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The meaning of green campus in UI GreenMetric World University Rankings perspective

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Abstract

The higher education institution sector has recently been recognized as an influential hub for sustainability innovation and education by considering the most critical sustainability challenges. It represents an invaluable chance to facilitate the essential generational change towards a more sustainable approach in life. Universities provide innovative approaches to sustainable development by pushing the envelope of practice and exploring new frontiers of knowledge. Furthermore, these institutions pave the way for breakthroughs and trend-setting findings to be transitioned to other implementations within the built environment; hence, communities become capable of learning and gradually developing the culture of sustainability. On a global scale, numerous universities have embarked on missions to create green campuses, known as a way to seek sustainability initiatives in universities. This research aims to expose the definitions and parameters of the green campus approach from the viewpoint of UI GreenMetric World University Rankings as one of the assessment tools specializing in evaluating green campus initiatives. This research shows that the GreenMetric functions as a guide which encourages universities to integrate sustainable development into their practices; since its categories are devised following sustainable development goals. In this research, the green campus approach is defined through investigating the GreenMetric approach regarding sustainability on university campuses by clarifying the reasons for its categorization that encompasses all university dimensions, including education, research, operation, outreach, assessment, and reporting. The study is conducted through an integrated review of literature focusing on higher education institutions' sustainability to investigate the green campus concept's historical, contextual, and evolving nature.

1. Introduction

The critical challenges of sustainable development movements have challenged the agendas of governments, organizations, corporations, and institutions, including higher education institutions (HEIs), to be aware of their sustainability responsibilities. Changing individuals' and organizations' mindsets takes a long-term effort at all levels, so HEIs are recognized as drivers of achieving a bright sustainable future through a paradigm shift. That is to say, HEIs' prominent role in the enhancement of sustainable development has become certain (Corcoran & Wals, 2004; Disterheft et al., 2013; Lukman & Glavic, 2006; Thomashow, 2014). Universities and colleges, as the educators of the majority of society's leaders, are profoundly responsible for raising awareness, knowledge creation, technological advancement, innovations, and tools required for a sustainable future (Wright, 2002; Clarke & Kouri, 2009; Bettencourt & Kaur, 2011; Thomashow, 2014). Therefore, it is a moral responsibility of HEIs to increase public awareness of sustainability and to cope with barriers of environmental, social, and economic developments as they are capable of influencing sustainable development advancement (James & Card, 2012; Filho et al., 1996; Cortese, 2003).

Several authors contended that universities are laboratories to practice sustainability initiatives (Shriberg & Harris, 2012; Verhoef & Bossert, 2019). In this sense, a university campus can be a research center not only to implement environmental projects but also to build up the knowledge and skills in students leading to profound changes and, consequently, to adopt sustainable behavior in their own lifestyle (Shriberg & Harris, 2012; Tukker et al., 2008; Jackson, 2011). Universities are essential transformational sites, as they are known as centers of discourse, education, and innovation. Therefore, they are living laboratories allowing teaching, learning, and research within a system known as a model for the community beyond the university (Filho et al., 2019). Since "Higher education has unique academic freedom and the critical mass and diversity of skills to develop new ideas, to comment on society and its challenges, and to engage in bold experimentation in sustainable living" (Cortese, 2003, 17).

Accordingly, universities pave the way for breakthroughs and trend-setting findings to be transitioned to a range of other applications within the built environment; hence, the communities can learn and gradually develop a culture of sustainability in the long run. In this regard, as leaders in research, education, and innovation, they are important places to address global issues and encourage progressive action within current and future generations (Moore, 2005; Clarke & Kouri, 2009). There is no sustainable world if universities do not promote sustainability (M'Gonigle & Starke, 2006). Moreover, "…no institutions in modern society are better situated and more obliged to facilitate the transition to a sustainable future than colleges and universities" (Orr, 2002, 96).

Seeking sustainability at universities is possible by creating green campuses. It should be noted that the terms green campus and sustainable campus are used interchangeably; studies in literature covering sustainability in HEIs used both terms. It is worth noting that although green and sustainability, especially in respect to university campuses, encompass the same scopes in studies, they differ to some extent. Based on the study done by Yanarella et al. (2009), who asserted that sustainability distinguishes itself from green in that, conceptually, the latter focuses on one of the pillars, namely environmental or economic, while sustainability balances on three pillars: environmental, social and economic known as "triple bottom line" (Elkington, 1999). The authors continued that the significant difference between these two terms lies in the scope and scale they operate, which does not necessarily mean that green operates on one pillar or dimension without considering the more extensive system (Yanarella et al., 2009). Therefore, to eliminate ambiguity concerning these terms, the scope and scale need to be determined, particularly in research studies. Since this study reviews green campus's meaning in the GreenMetric perspective, and the rankings system with its presented domains clarifies focuses on all three pillars of sustainable

development in university campuses, and the campus itself embeds an extensive system, the term green campus is used throughout the study as a holistic and multidisciplinary term embracing different, however, connected aspects.

The green campus concept is a more recent field of study, and there has been a mounting demand for transforming university campuses into green campuses. Consequently, numerous Universities have begun to figure out and act upon their sustainability responsibilities by implementing policies in their practices to fulfill sustainability ambitions (Johnston, 2012; Swearingen White, 2014). Indeed, universities have commenced following up on sustainability ideas in their strategies and trying to initiate actions to thwart the adverse impacts on the environment (Ceulemans et al., 2011; Lozano et al., 2015; Shephard & Furnari, 2013). On the way to achieving a green campus, HEIs' sustainability assessment tools play a crucial role. They guide in respect to the domains where sustainability initiatives need to be applied; moreover, they are platforms for self-evaluation and dissemination of the latest knowledge and information regarding green campus implementations. As one of the HEIs sustainability assessment tools, the GreenMetric, which is specialized in evaluating green campus initiatives, has encouraged universities to integrate sustainable development into their practices by guiding universities to apply sustainability initiatives within specific domains, including Setting and Infrastructure (SI), Energy, and Climate Change (EC), Waste (WS), Water (WR), Transportation (TR), Education and Research (ED); each category consists of indicators and criteria with apportioned points that demonstrate their importance.

Accordingly, this study reviews these domains presented in the latest version of the GreenMetric (2020) to determine how they serve HEIs to change their status to green campus by investigating their conformity with sustainable development goals (SDGs) and underlying each indicator's and criterion's essentiality for the integration of sustainable development into HEIs. Additionally, the study examines the GreenMetric approach regarding university dimensions, including education, research, operation, outreach, assessment, and reporting, to underscore its criteria and indicators' adaptability to these dimensions. Therefore, investigating each category's aim and scope through literature will define green campus from the GreenMetric viewpoint. Moreover, in a broader context, the study aims to acknowledge that by using the GreenMetric framework, HEIs can adopt green initiatives and move towards sustainable development. Consequently, the study is conducted through an integrative review of the literature focusing on higher education institution sustainability to investigate the historical, contextual, and evolving nature of the green campus concept.

2. Integration of sustainable development into HEIs

According to the etymology of the word sustainability, it can be understood that it consists of two words: to sustain and ability. The first part of the word is derived from the Latin word "sustinere"; -tenere, which refers to the verb hold. It also has been defined as to maintain, retain, support, and endure. In more general terms, sustainability is the endurance of systems and processes (Parker, 2017). Concerning Parker's definition of sustainability, it is comprehendible that the broad meaning can extend to every system and be associated with processes that support lives. Hawken (2007) stated that sustainability is about the balance between two complicated systems of the earth, including the human culture and the living world, which are currently in a disruptive relationship. As a straightforward explanation, it is said that sustainability enhances the quality of human life by improving living standards while considering ecosystems' capability with quantifiable limits to support (Milne et al., 2006).

As the rate of change and complexity in many dimensions, such as the environment, society, and technology, is accelerating, the sustainability subject has become urgent (Stephens et al., 2008). As evidence shows, it is obvious that the future will not look like the past; hence, this indicates the burgeoning need for sustainability (Gilding, 2012).

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The concept of sustainability is a centerpiece and has changed individuals' and organizations' relations with the surrounding environment and its embodied environmental, social, and economic aspects radically.

However, the idea of being responsible for preserving the source for future generations dates back to the mid-17th century by the emergence of two chief concepts: "bon ménage" and "bon usage", which mean good housekeeping and good use respectively, and later became the inspiration source for the terms "wise use" and "sustainable development" in the 20th century (Grober, 2007). The original version of the word sustainability made its debut in print in a comprehensive handbook of forestry in 1713, in which Hanns Carl von Carlowitz derived benefit from two sources: John Evelyn (1664) and Jean Baptiste Colbert (1669), as they dealt with the question of achieving conservation of timber in a way that there would be a continuous, constant, and sustained use. Accordingly, the origin of the word sustainable comes from a sector related to forestry (Wiersum, 1995) and is derived from the German term "Nachhaltiger Ertrag" which means "sustained yield" (Wilderer, 2007); it is referred to the idea of equilibrium between the consumption and the reproduction of resources to avoid long-term depletion (Van Zon, 2002). These words also describe sustainability: "To fulfill our obligations to our descendants and to stabilize our communities, each generation should sustain its resources at a high level and hand them along undiminished. The sustained yield of timber is an aspect of man's most fundamental need: to sustain life itself" (Duerr, 1975, 36).

By the end of the twentieth century, the discussions around environmental, socio-cultural, and socio-economic issues, which are profoundly rooted in equity and equality in the world, have engaged the minds of intellectuals and decision-makers to pave the way through the arrival of a new idea, sustainable development, which was the outcome of a series of conferences, international bilateral agreements, and summits. Ultimately, sustainable development was defined by The World Commission on Environment and Development (WCED) in the Brundtland Report with the title of Our Common Future. The commission successfully unified environmentalism with social and economic concerns on the world's development agenda and defined sustainable development explicitly by these words: "Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). It should be acknowledged that, before what was expressed by Brundtland Report about sustainable development, in a book titled "Limits to Growth" (1972), the earth's capacity to provide humans' basic needs was discussed, and sustainable development was described implicitly. In the Brundtland Report, the main pillars of sustainable development, including economic, social, and environmental protection, which are known as the initial phase for the evolution and the improvement of a strategic perspective concerning sustainability, have also been determined. The definition and pillars have played a catalytic role in promoting the subsequent adoption of two overriding concepts: giving priority to the world's poor and providing their basic needs, and determining the role of all kinds of organizations in limiting the boundaries of their actions on the environment in order not to prevent the ability of the environment to meet present and future needs (Bac, 2008). It is worth noting that the term sustainability is an objective of humanities toward human-ecosystem equilibrium (homeostasis). Sustainable development paves the way to reach sustainability aims by encompassing a holistic approach and temporal processes (Shaker, 2015). Almost three decades later, in 2015, sustainable development goals (SDGs), which are also known as Global Goals, a set of seventeen interconnected goals, were devised by The United Nations General Assembly to be a blueprint to achieve a better and more sustainable future all by the year 2030. The SDGs have a multidisciplinary approach addressing interlinked issues and demanding interconnected governance responses (Stevens & Kanie, 2016).

Consequently, sustainable development has become the center of thoughts and actions on every scale, including global, regional, and local, with various approaches to drive the idea into implementations. As stated by Bettencourt and Kaur (2011), "the concept of sustainable development … now pervades the agendas of governments and corporations as well as the mission of education and research programs worldwide" (p. 19540).

The first declaration that drew attention towards the importance of education in fostering environmental protection and conservation was the declaration of the United Nations Conference on The Human Environment, known as the Stockholm Declaration (Lozano et al., 2015) in 1972. This declaration has been signed by several universities around the world voluntarily, which is an indication of their commitments toward sustainability (Wright, 2002; Filho, 2011; Tilbury, 2012). Brundiers et al. (2010) stated that the Stockholm Declaration has pointed to sustainability matters of HEIs in general, but it also created a basis for subsequent detailed declarations regarding sustainability in HEIs. Following the Stockholm Declaration, the Belgrade Charter (1976) was also influential in pointing out the development of environmental education internationally. In the following year, the Tbilisi Declaration (1977) introduced five notions of environmental education goal to become the basis for the development of global environmental education, including consciousness, knowledge, attitude, skills, and engagement (Zhang, 2006). The Tbilisi Declaration's main focus was solely on sustainability in education, and it was not an outcome of a university sector conference.

Nevertheless, it gave momentum to later sustainability in HEIs' declarations (Calder & Clugston, 2003; Wright, 2004), which emerged more than a decade later in the early 90s (Wright, 2004). In the following part, early declarations that addressed sustainable development in HEIs and were outcomes of conferences held solely by the university sector are highlighted. They have profoundly influenced the emergence of further events and declarations on the crucial role of HEIs in sustainable development so far.

The Talloires Declaration (1990), which focuses on environmental degradation, natural resource depletion, pollution, and threats facing biodiversity and human survival, presents a ten-point action plan to incorporate sustainability and environmental literacy into teaching, research, operations, and outreach of HEIs. Moreover, it emphasizes the need for transdisciplinarity and sustainable development implementation throughout all campus practices (Lozano et al., 2013). The Halifax Declaration (1991) has similar targets and contents to the Talloires Declaration; it presents a comprehensive action plan that determines short- and long-term goals at each local, regional, and global scale. Moreover, it underlines HEIs responsibilities related to raising awareness of environmental degradation, unsustainable environmental practices, and impacts of poverty on sustainable development by focusing on the curricula, operations, and outreach. The Kyoto declaration (1993) emphasizes the definition of sustainable development presented in the Brundtland Report and targets to urge universities for sustainable utilization of resources, encourage people to prevent practices against sustainability, persuade academics to integrate sustainability subject in research and teachings, promote universities to apply sustainable development throughout campus operations, strengthen cooperation with the community, and urge interdisciplinary networks of environmental experts from a local to a global scale. The Swansea declaration (1993) is an outcome of a conference with the theme of People and the Environment - Preserving the Balance, held by the Association of Commonwealth Universities (ACU), which took steps to gather people affiliated with the universities to share their own experiences and actions regarding changing the status of their universities to sustainable. The declaration's scope and focus are similar to the Kyoto declaration and address the curricula, research,

operations, and outreach. Copernicus - The University Charter for Sustainable Development (1994)- addresses the challenges that universities face and outline a framework in which they need to tackle those difficulties regarding sustainability implementations. It urges HEIs to implement ten principles of action plans which consists of institutional commitments, environmental ethics, university employees' education, environmental education program, interdisciplinarity, dissemination of knowledge, networking, partnerships, continuing education programs, and technology transfer. Along with these declarations, which are known as the initial ones regarding sustainability in HEIs, sustainability-based partnerships and associations, such as Global Higher Education for Sustainability Partnership (GHESP), International Sustainable Campus Initiative (ISCN), and The International Alliance of Research Universities (IARU), have also emerged.

3. Green campus: An approach to sustainable development in HEIs

Although the word green literally represents a specific spectrum of color, it indicates verdure, vivacity, and vitality in a broader sense. Concerning its conceptual meaning, the term green has been widely used in various disciplines, from business practices to design and products, to express benefits to the environment. It has been diffused within an even broader context as "green economy". It was in the early 90s that the term green was first used in concepts related to HEIs in the form of the greening of the universities, but later, especially after 2010, it evolved into more particular concepts, such as green campus, green university, and green curriculum (Atici et al., 2020). The word green can be described as a conceptualized word related to sustainability.

The emergence of the green campus concept is an outcome of the debates on encompassing sustainability initiatives in university campuses. It has significantly gained momentum since the declarations on sustainable HEIs (Grindsted & Holm 2012). By realizing that universities contribute to environmental degradation through their activities, green campus initiatives have emerged since greening is the first step universities take towards sustainability (Jain & Pant 2010; Alshuwaikhat & Abubakar, 2008; Bernheim, 2003; Her- remans & Allwright, 2000). As a university campus consists of transportation systems, buildings, landscape, water, and energy infrastructures, which consume large amounts of natural resources and emit greenhouse gases, they are similar to cities (Blackburn, 2007; Alshuwaikhat & Abubakar, 2008). Razavivand Fard et al. (2019) noted that since the sustainability concept emphasizes the matter of wellbeing and quality of life and it ensures urban livability, it is also applicable to the university campus environment; however, it is of great importance to address the particular physical and functional parameters of each university campus setting.

Green campus initiatives have become essential components of current university systems as a response to impacts of human activities on the environment; therefore, the investment in building green campuses is recognized as the most promising due to its highest and the most long-lasting effects (Richardson & Lynes, 2007). The term green campus is defined in the literature as a place where environmental, economic, and social aspects need to be taken into consideration throughout all activities to achieve an ecologically sound, socially and culturally just, and economically viable place (Bekessey et al., 2003; Velazquez et al., 2006). The greening of higher education institutions diminishes the environmental impacts of campus decisions and activities and promotes environmental awareness within HEIs communities (Creighton, 1999). Therefore, the green campus provides leadership by example for society (Amaral et al., 2015), as it is a way to disseminate information about sustainability. Green Campus is a laboratory of self-scrutiny, experimentation, and application. At its best, it is a model where operational planning, business practices, academic programs, and people are interlinked to provide educational and practical values to the institution, region, and the world.

4. A framework for green campus initiatives: HEIs sustainability assessment tool

HEIs sustainability assessment tools operationalize declarations and charters of sustainable development in HEIs (Shriberg, 2004). They clarify the subfields under the domains in which sustainability practices have to be applied and elucidate the process. Alonso-Almeida et al. (2015) underlined the pivotal role of sustainability assessment ranking systems as a reporting tool that documents current sustainability practices and alludes to using the results in qualitative and quantitative methods in future sustainability implementation. The authors argued that "a sound sustainable development vision requires clear reporting to inform the HEIs stakeholders of the benefits of sustainable development by concerning their role in highlighting the sustainable development vision" (Alonso-Almeida et al., 2015, 152). The definite categorization presented in these ranking systems can alleviate concerns related to the ambiguousness of sustainability standards and operations; moreover, they can ease the way to find the proper method to transition universities into green campuses. Discovering best practices and utilizing them as a guide to commence sustainability practices in universities are the reasons to invest in sustainability assessment tools (Shriberg, 2004). Shriberg (2004) argued that there is a necessity of employing such assessment tools because HEIs need to compare their methods with each other, which results in developing a vision related to university campuses' sustainability to verify and guarantee the path they are moving along. Meanwhile, the potential of sustainability assessment in urging organizational change towards sustainability has been pointed by several authors (Lambrechts & Ceulemans, 2013; Ramos & Pires, 2013).

In sum, HEIs sustainability assessment tools

- outline the domains sustainability initiatives should be applied
- provide a platform for participation on a global scale via the Online Reporting Tool
- offer the opportunity to various universities with different systems and contexts to share their results
- gather and document information about the universities' sustainability initiatives and performance
- scrutinize the information accuracy and assure that this information meets the requirements
- present a report to receive public recognition
- alleviate the discontinuity between the theory of sustainability idea in university campuses and application of sustainability practices
- demonstrate similarities and diversities between processes and methods
- help the development of strategies and enhancement of practices
- strengthen cooperation and collaboration among universities for a common goal
- present easily interpretable information on the standing of universities
- encourage competitions among higher education institutions
- promote transparency

5. UI GreenMetric World University Rankings

UI GreenMetric World University Rankings is one of the self-evaluative cross-institutional sustainability assessment tools of green campuses which measures sustainability efforts. This ranking system persuades universities to share their data and information regarding sustainability practices in an online platform for further evaluations and translation into rankings. Moreover, it provides valuable information on the breadth and depth of campus sustainability activities. As a non-profit institution, which was launched in 2010 by Universitas Indonesia (UI), it is influenced by the heated topic of integration of sustainable development on university campuses and is in line with Education for Sustainable Development (ESD) (GreenMetric Guideline, 2020).

During the first year of its introduction, 95 universities from different countries applied to be ranked. However, the number of participants increased almost tenfold by 2020, reaching 911 universities. The total number of nations applied to the GreenMetric in 2010 was 35, whereas it has multiplied to 83 nations in 2020. Indeed, the GreenMetric has accomplished the

target of urging as many universities from different regions of the world. Although the number of countries in 2020 is fewer than the previous year, the exponential growth is apparent during the ten-year interval. Consequently, the GreenMetric has become a valid assessment tool for evaluating and improving green campus initiatives globally. The number of universities and nations that participated in the competition from 2010 until 2020 are demonstrated in Table 1.

As shown in Table 2, the GreenMetric consists of 39 criteria and indicators within six main categories. Each category has its points and influence rate in total; the points are apportioned to all indicators in the categories according to their significance. The first category, known as setting and infrastructure, with an influence rate of 15 percent in total scoring, contains six indicators with total points of 1500. The energy and climate change category includes eight indicators with total points of 2100 and an influence rate of 21 percent in total scoring, which is the most pivotal among others. The waste, transportation, education, and research categories are weighted as 18 percent with total points of 1800 each. 6, 8, and 7 indicators are allocated to them respectively. The water category comprises four indicators; besides 1000 points, an influence rate of 10 percent in total is associated with this category, which places it as the least effective within six categories.

Cortese (2003) stated that a university consists of a four-dimensional system including education, research, campus operations, and community outreach, to which sustainability initiatives should be applied to build a green campus. These four dimensions also were the focus of declarations regarding sustainability in HEIs. Later Lozano-Ros (2003), in his study, added a fifth dimension and claimed that the four dimensions needed to be assessed and reported. Accordingly, the GreenMetric provides a tool for looking at all dimensions of university campuses, including education, research, campus operations, outreach, assessment, and reporting to boost sustainability knowledge, strategic planning and operation,

Table 1. The number of universities and nations participating in the GreenMetric during 2010-2020. (Adapted from https:// greenmetric.ui.ac.id. Copyright 2020 by UI GreenMetric World University rankings.)

Year	Number of universities	Number of nations
2010	95	35
2011	178	42
2012	215	49
2013	301	61
2014	360	62
2015	407	65
2016	515	75
2017	619	76
2018	719	81
2019	780	85
2020	911	83

Table 2. UI GreenMetric World University rankings system categorization and indicators. (Adapted from UI GreenMetric World University Rankings guideline, 2020).

Categories	No	Criteria and Indicators	Points	Total
Setting and Infrastructure (SI) Weighting 15%	SI 1	The ratio of open space area to the total area	300	
	SI 2	Total area on campus covered in forest vegetation	200	
	SI 3	Total area on campus covered in planted vegetation	300	
	SI 4	Total area on campus for water absorption besides the forest and planted	200	
	SI 5	The total open space area divided by total campus population	300	
	SI 6	Percentage of university budget for sustainability efforts within a year	200	1500
Energy and Climate Change (EC) Weighting 21%	EC 1	Energy efficient appliances usage	200	
	EC 2	Smart building implementation	300	
	EC 3	Number of renewable energy sources in campus	300	
	EC 4	Total electricity usage divided by total campus' population (kWh per person)	300	
	EC 5	The ratio of renewable energy production divided by total energy usage per year	200	
	EC 6	Elements of green building implementation as reflected in all construction and renovation policies	300	
	EC 7	Greenhouse gas emission reduction program	200	
	EC 8	The total carbon footprint divided by total campus population	300	2100
Waste (WS) Weighting 18%	WS 1	Recycling program for university's waste	300	
	WS 2	Program to reduce the use of paper and plastic on campus	300	
	WS 3	Organic waste treatment	300	
	WS 4	Inorganic waste treatment	300	
	WS 5	Toxic waste treatment	300	
	WS 6	Sewage disposal	300	1800
Water (WR) Weighting 10%	WR 1	Water conservation program & implementation	300	
	WR 2	Water recycling program implementation	300	
	WR 3	Water efficient appliances usage	200	
	WR 4	Consumption of treated water	200	1000
Transportation (TR) Weighting 18%	TR 1	The total number of vehicles (cars and motorcycles) divided by total campus population	200	
	TR 2	Shuttle services	300	
	TR 3	Zero Emission Vehicles (ZEV) policy on campus	200	
	TR 4	The total number of Zero Emission Vehicles (ZEV) divided by total campus population	200	
	TR 5	Ratio of ground parking area to total campus' area	200	
	TR 6	Program to limit or decrease the parking area on campus for the last 3 years	200	
	TR 7	Number of initiatives to decrease private vehicles on campus	200	
	TR 8	Pedestrian path on campus	300	1800
Education and Research (ED) Weighting 18%	ED 1	The ratio of sustainability courses to total courses/subjects	300	
	ED 2	The ratio of sustainability research funding to total research funding	300	
	ED 3	Number of scholarly publications on sustainability	300	
	ED 4	Number of events related to sustainability	300	
	ED 5	Number of student organizations related to sustainability	300	
	ED 6	University-run sustainability website	200	
	ED 7	Sustainability report	100	1800

and foster cross-sector dialogue about sustainability on campus and stimulate collaboration between HEIs. The adaptability of the GreenMetric criteria and indicators to university dimensions is illustrated in Figure 1.

The criteria and indicators used in this ranking system are developed in accordance with three main constituents of the sustainable development concept: environmental, economic, and social (Suwartha & Sari, 2013). Accordingly, it can be concluded that the GreenMetric categorizations are in line with SDGs. The conformity of the GreenMetric categories with SDGs is shown in Table 3.
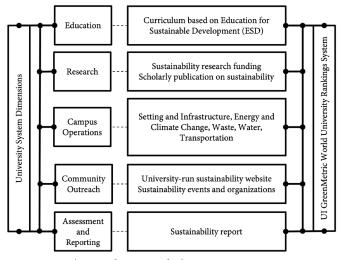

Figure 1. *The conformity of the GreenMetric criteria and indicators with university system dimensions.*

5.1. Setting and infrastructure (SI)

Within the six indicators of the SI categories, the most important ones are related to open spaces, forest, and planted vegetation areas within the campus, which emphasizes the importance of green spaces. "Open space," "open areas," and "public space" are other terms frequently used instead of green spaces (Cilliers, 2015). Green spaces are defined as public or private spaces covered by vegetation serving in two ways: directly, which is about active or passive recreation, or indirectly, which means having positive impacts on the urban environment (Cilliers, 2015). Accordingly, SI underscores necessary actions that should be taken to preserve existing green areas and create new ones in a campus environment. As previously mentioned in Table 2, the SI category is devised according to SDG's numbers 3, 4, 13, and 15. In the following parts, the SI approach to these goals is underlined.

Green spaces serve as opportunities for enhancing students' awareness regarding local biodiversity and its management (Speake et al., 2013). Also, being exposed to nature boosts the student's ability to learn about environmental matters (Brandli et al., 2020). Green spaces can improve social interactions by functioning as recreational and relaxing areas (Woolley, 2003). Reducing stress levels and increasing

Table 3. *UI GreenMetric World University rankings system categorization and indicators. (Adapted from UI GreenMetric World University Rankings guideline, 2020).*

Sustainable Development Goals	UI GreenMetric World University Rankings Categories	
GOAL 1: No Poverty	GOAL 3	
GOAL 2: Zero Hunger	GOAL 4	
GOAL 3: Good Health and Well-being	GOAL 13	Setting and Infrastructure (SI)
GOAL 4: Quality Education	GOAL 15	
GOAL 5: Gender Equality	GOAL 7	
GOAL 6: Clean Water and Sanitation	GOAL 9	
GOAL 7: Affordable and Clean Energy	GOAL 13	Energy and Climate Change (EC)
GOAL 8: Decent Work and Economic Growth	GOAL 6	
GOAL 9: Industry, Innovation and Infrastructure	GOAL 9	
GOAL 10: Reduces Inequalities	GOAL 11	Waste (WS)
GOAL 11: Sustainable Cities and Communities	GOAL 12	
GOAL 12: Responsible Consumption and Production	GOAL 6	
GOAL 13: Climate Action	GOAL 12	
GOAL 14: Life Below Water	GOAL 14	Water (WR)
GOAL 15: Life on Land	GOAL 15	
GOAL 16: Peace, Justice and Strong Institutions	GOAL 3	
GOAL 17: Partnerships for the Goals	GOAL 10	
	GOAL 11	
	GOAL 13	Transportation (TR)
	GOAL 15	
	GOAL 4	Education and Research (ED)

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self-esteem are the benefits of being in touch with green areas (Cammack et al., 2002; Kaplan, 1973; Lewis, 1978). According to Ulrich (1979), interaction with vegetation results in more calm and relaxing feelings for students in stressful situations. Students who are more in interaction with green spaces and use them frequently have a higher quality of life than those who do not (McFarland et al., 2008). Recent experimental works on school environments indicate that green spaces in the vicinity of schools enhance academic achievement. Factors needed for success at schools, including concentration performance and low levels of stress, are associated with the restorative impact of interaction with nature (Becker et al., 2017). Furthermore, green spaces in the surrounding places where people live and work will stimulate physical activities (Hansmann et al., 2007; Owen et al., 2004).

Additionally, green spaces are also recognized as practical solutions to deal with environmental problems. Therefore, land use management regarding green spaces is essential for shaping the urban environment (Steiner, 2014). In general, the environmental benefits of green spaces are as follows:

- Biodiversity maintenance (Farinha-Marques et al., 2011; Hodgkison et al., 2007); since green spaces can function as "wildlife corridors" or act as "urban forests", they can preserve viable populations of species that would otherwise disappear from the built environment (Byrne & Sipe, 2010). Therefore, the more green spaces, the more living spaces with better situations will be. That is an excellent example of "the more, the merrier".
- Mitigation of urban heat island effect and microclimate stability (Alexandri & Jones, 2008; Akbari et al., 2001); as green spaces manage to lower temperatures within their vicinity by evaporative cooling and shading (Shashua-Bar & Hoffman, 2000; Skoulika et al., 2014; Bowler et al., 2010) energy consumption of cooling will be diminished. According to several studies, the temperature of more dense urban green areas is lower than non-green urban areas

(Padmanabhamurty, 1990; Heisler & Wang, 1998; Yilmaz et al., 2007; Huang et al., 2008).
- Pollution reduction and air quality enhancement (Bolund & Hunhammar, 1999; Konijnendijk et al., 2013; Setälä et al., 2013); green spaces capture carbon dioxide from the atmosphere, which diminishes pollution and results in the improvement of air quality (Davies et al., 2011). They also positively influence global warming and help the mitigation of climate change (Paoletti et al., 2011). Also, soil contamination removal through the phytoremediation process is another example of the efficiency of green spaces (Reichenauer & Germida, 2008).
- Reduction of noise pollution (Watts et al., 2013; Veisten et al., 2012); green spaces provide a relaxing place for people to relieve their stress since they are characterized by a pleasant acoustical environment with natural sounds (van Kempen et al., 2014). They help absorb sounds and block the higher frequencies (Dimitrijević et al., 2017) and act as buffers against noise created in the urban environment (Yang et al., 2011; Veisten et al., 2012).

5.2. Energy and climate change (EC)

Creighton (1999) asserted that HEIs contribution to ecological footprint by using electricity, fossil fuels, water, and chemicals is more extensive than any other entity in a community. Electricity is their primary energy carrier and its associated emissions and fuel consumption, along with transportation, and waste management, result in greenhouse gas emissions (Aroonsrimorakot et al., 2013). University campuses' energy consumption is one of the primary greenhouse gas emission sources in the absence of renewable technologies on campus (IARU, 2014). Therefore, university campuses are identified as places to evaluate energy efficiency policies and sustainability implementation (Agdas et al., 2015). Among the GreenMetric categories, the highest score has been assigned to EC, which indicates its significance. Since climate change jeopardizes species survival, actions need to be taken

to reduce carbon footprint. On that account, the GreenMetric make universities compete by placing carbon footprint indicator as a leverage point to compute and rank universities (Mohammadalizadehkorde & Weaver, 2018). EC, in line with SDGs numbers 7, 9, and 13, emphasizes practices, which are recognized as effective ways to slow or reverse the climate change impacts on university campuses. These practices include:

- Renewable resource usage, in other words, usage of alternative clean fuels instead of fossil fuels and coal as well as substituting conventional equipment with energy-efficient appliances, which are recognized as effective ways to reduce greenhouse emissions (Toman, 2001).

- Green buildings' element implementation (Brown & Southworth, 2008), forasmuch as the green building initiative urges energy-efficient designs; they enable conditions for reduction of waste production, hazardous materials, and energy consumption (Alshuwaikhat & Abubakar, 2008). Mohammadalizadehkorde and Weaver (2018) also stated that actions regarding buildings' energy performance are recognized as a relatively immediate intervention that can be useful for universities to consume energy more sustainably.

- Smart building implementation, which is identified as "a building which controls its own environment" and characterized by benefits including "predictive maintenance," "energy-saving," "effective monitoring," "optimized site cleaning," and "redesigned space" (Rameshwar et al., 2020).

5.3. Waste (WS)

Today's communities' consumption trend produces a substantial amount of waste which has an adverse impact on the environment besides the negative influence on the socio-economic aspect of society. In addition to the fact that sources are not infinite, it is a challenge for authorities to manage the generated massive waste in an efficient and environmentally responsible way (Zaman & Lehmann,

2011). Therefore, sustainable waste management is an important factor in achieving sustainable development and needs to be considered by all community entities. It focuses on the collection, transfer, processing, recycling, and disposal of waste generated by human activities to ease the burden on landfills, conserve natural resources and save energy (Wan et al., 2019). Moreover, it reduces the negative impact on human health and preserves the visual quality of the environment (Popescu et al., 2016).

Since universities produce a substantial amount of waste, programs regarding recycling and treatments of waste need to be among the concerns of universities. However, HEIs are aware of the responsibility and have begun to implement integrated sustainable waste management programs, as it is a way to show their commitment to environmentally sound practices (Armijo de Vega et al., 2008). On this account, the GreenMertic in WS category, in accordance with SDGs numbers 6, 9, 11, 12, emphasizes programs of recycling waste and reducing paper and plastic usage, along with focusing on actions regarding organic, inorganic, and toxic waste treatment as well as actions concerning sewage disposal.

Lehman defined sustainable waste management as a way to turn waste into a resource (Lehmann, 2010). As an effective process to decrease the amount of waste that goes through disposal processes, such as landfills or incineration, in other words, changing waste to resource, universities use bin infrastructure for waste stream segregation that efficiently helps waste be recycled or reused. Additionally, via this action, organic, non-organic, and toxic wastes are separated and handled by the university itself by available technologies within the university campus or handed over to a third party for reuse, recycle or disposal. Moreover, the GreenMetric, by drawing attention to the implementation of programs regarding the reduction of paper and plastic usage on campus, urges universities to slow down waste generation. For instance, policies on double-sided printing, reusable bags,

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free water distribution, recycled cups usage instead of plastic ones, and dematerialization of administrative procedures are among programs related to sustainable waste management on university campuses.

Also, the matter of sewage disposals is significant for university campuses and should be considered. Therefore, instead of conventional treatment or being transported directly into waterways with no intervention, the sewage should be treated to be reused, downcycled, or upcycled. In the absence of technologies for sewage treatment on a university campus, delivering it to wastewater-treatment centers through a sewer system is a useful action to minimize environmental impacts.

5.4. Water (WR)

In recent decades due to the population explosion, the importance of water management has been increased, as water is one of the basic survival needs. Water management is recognized as one of the main factors of sustainable development and is an efficient way to face water shortage and preserve freshwater supplies (EL-Nwsany et al., 2019). The most critical sustainability issue of universities, depending on climate and location, is the matter of supplying and conserving adequate potable water; therefore, water management becomes essential to achieve sustainability in universities (Dave et al., 2014). Besides waste management, water management can also produce significant monetary savings. Therefore, water-efficient initiatives should be incorporated into the practices of university campuses since water is a natural source and should not be wasted (IARU, 2014). Moreover, the actions regarding water management in universities are initiating a movement towards a behavioral change of water consumption (EL-Nwsany et al., 2019; Faghihimani, 2010). In this regard, the GreenMetric, in its fourth category, in conformity with SDGs numbers 6, 12, 14, and 15, urges universities to reduce water usage on campus by increasing conservation and recycling programs, along with using water-efficient appliances and consuming treated water.

Water management on university campuses generally includes an imple-

mentation to reuse and recycle potable water for potable or non-potable purposes (Dave et al., 2014). Initiatives on campus facilities, such as installing low-flow water fixtures, waterless urinals, and automatic sensors on sinks, are considered as water efficiency actions (Rappaport & Creighton, 2003). The collection of rainwater and stormwater for irrigation (Creighton, 1999), and proper landscape design with drought-resistant native plants and grass are among practices of water conservation on university campuses (Bardaglio & Putnam, 2009; Alshuwaikhat & Abubakar, 2008). Utilization of recycled water and treated wastewater for irrigation and capturing greywater from showers, sinks, and lavatories to use in water closets are also considered as practices regarding sustainable water management on university campuses (Bardaglio & Putnam, 2009).

5.5. Transportation (TR)

The transportation sector, via greenhouse gas emission, negatively impacts the environment and is known as one of the factors responsible for the increase in carbon footprint. Therefore, concerns about climate change have converged to generate an increasing interest in alternatives recognized as sustainable transportation. Green or sustainable transportation refers to certain systems that serve for sustainable development (Jha et al., 2014) by taking into account the triple bottom line: environmental, social, and economic. It is identified as the transition from "vehicle-oriented" to "people-oriented" (Zhang et al., 2010). Sustainable transportation preserves humans' health and their environment in a way that economic progress will be continued and community balance will be met. The transportation system has become a significant feature of university campuses since users engaging in campus activities need to commute to and from campus. Therefore, to achieving sustainability on university campuses and to commit to the path of sustainable development, sustainable transportation should be taken into account by HEIs. The GreenMetric advocates sustainable transportation on university campuses by focusing on SDGs numbers 3, 10, 11, 13, and 15. It encourages universities to operate policies on

using Zero-Emission Vehicles (ZEV), applying pedestrian path policy on campus, implementing transportation programs to limit or decrease the parking area on campus, and using shuttle services and transportation alternatives to reduce the number of private vehicles on campus. Since alternative transportation initiatives provide safe and comfortable routes for campus users with the minimum level of impact on human and environmental health (Krueger & Murray, 2008), as they are characterized by low emission, low energy consumption, and low pollution.

Universities by providing bicycling opportunities, designated walking paths, and public transportation, such as shuttle services, which are all under the umbrella term green transportation (Martins et al., 2018) as well as vehicles with green technologies that run on electric, alternative fuel, or human-powered known as alternative transportation, (Krueger & Murray, 2008) can ease traffic congestion and reduce emission (Li, 2016). Consequently, it alleviates urban pollution and environmental problems. Moreover, universities can use carpooling and ride-sharing programs on campuses (Bardaglio & Putnam, 2009). All these actions are effective ways to reduce the number of private vehicles and solve related parking accommodation issues (Toor & Havlick, 2004). In addition to considering pedestrian policies on campuses to provide a safe place for users, a barrier-free landscape under the umbrella of universal design principles must also be considered in the design of roads and pedestrian pathways within university campuses.

5.6. Education and Research (ED)

Moving along with sustainable development and consequently providing a sustainable settlement for humans to live relies on the acquisition of sustainability knowledge; thus, the role of ESD becomes certain. Since it "empowers people to change the way they think and work towards a sustainable future" (UNESCO, 2021). ESD gives prominence to the necessity of teaching students for examination, critical thinking, and the development of flexible and adaptive practices for implementations (Wiek et al., 2011). Accordingly, a large-scale educational change is necessary to prepare a new generation of professionals to meet sustainability challenges through problem-solving methods that include systemic thinking and anticipation, value-added deliberation, evidence-based strategies, and strong collaboration among government, business, and civil society (Wiek et al., 2011). Therefore, sustainability programs in HEIs are responsible for preparing ground to convey these sustainability competencies and equip graduates in a way that they can contribute to resolving societal difficulties to achieve a sustainable future (Wiek et al., 2015).

On this account, the GreenMetric, in its last category in line with SDGs number 4, addresses the key role of ESD in fulfilling the green campus ambition by highlighting the significance of sustainability courses, research funding, publications, events, and student organizations along with the existence of sustainability reports and websites in universities; which is a significant factor in disseminating the latest sustainability knowledge, practices and experiences with community.

6. Conclusion

The GreenMetric fulfills the ambition of bonding sustainable development concept with strategies and implementations in HEIs, by emphasizing the application of sustainability initiatives in university dimensions, including education, research, operation, and outreach. The GreenMetric functions as a guide for university campuses, via its determined criteria and indicators based on SDGs, to be models for their society since university campuses resemble cities as they contain urban components on a smaller scale. Therefore, green campus initiatives include the sustainable management of buildings, landscape, energy, water, waste, transportation, and sustainable education. Accordingly, a green campus encompasses principles such as protecting the environment, lowering operating costs, and improving people's health and quality of life since the university campus is considered green in terms of its approach towards environmental, economic, and social dimensions. The green campus provides a ground

for teaching, learning, examining, and experiencing sustainability matters and integrating the value-laden outcomes with the built environment, and eventually, exposing the host communities to the sustainability implementation methods to utilize them. Moreover, it encourages professionals to perform duties regarding sustainable development in a society; since sustainable development is a holistic approach, and all majors and fields should serve for its achievement.

In the GreenMetric perspective, a university campus is genuinely green if:

- Both natural and artificial green areas are protected and enhanced, as they are vital factors in moving toward sustainable development by providing environmental, social, and economic benefits.
- The elements of smart buildings and green buildings are implemented to reduce energy consumption.
- Renewable resources are used instead of nonrenewable ones.
- The greenhouse gas emission reduction program is devised to reduce carbon footprint, and consequently, to reduce global warming and reverse climate conditions.
- Sustainable waste management is considered because of the waste produced as a result of campus activities. Therefore, waste recycling programs are devised. Organic, inorganic, and toxic wastes are separated for treatment. Programs for reducing paper and plastics are implemented, and proper actions for sewage disposal or treatment are operated.
- Sustainable water management is considered; thus, water conservation and recycling programs are adapted, and treated water is consumed.
- Green transportation principles, such as traffic reduction program, parking management, promoting pedestrian and cyclist, promoting clean vehicles, and vehicle-free development, are considered.
- ESD is integrated into university education and research programs. Sustainability courses, events, and student-based organizations are devised and developed.

- An adequate budget is assigned for sustainability research, initiatives, and operations.

All these actions will alleviate the environmental impacts of university campuses and bring social and economic benefits. In sum, this study highlights sustainability initiatives' domains by using the GreenMetric as a framework and encourages HEIs to have a commitment to carrying out various sustainability efforts and changing their status to green campus, and consequently, function as driving forces for the broader community. However, continuous development and improvement of efforts are required to achieve the expected purpose of integrating sustainable development in HEIs.

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