



CASE STUDY

THE SUN CATCHERS OF THE BLACK FOREST

Rexingen | Germany

THE SOLAR PARK IN REXINGEN



The idea is both simple and clever: photovoltaic modules that follow the path of the sun will generate a higher energy yield than fixed modules. German entrepreneur Artur Deger took this idea and built **DEGERenergie**, a company that today is global market leader in the field of tracking systems for solar plants. On the former Freudenstadt district refuse site near Horb-Rexingen, Germany the **subsidiary company, DEGERtechnik, produces electricity for around 800 four-person households.**

DEGERtechnik has installed **66 systems** on the former landfill site on the edge of the Black Forest. **These systems produce about 300,000 kilowatt hours of electricity annually from the sun's energy, enough to supply power to 800 four-person households.** By using patented, sensor-controlled tracking systems from **DEGERenergie**, solar modules tap the sun's energy and produce around 40 percent more power than fixed installed plants. **Without this tracking technology, the yield of these installations would only meet the needs of 570 households, not 800.**

Reaching this stage was not easy. At the Rexingen landfill site there was a soft subsoil and uneven terrain to deal with. **"This is why we have predominantly installed smaller, single-axis systems of the TOPtraker 8.5 type and set them on above-ground foundations,"** explains Artur Deger, founder and managing director of **DEGERenergie**. The benefit of this system is that if the ground sinks or settles unevenly over the years, the foundations can be easily corrected.

There are **54 TOPtrakers** in Rexingen. Each is designed for a module area measuring up to 8.5 square meters and a solar output of up to 1,290 Wp. **DEGERtechnik has also installed twelve dual-axis DEGERtraker 7000NT systems** on the north slopes of the landfill. "Because of the northerly alignment, we needed larger plants with higher masts. We fixed these two meters into the soil with extensive concrete foundations." The DEGERtraker 7000NT is designed for module areas of up to 60 square meters, giving an output of up to 9,000 Wp.

PROJECT OVERVIEW

Location: former landfill site
Rexingen
Completion: September 2008
System: dual-axis and single-axis tracking systems
Construction power: 190 KWp
Number of Systems: 66
Products: 54 xTOPtraker 8.5 and 12 x DEGERtraker 7000NT

AUTOMATIC CONTROL INCREASES YIELDS AND SAVES MONEY

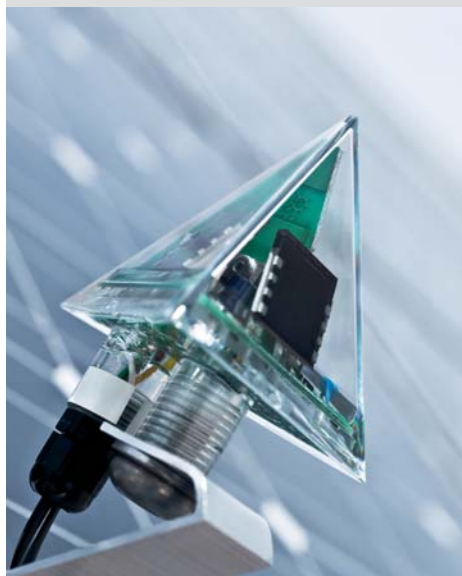
Dual-axis systems, such as the 7000NT, show the benefits of their patented, intelligence-control systems when used on subsoils that are still settling. According to Artur Deger, "When the ground changes in such a way that our plants are tilted, the control simply compensates for this. This means we can neutralize inclines of 20 or even 30 degrees without any kind of structural modifications. The control still aligns the module area with perfect precision."

THE PATENTED HEART – THE DEGERconector

All of this is possible thanks to the heart of the intelligent control- the DEGERconector sensor developed by Artur Deger, a small acrylic pyramid full of technology that was awarded the Inventor's Prize by the German state of Baden-Württemberg in 2001.

Each single-axis system, like the TOPtraker 8.5, is equipped with one DEGERconector, while the dual-axis systems, such as the DEGERtraker 7000NT, require two. The DEGERconector continually measures the intensity and angle of light rays and aligns the solar modules accordingly. The DEGERconector thereby takes into account not only exposure to direct sunlight, but also light as it would be reflected off of snow, water, or rock, or as diffused sunlight penetrates through clouds. This allows the connected solar modules to always receive the greatest possible amount of energy and to emit the energy as usable power.

For the operation of the control module, two sensor cells in the DEGERconector supply reference values that the integrated logic module evaluates in order that the module surface may correspondingly track the light radiation.



A SIMPLE PRINCIPLE – CONTRARY TO THE LIGHT

In order to achieve the greatest possible energy yield even with weak radiation, a differential amplifier produces the transition from the logarithmic characteristic line of strong radiation to the linear characteristic line of low currents, as they would occur in diffused light. In this dependency, the logic module assumes a much higher value in the linear characteristic line than in the logarithmic line. This leads to a significant increase in the readjustment precision as brightness decreases. The differential voltage is additionally charged, with the deactivation threshold set to up to 30 watts per square meter, therefore producing energy far into dusk.

Since the solar module surface is aligned to the west in the evening, a third sensor cell on the backside of the control module sets the system in the direction of sunrise in the morning. At dawn, the DEGERconector recognizes the brightest spot in the sky and resets the installation. The module for the power supply of the controller begins with a power output of 0.01 watt or less.

AN ADDED EXTRA – THE ENERGY CONVERTER

As soon as the DEGERconector attempts to control its electric motor, the voltage to the solar module begins to decrease. **DEGERenergie** has thus developed a power converter in order to prevent the control module from continuously activating and deactivating the drive system, achieving a quick resetting of the photovoltaic modules. It collects even the smallest amount of power from the solar module that would normally be lost in a supercapacitor and provides this power to the DEGERconector. The control module thereby adjusts the system to the brightest point in the sky even before the modules deliver enough power to be fed into the grid.

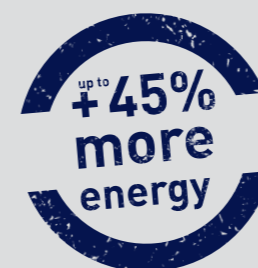
In order to prevent both drives in dual-axis systems from running simultaneously, the power converter is designed so that the east-west drive has priority over the elevation. Moreover, the converter ensures that no more than 1 to 3 watts are drawn from the solar module while in operation.

INDIVIDUAL ALIGNMENT INSTEAD OF DATA CABLES

The fact that **DEGERenergie** equips every tracking system with its own control has several advantages. First, every system is completely self-sufficient and aligns itself to its own optimum light exposure without the interference of a centralized control. This makes it unnecessary to network the park with data cables, reducing investment costs and accelerating construction time. Additionally, only one system is affected if there is any kind of control failure; the remaining park systems continue to operate normally.

The third effect appears during running operation and has demonstrable effects on the cost-effectiveness of the systems: the DEGERconnectors direct every system in the park into an optimal position, even under differing and/or rapidly changing weather conditions. Each system thus achieves the greatest possible energy yield. Quick reaction times ensure that even gaps in the clouds can be efficiently utilized.

Naturally, **DEGERenergie** systems only execute movements that directly lead to an increase in energy yield. Thus, on a day-to-day basis, the tracking systems are extremely energy-efficient to operate. A DEGERtraker 7000NT system, as operated in Rexingen, consumes 1 watt in control mode and 9 watts when the drive is running. Internal consumption per system is about 9 kWh per year. From this, the extra yield achieved by the tracking systems is around 5,000 kilowatt hours per system per year. This means that internal consumption is around 0.2 percent of the extra yield. Similar rates of return apply for small systems, such as the TOPtraker 8.5 with internal consumption verging on negligible at 0.3 kilowatts per year.



POSITIVE ENERGY BALANCE, QUICK AMORTIZATION



The result of such efficient handling of energy is noticeable in the environment/ energy balance in the earnings of solar park operators and their amortization calculations. This begins with the energy amortization, as Artur Deger calculates. "With our tracking systems, after about three years a solar park as in central Spain has already generated as much energy from the sun as was needed for the production of the entire installation – the entire infrastructure including concrete buildings, steel constructions, and wiring."

And it continues by recouping investments: **DEGERtechnik** spent more than one million euro on the new solar park in Rexingen. "This investment will have amortized in eleven to twelve years," says Artur Deger. "Without tracking, we would have had to wait at least 16 years before recouping our costs." Once the point of amortization has been passed, the 35 to 40 percent higher rate of return brought by tracking will continue to yield higher profit margins.

So, it is no wonder that more and more investors and potential operators, impressed by Rexingen, are planning similar parks. "Operators of decommissioned landfills are generally very broad-minded regarding the use of land for a solar park," says CEO, Artur Deger. "Ultimately they are making profitable use of an otherwise virtually useless bit of land, and they can even charge park operators for leasing it."

Udo Grosswendt, technical manager of the waste management company in Freudenstadt, and owner of the landfill site in Rexingen, agrees. "Installing solar modules on the decommissioned landfill site is one of the few ways of using the site after completion of landfill operations. The greatest challenge was in designing the foundations so that the sensitive bitumen seal on the landfill would not be damaged. The district now profits from annual remuneration from use of the site and for the savings in landscaping maintenance around the modules."



Opening in Rexingen in September 2008 (from left):
Peter Dombrowsky, district administrator for Freudenstadt;
Artur Deger, managing director; Anita Deger;
Michael Theurer, member of the Landtag for Baden Württemberg

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