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Present and Future Actions of CETYS University to Mitigate Climate Action

Isaac Azuz-Adeath[*1], Fernanda Aguiar[1], Adrián Valdes[1] and Ulises López[1]*

[1]*CETYS University, Institute for Sustainability Studies, Mexico*

[*]corresponding author: Isaac.azuz@cetys.mx

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Abstract. The strategic location of CETYS University, in Baja California state in the northwest of Mexico, gives it exceptional conditions for the use of renewable energies. With an installed photovoltaic solar energy capacity of 1.37 MW, it is the academic institution with the greatest generation potential in Latin America. The importance that CETYS University gives to the subject has stimulated the institution since 2015 to offer a degree and master's degree in renewable energy to have greater and better collaboration with solar and wind energy technology companies located in the state. With a vision of the future, in 2023 the CETYS Institute for Sustainability Studies (ISS) was created to promote and coordinate, among other actions, those related to energy and climate change. With a planning horizon until 2036, the ISS, looking forward, has proposed the following actions: a) an internal audit to increase the energy efficiency of their buildings and classrooms; b) support for research projects to build on-campus operational small-scale wind energy systems; c) the deployment of the 300 x 500 program, which seeks to plant at least 300 native trees in the region with low water consumption each year, to offset the atmospheric emissions of 500 vehicles; d) a policy to achieve 80% carbon neutrality, and e) the incorporation of CETYS to the network of Mexican universities for climate action. Among many others, these actions position CETYS as a leading institution in sustainable development at the regional level.

Keyword:

CETYS University, Climate change, Climate mitigation actions, Mexico.

1. Introduction

CETYS University (Centro de Enseñanza Técnica y Superior –Spanish full name-) is a multicampus (3 campuses), private, non-profit university, founded in 1961 and located in the Mexican state of Baja California in the Northwestern part of Mexico. The total surface extension of CETYS is 771,139 square meters (m^2), with a total buildings area of 97,463 m^2; a ground floor area of buildings of 52,504 m^2, and 3,6057 m^2 of semiarid forest vegetation with 80,000 m^2 of planted vegetation. During the academic year 2023, CETYS has 5,249 regular students and 937 academic and administrative staff. The total open space area

divided by the total campus population gives a ratio of 116 m^2/person.

Mexicali Campus, the oldest and largest one (501,339 m^2), is located in the state capital Mexicali, a highly developed industrial and agricultural region. Tijuana Campus (96,617 m^2) is located in Tijuana city, one of the most dynamic cities in the country with industry, commerce, and tourism, as well as having the highest population growth rate in the state. Ensenada Campus (173,182 m^2), located in Ensenada city is the youngest campus and recognized by its beautiful landscape and weather (tourism, wine production, and internationally recognized high-quality restaurants are the main economic engines). Mexicali and Tijuana Campuses are situated exactly on the USA-Mexico border, while Ensenada Campus is located around 100 km south of the border. This strategic location of the CETYS campuses allows, among other factors: easy international mobility, access to top-level technologies and laboratories, direct contact with cultural diversity.

Weather, climate variability, and climate change condition many of the actions, projects and programs that the institution develops. Located in a semiarid climate region (Mexicali campus) and Mediterranean region (Tijuana and Ensenada campuses), the minimum atmospheric temperature has shown increases from 10.7 ^oC during the period 1980-2003 to 13.3^oC (yearly average) for the period 2004-2023, and the rain regime –naturally scarce- has gone from 250 mm accumulated annually in 1980 to 160 mm accumulated annually in 2023. In this sense, CETYS University has been concerned about the adaptation of its physical facilities to have the greatest energy and water efficiency, but also about promoting programs that raise awareness among its students about the importance of climate action and promote research, various actions, and internal policies that help mitigate climate change.

Many higher education institutions around the world are engaged in efforts to tackle climate change [1,2]. These efforts arise from actions in different areas of academic institutions: a) incorporating programs and curricular elements on the subject, b) developing specific research that addresses the phenomena, c) accompanying awareness campaigns among the internal and external community, d) modifying and creating more resilient infrastructure, e) creating local, regional, national or international networks, and f) developing university policies and strategic programs for climate action, among other elements.

Higher education institutions are increasingly recognizing the urgency of addressing climate change within their campuses. From sustainable infrastructure projects to curriculum revisions integrating environmental, social and public policy studies, colleges and universities are pioneering initiatives to mitigate their carbon footprint. Research endeavors are also crucial, fostering innovation in renewable energy and climate resilience. Beyond academia, student-led movements are advocating for institutional divestment from fossil fuels, pushing for tangible action on climate justice. These efforts underscore the vital role of higher education in shaping a sustainable future for generations to come. There is no universal approach to incorporating the topic of climate change in the university curricula or in research; furthermore, it has been observed that organizational structures and programs do not reflect the interdisciplinary nature of the climate crisis, which is why it is necessary to take urgent actions [3,4].

Universities, as key elements in the generation, dissemination of knowledge, and awareness about the impacts of climate change, must not only focus their efforts on the academic community but also encourage the expansion of the culture of climate action to their nearby communities and at regional, national and global levels. Today, the climate

emergency requires the collaboration and efforts of all sectors and actors, and universities must assume the responsibility of leading knowledge-based initiatives that lead to good practices and real changes.

In this sense, as part of CETYS' dedication to student empowerment and under the guidance of the Institute for Sustainability Studies (ISS), the "EcoCampus" program started operating in September of 2023 at Campus Ensenada. This initiative was launched and coordinated internationally by the Foundation for Environmental Education (FEE). EcoCampus is an annual audited educational program that focuses on helping higher education institutions become change leaders by empowering and encouraging students to develop projects aligned with the Sustainable Development Goals (SDGs), that actively engage teachers, classmates, staff, and their local community. CETYS is the first higher education institution in Baja California to participate in the program. The institution's goal for its first year is to achieve the Green Flag Award, which certifies the campus as sustainable and committed to making positive environmental and social changes.

This year's focal point is climate change, which has guided the efforts of every institution while developing their projects. There are three ways to address climate change while working on the program: through the integration of the subject in the course syllabus, using student-led extracurricular projects, and by communication outlets. For instance, at the beginning of the program, the FEE shared with the faculty educational material that can be integrated into their classes, such as lesson plans and interactive manuals designed to guide both the teacher and the student while learning about relevant climate change problems to find practical solutions.

To obtain the award, students must lead extracurricular projects that make tangible improvements on their campus. One such example is CETYS' school garden, which helps mitigate climate change by teaching students how to produce their food, adopt a more plant-based diet, and advocate for natural food-growing methods over the use of fertilizers to grow vegetables. Lastly, students share their findings, progress, and solutions through platforms like Facebook and the official ISS website, encouraging the community to take part in mitigating climate change while enhancing their environmental education.

Some of the main ranking and certifying agencies for sustainability in universities are increasingly giving greater importance to elements related to climate change and climate action [5,6], as well as other specific instruments related to environment and energy issues like ISO 14001 from the International Organization for Standardization, Leadership in Energy and Environmental Design (LEED) or "Energy Star", to mention a few. International organizations like the Sustainable Development Solution Network (UN-SDSN), strive to accelerate the transition to net-zero emissions, providing national strategies towards decarbonizing energy systems, which can be easily adapted and adopted by universities, additionally contributing to compliance with the United Nations Sustainability Development Goals or SDGs.

CETYS University has been a pioneer in the development of study abroad programs related to the application of sustainability principles and actions to counteract climate change in regions of Baja California, such as the Valle de Guadalupe, Mexico's main wine producer in Ensenada, where wineries have collaborated with the academy on projects related to energy efficiency in wineries and grape fields, carbon and water footprint in the production of wine bottles, strategies for water capture from air humidity, the potential use of renewable energies and the generation of sustainability indices for the sector, among other multidisciplinary actions.

As an area of opportunity, it is necessary to say that the institution must work more for automation in the monitoring of variables that are related to the use of energy and the generation of emissions within its campuses. The region's inadequate public transportation infrastructure coupled with the affordability of cars exacerbates mobility challenges for students, leading to a reliance on personal vehicles for commuting to the university. In response, the institution has introduced car-sharing programs aimed at reducing single-occupancy trips. These initiatives not only alleviate parking congestion but also promote sustainable transportation practices. Moreover, by allocating prime parking spots to car-sharing participants, the university incentivizes and rewards environmentally friendly commuting choices, fostering a greener campus community.

The climate action program (in development) has begun to define the economic impact that these and many other measures would have on medium-term development with a time horizon of 2036 and 2045.

This paper is related to several actions put into practice by CETYS University, in Baja California, Mexico, to mitigate climate change through the installation of physical infrastructure and setting on their campuses, the deployment of academic programs, the operation of small-scale, hands-on, student-driven (at campus level) projects, and the discussion, consensus, and application of internal policies to achieve carbon neutrality. We believe that only planning supported by knowledge and community action can transform universities into promoters of positive changes related to climate change mitigation.

The following section talks about different programs already implemented by CETYS University focused on reducing and mitigating the impacts of climate change such as: “Solar Power”, “Zero Waste”, the reforestation program “300 x 500”, Eco-Campus certification and academic initiatives such as the bachelor's and master's program in renewable energy.

2. Scenario

CETYS University is an institution recognized for its high academic quality. Its multi-experiential educational model is based on humanism, curricular flexibility, and experience-based learning. Innovation and entrepreneurship, internationalization and cross-culturalism, leadership, and social responsibility, as well as sustainability, are some of the distinctive competencies of CETYS education.

Structured in 3 large colleges: Administration and Business, Engineering, and Social Sciences and Humanities, CETYS University has worked through the curriculum on the incorporation of sustainability and the knowledge of the SDGs including a series 8 of 16 core courses that all the students need to attend regardless of the school or career they belong to. All of the SDGs (17 objectives) are partially or totally addressed in these 16 subjects (Human being as a project, 21st-century philosophy, Humanism and spirituality, Science of Happiness, Effective communication, Scientific research, Learning and strategic thinking, Informational competencies, Global competence, Social skills in the digital age, Analysis of cross-border reality, Art and inter-culturalism, Ethics for 21st-century society, Citizenship and community development, Systemic thinking and global problem solving and Environmental responsibility). The institution also offers graduate (2-year program) and undergraduate (4-year program) studies in renewable energies and sustainability, which have had great success due to the expansion of companies associated with the development and use of wind and solar energy in the region.

CETYS University is a comprehensive academic institution in which research has taken an increasingly important place in recent years. The internal support for research has

allowed around 50% of the projects associated with sustainability issues to be carried out in the last 3 calls. All the Colleges and Research Centers have as priority research lines themes related to sustainability, like a) renewable energies and sustainability (Engineering College); b) ethics, sustainability, and leadership (Business College); c) social sustainable development (Social Sciences College); d) viticulture and sustainability (Center for Wine Studies); and e) water sustainability, carbon neutrality and SDG´s (Institute for Sustainability Studies). The Institute for Sustainability Studies (ISS) begins operations in 2022, it depends directly on CETYS President, works across all Colleges, and acts in all areas of the institution. The initial objective of this new Institute was to organize, coordinate, promote, and endorse the actions that the institution has been developing over the years around sustainability so that there is greater visibility regional and internationally on the subject, and that it contributes in a clear and determined with actions conducive to moving more quickly towards a sustainable development, from the local to the global level. Since its conception and creation, ISS has sought to be perfectly aligned and promote the achievement of the 17 Sustainable Development Goals of the United Nations, in the areas of education, research, networking, improvement of spaces and infrastructure, construction of a global citizenship, as well as the dissemination of sciences, arts and culture. Since 2022, the ISS has the responsibility of reporting progress in sustainability for various global certification and ranking agencies, including UI GreenMetric.

The scarcity of water and the climatic conditions of the region are key elements in the search for sustainability at CETYS University. Mexicali campus has an arid climate while Tijuana campus has semiarid and Ensenada campus has semiarid/Mediterranean. CETYS University has the largest solar photovoltaic power generation capacity of all the academic institutions in Latin America (1.37 Megawatts with 3,099 solar panels). Mexicali Campus has 2,873 solar panels and Tijuana Campus 226 in operation. Ensenada Campus started the installation of 20 panels in 2024. During 2023 and 2024 the Institute for Sustainability Studies (ISS-CETYS) deployed the reforestation program “300 x 500”, which seeks to plant at least 300 trees annually on the 3 campuses that will offset the emissions of 500 vehicles. Under the assumption of a 5% annual increase in vehicles, carbon neutrality of the vehicles present on campuses would be achieved by 2036. The planted trees are native species, with low water consumption, rapid growth, and vertical roots to avoid breaks in the surrounding floors and pavement roads.

The proper management of waste (Zero Waste program), the search for water and energy efficiency, the training and awareness of the academic community, and the adaptation and creation of resilient infrastructure, will allow, together with carbon neutrality policies, the institution´s climate action to have a real impact on the climate emergency. Below are some results obtained by the institution.

3. Results/Discussions/Implementation

Due to climatic characteristics, Mexicali region has the largest solar generation potential of the country. Besides the operational photovoltaic solar energy generation, in Mexicali campus, the building of the Centre of Excellence in Business Competitiveness (CECE Spanish acronym), has a sustainable building skin element surrounding all the complex, designed to regulate the indoor temperature for energy efficiency. On the Ensenada campus, the newest of the buildings (Center for Wine Studies), makes use of architectural elements such as windows to improve lighting and reduce energy consumption, as well as an element that regulates internal temperature, and that allows the community to enjoy

the beauty of the landscape (Figure 1).

Figure 1. Research center CECE at CETYS Mexicali. Sustainable building skin for energy efficiency (top) and Center for Wine Studies (CEVIT) at CETYS Ensenada. The use of large windows allows more natural light and regulates internal temperature (bottom).

Waste management has at least five types of impacts on climate change, attributable to (1) landfill methane emissions; (2) reduction in industrial energy use and emissions due to recycling and waste reduction; (3) energy recovery from waste; (4) carbon sequestration in forests due to decreased demand for virgin paper; and (5) energy used in long-distance transport of waste [7]. The CETYS program "Zero Waste" fully implemented at Campus Tijuana has had excellent results. Not only with the reduction of internal waste sent to the landfill, the separation, composting, and recycling of waste but also by the campaigns carried out with the community surrounding CETYS. The program managed to reduce the amount of waste deposited in landfills by 68%, with the consequent impact on the reduction of emissions into the atmosphere. Table 1 shows the historical results of the program.

The cultural change related to waste management observed in the Tijuana campus community is outstanding. Waste separation is carried out naturally in well-marked containers, there are no single-use containers, the use of paper and cardboard has significantly decreased, the use of water cylinders is common among students, to mention some relevant attitudinal changes. It is important to note that prior to the installation of the physical infrastructure for recycling and waste separation, a general awareness and training program was implemented with an approximate duration of 6 months. It is clear to the

CETYS community that the success of campaigns like these depends strongly on a series of actions that involve the community and that are implemented in a bidirectional top-bottom, bottom-top manner (Figure 2 shows some facilities of the Zero Waste program).

Figure 2. Containers for waste separation from the Zero Waste program.

Table 1. Quantity of Waste Generated and Recycled at CETYS University Campus Tijuana

Year	PET and HDPE (kg)	Aluminum (kg)	Carton and Paper (kg)	Organics and Pruning (kg)	Liquids (kg)	Recycled (kg)	Landfill (kg)	% Recycled
2018	456	92	877	2,919	0	10,648	15,558	41
2019	2,557	611	7,288	11,368	0	79,871	44,611	64
2020	829	223	3,606	2,769	0	56,091	14,477	79
2021	593	133	5,628	34	0	54,957	12,345	82
2022	1,374	511	5,125	817	479	57,783	39,716	59
2023	2,616	638	7,041	45,999	2,436	61,467	27,527	69
Total	**8,424**	**2,207**	**29,564**	**63,905**	**2,915**	**320,817**	**154,234**	**68**

The implementation of the Zero Waste program on Campus Ensenada has been stopped by external factors that are important to note. During the last two years, the costs of transporting the separated material to the central recycling companies (external to CETYS) have increased, causing the closure of 90% of the companies. The campus already

has 70 containers ready to operate, but it is necessary to solve the problem of managing these volumes of waste outside the institution to certified recycled companies.

The SDG 13 is at the core of many sustainability initiatives in Mexican higher education institutions. Yet, progress to SDG 13 and the entire 2030 Agenda might today appear unlikely to be met. To change this situation, it is necessary to form professionals aware of the impacts of climate change and competent to respond efficiently to its adaptation and mitigation [8], as well as clearly defining the institutional activities that are considered related to the SDGs [9]. SDGs awareness programs for students, including 13 goals related to climate action, have been implemented in CETYS with excellent results. Around 2,400 students and teachers have participated in person and online in the awareness workshops, which covers approximately 25% of the academic community (Figure 3).

The content of the awareness sessions includes the following elements and differs in its level of depth and technical terminology if the audience is students, teachers, administrative or operational staff: a) context of the 2030 agenda for development, b) history of the SDGs, c) objectives and goals of the SDGs, d) practical cases according to the different careers e) good practices.

The internal sustainability certification program will be launched online during the second half of 2024 (all the CETYS community including alumni will be able to attend).

Figure 3. Examples of academic activities related to the SDGs and climate action at CETYS University.

Higher education institutions are increasingly recognizing the urgent need for climate action plans to mitigate this global phenomenon. These plans often encompass initiatives such as reducing carbon emissions, implementing sustainable energy sources, and fostering eco-conscious practices across campuses, like waste management. By integrating climate action into academic curriculum and research, universities not only contribute to global sustainability efforts but also educate and empower the next generation of environmental

leaders. Collaboration with students, faculty, operational staff, and local communities is key to the success of these initiatives, ensuring impactful strategies for a more sustainable future.

According to recent studies [2, 10], some of the recommendations that may further the cause of a greater engagement of universities on climate change and the transit to zero-net carbon include a) curriculum reforms; b) education and awareness; c) research; d) broad collaboration with actors and sectors; e) renewable energy use and f) sustainable buildings. Also, some universities joined national and international group agreements or developed methodological proposals to work closely towards achieving target-based carbon neutrality, and some evaluated their carbon footprint and restructured their activities to reduce emissions [11, 12, 13].

The CETYS internal policy for carbon neutrality (under review with the President´s staff and academic authorities), as a part of the strategic plan CETYS-2036, seeks the progressive decrease of Green House Emissions (GHE), to attain 80% of reduction by the year 2040 to 2045. The economic implications associated with this policy have been taken very seriously by the university's senior management so that it is a realistic and achievable plan with the metrics and times established therein. Due to the high mobility of students and teachers at the institution (internationalization is a pillar of education at CETYS), the plan contemplates the reduction of emissions from scope 1, 2 and 3. The Action Plan will be announced during the second semester of 2024, and seeks to achieve carbon neutrality in the institution by 2045.

Figure 4. CETYS “Solar Power” program and facilities.

The CETYS climate commitment states: “CETYS University assumes the commitment to decisively contribute to mitigating the climate crisis with multiple educational, research, community awareness, student leadership, and entrepreneurship actions, adaptation of its physical infrastructure, reduction of its waste and carbon footprint, conservation of its green

areas and expansion of its forest areas, with a view to progressively reducing its greenhouse gas emissions and making significant progress (75 to 80%) towards carbon neutrality in the year 2036".

The CETYS climate action plan includes the following areas of action and goals:

3.1. *Setting and Infrastructure*.

CETYS University will have photovoltaic solar energy generation facilities on its 3 campuses with a generation capacity of 2 MW. The current capacity is 1.37 MW (see Figure 4).

CETYS University will diversify the renewable sources of energy generation on its campuses, operating at least 2 types of sources.

CETYS University will implement the "Zero Waste" program on its 3 campuses.

CETYS University will carry out annual energy audits on its 3 campuses to reduce their energy consumption.

CETYS University will implement compensation mechanisms for its carbon footprint for international mobility by plane.

3.2. *Reforestation and biodiversity conservation*.

CETYS University will continue the "300 x 500" program which seeks to plant at least 300 native trees annually between its 3 campuses, to compensate the emissions of 500 vehicles that enter their campuses, the native species are low water consumption trees adapted to the climate characteristics of the region.

CETYS University will continue the "Beneficial Aromas" program (beneficial smells in English), which generates added value to the region's own aromatic plants, which together additionally support the existence of pollinator islands. This hands-on program leading by students uses native aromatic plants to extract basic oils to generate soaps, candles, hand cream, etc. All the items are sold by the students themselves to raise funds for internal environmental organizations at eco bazaars

CETYS University will make an annual inventory of the flora and fauna existing on its campuses. The expectation is that with the increase in forest areas, biological diversity within the campuses will consequently increase.

3.3. Education

CETYS University will continue to offer the academic and research line of knowledge generation on sustainability and renewable energies in its master's and doctoral programs.

CETYS University will continue to offer the Renewable Energy Engineering degree in its degree programs.

CETYS University will continue to offer subjects related to sustainability in its high school programs.

CETYS University will continue to offer awareness and training programs on the Sustainable Development Goals and climate change.

CETYS University will offer internal certification programs in sustainability with curricular validity.

CETYS University through their Institute for Sustainability Studies will continue to promote all the education and research activities among its campuses.

3.4. Research

CETYS University will continue to support internal research projects in the line of generation and application of sustainability knowledge. For the past 3 years around 50% of the internal

research grants funds were related to sustainability projects.

CETYS University will promote the publication of scientific articles that address the topic of the Sustainable Development Goals.

CETYS University will promote interdisciplinary research that addresses the issue of climate change from different investigative and methodological perspectives.

CETYS University will support the deployment of technological and monitoring projects within the campuses that are related to climate change.

3.5. Communities and Networks

CETYS University will continue working in national and international networks related to climate change issues.

CETYS University will continue to participate in national and international certifications and rankings that include indicators related to climate action.

CETYS University will continue to support the creation and operation of student groups related to environmental and sustainability aspects.

CETYS University will continue to develop activities that raise awareness in the external community about climate change and possible adaptation and mitigation measures.

The action plan is currently being reviewed with the idea that it can be deployed in an orderly, planned manner and with sufficient financial support to make it a reality. Finally, it is important to indicate that the use of social networks, managed by the student associations related to the environment and sustainability in a precise, timely, and reliable manner, can be a very efficient mechanism for disseminating the plan. The use of this type of communication media has already been tested in the dissemination of other projects directed by the ISS itself.

4. Conclusions/Summary/Future Perspectives

CETYS University is immersed in a profound transformation that seeks to make the institution more sustainable and at the same time allows it to contribute to the mitigation of climate change. The creation in 2022 of the Institute of Sustainability Studies has concentrated and reinforced many of the actions that were carried out in isolation or individually and has made it possible to deploy new programs that cover the substantive areas of the institution such as physical infrastructure, institutional policies, academic and research actions, and high-impact local programs. Participation in local, national, and international collaboration networks that seek to mitigate the impacts of climate change has opened new perspectives for action. The influence of the university among regional actors and productive sectors has also allowed climate commitments to be extended beyond the physical borders of the university community.

There are still many things to do: it is important to continue raising awareness among new generations of students; energy audits of the facilities of the 3 campuses must be implemented based on uniform methodologies and standards; automation in the measurements of variables that are related to the climate action plan must be implemented; the use of bicycles must continue to be encouraged in areas where the topography allows it (e.g. Mexicali Campus); it is necessary to have more influence from the academy on the generation of local public policies to counteract climate change; projects related to circular neighbourhoods that impact the community and whose environmental benefits can be measured must be promoted as urgent measures. The good relationship between CETYS and the companies and industries of the region should be used to support and technically

guide those projects that allow these organizations to be greener and move more quickly to a low-carbon society since the impacts of climate change are strong and evident in this region of Mexico.

It is through planning based on scientific knowledge and actions undertaken from the local to the global that CETYS University seeks to contribute with real solutions to the climate emergency. To the extent that we are able to inculcate in our students the importance of taking individual and collective actions to mitigate the factors that produce climate change and build more resilient institutions, in the future we will be closer to overcoming this global climate crisis.

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