Norway: A Nuclear Demonstration Project?

EGIL LILLESTØL IS A MAN WITH A RATHER unusual mission: He wants his homeland of Norway to take the lead in developing a new form of nuclear power. Norway is Europe's largest petroleum exporter, from its North Sea oil and gas fields, and Lillestøl, a physicist at the University of Bergen, believes the country needs to do something about its carbon emissions. Norway has little experience with nuclear power but has one of the world's largest reserves of thorium. Lillestøl says Norway should pioneer a new, inherently safe form of nuclear reactor called an energy amplifier that runs on thorium. "It would be a good thing to have other [options] to stand on," Lillestøl says.

Carlo Rubbia, a Nobelist and former director-general of Europe's particle physics lab CERN, championed the idea of the energy amplifier in the 1990s, and CERN researchers developed a design and tested some of the key ideas. A conventional fission reactor holds enough fissile material for a nuclear chain reaction to take place; neutron-absorbing rods ensure that the reaction doesn't run out of control, although this always remains a risk. The energy amplifier doesn't have enough fissile material to sustain a chain reaction. Instead, an accelerator fires high-energy particles into the fuel, prompting a cascade of fission reactions and producing heat. The amount of heat is proportional to the intensity of the beam, and the accelerator can be designed so that the amplifier can never overheat. Although the amount of waste produced is expected to be low, particle accelerators aren't cheap, and one with the necessary power has never been built.

Lillestøl wants Norway to pioneer this form of energy by funding and hosting a prototype—at a cost of about €550 million—and has made it a personal crusade to win over the Norwegian public and government. Lillestøl says he makes two or three presentations a week. Although the government is wary of nuclear power, after a debate in the national assembly, the energy minister called for an in-depth study. Norway is in a unique position to undertake such an enterprise because it has been squirreling away oil revenue and has now amassed a fund of some $250 billion.

CERN's Jean-Pierre Revol, who worked on the energy amplifier at CERN, says that Lillestøl has made "a lot of political progress" in Norway. Renewed interest in nuclear power is generating curiosity about this technology, Revol says: "If it starts to fly, everyone will want to be part of it." **–DANIEL CLERY**

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NEGEV DESERT, ISRAEL—What looks like an upside-down umbrella made of mirrors is the future of renewable energy—at least according to its creator, David Faiman, a physicist who directs the Ben-Gurion National Solar Energy Center here. Photovoltaic cells have been around for decades, but they've never been competitive with fossil fuels. Faiman claims to have found a way to slash the price. "This technology is a real contender as a solution to the world's energy problem," says physicist Robert McConnell of the National Renewable Energy Laboratory in Golden, Colorado.

The secret ingredient is perched at the focus of his 10-ton reflector: a square grid 10 centimeters across called a concentrator photovoltaic (CPV) cell. Instead of spreading solar panels across a broad area to capture photons, Faiman uses a reflector to concentrate the light 1000 times onto a small target. Traditional silicon-based solar cells can't handle the heat, but a gallium arsenide–based cell developed by a team at the Fraunhofer Institute for Solar Energy Systems in Freiburg, Germany, "actually works far more efficiently at higher temperatures," says Faiman. By using a concentrating reflector, the system makes best use of its most expensive component, the CPV cell, which Faiman estimates can reach 40% efficiency at converting sunlight to electricity. With this system, Faiman believes he can build a power plant for less than the magic number of $1000 per kilowatt of electrical capacity. "Getting the price that low is feasible, but only on a large scale," says McConnell, "and there's a long way to go from this stage."

Large is exactly the scale Faiman is thinking along: spreading 20,000 CPV cells over an area of 12 square kilometers to generate 1 gigawatt. With mass-produced CPV cells, Faiman estimates the cost at $1 billion. "Considering the savings, the system can pay for itself within 2 decades," he says. The team is hoping to make it happen sooner by increasing the efficiency of the CPV cell, for example by adding extra layers of solar cells that capture a broader range of the wavelengths.

–JOHN BOHANNON