Discover Sustainability

Case Study

Green metrics: how are Brazilian universities doing?

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Abstract
Brazil is home to some of the world's most significant biodiversity, including vast portions of the Amazon rainforest. Universities are pivotal in leading environmental sustainability efforts within such a context, setting examples through their policies, research, and community engagement. Higher Education Institutions (HEIs) in Brazil, hubs for research and innovation, making them ideal places to develop, test, and refine new sustainability technologies and practices, are facing regulatory pressures to demonstrate their commitment to sustainability. By evaluating and publishing green metrics, Brazilian universities, like their counterparts in other countries, can set benchmarks for environmental performance, encouraging other institutions to adopt similar practices. There is a perceived need for research on green metrics at universities in Brazil, which may shed light on the factors that reflect their shift towards sustainability and environmental stewardship. Against this background, this paper outlines the status of the top 10 universities in Green Metric ranking located in Brazil. It provides some suggestions on how to improve the contribution of higher education institutions towards sustainability in a country that is both ecologically rich and diverse.

Keywords Brazilian universities · Green metrics · Sustainable development

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1 Introduction

The concept of UI Green Metrics refers to methods and indicators used to assess the environmental impact of processes, products, or activities. These metrics help quantify sustainability, vital for making informed decisions in environmental management, policy making, and product design. Green Metrics can be used in various fields, such as chemistry, manufacturing, energy production, etc. Many arguments support green metrics [1–3], as follows.

The first one is that green metrics ranking may help achieve energy efficiency since they measure the amount of energy required per unit of output [4]. Lower energy consumption for the same or increased output is typically seen as more sustainable. Also, they cater to the assessment of organisations' carbon footprint. Tools can be used to calculate the total greenhouse gas emissions caused directly or indirectly by activity or accumulated over the life stages of products or operations [4, 5].

The same applies to the water footprint. The amount of water consumed may be assessed, steering water-saving initiatives [6]. A further area is the waste generated by an organisation, assessing the volume and toxicity of waste produced within the institution [7]. Here, the impact of toxic substances (e.g., from labs) released into the environment may be measured, aiming to minimise the use of hazardous chemicals [2].

Implementing green metrics involves calculating the indicators above to provide a numerical value that reflects the environmental performance of an institution, process, or product. This approach helps organisations track improvements, comply with regulations, and communicate their commitment to staff, students, and external stakeholders [8, 9]. Figure 1 provides an overview of the items considered in green metrics.

Implementing green metrics in higher education offers many benefits, both for the institutions and for broader societal impacts [10]. For instance, by integrating green metrics into their operations and curricula, universities can educate students,

Fig. 1 Some of the items considered in green metrics in higher education. Source: Made by the authors, based on IPCC, SDG(s), and Criteria & Indicators—UI Green Metric. The colours represent the different dimensions of the UI Green Metric (together with discussions made in IPCC, SDG(s) and carbon print), that influence the environment of the Universities. Purple: represents the services in universities in all demands—from financial to educational. Blue: represents the actions in relationship with the SDG(s) (inclusive questions about carbon emissions). The SDG(s) must be applied in campus operations and curriculum. Green: represent climate and sustainable questions and your dissemination and communication with society. Pink: represents the events and purchases made in the Universities. These organisations must do these activities with sustainable concerns. Because this different notion contemplates the various dimensions that are necessary to universities achieve the aims of the UI Green Metrics. These notions are the result of the discussion in society and representative organs

academic staff, and operational staff about the importance of sustainability [11]. This awareness helps make all stakeholders more knowledgeable about environmental issues and more capable of making decisions considering long-term ecological impacts in the organisation. Also, green metrics help universities identify areas where they can improve energy efficiency, reduce water usage, and minimize waste. This not only leads to cost savings but also reduces the institution's environmental footprint [12–14].

Moreover, by adopting green metrics, universities can streamline operations and implement more sustainable practices across their campuses. This might include improving building efficiencies, optimizing waste management systems, or adopting greener technologies for heating and cooling [12–14].

One of the major arguments that also speak for green metrics is related to accreditation and ranking. Sustainability metrics are increasingly considered in university rankings and accreditation processes. Institutions that perform well in these metrics can improve their national and international standings, attracting additional attention and resources [15]. By integrating green metrics into their strategic plans, universities improve their own sustainability and contribute to global environmental goals, helping to educate and inspire future leaders in all sectors [13]. Additionally, the green metrics engage with not only environmental but also economic and social aspects of sustainability. While contributing to environmental aspects, accessing green metrics boosts economic resilience by fostering green industries and innovation [16]. Additionally, improving green metrics on universities ensure quality education in higher education relieving alleviating inequalities caused by difficulties in accessing education [17].

A growing body of literature shows that universities may not all universities walk the talk [18]. We can notice the absence of plans of action, accentuated by among other challenges in implementing green metrics in higher education [19]. These may impact the success and effectiveness of sustainability initiatives [18]. These challenges range from institutional to technical issues and understanding them can help institutions better plan and execute their sustainability strategies. One basic challenge is that implementing green metrics often requires initial investments in new technologies, infrastructures, and systems [19, 20].

In this vein, universities may face budgetary constraints that limit their ability to invest in these necessary upgrades, especially under economic pressures or funding cuts. Adequate expertise is crucial for effectively measuring, analysing, and implementing green metrics, but this is often not readily available. Universities may struggle with finding or affording staff knowledgeable in sustainability practices, or they may require additional training for existing staff, which also involves time and resources [21, 22].

Collecting and managing the data needed for green metrics can also be challenging. Institutions need robust systems to gather, store, and analyse data on energy usage, waste production, water consumption, and more. Implementing these systems can be complex and require significant technological support [5]. Another challenge is shifting an institution's culture to prioritize sustainability. This requires changing the behaviours and attitudes of students, academic staff, administration, and operational staff. This change is often slow and can be resisted, especially if it involves inconvenience or alterations to established routines [22, 23].

Given the gap in research, preliminary studies on university green metrics have found that there is a need for studies on this topic since the lack of coherent sustainability strategies with varying degrees of commitment and integration of sustainability principles into research, teaching, and operations [24]. According to the literature, universities have taken a piecemeal approach, implementing isolated "green" initiatives such as energy-efficient buildings or sustainability-focused courses, rather than adopting a comprehensive, institution-wide approach to sustainability [25]. Regarding Latin America region, green metrics are explored to assess campus sustainability performance [26], specifically, the Brazilian context has socio-political considerations that influence sustainability and green metrics in these institutions, such as economic inequality, access to resources or policy environment [27]. Evidenced by the gap in research from the academic literature, the social-political of Latin American countries, and the need to unveil the benefits of Green Metrics as a metric, this article had the objective of outlining the status of the top 10 universities in Green Metric ranking located in Brazil. To do so, we provide a thematic analysis of the institutional documents from 10 different institutions. The next section aims to enable discussion of the results obtained by providing evidence Brazil's context, history, and reasons why one should pay attention to this country.

2 Green metrics at universities in Brazil

University rankings related to sustainability are not just numbers; they are crucial tools for guiding university administrators to prioritise sustainable development actions. These rankings also help establish sustainability as a core institutional value and ensure that sustainability initiatives align with the institution's overall goals [15]. In 2017, the Green Metrics

ranking classified six hundred fifteen universities from 75 countries that chose to participate in the ranking model. The Green Metrics Index has been structured under six primary categories since 2016: Green Statistics, Energy and Climate Change, Waste Management, Water Usage, Transportation, and Education [12]. The ranking process involves the following steps: (i) gathering numerical data from universities worldwide, (ii) transforming the data into a unified score, and (iii) ordering the universities based on their scores. The rating system includes environmental, economic, and equity [28].

The rate at which universities undergo sustainability transformations varies significantly based on each institution's local context and capacity. Using internationally comparable indicators that are also meaningful at the local level can assist institutions in learning from one another and evaluating their progress. For instance, in 2021, the Times Higher Education (THE) Impact Ranking saw participation from over 1100 institutions in 94 countries, showcasing their contributions to the Sustainable Development Goals (SDGs) [18].

Recent research has examined the obstacles and hurdles to implementing environmentally friendly initiatives in various nations, particularly developing countries. It has been found that the main constraints in the advancement of eco-friendly universities in both developed and developing countries include a lack of relevant expertise, financial constraints, inadequate formal documentation, and the absence of a comprehensive framework for the development of environmentally friendly universities [29].

The obstacle undergoes Latin America countries. In relation to European context, there is a fragmented landscape presents a significant challenge in driving meaningful progress [25]. While European universities work on advanced research, disruptive innovation, community engagement and the disclosure of climate change [30], Latin America institutions play a prominent role in the development process, as it provides knowledge transfer through education, research and innovation [31]. Despite the Brazilian performance highlighted by unified health system, strengthening public institutions such as the National Foundation for Indigenous Peoples (Funai) and strengthening public policies to combat hunger [32], the socio-political context influences the adoption of sustainable practices. First, limited access to resources and funding makes implementing sustainable practices a significant challenge. Second, economic inequality leads these countries some paths behind once it has some challenges already overcome by European countries, e.g., extreme hunger and poverty. Nevertheless, Brazilian universities had the opportunity raise Education for Sustainable Development (ESD) among the population. ESD equips students with the knowledge and skills to initiate sustainable development projects. Therefore, universities should educate and lead by example in promoting SD [33]. In addition to producing and sharing knowledge, universities can promote learning that fosters the complex behaviours and decisions necessary for SD. This learning approach should embrace a global perspective of future-oriented responsibility and a participatory, prejudice-free process [34].

Recognising that universities are recognised as vital centres within cities for fostering innovation and environmental education, offering a valuable opportunity to drive generational behavioural change towards more sustainable lifestyles, next, we describe the methods conducted to unveil the research objective.

3 Methods

3.1 Case descriptions

This study comprehensively analysed the 10 Brazilian institutions based in UI Green Metrics Ranking—Table 1. These institutions were selected because the ranking's rigorous evaluation process, which includes detailed scoring and ranking criteria, ensures that they represent the diversity and quality of Brazilian higher education institutions.

Table 1 shows an overview from the cases selected. We provide the name of university, the logo, number of students enrolled available on the website or document analysed, the status – in Brazil, public education offers free access, while private education requires payment for enrolment -, the ranking Brazil and world, and finally the total score 2023. We can notice that the number of students decreases depending on the universities position in the ranking, except Federal Universiy of Itajubá and Facens University Center cases. The cases analysed are initially explained, putting the institutional settings into context to understand the actions and activities related to environmental sustainability practices.

The University of São Paulo (USP) was founded in 1934 and is recognised worldwide as one of the most important universities of Brazil. It develops undergraduate and graduate courses, research, extension activities and projects for community connection. USP has eight sites in cities of the state of São Paulo, 333 undergraduate courses, 264 graduate courses, 4 museums and four hospitals. Regarding the number of students, USP has 60,000 undergraduate

Table 1 Ranking of the Brazilian universities in the UI green metrics ranking

University	Logo	Number of Students	Status	Ranking GMU Brazil	Ranking GMU World	Total Score 2023
University of Sao Paulo		97.000	Public	1	8	9425
Federal University of Lavras		13.100	Public	2	40	8750
Federal Institute of Education, Science and Technology of the South of Minas Gerais		29.180	Public	3	64	8575
University of Campinas		34.652	Public	4	73	8550
Federal University of Mato Grosso do Sul		23.088	Public	5	74	8525
Federal University of Viçosa		20.356	Public	6	184	7925
Federal University of Itajubá		7.328	Public	7	194	7975
University of Vale do Taquari		12.690	Private	8	204	7800
Facens University Center		4.000	Private	9	213	7725
University Center of Rio Grande do Norte		5.000	Private	10	239	7585

students and 37,000 graduate students. Since the 1990's USP develops environmental sustainability projects in its campuses. Currently, it's [35] develops several ecological activities to support the community about environmental sustainability.

Founded as an institute, Federal University of Lavras (UFLA) became a federalized university in 1994, with agricultural sciences as the focus of its activities. As this institution has matured, it has also consolidated in the areas of exact, humanities, and health sciences, covering undergraduate, postgraduate, and extension practices in a multi-campus structure. There are more than 13,000 students in 35 undergraduate courses and 54 postgraduate programs.

The university directs its actions regarding sustainability initiatives through objectives and strategic guidelines in its [36]. The documents clearly demonstrate that environmental sustainability is an influential element in UFLA's activities, especially when it involves structure, the environment, and society. The institution also offers the possibility of consulting

its sustainable objectives and initiatives in Excel format. As a result of this concern, UFLA was the second university in the world to receive the Blue University certificate, being recognized as a practitioner of the rational use of water resources.

Created in 2008, Federal Institute of Education, Science and Technology of the South of Minas Gerais (IFSULDEMINAS) presents undergraduate, technicals, and graduate programs in its eight campuses. The IFSULDEMINAS mentions its contribution to sustainable development in its mission. In the [37] of 2024–2028, the institute presents as a strategic objective the expansion of activities towards sustainability.

The University of Campinas (Unicamp) was founded in 1966 and presents 66 undergraduate and 153 graduate courses, besides extension activities, research, and projects for community connection. In total, Unicamp has 34,652 students enrolled in its three campuses (Campinas, Limeira and Piracicaba). Unicamp considers the 17 Sustainable Development Goals (SDGs) since its [38] of 2016–2020. However, it was in the strategic plan of 2021–2025 that the university linked each strategic objective with the SDGs.

With the mission of developing and socializing knowledge, training qualified professionals for the transformation of society and the sustainable growth of the country, Federal University of Mato Grosso do Sul (UFMS) has approximately 37,000 students, of which 25,000 are enrolled in undergraduate courses and 12,000 in postgraduate courses. Originating in 1962 with the creation of the Faculty of Pharmacy and Dentistry of Campo Grande, the university was federalized in 1979 [39].

Sustainability is one of UFMS's core values, and the Sustainable Development Office is responsible for coordinating and articulating sustainability actions within the university. The UFMS Sustainable Logistics Management Plan [40], an instrument that assists in the sustainable management of the Institution, was built collaboratively and in line with the SDGs, and covers eight thematic axes: consumables; energy efficiency; water efficiency and wastewater; solid waste; quality of life in the workplace; sustainable purchases, works and contracts; personnel displacement; and socio-environmental education.

Federal University of Viçosa (UFV) is a university located in the state of Minas Gerais and is one of the oldest in Brazil, at 98 years old. Its historical vocation was linked to courses in the agricultural sciences, but in its contemporary context, it has become a multi-science university in teaching, research, and extension. With its multi-campus structure, offers 69 undergraduate courses and 50 postgraduate programs, and high school and technical education. There are more than 20,000 students and more than 65,000 graduates.

UFV's sustainability guidelines are set out in its [41] and [42]. The main items covering this issue are in the planned strategic institutional objectives and action plans. The institution also offers interactive dashboards using Power BI, with information on sustainability initiatives.

Federal University of Itajubá (UNIFEI) with its 110 year history, has its mission based mainly on technology and engineering. It works on a multi-campus basis in the state of Minas Gerais. It has more than 6500 undergraduate students enrolled in its 35 courses. With its 23 programs, it has almost 800 students enrolled in postgraduate studies. The university stands out in terms of extension, offering technological and business extension, with more than 100 active projects.

In terms of sustainability, UNIFEI'S actions are mainly in the [43], which describes programs, objectives, and institutional goals. At the IDP, sustainability is linked to the planning of the university's various sectors, units, and pro-rectories. The management and sustainable logistics plan also include initiatives to achieve appropriate sustainability practices. A digital sustainability report from UNIFEI is also available.

Located in the state of Rio Grande do Sul, in the city of Lajeado, University of Vale do Taquari (UNIVATES) has approximately 12,000 students. It was founded in 1964 and currently offers, among other modalities, 58 undergraduate courses and 33 postgraduate courses. In terms of sustainability, the university stands out in the Green Metrics Ranking among institutions located in the southern region of the country. In its Institutional Development Plan (IDP), social responsibility stands out as one of its guiding principles, based on the Sustainable Development Goals [44].

Founded in 1976, Facens University Center (FACENS) is in Sorocaba, São Paulo. It is considered a non-profit Federal Public Utility entity, certified as philanthropic by the Ministry of Education. With this, it grants scholarships to its students with proven socioeconomic needs and invests all its results in favour of the Institution. In 100 thousand m^2 of campus, more than four thousand undergraduate and postgraduate students have access to technological infrastructure, interactive classrooms, a modern and updated library and a sports area. As a reference for innovation, Facens has more than 60 specialised laboratories and several partnerships with renowned national and international companies. Sustainability is one of the main pillars and values of the institution.

In northeastern Brazil and stands out in the region, University Center of Rio Grande do Norte (UNI-RN) it is ranked tenth in Green Metrics Brasil. The university offers 13 different graduation courses to more than 5000 students. In university IDP, social responsibility is part of the [45] at the strategic actions from 2021 to 2025. This appears in the local impact

as it carries out research and extension focused on understanding the issues of the state in which it operates. UNI-RN is committed to building knowledge that contributes to the reduction of social, economic and environmental problems and it is disseminated through debate forums, scientific initiation congresses, workshops, publications and other means, which aim to communicate with the external public.

We conclude this section with a cross-case analysis of the universities selected, organised by criteria provided by Green Metric ranking. First, Education and Research, while FACENS emphasizes applied sustainability technology projects, USP, UNICAMP, and UFV lead with extensive sustainability-focused research outputs and curricula integration. Second, Energy and Climate Change, smaller institutions (e.g. UNIVATES, UNIFEI) focus on solar energy and local renewable solutions while the bigger ones (e.g. USP, UNICAMP) have advanced renewable energy systems and carbon neutrality goals. Third, Waste, larger institutions struggle with scale-related complexities while lower institutions invest in organic waste composting and recycling partnerships. Fourth, Settings and Infrastructure, on one hand, newer institutions (e.g. FACENS) focus on smart and compact infrastructure, on the other hand, older institutions (e.g. USP, UNICAMP) showcase green building certifications and efficient campus designs. Fifth, Water, universities located in the interior of Brazil (e.g. UFV, UFLA) demonstrate strong rainwater harvesting and irrigation efficiency programs reflecting agricultural expertise, still universities based in big cities innovate in wastewater reuse. Finally, Transportation progresses differently. In big cities, universities promote active and public transportation, while countryside universities (e.g. IFSULDEMINAS) face logistical challenges, even so, invest in community-based transport solutions. We conclude by saying that the age and location of universities influence sustainable practices. Overall, while larger institutions lead in infrastructure and systemic research, smaller universities excel in regional, applied sustainability practices.

3.2 Data collection and analysis

Employing a case study methodology facilitates a profound understanding of the subject matter, thereby fortifying the analytical insights derived from the research [46]. Following the selection of these case studies, a document analysis of the institutional documents was conducted. The documents were primarily sourced from the official websites of the respective institution. This methodological approach was chosen due to its efficacy in systematically investigating pre-existing documents to extract valuable information and insights, fostering a profound understanding of the subject matter [47].

The key documents subjected to analysis included the institution's Institutional Development Plan (IDP), Sustainability Reporting (SR), and Sustainable Logistics Plan (SLP). Each document provided unique insights into the university sustainability initiatives and practices. Table 2 has more information about the data collection.

In conducting the document analysis qualitative content analysis approach was employed [51]. This approach involved deductive analysis, drawing from the framework outlined in the UI GreenMetric Methodology, structured under six primary categories since 2016: Green Statistics, Energy and Climate Change, Waste Management, Water Usage, Transportation, and Education. The analysis process was facilitated by the utilization of the ATLAS.TI software, version v.24, which provided a structured platform for organizing and analysing the vast amount of qualitative data. The analysis was a dynamic process where researchers interact with institutional documents and qualitative interpretation, showed by Fig. 2.

In summary, the analysis process was made by the iterative process of moving back and forth between institutional documents and qualitative analysis based on looking for citations regarding Green Metric Methodology – the criteria. The criteria to code a citation under each code group was the connection with the code group, by describing a plan, objective, indicator or action. The analysis aimed to outline the status of green metrics among universities in Brazil. Next, we provide the results.

4 Results

ATLAS.ti software was used for co-occurrence analysis between groups of codes to "find codes that co-occur in the margin area" [52]. The code groups were formed deductively from GreenMetric Methodology and named. From this tool, we created the graphs present in this research with the support of Microsoft Excel software. Codes with zero occurrences were discarded in all results. Table 3 presents the codes, their descriptions, and the codification number.

In Table 3 we highlighted the six criteria from Green Metrics, understood as a code group in the analysis. We can point out that there is the predominance of the Education and Research code, with 103 quotations. The result is expected since the main objective of university is to provide quality education. To turn it evident, we mention.

Table 2 Details of documents used as secondary data

University	Documents		
	Institutional Development Plan (IDP)	Sustainability Reporting (SR)	Sustainable Logistics Plan (SLP)
University of Sao Paulo (USP)	■		
Federal University of Lavras (UFLA)	■		
Federal Institute of Education, Science and Technology of the South of Minas Gerais (IFSULDEMINAS)	■		
University of Campinas (UNICAMP)	■	■	
Federal University of Mato Grosso do Sul (UFMS)	■		■
Federal University of Viçosa (UFV)	■		■
Federal University of Itajubá (UNIFEI)	■		■
University of Vale do Taquari (UNIVATES)	■		
Facens University Center (FACENS)		■	
University Center of Rio Grande do Norte (UNI-RN)	■		
Total of documents	14		
Total number of pages	1.932		

USP: Date Document—IDP: 2012, 45 pages. UFLA: Date Documents—IDP: 2022, 202 pages. IFSULDEMINAS: Date Document—IDP: 2023, 264 pages. UNICAMP: Date Documents—[48]: 2020, 80 pages. SR: 2020, 25 pages. UFMS: Date Documents—IDP: 2023, 202 pages. SLP: 2022, 97 pages. UFV: Date Documents—IDP: 2023, 205 pages. SLP: 2021, 121 pages. UNIFEI: Date Documents—IDP: 2023, 440 pages. [49]: 2021, 49 pages. UNIVATES: Date Document—IDP: 2022, 58 pages. FACENS: Date Document—[50]: 2022, 44 pages. UNI-RN: Date document—IDP: 2021, 223 pages.

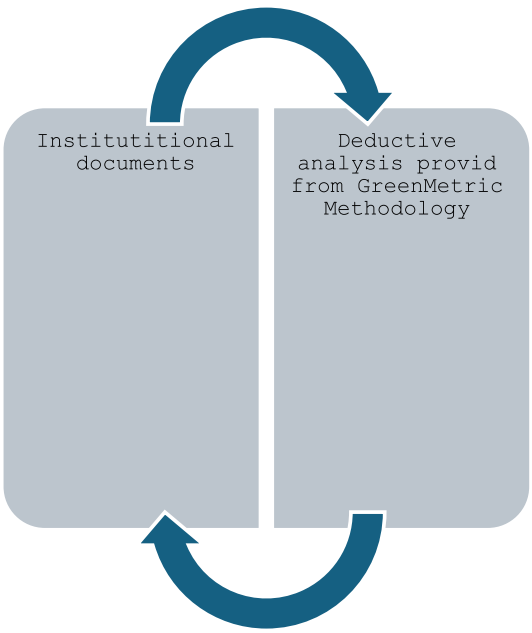

Fig. 2 Analysis process conducted

Promote the consolidation and sustainability of courses, with the Sectoral Administration Units paying attention to monitoring course performance indicators, which support justifications for proposing the creation and/or suspension of courses with a focus on the longevity and sustainability of courses and the expansion of the number of students[40].

Continuing, the results show a strong concern about Energy and Climate Change (65 quotation). Not only the number of quotations that evidenced this, as well as the following quote:

> *Adopt measures to combat climate change and its impacts; Integrate measures to combat climate change into university policies, strategies, and planning; Promote mechanisms for creating capacities for planning related to combating climate change and effective management focusing on women, young people, and local and marginalized communities.* [38]

The citation led us to argue that Brazilian universities are taking attention into transition to renewable energy sources, monitoring systems and promoting educational programs regarding climate science. In contrast, Transportation code is the least evident in the codifications, demonstrating a gap in practice to be filled. Some studies show us that Latin America, especially Brazil, faced a relevant challenge regarding new alternatives for urban mobility and innovation for sustainable transportation [53, 54]. The lack of practices in this criterion can be understood by this point of view.

The results shows that Brazilian universities are working forward to improve practices related to Waste and Settings and Infrastructure (58–49 codes, respectively). Some actions can be highlighted. In relation to Waste, there is a search for the implementation of selective collection systems, as well as training for employees and students on the correct management of waste – e.g. UNICAMP. In relation to Settings and Infrastructure, we highlight the implementation of solar power plants and the installation of cisterns for collecting rainwater—e.g. IFSULDEMINAS.

Next, we present Fig. 3 presents the occurrence between the codes from Table 3 and the documents analysed from Table 2.

We can point out that Energy and Climate Change criteria stands out after Education and Research. For example, IFSolar, action from IFSULDEMINAS, provide photovoltaic plants for solar energy generation on campuses, organic food production, and investment in information technology for the stability of basic resources such as electricity, air conditioning, and communication, among others. UNIFEI has highlighted the same topic, having actions on the creation of the Internal Energy Conservation Committee, which seeks to diversify the energy matrix on campus, use natural light, adapt the lighting system, and expand lighting circuits.

Waste stands out as well. Some actions can be noticed, such as: (*i) UFMS—Action It's Your Business, a program that proposes reducing water consumption and waste; (ii) UNIFEI—Adoption of the eight R's in all processes and (iii) UFV—the action of the electronic information system to process actions related to material inputs and services.* On the other hand, Water and Transportation are the codes with the least impact on the results obtained, leaving a gap in university practice to be explored. We highlighted some quotation. In relation to Water, IFSULDEMINAS stands out with "IFPLUVIAL Project", which aims to *implement or adapt, in all nine IFSULDEMINAS units, rainwater collection, storage and use systems in order to use it for cleaning external areas, irrigation, animal facilities, preserving hydro-sanitary conditions and in the technical reserve for fighting fires*. In relation to Transportation, we highlight some actions as installation of bicycle parking, expansion of internal roads, access ramps, cycle paths, crossings, bus stops, parking and external sidewalks.

5 Discussion

The UI GreenMetric Ranking calls universities to adopt conscious and sustainable education and research practices. The sample showed that most Brazilian universities perceive their role as educating for the future, bringing to the market professionals capable of dealing with environmental problems in other organizations and in society [55]. To achieve this, as mentioned in the documents analysed, future graduates need to be educated about sustainability principles and behaviours, as also referred to by [12]. The evidence allows us to verify that the universities analysed are concerned about training professionals' conscious of environmental sustainability. The term "sustainability" is recurred in the universities' values. UFV, for example, used the argument that "*sustainability now plays a central role in the value generation chain*" [41, p. 65]. This concept of value generation, explicitly or implicitly, was present in most of the university documents, with the understanding that the results generated in teaching (education) and research should be linked to environmental awareness and sustainable management. The inclusion of environmental education in the Pedagogical Projects of the courses was mentioned repeatedly in the IDP(s) of UFV, UFLA, UNIFEI, UFMS, USP and Unicamp.

The idea of contextualizing universities as "small cities" [56] leads to recognition of the impact of their activities on the environment and society, showing the importance of planning for sustainability. The most implement green campus practices, one of the first initiatives to become sustainable universities [57]. In this regard, the evidence shows that Brazilian institutions participating in UI Green Metrics are formally committed to aspects primarily related to Energy and Climate

Table 3 Code groups

Group	Description	Quotations
Education and Research	This criterion is based on the idea that universities have an important role in creating a new generation's concern with sustainability issues	103
Energy and Climate Change	The university's attention to the use of energy and climate change issues takes the highest weighting in this ranking. In our questionnaire, we define several indicators for this particular area of concern, i.e. energy efficient appliance usage, renewable energy usage policy, total electricity use, energy conservation program, green building, climate change adaptation and mitigation program, and greenhouse gas emission reductions policy. With this indicator, universities are expected to increase the effort in energy efficiency in their buildings and to learn more about nature and energy resources	65
Waste	Waste treatment and recycling activities are major factors in creating a sustainable environment. The activities of university staff and students in campus will produce a lot of waste, therefore some programs and waste treatments should be among the concern of the university, i.e. recycling program, toxic waste recycling, organic waste treatment, inorganic waste treatment, sewerage disposal, policy to reduce the use of paper and plastic in campus	58
Settings and infrastructure	The campus setting and infrastructure information will give the basic information of the university's policy toward a green environment. This indicator also shows whether the campus deserves to be called a Green Campus. The aim is to trigger the participating universities to provide more space for greenery, safeguard the environment, and develop sustainable energy	49
Water	Water use on campus is another important indicator in Greenmetric. The aim is for universities to decrease water usage, increase conservation programs, and protect the habitat. Water conservation programs and piped water use are among the criteria	24
Transportation	The transportation system plays an important role in the university's carbon emissions and pollutant levels. A transportation policy to limit the number of motor vehicles on campus and the use of campus buses and bicycles will encourage a healthier environment. A pedestrian policy will encourage students and staff to walk around campus and avoid using private vehicles. The use of environmentally friendly public transportation will decrease the carbon footprint around campus	18

*Description provides from green metrics website

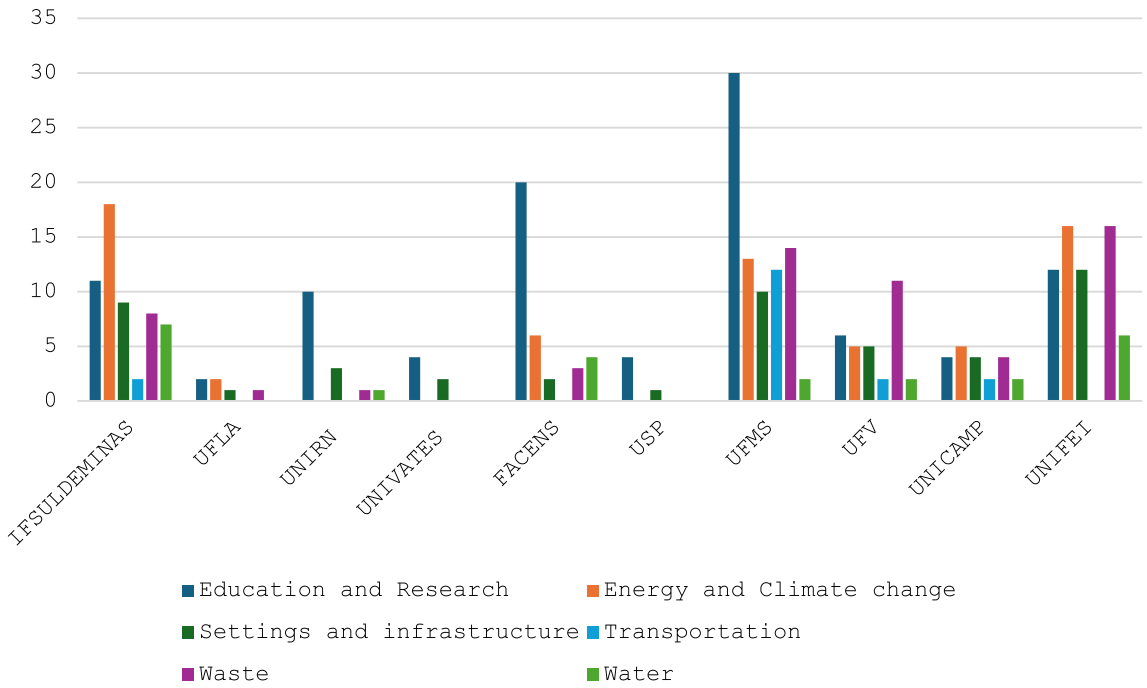

Fig. 3 Universities in each one of the six criteria from green metrics ranking

Change, Waste, and Settings and infrastructure. Some of these practices involve disclosing information about indicators on water use, energy, emissions, waste, and transport [58], which were also observed in the institutions from the sample.

It is important to mention that Brazil has solid and recognized legislation on environmental issues, such as the National Solid Waste Policy [59], which has brought the country a series of innovations in solid waste management. Similarly, the new Bidding and Contracts Law [60], establishes the Sustainable Logistics Master Plan, which should guide the preparation of annual contracting plans for all bodies and entities of the direct, autarchic and foundational federal public administration. Previous studies have already demonstrated that pressures from external legislation and decrees have the greatest influence on organisations' behaviour when adopting sustainable practices [61]. This also happens in the university context. As seven of the 10 universities in the sample are public and linked to state or federal administration, it is reasonable to assume that this legal scenario could have implications in this result.

The disparities between code groups regarding their green metrics performance may be understood by the structural and cultural challenges and the limitations of the ranking, as follows. At first, we need to highlight that Water and Transportation are the areas that call for more active involvement of the university in the sample. The literature states that the biggest challenge for universities is to implement sustainability holistically in their operations and structure so that it goes beyond isolated practices on campus [58, 62]. Brazil faces structural and cultural challenges. For instance, these gaps in Transportation exist why Brazil faced a challenge related to new alternatives for urban mobility, even though innovation for sustainable transportation [53, 54]. Another example of gaps, now related to Water, is why Brazil is the host of big rivers and there is low knowledge about the rational use of water. In this vein, there is a lack of concern about water management [63]. These structural and cultural challenges prevent a more comprehensive approach to sustainability.

Second, the disparities between code groups regarding their green metrics performance may be understood by the limitations from the ranking. The first reason is that the data is self-reported, that is, data for evaluation is provided peer which university, there is no audit to validate the information provided. In this sense that we find a second limitation: The ranking criteria are interpreted by the universities and may not be specific enough for the managers to interpret. Finally, the Green Metric had voluntary participation and is popularly known in the Asian region. This fact may cause a regional bias, especially in the formulation of ranking criteria.

Thereat, when we compare the participation of Brazilian universities in the UI Green Metrics editions to the total participation of other institutions worldwide, we can see that it is relatively low. The timid participation of Brazilian universities in the ranking may reinforce the need for greater publicity by the UI Green Metrics in Brazil. This position also raises the question of whether Brazilian institutions are interested in participating in global sustainability rankings such as UI Green Metrics or THE Impact Ranking, given the predominance of Asian and European countries in recent editions. This

opens the discussion for the "globalization versus. localization" of the metrics applied. The regional and institutional differences may interfere the practices of the universities, turning the Green Metric score [64] once the criteria were made to a specify region of the world. How flexible the metrics is to address the particularities of such distinct universities and countries in the world is a challenge to be faced by the ranking managers, by doing collaborative construction of the criteria [13]. We argue saying that the ranking need to improve promotion of adhering the ranking and call universities to discuss the criteria analysis to enable accessibility from other global regions.

In synthesis, the university sustainability rankings can be a good driver of sustainable practices, but they should also stimulate creativity and consider the diversity of the different institutions that participate. In this sense, universities can better engage with Green Metrics or leverage by going far beyond just meeting targets to achieve good ranking positions. It is necessary to reflect on this role, its real contributions, and the meaning of being a sustainable university. Universities in Brazil would better engage with Green Metrics or leverage in fostering curriculum and broader operational polices, with course content, research priorities and operational procedures. Also, managers can improve sustainability measures—sustainability initiatives as part of green metrics require long-term commitment, but the results may not be immediately visible. Continuous monitoring and adjusting strategies are necessary, demanding ongoing dedication and resources [33]. Addressing these challenges requires strategic planning, resource allocation, and a commitment to long-term goals. Success in overcoming these obstacles often hinges on strong leadership, community involvement, and a clear vision of the benefits of sustainable practices [11, 65]. This requires a thorough understanding and the ability to update their practices to meet evolving standards constantly [66, 67].

6 Conclusion

This article aimed to outlines the status of the top 10 universities in Green Metric ranking located in Brazil. The general conclusion is that the Brazilian universities are committed to "Education and Research", "Energy and Climate Change", and "Waste". In this sense, other developing countries around Latin America could learn from Brazilian case. We point out some benchmarks. First, UNICAMP is training for employees and students on the correct management of waste. Second, we highlight the implementation of solar power plants and the installation of cisterns for collecting rainwater—e.g. IFSULDEMINAS. Third and last example, UFMS—Action It's Your Business, it is a program that proposes reducing water consumption and waste.

However, there are still many opportunities for improvement. Starting with the publication of sustainability reports, among the ten, only two disclose the document to society. In the analysis of the co-occurrence of words, codes "Education and Research", "Energy and Climate Change", and "Waste" were highlighted, evidencing how it can still evolve in general on other fronts such as "Settings and Infrastructure", "Water" and "Transportation". It is important to reinforce that the sample have interesting practices separately, and the exchange of experience between these institutions could mean synergistic gains.

Brazilian universities can address the gaps identified in green metrics performance in several ways. First, regarding "Water", implementation of water systems to combat water loss and basic sanitation it is essential to address the Water criteria. Second, improvements on infrastructure will facilitate "Settings and Infrastructure" and "Transportation" criteria. There is a need to update the campus around Brazil evidenced by this low engagement at codification process. Third, training faculty to address SD in practice once they are the right wing with university practice.

The information presented here can greatly contribute to the debate on how universities can evolve towards SD; of course, it is worth remembering that our sample was restricted to ten universities, and the information was collected through a documented analysis, which can be characterized as a research limitation. Also planning documents does not directly imply that the actions described are being implemented as planned. Implementation may be more, less or over a longer period than planned. In this sense, Future studies can overcome this challenge by applying different data collection methods, such as surveys or interviews with managers. Finally, future studies may carry out in local contexts, to obtain details on the sub-themes presented here: Education and Research", "Energy and Climate Change", "Waste", "Settings and Infrastructure", "Water" and "Transportation".

Author contributions W.L.—idealization; introduction section and Fig. 1. R.B. and O.Q. —theoretical reference. W.L., R. Bichueti., I. R., A. B.J., G. L., L.T.—method idealization. R. Bichueti.; I.R.; L.T., A.B.J.—data collection. G.L.—analysis in ATLAS.ti; results; review; submission. W.L., B.G.—discussion section. W.L., R.A.- conclusions.

Data availability We declare that the secondary data used in this study is described in Table 2, present in the main document submitted to the journal. We guarantee that QDPX (archive) provided by ATLAS.ti is available from the corresponding author upon request.

Declarations

Competing interests The authors declare no competing interests.

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