SOLAR WATER PUMPING

WHAT IS SOLAR WATER PUMPING?

A solar water pump (SWP) is an electric water pump that runs on the electricity provided by photovoltaic (PV) panels. Solar pumps supply water to locations beyond the reach of grid electricity. In communities where electricity is scarce, there is the highest demand for sustainable water supply, especially in rural areas. This not only has less operational and maintenance costs, but also has fewer environmental concerns.

Figure 1: Solar Water Pump in Uganda [1]

A CLOSER LOOK AT SWP

System components:

Solar PV Panels:

Integral part of the PV panels is the solar cells that convert solar energy into electricity through photoelectric effect.

Pumps and motors

Pumps help to lift the water from the source to usage point. Pumps are run on electric motors which convert electricity produced by Solar PV modules into mechanical energy. Direct Current (DC) motors are appealing for small - medium scale SWP applications up to 5 kW. They also have higher overall efficiency than Alternating Current (AC) motors. AC motors are used in large SWP system, which also require an AC/DC inverter.

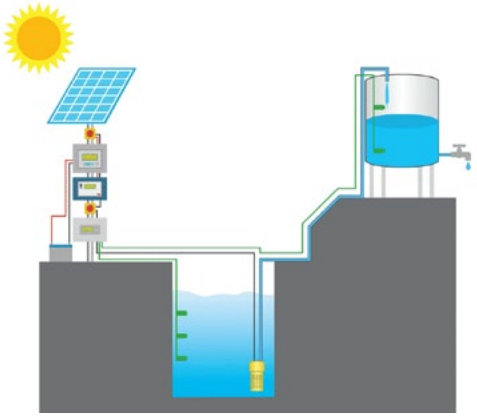

Figure 2: Solar Water Pump Components [2]

Controller

Controllers help to keep SWP safe and at low risk by switching off whenever the voltage is too less or too high than the optimal voltage of the system. This helps to increase the lifetime of SWP by lowering the maintenance costs.

KEY FACTS

SWP is more competitive in the regions with high solar radiation and abundance of water. In regions like **SOUTH AMERICA, SOUTHEAST ASIA, AFRICA AND SOUTH ASIA**, SWP has the best water outputs.

141% – 195% INCREASE IN YIELD OF MAIZE from utilizing solar water pumping from small-scale irrigation in Sub-Saharan Africa [8].

SWP has been utilized in the United States **for over 20 years** [9].

150,000 Solar Water Pumps are installed today in India [8].

As PV modules become more affordable and the energy efficiency of both the modules and pumping system increases, **SWP will become a leading technology in remote areas.**

TYPES OF SOLAR WATER PUMPS

Pump types are generally selected depending on the water source.

Surface pumps are a cheaper option compared to submersible pumps but are well suited to draw water from 6.5 m depth. In the case of a well, the pump needs to be placed underwater. Surface pumps are placed at the side of a lake or, in the case of a floating pump, on top of the water. Surface pumps are excellent for pushing water over long distances.

Submersible solar pumps are typically used for deep well pumping, pressurization, irrigation, home water systems, pond aeration and livestock watering. They operate directly off solar panels, batteries or a combination of the two - and in some cases, an AC power source.

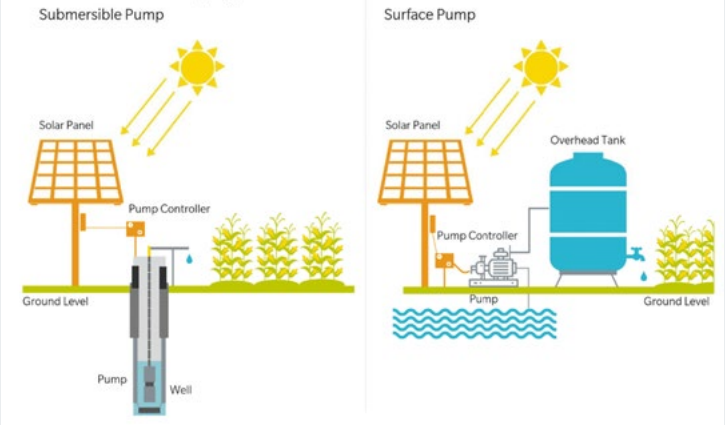

Figure 3: Representation of a Submersible Pump and Surface Pump [4]

FINANCIAL FACTS

The initial investment of SWP for irritagion is high. A typical SWP system ex-work cost is about 1.75 $/Wp and the total installed costs is about 3.2 $/Wp. In remote places, prices go higher because of the extra transportation and labor costs. For large scale SWP schemes they cost about 2.2 $/Wp [5].

There are economic benefits of SWP compared to diesel pumps.

	Diesel	Solar
Life cycle cost (LCC) ($)	93000	59000
LCC (water)	40 ¢/m^3	25 ¢/m3
Internal Rate of Return	0-1700	34%
Payback	0-1700	3.6Y

Table 1: Economic Comparison of Diesel and Solar Water Pumps [5]

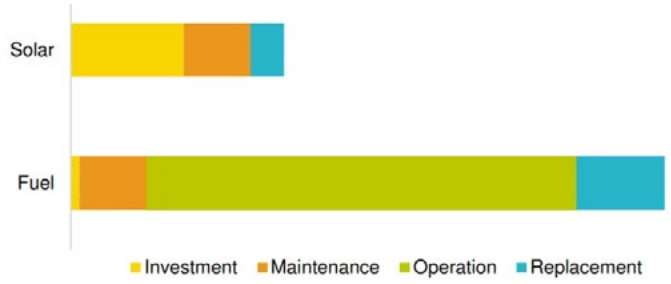

Figure 4: 20-year Life Cycle Cost Comparison between Solar-Powered Water Pumps and traditional fuel-driven pumps [4]

A study by the Bureau of Land Management at Battle Mountain, Nevada, USA, shows that certain PV systems cost only 64% over twenty years compared to a comparable diesel generator system over 10 years [7]. Additionally, the PV system required only 14% of the labor hours that the diesel generator system required. Solar water pumping systems are more cost-effective than diesel pumping systems for equivalent hydraulic energy below 5,750 m^3/day and 21.6 MJ/m^2 day average insolation.

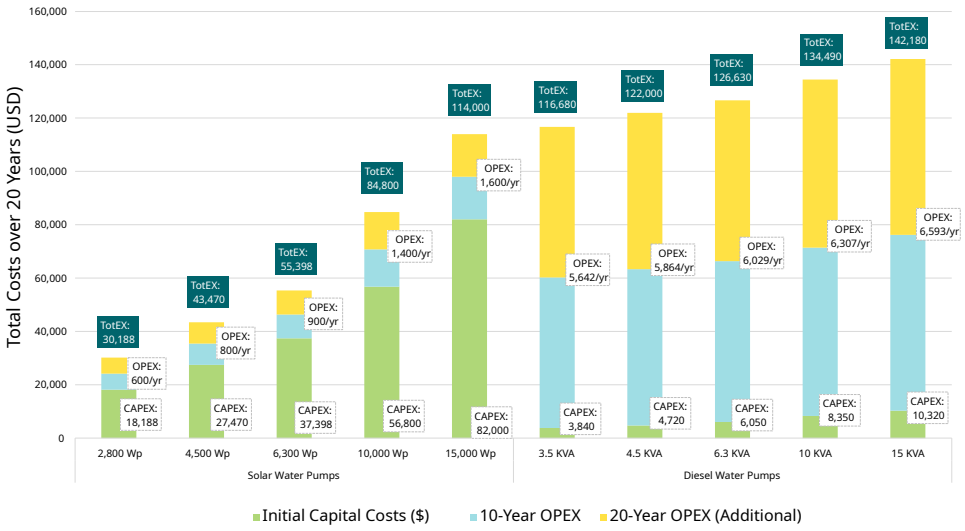

Table 2: Comparison of Cost Estimates Between Solar and Diesel Pump Systems [6]

SUSTAINABILITY OF SWP

Photovoltaic modules usually last 20 to 25 years depending on various factors like their maintenance, protecting them from strong winds, lightning and hail storms. SWP usually lasts about 10 years. The other electronics and controls in the system are designed to last at least 10 years with little electrical maintenance. Hence, the overall lifetime of the complete SWP system is designed to last 25 years considering future demands. SWP systems must be inspected at least once per week checking the pumping rate, operation of the controller, condition of PV modules, tanks, wires, and pipes (for leaks/ corrosion).

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Supported by:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

based on a decision of the German Bundestag