Article **Journal-Public Economy**
December, 2019 Vol.3 No.5 1-13

Sustainability in higher education schools in México

La Sustentabilidad en las Escuelas de Educación Superior en México

CHIHUAQUE-ÁLCANTAR, Jesús†*, RODRÍGUEZ-CASTAÑÓN, Carlos Alberto, PAZ-CABRERA, Mauro and MANDUJANO-NAVA, Arturo

Universidad Politécnica de Guanajuato, Ingeniería Automotriz.

ID 1st Author: *Jesús, Chihuaque-Álcantar* / **ORC ID**: 0000-0002-6718-6909, **CVU CONACYT ID**: 48887

ID 1st Coauthor: *Carlos Alberto, Rodríguez-Castañón* / **ORC ID**: 0000-0001-7495-8674, **CVU CONACYT ID**: 441187

ID 2nd Coauthor: *Mauro, Paz-Cabrera* / **ORC ID**: 0000-0003-0728-7377, **CVU CONACYT ID**: 305750

ID 3rd Coauthor: *Arturo, Mandujano-Nava* / **ORC ID**: 0000-0003-2022-4397, **CVU CONACYT ID**: 270254

DOI: 10.35429/JPE.2019.5.3.1.13 Received August 30, 2019; Accepted December 30, 2019

Abstract

The increase of gases in the ozone layer is an important issue nowadays in the Universities of Higher Education in Mexico; there is a great interest in contributing to the reduction of the carbon footprint, therefore, a study was carried out to calculate the footprint generated by the students of the Polytechnic University of Guanajuato through the use of software. The participants were 27 students of the Automotive Engineering degree of the sixth semester, which during this period kept a record of the consumption of PET bottles in their various presentations. The main findings were that the total CO_2 they produce is 131.7 Kg, which would be equivalent to 0.176 barrels of oil and 1.19 m^3 of space saved in landfills. Now, taking into consideration the entire student population (3,899), the calculation was projected annually and estimating the same consumption patterns, would save 76.3 barrels of oil against 515.55 m^3 of space in sanitary landfills.

CO_2, Carbon Footprint, Universities of Higher Education in Mexico

Resumen

El incremento de gases en la capa de ozono es un tema importante al día de hoy en las Universidades de Educación Superior de México; hay un manifiesto interés en contribuir a la disminución de la huella de carbono, por lo anterior, se realizó un estudio para calcular la huella de carbono generada por los estudiantes de la Universidad Politécnica de Guanajuato mediante el uso de un software. Los participantes fueron 27 alumnos de la carrera de Ingeniería Automotriz del sexto cuatrimestre, que durante este periodo llevaron un registro del consumo de botellas de PET en sus diversas presentaciones. Los principales hallazgos encontrados fueron que el total de CO_2 que producen es de 131.7 Kg, lo que equivaldrían a 0.176 barriles de petróleo y a 1.19 m^3 de espacio ahorrado en rellenos sanitarios. Ahora, tomando en cuenta a toda la población estudiantil (3,899), se proyectó el cálculo de forma anual y estimando los mismos patrones de consumo, se ahorrarían 76.3 barriles de petróleo contra 515.55 m^3 de espacio en rellenos sanitarios o tiraderos.

CO_2, Huella de Carbono, Universidades de Educación Superior en México

Citation: CHIHUAQUE-ÁLCANTAR, Jesús, RODRÍGUEZ-CASTAÑÓN, Carlos Alberto, PAZ-CABRERA, Mauro and MANDUJANO-NAVA, Arturo. Sustainability in higher education schools in México. Journal-Public Economy. 2019. 3-5: 1-13

* Correspondence del Author (jchihuaque@upgto.edu.mx)
† Researcher contributing as first author.

Introduction

In 1987, in the document called "Our Common Future", The World Commission on Environment and Development, led by Harlem Brundtland, issued the following recommendation:

[…] The Commission's hope in the future is conditioned to a decisive political action that must now begin to manage environmental resources so as to ensure lasting human progress and human survival. We are not forecasting a future; we are presenting a warning - an urgent warning based on the latest and best scientific arguments - that the time has come to make the necessary decisions to ensure the resources that will support the present and future generations

[...] We are borrowing capital from the environment of future generations without intention or prospects for reimbursement (United Nations, 1987, p. 16, 22). In this same document the word sustainability was coined:

"It is in the hands of humanity to make development sustainable, lasting, that is, to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own" (p. 23).

Years later, in June 1992, some principles were proclaimed at the Earth Summit in Rio de Janeiro to safeguard the planet:

Principle 2: States have the sovereign right to take advantage of their own resources according to their own environmental and development policies, and the responsibility to ensure that the activities carried out within their jurisdiction or under their control do not cause damage to the environment of other States or from areas that are outside the limits of national jurisdiction. (United Nations, 1992, para. 3).

Derived from this principle, higher education institutions, companies and any economic and non-economic agent must ensure that their activities do not cause damage to the environment, whether or not they are within their influence zone. In principle 3 of this same Rio Declaration is confirmed; "The right to development must be exercised in a way that responds equitably to the development and environmental needs of present and future generations (para. 4).

The carrying capacity of the planet does not resist the current practices of consumption, manufacturing and excessive population growth, therefore, sustainability must be included in the study plans and programs of all the country's universities. In the classroom, future decision makers are born that can favor or continue to harm our common future.

In Principle 13 it instructs that:

"States must develop national legislation regarding liability and compensation for victims of pollution and other environmental damage" […] (para. 14). We can interpret that in the agenda of public and private educational institutions in Mexico they must incorporate in their regulations, standards, policies and management systems the care of the environment.

The Earth Summit calls for a mobilization in the creativity, ideals and value of the world's youth to forge a global alliance aimed at achieving sustainable development and ensuring a better future for all.

In Mexico, in the 2017-2018 educational cycle there were 3,864,995 senior students distributed in 5,455 schools (Secretariat of Public Education, 2018). Taking into account this registration and a carbon footprint of CO2 per student of 4.8 Kg for the purchase and use of water bottles in presentations of PET material; 74,431 barrels of oil could be saved against 502,915 m3 of landfill space or landfills. This would mean sending the annual amount of 55,655,928 Kg of CO2 to the atmosphere.

Article 7 and its section XI of the General Education Law (2018, p. 3) mandates:

The education provided by the State, its decentralized agencies and individuals with authorization or with recognition of official validity of studies will have, in addition to the purposes set forth in the second paragraph of article 3. of the Political Constitution of the United Mexican States, the following:

Inculcate the fundamental concepts and principles of environmental science, sustainable development, the prevention of climate change, as well as the assessment of the protection and conservation of the environment as essential elements for the harmonious and integral development of the individual and society.

ISSN 2524-2016
RINOE® All rights reserved

The basic elements of civil protection, mitigation and adaptation to the effects of climate change and other natural phenomena will also be provided.

Continuing with the evolution of the international environmental agenda, in 2002 the Sustainable Development Summit was held in Johannesburg where it is recognized that:

The global environment continues to deteriorate. The loss of biodiversity continues; fish stocks continue to run out; desertification advances collecting more and more fertile land; the adverse effects of climate change are already evident; Natural disasters are more frequent and more devastating, and developing countries have become more vulnerable, while air, water and seas pollution continues to deprive millions of human beings of a dignified life. (United Nations, 2002, p.3)

For the year 2015, the signatory countries approved the 2030 agenda, which contains 17 sustainable development goals: 1. End of poverty, 2. Zero hunger, 3. Health and well-being, 4. Quality education, 5. Gender equality. 6. Clean water and sanitation, 7. Affordable and non-polluting energy, 8. Decent work and economic growth, 9. Industry and innovation, 10. Reduction of inequalities, 11. Sustainable cities and communities, 12. Responsible production and consumption, 13. Climate action, 14. Underwater life, 15. Life of terrestrial ecosystems, 16. Peace, Justice and strong institutions, 17. Partnerships to achieve the objectives. (United Nations, 2015).

Regarding the introduction of environmental education in Mexico, at its various levels it was from 1970. In the case of Higher Education institutions (HEIs), the integration of environmental education and sustainability emerged in the last two decades of the Last century. Documents such as the Talloires Declaration stand out, where about twenty HEIs gathered and assumed educational commitments in relation to sustainability. This meeting was followed by others, such as Halifax, Canada (33 universities) held in 1991 (Ortiz, Cruz & Bello, 2019).

In Mexico, the history of Institutional Environmental Plans (PAI) is contrasting, the Ministry of Environment, Natural Resources and Fisheries (SEMARNAP from 1994-2000) was when this practice was promoted in Mexican universities. The EPI can be understood as a proposal made by the academics of each institution, so that with its own characteristics it incorporates the environmental theme to its classrooms and so each university takes care of its environment, recycles its materials, reforests its green areas and creates awareness in its students on the culture of water and energy care, and aim to provide an education for sustainable development (UANL, 2006, cited by Ávila, 2014, p. 41).

In 1999 the National Association of Universities and Institutions of Higher Education (ANUIES) developed the first version of the Plan of Action for Sustainable Development in HEIs. It would be composed of four dimensions: academic, business, environmental and research; plus a new taxonomy that adds the dimensions: social, administrative, economic, philosophical and personal. (Gutiérrez and Martínez, 2010).

The Mexican Consortium of University Environmental Programs for Sustainable Development (Complexus) was established in December 2000 with the intervention of several Higher Education Institutions, by the Center for Education and Training for Sustainable Development (CECADESU) of the SEMARNAT [Secretary of the Environment Environment and Natural Resources] and by ANUIES; The Action Plan for Sustainable Development in HEIs was signed. The objectives of Complexus are:

1. Seek the improvement of academic work in environmental matters and sustainability in HEIs.
2. Encourage that among its members, programs that promote the development of knowledge, skills, competencies, skills, values and attitudes necessary in terms of sustainable development are established.
3. Promote the incorporation of the environmental dimension in higher education curricula.

ISSN 2524-2016
RINOE® All rights reserved

4. Strengthen training and updating programs in environmental education and sustainable development to improve the academic quality of higher education teachers.
5. Promote the dissemination of information on sustainable development among the institutions that constitute the Complexus, for the exchange of knowledge and experiences.
6. Promote the creation of environmental programs of institutional scope. Promote the creation and strengthening of environmental management systems within HEIs.
7. Promote the integration to IES Complexus that have environmental programs of institutional scope.
8. Establish collaborative relationships with related organizations. (Complexus, 2019).

The role of education in the planning, organization, dissemination and control of sustainable development is undeniable, as well as the requirement to consume it in the different areas of society: environmental, social and economic; in such a way that HEIs are established as key instances to carry out the correction of the development paradigm; by one whose achievement has a humanitarian approach, by generating knowledge, as well as human and technical resources prepared to address environmental challenges, and thus implement a transformation of society.

It would correspond to HEIs to carry out four actions to consider contributing to sustainability:

Internal management: The identification of a university community based on democracy, equity, transparency and promotion of sustainable development.

Teaching: This feature involves training actions to the academic plant with a nuance of social responsibility.

Research: Promote an agenda that links researchers and teachers in projects that solve problems, both urban and rural.

Social projection: Try to carry out development projects that may be the origin of applied research and teaching resources for the university community. (Cantú-Martínez, 2017)

The objective of this study was to identify the degree of ecological footprint produced by students of the Polytechnic University of Guanajuato [UPG] by consuming liquids packed in PET bottles.

In his encyclical called Laudato Yes, Pope Francis calls for an urgent challenge to protect our common home. The economic powers continue to justify the current world system, where speculation and a search for financial income prevail and ignore all context and the effects on human dignity and the environment. Awareness of the severity of the cultural and ecological crisis needs to translate into new habits. Many know that the current progress and the mere sum of objects or pleasures are not enough to give meaning and joy to the human heart, but they do not feel able to give up what the market offers them.

In countries that should produce the greatest changes in consumption habits, young people have a new ecological sensitivity and a generous spirit, and some of them admirably fight for the defense of the environment but have grown in a context of high consumption and well-being that It makes difficult the development of other habits. That is why we are facing an educational challenge (Papa Francisco, 2015, p. 159).

The Baby Boomers generation (1946-1964), the X generation (1965-1984) have failed to regenerate natural resources, we have consumed everywhere the share of water, air, species and forests that belonged to the Millennials (1985-1994) and these in turn are depleting the natural assets of generation Z (1995) and if we do nothing, this last generation will be condemning an uncertain future of men and women who are about to be born. Species in extinction, warmer and at the same time colder climates, growth of natural disasters, water scarcity, forests that are covered with asphalt by the so-called "economic development". Despite the 20 years since the beginning of sustainability in higher education universities, its process is not in development, much less in consolidation, it is in an incipient stage, therefore the urgency of placing sustainability on the university agenda, include them in the curricular maps, in the didactic contents, and not only in the discourse. HEIs are more concerned with being certified in ISO 9001 quality systems, than in ISO 14001 environmental care.

RINOE® All rights reserved

The UAEM [Autonomous University of the State of Morelos] is the first and only institution of higher education at the national level that has implemented and certified its Environmental Management System in accordance with the requirements of ISO 14001 in its 2015 version. University that has had an important development and evolution in its commitment to training, research and extension of culture, with a sense of care and respect for natural resources and the environment, with a strong focus on sustainability. (UAEM, 2017, para. 8)

The intellectual capital of this country is gestated mainly in university classrooms, if it does not commit to the sustainability of the planet, what can you expect from the rest of the population with a modest and average schooling of 9 years?

Social responsibility is an option for Public Institutions of Higher Education to have an effective impact on collective well-being, inclusion and sustainability. The university is a knowledge production system where the individuals who will later guide the social course in economic and political terms converge. HEIs have had to worry about responding to the demands of the industry or the productive sector, and as a result of this, an education without values has been generated that allows to strengthen some collective identity, since it is only educated to respond to the demands of the market, without incorporating social [and environmental] needs (Rivera, 2019).

If universities will align with environmental commitments, the carbon footprint could be positively impacted, the latter defined how:

"The total amount of greenhouse gases produced to directly and indirectly support human activities, usually expressed in equivalent tons of carbon dioxide (CO2)." (Time for Change, 2019, para. 1). Most of the scientific community and a growing number of social, business and political groups have accepted the evidence that climate change is caused by human activities, concluding that it constitutes one of the greatest environmental challenges I could get in the way of sustainable development. The cause of this phenomenon would be found in the high atmospheric concentrations of Greenhouse Gases (GHG).

Scientists know the greenhouse effect since 1824, when Joseph Fourier calculated that the Earth would be colder if there was no atmosphere. This greenhouse effect is what makes the Earth's climate fit for life. Without it, the surface of the Earth would be about 60 degrees Fahrenheit colder. In 1895, Swiss chemist Svante Arrhenius discovered that humans could increase the greenhouse effect by producing carbon dioxide, a greenhouse gas [...] Through the combustion of fossil fuels and other GHG emissions, humans are increasing greenhouse effect and warming the Earth. (National Geographic, 2010, para. 6).

In the same vein, the Intergovernmental Panel on Climate Change (IPCC) published a report explaining why we should stop global warming at 1.5 ° C. It is a bleak reading. If the planet warms up at 2 ° C, twice as many people will face water shortages as if the warming is limited to 1.5 ° C. That additional warming will also expose more than 1.5 billion people to extremes of deadly heat, and hundreds of millions of people to vector-borne diseases, such as malaria, among other damages. (Yangyang Xu, Veerabhadran Ramanathan & David G. Victor, 2018).

According to The National Institute of Ecology and Climate Change (2018, para. 4), the following impacts are already observed and will continue to be experienced in the coming decades:

Increase in the global average temperature of the oceans and the earth's surface. World average increase in sea level.

Sea acidification

Alteration of the abundance of algae, plankton and fish in marine environments.

Modification of natural precipitation patterns. Recurring floods

Increase in the number and intensity of hurricanes, mainly in the North Atlantic.

Longer droughts

Increase in the number of days and warm nights globally.

RINOE® All rights reserved

Decrease in the availability of water for human, agricultural and hydroelectric consumption.

Decrease in agricultural productivity

Reduction and thinning of snow layers in Greenland and Antarctica.

Decrease of glaciers worldwide

Loss of biodiversity and change in the composition of ecosystems.

Increased propensity to forest fires

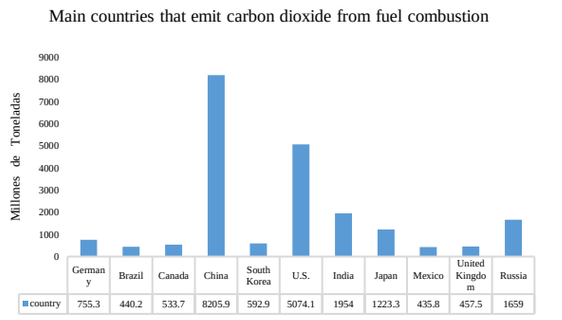
Alteration of biological cycles and geographical distribution of flora and fauna.

Climate change is not only an environmental problem but also a development problem, with profound potential impacts on society, the economy and ecosystems (Montañés, 2016).

It is estimated that the economic losses caused by climate change could cost between 18 and 20% of the world's gross domestic product (GDP) (WWF, 2010).

Humans are transforming Earth's natural landscapes so dramatically that as many as one million plant and animal species are in danger of extinction, representing a serious threat to the ecosystems of which people from all over the world. world depend for their survival, concluded a new comprehensive study of the United Nations [...] is the most detailed look that exists to the decline of biodiversity across the planet and the dangers it creates for human civilization [...] A crisis is coming of extinction, because the rate of extinction is currently between tens and hundreds of times faster than it had been in the last ten million years. (Plumer, 2019, Para. 1).

Graph 1 shows the emissions of carbon dioxide by selected countries, during 2012 and with an update to 2016. The first place is held by China with 8,205.9 million tons of carbon dioxide. While Mexico emits 435.8 million tons of carbon dioxide.



Graphic 1 Emissions of carbon dioxide
Source: INEGI (2015). Mexico in the world 2015. Recovered from http://internet.contenidos.inegi.org.mx/contenidos/productos/prod_serv/contenidos/espanol/bvinegi/productos/nueva_estruc/mex_mun2015/702825075613.pdf

Despite the environmental problem in Mexico, it is regrettable that in the National Development Plan 2019-2024, only a 16-line paragraph is allocated for environmental issues, without containing strategies, programs or action plans that allow climate change mitigation:

[… There are] insoslayables ethical, social, environmental and economic mandates that must be applied in the present to guarantee a minimally habitable and harmonious future. Ignoring this paradigm not only leads to the gestation of imbalances of all kinds in the short term, but also entails a severe violation of the rights of those who have not been born. Therefore, the Federal Executive will consider in all circumstances the impacts that its policies and programs will have on the social fabric, on the ecology and on the political and economic horizons of the country. (National Development Plan, 2019, p. 37).

Innerarity (2009, quoted by Didriksson, 2019, p. 28), prevents us from continuing to believe in the "enemies of the future", who, in the face of pressure from events, the image before the media and the Political antagonism always lends itself to the irresponsibility of assuming short-term visions, the logic of the urgent, the decision of the fundamental caught in electoral times. This author tells us: [...] "It is not the urgency that prevents the elaboration of long-term projects, [it is the absence of the project that subjects us to the tyranny of the present".

RINOE® All rights reserved

On September 23, 2019 at the Climate Action Summit convened by the UN in New York and before 60 leaders of the world, world youth manifested itself through the voice of Greta Thunberg of only 16 years old:

[…] We will be watching you. All this is wrong. I shouldn't be up here. I should be back at school [...] My dreams and childhood have been stolen from me with empty words [...] People are suffering. People are dying. Whole ecosystems are collapsing. We are at the beginning of a mass extinction. And the only thing they can talk about is money and fairy tales of eternal economic growth. How dare they? [...] How dare they keep looking the other way and come here saying that they are doing enough, when the necessary policy and solutions are not yet in sight? [...] They are based on my generation absorbing hundreds of billions of tons of its CO2 from the air [...] We have to live with the consequences [...] They are failing us. But young people are beginning to understand their betrayal. The eyes of all future generations are upon you. And if they choose to fail us, we will never forgive them. (BBC, News World, 2019, para. 12).

Educational policy in Mexico is limited to a six-year term, it has no long-term vision. The economic austerity of any government or School of Higher Education, are not enough arguments to let do and let pass the opportunity to live with dignity, there are estimated costs of environmental deterioration that exceed any calculation. Today, men and women, universities, governments, companies, NGOs and Society are the ones who will give or deprive future generations of environmental assets. From the classrooms sustainable minds must emerge, if man soiled our house in common [planet earth], that same man can also clean it and ensure the natural cycle of survival of all beings.

In 15 years, more than 3'188,000 tons of PET waste for recycling have been recovered in Mexico, which has been achieved:

Avoid the emission of 10’577.474 tons of CO2 into the atmosphere, which is equivalent to having planted 274 million trees or 726 Bosques de Chapultepec. With the accumulated collection, the equivalent of 140 Aztec Stadiums could be filled from floor to ceiling (Zindel, 2017).

According to data from SEMARNAT, in 2017 about 9 billion bottles of polyethylene terephthalate -PET- were generated in Mexico, as well as 86 thousand 343 tons of garbage are produced daily, about 770 grams per-capita (Rodríguez, 2019).

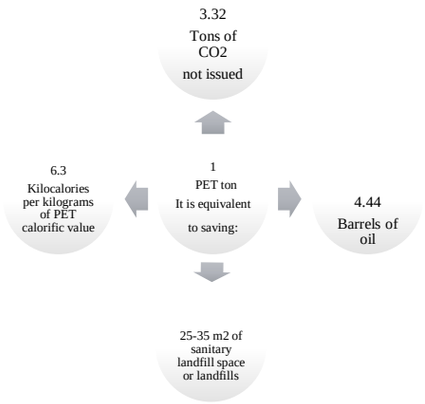


Figure 1 Equivalences of a ton of PET in CO2 and in oil barrels
Source: Zindel J. (2017)

Methodology

The study is quantitative and descriptive, it is descriptive "because it seeks to specify the properties, characteristics and profiles of people, groups, communities, processes, objects or any other phenomenon that is subjected to an analysis (Hernández, Fernández & Baptista, 2010, p. 85).

The research is also non-experimental since no variable was manipulated and the behavior of the consumer [student] was observed in a natural environment.

The study was applied in 27 university students attending the fourth semester of Automotive Engineering at the UPG, morning shift, during the September-December 2017 school year. The average age of the participants ranged from 20 years. Regarding its city of origin [all belonging to municipalities of Guanajuato] 60% were from the city of Celaya, 25% from Cortazar and 15% from Villagrán. The data collection process was via survey, the amount of PET bottles consumed by each of the study subjects was recorded weekly. Through a commercial software it was possible to identify the carbon footprint emitted by each of them by consuming this type of material.

ISSN 2524-2016
RINOE® All rights reserved

Table 1 shows that the most consumed PET bottle presentation is 600 ml (189), versus the 2000 ml bottle that only had 93 records in the four months of study.

Bottles (ml)	September	October	November	December	Total bottles
600	32	56	70	31	189
1000	40	59	33	23	155
1500	36	55	45	32	168
2000	9	41	22	21	93

Table 1 Bottle count, September to December 2017
Source: Own Elaboration

The variables demanded by the software to determine the calculation of the carbon footprint produced by PET bottles in the atmosphere are: Weight, both bottle and screw cap.

Bottle body	Weight (g)	Plug	Weight (g)
600 ml	24	600 ml	1.5
1l	30	1l	1.56
1.5l	42	1.5l	2
2l	60	2l	3.05

Table 2 Weight in grams of bottles and caps
Source: Self Made

Other variables considered in the research for CO2 estimation were:

Material and Manufacturing. The type of packaging material is fed into the software (PET Terephthalate Polymer and in case of the caps its composition is polypropylene), the mass and the primary process type (polymer molding) of both the body of the bottle is fed as of the tapas.

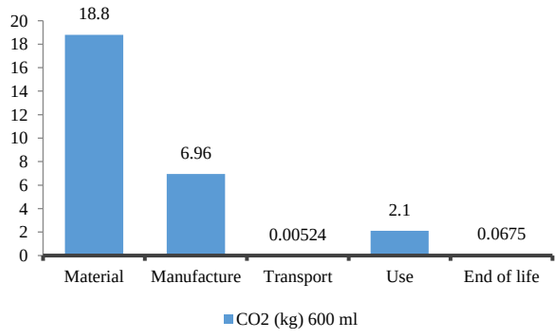
Transport. In this variable, the type of transport in which the bottles usually arrive at the UPG cafeteria was captured in the software, it was estimated that they are transported in cargo units close to 14 tons and that travel an average distance per unit of 35 kilometers.

Use. In the university cafeteria, water bottles undergo a 24-hour refrigeration process, connected to a 120 KW load power source

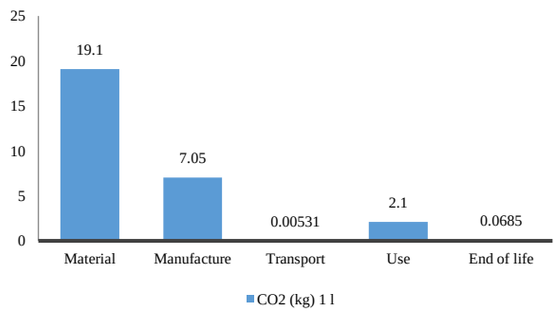
Results

In Graphic 2, the results of the 600 ml bottles are presented, the kilograms of CO2 of the material were evaluated: manufacturing, transportation, use and final life process.

Resulting in the amount of CO2 of 27.9 Kg; originated by the consumption of 189 bottles of the 27 students, during 4 months. In the results of Graphic 3, the 1 liter bottles, the kilograms of CO2 of the material were evaluated, generating the amount of 28.4 Kg of CO2, through the purchase and consumption of 155 bottles.

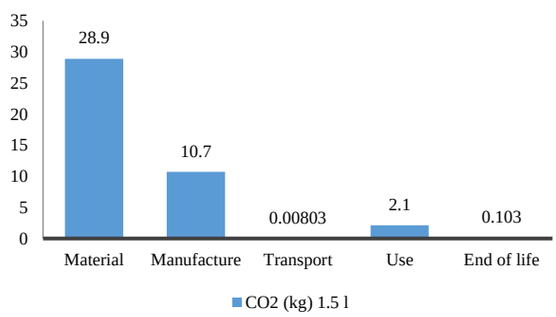


Graphic 2 Impact of CO2 in 600 ml bottles
Source: Self Made



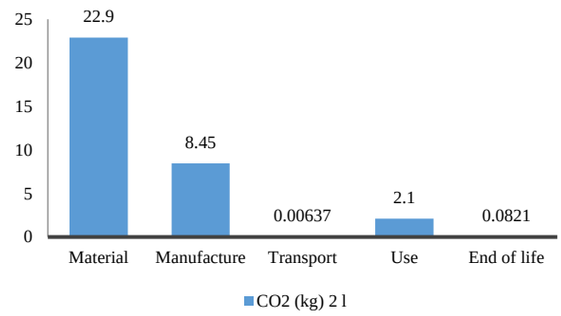
Graphic 3 Impact of C02 on 1L bottles
Source: Self Made

In the results of the Graphic 4, the 1500 ml bottles, the software produced a CO2 result of 41.8 Kg in the use of 168 bottles. While in Graphic 5, the 2000 ml bottles would have an emission of 33.6 kg of CO2 through the provision of 93 bottles.



Graphic 4 CO2 impact on 1.5L bottles
Source: Self Made

RINOE® All rights reserved



Graphic 5 CO2 impact in 2L bottles
Source: Self Made

Graphic 6 shows the summary of the CO2 emissions of the different sizes of PET bottles: 600 ml, 1 liter, 1.5 liter and 2 liters, with the different amounts of CO2 per PET bottles.

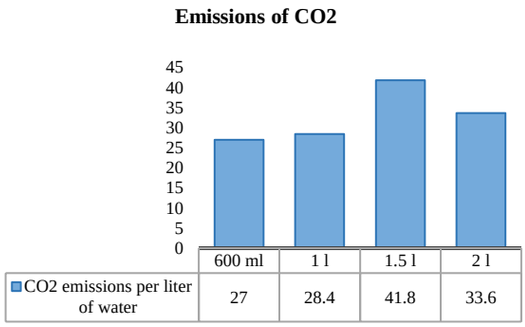


Gráfico 6 PET bottles and their quantity in kilograms of CO2
Source: Self Made

Table 3 shows the 600 ml to 2 liter containers, the amount of the carbon footprint in kilograms for each of the bottles and their total CO2.

Container	Liters consumed	Total carbon footprint of CO2 (kg)
600 ml	113.4	27.9
1 l	155	28.4
1.5 l	252	41.8
2 l	186	33.6
Total	706.4	131.7

Table 3 Total carbon footprint in CO2 of each of the bottles
Source: Self Mad

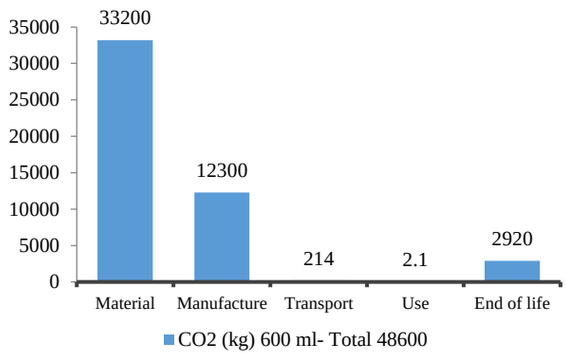
Table 4 shows the results of a total of 131.7 kilograms of CO2, in four months, and if we get an average of 27 students, it gives us the amount of 4.8 kilograms of CO2, per student. In the UPG there is a school enrollment of 3,899 students, estimating patterns of water consumption and similar types of packaging, for forecasting purposes.

It is expected that a total of 19, 018 kilograms of CO2 would be reached at the university level four-monthly and converting them from Annualized environmental impact would reach 57,055 kilograms of CO2.

UPG	Students	Total Carbon Footprint Total CO2	No. of months
Automotive Group	27	131.7	4
Total UPG	3,899	19,018	4
Total UPG	3,899	57,055	12

Table 4 Total CO2 data with different months
Source: Self Made

Since the end of 2017, nine drinking fountains were installed at UPG to mitigate the consumption of water in PET bottles. The results: the equivalent of 333,523 bottles of 600 ml were consumed, which meant a total CO2 savings of 48,600 kilograms, which would result in avoiding the production of 64.99 barrels of oil or 439.15 m3 of landfill space.



Graphic 7 Analysis of consumption in the drinking fountains of the UPG
Source: Self Made

Conclusions

The carbon footprint generated by the consumption of liquids in PET bottles in its various presentations by the study subjects is 131.7 Kg of CO2. In the 1500 ml bottles, the maximum amount of kilograms of CO2 (41.8 Kg) was found in 168 bottles of the 27 students for 4 months. The estimate of the total carbon footprint in the UPG for one year would be 57,055 kilograms of CO2 (only bottles included).

ISSN 2524-2016
RINOE® All rights reserved

Decarbonising student consumption habits is an institutional entrustment. In 2016, the UPG won the State Energy Efficiency Award, granted by the State Government through the State Council and the Ministry of Innovation, Science and Higher Education for the implementation of a program called "Color Code", consisting of the Student Committee of Energy Management (CEGE), which consists of making energy savings by turning off office lights or common areas according to the summer and winter seasons, with visual aids in yellow, green and red.

Since December 2017, the UPG has put into operation an ecological parking lot with a capacity of 48 drawers for hybrid vehicles (3,600 m2). As of January 2018, there have been talks, workshops and training courses in environmental education for administrative staff, teachers and students, institutional cleaning campaigns, etc. 9 drinking fountains have been installed that allow drinking water directly or through the filling of bottles. The reuse, reduce and recycle program has been consolidated to mitigate environmental impacts, organized tree planting brigades inside and outside the University, and implemented a permanent battery recycling campaign. The institution has two wastewater treatment systems and has installed solar panels at various strategic points.

Regarding the recycling of solid waste during the May-August 2018 period, 9 kg of plastic, 586 kg of PET glass, 48 kg of PET color, 51 kg of scrambled PET, 315 kg of paper and 669 kg of cardboard were recycled. This results in a decrease of 5,179 kg of CO2, 292,926.44 L in water savings and 10,371.88 KW / H of energy. This would mean avoiding the cutting down of 16.72 trees or providing oxygen for 66.88 people, it would mean lighting up 3.57 homes for a year, saving 49. 9 m3 of landfill space or removing a compact car (González, 2019).

In the PIDE 2025 (Institutional Development Program) of the UPG, it seeks the ISO 14001: 2015 certification for the year 2020, without a doubt, a great challenge and an opportunity to contribute to environmental sanitation.

The planet needs a green industrial surge, these exponential times of global warming undermine the fundamental and foundational rights of man: right to a healthy environment, to a dignified life, right to health, right to water, right to adequate food. It is not enough to consecrate and incorporate these rights in international treaties and in the country's magna Carta; when in practice they are not executed, they are violated, they are tainted, these rights are minimized. The UPG community is committed to mitigate and safeguard the environmental assets of the earth.

Recommendations

It is pertinent to recommend for future analogous studies, an extension of the sample, profiles of more diverse students (origin: urban and rural, by socioeconomic level, gender parity, etc.) to make a comparison between the carbon footprint produced by a public institution versus private campus; that allow to find more more correlations or divergences. The carbon footprint found in the 27 students through the consumption of PET bottles impacts the permanence of ecosystems individually, collectively and geometrically.

Universities in Mexico must declare and appropriate for the environment, in practice they must have indicators that show good use of water consumption and treatment, light, recycling of waste, implementation of alternative energy, good disposal of solid waste and dangerous, etc. Most educational institutions do not have environmental management committees installed, there is no sensitivity of administrative staff, teachers and students in natural resources care. HEIs must be a reference and cornerstone in the promotion, research and implementation of ecological measures that allow reducing the carbon footprint and consequently ensure that the inhabitants of the future can enjoy the benefits of nature.

The resources of the mother earth cannot be subject to the voracity of the markets, nor to the whim of the rulers in turn, they are heritage assets of humanity, which do not recognize borders, religion, ideologies or economic systems. If the application of sustainability in the educational field is wrong [guiding axis of every country], an environmental decomposition can be predicted in the rest of the sectors: business, social, government, etc.

ISSN 2524-2016
RINOE® All rights reserved

The land does not need men and women, governments and businesses to exist, but humans do need it to live. The labels on the products, in a general way, must indicate the ecological footprint they cause. It is necessary to modify the behavior and purchasing patterns of all students and consumers in general. On the other hand, promoting sustainable consumption is viable, a family does not need superfluous goods, having the essential is not synonymous with poverty, it is responsible behavior; subordinated to the commitment to the 21st agenda of the United Nations Organization. It must be ensured that the next generations have sufficient resources for survival.

Those interested in continuing this line of research are suggested to work in a software that allows measuring all the polluting variables that are generated in the educational facilities and not only studying the impact of PET; in order to issue a ranking of the most sustainable institutions, those that make tangible and intellectual efforts to reverse the ecological damage of their community and therefore of the planet. It is no longer a warning as stated by Harlem Brundtland more than 30 years ago, the problem is already causing human deaths, species extinction, water scarcity, unsettling temperatures, immigration, poverty. Therefore, the obligation to make sustainability a daily practice in public and private universities in Mexico.

References

Ávila Romero, L. (2014). Los programas ambientales universitarios en México. Entre el discurso ambiental y los negocios verdes. *Sociedad y Ambiente*, 1 (3), 26-51.

BBC News Mundo (septiembre 23, 2019). *Greta Thunberg: el desafiante discurso de la adolescente sueca ante los líderes mundiales en la cumbre del clima de la ONU*. Recuperado el día 24 de septiembre de 2019 de https://www.bbc.com/mundo/noticias-internacional-49804774

Cantú-Martínez, P. (octubre-diciembre, 2017). Instituciones de Educación Superior y la Sustentabilidad. *Ciencia UANL*. Núm. 86. Recuperado el día 18 de abril de 2019 de http://cienciauanl.uanl.mx/?p=7357

Complexus (2019). *Misión y Objetivos*. Recuperado el día 20 de abril de 2019 de http://www.complexus.org.mx/Mision.aspx

González, C. (2019). *PIDE UPG 2025*. Documento de trabajo. Universidad Politécnica de Guanajuato.

Didriksson, A. (2019, diciembre). Un futuro recobrado para la Educación en México. *Revista Práctica Docente, 1* (2) pp. 25-44. Recuperado el día 10 de septiembre de 2019 de http://practicadocenterevistadeinvestigacion.com/ojs/index.php/PD/issue/view/Practica%20Docente.Revista%20de%20Investigaci%C3%B3n%20Educativa/practica%20docente%2C%20vol%2C%201%2Cn%C3%BAm%202

Gutiérrez, B. & Martínez, M.C. (abril-junio de 2010). El plan de acción para el desarrollo sustentable en las instituciones de educación superior. Escenarios posibles. *Revista de la Educación Superior*. Vol. XXXIX (154), pp. 111-132.

Hernández, R., Fernández, C. & Baptista, P. (2010). *Metodología de la Investigación* (Quinta edición). Perú: Mc Graw Hill.

Instituto Nacional de Ecología y Cambio Climático (2018). *Efectos del Cambio Climático*. Recuperado el día 23 de abril de 2019 de https://www.gob.mx/inecc/acciones-y-programas/efectos-del-cambio-climatico

Ley General de Educación (2018). *Capítulo I. Disposiciones Generales.* Recuperado el día 18 de abril de 2019 de https://www.sep.gob.mx/work/models/sep1/Resource/558c2c24-0b12-4676-ad90-8ab78086b184/ley_general_educacion.pdf

Montañés, N. (2016). *Cálculo de la huella de carbono de un envase con ayuda del software "CES EduPack".* Recuperado el día 18 de abril de https://riunet.upv.es/bitstream/handle/10251/68299/Monta%C3%B1%C3%A9s%20-%20C%C3%A1lculo%20de%20la%20huella%20de%20carbono%20de%20un%20envase%20con%20ayuda%20del%20software%20%C2%BFCES%20EduPack%C2%BF..pdf?sequence=1

Naciones Unidas (1987). *Informe de la Comisión Mundial sobre el Medio Ambiente y el Desarrollo*. Recuperado el día 15 de abril de 2019 de http://www.ecominga.uqam.ca/PDF/BIBLIOGRAPHIE/GUIDE_LECTURE_1/CMMAD-Informe-Comision-Brundtland-sobre-Medio-Ambiente-Desarrollo.pdf

Naciones Unidas (1992). *Declaración de Río sobre el Medio Ambiente y el Desarrollo*. Recuperado el día 18 de abril de 2019 de https://www.un.org/spanish/esa/sustdev/documents/declaracionrio.htm

Naciones Unidas (2002). *Informe sobre la Cumbre Mundial sobre el Desarrollo Sostenible*. Recuperado el día 24 de abril de 2019 de https://documents-dds-ny.un.org/doc/UNDOC/GEN/N02/636/96/PDF/N0263696.pdf?OpenElement

Naciones Unidas (2015). *Cumbre de las Naciones Unidas sobre Desarrollo Sostenible*. Recuperado el día 25 de abril de 2019 de https://www.un.org/development/desa/es/about/conferences.html

National Geographic (2010). *¿Qué es el calentamiento Global?* Recuperado el 20 de abril de 2019 de https://www.nationalgeographic.es/medio-ambiente/que-es-el-calentamiento-global

Ortiz, T., Cruz, G.E., & Bello, L. (2019). La representación social de la problemática ambiental en profesores de ingeniería civil, de la Escuela Superior de Ingeniería y Arquitectura del Instituto Politécnico Nacional. *Revista de la Educación Superior*, *48* (190), pp. 185-209. Recuperado el día 10 de septiembre de 2019 de http://resu.anuies.mx/ojs/index.php/resu/article/view/716/290

Papa Francisco (2015). *Carta Encíclica Laudato Sí*. Recuperado el día 21 de abril de 2019 de https://www.vidanuevadigital.com/wp-content/uploads/2015/06/Laudato-Si-ES.pdf

Plan Nacional de Desarrollo 2019-2024 (2019). *Capítulo Desarrollo Sustentable*. Recuperado el día 18 de mayo de 2019 de https://lopezobrador.org.mx/wp-content/uploads/2019/05/PLAN-NACIONAL-DE-DESARROLLO-2019-2024.pdf

Plumer, B. (6 de mayo, 2019). La civilización acelera la extinción de más de un millón de especies y altera el mundo a un ritmo 'sin precedentes'. *New York Times*. Recuperado el día 7 de mayo de 2019 de https://www.nytimes.com/es/2019/05/06/civilizacion-extincion-reporte-onu/?rref=collection%2Fsectioncollection%2Fnyt-es&action=click&contentCollection=noticias&region=stream&module=stream_unit&version=latest&contentPlacement=2&pgtype=collection

Rodríguez A. (Marzo, 2019). El punto de venta también puede ser verde. *Revista Merca2.0*. Núm. 205. p. 72

Rivera, C. (2019). Sobre la función social del conocimiento humano mediante la vinculación y transferencia del conocimiento en América Latina. *Revista de Educación Superior*. *48* (189), pp. 121-132. Recuperado el día 10 de septiembre de 2019 de http://resu.anuies.mx/ojs/index.php/resu/article/view/621/281

Secretaría de Educación Pública (2018). P*rincipales Cifras del Sistema Educativo Nacional* 2017-2018. Recuperado el día 19 de abril de 2019 de https://www.planeacion.sep.gob.mx/Doc/estadistica_e_indicadores/principales_cifras/principales_cifras_2017_2018_bolsillo.pdf

Time for Change (2019). *What is a carbon footprint – definition?* Retrieved April 19 from https://timeforchange.org/what-is-a-carbon-footprint-definition

Universidad Autónoma del Estado de Morelos [UAEM] Departamento de Comunicación (2017). *UAEM única universidad en México certificada en norma ambiental ISO 14001:2015*. Recuperado el día 24 de abril de 2019 de https://www.uaem.mx/difusion-y-medios/publicaciones/boletines/uaem-unica-universidad-en-mexico-certificada-en-norma-ambiental-iso-140012015

World Wildlife Fund [WWF] (2010). *Impactos y Vulnerabilidad el Cambio Climático en México*. Recuperado el día 21 de abril de 2019 de http://d2ouvy59p0dg6k.cloudfront.net/downloads/03_impactos_nacionales_e_internacionales_del_cambio_climatico.pdf

RINOE® All rights reserved

Yangyang Xu, Veerabhadran Ramanathan & David G. Victor, (2018). *Global warming will happen faster than we think*. Retrieved April 20 from: https://www.nature.com/articles/d41586-018-07586-5

Zindel, J. (2017). Un estilo de vida ecológico y saludable. *ECOCE* 15 años, 15, 20-25.

RINOE® All rights reserved