Technology Aims to Convert Solar Energy on Large Scale

Over the years, the Palo Alto Research Center has developed numerous electricity-gobbling innovations.

Now, the storied lab that gave the world laser printing and graphical user interfaces is trying to harness the sun to power its inventions.

The Xerox Corp. subsidiary known as PARC has produced super efficient solar systems that experts say could make photovoltaic power--sunlight converted directly into electricity--available on a large scale at prices competitive with fossil fuels for the first time. PARC's technology is one of several promising approaches in the field, Contracostatimes.com reported.

"Solar is growing at 30 percent annually," said analyst Ron Pernick of Clean Edge Inc., a research organization that specializes in alternative energy technology.

Comparing the expansion to the best years of the personal-computer industry, Pernick forecasts that solar power will be a $51 billion global business in 2015, up from $11.2 billion last year.

The research at PARC is part of an eco-friendly technology trend that draws on the materials and know-how that built computer microprocessors and other high-tech staples.

PARC's efforts dovetail with Silicon Valley's push into "clean tech," including conservation and renewable energy. Reusable paper is another of PARC's development projects. The California Clean Tech Open--sponsored by dozens of companies, venture capital firms, universities and other groups--recently received 155 competing business concepts.

In an era of stratospheric oil prices, investors are beginning to see solar as the next big thing, despite its embryonic state. Many industry watchers expect to see large rooftop collectors for powering businesses, and solar farms that will approach the size of major power plants.

"The electricity market is as big as the sky," said Erik Straser of Mohr Davidow Ventures in Menlo Park, who has invested in emerging solar companies.

That hopefulness stems from dramatic technology changes. For decades, solar power was dominated by thermal systems that heat water for bathing or power small turbines to create electricity. Photovoltaic technology--the combination of light and electricity--gradually is replacing thermal.

At the core of photovoltaic cells are semiconductor materials such as silicon. Solar rays knock electrons loose from silicon atoms; those electrons are drawn off to create a current. Solar arrays combine many cells.

The first generation of photovoltaic technology was based on large, heavy collectors--costly, inefficient systems that converted only 10 percent to 15 percent of solar rays to power. The rest reflected away or diffused as waste heat.

Recently, a handful of companies have developed systems that use mirrors or lenses to concentrate the sun's rays as much as 500 times and increase efficiency to as much as 26 percent, with projections up to 50 percent. Higher efficiency means cheaper power.

Several such "concentrating photovoltaic" schemes have been devised.

PARC's concentrating technology was developed with SolFocus, a start-up being incubated inside PARC. The first-generation system comprises grids of solar collectors about 8 inches thick. Metal cones and optical systems concentrate sunlight on a 1-square-centimeter solar chip.

The second-generation system shrinks the collectors 90 percent and makes them about half an inch thick, creating a honeycomb of precision-molded glass coated with mirrors. The newer technology uses chips just 1 millimeter square made from layers of germanium and silicon. The layers absorb different parts of the solar spectrum to increase efficiency.

Their small size would make the collectors more economical and easier to mount on the rooftops of commercial buildings, such as big-box retailers in sunny climates. Last year, SolFocus' entry beat more than 100 competing designs to win the National Renewable Energy Laboratory Growth Forum award.

PARC estimates that the new system will easily compete with fossil fuels at today's prices, although it won't be ready for commercial use for a few years.

Electricity From Corn Stover

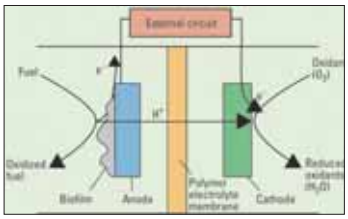
A team of Penn State researchers is exploring the use of microbial fuel cells (MFC) to convert corn Stover directly into electricity following the pre-treatment of the biomass to release the sugars.

Previous work has shown that these fuel cells can generate electricity from glucose and from municipal wastewater and that these cells also can directly generate hydrogen gas, Greencarcongress.com reported.

Corn stalks and leaves, amassing 250 million tons a year, make up a third of the total solid waste produced in the United States. Currently, 90% of corn Stover is left unused in the field. Corn Stover is about 70% cellulose or hemicellulose, complex carbohydrates that are locked in chains. Pre-treatment of the waste to release the sugars is the first step in fermentation processes for the production of cellulosic ethanol.

When anaerobic bacteria are placed in the oxygen-free anode chamber of an MFC, they attach to an electrode. Because they do not have oxygen, they must transfer the electrons that they obtain from consumption (oxidation) of their food somewhere else than to oxygen, and so they transfer them to the electrode. The two electrodes are at different potentials (about 0.5 V), creating a biobattery (if the system is not refilled) or a fuel cell (if refilled).

The microbial fuel cells were inoculated with domestic wastewater and a nutrient medium containing glucose, the researchers report in the journal Energy and Fuels. Once established, the bacteria colonies were fed the sugary organic liquid obtained from steam exploding of corn Stover.



Design of a microbial fuel cell (MFC). (Photo by Greencarcongress)

The researchers, who include Logan, Yi Zuo, a Penn State graduate student in environmental engineering, and Pin-Ching Maness, a senior scientist with the National Renewable Energy Laboratory, report that "the conversion of organic matter to electricity, on the basis of biological oxygen demand removal, was relatively high with greater than 93% of the biological oxygen demand removed."

In essence, there is no organic matter left to cause problems when disposing of the remaining liquid because there is nothing left to oxidize. The electrical production is about one watt for every square meter of surface area at about 0.5 volts. A typical light bulb uses 60 watts. To increase wattage, the surface area needs to increase. To increase voltage, fuel cells can be linked in series.

The US Department of Agriculture and the National Science Foundation funded this research.

Better Green Fuel Alternatives Urged

Fuels produced from corn and soybeans offer clear economic and environmental advantages over fossil fuels but scientists should still work to develop even cleaner alternative energy sources that do not sap the world's food supplies, a study said.

'There is a great need for renewable energy supplies that do not cause significant environmental harm and do not compete with the food supply,' said the study published online in the Proceedings of the National Academy of Sciences.

The study by the University of Minnesota and St Olaf College in Northfield, Minnesota examined the amount of energy soybean and corn fuels produced in relation to the energy it took to produce them. It also looked at the environmental impact of the fuels, according to Reuetrs.

Researchers of the study found that soybean-based biodiesel is more efficient than corn-based ethanol in spite of recent excitement surrounding ethanol.

There is a great need for renewable energy supplies that do not cause significant environmental harm and do not compete with the food supply. (Google File Photo)

'Among current food-based biofuels, soybean biodiesel has major advantages over corn grain ethanol,' the study said.

Biodiesel yields 93 percent more energy than it takes to produce, well above ethanol's 25 percent yield.

The production of soybean-based biodiesel emitted 41 percent less greenhouse gases than the fossil fuel process, while ethanol production's greenhouse gas emissions were 12 percent lower than for fossil fuels.

But growing soybeans and corn can cause harm to the environment through the application of pesticides and the use of nitrogen-based fertilizers.

Additionally, corn and soybean-based fuels will not be able to satisfy the demand for transportation without compromising the food supply around the world.

Ethanol currently has the clear lead in the alternative fuels race in the US. Companies are spending billions of dollars to build ethanol production plants.

Some forecasters are predicting the demand for corn will exceed the amount grown in coming years because of ethanol.

Ethiopia, Italy Sign $2b Hydropower Project

The Ethiopian government and an Italian company signed last week a $ 2 billion hydroelectric power project (Gibe111 Hydro Electric Power Project), which said to be the biggest in Africa.

The hydropower deal was signed between the Electric and Power Corporation (EEPCO) and SALINI Construction, an Italian construction company currently undertaking various construction works in Africa. The agreement was signed between Meheret Debebe, General Manager of EEPCO and Engineer Claudio Lautixi, General Manager International Division of Salini Constrottori in the presence of high-ranking government officials, including Foreign Minister Seyoum Mesfin, Allafrica.com reported.

The hydropower project will be constructed in the Northern West of Ethiopia where there are ample water resources in the area, including the Nile River.

It was reported during the deal that the installed power will be 1,870 MW with an annul production of 6,400 Gigawatt/hour, about 10 times the power of Gilgel Gibe phase, presently the biggest plant operation in Ethiopia. "The project costs about 15 billion Eth.Birr.In addition to costs of engineering, administration, environmental and social impacts as well as transmission line (Gibe111 wolaita, Wolaita Kaliti, Wolaita Mega 550 KM, 400 KV), it goes up to 17 billion birr-equivalent to two billion USD,"Meheret Debebe of EEPCO said.

This power plant will be the third cascade on the Omo-Gibe river basin to the already operational 184 MW Gilgel, Gibe1 plant and the 420 MW Gilgel gibe 11 plant which is currently under construction.

"As an investment, this major project will repay itself in only five years of operation. The hydroelectric plant generates electricity with the water freely given by the Omo River, and after the investment is repaid, the plant will give some 300 million Euro per year of revenues, at almost no cost. And the hydropower plant is long last,"Debebe added.

The hydropower plant project is expected to be operational by 2011 within a five years period and is expected to create job opportunity for 5,000 Ethiopian.

"In the global picture where oil is getting scarce and ever more expensive, hydropower is the white oil of Ethiopia, clean and renewable," Claudio Lautixi of Salini construction said. Up on the completion the project will augment the current 17 % access coverage to 50 %. It will also help Ethiopia for energy export to neighboring countries like Sudan Djibouti and Kenya.

Interconnection of Ethiopia -Sudan and Ethiopia-Djibouti are already finalized.

"By next year similar studies will be completed with Kenya, which will enable Ethiopia to export energy to meet the Kenyan demand and also far to countries in the Southern power pool, while our country will earn a foreign currency," Debebe added.

The country is largely believed to be endowed with a hydro potential reaching up to 45,000MW.

US 'Coal Rush' Will Threaten Environment

Energy companies are planning to build over 150 coal-fired power plants across the United States, according to a report released July 20, 2006 by US PIRG and other environmental groups nationwide, including Huntington, WV-based Ohio Valley Environmental Coalition (OVEC).

Far from enhancing America's energy security, the wave of proposed plants--most of them powered by dirty, last-generation technologies--would dramatically increase global warming emissions and pose energy security and economic problems, Huntingtonnews.net reported.

"We're lining up for a sprint in the wrong direction on US energy policy," said Rob Sargent of US PIRG. "Expanding our dependence on coal would only worsen its impact on global warming emissions and intensify the other environmental impacts and economic risks."

"There are at least five power plants proposed for West Virginal right now. Plus, Governor Manchin is touting coal-to-liquids as good for national security, but the opposite is true," said Vivian Stockman, OVEC project coordinator. "Mountaintop removal is creating an Appalachian security emergency as our forested mountains are blasted into oblivion and our life-giving streams are buried forever under the rubble. Global warming is a global security emergency."

The US PIRG analysis, based on information from the US Department of Energy and published reports, documented the potential impacts of completing the 150 plants proposed across the US Among the impacts would be the following:

A 10 percent increase in US global warming emissions. This increase would occur amid urgent scientific warnings about the dangers posed by global warming and growing consensus that, to avoid the worst consequences, America and the world must achieve steep cuts in global warming emissions by the middle of this century.

A 30 percent increase in US coal demand, which would require the opening of new mines and expanded infrastructure for delivering that coal to power plants. The increase in coal demand would exacerbate the environmental devastation caused by coal mining, which has already denuded more than seven percent of Appalachian forests, buried 1,200 miles of streams in fill, and resulted in the release of hundreds of millions of pounds of toxic chemicals. It would also increase the likelihood of future cost increases for coal.

Expanding America's coal demand would come at a high price," said Joe Lovett of the Appalachian Center. "New mines would level more mountains, permanently bury hundreds of miles of pristine mountain streams under billions of tons of mining waste and continue to devastate local communities located near the mines."

$137 billion invested in dirty, outdated coal-burning technology. Despite recent hype about the promise of "clean coal"--including the prospect of capturing and storing carbon dioxide emissions from power plants underground--only 16 percent of the proposed plants nationwide would use coal gasification technology, and none would incorporate carbon capture and storage. The rest would use older technologies that are already responsible for massive global warming emissions and the release of large quantities of pollutants responsible for human health problems.

Investing the $137 billion slated for new coal-fired power plants into cleaner alternatives would yield economic and energy security benefits for the United States. If invested in energy efficiency, those funds could reduce US electricity demand by about 19 percent in 2025 vs. business as usual – obviating the need for the all of the coal plants on the drawing board. If invested in wind energy, the United States could develop 110 gigawatts of the best wind energy locations in the western US, which could produce electricity at an overall cost comparable to coal.

"We could avoid the need to build any new coal plants if we simply invested the same amount of money in energy efficiency," said Travis Madsen, a policy analyst who authored the report for USPIRG, "and we'd save money at the same time."

The report, Making Sense of the Coal Rush: The Consequences of Expanding America's Dependence on Coal, calls for several steps to stem the "coal rush." First, our leaders should join Idaho officials in establishing a moratorium on new coal plants in, in order to evaluate the environmental and economic impacts. Second, our leaders should establish a cap on carbon dioxide pollution, to be lowered over time. Third, public money should not be spent on coal technology. Finally, our leaders should dramatically expand programs to develop energy efficiency and renewable energy resources.

At the federal level, on June 20, Rep. Waxman introduced the Safe Climate Act in the US House of Representatives. It would require the US to reduce its global warming pollution 15 percent by 2020 and by 80 percent by 2050. To achieve these targets, the bill calls for improved energy efficiency and a greater reliance on clean, renewable energy sources, while providing companies flexibility in meeting the pollution-reduction goals through a "cap-and-trade" program. Senator Jeffords of Vermont is introducing a similar bill in the Senate today.

"America could substantially reduce its global warming pollution using existing technology to improve energy efficiency and increase the use of clean, renewable energy sources such as wind, solar, geothermal and biomass," said Sargent. "What's more, these steps would be good for America's economy; creating jobs and improving productivity. But, none of this is possible if we stake our future on coal."