

Portugal builds on renewables effort with \$78M solar plant

A sun-powered system, part of a push to develop more sources of renewable energy, could cut greenhouse gas emissions by 30 000 tons annually.

An 11-megawatt solar power plant that's among the largest photovoltaic projects in the world will provide power to some 8000 homes in Portugal after it's completed in January 2007.

The plant will use a ground-mounted PV system comprising 52 000 modules and is being built on a 150-acre hillside in Serpa, a sleepy agricultural hilltop town in southeast Portugal, one of Europe's sunniest regions. Two local farmers are renting out the south-facing parcel under a 25-year contract.

Three businesses are involved in the €61 million (\$78 million) project. Portuguese renewable-energy company Catavento Lda developed the project; GE Energy Financial Services of Stamford, Connecticut, is financing it and will own the plant; and PowerLight Corp of Berkeley, California, a solar power system provider, designed the plant and will operate and maintain it.

Portugal was attractive to GE EFS for such an investment because of the region's perpetually sunny climate and because the nation has created renewable-energy development incentives, said Andrew Katell, spokesman for the GE unit. GE EFS, whose renewable-energy portfolio totals some \$1 billion, invests annually in environmentally friendly technologies, he added. (See PHYSICS TODAY, August 2005, page 25.)

According to a 2004 Energy Information Administration report (<http://www.eia.doe.gov/emeu/cabs/portugal>

.html#renew), Portugal plans to produce 39% of its power through renewable sources by 2010—which translates into an installed capacity of 150 MW of electricity—but as of July 2005 the nation was generating only 2 MW of solar power. The country expects to meet its renewable-energy goal through wind and wave projects already under development in addition to building solar plants, the EIA report said. A 2000 annual report by the International Energy Agency (<http://www.iea-pvps.org/ar00/prt.htm>) pointed out that Portugal has no fossil-fuel energy resources and depends heavily on imports of coal and oil.

One of the Portuguese government's renewable-energy development incentives, called a feed-in tariff, guarantees utilities' purchase of solar power at specific rates. "That makes it attractive from a developer's standpoint," Katell explained. "The developer [is] able to sell the power at a predictable rate that isn't subject to fluctuations in the market."

Project manager Marco Miller of PowerLight said the plant's modules range from 12.6% to 17.7% efficiency. The system's actual daily output will be governed by available sunlight, the season—which influences sun angles and number of daylight hours—clouds, and temperature. Because the plant's solar panels track the sun throughout the day, the plant will generate up to 20% more electricity on days with the most sunlight than

POWERLIGHT CORP



Construction is under way on a 52 000-module solar power plant on a 150-acre hillside in Serpa, southeast Portugal. When the plant is completed in January 2007, it will be among the largest in the world.

PPMS™ SPM

**LOW TEMPERATURE
SCANNING PROBE
MICROSCOPE**

AFFORDABLE !!

WORLD'S SMALLEST HALL PROBE: 50nm

VORTICES IN BSCCO
IMAGE COURTESY OF PROF S. J. BENDING

EXPERIMENTAL B(H) HYSTERESIS LOOPS MEASURED ABOVE THE INDICATED POSITIONS ON THE Fe DISK
IMAGE COURTESY OF PROF S. J. BENDING

- **Multi-Mode Operation:**
 - MFM, AFM, SHPM, STM, EFM
 - Fibre interferometer for ultimate resolution
 - Quartz or Akiyama sensor options
 - 18 x 18 μm scan range @ 4K
 - 3 mm coarse XY motion
 - 23.6 mm OD
- **Scanning Hall Probe Microscopy**
 - 50 nm spatial resolution
 - Real time scanning!
 - Unprecedented sensitivity: Up to 6 nT/Hz^{1/2} @ 4K
 - mK - 300 K Temperature Range for non-PPMS Systems

**QUANTITATIVE & NON-INVASIVE
MAGNETIC MEASUREMENTS AT
NANOMETER SCALE**

**NanoMagnetics
Instruments Ltd.**

www.nanomagnetics-inst.com
info@nanomagnetics-inst.com

PHOTO: B. TRADE MARK OF QUANTUM DESIGN INC.

more conventional fixed-mount systems.

"On a typical sunny day, the system ramps up slowly as the sun rises," Miller said. "The [rows of solar panels] track the sun from east to west and [the plant] achieves its maximum output by around 9:00am [depending on the season] and remains [at that output level] until 3:00pm when it begins ramping back down, shutting down at sunset."

Output would drop during cloudy or rainy periods.

The current top solar power plant worldwide, Solarpark Pocking, began operating in April 2006 on a former military base in Bavaria. With a peak output of 10 MW, it has 58 000 PV modules and generates electricity for about 3000 homes.

Miller said the Serpa plant will store no power and that the electricity it generates will be delivered to the Portuguese power grid. Construction of an electric substation on-site is under way.

The plant was designed with a life expectancy of at least 25 years, and as the modules wear out, they will simply be replaced. They'll need only regular clean-

ing to maintain peak efficiency—and the task won't require a crew with industrial ladders, as the modules are mounted only about five feet from the ground.

The plant is expected to reduce greenhouse gas emissions by more than 30 000 tons a year compared with equivalent fossil-fuel energy generation.

Although use of solar radiation to generate energy is highly desirable for many environmental reasons, the process is still too costly for solar power plants to replace other traditional energy sources on a mass scale worldwide, said Piero dal Maso, co-CEO of Catavento Lda. PV cells represent much of that cost, he added; presently no automated system exists that can manufacture them, and the silicon used in their production is also expensive.

When the Serpa plant is completed, it won't be the hillside's only occupant. Some 500 sheep now roaming the property will remain there, but they'll do more than just look picturesque. "We don't want bushes growing up over the modules, and the sheep will eat them," dal Maso said.

Karen H. Kaplan

been done." When assessing the health risks of nanoparticles, size matters because the particles are small enough to cross biological boundaries, such as the blood-brain barrier and the placenta, that other particles cannot, he said.

Maynard's first recommendation in the report is a call for "top-down authoritative oversight of strategic risk-based research within the federal government." He also calls for shifting nanotechnology risk research to "federal agencies with a clear mandate for oversight and for research into environment, health, and safety issues."

While most federal nanotechnology funds go to NSF and the Department of Energy, Maynard said the EPA, the National Institutes of Health, and NIOSH should be doing the risk research.

The report also calls for "adequate funding" directed specifically at risk research, which Maynard puts at about \$50 million a year. "If we're going to see business succeed with nanotechnology, we've got to see the safety issues dealt with up front," he said.

Clayton Teague, director of the government's National Nanotechnology Coordination Office, said the government's investment in risk research in 2005 was \$35 million and he projects spending of \$38 million in 2006. "We've been funding risk research since the inception of the National Nanotechnology Initiative in 2001. Since that time it has grown steadily." Maynard acknowledges the \$38 million figure in his report, but claims the number is vague and "no detailed information was released on the research being supported by this funding." Regardless, Maynard said, it is not enough. Teague said the NNI is completing a risk-related "research needs" document that will look in detail at all the risk research being done throughout the government, and recommend what new work needs to be done.

Business groups are pushing for more federal risk research to lessen their liability and reduce the likelihood of a public backlash against nanotechnology if there is a problem with a product in the marketplace. Paolo Gargini, director of technology strategy for Intel Corp, said Maynard's report was "an important contribution to building much needed consensus around the need for focused research into the implications ... of nanotechnology." Intel, he said, believes there is a need for more federal research "devoted to studying the environmental, health, and safety dimensions of nanotechnology."

The report calls for a short-term research plan to look at products already in

Nanotech risk research needs strategy, money

Physicist **Andrew Maynard** sat at the head table in a packed conference room at the Woodrow Wilson International Center for Scholars in Washington, DC, and unscrewed the lid from a jar of calcium powder containing nanoparticles. A puff of the powder rose into the air as he lifted the lid.

"Is it safe to breathe this in?" he asked the audience. He held up a jar of face cream containing carbon-60, or buckyballs. "You put this on your face. Is it safe, or not? I don't know."

Nobody else knows either, Maynard said, and that is the reason he is calling on the federal government to develop a research strategy to determine the health and safety risks of the emerging field of nanotechnology. In his new Wilson Center report, *Nanotechnology: A Research Strategy for Addressing Risk*, Maynard recommends that \$100 million be spent over the next two years on nanotechnology risk research.

Calculating how much is now being spent to determine the potential dangers of nanotechnology is difficult because the funding is spread across several agencies, he said, but he believes the annual amount is about \$11 million. Maynard, the chief science adviser to the Wilson Center, said it is critical to develop an overarching strategy to assess the safety of the myriad forms of

nanoparticles before widespread health problems develop, not after.

To give an idea of the scope and immediacy of the problem, Maynard points to a recent study by Lux Research, an investment advisory company. That study says more than \$32 billion worth of products using nanotechnology were sold worldwide in 2005. Government and private US investments in nanotechnology R&D have already reached \$3 billion, and NSF, a major sponsor of nanotech research, predicts that the global market for products and services using nanotechnologies will reach \$1 trillion by 2015.

"The fundamental issue is, we have risks we haven't seen before," said Maynard, an aerosols researcher who formerly worked on nanotechnology safety issues for the National Institute for Occupational Safety and Health (NIOSH). "Nanoparticles do behave differently in the environment and in the body than other things we've faced in the past."

"Are there risks from nanomaterials? In some cases, yes, in some cases, no," said Jeremiah Duncan, an American Association for the Advancement of Science fellow working in the US Environmental Protection Agency's office of pollution prevention and toxics. "But for the most part, we don't know because the bulk of the research has not