

# Solar Water Pumping for Center Pivot Irrigation North Africa



<b>Location</b>	North Africa		
<b>Application</b>	Irrigation	<b>Project Partner</b>	AE Photonics Maroc
<b>Size</b>	60 ha, daily requirements 3,300 m <sup>3</sup>	<b>Installation</b>	2013

**PROBLEM:** In the desert of Sudan, a large pivot system with a radius of 479 meters is used to irrigate 60 hectares of desert. The fuel costs of operating this system are very high and increasing.

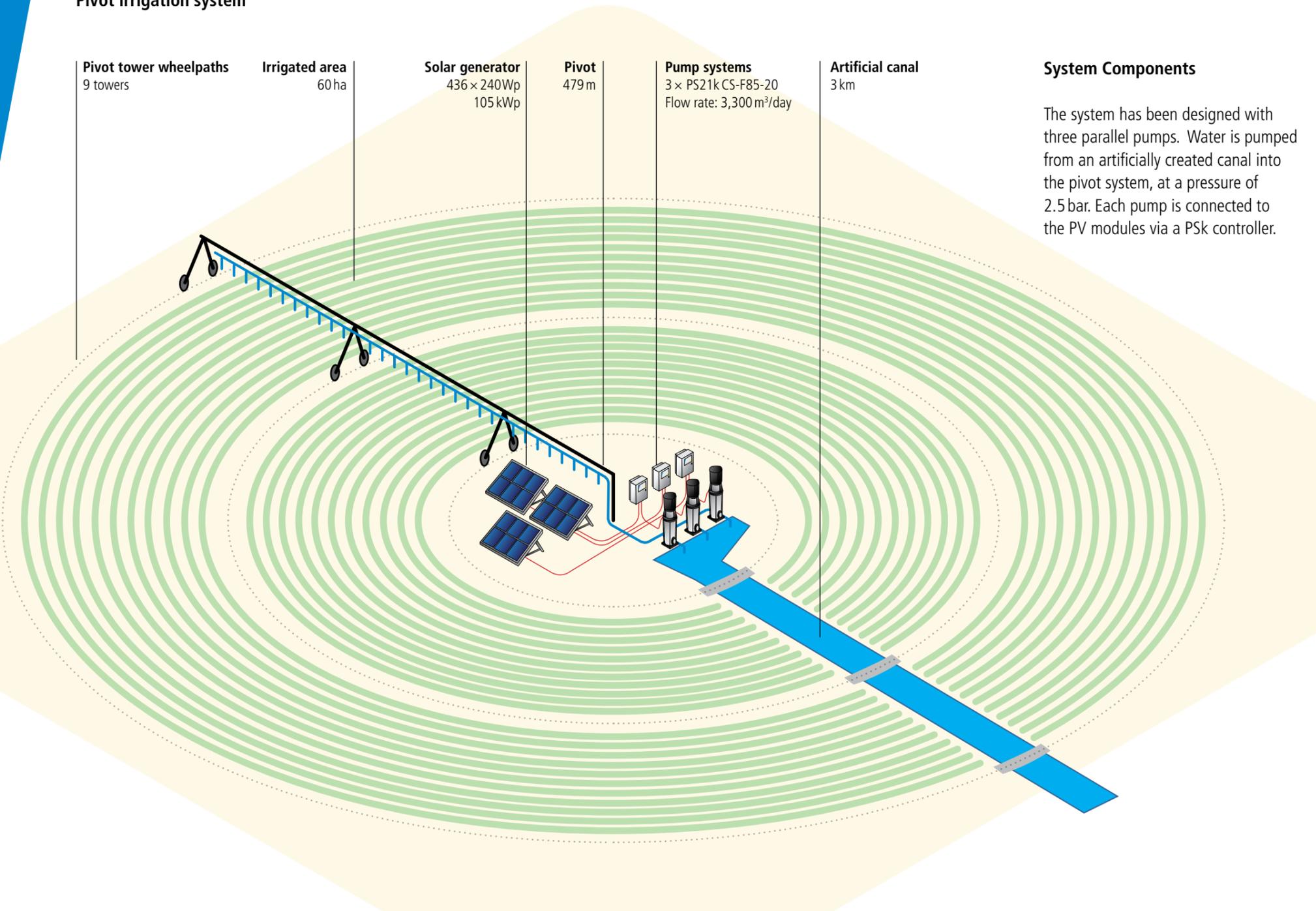
The irrigation system is needed to use otherwise dead land for agricultural purpose. Water is being supplied through an artificial canal from the Nile. At this point, Alfalfa is grown as feeding hay and harvested eleven times each year with the harvest season exceeding 300 days. Until 2013, a 55 kW diesel generator ran 24 hours per day to power the system.

In 2013, the Sudanese government scaled back fuel subsidies resulting in significantly higher prices for petrol, diesel and liquefied petroleum gas. Diesel increased by more than 75 % from USD 0.48 to USD 0.84 a liter. Increasing fuel prices and supply difficulties meant an alternative power source had to be found in this off-grid area.

**SOLUTION:** Following efficiency and feasibility analysis, AE Photonics Maroc designed and installed a solar powered system using LORENTZ pumps to replace the diesel powered generator and AC pumps. Pivot speed and fer-

tilizer pumps are automatically controlled proportional to water flow. In eleven hours the pivot completes one 360 degree turn, providing the required 3,300 m<sup>3</sup> of water per day. At startup, the PV array located at the center of the system is cleaned and cooled by the pivot itself. Also, all motors required to move the pivot now are solar powered. This not only means no longer relying on fuel but being independent from future reductions in subsidies, but also greatly reduced carbon emissions.

<b>Pivot tower wheelpaths</b> 9 towers	<b>Irrigated area</b> 60 ha	<b>Solar generator</b> 436 × 240Wp 105 kWp	<b>Pivot</b> 479 m	<b>Pump systems</b> 3 × PS21k CS-F85-20 Flow rate: 3,300 m <sup>3</sup> /day	<b>Artificial canal</b> 3 km
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**System Components**

The system has been designed with three parallel pumps. Water is pumped from an artificially created canal into the pivot system, at a pressure of 2.5 bar. Each pump is connected to the PV modules via a PSk controller.

**Benefits**

- Placing the solar array at the center of the pivot takes care of cleaning the PV modules, resulting in even higher efficiency of the system and less operating costs for maintenance.
- Solar water pumping systems require no fuel. This removes the energy bill plus the time and cost of filling fuel tanks and having costly fuel deliveries to remote areas. Also, cuts of subsidies are no longer an issue.
- Solar pump systems have few moving parts which makes maintenance unnecessary and gives them a long life. These elements give this solution a good return on investment and a best quality/price ratio in comparison to conventional pumping systems, especially for systems in remote areas.
- Solar energy is a clean and inexhaustible energy source. Solar provides a long term reliable supply of energy without producing any emissions. Use of solar energy preserves the environment and has no impact on human health.
- Adjusting the pivot's speed and, if used, the fertilizer pumps' performance to the flow of water allows precise irrigation and fertilization of the irrigation area, all on solar power only.

**Client**

"Our client is very happy with the all solar solution," says Ali Sedki of AE Photonics Maroc. "Initially they did not think a project of this magnitude was possible solely on solar power. Now, not only the huge required amount of water is provided by solar pumps, but even the pivot itself runs exclusively on solar power."

With the solar pivot pilot project being a great success, AE Photonics Maroc expects to equip several similar installations with LORENTZ solar water pumps in the near future.



**Pivot Wheel Towers**

Nine wheel towers carry the pivot's weight and move it. To cross the water supply canal, simple bridges were built.



**PV Array at Pivot Center**

The solar array is placed at the pivot's center. This allows the pivot to clean the solar panels once per turn.



**3 PS21k Solar Pump Systems**

Three PS21k pumps are positioned in parallel at the pivot's center to provide the necessary amount of water.



**Artificial Canal with Bridges**

Simple concrete bars serve as bridges for the pivot's wheel towers to cross the artificial canal.



**Ali Sedki, AE Photonics**

## Calculation of the Energy Cost and Financial Analysis

Table 1 compares the cost of operation of diesel and solar powered irrigation systems. The solar solution is significantly cheaper over a five year period, with 30 % costs savings per m<sup>3</sup> of water. Even without taking into account the resale value for the diesel generator, the return of investment for the solar solution is only 3 years.

The solar solution also provides certainty for future planning, as subsidies on fossil fuels may be scaled back even further, whereas solar power is unlimited and free. The solar solution provides the cheapest and most fixed known cost over five years of ownership.

**Return on Investment: 3 years.**

**Table 1: Comparison of Energy Costs**

For: daily water requirements: 3,300 m<sup>3</sup>, daily energy requirements: 560 kWh

Energy source	Diesel	PV
Efficiency	30 %	100 %
Energy required	560 kWh	560 kWh
Fuel energy content	9.29 kWh/l	-
Fuel consumed	201 l	-
Cost per unit	0.84 USD/l	0 USD
Fuel cost per day	169 USD	0 USD
Fuel cost per month	5,134 USD	0 USD
Fuel cost per year	61,606 USD	0 USD
<b>5 year cost</b>		
Fuel cost	308,030 USD	0 USD
Cost of fuel deliveries/refilling	30,000 USD	0 USD
Engine servicing/replacement parts	31,250 USD	0 USD
Typical Initial cost <sup>1</sup>	25,000 USD	250,000 USD
<b>Total costs</b>	<b>399,280 USD</b>	<b>250,000 USD</b>
<b>Costs per m<sup>3</sup></b>	<b>0.06 USD</b>	<b>0.04 USD</b>

<sup>1</sup> Typical initial system costs are given as the actual numbers are classified as commercially sensitive information.



**AE Photonics Maroc focuses on further developing the use of renewable energy and sustained environmental protection in Africa, especially in Morocco.**

Solar water pumps as isolated applications in particular are core of AE Photonics Maroc's technical know-how and business. Newly founded in 2010, it can already show intensive experience and first class references in large scale solar water pumping installations.

The services offered range from technical and financial analysis, specification and design to project management, fulfillment and customer support.

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## LORENTZ

**LORENTZ is a market leader in solar powered water pumping solutions.**

Founded in Germany in 1993 LORENTZ has pioneered, innovated and excelled in the engineering and manufacturing of solar powered water pumping.

Today LORENTZ is active in over 120 countries through a dedicated network of professional partners. LORENTZ technology uses the power of the sun to pump water, sustaining and enhancing the life of millions of people, their livestock and crops.

### LORENTZ

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