

# Study of Perceptions on Clean and Self-Sustainable Energy<sup>1</sup>

## Estudio de Percepción sobre Energía Limpia y Auto Sostenible

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**Abstract--** The objective of this article, is to identify the perceived benefits from the implementation of solar panels to generate clean, economical and sustainable energy at the Arcesio Caliz Amador School. Initially, the community supported the promotion of alternative energy sources and assessed different types of natural and artificial energy sources. A prototype solar panel was developed and awareness-raising efforts were made in the community to promote the use of alternative energy sources and caring for the environment. This study is quantitative and experimental. The study uses the technique of structured interviews with a sample of 50 students from the Arcesio Caliz Amador School. The main finding is that the students recognize that the use and implementation of this type of energy offers environmental, educational, economic and social benefits.

**Keywords--** Solar energy; renewable energy; clean energy; environmental care.

**Resumen--** El presente artículo permite estudiar la energía solar; considerada la fuente de energía renovable disponible más abundante y limpia. El objetivo entonces de la presente investigación identificar los beneficios de la implementación de paneles solares para generar energía limpia económica y auto sostenible en la IETD Arcesio Caliz Amador. Inicialmente, se logró apropiarse a la comunidad para el fomento del uso de energías alternativas; se identificaron los tipos de energía, natural o artificial, se diseñó un prototipo de panel solar y finalmente se creó conciencia sobre el uso de las energías alternativas, fomentando el cuidado del medio ambiente. El estudio es de tipo cuantitativo, experimental. Como técnica de recolección se empleó la entrevista estructurada a una muestra de (50) estudiantes de la IETD Arcesio Caliz Amador. Como conclusiones se puede decir que los estudiantes reconocen que uso e implementación de esta energía trae consigo beneficios tanto medioambientales, educativos, económicos y sociales.

**Palabras clave--** Energía solar; energía renovable; energía limpia; cuidado medioambiental.

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## I. Introduction

Solar energy is considered the most abundant, clean and available source of energy on the planet, and is highly renewable. Colombia is one of the countries with most abundant solar energy resources in Latin America. Consequently, solar energy stands out among all the usable renewable sources for various uses, particularly thanks to new scientific developments.

In European countries, solar electricity generation has reached a large scale, based on industrial development. In specific cases such as Germany, for example, about half of all electricity is being generated by the sun, for the first time since 2013. Another case is the United Kingdom, which enjoys sunny weather and long days during the summer, and has large solar potential. France, Italy, Denmark and others have similar situations. [1].

“According to the Solar Trading Association (STA), the total installed solar capacity in the UK generated from homes, buildings, and solar energy parks is currently about 4.7 Giga-watts, compared to 2.7 GW in July last year. Solar energy is flexible because solar plants can be built in distributed generation arrangements (located at or near the point of use), or as a large-scale centralized power utility plant (similar to conventional power plants). Some of the large-scale utility plants can store the energy they produce for use after dark” [1].

Sustainability is studied from different perspectives, such as based on the choice of materials used, or even its safety for human beings. Solar power includes photovoltaic energy, an energy source that is growing rapidly worldwide, the specific features of which include clean energy of a scalable nature and favorable conditions.

Given the changes being experienced by current societies, human beings require new innovative strategies to satisfy their needs. In the current consumer society, individuals often do not acquire products for a specific benefit, but rather are interested in various aspects that directly or indirectly affect their social lives [2]. Consequently, the idea of implementing a solar energy project was born with the intention of raising the awareness of individuals about their effects on the environment and to promote sustainability.

The growing scientific, technological and industrial development of societies has brought about new tools that enable the fast and sustainable satisfaction of human needs. It is in this context that the idea for the project was born: to design an electrical system based on photovoltaic cells at the Arcesio Caliz Amador School, in order to provide clean, economical and self-sustainable energy.

### A. Conceptualization of solar energy

“Solar energy is energy captured from the light and heat emitted by the sun. The solar radiation that reaches the Earth can be used in the form of heat or as absorption of radiation, for example in optical and other devices. It is one of the so-called renewable energies, in particular of the non-contaminating type, known as clean or green energy, even though at the end of their useful life the photovoltaic panels may become a polluting residue that is difficult to recycle at present” [3].

Solar energy is used as backup power, especially to meet peak demand, because it is synchronized with demand from air conditioning. It is not as useful in satisfying demand at night or during the winter season. Even though in this article we discuss solar energy, it should not be disassociated from wind energy, which in the United States “has a non-subsidized cost of 4 cents/kWh, which is, therefore, lower than electricity generated with gas. This represents a real challenge for coal.”[3]

The power of radiation tends to vary depending on the time of day, atmospheric conditions and the latitude of the location. In optimal conditions, radiation has a value of approximately 1000 W/m<sup>2</sup> on the earth surface, which leads to the definition of irradiation. Radiation is usable to the extent that it is direct and diffuse, and the articulation of both.

### B. Renewable energy

For over a decade, renewable energy sources – specifically electric, solar and wind energy – have become the sources of choice for energy generation to meet human needs. Initially, it was thought that these could complement existing sources of energy without having to introduce major changes. However, given all the benefits they offer in terms of economy, demand for renewable energy has grown substantially, though numerous challenges remain in terms of connecting the renewable energies with the permanent systems.[4].

It is important to point out that greater progress is required in terms of electricity supply in order to be able to articulate innovative sources of photovoltaic energy, which is considered an essential component of the electricity generation system.

For many centuries, and particularly since the industrial revolution, mankind has made use of electric energy sources, including solar, wind and hydraulic energy. For many years, the factor that limited their use was the low cost of oil.

In recent years, however, the increase in fuel prices and environmental issues has driven the resurgence of renewable energy. The main features of renewable energies include that they are non-exhaustible and clean, and they are predominantly used under self-management schemes in order to satisfy demand in the areas where they are produced.

They also offer significant advantages, such as the possibility of integrating them. One of the clearest examples is that photovoltaic energy can supply power on sunny days, while other sources of electricity meet demand on colder days.

Types of energy	Conceptualization
Solar photovoltaic energy	<p>“The simplest way to capture sunlight is through photovoltaic conversion, which consists in converting solar energy into electric energy by means of solar cells. These cells are made of pure silicon with the addition of certain chemical substances. Each cell is capable of generating between 2 a 4 Amperes, at a voltage of between 0.46 and 0.48 V, using solar radiation as raw material”. Solar cells can capture both direct and diffuse radiation, and they are capable of producing electric energy even on non-sunny days. The cells are placed in rows on top of solar panels or modules, which enables producing an expected and precise voltage for electric applications. These panels capture the energy and later convert it into electricity, in the form or continuous current, which must be stored for later use. [4].</p>
Hydraulic energy	<p>“A very interesting application from small facilities near waterfalls is the hydraulic mini-plant, which can produce between 100 W and 5 kW, and may be combined with other types of energy. It has a wide range of applications because three-fourths of humanity does not have electric energy from which to obtain drinking water, lighting, electric tools, food conservation or access to culture (audiovisual media). Currently, these systems are the best form of direct assistance for the third world.” [5] [6]</p>
Electric current	<p>“Electric current is defined as the movement of electrical charges. The current may be produced by any electrically-charged particle in movement, usually electrons, but any other charge in movement may be defined as current.48 According to the International System, a current’s intensity is measured in amperes, the symbol for which is A [3]. [7]. On the other hand, [5] the process through which the current circulates through a material is called electrical conduction, and its nature varies depending on the charged parties and the material through which they circulate”.</p>

Source: Authors.

### C. Solar panels

The technologies that are currently in use were originally developed to address a variety of needs worldwide, such as supplying space rockets and detaching satellites. “A solar panel is a module that uses energy from solar radiation to transform it into electricity by means of the so-called photovoltaic cells. By means of a sophisticated process, silicone, which is a natural chemical element that is widely abundant on our planet, particularly in beach sand, is extracted to use it to manufacture solar or photovoltaic cells” [8].

A photovoltaic cell is a delicate sheet whose contents include silicone, approximately similar to a 10-centimeter square that enables the transformation of direct sunlight into electricity. In other words, its acts like a rechargeable battery. A photovoltaic panel is formed by several solar cells, which link the sunlight to electricity generation. Its approximate duration is 25 years of power, and its wear produces a noticeable decrease in production over time. [9]

Photovoltaic batteries are designed to receive large-scale charges, as well as permanent discharges, and for this reason they require a system to control the energy that they receive and emit. These batteries are designed to receive large charges and to constantly produce discharges, and for this reason, they require a system to regulate the energy they receive and emit. “This system is the controller or regulator of the charge for the storage batteries; it consists in an electronic unit whose function is to prevent over-charges or discharges from the storage batteries once they are fully charged, in order to prolong their useful life.”[8][18].

Solar radiation can vary depending on the time of day and season, and the battery is considered the critical element to provide a quick solution by making energy available throughout the year. A malfunctioning battery is treated as inorganic waste, and because of its nature and components, it must be recycled in order to prevent damages to the environment [10].

### D. Household solar panels

Since its origins, the earth has offered various sources of life. The sun comes in first place as the source of life on earth. It can satisfy all needs if it is adequately used. “The amount of energy sent daily by the sun to the earth is ten times greater than the energy consumed daily by the entire planet. [11]

There are many ways to make use of energy sources. One of them, which has been in use for a long time, is a passive solar architecture, which uses direct radiation without any type of artifact and is based on using suitable materials.

Solar energy is the energy captured by the solar radiation systems and which is transformed, depending on the instruments that are used, which may be either thermal or electric, for subsequent use. The solar panel is an element that directly traps solar radiation and converts it into useful energy; there are two types: thermal solar collectors and photovoltaic modules. The latter will be used for the effects of this study.

Solar cells are devices that transform sunlight energy into electricity. This household project is intended to build a solar cell to produce energy that is clean, economical and self-sustainable at the school [12].

There are numerous benefits from installing household solar panels, as it is a non-exhaustible renewable resource, it does not damage the environment, and the only required input is the sun. It has zero environmental impact because it does not produce waste, smoke, noise, smells, etc. The implementation of panels is a definitive solution in places where no electric power is available, while at the same time it assures clean energy and respects the environment, because “for every 100 KW of solar power capacity that is installed, we prevent 75,000 Kg of CO<sub>2</sub> from being expelled into the atmosphere.”[12] It is also resistant to a wide range of weather conditions: rain, snow, wind, hail.

Lastly, solar energy is one of the most developed energy sources in recent years, and further development is expected in the future.

## II. Methodology

This study is of the quantitative type with a descriptive scope. [13]. The phenomena are studied in

the natural context, in order to analyze data and produce results. The population that participated in the study was the students of the Arcesio Caliz Amador Departmental School. The sample consisted of (50) students in different grades of mid and high school, with the following distribution: 15 from eighth grade, 15 from ninth grade, 10 from tenth grade and 10 from eleventh grade. The data were collected using interviews based on open-ended questions with the participants [14].

The following are the stages of the study.

Stage (1): Identification of the issue to be studied.

Stage (2): Definition of the population and the sample.

Stage (3): Definition of the variables of the study.

Stage (4): Theoretical framework.

Stage (5): Selection of data gathering techniques and instruments.

Stage (6): Application of the instruments.

Stage (7): Data analysis and processing.

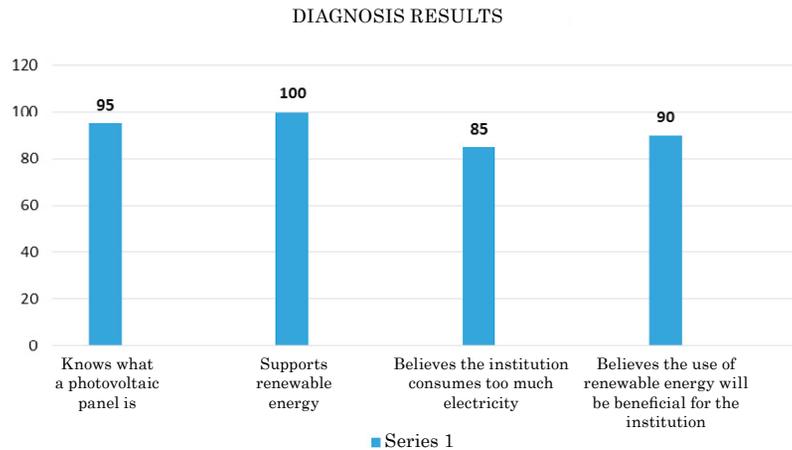
Stage (8): Generation of results.

Stage (9): Publication and discussion of the findings.

## III. Results

The following were the leading questions made to study participants:

1. Do you know what a photovoltaic panel is?
2. Do you support renewable energy?
3. Do you believe the institution consumes too much electric energy?
4. Do you believe it would be beneficial for the institution to use renewable energy?



Source: Authors.

The obtained results for question No. 1 of 95% indicate that the overwhelming majority of the students and teachers are clearly aware of what a photovoltaic panel is.

In question No. 2, 100% both of students and teachers support the use of renewable energy, because they believe it is an alternative to take care of the environment.

Regarding question No. 4, 85% of respondents said yes. This is because the geographic location of the school requires the use of numerous fans and air conditioners.

Lastly, 90% of participants do believe that this contributes to caring for the environment.

#### IV. Conclusions

The use of clean, economical and self-sustainable energy offers a wide variety of benefits for communities, particularly in rural areas. It is an alternative that helps preserve resources and that promotes behaviors that are environmentally sustainable. It is also an alternative to the creation of business ideas for implementation in big cities. The students mentioned the following benefits from the implementation of clean, economical and self-sustainable energy:

- There is no exhaustion of solar energy
- It is not harmful to the environment
- It improves life quality thanks to the transformations that it enables
- Sunlight becomes a renewable source for life
- The cost is high, but it produces life-changing transformations and makes better use of resources.
- It reduces ecological destruction.

[16]. It can be inferred that the identification of benefits from the implementation of solar panels will enable the installation of a renewable energy system in the short term that will improve electric power service, through the installation of a photovoltaic system to benefit the educational community of the Arcesio Caliz Amador School during school hours, and will significantly reduce the use of commercial electricity, which also helps care for the environment.

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