SUNLIGHT PUMP

TURNS SUNRAYS INTO SAVINGS

A high performance, small-scale solar pump

How does a solar pump work?

In a solar pump system, the sun – an inexhaustible and free source of energy – plays a major role. The solar energy is harnessed through a solar PV panel which converts the sun's rays into electricity. Whenever the sun shines, the current turns the motor and the pump operates. If there is a requirement to run the pump for longer hours (for example at night) then a battery system can be included.

1 The *solar panel* which provides the power

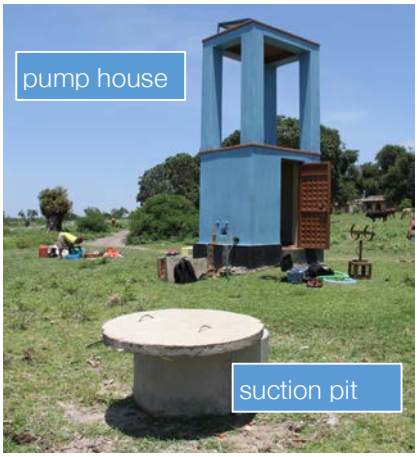
2 *Electronics* which controls the system (in the case of the sunlight pump integrated into the pump unit)

3 A *pump head* which is coupled to

4 a *motor*

What are the main parts of the sunlight pump?

Important: *A well prepared water source is essential to a functioning solar pumping system!*
When pumping from a stream, pond or lake, ennos recommends to build a *suction pit.* This allows to filter the water and to have a clean, undisturbed water source.
Also: The suction hose with the non-return valve *must not touch the ground* – otherwise sludge and sand will be sucked in which will clock and damage the pump.



Electronics

- The sunlight pump operates from multiple panel configurations from 100 to 400 Watt depending on the local requirements (see below)
- User interface for monitoring and on the spot problem solving
- Bluetooth interface to connect your smartphone to the pump via Android app
- Integrated water flow and tank overflow sensors for an automated and simple operation of the pump system. No running dry of the pump. No over-flowing of the tank and water wastage.

Motor

- High efficiency brushless DC Motor (high efficiency = less solar panel required = less cost)
- Maintenance-free operation over wide flow and pressure range

Pump head

- Progressive cavity pump: In this type of pump, the helical rotor rotates inside a rubber tube called the stator. There is a small cavity between these two parts which moves from one end of the pump to the other. With each rotation, a certain amount of water is forced through the pump
- Very robust
- Low maintenance
- Can create up to 4 bar of pressure = 40 meters of water lift

What is the capacity of the sunlight pump?

Water flow liters per **MINUTE**

Head in meters	Solar power in Watt			
	100W	200W	300W	400W
5m	28	43	45	45
10m	23	37	45	45
15m	17	32	45	45
20m	13	27	38	45
40m	3	13	22	31

Water flow liters per **DAY** at 6 full load hours

Head in meters	Solar power in Watt			
	100W	200W	300W	400W
5m	10'080	15'480	16'200	16'200
10m	8'280	13'320	16'200	16'200
15m	6'120	5'760	16'200	16'200
20m	4'680	9'720	13'680	16'200
40m	2'160	4'680	7'920	11'160

- The water flow is a function of the total water head (in meters) and the solar power (in Watt)
- The maximum water flow is 45 liters/minute
- The solar panel must not be under-sized because then the required amount of water cannot be supplied
- The solar panel must not be over-sized because this causes unnecessary costs to the user
- The sunlight pump can create up to 4 bar pressure (= 40 meters lift)

What are the limitations of the sunlight pump?

The **maximum water flow** per minute is limited to 45 liters = around 16'200 liters on a sunny day. Depending on the local water requirements (which again depends on the crop type, soil conditions, type of irrigation, weather etc.), this is sufficient to irrigate up to 10'000m^2.

The **maximum suction depth** (= vertical distance between the water table and the pump) is limited to 7 meters at sea level. For every 1'000 meters higher in altitude, the suction capacity will decrease by one meter. This applies to all surface pumps, not only the sunlight pump. Consequently, there are two possibilities:

Installation on the surface if the suction depth is less than 7 meters

Lower the pump down into the well to get it closer to the water table if the suction depth is more than 7 meters

- The sunlight pump is not suitable for regions where the water table is considerably lower than 7 meters

What are the advantages of the sunlight pump?

- *Over other solar pump systems?*
  - Most solar pumps on the market are designed for large-scale industrial farms, not smallholders
  - The solar pumps that are of high quality are very expensive
  - The solar pumps that are affordable are of low quality
  - Compact design makes the sunlight pump portable
  - Interface and water sensors make the sunlight pump an automated, user-friendly system
- *Over diesel pumps?*
  - No running costs for diesel
  - Low maintenance cost (minor revision every 2-3 years for the sunlight pump)
  - Longer lifetime (around 3 years for diesel pumps vs. 10 years for the sunlight pump)
- *Over electric pumps?*
  - The quality and quantity of electricity supplied from the grid is often insufficient. The sunlight pump ensures a reliable water supply
  - No running costs for electricity
- *Over hand pumps?*
  - Manual irrigation is a huge physical and time-consuming burden. Especially women and girls spend many hours a day pumping water.
  - The sunlight pump lifts 12 tons of water, 40 meters high over the course of a day without any effort

What are the main applications for the sunlight pump?

IRRIGATION

→ There are **several hundred million** smallholder farmers around the world who cultivate a few acres of land (<10'000m^2)

→ Most smallholder farmers in developing countries still rely on traditional, low-productive irrigation practices and on rainfall – and therefore face a **high risk of crop failure**.

→ They have **no access to innovative technologies**, nor to services – and this is what we need to change!

We have a technology that serves their needs: the sunlight pump

What surface can the sunlight pump irrigate?

The water requirements of a specific crop depend on a multitude of factors: plant type, growth stage, soil conditions, weather (rain, wind) etc.

One cannot accurately "calculate" water requirements – in order to have an optimized irrigation, the soil moisture needs to be ***measured on the spot*** (simple and cheap tensiometers are available)

One case as an illustration: Two tomato farmers, Northern Honduras, mid growth season, month of August: water requirement of 6.6 liters of water per day and m^2

Farmer with manual irrigation	vs.	*sunlight pump solar farmer*
500m^2 of tomato = 2'500 liters per day = 2.5 tons of water to carry every day = 125 cherry cans to carry every day		Can pump up to 16'200 liters/day = can irrigate 2'540m^2 of tomato = no physical work, automated system = 5 times the surface = 5 times the income

Please use the „sunlight pump configurator" on www.ennos.ch to design the sunlight pump system according to ***local needs and conditions***!

EFFICIENT IRRIGTATION WITH DRIP OR SPRINKLER

Farmer irrigates directly

Gravity-feed from tank

Drip irrigation

Sprinkler irrigation

→ Solar pump systems require a **relatively high investment** but have very low running and maintenance costs compared to diesel and electric pumps.

→ In conclusion: **the more often the solar pump is used, the earlier the cost break-even is reached** compared to diesel and electric pump.

→ A solar pump should not be seen as a 1:1 replacement of existing diesel pumps. Farmers have a tendency to over-irrigate their fields using diesel pumps. With a solar pump, every drop of water needs to be used efficiently.

→ The farmer has several options:

- *Irrigate directly* by connecting a hose to the sunlight pump → time-consuming because farmer needs to be in the field
- *Pumping water into a tank* and gravity-feed into the field → less time-consuming because farmer only needs to set up the system, but also very wasteful way of irrigation
- *Automatized and efficient system* where the sunlight pump is combined with a tank and a sprinkler or drip irrigation kit

The most efficient irrigation system is the sunlight pump coupled with a drip or sprinkler irrigation system

Sprinkler irrigation: Water is distributed through a system of pipes and through spray heads so that it breaks up into small water drops. Wide range of systems available, already working at 1.5 bar pressure.

Drip irrigation: system to deliver a measured quantity of water to the root zone of each plant at regular intervals. This is to ensure that the plants do not suffer from stress from under- or over-irrigating. The desired amount of water and nutrients is carried directly to the root of the plant where it is needed. Wide range of systems available, already working at 1.5 bar pressure.

Combination sunlight pump with drip and sprinkler kits:

i) *Direct connection* of the sunlight pump to the drip or sprinkler. Disadvantage: fluctuations in sunshine can cause massive energy losses and for some systems air locks.
ii) sunlight pump pumps into a *small equalizing reservoir* (few hundred liters) which balances the water flow and feeds directly into the drip and sprinkler system.
iii) sunlight pump fills a *large storage reservoir* (few thousand liters) over the course of the day and feeds into the drip and sprinkler kits during the night (or late evening/early morning when evaporation is reduced)

Advantages these Micro Irrigation Systems:

- Water savings (up to -70%) compared to flood irrigation
- Higher yield (up to +230%) → higher income
- Increase fertilizer use efficiency (up to +30%)
- Early maturity
- Better quality
- Labor cost savings

Important: Sprinkler and drip systems need to be installed by an expert based on a thorough understanding of local needs and conditions (crop, soil, topography etc.) → get in touch with ennos to discuss your needs

PROCESSING OF AGRICULTURAL PRODUCTS

Some agricultural products need processing at the place they are harvested. Especially *washing processes* can be very water intensive.

In the coffee regions, for example, the coffee beans are usually washed directly at the fincas where they are harvested. Those fincas often use a water circuit, where the same water is re-used several times. The sunlight pump is an ideal solution to pressurize and move that water, to optimize the water use and to reduce costs.

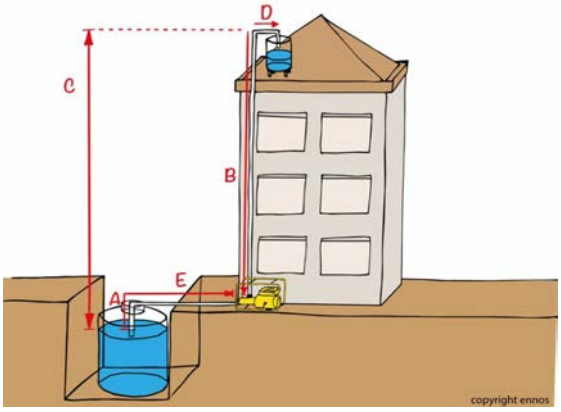
LIVESTOCK AND FISH FARMING

Another customer segment for the sunlight pump are *animal breeders which need water for the animals to drink and to grow fodder*.

One example: a cattle farmer in Nicaragua uses one sunlight pump to supply water for drinking and to grow fodder for to 40 cows.

The sunlight pump can also be used to circulate water in a pond or tank for *fish farming*.

DOMESTIC WATER SUPPLY FOR DRINKING, SANITATION AND HYGIENE



A = Suction depth in meters
B = Vertical lift from the pump to the highest point
C = Total lift (geodetic or static lift, A+B)
D = Horizontal distance between pump and tank
E = Horizontal length suction line

Many families in *rural and urban areas* do not have running water in their house. This mainly because the *electricity supply is inexistent, unreliable or very expensive*. Diesel pumps, on the other hand, are associated with high fuel and maintenance costs.

The sunlight pump can be used to provide domestic water to a multi-story house in a city or several family houses in a village. In a first scenario, water will be pumped into a water reservoir on the roof to provide a *continuous household water supply* through gravity. The water can be used for drinking, cooking, washing, cleaning, sanitation and personal hygiene.

Combined with a *pressure tank and a pressure switch* the sunlight pump can also be used to install an *automated system* and pressurize water. What is missing in the picture is an additional small storage tank (20-100 liters) which is necessary. If you operate on solar energy (without battery), that storage should be bigger in order to have a sufficient amount of water available under pressure when the sun is not shining. One can also work with a battery for the time when the sun is not shining. In the solar mode, the sunlight pump starts automatically. In the battery mode, the pump has to be started manually by pushing the start button on the electronics.

In this setup, you can connect various *water taps and you will have water under pressure in the entire house*. As soon as you use water, the pressure in the pressure tank will fall. If the pressure hits the lower limit, the pressure switch gives a signal and the pump will start pumping until the tank achieves maximum pressure again. You can reach a *pressure of up to 4 bar*.

DRINKING WATER KIOSK

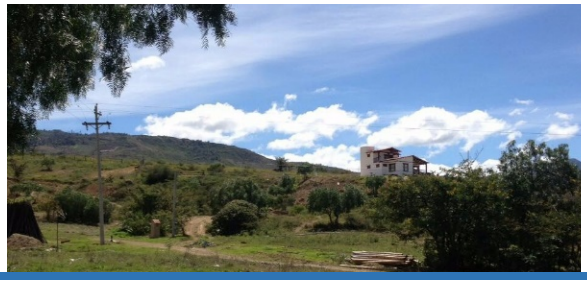
Waterborne *diarrhoeal diseases are responsible for 2 million deaths each year*. Clean drinking water and proper sanitation facilities significantly decrease this risk.

At a *drinking water kiosk*, people can get water against a small fee which is used to operate and maintain the kiosk. With a sunlight pump plus a water purification system (filter, chlorination, reverse osmosis or other), the kiosk becomes energy-efficient.

According to the World Health Organization, around *20 liters of clean water are required per day and per person* for drinking an to take care of basic hygiene needs and basic food hygiene. One sunlight pump can serve a *few hundred people* every day (margin has to factored in for cloudy days).

In Uganda, water is pumped from Lake Victoria, filtered and supplied to children at three schools and to the surrounding communities. The water is pumped over long distances - *more than 2 kilometers* in one case!

(AGRI-)TOURISM



Fincas and small hotels in rural areas are another segment for the sunlight pump. With the sunlight pump, tourism facility owners no longer depend on the unreliable local electricity and water networks.

One example as an illustration: a hotel owner near Villa de Leyva in Colombia, which is a very dry region, has an electric pump to irrigate the surrounding area of his hotel (trees and pasture). The *electricity costs to run this pump are high*. If he had a sunlight pump, he would break-even compared to electric pump within two and a half years and would have only minor maintenance costs but no running costs after that.

Within the tourism industry, *agritourism* is becoming increasingly important. The sunlight pump runs with solar energy, does not cause any CO_2 emissions, nor exhaust fumes. The sunlight pump is *environment-friendly* and therefore an ideal solution for guests with a high awareness for ecological and sustainable tourism. You can create costumer value by using an environment-friendly and sustainable solution for your water provision.

PONDS AND SWIMMING POOLS

Together with a filter system, the sunlight pump can also be used to *supply and circulate water in a pond or swimming pool*. This application is ideal for holiday homes or small hotels in rural areas, where reliability of local water provision is low. In some cases, it might also promote a more sustainable use of water since the sunlight pump with the sunlight pump app allows for rigorous control of the water quantity pumped, people might more easily develop an awareness about their real water consumption.

There are many more possible applications for the sunlight pump – discuss your ideas with us!