



Desert visions

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Water may be scarce in the Sahara Desert, but it has plentiful amounts of another natural resource: sunshine. Now, as part of an ambitious initiative called Desertec, countries in the Middle East and North Africa (MENA) are moving toward turning this solar abundance into a valuable source of clean electricity.

The vision behind Desertec is to build a network of solar and wind power plants across deserts in the MENA and to distribute that electricity throughout the region and to Europe. Desertec's goal is "to satisfy a substantial part of the energy needs of the MENA countries and to meet up to 15 percent of Europe's electricity demand by 2050." Its first pilot project will be built in Morocco in 2013, taking advantage of an existing undersea transmission line that connects Morocco to Spain.

"Energy from the deserts is the largest energy source on Earth," said Paul van Son, CEO of the Desertec Industrial Initiative (Dii), a consortium of private organizations working to bring the Desertec concept to fruition. "Our aim is to make the best use of it for the benefit of millions of people."

Desertec began in 2003 as the brainchild of Gerhard Knies, a retired high-energy physicist who calculated that the amount of sun that hits the world's des-

erts in just six hours could power all of humankind for one year. Knies started the Trans-Mediterranean Renewable Energy Corporation (TREC), which developed the Desertec concept with scientists from the German Aerospace Center. TREC became the Desertec Foundation in 2009, and now Knies serves as chair of the supervisory board.

Desertec proponents see the initiative as a "win-win" scenario, with both practical and idealistic benefits. European countries would get additional sources of power to fulfil their goals for transitioning from fossil fuels to renewable electricity. The MENA countries would gain sources of sustainable power to support the needs of their growing populations, as well as a valuable product for export. The economic stimulus would create jobs on both sides of the Mediterranean, and the sharing of electricity across the grid would foster positive relationships between nations, they said.

"The concept isn't purely about solar power in the desert," said Gerry Wolff, coordinator of Desertec-UK, a volunteer group working to promote the concept in the United Kingdom. "It is about integrating solar and wind power in deserts with the whole range of renewables," even geothermal power in Iceland, for example. Developing an interconnected electric transmission grid across Europe and the MENA will be key. A French industrial consortium called Medgrid is focusing on transmission issues and shares some of Desertec's industrial partners.

Dii was established in 2009 and includes companies such as Siemens, ABB, Deutsche Bank, and Munich Re, as well as non-commercial ones such as the Max-Planck Society and the Fraunhofer Society. By 2012, the Dii expects to draft a "long-term, holistic 'roll-out' plan" to guide governments and investors interested in developing a market for renewable energy in the MENA deserts, said van Son. "That will include regulatory, social, economic, financial, generation, and transmission grid conditions, ensuring the feasibility of desert energy." The plan will run through 2050.

Dii itself does not invest in or build power plants but rather acts as a fa-

cilitator, encouraging governments and funders to take on solar and wind power projects. One of its first reference projects will be a 500-MW solar power plant developed in cooperation with the Moroccan Agency for Solar Energy (MASEN). The plant will use a combination of technologies: 400 MW of concentrated solar power (CSP) and 100 MW of photovoltaics (PV). Eighty percent of the electricity generated will be exported to Europe, carried by the transmission line now used to ferry electricity in the other direction from Spain.

Dii is also working with the utility company STEG Energie Renouvelable to examine the feasibility of building large-scale solar and wind projects and transmission lines in Tunisia. Egypt and Algeria are also talking with Dii to find avenues of cooperation, according to van Son.

A variety of power generation technologies are being considered for Desertec, including CSP, PV, and wind. CSP plants use focused sunlight to heat a material such as molten salt or sand. That stored heat can then be tapped to produce steam to power a turbine. When the Desertec concept was being developed a few years ago, CSP was the main focus, Wolff said. But recently, PV prices have dropped enough to make that technology practical. In some areas of the MENA, especially in the Western Sahara, wind might make the most sense.

"The market conditions of these technologies are very different," van Son said. "Wind is almost at market, and PV is rightly on its way to being integrated, whereas CSP still needs strong support. We believe that these technologies will, after a certain phase of incentives, be able to compete in the markets without financial support."

The electrical grid in the MENA and in Europe will need a host of new transmission lines to carry the electricity generated by these new plants. Dii is working with RWTH Aachen University in Germany and the Technical University Munich to find solutions for these lines to serve the new interconnected markets, said van Son. High-voltage direct current (HVDC) cables, which allow for long-

distance transmission without power losses, will have to be installed under the Mediterranean and technology deployed to convert dc electricity to ac.

The desert environment also presents potential problems for solar, such as sandstorms and the lack of water for cleaning and cooling. But other CSP projects in desert locales have shown that those technical challenges are surmountable, Wolff said. CSP plants in the Mojave Desert have shown that they can be air-cooled, and new technology allows the solar col-

are ahead of the curve, said Wolff, while others are lagging. Germany's Renewable Energy Act of 2000 established feed-in tariffs that encouraged people to make long-term investments in technologies such as solar. As a result, Germany now gets about 17 percent of its electricity from renewable sources.

Part of Dii's task is to talk to organizations such as the European Commission, Wolff said, and convince them to provide a subsidy for the electricity produced by Desertec. The industry partners give Dii

which includes the investments for solar thermal power plants and HVDC transmission lines that would satisfy 17 percent of European power demands over the next four decades. A 2010 study by the E.ON Energy Research Center at RWTH Aachen University investigated the economics of Desertec by looking at the costs, risks, and uncertainties of a pilot project comprising a 2 GW HVDC cable and 10 power plants with 200 MW of capacity each. Based on this scenario, "unless marked cost reductions for CSP power plants can be achieved in the coming years, we conclude that the estimated budget of €395 billion for the realization of the entire Desertec project will likely be overrun," the authors stated.

This year, the widespread political turmoil in Egypt, Tunisia, and other MENA nations raised questions about whether the "Arab Spring" would derail progress on renewable energy projects in the region. Katrin-Susanne Richter, director of the Desertec Foundation, issued a statement that they did not expect the solar plans of the affected countries to change. What's more, the wave of civil uprisings reinforces the importance of improving the economic prospects of the MENA countries' fast-growing populations, she said.

"The Desertec concept . . . supports the socio-economic development in the countries where the projects will be carried out, through a transfer of knowledge, investments, and the creation of jobs in a new, sustainable industrial sector," according to Richter. "Also, for reasons of security policy, it is useful for Europe, particularly at the present time, to support an energy cooperation such as the Desertec concept."

When people express concern about relying on "unstable" countries for power, Wolff said that they forget that Europe already depends on those countries for oil. "With oil, there are only a few countries that have a lot of it, so they can create a cartel and hold the world to ransom," he said. "I think it's highly unlikely you would get some kind of solar cartel, a solar OPEC. With solar power it's different. The amount of potential is far greater than the market." □



The parabolic, trough-shaped mirrors in a concentrated solar power plant focus sunlight onto a tube containing oil or similar fluid. The heated fluid then can be used to make steam and generate electricity. Courtesy of Desertec-UK.

lection mirrors to be cleaned with very little water, he said. The mirrors can also be rotated to protect them against damage during sandstorms.

Research to develop these enabling technologies will be conducted by members of the Desertec University Network, which consists of 18 institutions in the MENA and two in Europe. The universities will also be crucial in providing scientific training and expertise for Desertec projects.

Much of the basic technology to achieve Desertec's vision already exists. But building the economic and policy framework to make it a success might pose a greater challenge. Countries on the receiving end will need to implement policies to encourage the use of renewables. Some countries such as Germany

a strong voice, he said. "Because they have these large, heavy duty companies involved, they have the political clout to make it happen."

Those policies will affect the economics of the Desertec initiative, since the high initial costs of renewable energy projects will require government support to get off the ground. "It will take some years until the cost level of solar energy, for example, will reach market level," said van Son. "Initially, industries would thus not invest without government support. And without investments, we would not reach economy of scale, so the cost level would not decrease over time. This deadlock situation must be overcome."

Early on, the German Aerospace Center calculated the total cost of Desertec to be about €400 billion (\$565 billion),