

Using solar energy at Cumbres School

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Envigado
Research project
April 2018

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Introduction

In today's society, mobile phones and other electronic devices are no longer a luxury that only wealthy people have, nowadays it is a necessity to have them. Studies have shown that people spend more or less 5 hours on their phones each day, check them every twelve minutes, approximately 150 times. These statistics show how much do people use phones daily. All the activities that involve phones consume battery, when there is no more battery people rely to the phone chargers. This is where this project enters to the scene. The product consists on a charging spot powered by solar energy. It's a park table with a solar panel as a roof that powers the batteries that later will be used for charging whatever we need to.

The elaboration of this project will fulfil the necessities of a place where the school community can charge their electronic devices, seat and relax, save money on energy costs for the school and develop an ecological awareness in Cumbres school in Envigado.



1 <https://ecologismos.com/puntos-de-recarga-solar-con-mesa-y-bancos-de-madera/>

1. Justification

The main reason of the project is to satisfy a necessity among the school community, this is a place to charge the devices while students are sitting down, avoiding the necessity to sit on the floor to wait for the phone to charge, at the same time showing that people can rely on alternative energy sources for daily activities, and save money for the school regarding the energy that charging phones require and creating awareness of the small things that can help to make the world a cleaner place, finally tis project is also helpful for developing a more ecological culture among the school community. In a place that the future of the country is being cultivated, kids should be taught to save the world while they are still at school.

2. Problematizing question

How can the school community benefit from the use of solar energy?

3. Objectives

3.1 General objective:

To develop a product that will benefit both school and students by saving energy costs to the school and providing a friendly alternative to the environment so that students can charge their electronic devices.

3.2 Specific objectives:

- 3.2.1. To create awareness about the benefits of using solar energy, and the importance of it.
- 3.2.2. To promote an eco-friendly behavior among students.
- 3.2.3. To implement two solar charging tables by the year 2020.

4. Conceptual framework

4.1 Glossary

Artificial photosynthesis: chemical process that replicates the natural process of photosynthesis a process that converts sunlight, water, and carbon dioxide into carbohydrates and oxygen.

Carbon footprint: the amount of carbon dioxide released into the atmosphere as a result of the activities of a particular individual, organization, or community.

Carbon emission: emission of carbon, especially into the atmosphere in the form of carbon dioxide as a contributor to global warming.

Photovoltaic cells: in simple terms they are like the cells of our body, except that these make up the solar panel and make it able to convert sunlight into electricity

Renewable energy: energy from a source that is not depleted when used, such as wind or solar power.

Solar panel: a panel designed to absorb the sun rays as a source of energy for generating electricity or heating.

Solar energy: radiant energy emitted by the sun.

Sunlight: light from the sun.

Renewable energy: energy from a source that is not depleted when used, such as wind or solar power

Sustainability: avoidance of the depletion of natural resources in order to maintain an ecological balance.

Chapter 1

Solar energy

It is a renewable source of energy that consists of the use of the energy coming from the sun radiation, for then converting that energy in a simpler way that people can take advantage of, by a process called photovoltaic effect. This effect will be explained in the following chapters.

In the last years with all the concern about global warming and the depletion of natural resources, the people started looking for new ways of producing energy for replacing fossil fuels and creating a sustainable way of living. There are many options available today including wind, solar and hydropower. Of the three, solar is the fastest growing one, because it is the easiest to use in various aspects, like heating, cooking or generating energy. Solar energy is one of the most profitable renewable energies because it has an almost limitless source and this type of energy doesn't endanger any other natural resource nor a living thing, aside from that it is the cheapest of them all.

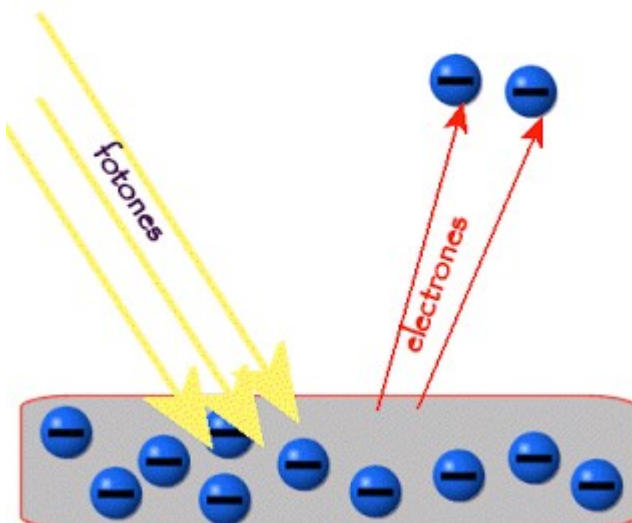
Solar energy is the energy provided by the sun. This energy comes in the form of solar radiation, which makes the production of electricity possible. This energy is produced by solar panels that use photovoltaic cells that by the use artificial photosynthesis to produce energy from the sunlight. The energy that the sun produces in one hour is enough to power all the earth needs for at least one year, and we are only able to use 0.001 of it. since the renewable energy has become a trending topic, solar energy has taken the lead, it is one of the most beneficial ones for both environment and people.

How do solar panels generate electricity?

Solar panels generate electricity by a process called photovoltaic effect; that takes place inside the solar cells. For understanding this process, it must be clear that a solar cell is made up by two different layers of semiconductor metals that react to the sunlight, causing the creation of an electron flow when the sunlight strikes them.

Basically, by a chemical process called oxide reduction the energy is produced. As it was previously mentioned the metals that the solar cells are made of: silicium and boron (in most cases) have different charges, causing the electron flow.

A solar cell is built with a semiconductor material that has excess electrons with negative charge (silicium) and another part is made with a semiconductor material that lacks electrons (boron) with positive charge, as the cells are exposed to the sun, the spare electrons move from the region of excess to the region were there are less electrons, by this displacement electrons are produced, this generating electricity.



Advantages of solar energy

The solar energy has a lot of advantages some are good for the environment and other for the people. Here are some advantages of solar energy:

- Renewable Energy Source: solar energy is a true clean renewable resource. Solar energy will be accessible as long as we have the sun.
- Reduces Electricity Bills: since you are accessing to a free and unlimited source of energy, how much you save on your bill will be dependent on the size of the solar system and your electricity or heat usage. In the U.S the average cost per kilowatt is about 68 cents.
- It is an eco-friendly source of energy: it uses the sun for producing clean energy at almost any cost, this being beneficial to the environment because we don't rely on fossil fuels.
- At long term it is the cheapest, because once the panel is installed the only thing that it requires is about \$ 200000 pesos yearly in maintenance.
- get extra money by selling the spare energy back to the company that sells energy-
- it causes a notorious decrease on the energy bill, since you produce your own energy it is no longer necessary for you to buy it.



2 <http://news.mit.edu/2016/mit-neutralize-17-percent-carbon-emissions-through-purchase-solar-energy-1019>

Chapter 2

History of solar energy

From the beginning, the human being has always take advantage of the sunlight, by the time that Egyptians stop seeing the sun as a deity, they began to make it useful. For example, mirrors were used to reflect the light from the sun to illuminate the entrances and corridors to their tombs.

The first recorded use was in the 700b.c. when the man found out how to lit a fire by using the sun power, so in that time the solar energy was used for creating fire for cooking, heating and producing light, not that different from the purposes we use solar energy nowadays.

Around 214–212 B.C the Romans and Greeks used solar energy for domestic and ceremonial purposes. The sun's energy was used to light torches for these various ceremonies. The Chinese also used mirrors and reflective objects to light fires for religious events.

During the Syracuse siege the Greeks found a way to use the solar energy as a weapon; Archimedes, a Greek inventor used mirrors for reflecting the sunlight and creating a heat beam to burn the enemy ships.



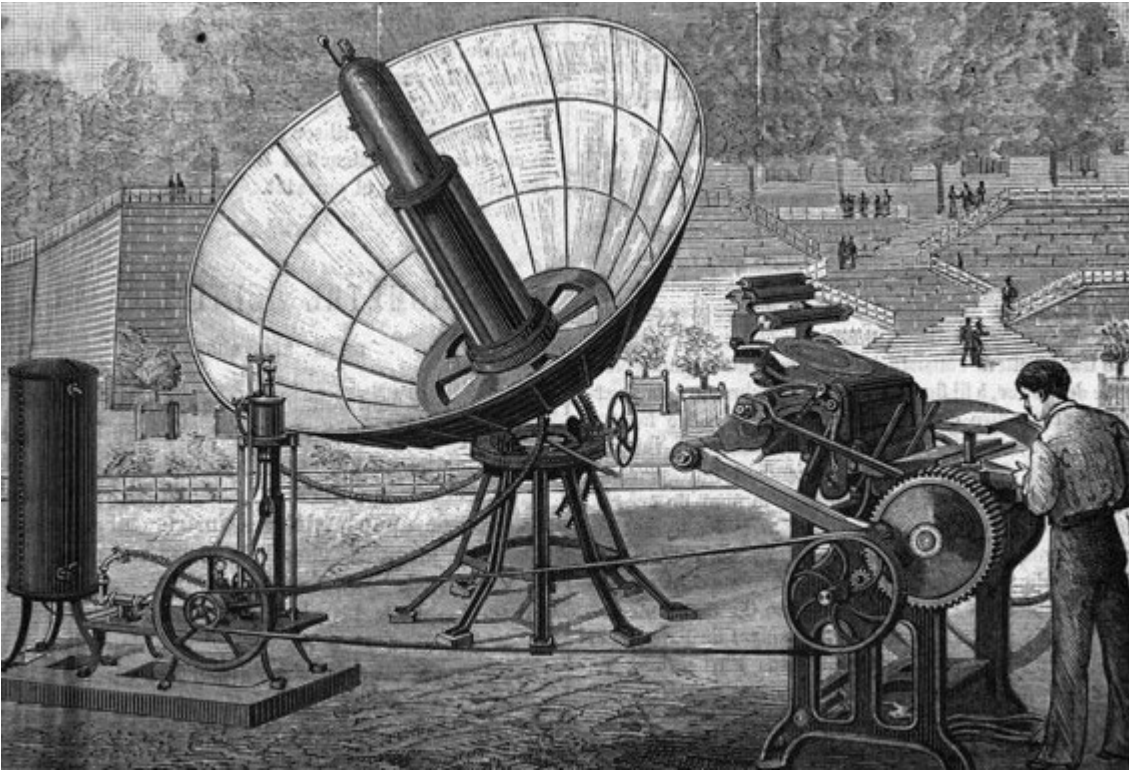
19th century

The Swiss inventor Horace de Soussare made the first Solar Collector in 1767. The design consists of a rectangular box covered in glass with two smaller boxes inside. When left in the sun, the bottom small box reached temperatures over 100 C. without knowing Horace created the first solar oven.

In 1839 Edmund Becquerel found out that some materials when exposed to light can generate electricity. He became the first person to ever propose the theory of photovoltaics.

In 1876 William Grylls Adams by performing an experiment became the first person to ever see the electricity produced by the photovoltaic effect; by conducting an experiment that consisted in two electrodes onto a plate of selenium, that produced a tiny amount of electricity when the plate was exposed to light.

In 1883 Charles Fritts came out with the first design of a photovoltaic cell



20th century

In 1905 Albert Einstein proposed the photon theory of light, which describes how light can “liberate” electrons on a metal surface.

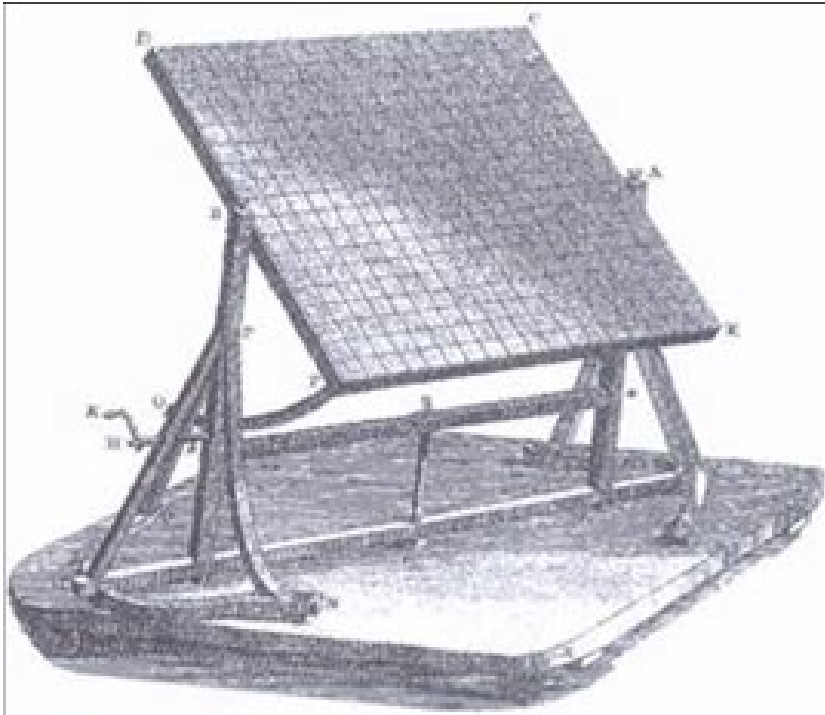
In 1918 Jan Czochralski figured out a method to grow single-crystal silicon. His discoveries laid the foundation for solar cells based on silicon. These types of cells are the ones we use in the modern solar panels.

In 1954 David Chapin, Calvin Fuller and Gerald Pearson created the first functional photovoltaic cell, the first device that turns sunlight into energy.

In 1962 the solar panels travelled to space, on board of the first telecommunication satellite, Telstar.

After the oil crisis of the 1970s, oil companies recognized that oil would be too expensive in the future. Companies including Shell, BP and Mobil began to invest in solar research.

3 <http://globedia.com/ehegaray-inventos-energia-solar-mareomotriz-siglo-xix>



21st century

In the past decades the evolution of the solar energy hasn't been greater, since the only thing that has happened is that the technology has evolved, making the process more effective and more affordable, allowing the residential use of it.

Since the world is following a more sustainable path, the solar energy became one of the most important and effective ways of producing energy. It is so important that in the past months it became a law that all the new houses built in California must have a solar panel.

Since the process is way more effective, all the structures in space are powered by solar energy, constituting one of the key agents at the moment of the space colonization.

4 <http://www.erroreshistoricos.com/curiosidades-historicas/ciencia/1303-la-energia-solar-a-lo-largo-de-la-historia.html>



5

5 https://es.wikipedia.org/wiki/Energ%C3%ADa_solar

Chapter 3

common uses

As the solar energy is relatively easy to convert and use, there are various tasks or activities that it can be used for. As it produces energy, it can be used in almost everything that requires energy.

There are uses for it in the industry or even in a common house.

A study was conducted, it showed that for 2050 45% of the energy used in the industry will be solar. Nowadays they use this energy for heating up spaces, powering ovens, lights, fans and refrigerators. Their use don't stop in here, as the technology evolves, the different methods for producing energy will evolve too, this meaning that the solar energy will evolve too, allowing their use for more energy consuming activities like powering up a whole factory.

On the daily use on a common household the solar energy is used for a whole set of activities that involve powering the house's electronic devices, heating water and powering the kitchen. All this depend on how strong your panels are.

As well there are other uses for solar energy and panels, they are used in space for powering up the spacecrafts.

photovoltaic cells

Photovoltaic cells or commonly known as solar cells are what makes solar energy possible, they are the ones in charge for creating the energy. They convert the energy from light into a usable type of energy by the process of photovoltaic effect.

What is the photovoltaic effect? It is the creation of voltage and electric current in a material upon exposure to light and is a physical and chemical property/phenomenon.

P.V cells are electrical devices that convert the energy of light directly into electricity by the photovoltaic effect, it is a form of photoelectric cell, defined as a device whose electrical characteristics, such as current, voltage, or resistance, vary when exposed to light. Solar cells are the building blocks of photovoltaic modules, otherwise known as solar panels.



solar panels

Solar panels are devices made from photovoltaic cells or solar cells, that are used to generate heat and electricity from the sunlight, by a process called photovoltaic effect in which two dissimilar materials in close contact produce an electrical voltage when struck by light or other radiant energy.

A lot of small solar cells spread over a large area can work together to provide enough power to be useful. The more light reflects the cell, more energy will be produced. For example, the spacecraft, they are made with solar panels because they always are looking the sun so with this panels they got energy.

The materials that you have to use to make the cells for solar panels are only one part of the solar panel itself. The solar panel making process brings together six different components:

Here are the common materials required
for a standard solar panel:

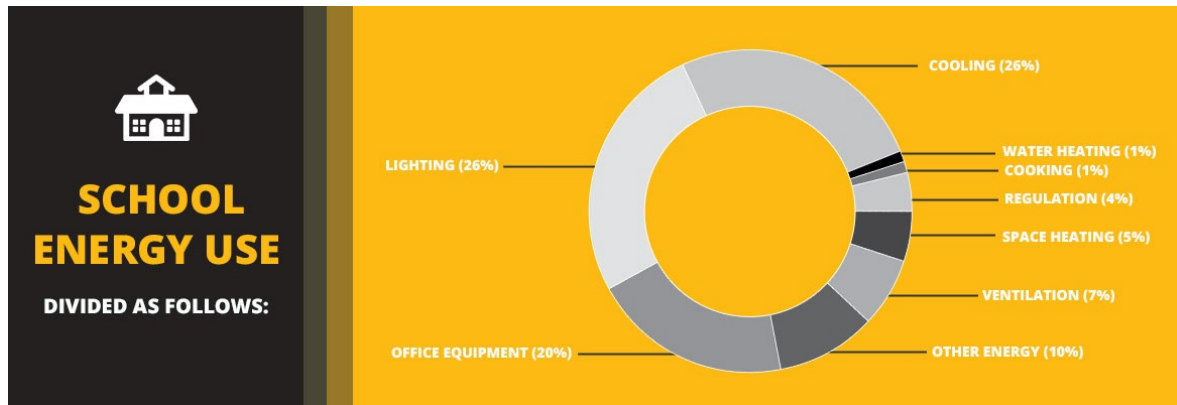
- Silicon solar cells
- Metal frame (aluminium)
- Glass sheet for casing
- 12V Wire
- Bus wire
- Plexiglas



Chapter 4

Statistics of energy consumption in Cumbres school

MR SIMON ESTA PARTE LA VAMOS A LLENAR DESPUES DE PREGUNTAR EN EL COLEGIO TODO EL COSTO DE LA ENERGIA POR LA QUE DEBE PAGAR



Cost of the product and description of the parts

the product has three main parts, the panel, the table and the mechanism required for the transformation of the energy.

The panel has to be a large one with a capacity of production of 250 W (Let's take into account that an average phone needs 8.4 W for fully charging its battery⁷). The solar panel has an average cost of \$1000000 cop.⁸

A battery is needed, but it can't be a common one because it has to be one that can be depleted and charged again. The energy the batteries store is just a surplus of the energy that the panels produce during the day, so this energy is the one used during night time or in cloudy days when the panel can't produce energy. The battery cost \$600000 cop⁹.

⁷ <https://www.quora.com/How-much-energy-is-required-to-fully-charge-an-average-phone>

⁸ https://articulo.mercadolibre.com.co/MCO-457053156-panel-solar-kyocera-de-250w-4000-el-watio-_JM

⁹ https://articulo.mercadolibre.com.co/MCO-464872989-bateria-de-gel-para-panel-solar-de-12v-150ah-paneles-solares-_JM

The energy inverter is the one that distributes the energy directly to the device. It is important that it is one with usb ports or plugs It costs \$80000 cop¹⁰

The table that is the structure that holds the whole product has to be from a durable and outdoor resistant material. It may cost \$1200000 cop¹¹

A charge controller that manages the amount of energy that the battery will receive.



12

10 https://articulo.mercadolibre.com.co/MCO-452897774-controlador-regulador-de-carga-10a-1224v-pwm-solar-marca-ps-_JM

11 https://articulo.mercadolibre.com.co/MCO-459767091-patio-8-asiento-madera-picnic-mesa-cerveza-comedor-asiento-_JM

12 <http://www.seccion.es/renovables/energia-solar-fotovoltaica-en-viviendas-para-autoconsumo-mito-o-realidad/>



Description of the technology

There are two main types of solar energy technologies: photovoltaic and concentrating solar power. The most common is the photovoltaic (PV), this one is utilized in panels. When the sun shines to a solar panel, the sunlight photons are absorbed by the cells of the panels, that creates an electric field across the layers

The second energy is the concentration of solar energy (CSP). This is used in large power plants and is prohibited in residential homes. this technology uses the mirrors to reflect and make the sunlight in the receptors that receive the solar energy in calories, that later can be used to produce energy

Impact on the environment

As it is commonly known the alternative sources of energy are way more clean and ecologic than the energy based on fossil fuels, that's why a solar panel has a more positive impact on the environment, why? Because it doesn't produce co2 emissions or any other type of waste.

“That solar panels do not emit greenhouse gases such as carbon dioxide when they are generating electricity is without question. This is why they are beloved of many who worry about the climate-altering potential of such gases”¹³

13 <https://www.economist.com/news/science-and-technology/21711301-new-paper-may-have-answer-how-clean-solar-power>

Technological devices use battery for accomplishing their function. With this product we can use them more and charge them with a source of power that doesn't damage the environment, making a positive impact to the environment.

So technically by the use of this we rely on a clean source of energy, replacing the use of energy sources that produce greenhouse gases.



Impact on the school population

The impact on the school population is positive mainly because it benefits the school by reducing the cost of the energy bills, teaches the students about the different renewable energy sources, makes the school more innovative in the area of the usage of clean energy and the last is that it benefits all the school population by providing a spot to charge their device while they are outside during break, avoiding the need for them to stay in the classrooms watching their devices.

This product will take the lead in the adaptation process of the school for becoming a greener and cleaner place where all the future generations are thought about the importance of taking care of the environment.

5. Methodology

5.1 time and space of the research

The research about the benefits of the implementation of this product will occur during the school years between 2017 and 2019, for later being implemented in the year 2020 by placing all around the school 2 tables for the use of the school community.

The research would take place in the Cumbres school.

5.2 Analysis unit

What benefits does it bring?

The benefits that solar energy can bring to the school are:

- Reduce operating costs for the school: solar power is a free source of energy, found in abundance in all the world, and advanced technology and installers have made it even more accessible for institutions
- .- The school acquires attractiveness: is an innovative and technological product for a school, making it more attractive. And giving it prestige.
- Is a secure investment: with solar panels and simple math, we can calculate how much electricity will be generated.
- Provides unlimited and reliable energy: solar power systems offer a dependable source of unlimited energy. While fossil fuels are a finite source of energy, solar power is not.

- Incentive students to use solar energy in the future.
- It fits perfectly to the school.

This benefit makes a very positive impact to the school, making solar energy each time more viable for the institution.

5.3 Sample

Students that will use this product, are students with access to technological devices. For example, a Tablet, a cell phone or a laptop that needs energy for charging its battery. Also, a student that wants to charge his devices in a comfortable way and not sitting in the floor or staying in the classroom. This description of the student also applies to a teachers and other members of the school community that have the same necessities.

6. Conclusions

During the research stage of this project it was remarkable the fact that the solar energy is not being used and that if Cumbers starts using it, it may bring a lot of benefits to both school and its members; this benefit will be a cleaner environment, a greener option at the moment of charging the electronic devices; a place to be in contact with the nature while we use technology; a place to learn about how take care of the environment with small actions that will generate a change.

It was concluded that the implementation of the project will bring huge monetary benefits to the school; these benefits may not be significant in the first years of the product but in long term it would mean a huge saving on energy costs.

Cybergraphy

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[https://erenovable.com/energia-solar-ventajas-y-desventajas/
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[https://www.google.com.co/search?
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<https://www.quora.com/What-is-the-cheapest-form-of-energy>
<http://www.verengosolar.com/advantages>
[https://blog.selfbank.es/cuanto-podemos-ahorrar-con-paneles-solares-fotovoltaicos/
 https://www.epm.com.co/site/Portals/2/documentos/tarifas/2015/Publicacion%20Enero
 %2017%20de%202015.pdf](https://blog.selfbank.es/cuanto-podemos-ahorrar-con-paneles-solares-fotovoltaicos/)

https://www.google.com.co/search?q=solar+energy&source=lnms&tbm=isch&sa=X&ved=2ahUKEwj725636-LaAhWKwFMKHfKnAG0Q_AUoAXoECAAQAw&biw=1920&bih=974#imgrc=Wp7zDqHWdXd8MM:

<https://sipse.com/novedades/costo-de-la-energia-electrica-en-las-escuelas-de-quintana-roo-148154.html>

https://es.coinmill.com/COP_MXN.html#COP=1195919119591907.307.31

<https://www.quora.com/How-much-energy-is-required-to-fully-charge-an-average-phone>

<http://www.intermtwindandsolar.com/3-reasons-solar-energy-is-perfect-for-schools/>

<https://www.sunrun.com/solar-lease/cost-of-solar>http://solarcellcentral.com/cost_page.html

<https://us.sunpower.com/blog/2018/01/30/solar-energy-pros-and-cons/>

<https://solartribune.com/history-of-photovoltaics/>

<http://energyinformative.org/the-history-of-solar-energy-timeline/>

http://energyeducation.ca/encyclopedia/Photovoltaic_effect

<https://solar-energia.net/definiciones/efecto-fotovoltaico.html>

<http://www.gstriatum.com/energiasolar/blog/2012/10/17/que-necesito-para-instalar-un-panel-solar-en-mi-casa/>