

Industry 4.0 for a Sustainable World

(Renewable energy sources-solar)



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La Salle-Buen Consejo
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Spain Team





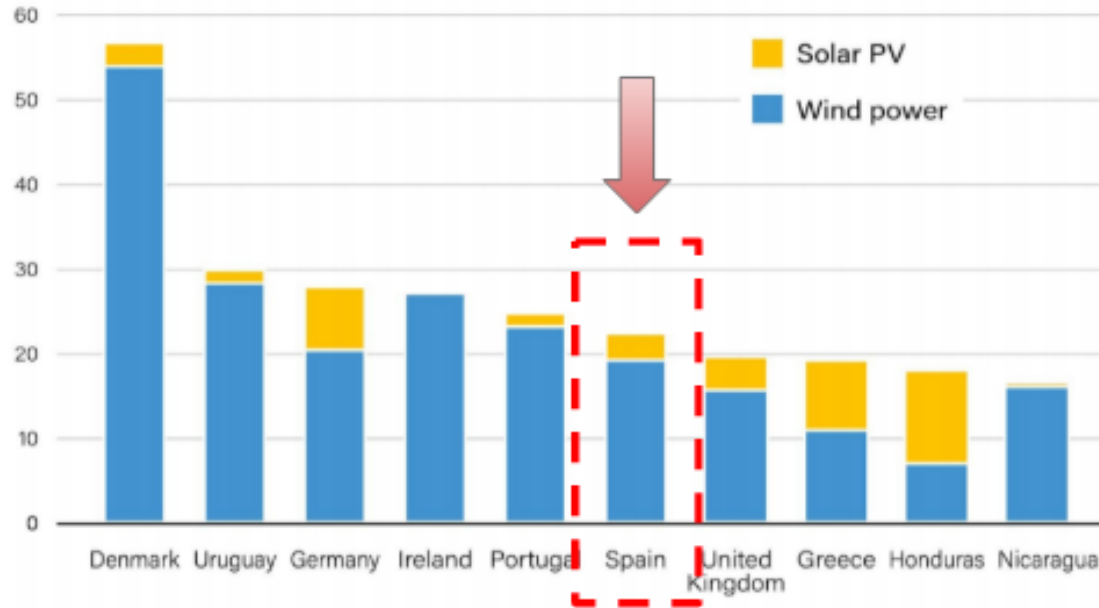
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Solar energy: History

Share of Electricity Generation from Variable Renewable Energy, Top 10 Countries, 2017

Share of total generation (%)



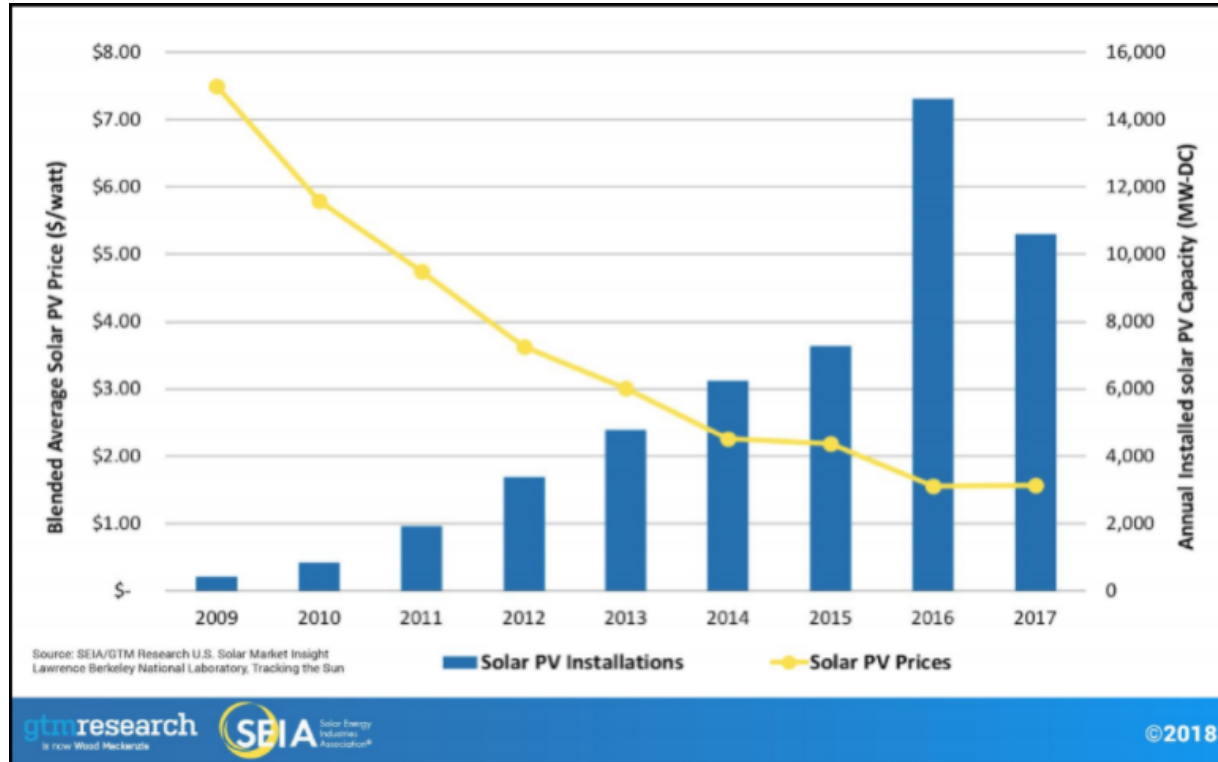
Comparing solar and wind energy in Spain in 2015, solar power produced less than a third of that of wind power.



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Solar energy: History





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Solar energy: Classification

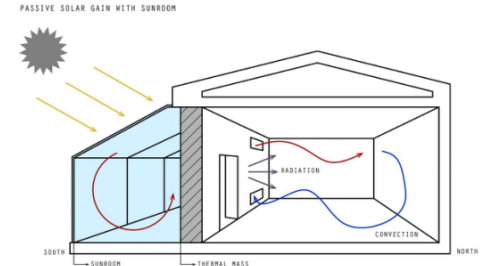
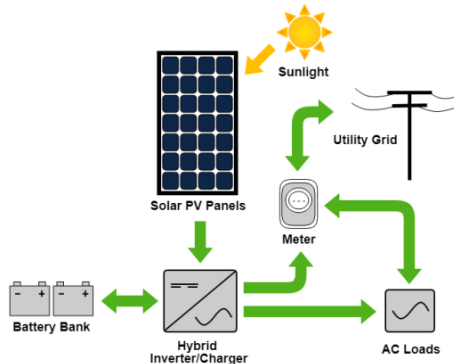
Solar power is energy coming from **the sun** that is converted into electrical or thermal energy.



Photovoltaic systems

Solar water heating systems

Passive solar heating





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Solar energy: Characteristics

Photovoltaic Systems	Solar power plant	Solar water heating systems	Passive solar heating
<p>Solar energy releases electrons from their atoms and makes them flow through the semiconductor material which produces energy.</p>	<p>Non-renewable fossil fuels to boil water.</p> <p>The steam from the boiling water makes a large turbine rotate which in turn activates a generator to produce electricity.</p>	<p>It involves heating up water using the sun's heat.</p> <p>The idea behind this solar water heating systems comes straight from nature.</p>	<p>The solar power can be harnessed through the method of passive solar heating and day lighting.</p>





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Solar energy: Localization

We will group the countries by their size:

- *Spain and Germany*  *Extension over 300.000 km².*
- *Lithuania and Czech Republic*  *Extension under 100.000 km².*



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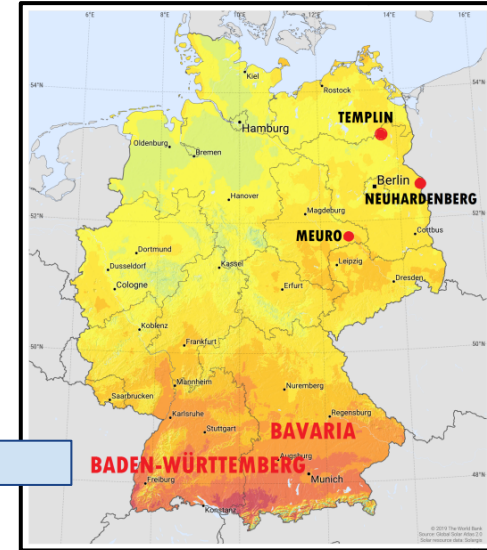


Solar energy: Localization

Spain and Germany

Farms located **all over both countries.**

Most of the solar energy is generated in the **southern half** of each country.

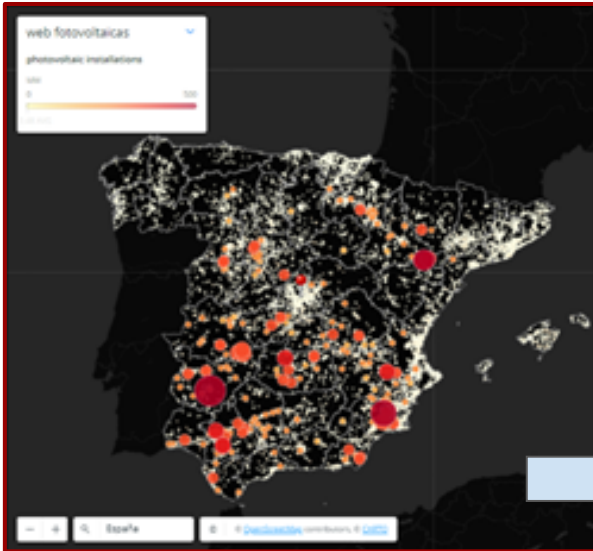


Germany

Less hours of sunshine
(northern half of Europe)

Spain

Many hours of sunshine =
reduce energy dependence
(south of Europe)





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Solar energy: Localization

Lithuania and Czech Republic



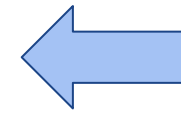
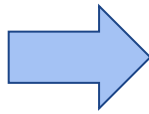
Czech Republic

They have farms located **all over the country.**

They have **less farms** than the large countries.

Less distance between north and south > **similar number of hours of sunshine.**

Lithuania





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Solar energy: Localization

Conclusion:



Extension is important when it comes to location.



*In the **big countries**, most of solar energy is generated in the southern half.*



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Solar energy: quantification

1. How much energy is produced by solar renewable energy in different countries?

2. How important is for Industry the consumption of electricity produced by solar panels by renewable energy?

- Solar energy is an important renewable energy.
- This renewable energy has many uses, such as:
 - Generate electricity.
 - Distilling water.
 - To power satellites in space.



- Eurostat corresponding to solar renewable energy and others is analysed.
- The total energy supply is one of the most important aggregates of the energy balance.
- The total energy delivered/consumed.



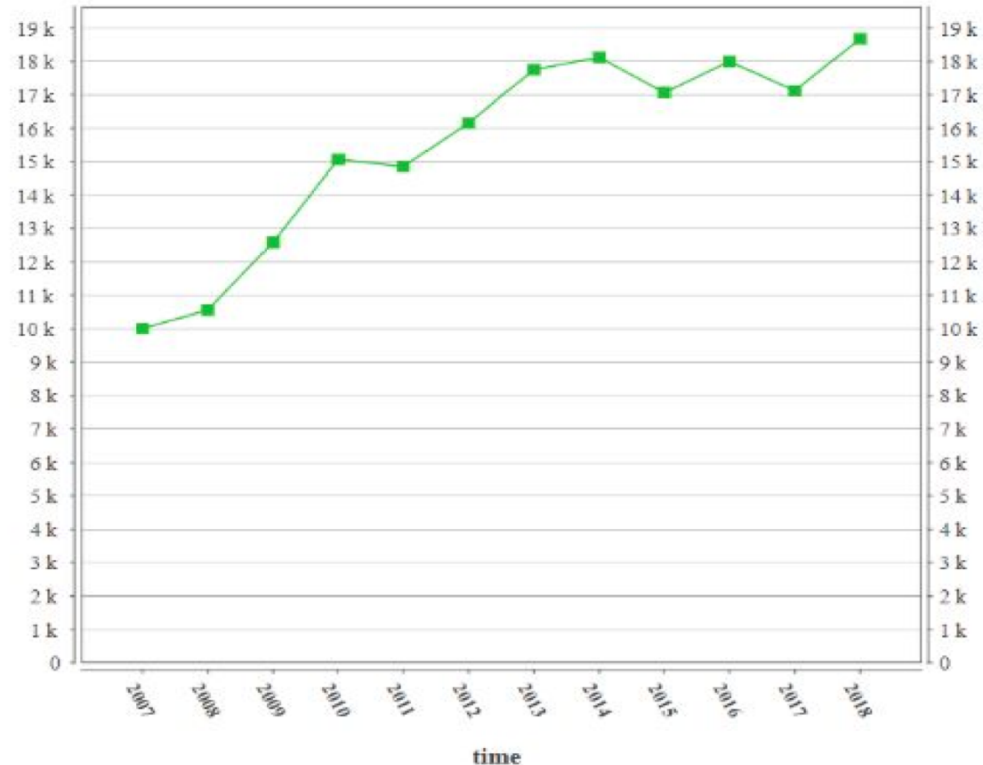
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Solar energy: quantification

SPAIN

- In Spain, there are many hours of sunshine, that is why the autonomous energy must be increased.
- The next graph describes the total energy supply in Spain in recent years.
- From 2007 to 2010 there is an increase, there is a small decrease in 2011, from 2011 to 2014 there is an important increase, and in 2015 and 2017 there is another increase.
- Around 22 % of the final energy we consume is electricity and it comes from different sources.





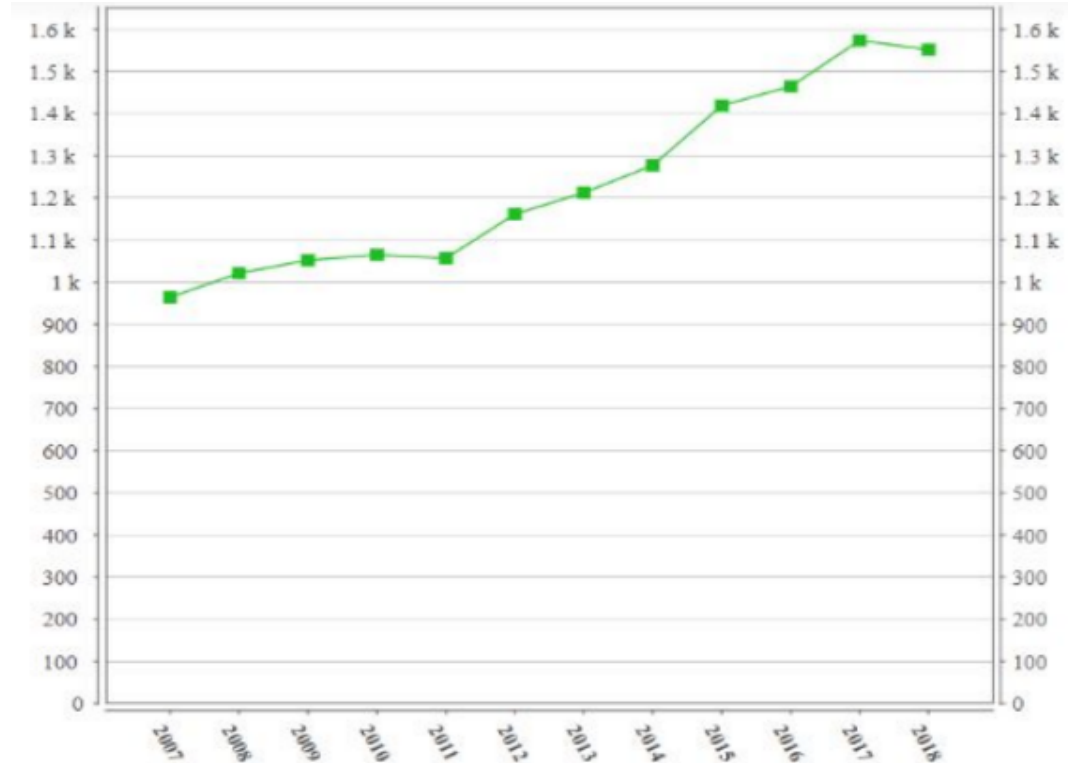
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Solar energy: Quantification

LITHUANIA

- The graph of Eurostat informs that the energy produced in Lithuania increased from 2007 to 2010. This year, it decreased slightly until 2011. From 2011 to 2017, it did not stop to increase and, finally, it decreased slightly in 2018.
- Concluding, we can see a very important renewable energy and biofuels rise. Beginning 2007 with 964 thousand tonnes of oil and in 2018 Lithuania has 1551.47 thousand tonnes of oil.





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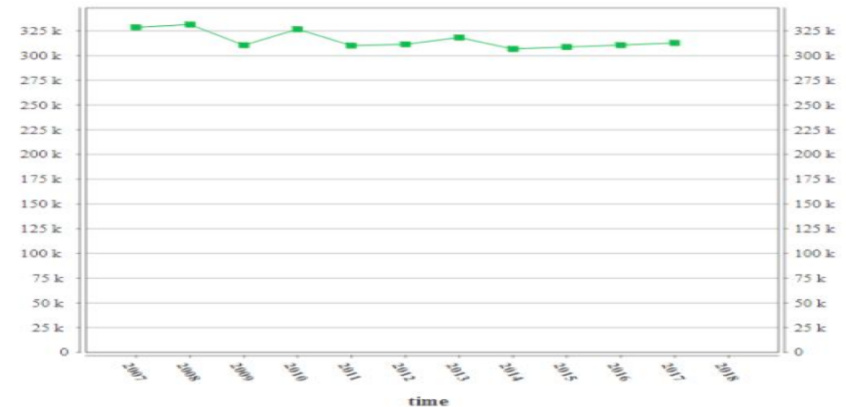


Solar energy: Quantification

GERMANY

- Germany is the country with the highest average of solar energy produced.
- Although, it is not the country with the most hours of sunshine, it is the country with the most inhabitants, so this is an advantage.

From 2007 to 2014 the energy supplied in Germany had many decreases and increases, supply increased a lot from 2009 to 2010, in 2010 is the last important decrease to 2011, since 2014 to 2017 the supply in Germany had a small increase.





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Solar energy: Quantification

CEZCH REPUBLIC

- In Czechia the total supplied energy decreased from 2007 to 2009 and increased from 2009 to 2010.
 - The supply remained almost constant between 2011 to 2017 with small variations.
 - Finally it remained totally constant for one year, from 2017 to 2018.
-
- | Year | Total Supplied Energy (kWh) |
|------|-----------------------------|
| 2007 | 45.5 k |
| 2008 | 44.5 k |
| 2009 | 42.5 k |
| 2010 | 45.0 k |
| 2011 | 43.5 k |
| 2012 | 43.0 k |
| 2013 | 43.5 k |
| 2014 | 42.0 k |
| 2015 | 42.0 k |
| 2016 | 41.5 k |
| 2017 | 43.0 k |
| 2018 | 43.0 k |
- In the Czech Republic the total supplied energy will continue to have variations of increases and decreases, and will sometimes remain constant.



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Solar energy: Quantification

Number of hours of sunshine between the countries

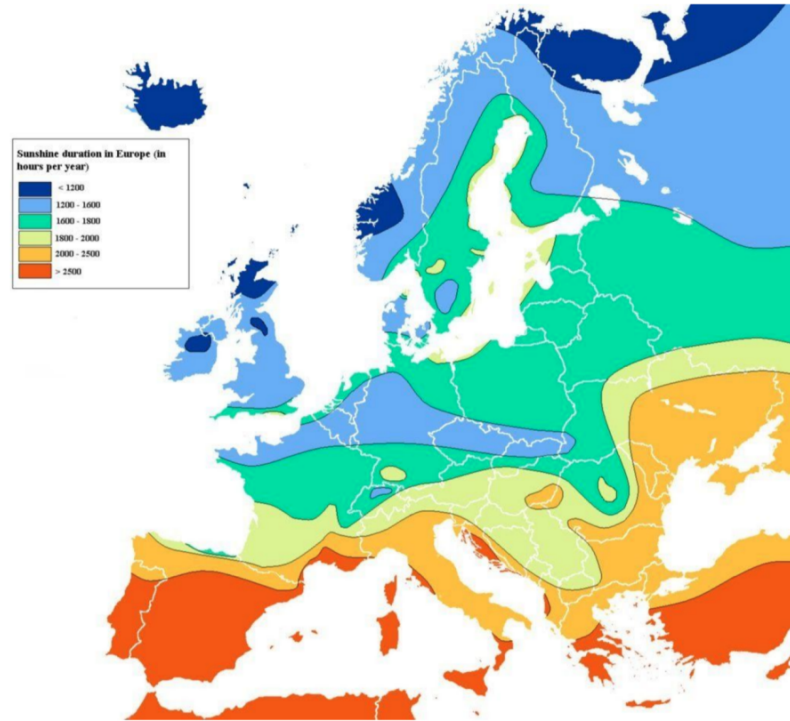
Spain: more than 2500 hours of sunlight.

Czech Republic: between 1200 and 1600
hours of sunlight.

Lithuania: between 1600 and 1800 hours
of sunlight.

Germany: between 1600 and 1800 hours
of sunlight.

Europe: between 1200 and 1600 hours of
sunlight.





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Solar energy: Interestings

1. How does solar energy help the sustainability of the world?

Solar energy creates clean and renewable energy from the sun which is beneficial for the environment. It is an alternative to fossil fuels.

In addition, carbon footprint is reduced since no greenhouse gases are release into our atmosphere.

It is worth mentioning that we can get much more energy from the sun than from fossil fuels, 10 times more energy.





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Solar energy: Interestings

2.- Do solar panels and farms have either a negative visual impact or an ecologic impact?

Advantages:

- Any type of combustion is required, so, there is no thermal pollution nor CO₂ emissions which contribute the greenhouse effect.
- Maintenance costs.
- Electricity can be generated almost anywhere.



Disadvantages:

- Solar farms have an ecological impact (in the ecosystem where panels are installed) and visual impact (it is not aesthetic).
- Initial investment.



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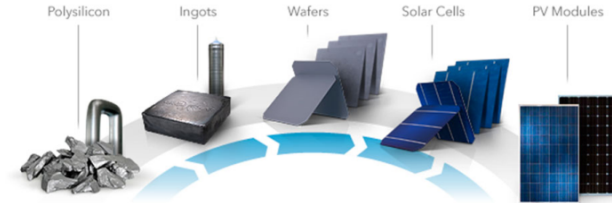
Solar energy: Interesting

3.- Is the massive construction of the solar panels sustainable in relation with the chemical raw materials used?

Nowadays, in the manufacture of solar panels, several dangerous materials are being used.

After 20 or 25 years of useful life, the panels become polluting garbage that contains components dangerous to the health of people.

Nevertheless, compared to conventional forms of energy, the cycle of life of photovoltaic systems needs less hazardous materials. For example, cadmium emissions are almost 300 times higher in the case of coal-fired power stations.





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Solar energy: Interestings

4.- Self-sufficient homes and cities: What kind of impact could have solar panels?

Being self-sufficient, both in our homes and in our cities carries good and bad consequences, some examples are:



- **Climate:** As it does not need to burn any kind of fuel, they do not produce CO₂ so solar panels do not contribute to the global warming.
- **Geology:** The cells from the solar panels are made of silicon, that means that we will need exaggerated amounts of silicon but, compared to the amount of silicon that our planet has, that's not an actual problem.
- **Noise:** Solar panels do not make any kind of noise.
- Also solar panels work for at least 15 years so families will save a lot of money during this period.



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Solar energy: Interestings

4.- Self-sufficient homes and cities: What kind of impact could have solar panels?

To conclude with this section, we want to emphasize the fact solar panels can be used also in public buildings, so both, families and companies can produce their own electricity, which means that we will not depend on fossil fuels anymore, we would not need power thermal plants either.



Thank you for your attention!

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Resources

¿Qué impacto ambiental tiene la energía solar fotovoltaica? in Conectate al sol. Retrieved from <https://conectatealsol.com/news/que-impacto-ambiental-tiene-la-energia-solar-fotovoltaica/>

¿Qué impacto medioambiental y social tiene la energía solar fotovoltaica? in Quetzal ingeniería. Retrieved from <https://www.quetzalingeneria.es/impacto-medioambiental-social-energia-solar/>

Compare prices of solar energy in Green Match. Retrieved from <https://www.greenmatch.co.uk/blog/2015/01/impact-of-solar-energy-on-the-environment>

Demanda de energía eléctrica en tiempo real in Red Eléctrica de España. Retrieved from demanda.ree.es

Energía solar en España in Wikipedia. Retrieved from https://es.m.wikipedia.org/wiki/Energ%C3%ADa_solar_en_Espa%C3%B1a

Energía solar in Acciona. Retrieved from <https://www.acciona.com/es/energias-renovables/energia-solar/>

Environmental impacts of Solar Power in Union of Concerned Scientist. Retrieved from https://www.ucsusa.org/clean_energy/our-energy-choices/renewable-energy/environmental-impacts-solar-power.html

Farerwayer (2009). Los paneles solares contaminan después de 25 años de uso. Retrieved from <https://www.fayerwayer.com/2009/01/los-paneles-solares-contaminan-despues-de-25-anos-de-uso/>



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Resources

Fernández Mungia, S. (2018). España nominada a los Fossil Subsidy awards por su apoyo al carbón in Diario Renovables. Retrieved 26 April of 2019 from

<https://www.diariorenovables.com/search/label/Otras%20fuentes#archive-page-1>

Fylladitakis, E. Environmental impacts of Photovoltaic systems. Helios Lab: Open Educational Resources. Retrieved April 26 of 2019 from

http://www.labri.fr/perso/billaud/Helios2/resources/es15/Chapter_15_ES.pdf

Los costes de la energía solar renovables disminuirán a la mitad para 2020 in Panorama. Retrieved from

<https://www.energias-renovables.com/panorama/los-costes-de-la-energia-solar-fotovoltaica-20180115>

Pepe (2011). Centrales solares instaladas en España. Centralsolars. Retrieved 26 April of 2019 from

<http://centralsolars.blogspot.com/2011/03/centrales-solares-instaladas-en-espana.html>

Photovoltaic structures in Esasolar. Retrieved from <http://esasolar.com/>

Plataforma solar de Almería (PSA) in Gobierno de España. Ministerio de Ciencia, Innovación y Universidades. Retrieved from <http://www.psa.es/es/index.php>

Renewable Energy in Spain in Wikipedia. Retrieved from

https://en.wikipedia.org/wiki/Renewable_energy_in_Spain.



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Renewable Energy in Spain in Wikipedia. Retrieved from
https://en.wikipedia.org/wiki/Renewable_energy_in_Spain.

Solar Energy in SEIA (Solar Energy Industries Association). Retrieved from
<https://www.seia.org/initiatives/about-solar-energy>

The different types of solar energy in Greentumble. Retrieved from <https://greentumble.com/the-different-types-of-solar-energy/>

The health & environmental benefits of solar energy in Energysage. Retrieved from news.energysage.com

The two types of solar energy, photovoltaic and thermal in Planete energies. Retrieved from
<https://www.planete-energies.com/en/medias/close/two-types-solar-energy-photovoltaic-and-thermal>

Torresolenergy. Retrieved from <http://torresolenergy.com/en/gemasolar/>

What is the source of the energy that we consume? in Eurostats. Retrieved from
<https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-3b.html>