

Proposal for an energy sustainability strategy for the Universidad Tecnológica de Aguascalientes

Propuesta de estrategia de sustentabilidad energética para la Universidad Tecnológica de Aguascalientes

CASTILLO-ZÁRATE, Ma. Alicia†*

Universidad Tecnológica de Aguascalientes, México.

ID 1st Author: Ma. Alicia, Castillo-Zarate / ORC ID: 0000-0003-0812-1125

DOI: 10.35429/JEE.2022.17.6.1.8

Received July 10, 2022; Accepted December 30, 2022

Abstract

Due to the high consumption of electrical energy that the Technological University of Aguascalientes has had during the last 5 years and the interest of moving towards a sustainable university campus, a strategy with an environmental approach is presented that addresses this problem, to reduce the consumption of electrical energy from campus. The work is developed from a meeting with representatives of the Rectory, the Directorate of Administration and Finance and the undersigned, in academic representation of the Renewable Energies career Solar Area of the Institution, to identify the impacts derived from this problem. From the investigation process of the Energy Reform regarding the tariff scheme of the Federal Electricity Commission (CFE) network as of 2017, as well as the calculation procedures for the cost of energy consumed in the High Demand Medium Voltage Hourly rate (GDMTH), an analysis is carried out and the behavior of the costs generated by the energy demand in base, intermediate and peak hours, as well as the consumption for summer and winter hours, is identified. The information from the Single Line Diagram of the Institution allows detecting the supply network and the areas with the highest energy consumption in the Institution. Based on this internal analysis and following the SR-Sustainable methodology, the strategic plan of the proposal is drawn up in the lines of action efficient energy, infrastructure for energy sustainability and Alternatives for energy generation: Sizing, design and installation of sources power generators.

Resumen

Debido al elevado consumo de energía eléctrica que la Universidad Tecnológica de Aguascalientes ha tenido durante los últimos 5 años y, al interés de transitar hacia un campus universitario sustentable, se presenta una estrategia con enfoque ambiental que atiende esta problemática, para disminuir el consumo de energía eléctrica del campus. El trabajo se desarrolla a partir de una reunión con representantes de Rectoría, de la Dirección de Administración y Finanzas y quien suscribe, en representación académica de la carrera de Energías Renovables Área Solar de la Institución, para identificar los impactos derivados de esta problemática. Del proceso de investigación de la Reforma Energética respecto al esquema tarifario de la red de Comisión Federal de Electricidad (CFE) a partir del 2017, así como los procedimientos de cálculo para el costo de energía consumida en la tarifa Gran Demanda Media Tensión Horaria (GDMTH), se realiza un análisis y se identifica el comportamiento de los costos generados por la demanda de energía en horario base, intermedio y punta, así como el consumo por horario de verano e invierno. La información del Diagrama unifilar de la Institución permite detectar la red de suministro y las áreas de mayor consumo de energía en la Institución. A partir de este análisis interno y siguiendo la metodología de RS-Sostenible se elabora el plan estratégico de la propuesta en los ejes de acción Energía eficiente, Infraestructura para la sustentabilidad energética y Alternativas para la generación de energía: Dimensionamiento, diseño e instalación de fuentes generadoras de energía.

Sustainability, Strategy, Energy

Sustentabilidad, Estrategia, Energía

Citation: CASTILLO-ZÁRATE, Ma. Alicia. Proposal for an energy sustainability strategy for the Universidad Tecnológica de Aguascalientes. Journal Electrical Engineering. 2022. 6-17:1-8.

* Author's correspondence (E-mail: acastillo@utags.edu.mx)

† Researcher contributing as first author.

Introduction

Although the trend of the history of electricity consumption over the years, at the Technological University of Aguascalientes (UTA) follows the same pattern, consumption costs tend to increase due to the constant updating of the price of energy stipulated by the Federal Electricity Commission (CFE) in its tariff scheme, especially for micro and small businesses.

Statistical data for 2018, show an average 54,243 kW/month per year with a maximum consumption of 61,494 in the month of October and a minimum of 44,726 kW/month during April. For 2019, the average consumption was 55,097 kW/month per year with a maximum consumption of 63,192 in the month of October and a minimum of 48,491 kW/month during December. In both years, the consumption ranges ranged between 44 and 63 kW per year.

Subsequently, in February 2020, an interconnected photovoltaic system (SFV-I) with a capacity of 48,380 kW was installed and from March onwards the trend (see Figure 4) shows a decrease with a consumption of 45,422 kW, lower than the minimum consumption of the previous year. At the end of March 2020, due to the suspension of academic activities at the Institution due to the pandemic, in the months of April and May the trend be even lower, i.e., 38,073 kW and 32,877 kW respectively.

For the year 2022, the on-site academic activities are regularized and the consumption trend in the first five months continues with the same pattern as in other years, except that consumption continues to fall with an average of 35,579 kW/month and in the month of May with a maximum consumption of 43,937 kW, lower than the energy consumption before the installation. Despite this decrease, there is still an economic impact due to the costs of this consumption, therefore, considering that the investment to install another photovoltaic generation system is high and, given the Rector's interest in the transition of the Institution towards a sustainable campus, this document describes the development of a strategy based on the methodology proposed by RS-Sostenible with an environmental approach, which reinforces the results of the SFV-I and addresses the problem of energy consumption, as a starting point for this transition.

The article describes the energy problem, the proposed attention, the objective, the development of the energy sustainability strategy based on the methodology of the company RS-Sostenible, the lines of action and the strategic planning of activities.

Theoretical framework

Sustainable development

In 1983 (UN, 1987), the United Nations (UN) created the World Commission on Environment and Development, chaired by Gro Harlem Brundtland, Prime Minister of Norway. In October 1984, this Commission met in response to an urgent call to establish a global agenda for change, and carried out studies, lectures, analyses, debates and public consultations throughout the world. As a result of this work, in 1987 it published and disseminated the report "Our Common Future", which describes the need for society to modify its lifestyle and habits in order to prevent the social crisis and the degradation of nature from spreading irreversibly. The report raises the possibility of obtaining economic growth based on sustainability policies that will extend the capacity of the environment to meet present and future needs. The concept of sustainable development is defined as "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (Ramírez, 2002).

Beyond pretending to be a futuristic prediction, this represents an urgent call to adopt decisions that will ensure the resources to sustain this and the following generations.

Since then, in many countries there has been a commitment to maintain, through strategic actions and policies, a balance in the economic, social and environmental dimensions of sustainable development, seeking the viability of using environmental resources for economic growth, ensuring that economic and social growth is equitable, and that available environmental resources support social growth.

In this context, the integration and conjugation of these three dimensions will be the basis for the functionality and growth of the Organization under a Sustainability scheme.

To this end, it is important for the Organization to define the key aspects to be addressed in each dimension and to establish the appropriate sustainability strategy for their fulfillment.

Given this scenario and the commitment to contribute to the fulfillment of the Sustainable Development Goals (SDGs) and the recent agreements of the 2030 Agenda, efforts to define and establish sustainability policies and strategies have become increasingly widespread within the Organizations of the participating countries.



Figure 1 Dimensions of sustainable development

Source:

http://cidecame.uaeh.edu.mx/lcc/mapa/PROYECTO/libro/3/21_definicion_de_desarrollo_sustentable.html

Sustainability strategy

According to (González López, Benítez, Loreto, & Aranda Sánchez, 2015) "Sustainable development supposes the harmoniously viable articulation in time and space of the social with the environmental" therefore the sustainability strategy must provide the university environment with social, environmental and consequently economic value.

There are several methodologies to develop sustainability strategies, in the course called Sustainability Manager given by the company RS-Sostenible.¹ and CAMEXA, the following steps are considered:

a) Context analysis

The organization analyzes the internal and external context to identify the challenges and trends in the environmental, social and economic aspects.

It includes the identification of the type of organization, the problems to be addressed, environmental trends (some actions for the preservation and care of natural environmental resources), social trends (some actions for social coexistence among members of the community) and economic trends (planning and appropriate use of economic resources for physical infrastructure and personnel training) that are developed in the company.

In addition, it includes the review of compliance with the national and international legal framework, reports on sustainability trends of organizations and the review of sectoral sustainability reports (national and international).

b) Stakeholder mapping

Stakeholders are the key groups or individuals with an interest in the organization's issues, decisions and activities, who are involved to inform decisions and support the management of sustainability strategy activities. This process identifies the interested parties, their expectations, and the criteria for prioritization in sustainability.

c) Materiality

Materiality is the resources that can be counted on for the strategy's activities. This is the initial aspect that allows defining and prioritizing environmental, social, economic and governance issues that matter most to the organization and its stakeholders.

d) Action Plans

To implement the sustainability strategy, the different actions are planned with clear objectives, defined scope, execution period, description of indicators and their measurement, responsible team and available resources (budget, training, platforms, etc.).

¹ <https://www.rs-sostenible.net/acerca-de>

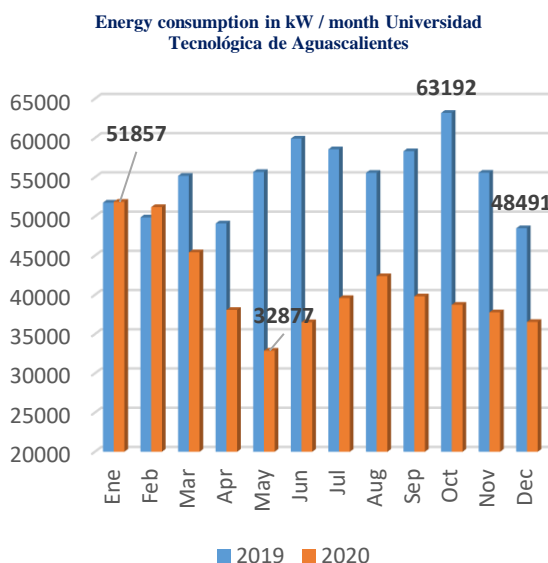
Rates of the Federal Electricity Commission (CFE) for businesses

The consumption cost rates for companies stipulated by CFE² are as follows:

- PDBT rate up to 25 kw for small to medium businesses and commerce.
- GDMTO rate for consumption less than 100 kilowatts per month and has the same cost for energy 24 hours a day.
- GDMTH rate. Generally, the highest of the rates for business and industry, although this varies depending on the characteristics of the load. It is for a voltage ranging from 1000 V to 36000 V and for consumption equal to or greater than 100 kilowatts per month.

Problem

In the year 2019, before the pandemic, the Technological University of Aguascalientes (UTA), shows a high consumption of electrical energy, with an annual average of 55,097 kW per month, a minimum value of 48,491 kW/month and a maximum value of 63,192 kW/month.



Graphic 1 Electricity consumption during 2019 and 2020 in UTA

Source: Own elaboration

As shown in the graph, for the year 2020, despite the fact that, due to the pandemic, academic activities at the Institution decreased and, at the same time, an interconnected photovoltaic installation was installed in February, the annual average consumption decreased to 40,895 kW/month with a minimum value of 32,877 kW/month and a maximum value of 51,857 kW/month; however, this was not significant for the cost of energy.

Proposal for attention

Within the framework of the University's interest in a transition to a sustainable campus, a sustainability strategy is presented as a starting point, with an environmental approach that addresses the problem of energy consumption, through the axes Efficient energy, infrastructure for energy sustainability and alternatives for energy generation.

Goal

Reduce electricity consumption through the implementation of a proposed energy sustainability strategy on the university campus.

Methodology

Under the Sustainability approach, an environmental approach proposal called Energy Sustainability Strategy for the Technological University of Aguascalientes, which aims to address the problem of high energy consumption in the institution, which impacts on the cost of consumption, so the intervention is developed in the following stages:

Definition of the scope of the UTA for sustainability.

From a meeting with representatives of the Rector's Office, the Administration and Finance Department and the undersigned, in academic representation of the Renewable Energies Solar Area of the Institution, the main aspects to be addressed by the University in the Economic, Environmental and Social dimensions are proposed.

²<https://app.cfe.mx/Aplicaciones/CCFE/Tarifas/TarifasCREIndustria/Industria.aspx>

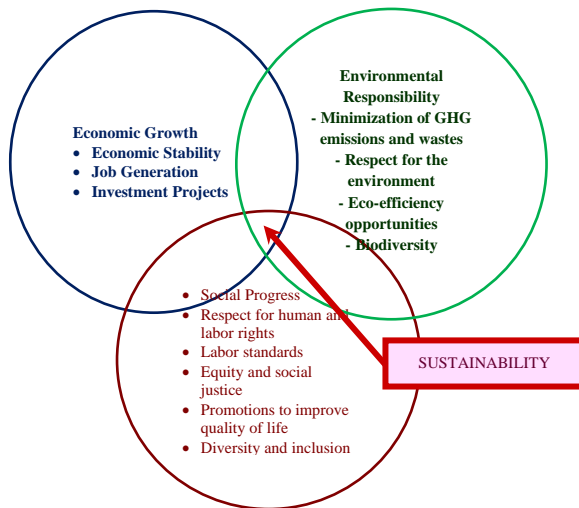


Figure 2 Sustainability approach of the Technological University of Aguascalientes

Source: Own elaboration

Progress in the achievement of the aspects indicated in the three dimensions of sustainability is intended to be gradual, seeking:

- The viability of the use of environmental resources for economic growth with minimum environmental impact, so for this dimension it is necessary to define and establish policies for an environmental university culture.
- That the economic and social growth be equitable, therefore it is necessary to define adequate policies focused on the increase of skills for the improvement promotions.
- That the available environmental resources support social growth, through the use of new and adequate technologies.

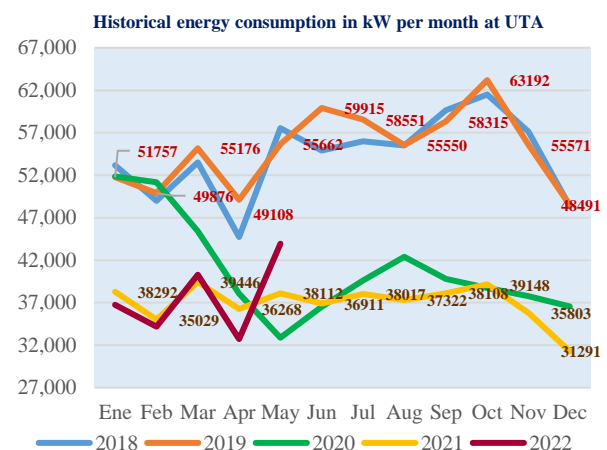
It is important to emphasize that, due to the problems raised, the economic impacts derived from them and the Rector's interest in the transition of the Institution towards a sustainable campus, the development of a strategy with an environmental focus is proposed as a starting point, using the methodology proposed by RS-Sostenible, to address the problem of high electricity consumption.

Context analysis

The problem of high energy consumption begins with the analysis of the procedure used by CFE to calculate the cost of electricity consumption. In this sense, it is detected that the consumption during the year 2021 positions the Institution in the tariff scheme of the Federal Electricity Commission (CFE) as a GDMTO consumer (tariff for consumption less than 100 kW), however, because the contracted demand for electricity of the Institution is greater than 100 kilowatts per month, the tariff that applies to the Institution is GDMTH (Consumption greater than 100 kW).

Despite the fact that in 2020 a SFV-I was installed and academic activities were suspended due to the pandemic, the decrease in consumption reflected in the costs was not significant, probably due to the rate assigned to the Institution (GDMTH) despite the fact that less than 100 kW/month is consumed.

In addition, there are changes in the costs of CFE tariffs, stipulated in the Official Gazette of the Federation throughout the year, and specifically for the GDMTH tariff contracted by the Institution, there is a schedule of Base, Intermediate and Peak levels, where the cost of energy varies depending on the time of day that the energy is consumed. In addition, there are changes due to summer and winter schedules. In a comparison of consumption during 2019 (before the pandemic) and 2021 (after the pandemic and with a SFV), the decrease in energy consumption is observed.



Graphic 2 Comparison of energy consumption before and after pandemic and installation of photovoltaic system at UTA

Source: Own elaboration

The analysis of this trend generates awareness regarding energy use, therefore this behavior can be reinforced through the implementation of an energy sustainability strategy.

The analysis of the single-line diagram indicates the areas served by each transformer in the energy supply.

Stakeholder mapping

It shows the stakeholders and their prioritization, on a scale of 1 to 4 (4 being the highest value) to address this problem.

Stakeholder identification and prioritization (IP)						
Categories	Responsibility	Influence	Proximity	Negative effect of the company on IP	Dependence on the company	Priority
Rector	4	4	4	4	4	4
Administration and Finance Directorate	4	3	4	4	4	4
Maintenance and Services Area	3	1	4	3	3	4
Renewable Energies Solar Area	3	1	3	3	3	4

Table 1 Identification and prioritization of stakeholders. Source: RS-Sustainable format and content with own elaboration

Materiality

The resources with which it is considered feasible to implement the sustainability strategy are:

Basic Subject Matter	Subject Material	Feedback sources	Interested Party	Responsible area
Environment	Energy Management Power supplies (light bulbs, wiring, etc.)	Energy Receipt External suppliers	Maintenance	
	Management to address energy saving infrastructure	External suppliers		
Community	Training on the topic and scope of sustainability in its three dimensions	Training material on the subject	Energy Staff	Energy Management
	Training and awareness-raising on efficient energy use	Training material on the subject	Maintenance Personnel	Finance
Labor Practices	Efficient use of energy and technological equipment	Definition of energy saving and efficient energy use policies	University community	Rectory
Governance	Commitment of the Institution's leaders	Definition of energy saving and efficient energy use policies	Rector	Rectory

Table 2 Materiality Source: Own elaboration

Action plans

Based on this internal analysis, three lines of action are defined, each with the following actions:

- a. Energy Efficiency: Development of efficient energy use policies, Energy Efficiency Awareness Program, Awareness campaign.

- b. Infrastructure for energy sustainability: Change of lighting fixtures, Energy diagnosis by areas.
- c. Alternatives for energy generation: After implementing the actions of the previous axes, it is considered relevant to evaluate the reduction of energy consumption to perform sizing (with the results of the energy diagnosis), design and installation of new energy generating sources.

The action plans are shown in the Results.

Finally, in this first step towards sustainability, this proposal considers including the indicators GRI-302-4 Reduction of energy consumption and GRI-305-5 Reduction of GHG emissions, as the first results that can be considered for the future elaboration of Sustainability Reports of the Institution.

Results

Paradigm of the Sustainability concept

As a result of this work, at the management level, the paradigm that the concept of sustainability only includes the care and preservation of environmental resources is broken.

Energy Sustainability Strategy

This strategy is intended to contribute to Sustainable Development Goal SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all (Wu, 2022).

The strategy is outlined in the following illustration.

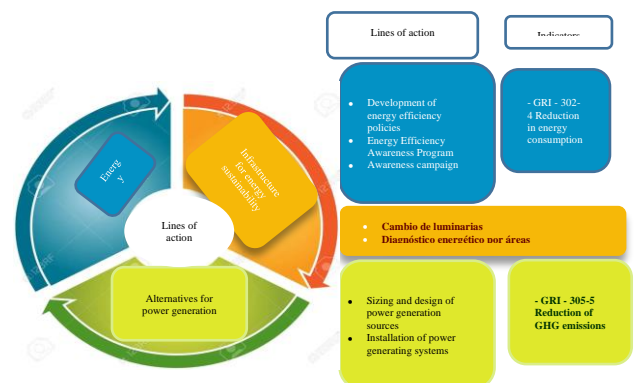


Figure 5 Proposed energy sustainability strategy for the Technological University of Aguascalientes Source: Own elaboration

Inclusion of Graphs, Figures and Tables

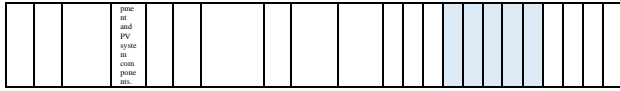
It is worth mentioning that, in this first step towards sustainability, after one year of implementation, the proposal considers making the necessary calculations to show the indicators GRI-302-4 Reduction of energy consumption and GRI-305-5 Reduction of GHG emissions.

Strategic Energy Sustainability Planning for the Universidad Tecnológica de Aguascalientes

Based on the lines of action indicated in the strategy, the following Strategic Planning is carried out.

Table with columns: Line of action, Shares, Activities, Resources, Infrastructure, Resource management, Response for monitoring, and Management schedule 2022 (J, F, M, A, M, J, J, A, S, O, N, D).

Table with multiple empty columns for detailed project information.



Strategic planning for energy sustainability for the Technological University of Aguascalientes. Source: Own elaboration

Acknowledgments

Special thanks to the company RS-Sostenible for their support, advice and accompaniment in the development of the energy sustainability strategy.

Financing

This work has not been financed since it is the first strategic proposal that is subject to approval by the Institution's governing authority.

Conclusions

The proposed energy sustainability strategy represents an opportunity to initiate, in the environmental dimension, the transition of the campus to a Sustainable Higher Education Institution.

The successful implementation of this strategy requires the sensitization of stakeholders, with the commitment and responsibility for the execution of the actions proposed.

The commitment of senior management is the fundamental factor to promote the execution of actions through the definition and implementation of institutional policies on sustainability.

As a result of this work, at the management level, the paradigm that the concept of sustainability only includes the care and preservation of environmental resources is broken, hence the importance of training the university community on the scope of sustainability.

It is important to extend the invitation to the different areas of the Institution to form a Sustainability Committee with interdisciplinary personnel. Due to the change of authorities during May 2022, this proposal is left for the consideration of the new authorities for their approval.

References

González López, S., Benítez, S., Loreto, J., & Aranda Sánchez, J. M. (2015). *Estrategias hacia la sustentabilidad socioambiental desde los ámbitos locales y la Universidad* (Vol. IX). Estado de México, México: Proyección 18. DOI: ISSN: 1852 - 0006

ONU. (2 de 08 de 1987). *CMMAD - Informe de la Comisión Mundial sobre el Medio Ambiente y el Desarrollo*. Obtenido de https://www.ecominga.uqam.ca/PDF/BIBLIOGRAPHIE/GUIDE_Lecture_1/CMMAD-Informe-Comision-Brundtland-sobre-Medio-Ambiente-Desarrollo.pdf

Ramírez, A. &. (2002). El Desarrollo Sustentable: Interpretación y Análisis. *Revista del Centro de Investigación. Universidad La Salle*, 6(21), 55-59. doi:ISSN: 1405-6690

Wu, J. W. (15 de Mayo de 2022). *Naciones Unidas*. Obtenido de Crónica ONU: <https://www.un.org/es/chronicle/article/objetivo-7-garantizar-el-acceso-una-energia-asequible-fiable-sostenible-y-moderna-para-todos>