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Measuring Universities' Sustainability Performance with Using UI GreenMetric World Ranking: A Case Study of Düzce University

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Abstract

The university campus is a dynamic system in which the concept of sustainability can be applied to all the needs of the university. Universities with the "green campus" approach provide effective use of their resources. As part of the study, the data of the main campus of the Düzce University for 2021 was evaluated based on the UI GreenMetric Ranking. Calculations and assessments were made for the campus land cover, structural and vegetative areas. A general assessment of the entire campus was carried out using the sustainability and green campus approach with dataset. As a result, Düzce University is progressing towards the realisation of a sustainable/green campus, facilitated by the discernible impact of the survey components. The creation of a sustainable/green campus will make a difference in the province of Düzce and accelerate local development actions.

Keywords: *Climate change, green campus, nature-based solutions, resource efficiency, Türkiye.*

Üniversitelerin Sürdürülebilirlik Performansının UI GreenMetric Dünya Sıralaması Kullanılarak Ölçülmesi: Düzce Üniversitesi Örneği

Öz

Üniversite kampüsü, sürdürülebilirlik kavramının üniversitenin tüm ihtiyaçlarına uygulanabileceği dinamik bir sistemdir. "Yeşil kampüs" yaklaşımına sahip üniversiteler kaynaklarının etkin kullanımını sağlamaktadır. Çalışma kapsamında Düzce Üniversitesi ana kampüsünün 2021 yılı verileri UI GreenMetric Ranking'e göre değerlendirilmiştir. Kampüs arazi örtüsü, yapısal ve bitkisel alan hesaplamaları ve değerlendirmeleri yapılmıştır. Karbon ayak izi kampüs nüfus verileri kullanılarak hesaplanmıştır. Sürdürülebilirlik ve yeşil kampüs yaklaşımıyla veri setine dayalı tüm kampüsün genel bir değerlendirmesi yapılmıştır. Sonuç olarak, Düzce Üniversitesi, anket bileşenlerinin fark edilebilir etkisiyle kolaylaştırılan sürdürülebilir/yeşil bir kampüsün gerçekleştirilmesine doğru ilerlemektedir. Sürdürülebilir/yeşil bir kampüsün oluşturulması, Düzce ilinde fark yaratarak yerel kalkınma eylemlerini hızlandıracaktır.

Anahtar kelimeler: *İklim değişikliği, yeşil kampüs, doğa tabanlı çözümler, kaynak verimliliği, Türkiye.*

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1. Introduction

The security and sustainability of fundamental resources, including water, food, and energy, represent a global concern (Fader et al., 2018; Hao et al., 2022). Numerous systems, and frameworks (Shah, 2020), models, and methodologies exist that develop nature-based solutions for promoting the integrated management of natural resources, supporting their conservation and sustainable use (Sahani et al., 2019; Kumar et al., 2021; Yuan et al., 2022). Amidst the escalating deterioration of the environment and the escalating ramifications of climate change, diverse strata of society are progressively delineating their roles in assuming responsibility for concurrent social and environmental quandaries (Wang et al., 2020; Li et al., 2022). This circumstance has made it possible to create development strategies for environmental problems at different levels of society, to elaborate nature-based solutions, and to increase green practices (Fu et al., 2022; Abbas & Dogan, 2022; García-Madurga, 2022). The Sustainable Development Goals (SDGs) collectively agreed by 193 countries upon during the Sustainable Development Summit. Primary goals of SDGs are to promote environmentally friendly regulations in different sectors and levels, eliminate inequality, and minimize the effects of climate change (Mushtaha et al., 2022).

Universities are a significant stakeholder in the success of sustainability (Findler et al., 2019). Particularly, they can play a crucial role in capacity building among the youth to support the global agenda for sustainable development, aiming to establish a foundation (Disterheft et al., 2019; Haseeb et al., 2022). The literature refers to various sustainable practices observed on campuses, such as environmental management planning and sustainability reports sharing information with indicators related to water, energy, emissions, waste, and transportation use for the implementation of sustainable buildings (Hooey et al., 2017; Weiss, et al., 2021).

The global imperative of climate change mitigation and the promotion of campus sustainability have prominently emerged as focal areas of concern for university leadership. Prominent academic institutions are actively engaging in efforts to address climate change by methodically diminishing their carbon footprints, thereby demonstrating a commitment to the effective management and augmentation of their sustainability initiatives (Suwartha & Sari, 2013). Assessing environmental factors in heavily pressured urban areas poses challenges. However, initiatives focusing on development-driven ecotourism and similar activities in rural areas offer solutions that support sustainable development environmentally, economically, and socially (Kiper et al., 2022). In urban settings, efforts are underway to enhance environmental sustainability through nature-based solutions aimed at strengthening green infrastructure (Mertens, 2022). As for universities represent spaces at an urban scale but with high social mobility. In these areas, embracing ecological, economic, and social approaches is essential. Universities are small cities characterized by education, research, and community-involved activities, with high daily mobility. It's notable that this mobility contributes to increased greenhouse gas emissions linked to transportation/accessibility. Depending on the university's structure and functioning, there are different energy needs, electricity consumption, waste generation, water and material consumption, public transportation, and educational activities. All of these pose pressures for actions that would contribute to a sustainable world. Hence, recent efforts have focused on evaluating and enhancing these small cities in contemporary studies (Heinz, 1995; Lukman et al., 2010; Grindsted, 2011; Grindsted & Hol, 2012; Suwartha & Berawi, 2019; Boiocchi et al., 2023).

Universities, like other sectors of society, are taking serious steps to achieve the Sustainable Development Goals (SDGs). Universities are educational establishments for future environmental, social, political and economic decision-makers (Marsudi et al., 2021). Considering the university campus as an urban space, or even as a microcosm of society, it is clear that the steps towards sustainability taken by universities are directed by society (Dalbelo, 2021). The community well-being of universities depends on advancing in environmental, social, and economic areas (Romero-Infante et al., 2022). The sustainability paradigm is based on economic growth, social progress, and environmental sustainability. The Talloires Declaration, published by the "Association of University Leaders for a Sustainable Future" in 1990, explained that universities should focus on environment,

population, and development issues (Alshuwaikhat & Abubakar, 2008). In this context, measures have been initiated for effective waste management and implementing environmentally sustainable spatial plans to mitigate carbon emissions (Abtahi, 2021). Nowadays, an increasing number of universities are adopting sustainability strategies. These approaches go by various names, including "environmental university," "eco-campus," "green campus," "sustainable university," "sustainable campus," and "environmental campus." (Ribeiro et al., 2021). These approaches support long-term development activities such as adequate energy and water conservation, rainwater harvesting, green building practices, and renewable energy, increasing the amount of green space per capita, green infrastructure applications, accessibility, reducing carbon footprint, etc. (Setyowati et al., 2013; Lai et al., 2020).

SDGs that include 17 goals are addressed in the UI GreenMetric criteria and indicators. The SDGs are defined within universities under 6 main categories (GreenMetric, 2023) (Figure 1). The universities use their own ranking teams to apply and evaluate the UI GreenMetric criteria provided by the UI GreenMetric database.

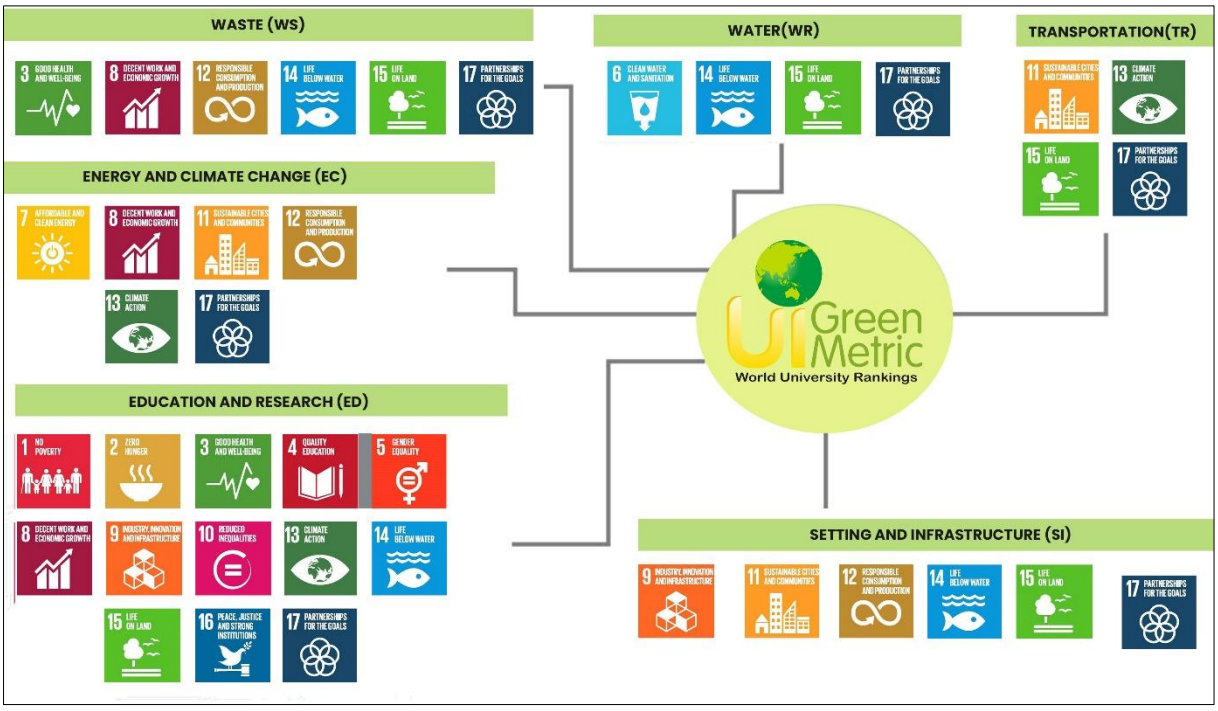


Figure 1. Implementation of SDGs at campus level (GreenMetric, 2023)

The 17 main SDGs, which intend to eliminate poverty, conserve the environment, prevent the climate crisis, ensure equitable distribution of wealth, and promote peace, have been reviewed by universities in the areas of infrastructure, energy and climate, water, transport, waste, and education. Indexes have been created to evaluate the environmental studies of universities in line with SDGs such as "Green League," "Environmental and Social Responsibility Index," "Sustainability Tracking and Assessment System-STARS," and "GreenMetric". GreenMetric is the first global measurement system (Grindsted, 2011; Suwartha & Sari 2013; Kalayci Onac et al., 2021).

The GreenMetric is a ranking system that rates universities on their sustainability efforts and potential (Suwartha & Sari, 2013). This ranking aims to enhance the standing of a university, foster sustainability, and implement a range of measures to attain green campus standards (Abtahi, 2021). Every year, more than 800 applications are made from different countries of the world. 950 universities applied in 2021 (GreenMetric, 2022). Düzce University, examined in this study, has been applying for this ranking system for 4 years, and the campus is evaluated in accordance with the GreenMetric methodology.

Regional development plans comprehend land sustainability, scientific management of soil wealth, space efficiency, environmentally friendly economic and urban development, etc. as main goals. In this context; the university has been declared as a "Specialization University in the Field of Environment

and Health" by the Turkish Higher Education Council. Within this direction; "Recycling of Agricultural Wastes for Industry Application and Research Center" was established. This study aims to determine the practices and deficiencies of Düzce University Main Campus in terms of infrastructure, climate change, energy, and waste management. In this context, the main questions of the research are:

RQ 1: Does Düzce University main campus have adequate practices aligned with the sustainability goals?

RQ 2: Are Düzce University's environmentally friendly approaches sufficient in terms of infrastructure, climate change, energy and waste management?

1.1. Conceptual Framework

The GreenMetric ranking measures the university's efforts under the categories of infrastructure, energy and climate change, transportation, education, energy and waste management, each scored on a scale of 1-5 (Maçin et al., 2020). The ranking then multiplies the score of each category by its respective coefficient score. GreenMetric is a ranking system based on the questionnaire. The questionnaire consists of 51 different questions focused on sustainability concept that has three elements environmental, economic, and social. These aspects provide campus sustainability efforts (Rodríguez-Rodríguez et al., 2022) (Figure 2).

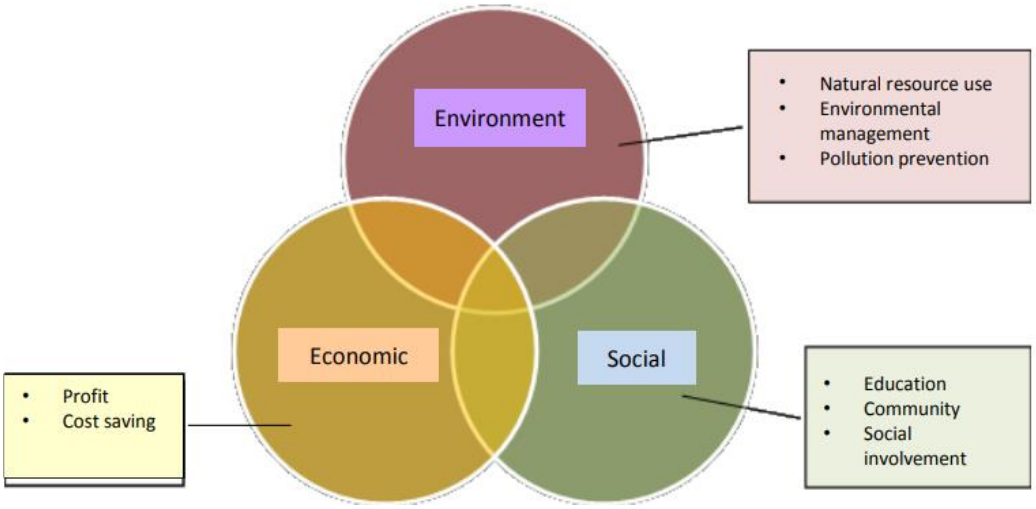


Figure 2. Conceptual framework of GreenMetric (GreenMetric, 2023)

The questionnaire consists of 6 stages: Setting and Infrastructure (SI), Energy and Climate Change (EC), Waste (WS), Water (WR), Transportation (TR), Education and Research (ED). While ED is directly related with social context, EC and SI are directly related with economic context. EC, WS and WR are directly related with environmental context.

2. Material and Method

2.1. Study Area

The field of study was determined as Düzce University main campus, a newly developing university. Düzce University was established in 2006. Düzce University has nearly 30 thousand matriculated students; and comprises 13 Faculties, a Graduate School, 2 Colleges, 10 Vocational Schools, 31 research centers, a Technopark and a University Hospital. Though the main campus was built 10 km away from the city center, the city has been growing towards the university and today the university has remained in the city periphery. The main campus of the university is 1.78 km² (Figure 3, Table 1).

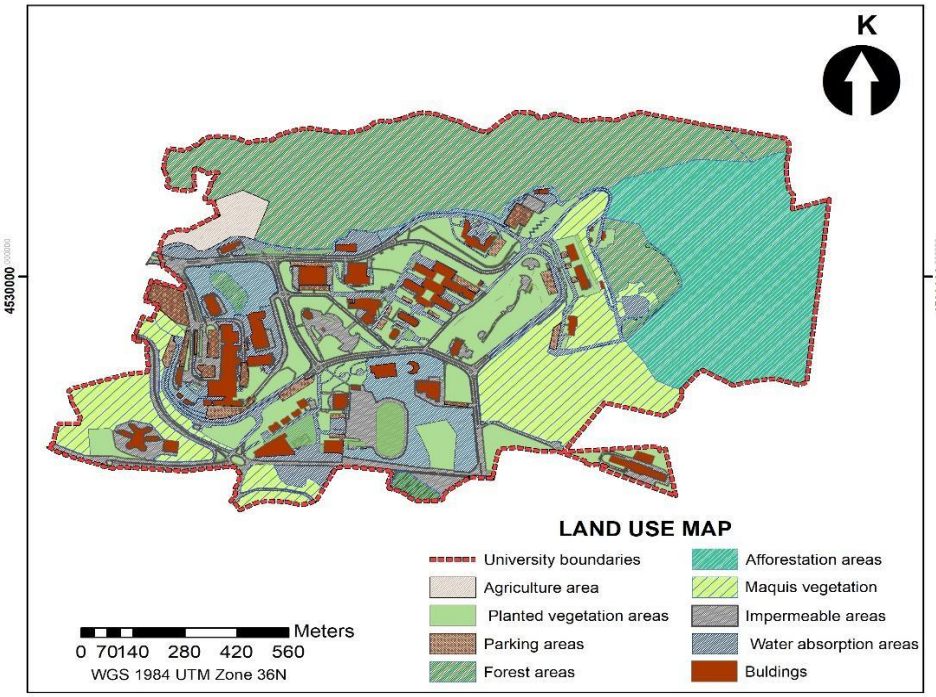
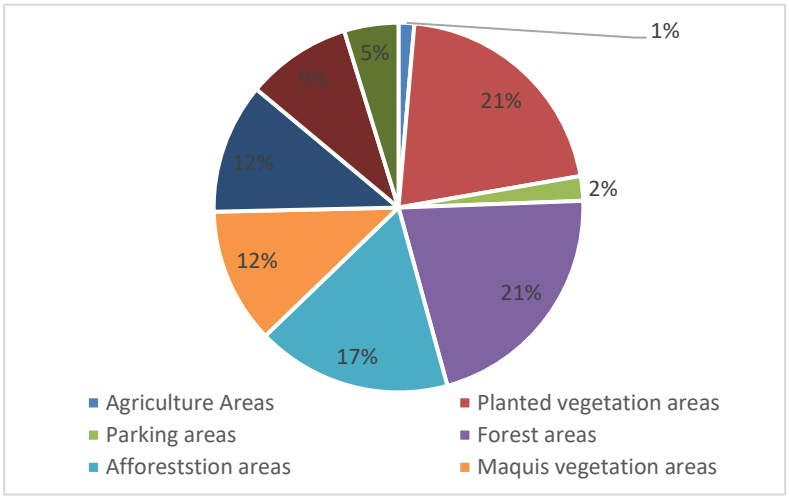


Figure 3. Main campus area of Düzce University (Prepared by authors)

Table 1. Land use distribution of Düzce University main campus (Prepared by authors)

Land use	Area (m^2)	Graphic
Agriculture areas	24.712	
Planted vegetation areas	382.586	
Parking areas	2.625	
Forest areas	400.650	
Afforestation areas	304.644	
Maquis vegetation areas	219.535	
Impermeable areas	209.953	
Water absorption areas	173.481	
Buildings	84.214	



The main campus contains 3 types of natural areas; natural oak forest, black pine afforestation area, and maquis vegetation, specific to the mediterranean climate. The area covered by the natural oak forest is 400.850 m^2, the black pine forestation is 304.744 m^2 and the area covered with maquis is 219.635 m^2 (%51). The ratio of planted vegetation area compared to total area is 382.786 m^2 (% 21).

2.2. Method

The method is based on a questionnaire prepared by GreenMetric (GreenMetric, 2022a). The survey instrument was devised to investigate prospective challenges to civilization, encompassing issues such as population pressure, climate change, energy security, environmental degradation, water and food security, and sustainable development. Within this framework, the survey's objectives incorporate salient concepts aligned with the triple bottom line, namely equity, economy, environment, as well as considerations of green building and education for sustainable development. The survey was applied to 44 departments in 12 faculties located on the main campus of Düzce University. As a result, activities

relating to six of the headings were recorded in all the sections. In this study, the campus was evaluated according to the six main categories and indicators given in this questionnaire. The six principal categories are universally acknowledged as pivotal considerations among universities prioritizing sustainability. These encompass the compilation of fundamental data pertaining to the university's scale and zoning profile, delineating its geographical classification as urban, suburban, or rural.

The data pertains to the university's ecological footprint, as it encompasses factors such as the extent of green spaces, electricity consumption, transportation practices, water utilization, and waste management. The six main categories: Setting and Infrastructure (SI), Energy and Climate Change (EC), Waste (WS), Water (WR), Transportation (TR), and Education and Research (ED). These mechanisms offer insights into the university's responsiveness to, and management of, sustainability issues through the formulation of policies, implementation of actions, and communication strategies. There are categories, indicators and their percentages in the GreenMetric questionnaire (Table 2). Scoring of each indicator is done numerically and these numerical data are evaluated statistically. In addition, evidence information is requested beside categories and indicators. The calculation details are based on the equations shown in the GreenMetric Guide. Each criterion will be systematically classified within a broader category of information, and during the results analysis, the raw scores will undergo a weighting process to derive a final computation. The GreenMetric ranking is being developed and continuously updated in light of the feedback from the participants and the latest developments in the field (Dağlıoğlu et al., 2018; GreenMetric, 2022b).

Table 2. Criteria and indicators of questionnaire (GreenMetric, 2022a)

No	Criteria / Indicators	Point
	Setting and Infrastructure (SI)	**1500**
1	SI1 The ratio of open space area to the total area	
	SI2 Total area on campus covered in forest vegetation	200
	SI3 Total area on campus covered in planted vegetation	200
	SI4 Total area on campus for water absorption besides the forest and planted vegetation	100
	SI5 The total open space area divided by the total campus population	200
	SI6 Percentage of university budget for sustainability efforts	200
	SI7 Percentage of operation and maintenance activities of building in one year period	100
	SI8 Campus facilities for disabled, special needs, and/or maternity care	100
	SI9 Security and safety facilities	100
	SI10 Health infrastructure facilities for students, academics, and administrative staff's wellbeing	100
		100
	SI11 Conservation: plant (flora), animal (fauna), and wildlife, genetic resources for food and agriculture secured in either medium or long-term conservation facilities	100
	Energy and Climate Change (EC)	**2100**
2	EC1 Energy-efficient appliances usage	200
	EC2 Smart building implementation	300
	EC3 Number of renewable energy sources on campus	300
	EC4 Total electricity usage divided by total campus' population (kWh per person)	300
	EC5 The ratio of renewable energy production divided by total energy usage per year	200
	EC6 Elements of green building implementation as reflected in all construction and renovation	200
	EC7 Greenhouse gas emission reduction program	200
	EC8 Total carbon footprint divided by total campus' population (metric tons per person)	200
	EC9 Number of the innovative program(s) in energy and climate change	100
	EC10 Impactful university program(s) on climate change	100
	Waste (WS)	**1800**
3	WS1 Recycling program for university's waste	300
	WS2 Program to reduce the use of paper and plastic on campus	300
	WS3 Organic waste treatment	300
	WS4 Inorganic waste treatment	300
	WS5 Toxic waste treatment	300
	WS6 Sewage disposal	300

	Water (WR)	**1000**
4	WR1 Water conservation program & implementation	200
	WR2 Water recycling program implementation	200
	WR3 Water-efficient appliances usage	200
	WR4 Consumption of treated water	200
	WR5 Water pollution control in the campus area	200
	Transportation (TR)	**1800**
5	TR1 The total number of vehicles (cars and motorcycles) divided by the total campus' population	200
	TR2 Shuttle services	300
	TR3 Zero-Emission Vehicles (ZEV) policy on campus	200
	TR4 The total number of Zero-Emission Vehicles (ZEV) divided by the total campus population	200
	TR5 The ratio of the ground parking area to the total campus' area	200
	TR6 Program to limit or decrease the parking area on campus for the last 3 years (from 2019 to 2021)	200
	TR7 Number of initiatives to decrease private vehicles on campus	300
	TR8 The pedestrian path on campus	200
	Education and Research (ED)	**1800**
6	ED1 The ratio of sustainability courses to total courses/subjects	300
	ED2 The ratio of sustainability research funding to total research funding	200
	ED3 Number of scholarly publications on sustainability	200
	ED4 Number of events related to sustainability	200
	ED5 Number of student organizations related to sustainability	200
	ED6 University-run sustainability website	200
	ED7 Sustainability report	100
	ED8 Number of cultural activities on campus	100
	ED9 Number of university program(s) to improve teaching and learning	100
	ED10 Number of sustainability community services projects organized and/or involving students	100
	ED11 Number of sustainability-related startups	100

According to the category and indicators expected from us in the GreenMetric questionnaire, the data were obtained from the following units of the rectorate:

- Department of Strategy Development
- Department of Construction and Technical Works
- Department for Student Affairs
- Scientific Research Projects
- Department of Landscape Architecture
- Department of Environmental Engineering
- Health Application and Research Centre
- Health, Culture and Sport Center

The data obtained from the units are presented with verbal and numerical values. Some have been mapped and reported with evidence. At this stage; ArcGIS 10.4 and Microsoft Excel programs were used by using aerial photographs.

3. Findings and Discussion

The objective of the GreenMetric classification is to facilitate comparative assessments of environmental concerns, as well as social and economic dimensions, with a concurrent emphasis on advancing the attainment of the 17 SDGs (Lambrechts & Ceulemans, 2013). Evaluating the sustainability of higher education institutions is a multifaceted problem (Shi and Lai, 2013). In this context; The GreenMetric survey directs universities to various actions to improve their own sustainability. Düzce University also had the opportunity to take an x-ray of the campus with the

components of this survey. It has been a mirror for Düzce University, which aims for a sustainable campus, to see the deficiencies.

In 2021, 71 Turkish universities were included in the index, which included 956 universities from different countries of the world. The rankings of Düzce University, which has been on the list since 2018, are given in the Table according to the criteria. In 2021, Düzce University rose to the 507th place among 956 universities, with a total score of 5375 from the indicators. Wageningen University & Research (Netherlands) is at the top of the list with a total score of 9300 (Table 3).

Table 3. Comparison of the scores of Düzce University with the scores of the top 3 universities in 6 categories (GreenMetric, 2022)

Rank 2021	**1**	**2**	**3**	**507**
University	Wageningen University & Research	University of Nottingham	University of Groningen	Düzce University
Country	Netherlands	United Kingdom	Netherlands	Türkiye
Total Score	9300	8850	8800	5375
Setting & Infrastructure	1325	1375	1275	1150
Energy & Climate Change	1825	1525	1550	850
Waste	1800	1800	1800	450
Water	1000	1000	1000	400
Transportation	1550	1500	1650	1175
Education & Research	1800	1650	1525	1350

It is seen that the universities in the top three are particularly successful in water and waste management. Düzce University is successful in the location and transportation of the campus. However; has not yet developed effective solutions in energy, water and waste management. There are processes and initiatives adopted in this regard. When we examine the last 3 years of the ranking, it is seen that the score of Düzce University has increased (Table 4). Rankings vary based on the number of universities participating in the year. According to years; the total score of Düzce University is given in the Figure 4 among the universities with the maximum and minimum scores in list.

Table 4. The total score of Düzce University among the universities with the maximum and minimum scores (GreenMetric, 2022)

Years	**2018**	**2019**	**2020**	**2021**	**2022**
Number of Total University	719	780	912	956	1050
Rank	573	525	645	507	382
Max. Score in List	9125	9075	9150	9300	9300
Total Score	3625	4275	4300	5375	6610

Figure 4. The total score of the university according to the years in the ranking (GreenMetric, 2023a)

In the last 3 years, the rankings according to the indicators were examined (Table 5). The presented evidence after the study with aerial photographs in the Setting & Infrastructure section contributed to the increase of the score. The increase seen in the Energy & Climate Change section has provided experimental areas to be prepared for academic research on campus. Waste section is a critical issue that concerns the municipality as well as the university administration. The score of this section is fixed according to the years. In order to ensure the increase, there is a need for improvement in the policies and practices of the local government. In the Water management section, the score varies periodically based on technical problems and solutions on campus. The policies and investments followed by the rectorate on the campus regarding Transportation increased the score. In the field of Education & Research, the academic studies of the university show international developments and accept students as part of the team. It is predicted that the increase of the score in this area will be seen. In the list, the total scores of Düzce University in maximum indicator scores are given in Figure 5 according to the years.

Table 5. The rankings of Düzce University according to the indicators in the last 5 years (GreenMetric, 2023a)

Years	2018	2019	2020	2021	2022
Setting & Infrastructure	625	850	850	1150	1125
Energy & Climate Change	525	825	875	850	1235
Waste	450	450	450	450	1050
Water	475	250	150	400	350
Transportation	575	1125	1125	1175	1275
Education & Research	975	775	850	1350	1575

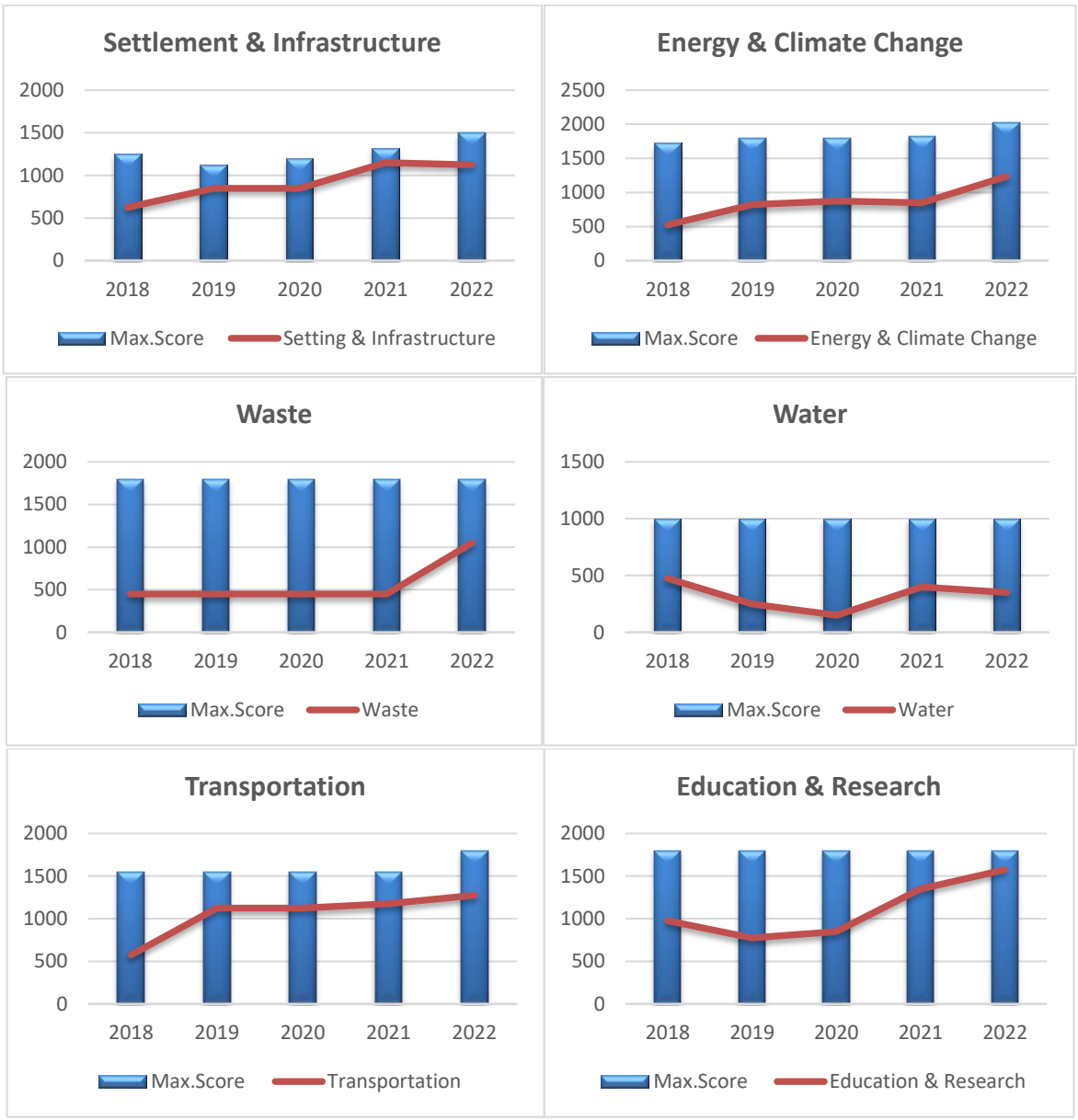


Figure 5. Scores of Duzce University in 6 categories for 5 years (GreenMetric, 2023a)

Scoring in the questionnaire is determined by the evidence presented to the questionnaire. According to the answers to the questionnaire; the evidence of Düzce University campus is explained under the 6 categories.

3.1. Settlement and Infrastructure (SI)

The campus environment and infrastructure will afford a comprehensive assessment of the campus's proclivity towards ecological sustainability. This indicator will also show whether a university is ultimately deemed as a green campus. The aim is to trigger participating universities to green their campuses and provide more green open spaces to preserve the environment. Thus, the increased green spaces on campus grounds can also support initiatives in the city's green infrastructure (such as xeriscaping, sustainable agriculture, rainwater management, and wastewater management, etc.), in line with the understanding of sustainable urban management (Turna & Solmaz, 2023).

Düzce University main campus is 1.78 km². Open spaces area of main campus is 1.661.123,50 m^2 (Figure 6).

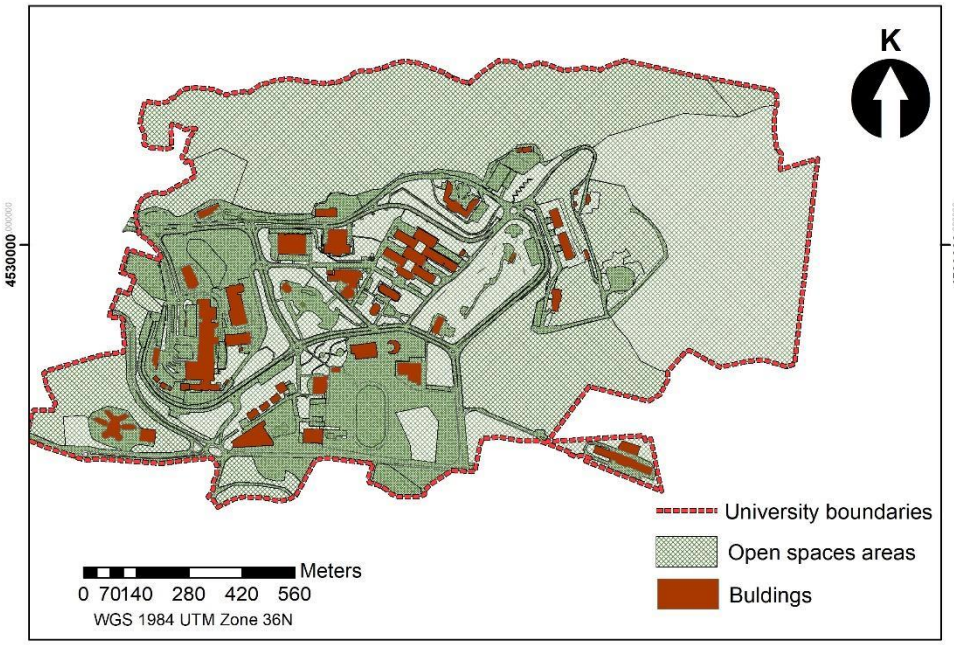


Figure 6. Open spaces areas of the Duzce University's main campus (Prepared by authors)

There is a botanical garden of 46,276 m^2 and a forest of 298,770 m^2 in the open areas. Other open areas consist of planted green areas, permeable and impermeable surfaces (%86). Total campus population (include students and staff) is 22.487 and the total open space area divided by total campus population is 66,7 m^2.

Various facilities are being provided for the disabled in the indoor and outdoor areas of the campus. There are elevators, ramps, toilets for disabled people, and notices written in Braille in all buildings. Pedestrian routes are suitable for the standards stated for disabled people. There is a yellow band application on the pedestrian roads. However, opportunities such as child care room, stations for electrical vehicles are limited.

The university has got healthy infrastructure facilities for students, academics and administrative staffs' wellbeing. Within the scope of medium or long-term conservation; Greenhouse for planting vegetables for campus residents, Experimental Animals Application and Research Center, Herbarium at Düzce University Forest Faculty, Botanical Garden, Clean Energy Resources Application and Research Centre, Application and Research Centre for Recycling of Agricultural Wastes to Industry are available.

3.2. Energy and Climate Change (EC)

Sen et al. (2022) scrutinized the sustainability strategies employed by multiple Australian universities, selecting six institutions as focal case studies for in-depth analysis. The primary challenge for universities is determining how to reduce their own carbon footprints. Wai (2022) reported that more than 80% of universities' CO^2 emissions come from electricity consumption. Therefore, it is crucial to conduct an inventory of the primary electricity usage on campus, considering the amount of electricity consumed, its service life, technology maturity, and financial requirements. Subsequently, setting energy-efficient goals for continuous improvement is essential.

In the questionnaire, various indicators are identified for specific areas of particular importance, such as usage of energy-saving tools, smart building applications, renewable energy usage policy, total energy consumption, energy-saving programs, green building elements, climate change adaptation and mitigation, greenhouse gas policies and carbon quantity. It is expected that these indicators will encourage universities to intensify their efforts towards energy efficiency in buildings and increase concerns about the nature and sources of energy.

In this section, it is evident that Düzce University's performance score is steadily rising. Nevertheless, the pace of advancement is hindered by fiscal constraints and infrastructural deficiencies. Düzce University aims to achieve more energy savings by focusing on energy management. Renewable

energy activities are carried out with solar panels and wind measurements. There are solar panels with a total power of 7.5kW on the roof of the University's Central Laboratories. Here, each type of solar panel is connected to different inverters to produce clean energy for Düzce University Scientific and Technological Research Application and Research Center (DUBIT) by solar panels. 3500 kWh is produced annually from wind energy. In addition, the use of energy-saving light bulbs, LED lighting and Class A devices has become mandatory in the campus. 90% of the bulbs used for lighting on campus are in the category of energy saving bulbs.

At Düzce University, smart stations have been established on campus in order to reduce gas emissions. In order to reduce the use of vehicles, the transportation of the students within the campus has been facilitated by the ring shuttles. Motorcycles are used for transportation of personnel between units. In addition; within the scope of energy conservation and climate change; “Sustainable and Smart Cities, Landscape Architecture, Network Technologies (5G, Internet of Things), Climate Change” doctorate programs were opened.

According to the results of the questionnaire; the campus has many shortcomings in terms of energy. Among the main reasons for this are economic and infrastructural inadequacies. There are academicians who are competent enough in the fields of energy conservation, water management and healthy food. However; no structures were created in the energy-based system during the establishment of the campus. Intelligent building systems are very costly today. Large funds are needed to re-establish these systems in an old structure.

3.3. Waste (WS)

Activities related to waste processing and recycling are significant factors in creating a sustainable environment. The activities of university staff and students on campus are likely to generate a considerable amount of waste. Therefore, waste management and recycling programs such as handling toxic waste, organic waste processing, managing inorganic waste, sewage disposal, and policies aimed at reducing paper and plastic usage should be among the university's areas of interest.

Universities are living laboratories where learning and social interaction thrive (Berchin et al., 2017). Consequently, the adoption of separate waste collection in universities can contribute to the societal embrace, creating a synergistic effect (Adeniran et al., 2017). There are examples globally from various universities (de Vega et al., 2008; Iresha & Prasojo, 2018; Dahlawi & El Sharkawy, 2021): Cornell University (Sun et al.,2022) recycles over 70% of its waste, Florida University (UF Sustainability Task Force, 2002) manages 30% of its waste, and Lagos University (Adeniran et al., 2017) recycles 53% of its waste (Haksevenler, et.al, 2022).

Recycling activities at Düzce University; continues in cooperation with private companies in the recycling of paper waste. For Düzce, which has a high agricultural quality, paper production is carried out with the agricultural wastes (sawdust, hazelnut shell) obtained from these areas within the university. Online systems are used to save paper and speed up transactions during the work and transactions. Paper cups are preferred in campus cafeterias. Used papers are shredded in the shredder machine or collected in paper collection boxes and made ready for recycling. It is forwarded to contracted recycling companies for the processing of solid wastes. Waste batteries are stored and evaluated in the program of the Ministry of National Education. A zero-waste management system has been established at Düzce University Training and Practice Hospital. The zero-waste certificate is given by the Ministry of Agriculture and Forestry. Düzce University’s electronic waste (computers, tablets, printers, etc.) is re-organized and distributed to the primary schools. With the decision taken in May 2021, the installation of a 3.500-liter compost unit machine was started. Work continues with the Zero-Waste Management Project. Since the processes related to sewage waste depend on the local administration, the university administration cannot make any arrangements.

3.4. Water (WR)

The reuse of wastewater has been traditionally allocated for agricultural use (Angelakis et al., 1999; Fatta-Kassinos et al., 2011; Pedrero et al., 2009). Worldwide, the reuse is progressing to encompass urban and industrial applications (Kellis et al., 2013). The recycled wastewater on university campuses

serves a multifaceted purpose, finding application in landscape irrigation, toilet flushing, and various other washing activities.

Water usage on campus is a significant criterion highlighted in the GreenMetric standard. This criterion aims to reduce water consumption on campuses, develop conservation programs and preserve living spaces. Diverse criteria, encompassing initiatives related to water conservation, water recycling, water use efficiency, and the utilization of treated water, are assessed as integral components in the pursuit of attaining these objectives. These indicators measure campus sustainability efforts by focusing on sustainable water resources and efficient water usage.

One of the components negatively affecting Düzce University's ranking is wastewater reuse/recycling. The wastewater line of the campus is connected to the local sewer system. This is a situation that prevents scoring and sustainability evaluation. However, treatment works related to municipal activities continue in the local sewage system. Because Düzce Province basin is a valuable basin that provides drinking water. A different campus wastewater scoring method is needed in the survey, taking into account country-specific regulations for water reuse and recycling (Angelakis et al.; 2003).

Within the framework of the Düzce University Climate Change Action Plan, determinations pertaining to water management have been formulated and are poised for execution. The wastewater treatment facility affiliated with the faculty of medicine is in active use. There are warnings about the effective use of water in toilets for water saving. A botanical garden is being built in the valley structure within the university. The dried-up stream in the valley is being revived. With the recirculation unit installed in the water element, the water becomes reusable.

Progress could not be made as some decisions regarding water management depend on the local government in this category. However; there are nature-based sustainable solutions for water management. In this regard, the initiatives of academicians on open spaces have started.

3.5. Transportation (TR)

Sustainable transportation is considered as a factor of social transformation to achieve social rights such as education (Randal et al., 2020). Thus, spatial mobility is an important factor for participation in education and other activities (Sterzer, 2017).

It's impressive to see universities embracing carbon neutrality and prioritizing the assessment of climate impacts within their products and services. The concurrent shift towards low-carbon technologies across electricity, buildings, and transportation sectors highlights a proactive stance in addressing climate change. This commitment solidifies universities' influence and active contribution to reducing their environmental footprint while combatting climate change (Tian & You, 2019; Zhang et al.,2020; Sun, et al., 2022).

Transportation policies on campuses play a crucial role in reducing environmental impact. Limiting the number of vehicles can reduce carbon emissions and air pollution within and around the campus. Campus buses, bike lanes and pedestrian policies not only encourage students and staff to reduce private vehicle usage but also contribute to a cleaner environment. Additionally, using eco-friendly public transportation can decrease carbon pollution, thereby supporting the sustainability efforts of the campus. Such initiatives are crucial in reducing the environmental footprint of campuses and providing a cleaner living environment.

Transportation is one of the parts of the campus that gets good scores. In order to provide access within the campus, ring services (shuttle/bus campus inside campus, campus motocycle using by personal) are organized at certain times. Cycling is common. That's why there are bike parks. However, bicycles do not belong to the campus. Düzce University Cycling Club organizes various activities in this context. Moreover; the Electric Vehicles and Digital Transformation Application and Research Center at the university conducts academic studies on clean and economic energy consuming electric vehicle technologies and smart factory technologies. There is an average of 100 zero-emission vehicles per day on campus. Parking area is % 8 of the campus area. Roads are reserved for vehicular and pedestrian paths. Access to each building is available. With sufficient lighting, separators are used in places on the

roads. Permeable floors are given priority. There are ramps and direction blocks with a suitable design for pedestrians with physical disabilities. Efforts to increase the accessibility of the disabled need to be continued. And, approximate daily travel distance of a vehicle in campus is 5 km.

3.6. Education and Research (ED)

Education and research play a fundamental role in sustainable development and environmental empowerment. Environmental education enhances students' awareness of the environment and encourages them towards an eco-friendly lifestyle. This positively influences their personalities by enabling the growth of cultured and environmentally conscious individuals. This process can contribute to the future generations being more environmentally sensitive and responsible.

This section is the area with the highest score. Academic studies are generally based on sustainability. There are actively 72 courses related to sustainability at Düzce University. In the last three years, 7 projects and startups related to sustainability have been produced within university. Funds dedicated to sustainability research is %20 of total research funds. The number of scientific publications on sustainability in the 2018-2020 academic year is 311. A large number of events related to sustainability are carried out in cooperation with students, academics and staff. There is university-run sustainability website. Düzce University of sustainability report is published every year.

Muñoz-Suárez et al. (2020) drew attention to the fact that young universities mostly applied to the GreenMetric ranking in their studies. In the study; it is discussed that while the old universities' campuses have more rigid structures that make it difficult to adapt to sustainability, the developing universities are more connected to the natural environment and adapt to the new needs of the society. Düzce University also has a developing campus. However, the fact that on-campus buildings are not built on an energy-efficient basis has a negative impact on the scoring. The revitalization and sustainable reconfiguration of buildings necessitate substantial financial investment. This limits the university as an indicator that is difficult to achieve in the country's conditions. There may be a flexibility in the survey for old or young universities in similar circumstances.

In this ranking, when the geographical and economic conditions of the countries are examined; it is discussed in the literature that some indicators in the survey have conflicting situations in sustainability assessment and ranking (Suwartha & Sari, 2013; Lauder et al., 2015; Boiocchi et al., 2023). When the indicator regarding the number of renewable energy sources (EC) on campus is evaluated; points are taken based on increasing the diversity of renewable energy sources used in the guide. Various renewable energy sources are used and developed in the experimental areas of Düzce University. Considering the geographical conditions of the university; it is possible to benefit from wind and solar energy (Yerli & Özdede, 2017). For universities that do not have these conditions, a disadvantageous scoring system is formed in the evaluation of sustainability (Boiocchi et al., 2023). Under this indicator, parameters related to electricity consumption are questioned. Düzce University has a developing campus. There is an increase in electricity consumption due to population growth on campus and the presence of many laboratories. The decrease in consumption due to the decrease in the campus population during the Covid-19 process is an indicator of this situation. There is a demand situation on campus that cannot be met from renewable energy sources. The fact that universities with small campuses and less population are more advantageous in this indicator affects the ranking.

When waste management is examined globally, it's observed that developed countries are ahead in transforming waste into more efficient and sustainable forms (Moya et al., 2017; Nanda & Berruti, 2020). Nevertheless, developing nations, having recognized the import of waste management belatedly, have consequently experienced a relative lag; Türkiye is emblematic of a similar circumstance (Al-Khatib et al., 2007; Ikhlayel, 2018; Haksevenler et al., 2022). For instance, while municipal waste recycling rates are at 67% in Germany and 57% in Austria (EEB, 2018), they stand at only 13% in Türkiye (Turkish Statistical Institute, 2021). The execution of initiatives such as the Zero Waste Regulation in Türkiye denotes substantial strides towards the advancement of waste reduction and recycling endeavors. Policies of this nature can assume a pivotal role in fostering awareness regarding waste management and cultivating improved recycling practices within academic institutions.

4. Conclusion and Suggestions

GreenMetric primarily serves as a tool for heightening awareness; however, in subsequent iterations, it is envisioned to undergo adaptations aimed at catalyzing tangible transformative changes. Understanding needs to shift to action if we are to address emerging global challenges is crucial. Engaging in the GreenMetric assessment serves to advance the Düzce university's internationalization endeavors and bolster its recognition by positioning its sustainability initiatives on the global stage. This participation may yield heightened web traffic to the Düzce university's website, increased references to the institution in relation to sustainability issues across online platforms, and expanded communication channels with institutions expressing interest in the university's sustainability initiatives. Düzce University is advancing its trajectory toward the realization of a sustainable/green campus, facilitated by the discernible impact of the survey components. The creation of a sustainable/green campus will make a difference in Düzce province and accelerate the actions of local development. Additionally, Düzce University is committed to promoting energy efficiency, increasing the use of clean and renewable energy resources, and actively participating in the fight against climate change. The University's goal is to become a university that offers a high quality of life and welfare to all students and employees with low carbon intensity, in line with Turkey's national vision for climate change. In this context, Düzce University is at the beginning of its journey towards sustainability, and in the coming years, GreenMetric will serve as a guide to help take decisive and concrete action towards achieving tangible change. Although Düzce University makes improvements in UI GreenMetric rankings every year, it should focus on waste management, water management, infrastructure and transport issues that need to be improved.

Finally, on the way to achieving the 2053 Net Zero Emission and green growth target, it is essential to take innovative steps at the university level to the national level. The GreenMetric ranking system is a valuable tool for the improvement of the universities.

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