Chapter 1 Optoenergía

Capítulo 1 Optoenergy

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Abstract

The generation of energy through renewable sources is of paramount importance for humanity since we are looking for developing clean and sustainable systems. In that enterprise, two branches of Physics, Optics and Photonics, has been dedicated to developing significant studies related to this topic. Optics and Photonics are related with study of generation, propagation and detection of electromagnetic radiation. As we know light, a type of energy, is electromagnetic radiation. In this paper we mention a term called Optoenergy. In this document, we will explain that this concept is beyond just considering photovoltaic cells.

Energy Conservation, Light Management, Photoenergy, Photonics

Resumen

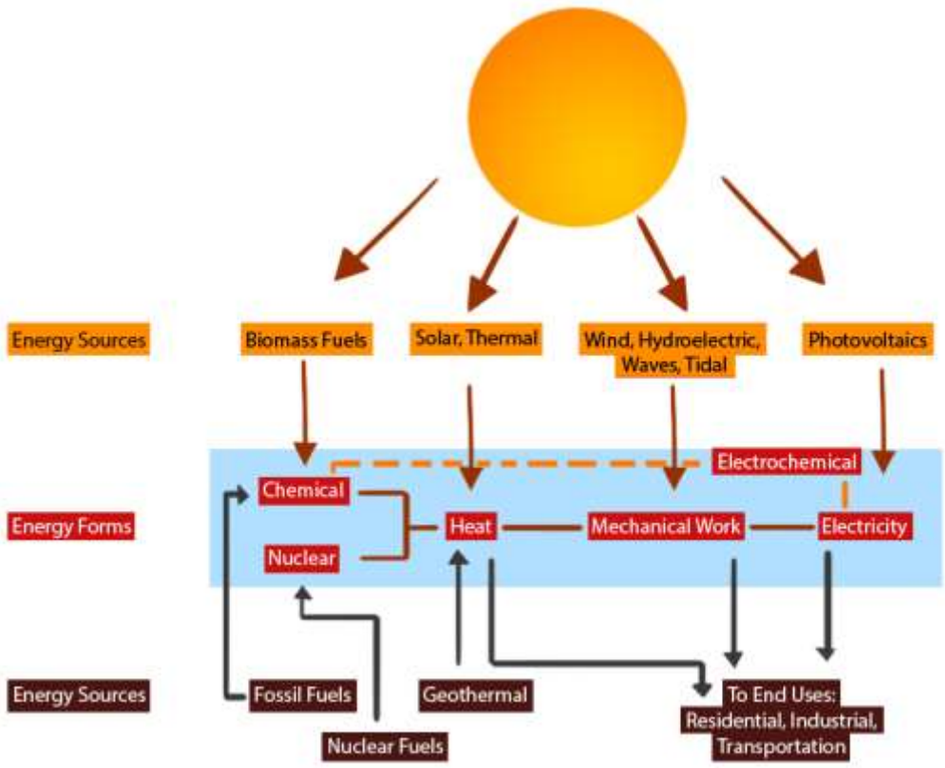
La generación de energía a través de fuentes renovables es de suma importancia para la humanidad ya que buscamos desarrollar sistemas limpios y sostenibles. En este contexto, dos ramas de la Física, la Óptica y la Fotónica, se han dedicado a desarrollar importantes estudios relacionados con este tema. La Óptica y la Fotónica están relacionadas con el estudio de la generación, propagación y detección de radiación electromagnética. Como sabemos, un tipo de energía es justamente la radiación electromagnética. En este artículo nos avocamos en un término denominado Optoenergía. En este documento explicaremos que este concepto va más allá de considerar las células fotovoltaicas.

Conservación de Energía, aprovechamiento de la luz, Fotoenergía, Fotónica.

1. Introduction

At present we relate energy in terms of fuel for transport, heat, electricity, among others; however, that does not define energy; that merely tells us that these fuels give us. Despite the concept of energy is of paramount importance in the subjects of engineering and science, it cannot be easily defined. The notion of energy is more inclusive (Serway & Jewett, 2004). According to (Chang & Goldsby, 2016), "The energy is usually defined as the capacity to do work; all forms of energy are capable of doing work." There are many types of energy (SolarSchools, 2018); the majorities of these are represented in Figure 1:

Figure 1 Types of energy

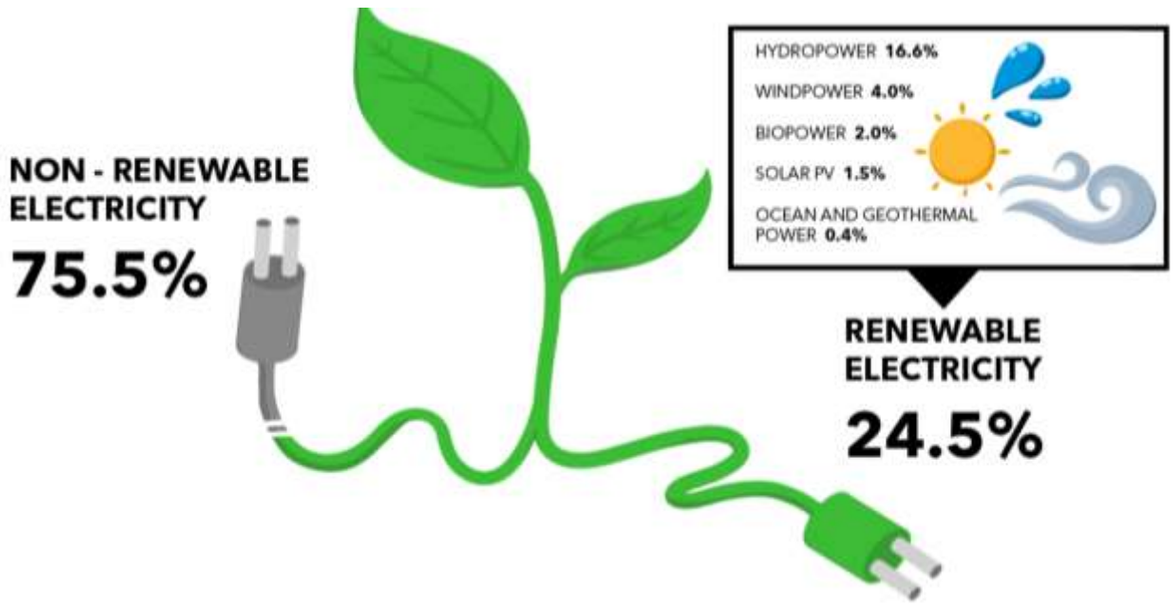


Source: Own Elaboration

Some types of energy are related each other, as one can transform into another type of energy. Of those, is highlighted the energy sources that have been of great interest in production mainly of electrical energy.

On the other hand, at the present, the energy sector is in a phase of change and reflection because conventional energy sources are polluting and limited. That is why there is extensive socioeconomic and environmental interest in the development of clean renewable energies; for this reason, it becomes necessary for the development of clean and sustainable systems. Agreeing to reference (REN21, 2018), Figure 2 shows a scheme of the renewable energy used in the generation of electric energy in comparison with conventional energy sources.

Figure 2 Estimated Renewable Energy Share of Global Electricity Production (REN21, 2018)



Source: Own Elaboration

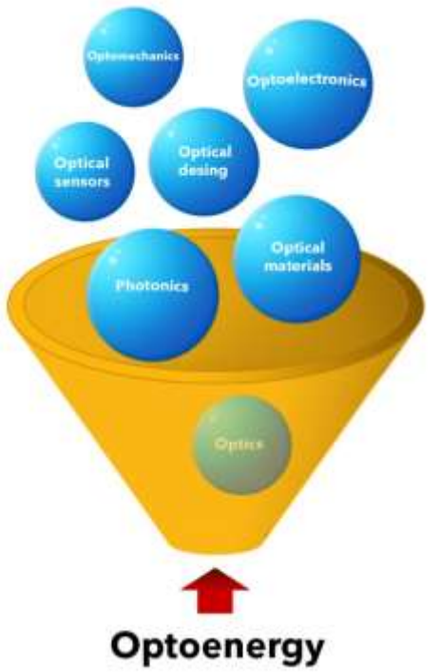
2. The concept of *Optoenergy*

Optics study the behavior and properties of light at visible, infrared and ultraviolet wavelengths. Light is a way of energy. While the term photonics emphasizes the replacement of the electron by the photon in typical operations of the electronics (B.E.A. & M.C., 2017). Photonics has been established as an autonomous discipline and is present in technologies for everyday use as optical sensors and telecommunications (SPIE, 2018), (OSA, 2018), (IEEE, 2018) (Barbosa García & et-al, 2016).

Optics and photonics develop an increasingly relevant role throughout the world (light, 2018); as they are keys in industrial processes that allow telecommunications, energy generation (Kafafi, 2015), detection and diagnosis of diseases (Prasad, 2003), among others (McDonald, 2007).

Since the scientific and technological point of view, we have conceived the ***optoenergy*** as an area of research and development, broad and multidisciplinary; in which we must consider not only the generation of energy from light radiation, as fundamental concept (here typically involves optics and photonics concepts); but also include the design and development of instruments; i.e. optical design, optical engineering, and optoelectronic instrumentation necessary to carry out this generation, see Figure 3; likewise, the optoenergy also would include the development and employment of sensors, of type optical, for the various forms of monitoring energy generation.

Figure 3 Optoenergy involves optics and photonics

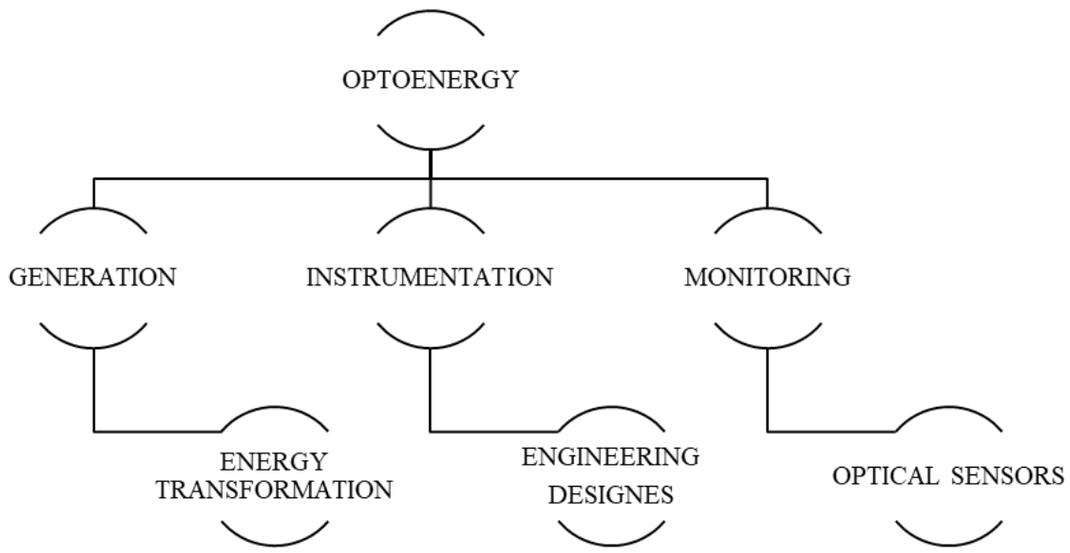


Source: Own Elaboration

Another way to mention the concept of ***optoenergy***, is represented in Figure 4; the optoenergy go on an area of multidisciplinary research which involves:

- The Generation would refer to the understanding of fundamentals and physical description of the phenomena involved in the instant that optical energy is transformed into another type of energy. For example, the photoelectric effect.
- The Instrumentation (mechanic, electronics, etc.) necessary for a suitable manipulation, concentration and optimum in the generation of luminous energy. For example, photocells, solar reflectors, etc.
- The development of methods or techniques for the monitoring of physical parameters; during the generation process of energy (but not only in the photovoltaic generation).

Figure 4. Diagram of the branches of optoenergy



Source: Own Elaboration

3. Discussions

Since years ago and unconscious, the optoenergy concept had been present in literature. Based in the branches of optoenergy we mention some examples of their presence.

Solar energy generation is related with fundamentals, the theoretical study of light interaction with mater, for exmple the photovoltaic effect. There is a lot to say at respect.

Respect to the branch of instrumentation, this is related to the optical design of several types of surfaces and optical devices to collect light. That is also related with the study of materials and their configuration, optical filters to different types of photovoltaic cells, among others.

Monitoring in principle is related to the implementation of optical sensors, but not only in solar energy. This could be implemented to monitor may others ways of energy production. Some specific examples should be: optical sensors to track solar energy to improve the energy collection; the use of optical sensors, to monitor several parameters in energy production (angular speed, vibration, dilatation, hydrostatic flux, temperature, etc.)

We can mention some other words related to a multidisciplinary relationship: In recent years, optical design topics are rapidly expanded into the infrared energy band; offering new approaches to reduce thermal emission losses and to do non-contact radioactive cooling of cells: as well as optical and electronic circuitry (Boriskina, 2016).

It is now possible and economically practical, cover an energy demand increasingly wide; with the production of solar energy in almost all over the world; including in the boreal zones and the Polar Regions. While the solar radiation in these regions is of intensity comparatively low, and the production of energy will be reduced to a large extent during the winter; photovoltaic cells provide a viable source of energy. For that reason, they are looking at the optical properties of the snow would get better efficiency in the cells or panels (Andenæs, 2018).

The world's largest solar plant will be the rambling park; it is expected to produce 2,000 megawatts of electricity, enough to feed 700,000 households, and the latest milestone in India's transition to generating more green energy. Prime Minister of India Narendra Modi has to 100 of capacity in 2022- almost 30 more than it three ago and to the total output of Spain (Bengali, 2018).

For its part, investments in this sector also show a tendency to rise. In 2015, it was invested about 285,000 million dollars to support the growth in electricity generation capacity from renewable energy sources. Mexico offers much potential for the generation of renewable energy; particularly solar energy, since the country occupies a privileged geographic location; within one of most intense solar radiation areas at the global level. While the global manufacturing network for photovoltaic energy is firmly established, opportunities for innovation in manufacturing prevail in (Rodríguez Suárez, 2017).

An application of the optoenergy instrumentation branch can be in an optical filter that reflects wavelengths higher than 1,000 nm. The application of this proposed filter achieves gains between 6.8% and 1.1% in energy generated by crystalline silicon modules, depending on the reflectance of the filter; as well as a method to design an optical filter that reflects wavelengths that heat the module without significant energy generation. Therefore, reducing the temperature of the module, increasing the total amount of energy generated (Heideier, 2018).

Another example of generation as a branch of optoenergy is the direct conversion of nuclear energy; it is a promising proposition in optical energy generation, including its perfect form of coherent light. A study of the optical emission of the gaseous medium, excited by the products of nuclear reactions; is of the interest to develop the method of the power output of the nuclear reactor, as well as to supervise the adjustment of its parameters. (Gordienko, 2017).

Conclusions

It is significant to continue and search for better options in the development of technologies for the generation of renewable energy through solar energy. Such as Optoelectronics, Optomechanics, Optoacustic, among others, we define ***Optoenergy***. In performing this, we must take into account the concept of optoenergy, which primarily involves three branches; energy conversion (includes photonics and fundamental optics); instrumentation (includes optical design) and monitoring (consider optical sensors for monitoring). As a result, this document describes the relationship and integration of several branches of optics; and the distinct branches of energy generation, trough the optoenergy concept. The field of optoenergy should be considered important as part of solar energy collection, and important related to other fields of energy production.

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