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Energy Efficiency: Training for Baccalaureate Students

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Abstract

Ecuador has an enormous unused potential in renewable energy, due to factors such as its location on the equator, which allows it to receive the maximum solar energy per unit of surface area, its high rainfall and the Andes mountain range, which provide it with considerable hydroelectric and geothermal resources. As a result of the relative abundance of oil from 1972 and the debt crisis that began in 1982, the development of renewable energy in the country has been discontinuous, insufficient, and has concentrated on large hydroelectric projects, which in some cases have suffered serious deficiencies. The energy transition towards the adoption of renewable energy sources is a strategic need in Ecuador, mainly due to the progressive depletion of oil reserves, which will hardly allow exports to be maintained for more than 20 years.

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1 Introduction

The research focuses mainly on the adequate and efficient use of electrical energy as the first renewable energy that is energy efficiency, the training was given to students in the tenth grade of basic and third of high school. The development of renewable energies is also justified by the negative impacts of oil extraction both on biodiversity, which constitutes the main enduring wealth of the country, and on climate change, which is the main threat to global sustainability in the present century (Rodriguez & Vazquez, 2018; El-Ghonemy 2012; Al Malki *et al.*, 1998; Koroneos *et al.*, 2003).

Energy efficiency as a concept group's actions taken on both the supply and demand sides, without sacrificing well-being or production, allowing for improved security of supply. Achieving, also, savings both in energy consumption and in the economy of the general population. Simultaneously, reductions in greenhouse gas emissions and improvements in the finances of energy companies are achieved (Vazquez *et al.*, 2018; Arcentales *et al.*, 2017; Herring, 2006).

It is considered necessary to research because it is a topic that concerns the daily life of each of the students and will serve to put it into practice in their day to day, from school to their homes. The desire to publish this research is to contribute to institutions to help prevent the consequences related to the factors that predispose students to misuse of electrical energy. The objective is to strengthen the knowledge of the efficient use of electrical energy in students in tenth grade and third year of high school in the province of Manabí. Since various studies show that there are difficulties in the daily use of electrical energy and its resources (Zhou *et al.*, 2000; Costanza & Patten 1995; Schaller, 1993).

The possibilities of energy efficiency worldwide have been proven through the availability of vehicles that require less fuel, appliances that consume less electricity and lamps that consume a quarter of the energy that the old ones. But the magnitude of the potential that efficiency programs have is only understood when it is known that only 37% of primary energy is converted into useful energy. The chain of transformations and processes that energy companies go through before providing the required service cause 63% of their potential capacity to be lost. It must be borne in mind that energy efficiency in its broadest conception aims to maintain the service it provides while reducing energy consumption. In other words, it is about reducing the losses that occur in any transformation or process, incorporating better usage habits and better technologies. It is even going beyond just maintaining the services obtained from energy and it is shown with multiple examples, that it is possible to cut consumption in half by doubling the benefits.

Ecuador has enormous unused potential in renewable energy (Vázquez *et al.*, 2019; Boyd & Pang, 2000; Zhou & Ang, 2008), due to factors such as its location on the equator, which allows it to receive the maximum solar energy per unit of surface, its high rainfall and the Andes mountain range, which provide it with considerable hydroelectric and geothermal resources. As a result of the relative abundance of oil from 1972 and the debt crisis that began in 1982, the development of renewable energy in the country has been discontinuous, insufficient, and has concentrated on large hydroelectric projects, which in some cases have suffered serious deficiencies. The main objective of this article is to strengthen the importance of the efficient use of electric energy and its renewable resources for students in tenth grade and third year of high school in the educational unit under study.

2 Materials and Methods

A bibliography review was conducted to find out the behavior and regulations of energy efficiency in the country, the inductive deductive method was used and a survey was applied as an instrument and a qualitative and quantitative analysis was performed on the knowledge that the students had before and after receiving the training.

3 Results and Discussions

Training can be applied in an educational unit, in the province of Manabí, located near a sports complex, currently, it has approximately 1100 students in the two days, morning (First, Second and Third Baccalaureate), evening (1st. to 10mo, basic education) and has about 70 employees, including managers, administrators, teachers, and staff. Currently, the campus offers the Manabí community, the following study alternatives: initial education 2, basic general education from second to the tenth year, general baccalaureate unified in science and techniques.

The education that is given has the purpose of integrally training students applying technological strategies (López *et al.*, 2019), so that they can successfully embark on a university career or join the world of work so that they become citizens that they can live in peace and democracy, that they respect the laws and the established order and that they contribute with their effort to the development of their environment and the country in general.

Inclusive education is practiced in the institution, which promotes the integration and practice of ethical and moral values (López *et al.*, 2020), Project-based Learning Strategy: An Innovative Proposal for Local Education System). The teaching staff is highly qualified, qualified in their respective areas of study. Tomorrow's leaders are trained in their classrooms with participation in electoral processes, workshops, musical groups, science and technology clubs, knowledge fairs, academic contests, solidarity, justice and respect practice, sport occupies an important space as a means of socialization and healthy coexistence, integration, and connection with the community, among others.

Figure 1. The geographic location of the educational unit
Source: (www.googlemaps.com)

For Ecuador, energy efficiency began with plans to renovate household appliances, vehicles, and the change from incandescent lighting to fluorescent technology was also implemented, and the use of induction cookers has recently been made. In the health sector, specifically in the public sector, no energy indicator studies have been carried out, nor have energy management policies been implemented. The development of energy efficiency requires permanent programs that lead to the continuous improvement of the energy system that grows as there are economic improvements and population growth.

Electric power is currently a fundamental basis for the development of peoples, in other words, it is the engine of the modern world, but in the country, there is no awareness of energy saving and efficiency, most of the equipment, lighting systems, office equipment, motors, pumps, etc. For all of them to work correctly, the electrical service must be of good quality without the presence of fluctuations or disturbances, even worse, power cuts, as this would endanger the lives of the students.

It can be defined that renewable or alternative energies to those that can replace conventional energy (fossils, large hydroelectric plants, nuclear energy), and that do not imply significant negative impacts. Within the generation of energy using renewable energies, directly or indirectly, are the following: Biofuels, biomass, wind, geothermal, marine or tidal, hydraulic (micro plants up to 100 kW of power, mini plants of 100 to 1000 kW of power and small plants total installed power of up to 3000 kW), solar photovoltaic, solar thermal, solar thermoelectric, shown in figure 2.

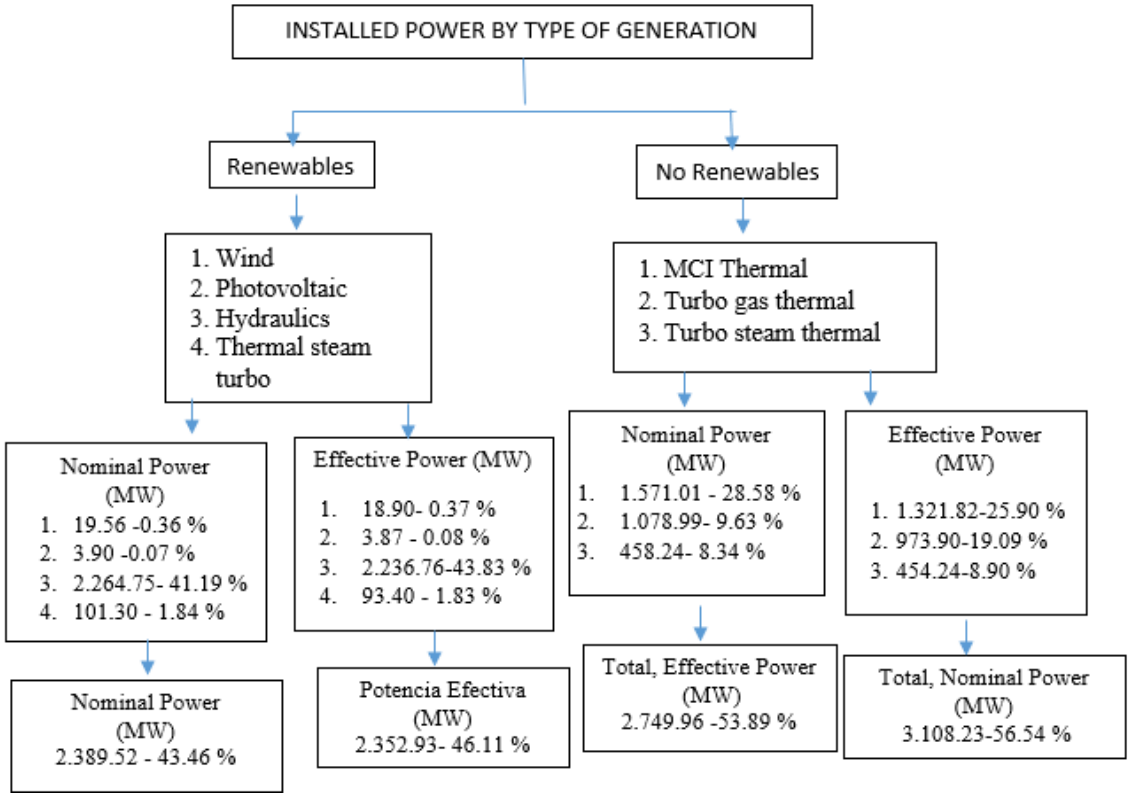

Figure 2. Types of generation
Source: (Conelec, 2015)

The effective power of generation plants according to the type of plant, those with the highest representation are thermoelectric plants with 55.72% effective power, hydraulic plants with 43.83% with 0.08% Solar, 0.37% Wind (CONELEC, 2015).

In the Ecuador Master Plan (CONELEC, 2013), it is stated that: "the national production of energy plus imports reached a total value of 27,395.53 GWh of which 16,445.95 GWh (60.03%) were generated with Renewable energy sources, while 10,867.91 GWh (39.67%) was obtained using non-renewable sources. The generation of electricity based on the water was the most representative with 15,833.84 GWh equivalent to 57.80% of total energy production and imports.

The National Plan for Good Living establishes the adequate and rational use of resources as a state policy. As a transversal axis in the change of the energy and productive matrix, it is planned to increase the use of renewable energy and implement energy efficiency plans in public and private institutions (Senplades, 2017). From an economic perspective, all actors (both consumers and providers) evaluate the higher initial costs of acquiring more energy-efficient devices against the expected benefits (future savings). Inclusively, the producers of new technologies carry out a similar evaluation, where innovation in energy efficiency responds to the expected benefits of its development (Balsalobre *et al.*, 2016).

The choice of energy efficiency level must balance the higher initial cost of new capital goods with less energy use and the future savings of the same. Future savings is uncertain and depends on expectations about energy prices, the costs associated with its use (for example, charges or taxes), the intensity of use, the life of the equipment, the needs for its maintenance, and the speed of technological change. The price of energy also influences consumer decisions, while short-term cost increases lead to reduced energy consumption, persistent increases translate into greater investments in the adoption of new devices. In other words, the long-term price elasticity (reaction of the quantity consumed to increases in the price of energy) is greater (due to the renewal of equipment) than the short-term elasticity (simple control of consumption) (Gillingham *et al.*, 2009)**.** Energy consumption is not defined by individual consumer behavior; but by rather collective lifestyle patterns; Individual choice in industrial societies is limited by the way they are configured: schools, water, and energy supply systems, the design of buildings and products, etc. Individuals can

influence what happens at the end of the chain, but significant changes in energy use are tied up by the primary systems in which individuals operate.

A consequence of the changes in lifestyles is the increasing behavior of the demand for household appliances, houses, cars, etc., not only in quantitative but also in qualitative terms. These qualitative changes are manifested in larger units and sizes: refrigerators with larger volumetric capacities, wide-screen televisions, faster and more powerful computers, larger, more comfortable homes, larger, four-wheel-drive cars, etc. From these findings, a basic premise arises: since teams convert energy into services, then individuals are interested in those services and not in energy**.** The phenomenon by which improvements in the efficiency of energy use are accompanied by a growth in energy demand is called the "rebound effect", that is, improvements in efficiency result in reduced use costs for the consumers, those who induce them to use more appliances, buy a larger car or use savings for activities or energy-intensive uses (Elfrink & Baldock, 2002).

There is no doubt that the general trend in developing countries and most Latin American countries are towards more intense consumption patterns, which means greater energy consumption not only in households but also a greater demand for industrial goods. , which in turn induces growth in the energy demand of these production processes. These trends are confirmed by econometric studies (Gately & Huntington, 2001)**.** Figure 3 shows a graph showing which sectors use electric energy and which are incorporated into the national energy efficiency plan in Ecuador.

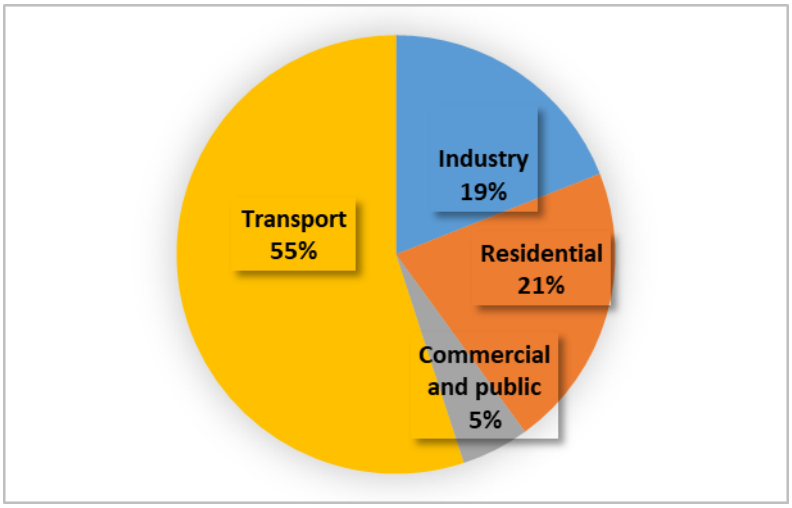

Figure 3. Use of electrical energy by sector
Source: (Celec, 2017)

Education draws major flaws, among them the lack of attractive teaching resources can be mentioned, in this sense the university prepares spaces that allow the student methodologies to promote the learning and promoting creativity, framed within principles and values of solidarity and mutual aid (Pérez *et al.*, 2020), many of these proposals improve the poor environmental preparation of teachers and the precarious adaptation of educational facilities (Garcia, 2010).

To formulate environmental educational strategies on the efficient use and saving of electrical energy as a concept, it groups together actions that are taken on both the supply and demand sides, without sacrificing well-being or production, allowing the safety of the product to be improved. Supply achieving, also, savings in both energy consumption as in the economy of the general population (Poveda, 2007).

In this way, the strategies must be understood as pedagogical actions from the action, where the critical analysis of socio-environmental realities is promoted and the changes suggested by this analysis are contributed to. Likewise, reflective training was generated within the environmental intervention (an act or a project for the environment) and educational (a process of personal and social development). The educational unit where the study was carried out, had its beginnings on March 11, 1996, through Ministerial Agreement No. 00211. On July 8, 2011, it became a complete Educational Unit, welcoming students in its classrooms from the First Year of Basic General Education to the Third Year of Baccalaureate, in the morning sessions (First, Second and Third of Baccalaureate) and the afternoon (1st. 10th of Basic Education). Before carrying out the educational intervention, the students were surveyed to determine how much knowledge they have related to the topic, in which after the talk the following two most relevant questions were analyzed:

Knowledge of energy use before of applied the survey		Knowledge of energy use after applying the survey	
YES (%)	NO (%)	YES (%)	NO
83	17	100	0

Figure 4. The comparative table before and after training

83% of the percentage that Equivalent to 25 students marked that they did know the correct use of electric energy, while 17%, which is equivalent to 5 students, indicated that, once the talk had been given, 100% of the results, equivalent to 30 students, all pointed out that if they know the correct use of energy.
They were asked if they considered electrical energy important, and in both cases, before and after, the students answered yes. At the end of the training, the students began to apply different techniques to save electrical energy and prepare that it is the first source that must be efficient because this reduces the economic and environmental impact.

As the knowledge transmitted to these children through talks where I explain where they could obtain more information is considered, to achieve these objectives two things are very important: On the one hand, learning to obtain energy economically and respectfully with the environment of alternative sources such as using low-energy light bulbs or fluorescent lamps, with good thermal insulation in the institution, but more importantly, learning to use energy efficiently, which means not using them in unnecessary activities to bet on a healthy planet where you can live without affecting the environment, so it is a task for everyone to save energy efficiently.

4 Conclusion

Energy efficiency is the first source of renewable energy that must be consciously harnessed through training from the first years of human life whose objective is to reduce the use of energy; but producing the same final results, the saving in the energy generation is produced for example using electrical controls with high yields or using the cogeneration that simultaneously produces the electrical energy and useful thermal energy, the electrical energy efficiency is the ratio between the amount of energy consumed and the final products and services obtained can be improved by implementing various measures and investments at the technological level of management and consumption habits in society.

Conflict of interest statement
The authors declared that they have no competing interests.

Statement of authorship
The authors have a responsibility for the conception and design of the study. The authors have approved the final article.

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