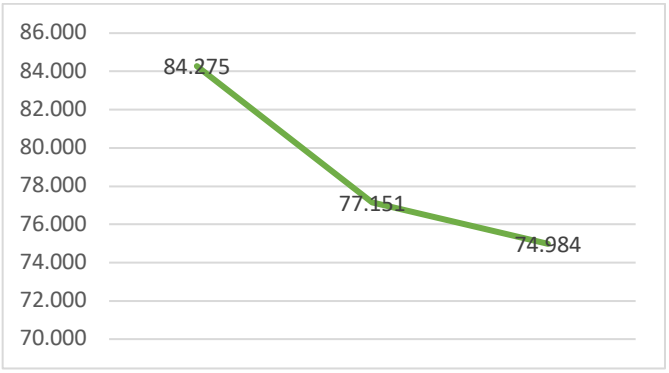

Figure 41 Etra S.p.A.'s trend in waste generation over the years.

When considering the total waste generation data without standardization, Veritas appears to generate the highest quantity of waste compared to the other two companies.

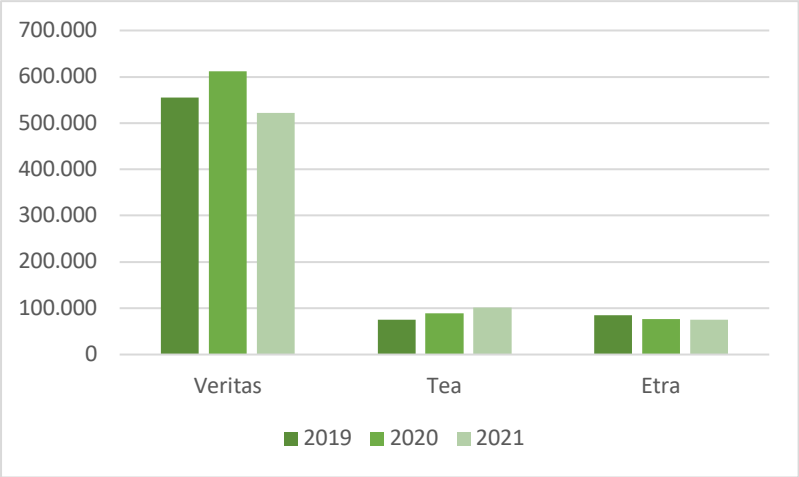

Figure 42 Waste generation of case study's companies over the years.

To provide a fair basis for comparison, waste collected by the companies is used as standardization factor. This enables a more equitable evaluation of each company's waste generation in relation to their waste collection efficiency. Upon standardization the waste generation data using waste collected as the factor, a new perspective emerges, as shown in Figure 43. Initially, it might seem that Veritas generates the most waste, implying a greater environmental impact. When the data is divided by the waste collected by the companies, this hypothesis is confirmed. The standardized data indicates that Veritas has a higher value compared to the other companies, reflecting lower efficiency in their waste management operations. It is important to consider certain factors in this analysis. Veritas owns a waste-to-energy plant, which results in waste generated from the ashes produced during the incineration of residual waste. Additionally, Veritas deals with a substantial number of tourists, contributing to a significant portion of their collected waste, classified as residual waste. The standardized waste generation value for Tea, when compared to Etra, suggests lower efficiency in its waste management operations. This finding is particularly significant when considering the environmental impact of waste generation. Tea appears to generated more waste in relation to the waste it collects, as indicated by the standardized data. This could be due to various factors such as less effective recycling processes or challenges in manages waste streams effectively.

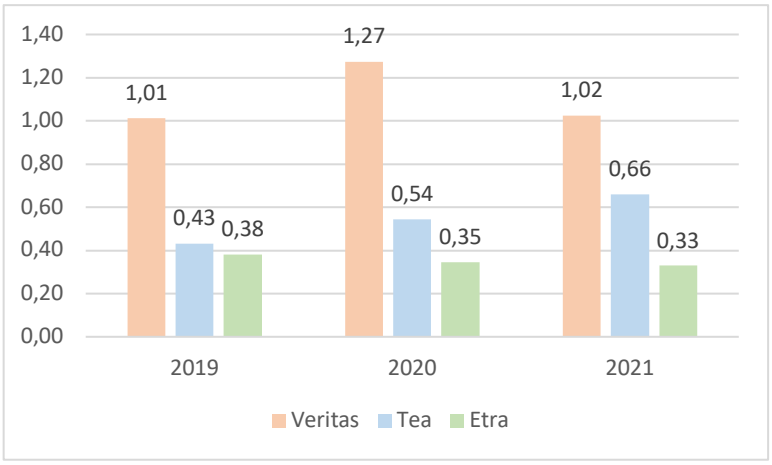

Figure 43 GRI 306-3 standardization by waste collected.

In summary, standardizing waste generation data using waste collected as a factor reveals that Veritas' waste generation is less efficient in comparison to the other companies. Tea appears to generate more waste in relation to the waste it collects. Therefore, the standardized waste generation data highlights differences in efficiency among the three companies, with Veritas, Tea and Etra exhibiting varying levels of effectiveness in managing their waste streams. This information is valuable for assessing and optimizing environmental practices within each organization.

5.3 Assignment of scores to the standardized GRI data

The assignment of the scores for each standardized data was conducted in a relative manner, comparing each company within the case study. This means that the scores are not intended to be absolute, but rather relative to other companies of the same industry. Indeed, the scores were assigned by systematically comparing the standardized data of each company. It is crucial to note that, at this stage of the case study, all disclosure data for each company had already been standardized to a common baseline, facilitating meaningful comparisons. Given that there were only three companies under scrutiny, scores were assigned on a scale of 1 to 3. In this context, a score of 3 was allocated to the company demonstrating the best performance, characterized by the lowest values in standardized data. This approach underlines the notion that superior performance is associated with lower energy consumption, emissions, water withdrawal, and waste generation, per unit of standardization factor. By awarding the highest score to the top performer, it was accentuated that a higher cumulative Environmental Score corresponds to better overall environmental performance. While this scoring approach initially results in a ranking among the studies companies, it is essential to recognize that, as detailed in

the next chapter, the assignment of scores takes on a different dimension when applied to a larger pool of companies beyond the scope of this case study. As depicted in the tables found in the subparagraph before, the score 3 was assigned to the standardized GRI data referring to the company with the lowest value, 1 to the data referring to the company with the highest value, and 2 the one in the middle between the two values. This was done for each standardized data for each GRI and company. The line score in the tables of paragraph 5.2 is the sum of all the scores obtained for the same GRI.

5.4 Calculation of GRI Data Scores and GRI Weighted Scores

In this step, a series of calculations took place to derive the weighted GRI scores for each selected indicator. Firstly, the GRI data score for each indicator was divided by the number of standardization factors (4). This computation yielded the average score obtained by each company for every standardization within each GRI Standard. Subsequently, the GRI weighted score was calculated by multiplying the GRI data score of each indicator, after it had been divided by the number of standardization factors, with the relative weight assigned to that specific indicator (the weights assigned to the GRI are: 302-1 0,20; 303-3 0,15; 305-1 0,25; 305-2 0,25; 306-3 0,15). The tables below report the weighted score for each GRI Standard for every year considered in the case study.

Table 37 Weighted score for GRI 302-1.

Weighted score			
302-1	Veritas	Tea	Etra
2021	0,30	10	8
2020	0,35	0,50	0,35
2019	2,00	2,50	1,50

Table 38 Weighted score for GRI 303-3.

Weighted score			
303-3	Veritas	Tea	Etra
2021	0,30	0,41	0,19
2020	0,26	0,41	0,23
2019	0,30	0,41	0,19

Table 39 Weighted score for GRI 305-1.

Weighted score			
305-1	Veritas	Tea	Etra
2021	0,56	0,25	0,69
2020	0,50	0,25	0,75
2019	0,56	0,25	0,69

Table 40 Weighted score for GRI 305-2.

Weighted score			
305-2	Veritas	Tea	Etra
2021	0,44	0,38	0,69
2020	0,50	0,63	0,38
2019	0,38	0,50	0,63

Table 41 Weighted score for GRI 306-3.

Weighted score			
306-3	Veritas	Tea	Etra
2021	0,19	0,26	0,45
2020	0,15	0,30	0,45
2019	0,15	0,30	0,45

5.5 Calculation of GRI Environmental Score

In order to derive the final GRI Environmental Score, the individual GRI Weighted Scores were consolidated. This was done by summing up the Weighted GRI Score obtained for each GRI Standard. At this point, since the scores given went from 1 to 3, the GRI Environmental Score was shown on scale 3. Therefore, for easier comprehension, clarity and easier interpretation, the score was transformed into a scale ranging from 0 to10. In this revised scale, a score of 10 represents the highest level of performance, while 0 represents the poorest. The tables below present the final GRI Environmental Scores for each company over the years, both on the original 3-point scale and the transformed 0 to 10 scale.

Table 42 Final GRI Environmental Score in 2021.

Total score			
2021	Veritas	Tea	Etra
Sum of weighted scores	1,79	1,80	2,41
Scale of 10	5,96	6,00	8,04

Table 43 Final GRI Environmental Score in 2020.

Total score			
2020	Veritas	Tea	Etra
Sum of weighted scores	1,76	2,09	2,15
Scale of 10	5,88	5,22	7,17

Table 44 Final GRI Environmental Score in 2019.

Total score			
2019	Veritas	Tea	Etra
Sum of weighted scores	1,79	1,96	2,25
Scale of 10	5,96	6,54	7,50

The GRI Environmental Score, as applied using the developed methodology, provides a comprehensive view of each company's environmental performance across various areas. It takes into account different factors, ensuring a balanced assessment even if a company excels in one aspect but lags in another.

In terms of energy consumption, Tea consistently obtained the best-weighted score each year, reflecting its strong performance in this area. Veritas, while occasionally matching Etra's performance, maintained a stable score over time in the energy consumption area.

Regarding water withdrawals, Tea consistently led the pack with the highest score, while Veritas secured a slightly lower score. On the other hand, Etra had a significantly lower score in this category compared to the other two companies, indicating room for improvement. However, Etra had the best performance in other GRIs which weighted more for their importance.

Emissions, both in Scope 1 and Scope 2, revealed interesting trends. Etra consistently outperformed the other companies in Scope 1 emissions, with Tea lagging significantly behind due to a very low score in this area. This discrepancy was reflected in the final GRI Environmental Score due to the high weight attributed to emissions, emphasizing the importance of reducing direct emissions in the waste management sector. Indeed, even though Tea had the best performance in water withdrawals and energy consumption, the weight of the GRIs corresponding to those areas was lower compared to the one of the emissions. Therefore, the low score in the emissions GRI outbalanced the high scores obtained in the other areas. Etra also scored well in Scope 2 emissions, further boosting its overall score compared to Tea and Veritas.

Waste generation once again showcased Etra as the leader, Tea as average, and Veritas with a notably lower score. Veritas consistently scored lower in all areas, especially in the waste one, which significantly impacted its final GRI Environmental Score compared to Tea and Etra.

In summary, the methodology's application allowed for an evaluation of these companies' environmental performance. While Veritas maintained a consistent score over time, Tea's score declined, and Etra saw an improvement in 2021. Each company's strengths and weaknesses were evident across different GRI standards and were reflected in the final scores, highlighting areas where they excel and areas needing attention.

It is important to emphasize the fact that the final scores assigned to the companies derive from the scores given to the standardized data. Therefore, the final scores are a reflection of how their standardized data compare to each other. In other words, these final scores demonstrate the environmental performance of the companies in relation to one another. For instance, if a company's score was higher in one year compared to the previous year, it does not necessarily indicate an improvement in its environmental performance. Instead, it could signify that the environmental performance of other companies has worsen, resulting in the scrutinized company receiving a higher score than in the previous year.

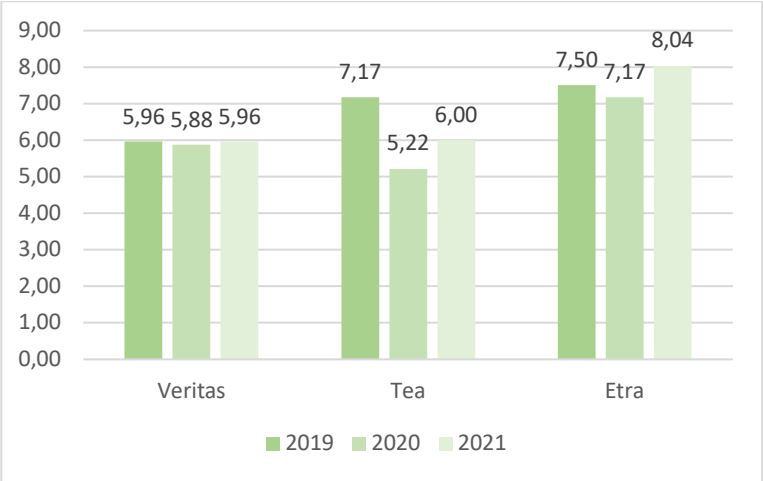

Figure 44 GRI Environmental Score over time

Chapter 6. Conclusions and perspectives

In today's global business landscape, an increasing number of companies are recognizing the importance of reporting information that extends beyond their financial performance. Many of these companies are choosing to adhere to the standards established by the Global Reporting Initiative (GRI). These standards bring many benefits which are hard to dispute, including enhanced transparency and the standardization of reporting practices across industries. However, sustainability reporting within the GRI framework also reveals certain limitations, most notably the absence of a comprehensive scoring system. As a consequence, these reports often fall short in providing a holistic view of a company's sustainability performance, limiting the ability to compare companies effectively. This limitation, in turn, hampers stakeholders' capacity to assess the real commitment of reporting companies towards environmental sustainability.

To bridge this existing gap, this thesis turned its attention to introduce an innovative solution that incorporates scores into GRI disclosures. The focal point was the development of a methodology designed to assign a GRI Environmental Score to reporting companies. This approach was tested through a real-world case study involving three companies operating in the waste management sector. The case study aimed to evaluate the methodology's effectiveness by analyzing actual corporate data, thereby offering insights into companies' environmental performance and the viability of the proposed approach.

The case study findings affirmed the hypothesis: examining GRI data disclosed by companies, without any standardization or relative information, showed challenges when attempting to assess which company was the most efficient and environmentally conscious in comparison to its peers. As elucidated in Chapter 5, Veritas initially appeared to have consistently utilized more resources compared to the others. However, a shift in perspective occurred when this was evaluated relative to the companies' dimensions and characteristics. By considering unstandardized data, it became apparent that the larger company consumed more resources. Yet, through standardization, these companies were placed on a level playing field for equitable comparison.

In the final GRI Environmental Score, Etra consistently emerged as the top performer each year. This was primarily attributable to its performance in the two GRI standards that carried the most weight in the final score. While Etra exhibited lower performance in other GRIs, this was offset by its superior standing in the more heavily

weighted standards. Veritas displayed a stable trend in its final scores over the years. Conversely, Tea, while obtaining favorable scores in numerous GRIs, struggled significantly in the GRI related to emissions, which carried substantial weight, thus impacting its final score.

This thesis not only introduces a pioneering concept to the field but also highlights the pressing need for GRI Standards to adopt a scoring system. At present, existing scoring systems tend to focus predominantly on economic performance relative to other dimensions of sustainability, sidelining environmental performance. Additionally, this research presents a tool for assessing a company's performance over several years, while the current practice is presenting data for only two years without standardization.

Despite these contributions, it is crucial to acknowledge the limitations of the method. In the case study, where only three companies were examined, score assignment in Step 5 of the application was largely a ranking relative to each other, lacking an absolute measure of performance. For example, in the case study it happened many times that the standardized data between the companies were very similar with one another. However, they were still classified as 1, 2 or 3, which clearly influenced the final GRI score. As shown in Table 23, where scores are assigned to the standardized data of GRI 302-1 for year 2020, the collected waste standardization data for example is very similar comparing all three companies. To enhance the method's validity, it would be beneficial to collect data from many more companies within the same sector, allowing for the establishment of performance thresholds for score assignment based on standardized values. For example, if a range for good, average, and bad performance was established, the similar standardized data in the case study would probably be categorized in the same range, giving different final score result than the method as it is now.

If the standardized data of thousands of companies was available, two approaches for the selection of the reference point/baseline could be used:

- Using the mean as reference point: essentially creating a division based on the central tendency of the data. Companies with standardized data above the mean would be considered "above average," while those with consumption below would be "below average." This approach would be useful when wanting to clearly distinguish companies that fall above or below the norm in terms of environmental data per characteristic of the company. However, it may not account for variability in the data. Some companies may have much higher or much lower consumption than the

mean, but this may not be clearly evident with an approach based solely on the mean.

- Using standard deviation as reference point: this approach could be more sensitive to data variability. For example, if you choosing a reference value equal to one standard deviation above or below the mean, the data dispersion would be taken into account. This approach would be useful when wanting to capture companies that significantly deviate from the mean and consider them "outliers." The number of standard deviations could be changed based on the selected tolerance for extreme data. For instance, choosing two or three standard deviations would make the evaluation more selective and include only companies with extremely high or low standardized data.

These approaches could also be combined. For example, selecting the mean as a reference point and include an interval based on standard deviation to identify companies that deviate significantly from the mean. This would allow you to capture both central tendency and significant deviations in the data.

Furthermore, the method exclusively considered the GRI environmental series, thereby neglecting the social and governance dimensions of sustainability reporting. A more comprehensive scoring system would consider GRIs from all three dimensions. Additionally, the method primarily concentrated on the total values within each GRI Standard, missing opportunities to delve into more specific GRI disclosure. For example, GRI 302-1 provides the % of renewable energy consumed. A more complete method would involve a way to assign a higher score to companies whom % in renewables consumption is higher. The same for GRI 303-3, since it discloses the % of areas at water stress. To refine the scoring system, it would be necessary to explore these and assign scores accordingly.

In conclusion, this thesis lays the foundation for the development of a scoring system that can be applied to GRI Standards. While the method exhibits limitations and areas for improvement, it emphasizes the necessity for GRI Standards to adopt a score-based approach, allowing for a more precise evaluation of companies' environmental performance and their progress over time. The famous quote by the management thinker Peter Drucker (2012) holds true: "You can't manage what you can't measure." Thus, introducing a comprehensive scoring system within GRI Standards is an imperative step toward managing and advancing environmental responsibility in the corporate world.

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