



Impressions from Ferrarelle PV power plant, Italy.

Photovoltaic Energy: Solar Power for the 21st Century

Several current developments and projects around the globe point to photovoltaic energy being used in increasingly larger installations in the future. Siemens' mission is making solar power affordable for the world, with new plants that feature technologically better, less expensive, individually customized components.

By Peggy S. Allen

When a 16th-century pope needed cutting-edge technology, he turned to Michelangelo. The great Renaissance artist was asked to guide construction on St. Peter's Basilica at the Vatican. Michelangelo's dome is still the tallest in the world, and the Basilica endures as an artistic and structural wonder. Now, less than half a millennium later, the Vatican imagines a technological wonder for the 21st century. It will rely on one of the oldest power sources in our universe that we know of, the sun. According to Bloomberg,* the Vatican

Photo: Antonio Zambardino/Contrasto

hopes to build a 300- to 400-million-euro project and harness 100 MWp of photovoltaic energy. The power generated will operate the Vatican radio station, which broadcasts around the world. The radio station needs only one-tenth of the energy that will be produced, and the surplus energy could meet the electricity needs of 40,000 homes near Rome. Using the power of the sun to benefit mankind is not a new idea – we are just getting better at doing it. The sun is a vast natural atomic furnace that

*Source: <http://www.bloomberg.com/apps/news?pid=20601072&sid=aXLV7LFLWAGE&refer=energy>

**Source: <http://www.ren21.net/globalstatusreport/g2009.asp>

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Jens Vorbrodt, General Manager for Solar Power, Siemens Renewable Energy Division

turns mass into energy. After converting hydrogen to helium, the sun releases about 4 million tons per second of energy into space. From another perspective, even if you total all the energy that will be obtained forever from coal, oil, natural gas and uranium, the solar energy that reaches the surface of the earth is about two times that amount, each and every year. Converting that energy into electricity is, at least in principle, a fairly simple process involving a photovoltaic (PV) system (PV = “photo” [light] plus “voltaic” [electricity]) that utilizes cells, or semiconductors, on solar panels. Today's solar energy facilities are efficient, extremely powerful and profitable. Solar energy is the fastest-growing energy technology in the world, according to the Renewables Global Status Report, recently published by the Renewable Energy Policy Network (www.ren21.net).** Modern PV cells are designed to capture photons (particles of light) and turn them into electricity. The best of today's silicon-based PV modules can reach an efficiency rating of over 18 percent; around 15 percent efficiency is now standard. Even though meteorological and environmental factors are highly variable over time, the sun is a reliable and constant source of energy. The amount of solar radiation that reaches the earth varies according to weather, water vapor in the air, time of day and season. Also affecting irradiation levels are particles in the air such as dust and pollution, the amount of solar activity occurring, and the earth's distance from the sun. “The weather on a day-to-day

Glossary

- **Solar Energy / Solar Power:** Electromagnetic energy generated by the sun (solar radiation).
- **Photon:** A particle of light that acts as an individual unit of energy.
- **Photovoltaic / PV:** “Photo” (light) plus “voltaic” (electricity); the process of directly converting sunlight (photons) into electricity without mechanical conversion.
- **Photovoltaic System / PV System:** A complete set of components for converting sunlight into electricity by the photovoltaic process, including the array and balance of system components.
- **Photovoltaic Cell / PV Cell / Solar Cell:** The smallest part of a solar panel; the semiconductor element that converts sunlight into electric current.
- **PV Module:** Packaged, interconnected photovoltaic cells designed to produce power when exposed to sunlight.

For further glossary terms see:
www.siemens.com/glossary



Using prefabricated, lightweight aluminum supports like these, Siemens built a photovoltaic plant in Italy in just one month that serves 350 families.

basis seems to change a lot. But on a 20-year cycle, which is the time frame used in our contracts for a PV facility, the sunshine for a given location will only vary by 3 percent,” says Jens Vorbrodt, Head of Solar Power at the Renewable Energy Division of Siemens AG.

Not Your Father’s PV System

Siemens’ Renewable Energy Division is currently concentrating on building big projects like the one the Vatican is planning and connecting them to on-grid utilities. Large-scale PV projects – plants that produce 20, 40 or 50 MWp – make up only about 10 to

15 percent of the PV industry. “Newer production standards will make even bigger facilities possible,” says Vorbrodt. “The trend is clearly to bigger plants – 100 MWp or larger.” By 2020, Siemens predicts that there will be a 300-billion-euro market in renewable energy. More than half of the total renewables market will be in solar energy, and more than 40 percent of the PV industry will be focused on large-scale projects. In the future, that could mean PV electrical generating plants that produce even more than the 300- to 500-MWp plants, while 60 MWp is the largest installation today.

The Next Frontiers

In each of the past two years, 2007 and 2008, three out of the five biggest PV installations have been in Spain. Attractive financial incentives by the government helped spur development. Siemens, working to meet the particular needs of their client, provided the electrical components for one huge project that generates 20 MWp. That plant, the largest in the world at the time it was finished, can provide energy for up to 8,000 average households. Italy is a current focus for Siemens-built projects. A 5-million-euro project in Rende, Italy, has a special custom-

ized mounting system that allows 1 MWp to be generated on an area that is too small for standard solutions. Another 5-million-euro project, also in Italy, went into operation at the end of 2008. The PV plant for Ferrarelle S.p.A., an Italian bottled water company, took less than six months to realize, from awarding the contract to project completion. Building the installation, over an area of three football fields, took less than one month. The rapid construction was facilitated by using prefabricated, lightweight aluminum supports to hold over 4,000 Sharp solar modules, which were connected to three Siemens SINVERT inverters and a Geafol voltage transformer. The residents of 350 apartments in the town of Ricardo, north of Naples, now have efficient and environmentally friendly electricity. The USA could become another important market – despite, or perhaps because of, the country’s economic downturn. “It’s a well-known fact that President Barack Obama favors solar energy development and encourages Americans to use more renewable energy,” says Vorbrodt. But he also notes that the USA are a challenging market. “It’s a big country, and each state has its own set of regulations,” he explains. In the USA, projects are often conceived and financed by independent power producers (IPPs) rather than by a government-owned utility, which can complicate development. Some states, such as California, which has a climate well suited to harnessing solar power, show particular interest in many forms of greener power. In 2008, Governor Arnold Schwarzenegger upgraded an initiative that now requires California utilities to reach a goal of 33 percent renewable energy in their electrical mix by 2020. The goal of a PV facility is to produce and deliver the right electrical output at minimum cost with a short payback period and a high level of efficiency. The eventual financial goal is to reach “grid parity,” meaning PV-generated electricity is equally as economical to produce as grid power from conven-

Photo: Alfred Buellesbach/Visum

tional plants. Financial incentives, such as Feed in Tariffs (FIT) and net metering make investment in PV power profitable and allow producers to sell power into the grid. Siemens is able to completely engineer the installation of plants and offer nonstandard solutions, while providing performance guarantees of 20 years or more. Ongoing monitoring of the entire system and preventative maintenance are further services aimed at upholding performance standards. By planning and delivering a fully personalized, integrated design solution, Siemens, like Michelangelo, can craft a masterpiece.

Peggy S. Allen is an American/Swiss freelance journalist based in Zurich. She writes about a variety of topics, but has a special interest in emerging technologies. She has worked with many US publications, including the New York Times, Newsweek and Forbes.

Summary

Siemens helps its customers produce clean renewable energy by continuously innovating and optimizing solar power solutions. Photovoltaic (PV) energy is a rapidly growing field with a worldwide trend toward bigger installations (100 MWp or more). These facilities are efficient, very powerful and highly profitable. Modern PV cells capture particles of light (photons) and transfer them into electricity. Siemens’ Renewable Energy Division offers full service and all-inclusive delivery on PV-related products and is currently focusing on large-scale projects.

Further Information

www.siemens.com/energy

PV Measurement Standards

Photovoltaic (PV) technology is developing rapidly, and new commercial uses are continually being discovered. Simultaneously, measurement standards for the industry and for the individual components of PV-generated power are improving. The quality of industry production advances as better measurement standards become available to accurately examine and compare all areas of production. PV cell (or solar cell) efficiency is the single most important measurement. The expected economic return of the PV facility is also closely related to cell efficiency. To gauge how well things are working, a PV reference cell is used. It is designed to accurately reflect the conditions of an individual project. This reference cell is carefully matched to the specifications of the site as it would operate under ideal conditions. Siemens certifies and guarantees performance and quality in all of its installations. Every project has custom-tailored components selected by Siemens to be suitable for the particular requirements of each installation. The reference cell allows comparison between expected results and performance under real conditions. “A full-service and -maintenance contract is required,” says Jens Vorbrodt, “to ensure the high performance of the PV power plant over the minimum 20-year expected operation period.”