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Comparative Analysis of Sustainable Development Environmental Indicators Between Worldwide, Portugal and Brazil and Between two Universities within these Countries

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Abstract. Measuring the environmental performances by indicators is considered as a crucial step to keep track of progress towards sustainability. This study compares trends in environmental sustainability indicators worldwide, Portugal, Brazil and two universities in these countries. The data collection is done based on findings from the Organisation for Economic Co-operation and Development (OECD) between 2007 and 2017, and reports from both universities between 2010 and 2018. As a result, it can be seen that global Carbon Dioxide (CO_2) emissions decreased (10.6 to 9 ton/capita). Portugal also reduced its CO_2 till 2014 (5.2 to 4.6 ton/capita) but experienced a raise in its rates in the following years. Brazil experienced a growth in its CO_2 (1.7 to 2 ton/capita), as did the Portuguese university (0.85 to 0.87ton/alumnus). World municipal waste decreased (541.8 to 524.4 kg/capita), as well as in Portugal until 2013 (513.7 to 436.7 kg/capita), but in the following years increased. Similarly, Brazil reduced the indexes until 2011 (271.9 to 266.8 kg/capita) and increased in 2012. In the Portuguese university, the rates increased until 2014 (4.02 to 9.02 kg/student) and reduced in 2015, as in the Brazilian university that increased until 2018 (19.53 to 25.08kg/student). Portugal, Brazil, and the two universities pointed out a trend of increasing emissions and waste while the world data a reduction. The Brazilian university had higher municipal waste rates than Portugal. The consumption of water and energy in the Portuguese university decreased while it increased the Brazilian university. Actions have already been undertaken at universities to lower the environmental burden by improving the energy efficiency of buildings through the use of cleaner energy, setting up mobility studies, and campaigns to reduce consumption and cut down waste generation.

1. Introduction

Reflection on economic development has led to increased awareness of environmental problems that have occurred due to living standards, which are incompatible with environmental regeneration. This resulted, from the 1970s, to the emergence of the concept of sustainable development, which: "advocates a type of development that ensures the quality of life for current and future generations without destroying the support base that is the environment." [1]

From this perspective, to achieve sustainable development, it is required changes in business practices through a lean, efficient and green organization (green business practice means "formally mindful of environmental issues"). This implies applying some principles in every step of an

SBE: urban planning, global problems, local policies

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organization's work, such as doing more with less, waste-free design, carbon-friendly power supply, and more. [2]

The approach to sustainable development has become more globalized and less localized. In the global context, it seems that the dependence of human societies on natural resources has been decreasing. This fact that can be confirmed from the decrease of production and consumption of energy intensive resources, increase of non-intensive energy products and the service sector. [1]

For effective actions to take place concerning existing and potential social/environmental challenges, society needs to base its development scientifically based on: appropriate policies; education that raises collective awareness and leads to action; investment to build new or improved existing technologies; and changes in economic and social structures. [3]. Thus, sustainable development can be defined and operationalized through the development and application of indicator systems or assessment tools that can measure sustainability. Some methods seek to assess sustainability from the assumption of some characteristics and goals of society, while others seek to observe the goals and emerging principles of society itself. Both are considered important for a more elaborate picture of what sustainable development is. [1]

Indicator systems and assessment tools can be targeted at buildings or organizations. Thus, a campus, as an organization that often has a robust building infrastructure, can benefit from the existing different systems and tools. [4] A university is made up of a community of individuals in which its operations involve a wide range of facilities and activities, including all waste generated, chemical consumptions, energy used and other demands. [5]

A campus can be compared to small urban centers. Higher education institutions carry out a series of core activities related to teaching, research, extension, and others related to the operation including food, lodging, convenience. Campus activities, therefore, require a complex of buildings and basic infrastructure, consisting of water and energy supply networks, sewage and rainwater collection networks, and access and waste collection routes. [4]

In building analysis, sustainability assessment systems aim to collect and report information and indicators for decision making during the different phases of building construction, design and use. From the use of indicators, phenomena are identified, analyzed and valued. [6] These systems aim to assess the environmental impact of buildings and construction projects, and may include urban scale projects, community projects and infrastructure. They involve issues related to reducing the use of non-renewable materials, water use, emissions, waste and pollutants. [7] It can also point out the optimization of local potential, preservation of regional and cultural identity, minimization of energy consumption, protection and conservation of water resources, use of environmentally friendly materials and products. [6]

These systems are based on the evolution of categories and indicators, in which a building's sustainability index is expressed by a score derived from weights assigned to system categories and indicators. The sustainable performance of the building is then evaluated by a certificate issued by the adopted system. [8]

Some environmental assessment systems are used by organizations in the search for of environmental impacts parameters and control, aligned with the concept of sustainability. We highlight the environmental management system (EMS) according to ISO 14001 and the management system by the Global Reporting Initiative (GRI), since both are the systems used by the universities studied in this work.

The application of ISO 14001 helps organization to achieve results that add value to the environment, to the organization itself and to stakeholders by considering environmental aspects of its activities, products and services, with a perspective of life cycle. [9]

GRI is an independent, non-profit, international, partner-supported international organization that has pioneered sustainability reporting since 1997. GRI has helped companies and governments to understand and communicate their impact on sustainability, climate change, human rights. human rights, governance and social welfare, enabling social, environmental and economic benefits to those involved, created from real actions. [10]

According to the Global Sustainability Standards Board (GSSB) [11], sustainability reports make it possible to publicly report economic, environmental and / or social impacts and contributions to the goal of sustainable development. From these reports, an organization can identify impacts on the economy, the environment and / or society, and disseminate the results in a globally accepted standard.

The objective of this study is to compare the trends of environmental sustainability indicators regarding CO_2 emissions, waste generated, water and energy consumption, from global values, considering Portugal and Brazil and from two universities in these countries.
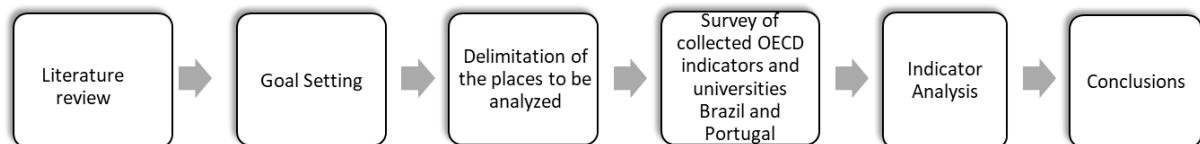
As specific objectives it is intended:

a) to point out the collected environmental indicators.

b) to analyze the values obtained.

c) to identify the actions taken from the universities to reduce indicators.

2. Research Method

The main steps of the research method are shown in Figure 1.

Figure 1. Research main steps

Source: Prepared by the author

The survey of environmental indicators was made from data released by the Organization for Economic Cooperation and Development (OECD), considering the global values, the indices of Portugal and Brazil. The choice of the OECD was based on the worldwide representativeness and participation of several countries.

The OECD data were presented from a global view in the last year collected, the evolution of indicators from graphs and tables, considering the number of inhabitants.

For universities, the sustainability and environmental management reports generated by them were used. University indicators were analyzed considering the number of students enrolled. The analysis period varied according to the availability of information.

2.1. Universidade do Minho (UMinho) - Portugal

It was founded in 1973 and is recognized as an important national reference in the European and global panorama. [12] It has three poles, the campus of Gualtar, Braga, Azurém (photo 1) and Couros, Guimarães.

Photo 1. Campus Gualtar

Source: https://www.uminho.pt/PT/uminho/Paginas/default.aspx# [13]

It has a range of student and educational support facilities and services, which include libraries, laboratories, print shops, banks, bookstores, bars, canteens, restaurants, sports halls and residential apartments. [14]

The university followed the GRI guidelines to develop sustainability reports. UMinho is the first Portuguese university to make this report according to the GRI, the second European and the sixth worldwide. [15]

2.2. *Universidade do Vale do Rio dos Sinos (UNISINOS) – Brazil*

UNISINOS (photo 2) has 50 years of history, seeking development, continuing education and the capacity for innovation. [16]. It was the first university in Latin America to achieve ISO 14001 environmental certification, which shows its commitment to issues related to the environmental impacts of its activities. The implementation and maintenance of ISO 14001 certification is carried out by the Environmental Management System (EMS), based on continuous improvement. [18].

Photo 2. Campus São Leopoldo

Source: http://www.unisinos.br/noticias/sobre [17]

It has one of the largest libraries in Latin America, a multifunctional complex, research institutes, technology and reflection, and a technological complex. [19] The institution is among the largest private universities in Brazil and, besides the campuses in São Leopoldo, and Porto Alegre, is present in eight states of the country. [20]

There are several actions concerning the environment such as the program "Positive Energy", Comitesinos, in which the EMS develops activities for the integration of the entire academic community. Results are presented through reports available on the institution's website. [21] [22] [23] [24].

3. Results and discussion

The results are presented in terms of carbon dioxide (CO_2) emissions, urban waste, water and energy consumption. Table 1 shows which indicators were analyzed.

Table 1. Analyzed indicators

Indicator	OECD Total	OECD Portugal	OECD Brasil	UMinho	UNISINOS
CO_2 emission	X	X	X	X	
Waste	X	X	X	X	X
Water consumption				X	X
Energy consumption				X	X

Source: Prepared by the author
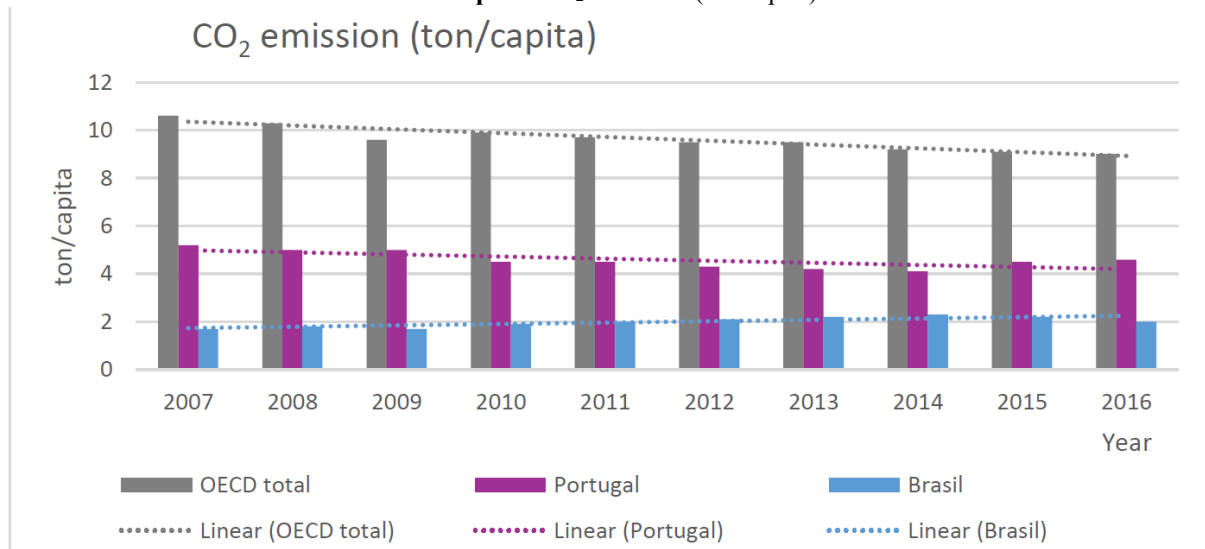
3.1. CO_2 Emission

3.1.1. OECD

Figure 2, Graph 1 and Table 2 show the dimensions of CO_2 emissions in the countries with focus in Portugal and Brazil.

Figure 2. Worldwide CO_2 emission in 2016 (Tons/capita)

Source: OECD [25]

Graph 1. CO_2 Emission (ton/capita)

Source: Prepared by the author, based on OECD [25]

Table 2. CO_2 Emission (ton/capita)

	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
OECD total	10.6	10.3	9.6	9.9	9.7	9.5	9.5	9.2	9.1	9
Portugal	5.2	5	5	4.5	4.5	4.3	4.2	4.1	4.5	4.6
Brasil	1.7	1.8	1.7	1.9	2	2.1	2.2	2.3	2.2	2

Source: Prepared by the author, based on OECD [25]

According to OECD, in 2016, the total CO_2 emission index is 9.0 ton/capita. Portugal and Brazil emit lower index, which is equivalent to 4.6 ton/capita (-48.89%) and 2.0 ton/capita (-77.78%), respectively.

Total OECD tends to reduce CO_2 emissions, as does Portugal. However, Portugal has shown a slight increase in recent years. Brazil has an increase in emissions over the years, but in 2016, reduced its index.

3.1.2. UMinho

UMinho controls CO_2 emissions from natural gas used for heating, electricity and from other sources, considering the consumption of goods and services, waste generated from operations and mobility. Table 3 and Graph 2 show a slight increase in total emissions. The indicator for student emission reflects this slight increase.

Table 3. CO_2 Emission (ton/student), UMinho

Indicator	2010	2011	2012	2013	2014	2015
	UMinho (Portugal)					
CO_2 Emission (ton CO_2eq) **-** total	15131	14982	15499	14726	14580	16038
CO_2 Emission (ton CO_2eq) – directs emissions	1247	1060	891	1060	874	716
CO_2 Emission (ton CO_2eq) – indirects emissions (GEE)	4142	4115	4539	3839	3970	6672
CO_2 Emission (ton CO_2eq) – other indirects emissions	9742	9807	10069	9827	9736	8650
Number of students	17828	17957	18729	18522	18332	18331
CO_2 /student (ton CO_2eq/student)	0.85	0.83	0.83	0.80	0.80	0.87

Source: Prepared by the author, based on UMinho [15] [26][27][28][29]

However, according to chart 2, the total emission in 2015 was higher than 2014 making a 10% increase from one year to another, and from 2010 to 2015 an increase of 5.99%. This fact can be observed due to the high energy consumption in this period and consequently an increase of gas emissions. Indirect emissions and other indirect emissions depend on third parties. [15] In 2015 indirect emissions were marked by unfavorable weather conditions recorded in 2015.

Graph 2. CO_2 Emission (ton. CO_2 eq)
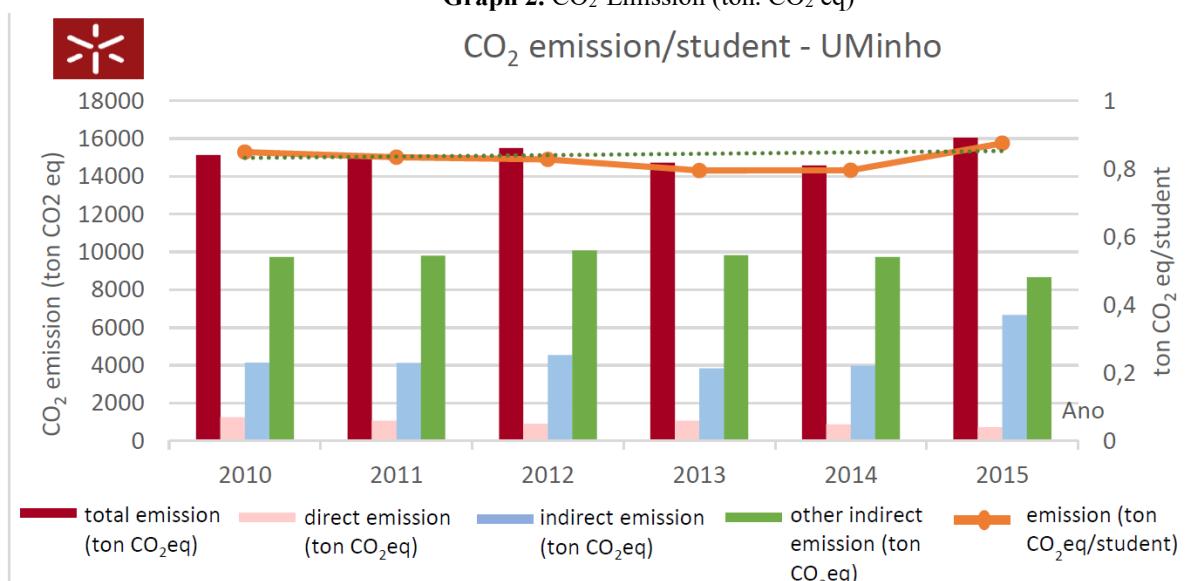
Source: Prepared by the author, based on UMinho [15]

The main source responsible for total emissions is represented by other emissions, where the item mobility is the one that most influences this index (99.32%). This rate has been declining over the years due to studies on the use of cars by the academic community.
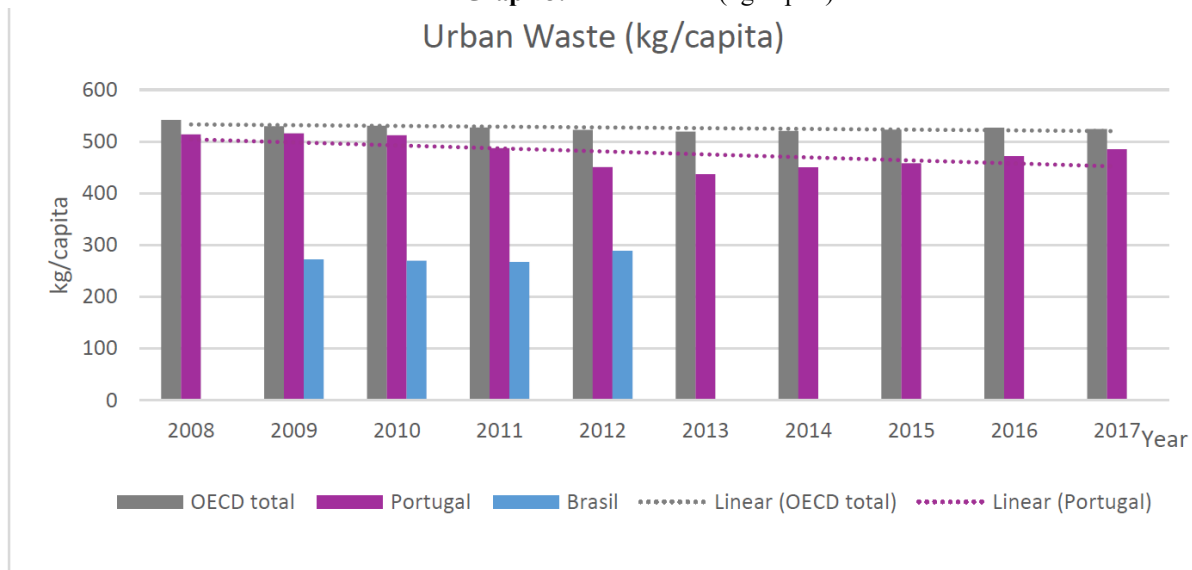
3.2. Urban Waste

3.2.1. OECD

Figure 3 shows the generation of municipal waste (2017). This map can be analyzed in conjunction with graph 3 and table 4.

Figure 3. Urban Waste worldwide in 2017 (kg)

Source: OECD [30]

Graph 3. Urban Waste (kg/capita)

Source: Prepared by the author, based on OECD [30]

Table 4. Urban Waste (kg/capita)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
OECD total	541.8	530	530.3	527.4	522.2	519.7	520.6	523.2	526.8	524.4
Portugal	513.7	515.6	512.3	487.3	450.4	436.7	449.9	457.7	472.2	485.2
Brazil	-	271.9	269.3	266.8	288.7	-	-	-	-	-

Fonte: Prepared by the author, based on OECD [30]

In accordance with Table 4, in 2017 the total OECD index is 524.4 kg / capita. Portugal emits 485.2kg/capita, which is equivalent to -7.48% of the total OECD. According to the last year of collection in Brazil, the index collected was 288.7 kg/capita, equivalent to -44.71% of the total OECD. Portugal and Brazil generate indices lower than total OECD. Both the total OECD index and Portugal show a downward trend considering the years 2008 to 2017. It is noteworthy that in Portugal, their indexes have been increasing, from 436.7 kg/capita in 2013 to 485.2 kg/capita in 2017. In Brazil, considering the years from 2009 to 2012, an increase in trend is indicated.

3.2.2. UMinho e UNISINOS

Both studied universities have indicators of total weight of waste concerning the number of students (table 5).

Table 5. Waste Indicators

Indicador	2010	2011	2012	2013	2014	2015	2016	2017	2018
	UMinho (Portugal)						UNISINOS (Brasil)		
Waste (kg.)	71680	71650	117270	122210	165380	63410	543083	617000	601485
Number of studens	17828	17957	18729	18522	18332	18331	27811	26381	23982
Waste/student (kg/student)	4.02	3.99	6.26	6.60	9.02	3.46	19.53	23.39	25.08

Source: Prepared by the author, based on UMinho [15] [26][27][28][29], UNISINOS [22][23][24]

For UMinho, regarding the global indicator, there is an upward trend over the years (graph 4). It is possible to observe a high increase from 2011 to 2012 (45.62ton), which is not due to an increase in production, but due to new processes and methodologies that have been changed, allowing accurate quantification for publication of results. [28]. In the years 2013 and 2014 there was a significant increase of 43.17 ton.

However, from 2014 to 2015, there is a significant reduction of this indicator from 101.97 tons in which the rate of tons of waste generated decreased from 9.02 kg / student to 3.46 kg / student.

Graph 4. Waste/student (kg/student)
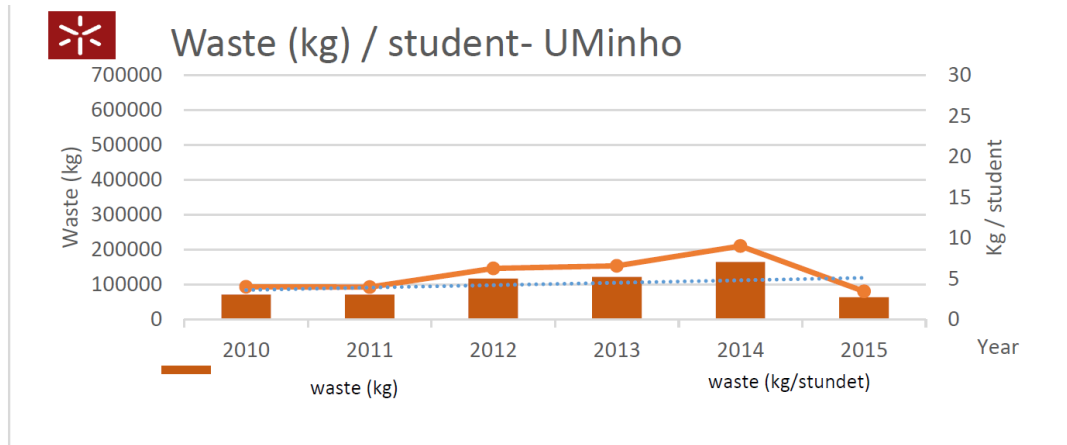
Source: Prepared by the author, based on UMinho [15]

In relation to the waste/student of UNISINOS, there is an upward trend in this indicator (chart 5). It is possible to observe an increase in 2017 of 73.92 ton compared to 2016, as well as an increase of 2.47 kg/student. In 2018, there is a reduction concerning the previous year of 15.52 ton, which is equivalent to a reduction of 0.52 kg/student.

Graph 5. Total waste generation and number of students
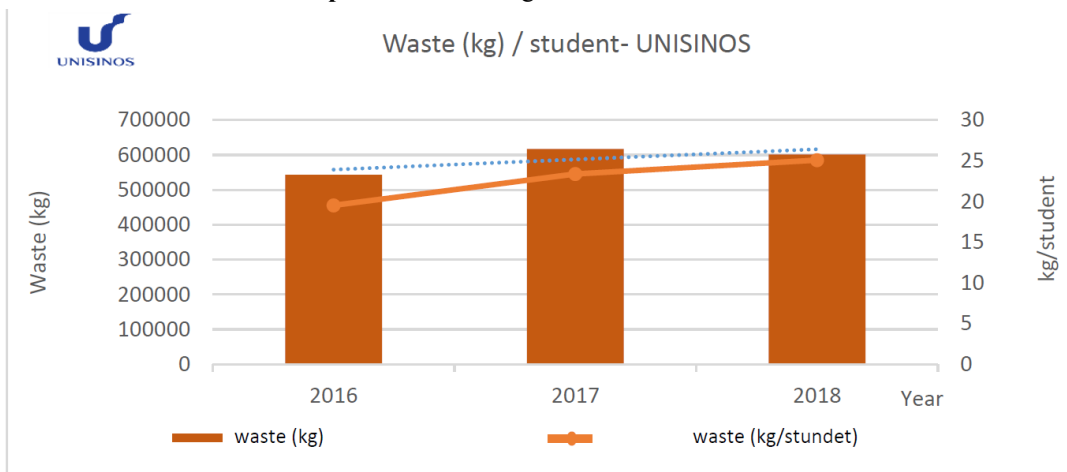
Source: Prepared by the author, based on UNISINOS [22][23][24]

3.3. Water Consumption

3.3.1. UMinho e UNISINOS
The indicators are presented in terms of water consumption (m³) in relation to the number of students (table 6).

Table 6. Water consumption indicator

	2010	2011	2012	2013	2014	2015	2016	2017	2018
Indicator	UMinho (Portugal)						UNISINOS (Brazil)		

Water consumption (m³)	73390	74287	75780	66462	64851	65103	65558	71151	70454
Number of students	17828	17957	18729	18522	18332	18331	27811	26381	23982
Water /student (m³/student)	4.12	4.14	4.05	3.59	3.54	3.55	2.36	2.70	2.94

Source: Prepared by the author, based on UMinho [15] [26][27][28][29], UNISINOS [22][23][24]

According to graph 6, it is possible to verify that there is a tendency to reduce the water consumption in UMinho. It can be seen that consumption has been reducing since 2013, from 73.39mil m³ to 65mil m³ in 2015. If we consider the consumption difference of 2010 and 2105, there is a reduction of 8.287m³, equivalent to -11,29%, as well as the rate of consumption per student that has also been decreasing over the years. There is concern about both economic and laboratory activities regarding the level of water quality that is sent to the municipality system. To this aim, training actions were carried out for staff and students.

In relation to UNISINOS, it is observed (graph 7) a tendency of increase of this index, as well as the index per student. In 2016, an index of 2.36m³/student was found, while in 2018 this index increased to 2.94. In addition to awareness campaigns, constant corrective and preventive monitoring and maintenance are performed to avoid potential leaks in underground networks. Even so, some leaks occur in the secondary networks (near the buildings), due to pipe rupture that becomes difficult to detect.

Graph 6. Water consumption (m³) – Uminho
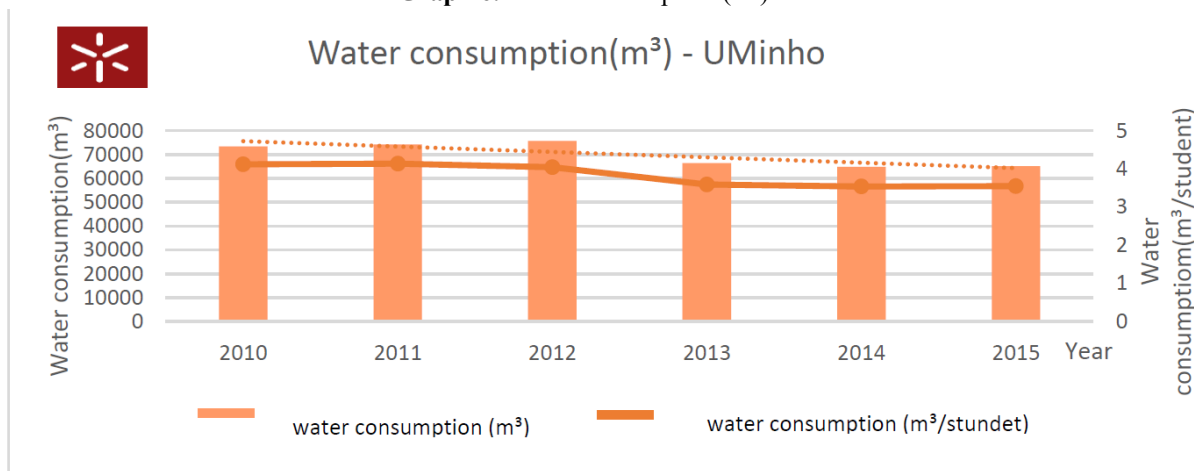
Source: Prepared by the author, based on UMinho [15]

Graph 7. Water consumption (m³) UNISINOS
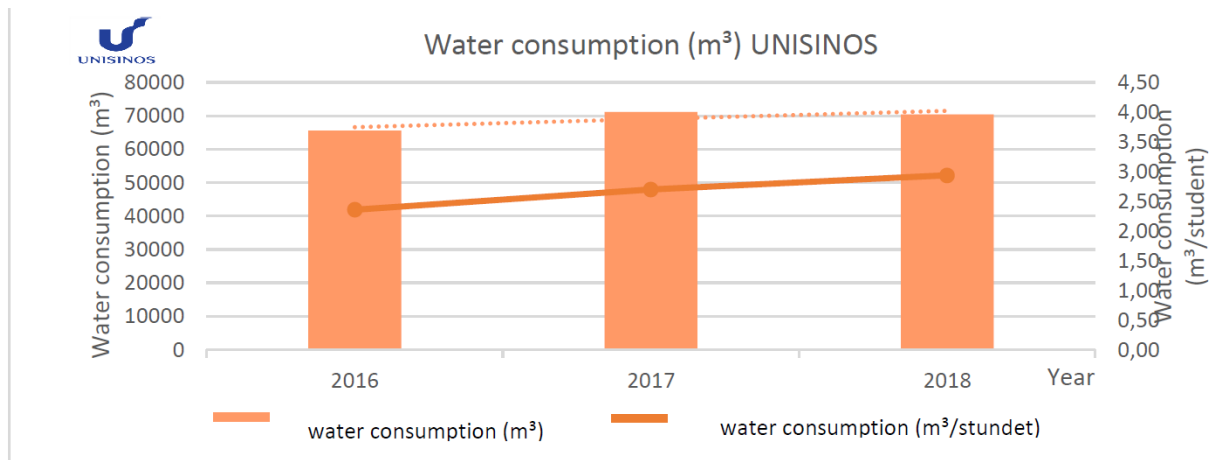
Source: Prepared by the author, based on UNISINOS [22][23][24]

3.4. Energy Consumption
UMinho e UNISINOS
The indicators refer to the energy consumption in relation to the number of students (table 7).

Table 7. Energy consumption (GJ)

Indicador	2010	2011	2012	2013	2014	2015	2016	2017	2018
	UMinho (Portugal)						UNISINOS (Brasil)		
Energy Consumption (GJ)	84359	70871	66941	68245	66620	74359	32599	32461	32751
Propane gas (GJ)	2.5	7.0	13.0	0.0	0.0	0.0			
Natural gasl (GJ)	22227	18888	15861	18892	15572	12771			
Electricity (GJ)	62129	51976	51067	49353	51048	61588	32599	32461	32751
Number of students	17828	17957	18729	18522	18332	18331	27811	26381	23982
Energy/Students (GJ/student)	4.73	3.95	3.57	3.68	3.63	4.06	1.17	1.23	1.37

Source: Prepared by the author, based on UMinho [15] [26][27][28][29], UNISINOS [22][23][24]

At UMinho [26] [27], direct energy consumption by primary energy source accounts for the institution's energy consumption and distributes according to the main primary energy sources, considering the consumption of electricity, natural gas and propane in GJ/year. According to Graph 8, it can be observed a reduction in the consumption trend, where the difference between 2010 and 2015 was 9,999.51 GJ, corresponding to a reduction of -11.85%. However, there is an increase in consumption from 2014 to 2015 of 7,739 GJ, which corresponds to an increase of 11.62% from one year to the next, which is also seen in the increase in the consumption rate per student.

**Graph 8.** Energy consumption UMinho
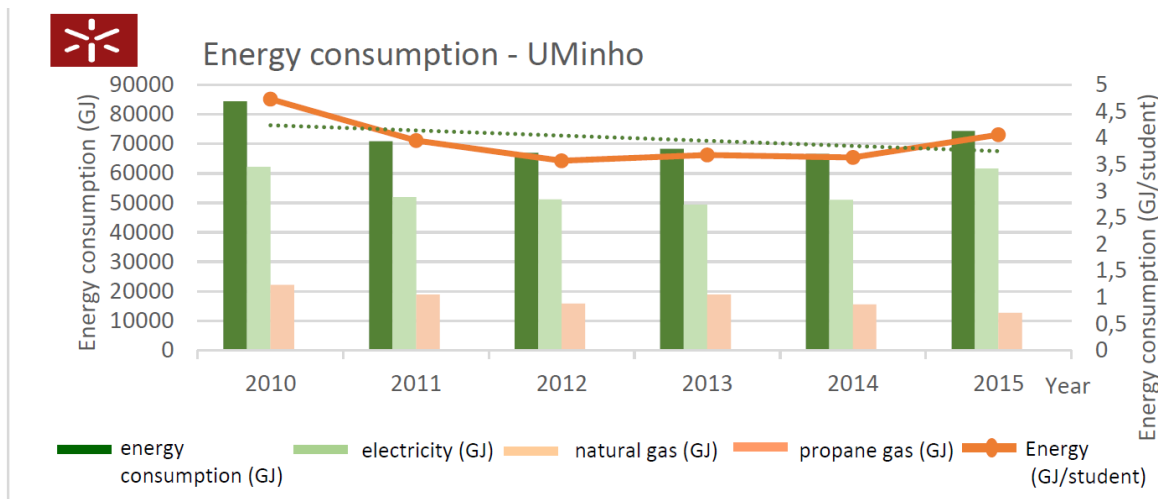
Source: Prepared by the author, based on UMinho [15]

Some actions are being taken as a guide to good practices, infrastructure rehabilitation at UMinho facilities; execution of the medium voltage ring, connecting three sectioning and transformation stations; installation of automatic power factor correction equipment at transformer stations; adequacy of HVAC systems; installations for energy metering and management systems; structural measures to improve the energy efficiency of buildings; awareness-raising campaign on the rational use of energy; training given to the academy.

UMinho has been seeking to increase the energy efficiency of buildings through the use of cleaner energies, for example by using around 47% of electricity supplied from renewable sources such as wind. One of the actions regarding facilities was the inclusion of the electric car charging system on the campus in 2015. [15]

Graph 9 shows UNISINOS indexes of energy consumption, which presents a slight upward trend: 2016 presented consumption of 32,599, while 2018, 32,751GJ. Consumption per student increased from 1.17 to 1.37 GJ student.

Graph 9. Energy consumption (GJ) UNISINOS
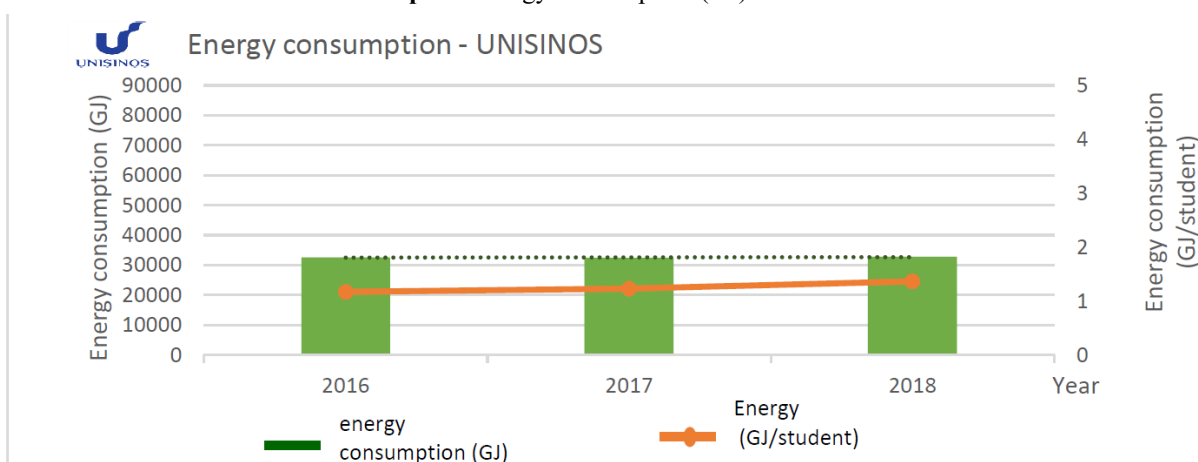
Source: Prepared by the author, based on UNISINOS [22][23][24]

Electricity consumption varies according to some external interference at Unisinos, such as the number of students, government fees, and summer temperatures that result in higher consumption of

air conditioners by the academic community, which requires constant action by investment. The University has been buying electricity from the free market since 2017, which makes the rate lower. In addition, it maintains permanent maintenance actions such as replacement of air conditioning systems with more efficient and modern equipment; reduction of lighting systems of buildings and parking lots between 23h and 6h; replacement of conventional fluorescent lamps with LED's.

4. Conclusions

In this study one can compare the trends of environmental sustainability indicators regarding CO_2 emissions, waste generated, water and energy consumption, from global values, from Portugal, Brazil and two universities in these countries. For countries and worldwide, data obtained from OECD indicators between 2007 and 2017 were used. For universities, the sustainability and environmental management reports of the institutions from 2010 to 2018 were surveyed.

Worldwide CO_2 emission rates are decreasing (10.6 to 9ton/capita) as well as Portugal (5.2 to 4.6 ton/capita). Brazil showed an upward trend (1.7 to 2ton/capita), as did the University of Portugal (0.85 to 0.87ton/student). At UMinho this fact can be observed due to the high energy consumption and mobility issues related to the use of cars by the academic community.

For the waste generated, both the total OECD index (541.8 to 524.4 kg/capita) and Portugal (513.7 to 485.2kg/capita) indicate a downward trend considering the years 2008 to 2017. It points out that in Portugal the rates have been increasing (from 436.7kg/capita in 2013 to 485.2kg/capita in 2017). In Brazil, considering the years from 2009 to 2012, there is an increase in trend (271.9 to 288.7 kg/capita), as well as in UMinho (4.02 to 9.02 kg/student by 2014 and a reduction in 2015) and at UNISINOS (19.53 to 25.08 kg/student).

Water consumption (4.12 to 3.55 m³/student) and energy (4.73 to 4.06 GJ/student) at UMinho decreased over the years, while UNISINOS water indices (2.36 to 2 94 m³/student) and energy (1.17 to 1.37 GJ/student) increased. UNISINOS had higher urban waste rates than Portugal and lower rates in terms of water and energy consumption. Actions were taken to reduce the environmental burden, improving the energy efficiency of buildings through the use of cleaner energy, establishing mobility studies and campaigns to reduce consumption and reduce waste generation.

Acknowledgments

References

[1]   Bellen H 2006 *Indicadores de sustentabilidade* 2 ed (Rio de Janeiro: FGV).
[2]   Sauven J 2017 Reduce consumption *The green building bible* ed K Hall (Reino Unido: Green Building Press) 5 ed vol 1 pp 14-15.
[3]   Motesharrei S, Rivas J, Kalnay E, Asrar G, Busalacchi A, Cahalan, R, Cane M, Colwell R, Feng K, Franklin R, et al 2016 Modeling sustainability: Population, inequality, consumption, and bidirectional coupling of the Earth and Human Systems *Natl. Sci. Rev*.3 pp 470–94 Available in: <https://academic.oup.com/nsr/article/3/4/470/2669331> Access in: 6 de mar 2019.
[4]   Tauchen J and Brandli L 2006 A gestão ambiental em instituições de ensino superior: modelo para implantação em campus universitário *Gestão & Produção* n. 13 pp 503-15.
[5]   Leal Filho W et al. 2018 Planning and implementing sustainability in higher education institutions: an overview of the difficulties and potentials *International journal of sustainable development & world ecology* vol 25 n 8 pp 713–21 Available   in: <https://doi.org/10.1080/13504509.2018.1461707> Access in: 18 feb 2019.
[6]   Bragança L, Mateus R and Koukkari H 2010 Building sustainability assessment *Sustainability* pp 2010–2023. Available in: https://www.mdpi.com/2071-1050/2/7/2010. Access in: 7 mar 2019
[7]   Bernardi E et al 2017 An analysis of the most adopted rating systems for assessing the

environmental impact of buildings *Sustainability Assessments of Buildings* Printed Edition of the Special Issue pp 1-27. Available in: <http://www.mdpi.com/journal/sustainability/special_ issues/ assessments_buildings>. Access in: 10 mar 2019

[8]   Conte E 2018 The era of sustainability: promises, pitfalls and prospects for sustainable buildings and the built environment *Sustainability* vol 10 iss 6 p. 2092. MDPI AG, https://doi.org/10.3390/su10062092

[9]   *Associação Brasileira De Normas Técnicas 2015* NBR 14001: sistemas de gestão ambiental — requisitos com orientações para uso *(Rio de Janeiro)*

[10]   Global Reporting Initiative 2019 *Empowering Sustainable Decisions* About GRI Available in: <https://www.globalreporting.org/Information/about-gri/Pages/default.aspx> Access in: 11 mar 2019

[11]   *Global sustainability standards board 2018* GRI Standards. Consolidated set of GRI sustainability *reporting standards 2018* Available in: <https://www.globalreporting.org/standards/gristandards-download-center/> Access in: 12 mar 2019

[12]   Universidade do Minho 2019 *História* Braga Available in: <http:// https://www.uminho. pt/PT/uminho/Informacao-institucional/Paginas/Historia.aspx> Access in:15 feb 2019

[13]   Universidade do Minho 2019 *UMinho* Braga Available in: <https://www.uminho. pt/PT/uminho/Paginas/default.aspx#> Access in: 15 feb 2019

[14]   Universidade do Minho 2019 *Serviços* Braga Available in: < https://www.uminho. pt/PT/uminho/Unidades/Servicos/Paginas/default.aspx > Access in: 15 feb 2019.

[15]   Universidade do Minho 2016 *Relatório de sustentabilidade 2015* Braga. Available in: < https://www.uminho.pt/PT/uminho/Informacao-Institucional/Relatrios/Relato%CC%81rio %20de %20 Sustentablidade%202015.pdf>. Access in: 16 feb 2019

[16]   Universidade do Vale do Rio dos Sinos 2019 *História* São Leopoldo Available in: <http://www.unisinos.br/institucional/a-unisinos/historia)> Access in: 19 apr 2019

[17]   Universidade do Vale do Rio dos Sinos 2019 *Notícias Unisinos: sobre* São Leopoldo Available in: <http://www.unisinos.br/noticias/sobre> Access in: 20 apr 2019

[18]   Universidade do Vale do Rio dos Sinos 2019 *Reconhecimento* São Leopoldo Available in: <http://www.unisinos.br/institucional/a-unisinos/reconhecimento> Access in: 19 apr 2019

[19]   Universidade do Vale do Rio dos Sinos 2019 *Estrutura* São Leopoldo Available in: <http://www.unisinos.br/institucional/estrutura/apresentacao)> Access in: 19 apr 2019

[20]   Universidade do Vale do Rio dos Sinos 2019 *Apresentação* São Leopoldo Available in: <http://www.unisinos.br/institucional)> Access in: 20 apr 2019

[21]   Universidade do Vale do Rio dos Sinos 2019 *SGA Unisinos* São Leopoldo Available in: <http://www.unisinos.br/institucional/meio-ambiente/sga-unisinos> Access in: 20 apr 2019

[22]   Universidade do Vale do Rio dos Sinos 2016 *Relatório anual sistema de gestão ambiental Ano 2016* São Leopoldo Available in: <http://www.unisinos.br/images/institucional/meioambiente/relatorios/relatorio-atividades-SGA-2016.pdf> Access in: 19 apr 2019

[23]   Universidade do Vale do Rio dos Sinos 2017 *Relatório anual sistema de gestão ambiental ano 2017* São Leopoldo Available in: <http://www.unisinos.br/images/institucional/meioambiente/relatorios/Relatorio-Atividades-SGA-2017.pdf> Access in: 19 apr 2019

[24]   Universidade do Vale do Rio dos Sinos 2018 *Relatório anual sistema de gestão ambiental ano 2018* São Leopoldo Available in: <http://www.unisinos.br/images/institucional/meioambiente/relatorios/Relatorio-Atividades-SGA-2018.pdf> Access in: 19 apr 2019

[25]   OECD 2019 *Air and GHG emissions* Available in: <https://data.oecd.org/air/air-and-ghgemissions.htm> Access in: 22 mar 2019

[26] Universidade do Minho 2012 *Relatório de sustentabilidade 2010* Braga Available in: < https://www.uminho.pt/PT/uminho/Informacao-Institucional/Relatrios/relatorio-desustentabilidade-2010.pdf> Access in: 16 feb 2019

[27] Universidade do Minho 2013 *Relatório de sustentabilidade 2011* Braga Available in: < https://www.uminho.pt/PT/uminho/Informacao-Institucional/Relatrios/relatorio-desustentabilidade-2011-af.pdf> Access in: 16 fen 2019

[28] Universidade do Minho 2014 *Relatório de sustentabilidade 2012-2013* Braga Available in: < https://www.uminho.pt/PT/uminho/Informacao-Institucional/Relatrios/relatório_sustentabili dade_ 2012_2013.pdf> Access in: 16 feb 2019

[29] Universidade do Minho 2015 *Relatório de sustentabilidade 2014* Braga Available in: < https://www.uminho.pt/PT/uminho/InformacaoInstitucional/Relatrios/relatorio_sustentabilidade_20 14.pdf> Access in: 16 feb 2019

[30] OECD   2019   *Data*   Municipal   waste   Available   in: <https://data.oecd.org/waste/municipalwaste.htm> Access in: 24 mar 2019