The Classification of the University for Type of Campus Setting in a World Sustainability Ranking

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Abstract. Sustainability indicators and integrated indexes are gaining lot of importance and increasingly recognized as a powerful tool for policy making and public communication, in providing information on countries in fields such as environment, economic or social improvement. All over the world a network is being developed to tackle these issues in a homogeneous way. UI GreenMetric world ranking has been recognized globally as the only simple and accessible sustainability ranking and acts as a reference point, in particular to help universities in developing countries to create sustainability, promote research and development technology and accelerate development in all research areas, through various technological improvements. The aim of this work is to study the relationships between the rankings made on the basis of sets of sustainability indicators and the corresponding typology by Campus Setting.

Keywords: International ranking · Sustainability indicators · Campus setting

1 Introduction

Sustainability indicators and integrated indexes are gaining lot of importance and increasingly recognized as a powerful tool for policy making and public communication, in providing information on countries in fields such as environment, economic or social improvement [1, 2].

All over the world a network is being developed to tackle these issues in a homogeneous way. In particular, the UIGWURN (UI GreenMetric World University Ranking Network) network has defined three main thematic priorities for activities: 1) shaping global higher education and sustainability research, 2) creating global sustainability leaders and 3) collaborating on solutions to sustainability challenges.

The contribution is the result of joint reflections by the authors, with the following contributions attributed to S. Montrone (Sect. 1, Subsect. 3.2), M. Cazzolle (Sect. 2, Subsect. 3.1) and to P. Perchinunno (Subsect. 3.3, Sect. 4).

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The 2030 agenda, with the 17 sustainable development goals (SDGs), also presents an integrated vision of the three different development dimensions. Among the proposed objectives, the following are particularly important and can be related to the indicators used in green metric classification:

GOAL 3 - Ensuring health and well-being conditions for everyone at all ages: reduction of the world mortality rate of maternal, neonatal and children under 5 years of age due to preventable causes, through adequate health care for all and by supporting the research and development of vaccines and medicines for communicable diseases.

GOAL 4 - Offer quality, inclusive and equal education and promote lifelong learning opportunities for all: education can guarantee young people a better future because reading and writing has helped men and women by eliminating all forms of gender discrimination and promoting equal access to all levels of education.

GOAL 6 - Ensure the availability and sustainable management of water and hygiene conditions for everyone: water is a source of life and must be accessible to anyone; universal access to clean and drinking water is essential and hygiene conditions must be adjusted with particular attention to the most vulnerable people.

GOAL 7 - Ensuring access to clean, cheap and sustainable energy for all Energy systems are a fundamental element for everyone's daily life: it is necessary to make them accessible to everyone.

GOAL 9 - Building resistant infrastructures, promoting sustainable and inclusive industrialization and promoting innovation: both infrastructure and industry are important to support the entire economic development and our well-being by becoming sustainable and reliable with technological development and research.

GOAL 11 - Make cities and communities safe, inclusive, resistant and sustainable. The environment that surrounds us affects our habits and lifestyles: the improvement from a sustainable point of view of our living spaces is important.

GOAL 12 - Ensuring sustainable consumption and production models. Our planet needs to be respected and safeguarded: waste and chemicals released above all by large multinational companies must be reduced through sustainable policies based on product recycling.

GOAL 13 - Take urgent action to combat climate change and its impact: the issue of climate change must be addressed with sustainable global policies and strategies in order to stem environmental risks and actual natural disasters.

GOAL 14 - Safeguarding the oceans, seas and marine resources for their sustainable development: the conservation and sustainable exploitation of the oceans, seas and all those resources within them are important for our life and for our health.

GOAL 15 - Protect, re-establish and promote the sustainable use of terrestrial ecosystems, the sustainable management of forests, combat desertification, stop and reverse the degradation of the territory and stop the loss of biodiversity.: preserving our planet is a task entrusted to all and for this reason it is necessary to pursue a joint action to protect, restore and promote the sustainable use of the terrestrial ecosystem.

GOAL 17 - Reinforce the meanings of implementation and revitalize global collaborations for sustainable development: strong involvement of all components of society, from businesses to the public sector, from civil society to philanthropic institutions, from universities and research centers to information and culture operators.

The GreenMetric user interface has been recognized globally as the only simple and accessible sustainability ranking and acts as a reference point, in particular to help universities in developing countries to create sustainability, promote research and development technology and accelerate development in all research areas, through various technological improvements.

The significant impact of the GreenMetric UI ranking is shown in the growing number of participants covering regions of North America, South America, Europe, Africa, Asia and Australia and Oceania [3, 4].

2 UI Greenmetric World University Ranking

2.1 Short Presentation of the Survey

UI GreenMetric World University Ranking, promoted by the University of Indonesia (UI), is a world ranking of universities launched in 2010 with the aim of creating an increasingly extensive sustainable environment.

This ranking offers the opportunity to compare the environmental sustainability of the various university campuses through scores assigned to certain indicators that measure the efforts made in developing an ecological infrastructure that involves education, research and the surrounding environment and stimulates improvement actions.

The initiative has always been appreciated by academic communities all over the world, recording over the years a continuous increase in universities and in the different participating countries (in 2019 the number of universities that joined the ranking is 8 times higher than in 2010). Over the years more and more attention has been shown not only to the environmental aspect but also to the economic and social aspect, comparing itself more fully on the concept of global sustainability (Fig. 1).

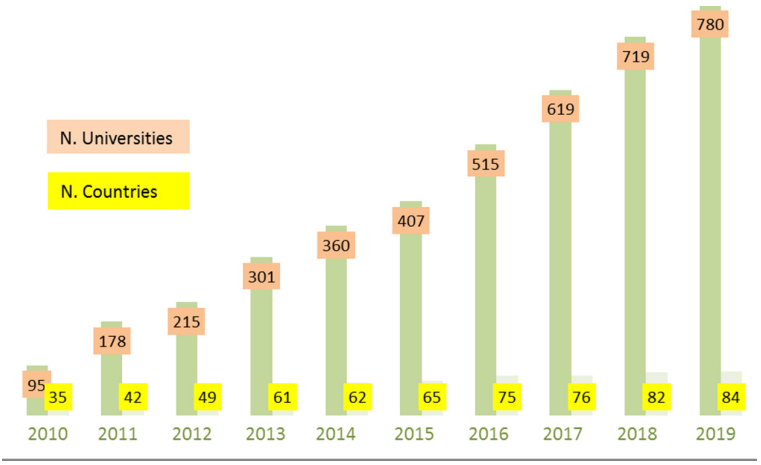

Fig. 1. Number of universities and countries belonging to the UI GreenMetric. Source: Our elaboration on Green Metric data

2.2 Methodology of Green Metric

The Green Metric working group, made up of experts in cross-cutting areas, selected 6 categories deemed most important for the assessment of universities that deal with sustainability using certain criteria. These criteria allow universities to be grouped according to their size, location (urban, suburban, rural), degree of green space available, electricity consumption and carbon emissions, transport used and related policies, water resource management, waste management. The information required to construct the sustainability indicators is therefore placed in the respective categories chosen and, in some case, they are transversal to several categories. Each category is assigned a specific weight and the indicators are assigned a certain score useful for the construction of the ranking [5].

Of course, over the ten years the methodology used has changed, adapting to different needs. In the first version used in 2010, 23 indicators were used within five categories; in 2011 the indicators were increased and brought to 34; in 2012 only one indicator was eliminated. Subsequently, the introduction of a new category related to education and research on sustainability was considered. In 2015, the methodology improves with the inclusion of two questions relating to carbon footprints in the "energy and climate change" section and some sub-indicators in the "water" and "transport" section. A big change in the methodology is made in 2016 considering the new sustainability trends. In 2017, documentation was requested to demonstrate what was declared [6].

The six categories identified and currently used are [5]:

- Setting and Infrastructure (15%): the category of indicators focuses on the type of Campus and its infrastructure by providing basic information on the impact of the university on the environment. This allows the participating universities to reflect on the possibility of providing more space for greenery and protecting the environment, as well as investing in the development of sustainable energy to be considered Green Campus.
- Energy and climate change (21%): the category of indicators focuses universities on energy issues and climate change by verifying the use of energy efficient appliances, the policy of using renewable energy, the energy saving program, green building, adaptation to climate change, the policy of reducing greenhouse gas emissions, for their greater commitment in this direction in buildings. Carbon footprint measurement was introduced in 2015 to induce universities to look into problems within their campuses.
- Waste (18%): the recycling of toxic waste, the treatment of organic waste, the treatment of inorganic waste, the disposal of water waste, the policy to reduce the use of paper and plastic are important factors since university staff and students on campus contribute to the production of a large number of waste. So, it is important to monitor and measure waste treatment and recovery activities.
- Water (10%): universities must reduce water consumption and increase the water conservation program through the use of water-efficient equipment and habitat protection.

Table 1. Indicators by category and maximum score

Categories	Indicators	Max score
Setting and Infrastructure (SI)	The ratio of open space area to total area	300
	Total area on campus covered in forest vegetation	200
	Total area on campus covered in planted vegetation	300
	Total area on campus for water absorption besides the forest and planted vegetation	200
	The total open space area divided by total campus population	300
	Percentage of university budget for sustainability efforts within a year	200
Energy and Climate Change (EC)	Energy efficient appliances usage	200
	Smart building implementation	300
	Number of renewable energy sources in campus	300
	The total electricity usage divided by total campus population (kWh per person)	300
	The ratio of renewable energy production divided by total energy usage per year	200
	Elements of green building implementation as reflected in all construction and renovation policies	300
	Greenhouse gas emission reduction program	200
	The total carbon footprint divided by total campus population (metric tons per person)	300
Waste (WS)	Recycling program for university waste	300
	Program to reduce the use of paper and plastic on campus	300
	Organic waste treatment	300
	Inorganic waste treatment	300
	Toxic waste treatment	300
	Sewage disposal	300
Water (WR)	Water conservation program implementation	300
	Water recycling program implementation	300
	Water efficient appliances usage	200
	Treated water consumed	200
Transportation (TR)	The total number of vehicles (cars and motorcycles) divided by total campus population	200
	Shuttle services	300
	Zero Emission Vehicles (ZEV) policy on campus	200
	The total number of Zero Emission Vehicles (ZEV) divided by total campus population	200
	The ratio of the parking area to total campus area	200
	Transportation program designed to limit or decrease the parking area on campusfor the last 3 years (from 2016 to 2018)	200
	Number of transportation initiatives to decrease private vehicles on campus	200
	Pedestrian path policy on campus	300
Education and Research (ED)	The ratio of sustainability courses to total courses/subjects	300
	The ratio of sustainability research funding to total research funding	300
	Number of scholarly publications on sustainability	300
	Number of events related to sustainability	300
	Number of student organizations related to sustainability	300
	University-run sustainability website	200
	Sustainability report	100

Source: Our elaboration on Green Metric data

- Transportation (18%): transport policy is important for limiting the number of private cars on campus, encouraging the use of environmentally friendly public transport, cycling or walking to reduce the carbon footprint on campus and create an environment healthier.
- Education (18%): the university plays an important role in training new generations on issues related to sustainability. Therefore, the offer of training in this sense and any other available means of awareness (events, publications, web) have a fundamental educational role.

Specific indicators are required within the 6 categories. Most of them have an associated score to be able to draw up the ranking (Table 1).

3 Main Results

3.1 International Ranking

It is possible to calculate some significant statistical indicators in the period from 2010 to 2019 based on the total scores from general classification.

The number of universities that participated in the ranking over the years has increased, starting from 95 universities in 2010 up to 780 international universities in 2019 (last year of the survey).

The total average score since 2010 has decreased until 2015, except for 2014 and then increases again until 2019. The minimum and maximum scores oscillate between 550 and 9,125 in the 10 years considered (Table 2).

Table 2. Some descriptive statistics about total score (2010–2019)

Year	N. Universities	N. Countries	Total score			
			Average	Min	Max	Std dev.
2010	95	35	5,464	2,153	8,213	1,324
2011	178	42	5,423	2,185	8,034	1,298
2012	215	49	4,980	1,857	7,569	1,127
2013	301	61	4,945	1,807	7,521	1,138
2014	360	62	5,169	1,957	7,803	1,208
2015	407	65	4,351	1,449	7,267	1,278
2016	515	75	4,425	805	8,398	1,360
2017	619	76	4,426	1,413	7,552	1,185
2018	719	82	4,810	1,025	9,125	1,523
2019	780	84	4,990	550	9,075	1,656

Source: Our elaboration on Green Metric data.

These universities are located all over the world; in 2019 most of them (about 80%) are in the following countries (Fig. 2), with a prevalence in Indonesia (9.2% of the total), Russia, Iraq, Colombia and Turkey (5%).

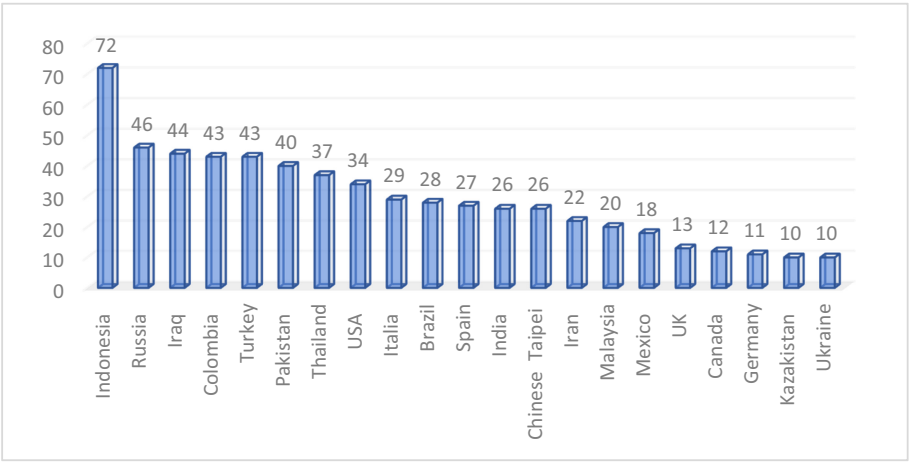

Fig. 2. Number of universities in the ranking by country (2019). Source: Our elaboration on Green Metric data

The universities classified in the Top 25 (Fig. 3) are mainly located in the United Kingdom (32%), United States of America, Netherland and Ireland (12%).

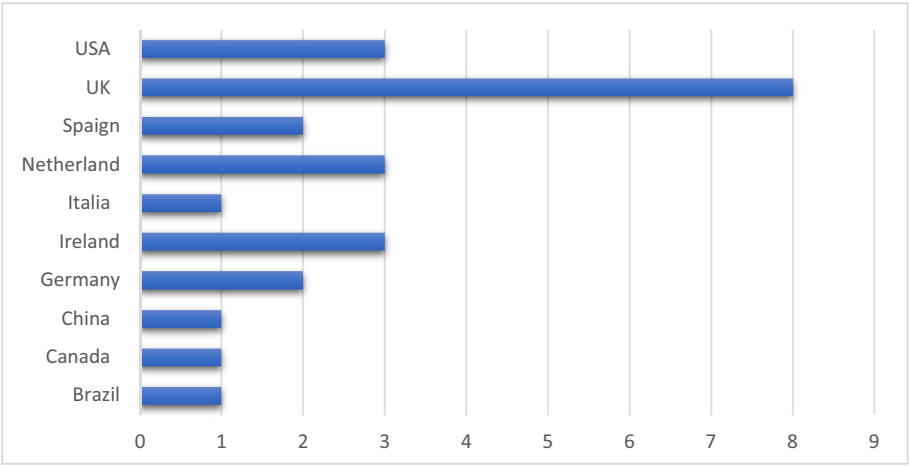

Fig. 3. The Top 25 university in 2019 by nationality (2019). Source: Our elaboration on Green Metric data

The top 10 universities of 2019 are instead located mainly in the United Kingdom (Fig. 4).

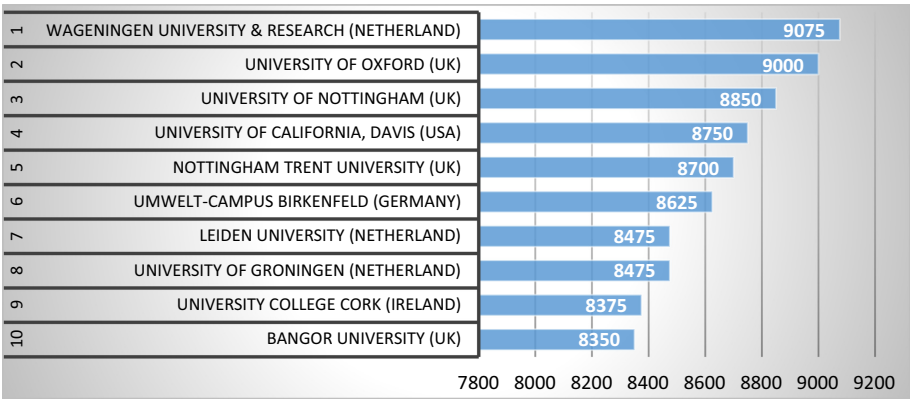

Fig. 4. The Top 10 university in 2019. Source: Our elaboration on Green Metric data

In the 2018 edition we find all the top 10 of 2019 but with different positioning, except for Leiden University which is replaced by the University of Connecticut. The University of Wageningen is confirmed first in the two editions.

In the last four years (2016–2019) at least 5 universities remain in the top 10. In the other years the number decreases but the presence of other universities intensifies. The University of Nottingham is always present among the top 10 in the whole decade.

3.2 The Rankings for Categories of Indicators

In addition to the general classification it is possible to draw up a sub-ranking: ranking by Indicators (for 6 categories), ranking by Campus Setting for the type of Campus (urban, suburban, rural, in the city center - high rise building), ranking by Country.

Analyzing the ranking of the Top 10 by categories of Indicators (Table 3) it is clear how the overall score hides the peculiarity of the results achieved in the different categories, since it is made up of the sum of several indicators (as indicated in the previous paragraph). In fact, it can be noted that universities that have not obtained the highest score have excellent ratings in certain categories. For example, Bangor University, which is positioned in tenth position, has very high values in the categories "Transportation" and "Education and research". On the contrary, Wageningen University & Research (Netherland), which is in first position in the ranking with 9,075 total points, presents lower values than the universities classified in the following positions as regards the category "Setting and Infrastructure" and "Transportation".

This further classification helps universities to understand for which categories of indicators it is necessary to intervene more in order to improve both the ranking and the living conditions of their university.

Table 3. The Top 10 university per categories of indicators in 2019

	University	Setting and infrastructure	Energy and climate change	Wast	Water	Transportation	Education and research	Total score
1	Wageningen University & Research	1,125	1,800	1,800	1,000	1,550	1,800	**9,075**
2	University of Oxford	1,200	1,800	1,800	1,000	1,625	1,575	**9,000**
3	University of California, Davis	1,300	1,650	1,725	1,000	1,525	1,650	**8,850**
4	University of Nottingham	1,250	1,525	1,800	925	1,525	1,725	**8,750**
5	Nottingham Trent University	1,200	1,675	1,800	700	1,525	1,800	**8,700**
6	Umwelt-Campus Birkenfeld	975	1,775	1,500	1,000	1,650	1,725	**8,625**
7	Leiden University	650	1,850	1,725	1,000	1,750	1,500	**8,475**
8	University of Groningen	925	1,575	1,800	1,000	1,525	1,650	**8,475**
9	University College Cork	900	1,750	1,725	775	1,650	1,575	**8,375**
10	Bangor University	1,025	1,675	1,725	425	1,700	1,800	**8,350**

Source: Our elaboration on Green Metric data.

3.3 Classification for the Type of Campus Setting

Regarding the classification for the type of Campus Setting there are 5 different types:

- rural: located in the countryside
- suburban: located in extremely peripheral area with respect to the city
- urban: located in a large urban area
- in city center: located in the city center
- high rise building: consisting of a single tall building

In 2019 they belong to the first group, i.e. the **Rural**, 64 universities mainly located in the USA (9 universities) and India (7 universities). The top 10 of these categories is represented by the following universities (Fig. 5) among which there is the sixth classified in the general top.

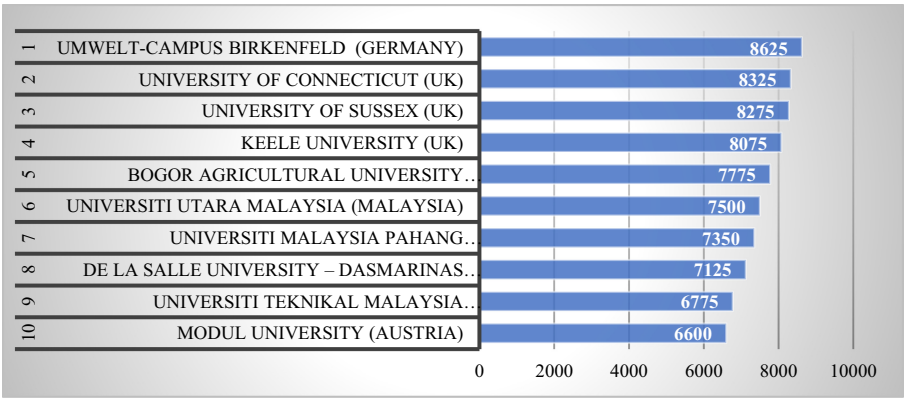

Fig. 5. The Top 10 Rural university in 2019. Source: Our elaboration on Green Metric data

Also, in the 2019 ranking belong to the group of **Suburban** 183 universities mainly located in Indonesia (19 universities) and Thailand (18 universities). The top 10 of these categories is represented by the following universities (Fig. 6) among which there are the first, third and tenth classified in the general top.

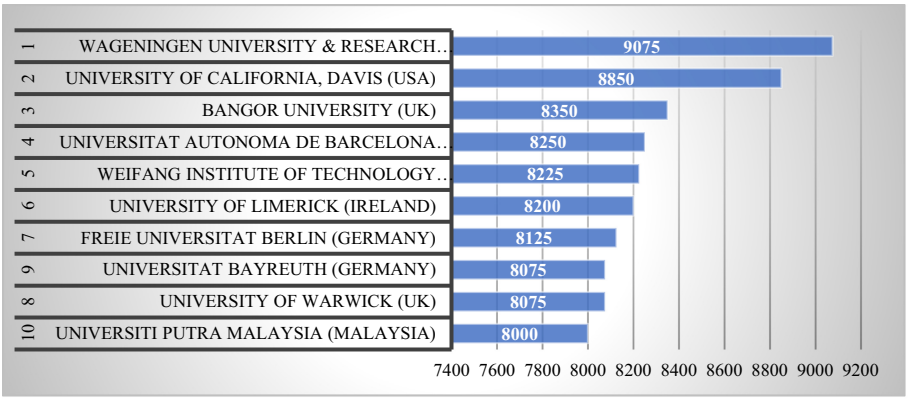

Fig. 6. The Top 10 Suburban university in 2019. Source: Our elaboration on Green Metric data

In the **Urban** ranking we find 385 universities mainly located in Indonesia (35 universities) and Colombia (30 universities). In the top 10 we find several universities in the United Kingdom and the fourth, fifth and eighth universities of the top 10 general (Fig. 7).

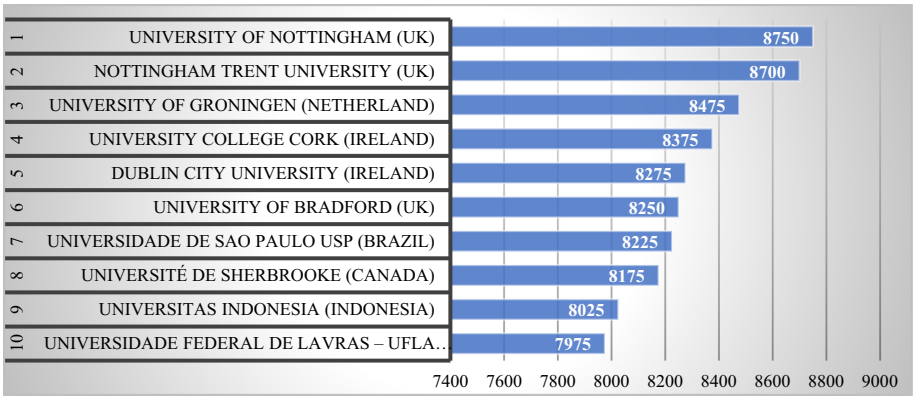

Fig. 7. The Top 10 Urban university in 2019 Source: Our elaboration on Green Metric data

In the ranking of **in city center** we find 142 universities mainly located in Iraq (16 universities) and Russia (15 universities). In the top 10 we find two large Italian universities (Bologna and Turin) and the second and seventh universities of the top 10 general (Fig. 8).

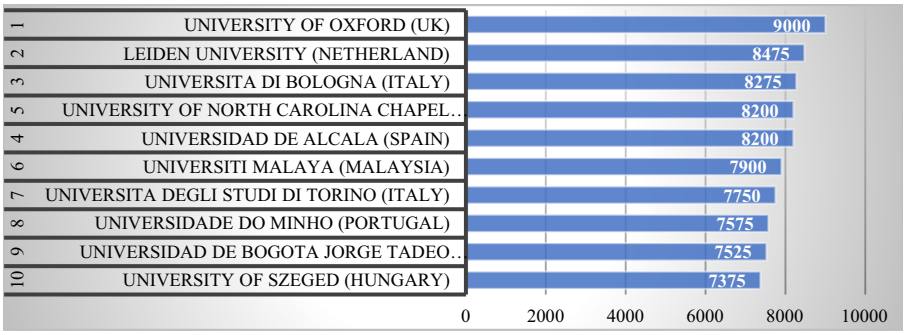

Fig. 8. The Top 10 In City Center university in 2019. Source: Our elaboration on Green Metric data

Last category is the **High-Rise Building** (Fig. 9) which includes only 5 universities occupying very low positions in the general ranking (starting from position 89).

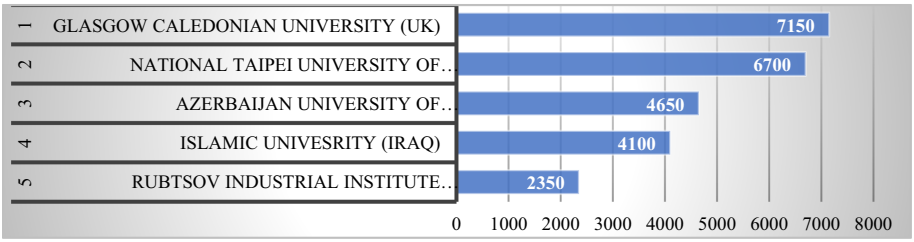

Fig. 9. The Top 10 High Rise Building in 2019. Source: Our elaboration on Green Metric data

Comparing the average scores of all types of universities (Table 4), it emerges that the "In City center" category presents values below the average in all the Categories of Indicators, unlike the universities present in the ranking of "Suburban" which have values above the average in all the Categories.

As for universities classified as "High rise building", they have the lowest average values for Setting and infrastructure and the highest ones for Energy and climate change, Wast and Transportation.

Universities classified as "Rural" have higher average values for Setting and infrastructure and lower average values for Education and research.

Values very close to the general average are found for universities classified as "Urban".

Table 4. Average of the scores by Category of indicators and by type of Campus setting

	Total score	Setting and infrastructure	Energy and climate change	Wast	Water	Transportation	Education and research
General	4,990	735	974	892	475	944	971
Rural	5,115	830	997	884	486	975	942
Suburban	5,328	832	1,002	975	534	992	994
Urban	5,002	721	976	892	478	938	997
In City center	4,456	615	915	783	381	880	882
High rise building	4,990	495	1,070	1,005	505	1,005	910

Source: Our elaboration on Green Metric data.

4 Conclusions

The construction of the ranking is based on a combination of parameters, indicators, properly weighted, chosen by the promoters of the rankings and are often the subject of some controversies due to the subjectivity in the choice of the indicators, arbitrary attribution of weights, variability in the definition of the classification of the results [7–15].

Therefore, a continuous review of indicators and weight systems is always desirable, which often are not univocally applicable to the specificity of universities. To this end, the established networks (UIGWURN network) provide an excellent tool to improve.

The indicators are fed on the basis of the data provided directly by the universities being assessed and therefore the methods of construction and attribution of the scores are subject to attention by the participants thanks also to the return of a fact file with the individual scores obtained by the team Green Metric.

In this way, universities can improve in individual categories with a greater comparison, for example, with universities located in the same geographical position or with a similar structure (campus setting).

The results reported in this study are undoubtedly encouraging and show how universities are increasingly willing to participate in order to achieve good ranking levels and improve in the field of sustainability.

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