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Solar Energy Profile: Straight from the Source

Every day, the Earth receives more energy from the sun than mankind uses in a year. Still, solar energy remains a tiny sliver in the global energy mix. Falling prices and better efficiency could change this, but can it happen fast enough?

Picture Gallery (click on the picture to start)

Take a peek at solar energy technology in action (Photo: Reuters)

When it comes meeting energy needs, humanity has not been able to eliminate the middle man. The energy we use today comes from the sun, but we get it indirectly. Sunrays fed countless generations of plants and organisms millions of years ago, which we now use to burn to produce electricity, heat our homes, and run our cars. Its heat also strikes up the winds that we use to sail ships and run turbines. Despite our dependence on the sun, mankind has still not fully realized the potential of harnessing the sun's vast energy directly.

Worldwide Importance and Future Trends

Even with steady annual growth, the International Energy Agency says solar energy - combined with wind and geothermal power - still only supplies less than one percent of the world's energy. In Germany, the global solar market leader, solar supplies around 0.3 percent of national electricity demand; in the United States, it supplies less than 0.1 percent.

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The UN's annual "Global Trends in Sustainable Development" report said that the solar sector attracted 16 percent of the 70 billion U.S. dollars invested in renewable technology in 2006 - behind wind (38 percent) and biofuels (26 percent). According to the World Energy Council, solar water heating market is growing at a rate of around 20 percent a year, and solar PV at 35 percent.

If the costs of solar technology continue to drop, it has a chance to compete with other forms of energy production. In places like sunny California, solar has already reached "grid parity," which means the costs of producing solar power are now competitive with conventional energy production even without government subsidies. Sinking production costs would allow solar power to eventually join or even replace coal, gas, and oil as a primary energy source by the end of the century, which some experts say is possible.

Global Resources and Producers

The amount of solar energy that reaches the Earth's surface every 20 days exceeds the energy trapped up in all of the planet's coal, oil, and natural gas reserves. The trick is finding cost-effective and efficient ways of converting this abundant resource into usable energy.

Currently, there are two main ways of doing so. Photovoltaic (PV) panels, thin pieces of crystalline silicon, transfer sunlight directly into electricity. Solar thermal collectors, on the other hand, are used to heat water for domestic or industrial use and to run steam power plants.

Solar Cooker

It does not have to be high-tech: A Tibetan woman washes her laundry while boilin water using solar energy in the outskirts of Lhasa. The Tibet Plateau abounds in solar resources, with annual average sunlight standing between 2,300 hours and 3,600 hours (Photo: Reuters)

Germany is the world's leading producer of PV and solar heating technology and energy. In 2006 alone, 968 Megawatts (MW) of PV was installed in Germany. Japan, which added 292 MW last year, is also an important market and exporter of PV technology. China is aggressively adding solar systems to its energy mix. The country already consumes half of all solar-heated water in the world, and aims to increase solar water heater coverage by 50 percent by 2010. China is also emerging as an important producer and consumer of PV cells, which the government is integrating in remote and urban areas.

Energy Output

The energy output of photovoltaic and solar heating depends on the size location of the system. Most areas receive ample sunlight, but deserts that seldom get cloud cover are better suited for solar energy production.

Standard PV cells have an energy conversion rate of 6 to 8 percent, meaning that 6 to 8 percent of all solar power absorbed is turned into energy. Some prototypes have already achieved conversion rates of more than 40 percent, but are still too expensive for mass-market production. Solar heaters utilize solar collectors that are significantly more efficient. Current collectors turn between 60 to 70 percent of

absorbed sunlight into heat.

Concentrated solar thermal systems use mirrors to reflect sunlight onto a tower, producing extremely hot temperatures to boil water or other fluids and produce steam to drive a thermal power plant. An 11 MW concentrating solar power plant was completed near Seville, Spain in March 2007. A 154 MW facility is planned in Australia, and a 500 MW system in California's Mohave Desert.

Environmental Impact and Drawbacks

Manufacturing and installing solar systems requires energy, and as with almost any industrial activity, involves handling hazardous materials, such as arsenic and cadmium. Mass production of PV cells is sometimes marred by shortages of quality silicon. Large-scale solar power plants also take up lots of land.

Overall, however, the environmental impacts of switching to solar energy are positive. Solar heaters require significantly less fossil energy input than natural gas and electric systems. PV systems are cleaner energy producers compared to coal and oil. Greenhouse gas emissions of solar PV plant including production and installation are eight times less than that of a coal-fired plant.

The initial costs of solar heating and PV systems, however, prevent many homeowners from installing them. But falling costs and subsidies have helped sustain market growth in some countries. Like with wind turbines, another technical problem is effectively storing solar energy to provide power throughout nights and cloudy days.

editor: Valdis Wish

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