

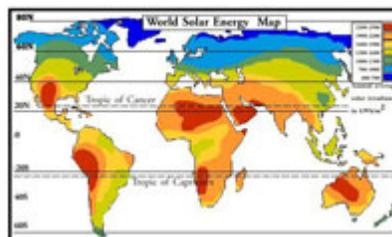
GreenLearning - eCards

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Solar

Since the word "solar" means from the sun, solar energy is the energy that comes to us from the sun as light energy. The sun's energy is transformed into heat as it strikes the land, sea or any object. The heat produced by the sun drives the world's weather systems including wind, rain and river flow. We rely on energy from the sun for our warmth, food, wind and water. We simply could not live on the earth without it!

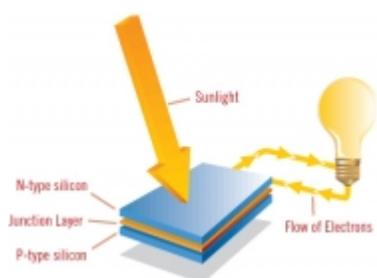
Solar energy is a renewable energy source because we will never run out of sunlight. Solar energy can be used to heat air and water and provide high temperatures for industry and power generation. There are four ways to harness solar energy: photovoltaic cells, which convert light to electricity; heating and cooling systems (solar thermal); concentrating solar power (utility scales); and lighting¹. In one hour, the amount of solar energy falling on the Earth could power the whole planet for an entire year!



Solar irradiance indicates the average annual energy available per m²

Some believe that the 21st century will become the solar century. As technology advances, it is becoming more affordable and more efficient to convert solar energy into electricity and heat. Climate change and energy security issues have governments rethinking traditional ways of generating and using energy, and they are beginning to put new policies in place to encourage the use of solar energy and other renewable sources of energy.

How Does the Sun's Energy Become Electricity For Human Use?



Solar electricity uses photovoltaic (or PV) technology. This word comes from "photo" meaning light and "voltaic" meaning electric. Fine wires are sandwiched between two wafers with different electrical properties. Sunlight causes electrons to travel between the layers and produce electricity.

The most common material used for PV cells is a special kind of silicon crystal. Silicon, in the form of sand or quartz, is one of the most common elements found on earth.

A solar PV collector or module consists of several individual PV cells connected together. When these solar cells are connected together, they are called an array, and these can be of various sizes, providing small or large amounts of power. Some collectors use reflective mirrors to focus the solar radiation onto the PV cells. Concentrating the energy means higher efficiency in producing the electricity. The PV cell industry is rapidly changing as new manufacturing techniques are introduced to increase efficiency and decrease costs.



Solar PV collectors were first developed for satellite applications. They then became the technology of choice for remote power applications such as radio towers, lighthouses and other buildings not connected to the electrical

grid. PV collectors have also been used to meet home lighting and other power needs in developing countries. In each of these applications, batteries are used to store power so that electricity will be available when sunlight is not.



The Gemasolar solar power station near Seville, Spain has 2,650 panels spread across 185 hectares.

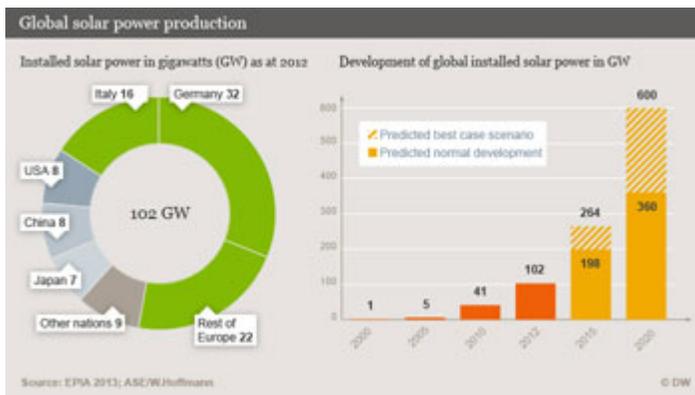
Solar PV has now joined the big leagues and can be used to supply the electrical grid. In this case, batteries are not needed. Large-scale standalone PV power

plants are now being built in several countries including the United States, Spain and Portugal. Thanks to special incentive policies, smaller roof-mounted systems are now common in the state of California and many European countries thanks to special incentive policies. Germany - the world leader in solar electricity - installed over 600 megawatts (MW) in 2005, while Canada installed less than 2 MW.

What are the Advantages and Disadvantages of Solar Power?

Advantages

- Solar electricity is a renewable resource.
- Solar energy is available all over the world and can be "harvested" with existing technologies.
- Solar energy is available wherever it is needed, and therefore can be used efficiently and without the costs and risks associated with transportation.
- No one owns or controls solar energy, and solar technology is easily managed at the local, community or regional level.
- Solar electricity helps us reduce our dependence on sources that need to be imported or transported great distances.
- Once a system is installed, solar energy is free because there are no fuels to buy.
- With solar energy, the energy source is controlled by those who use it and not by a few companies or countries. With sources that allow for more energy autonomy, we could hope for fewer world conflicts and other dangers associated with conventional energy sources.
- Because solar electricity produces no waste or pollution, it can help reduce global warming, smog and acid rain.
- Solar photovoltaic cells make no noise when producing power, and they have no moving parts that can break down.
- Unlike conventional energy sources, photovoltaic cells are becoming cheaper and cheaper to produce. They will drop in price the more they are used.
- Solar electricity from PV is flexible and can be connected to the grid or used on its own with a battery to provide power in remote locations.
- Because solar power systems are "modular," they can be easily and quickly added on to at anytime. They are limited only by the capacity to manufacture and install them, and policies to support them.
- Solar electricity can easily be integrated into the current grid, or it can be used with other renewable power sources such as wind, hydro and biomass to provide a new power system based only on renewable sources.
- The production and use of solar PV systems leads to new businesses and creates new jobs all over the country.



Disadvantages

- Today's PV cells convert about 20% of the sun's energy into electricity. Cells with over 40% efficiency are currently in the early production phase.
- Because solar power systems have no on-going fuel costs, all of the costs of solar PV systems are wrapped up in the purchase price that must be paid before any energy is obtained.
- Even if you calculate the cost of a solar PV system over its lifetime, its current price is still a lot higher than that of conventional fuels. The environmental and social costs of using conventional energy sources like fossil fuels and nuclear power are not reflected in their cost, however, making the comparison a difficult one.
- Governments are only just starting to put new policies in place that give solar energy its due.
- Our current electricity grids were designed to distribute power from large central power stations and not a large number of dispersed solar energy systems.
- Because solar energy is only available during the day, some form of power storage system is needed to make it available all the time.

Can Solar Power Help Meet Our Needs?

Solar power can help us reduce our dependence on fossil fuels like oil and natural gas, and make the use of nuclear power unnecessary. As the cost of generating electricity increases and people worry more and more about the effects of global warming, toxic pollution and world security, solar power is very appealing. It is efficient and clean, and its energy source, the sun, costs nothing at all and is not owned by anyone!



Before considering any energy source to meet our future power needs, we must minimize our use of electricity through energy efficiency and conservation. This is always the cheapest and cleanest first option.

In the future, solar electricity provided to the grid from homes and businesses and from solar power plants could be used with other renewable power sources such as wind, hydro and biomass to provide a new power system based only on renewable sources. There are more than enough renewable energy sources for everyone, and research is already underway to design a grid that does not depend on central power plants.



Despite not having sun all day, and having less sun in winter months than other times of the year, Canada can benefit greatly from solar power. Ironically, solar PV cells work more efficiently in the winter. To maximize the contribution of solar energy, solar power systems will need to be spread across many locations to take advantage of weather differences. Through the use of proven power storage systems, electricity from solar energy can be provided from

Up close view of a solar panel.

renewable sources whenever it is needed - without back up or conventional sources.

New businesses and organizations are springing up to help Canadian families, farms, industries and cities understand and use solar power systems. Provinces like Ontario are providing premium prices for solar electricity fed into the electrical grid.



An installation of rooftop solar panels

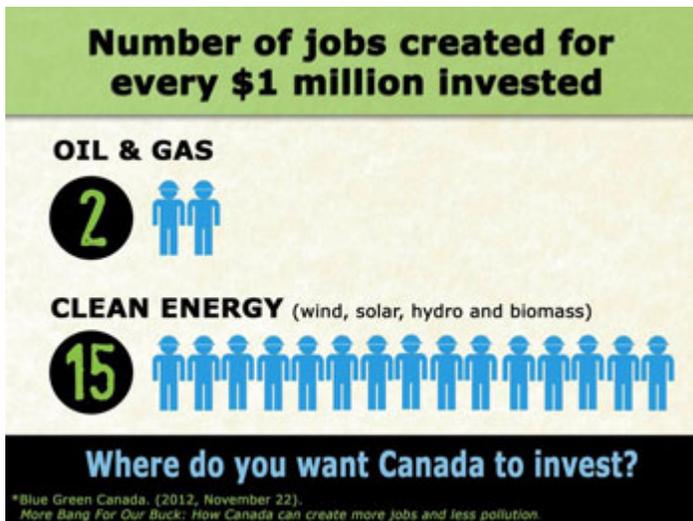
Solar Power Facts

- A solar-powered airplane flew more than 4,000 km across the United States in 1990.
- As of April 2013 the world's largest solar PV power plants are located in the United States (Arizona, the Aqua Caliente Solar Project), India (Charanka Solar Park), China (Golmud Solar Park), Germany (Solarpark Meuro) and the United States (Nevada, Cooper Mountain Solar Facility). These 5 facilities generate peak outputs of 250MW, 221MW, 200MW, 166MW and 150W.
- 45% of the cost of a solar cell is for the silicon wafers, and about 35% of the cost is for other components.
- With increasing numbers of photovoltaic cells being sold around the world and with on-going scientific work that has continued to make them more efficient, the price of PV cells has gone down about 4% per year for the last 15 years.
- In Canadian provinces that use natural gas for power production, a house producing power from a roof-mounted 3 kW solar PV system could prevent the production of more than 700 kilograms of the greenhouse gas carbon dioxide each year. In provinces that use coal for power, that number would be much higher.
- Solar technology produces jobs and money from exports. For example, more than 60% of solar technology sales in the United States are sales to other countries.
- Currently, the solar industry in Canada employs between 2,000 and 3,000 people. The 652 MW of solar approved in Ontario in 2010 has resulted in an estimated 10,000 jobs.²

Global Usage Facts

- Some experts predict that 50% of the world's energy will come from renewable sources by 2040.
- Demand for solar energy has grown 25% per year for the past 15 years.
- Some countries help people switch to solar electricity - Germany, Spain and many other European countries, for example, pay generous amounts for solar-generated electricity and give low interest loans for its production. In 2012 Germany saw an increased their solar installations by 30% to 32.3 GW to provide the country with 18 billion kwh of electricity (3% of their electrical needs).
- The California Solar Initiative that was launched in 2006 provides \$2.8 billion in incentives to the homes and businesses that use solar electricity and solar hot water heating.

- Worldwide, photovoltaic installations are rapidly gaining in popularity. In 1985, they produced 21 megawatts. In 2004, 1,086 megawatts. In 2005, 1,460 megawatts. In 2006, 1,900 megawatts. More recently those numbers have increased to 39,778 MW, 69,684 MW and 102,024 MW in 2010-2012 respectively.
- In 2006, 68% of all solar PV cells installed around the world were in Germany and Japan. In 2011 Germany produced 35% of the total peak power capacity, Italy (18%), Japan (7%), the United States (6%), and Spain (6%) round out the top 5.
- Two billion people in the world have no access to electricity, and solar energy would provide them with a clean, affordable solution.
- The number of homes in the USA with rooftop panels has roughly tripled since 2010. By one count, a new solar system is now installed every four minutes.



Canadian Usage Facts

- Canadian businesses now have some incentive: they can write off investments in solar PV against their taxes.
- The Sarnia Photovoltaic Power Plant in Ontario is the largest in Canada with a capacity of 80MWp it is expected to yield an annual energy output of 120,000 MWH. A coal-fired plant would emit 39,000 tonnes of CO2 a year to produce the same amount of energy in a year.
- The cost of solar panels is 100 times lower than in 1977
- In 2011 Canada generated over 560MW, which is roughly 0.8% of worldwide power capacity and nearly double the capacity Canada generated in 2010.
- Ontario has over 70 large solar farms across the province.



Solar panels on Okotoks pool. Photo: Gordon Howell

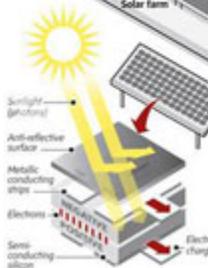
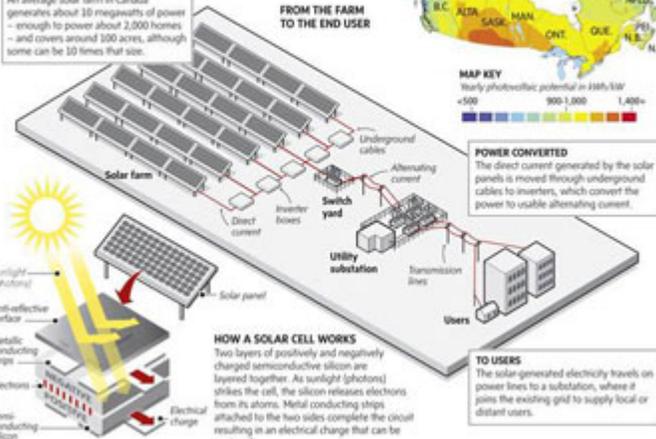
Harnessing the power of the sun

A solar farm building boom is underway in Ontario, thanks to the subsidized prices developers receive for the power they generate. As the cost of photovoltaic panels continues to fall, however, solar power will become more competitive with other forms of generation, opening the way for large-scale developments in other sunny provinces.



THE FARM
An average solar farm in Canada generates about 10 megawatts of power – enough to power about 2,000 homes – and covers around 100 acres, although some can be 10 times that size.

FROM THE FARM TO THE END USER



JOHN SOPHON AND RICHARD BLACKBURN/THE GLOBE AND MAIL ■ SOURCES: STATSCAN, NASA, CHESTERFIELD SOLAR

Drawing is schematic and not to scale.

How solar power could work for you. Do you live in a good area for solar energy?