

FLEXIBLE AND
SUSTAINABLE
**WATER SUPPLY
USING CLEAN
ENERGY**



CLEAN ENERGY INCREASINGLY THE PREFERRED CHOICE FOR WATER SUPPLY

In recent years, the cost of generating clean energy from renewable sources has decreased sharply. At the same time, governments around the world are insisting that a greater proportion of energy is generated from renewable sources. The drive to increase motor efficiency and reduce CO₂ emissions has led to increasing regulation as to how energy is generated. This is a trend that is set to continue.

Solar submersible pumping systems from Grundfos present a cost effective, flexible and secure water supply solution using clean energy. Utilising solar power saves on energy costs and on the costs of energy infrastructure, wherever the application is installed.

Solar submersible pumps offer tangible benefits

- › **Easy installation**
Solar submersible pumping systems can be tailored to your application and local conditions. Supplied as a plug-and-go solution, the solar submersible pumping systems are remarkably easy to install and use under even the most difficult conditions.
- › **Extend pump lifetime**
The built-in protection features for the pump motor ensure a low maintenance solar submersible pumping solution.
- › **Cost-efficient pumping**
Designed for continuous as well as intermittent operation, solar submersible pumping systems are especially suitable where cost is all-important. Once the initial investment in the system is made, operating costs are low.

Solar submersible pumping systems are ideal for irrigation, livestock and fish farming, and for water supply.

GRUNDFOS RENEWABLES A SOLID INVESTMENT

Grundfos pumping systems using renewable energy sources provide the perfect sustainable, reliable and cost-efficient alternative to grid-based systems, with substantial benefits for your investment.

Bringing down lifecycle costs

The lifecycle costs of a Grundfos submersible solar pumping solution will be considerably lower than with other water supply systems, because you can save substantial sums on reduced maintenance costs and no energy costs.

Typically, the lifecycle costs for a grid-based pump system would include the following elements:

- › Initial purchase price of the pump and all system components
- › Operating costs, of which energy is usually the largest single cost item
- › Service agreement ensuring correct system sizing, high pump efficiency and performance, technical advice, service and reliable logistics.

For a Grundfos renewable energy-based system, the initial purchase price is the greatest investment. Once the pumping system is installed, you no longer get energy bills, meaning a rapid pay-back time on the initial investment.

The benefits of a relationship with Grundfos mean that that the pumping system is sized, configured or packaged to fit your application right from the start, reducing costs for installation, commissioning and service.

You cannot afford not to invest

Renewable energy-based pumping systems are a good investment. Governments increasingly encourage investors to choose renewable energy in new installations, and there is a growing awareness of the low risk of such investments. This is because the installation is not dependent on energy prices staying low to ensure a payback on the investment.

THE SOLAR SUBMERSIBLE RANGE OF PUMPING SYSTEMS

The family of solar submersible pumping systems ranges from 0.05 kW to 9.2 kW, more than meeting the requirements of many irrigation, livestock and fish farming, and water supply applications.

SQflex

0.05 kW to 3 kW system, using one SQFlex pump, or two SQFlex pumps with a manifold

SP with RSI

3 kW to 9.2 kW system, combining a standard SP pump with a Renewable Solar Inverter (RSI). The RSI system is configured especially to run with Grundfos SP pumps

Highly versatile with many applications

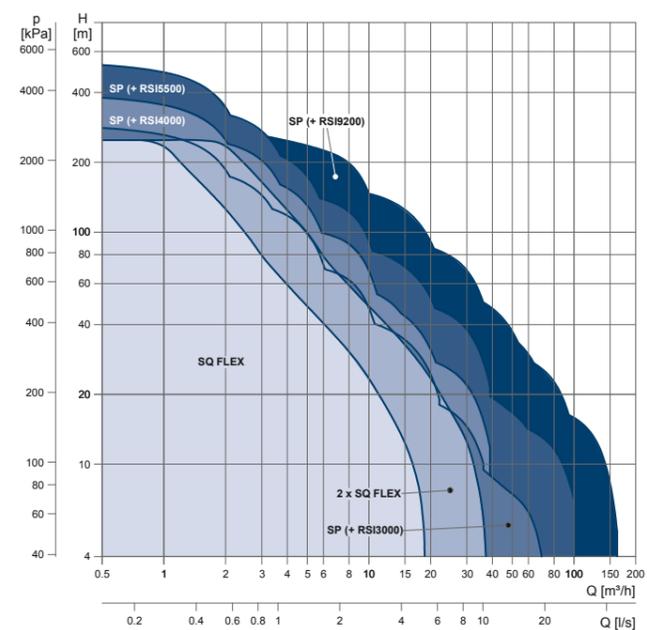
Designed for continuous as well as intermittent operation, solar submersible pumping systems are especially suitable for water supply applications such as:

- > Villages, schools, hospitals, and single-family houses
- > Farms and ranches, including watering of livestock and irrigation of crops and greenhouses
- > Watering applications in game parks and game farms

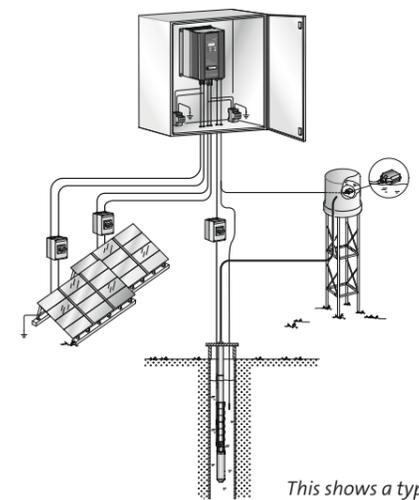
For applications requiring an output greater than 3 kW, the RSI system can be used in any existing SP pump application, providing a very wide range of applications. The only difference is that you use solar panels as the power supply.



The components of the 3 kW to 9.2 kW solar submersible solution: SP pumps, a Renewable Solar Inverter (RSI), the GF100C solar panel and the circuit breaker and surge control that make up the combined junction box.



The performance curves are respectively for the SQFlex pump, two SQFlex pumps with manifold and an SP pump with RSI inverter. Up to 3 kW output, two SQFlex pumps with manifold would in most cases be more efficient than using an SP pump with RSI.



This shows a typical installation using an SP pump with RSI, water tank for storage and level switch to control start/stop. The system is equipped with circuit breaker and surge protection.

HIGH EFFICIENCY FROM SQFLEX SOLAR SUBMERSIBLE PUMPS

The complete SQFlex pump range consists of 11 different pump sizes: 5 helical rotor pumps for medium to high heads and low to medium flows, and 6 centrifugal pumps for shallow heads and high flows. It is available in two different stainless steel material variants: type AISI 304 as standard and type AISI 316 for slightly aggressive water. The pump is fitted with a high efficiency motor for DC or AC voltage. This makes pump sizing and selection extremely easy.

SQFlex pumps can run from the GF100C mono crystalline silicon solar panel. The SQFlex system is available with a user-friendly CU200 control unit that maintains two-way communication with the pump and monitors the operating conditions. Built-in diagnostics indicate faults and dry-running, display operating status power consumption and level switch input. A level switch in the water storage tank means the pump only runs when necessary.

How the SQFlex pump benefits your application

SQFlex pumps have built-in protection features that protect the pump itself and in many cases the well. Among these features are:

> One motor size

The motor size available for the SQFlex system is 3600 rpm with built-in unique features. Helical pumps and centrifugal pumps have a segmented stator and permanent magnet rotor for high efficiency and starting torque.

> Runs at any voltage

A wide voltage range enables the motor to operate at any voltage from 30 to 300 VDC or from 90 to 240 VAC, which makes pump sizing and selection extremely easy.

> Built-in motor protection

The motor is protected against overloading and overheating, and load condition and voltage is monitored continuously.

> System monitoring

Continuous load condition and voltage monitoring. It is possible to connect the solar submersible pump solution to Grundfos Remote Management (GRM) for system monitoring at a distance.

> Dry running protection

The pump is shut down if it detects water shortage and restarts automatically when water returns to the well or when the motor temperature returns to the safety range. This protects the well from being over-pumped and the motor from burning out.

> Maximum system efficiency

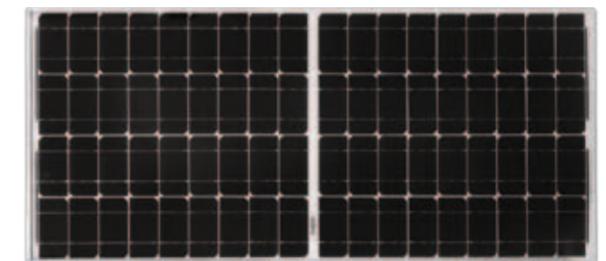
The motor will continuously optimise the speed according to the input power available. This is called Maximum Power Point Tracking (MPPT) and operates only when the pump is connected to DC supply.



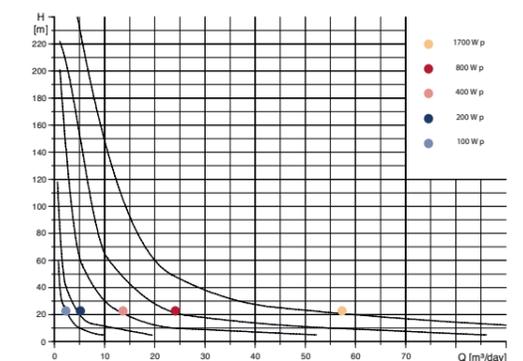
Sizing and selection of your SQFlex or SP submersible pump
You can draw on a wide range of expert knowledge, documentation, installation and service information using the Grundfos WinCAPS sizing program available on CD.

HIGHLY EFFICIENT SOLAR PANEL

The GF100C mono crystalline silicon solar panel is made exclusively for Grundfos, for operation with our pumps. This means that the efficiency of the solar panel is high and, at the same power output, Grundfos pumps work better at high voltage and low current.



| | |
|---------------------------------------------------------------|--------------------------------------------|
| Peak Power (P_{max}) | 100 W |
| Voltage (V_{mp}) | 37.6 V |
| Current (I_{mp}) | 2.65 A |
| Open Circuit Voltage (V_{oc}) | 45.3 V |
| Short Circuit Current (I_{sc}) | 2.80 A |
| Reference Cell Temperature (T_{ref}) | 77 °F / 25 °C |
| Solar Irradiation at Reference cell Temperature (I_{ref}) | 1000 W/m ² |
| Net Weight | 17.0 lbs / 7.7 kg |
| Shipping Volume | 2.12 ft ³ / 0.06 m ³ |



Performance curves for the entire SQFlex range, based on different levels of solar radiation.



How much water can solar power pump?
 See how much water 75 of the GF100C solar panels together with a SP17-5 pump and RSI5500 can pump in different locations around the world. Total annual water production (m³) and average water production per watt per day (L/Wp/day) are listed for each city.

Canada Montreal
 28,000 m³ of water
 10.21 L/Wp/day

USA Houston
 37,000 m³ of water
 13.5 L/Wp/day

Honduras Tegucigalpa
 28,700 m³ of water
 14.98 L/Wp/day

Argentina Buenos Aires
 37,100 m³ of water
 13.57 L/Wp/day

Brazil Rio de Janeiro
 29,200 m³ of water
 10.65 L/Wp/day

Spain Seville
 44,200 m³ of water
 16.14 L/Wp/day

Turkey Istanbul
 34,900 m³ of water
 12.75 L/Wp/day

Algeria Adrar
 56,600 m³ of water
 20.68 L/Wp/day

Nigeria Abuja
 44,300 m³ of water
 16.17 L/Wp/day

Ethiopia Addis Ababa
 42,200 m³ of water
 15.41 L/Wp/day

Namibia Windhoek
 57,000 m³ of water
 20.83 L/Wp/day

Kazakhstan Astana
 32,600 m³ of water
 11.91 L/Wp/day

Pakistan Karachi
 49,500 m³ of water
 18.09 L/Wp/day

Tanzania Dodoma
 47,800 m³ of water
 17.45 L/Wp/day

India Madras
 44,900 m³ of water
 16.4 L/Wp/day

Vietnam Ho Chi Ming City
 40,100 m³ of water
 14.66 L/Wp/day

Thailand Chiang Mai
 28,300 m³ of water
 10.34 L/Wp/day

Singapore Singapore
 31,700 m³ of water
 11.57 L/Wp/day

Philippines Claveria
 39,900 m³ of water
 14.58 L/Wp/day

SP PUMPS FOR SOLAR SUBMERSIBLE SYSTEMS

Grundfos SP submersible pumps are renowned for their high efficiency and reliability throughout the range. Made entirely of corrosion-resistant stainless steel, SP pumps are ideal for a wide variety of applications.

When combined with the RSI solar inverter system, the SP pump becomes the perfect solution for applications requiring from 3 kW to 9.2 kW output for applications where renewable energy water pumping is preferred.

Grundfos SP pumps represent state-of-the-art hydraulic design. Built to deliver optimum efficiency during periods of high demand, the SP pumps provide low long-term costs and high operating reliability regardless of the application.

The Grundfos SP range offers high efficiency, high resistance to sand and other abrasives, motor burnout protection, and easy maintenance. A complete monitoring system is available for constant optimisation of the pumping system.

Why build a larger solar submersible system?

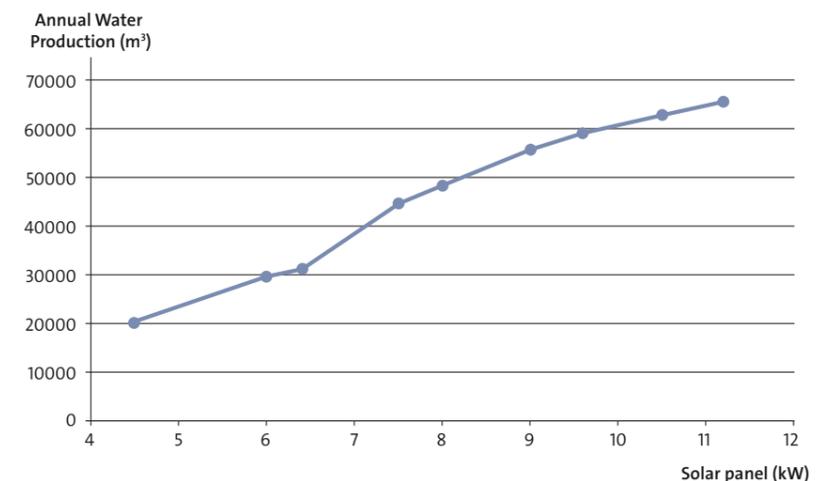
The cost of solar panels has been decreasing over many years, as manufacturing capacity increases. This has opened up the market for a larger power size off-grid system, as the initial investment in a large system become more acceptable and the return-on-investment looks more attractive than ever before.

Apart from the savings from the solar panels and reduced energy bills, many countries around the world actively advocate the use of renewable energy, and show this by, for example, subsidising irrigation projects to install renewable energy systems. Renewable energy water pumping is therefore no longer limited to well water pumping in remote locations.

Case study, India.

Country: India
 City: Madras
 Month: July
 Head: 50 m

| Solar panel (kW) | Annual Water Production (m³) |
|------------------|------------------------------|
| 4.5 | 20,100 |
| 6 | 29,900 |
| 6.4 | 31,300 |



THE RENEWABLE SOLAR INVERTER (RSI) SYSTEM

Grundfos has sourced the RSI off-grid solar inverter to enable us to expand the family of solar submersible pumping systems. The RSI is designed specifically to be compatible with a wide range of the famously reliable SP submersible pumps.

This has created a modular system that allows maximum components flexibility with the easiest maintenance. The SP pump can be customised to fit closely the particular application, and a range of material variants ensure top reliability, even in corrosive environments. Grundfos offers global service on all SP pumps.

Benefit from a solar submersible SP solution

Adding the RSI to your SP application offers tangible benefits, protecting the water source and ensuring water supply, even with intermittent operation.

- > Convert power from DC to 3 phase 380 VAC
- > MPPT software – the inverter will continuously optimize the output frequency based on the available input power to constantly deliver maximum system efficiency
- > Automatic recovery from operation signal stop
- > Adjustable operation parameters
- > Display historical operation data

- > Built-in system protection for:
 - Over- or under-voltage protection
 - Over current and overload protection
 - Over-temperature (of Inverter) protection
- > Fault detection with error code display
- > Multiple sensor input

Use on any existing SP installation

The RSI can be used in any existing SP pump application, so there is a very wide range of applications. The only difference is that you use solar panels as the power supply.



The Renewable Solar Inverter (RSI) is an off-grid solar inverter with MPPT and fault protection which is easy to operate and can be paired with an SP pump for a larger performance range, greater versatility and for many different applications.

| | Grundfos Product Name | RSI 3000 | RSI 4000 | RSI 5500 | RSI 9200 |
|--------------|-------------------------------|--------------|--------------|--------------|--------------|
| Installation | Ambient Temperature | -10 to 50 °C |
| | Relative Humidity | 0 to 95 % |
| Electrical | P1, Motor (max.) kW | 3 | 4 | 5.5 | 9.2 |
| | Recommended MPP Voltage | 530 to 600 | 530 to 600 | 530 to 600 | 530 to 600 |
| | Input DC Voltage, max | 750 | 750 | 750 | 750 |
| | Input DC Current per set, max | 15 | 15 | 15 | 15 |
| | Frequency, Hz | 30 to 53 | 30 to 53 | 30 to 53 | 30 to 53 |
| | Rated Output Voltage, AC | 3 x 380 V |
| | Rated Output Current, AC | 9 | 13 | 18 | 24 |
| Others | Enclosure class | IP41 | IP41 | IP41 | IP41 |
| | Net Weight, kg | 7.2 | 7.3 | 7.7 | 8.2 |
| Packing | Gross Weight, kg | 9.5 | 9.6 | 10 | 10.5 |
| | Length, mm | 355 | 425 | 425 | 425 |
| | Width, mm | 280 | 325 | 325 | 325 |
| | Height, mm | 225 | 285 | 285 | 285 |

