



SPWS configurations and components

By Asenath W. Kiprono

Wednesday, 25 Nov at 11:00 am CET

INTRODUCTION OF the global solar and water initiative (GLOSWI)

1. Coordination and Knowledge Sharing



2. Build up Evidence, Development of Knowledge Material



3. We Provide Field Support Through Country Visits



4. Capacity Building



5. Technical Helpline



TYPICAL SOLAR PUMPING SCHEME

IEA INTERNATIONAL ENERGY AGENCY

PHOTOVOLTAIC POWER SYSTEMS PROGRAMME



PVP System



PV generator

Inverter / electronics

Borehole head

Protective fence

Lifting pipe

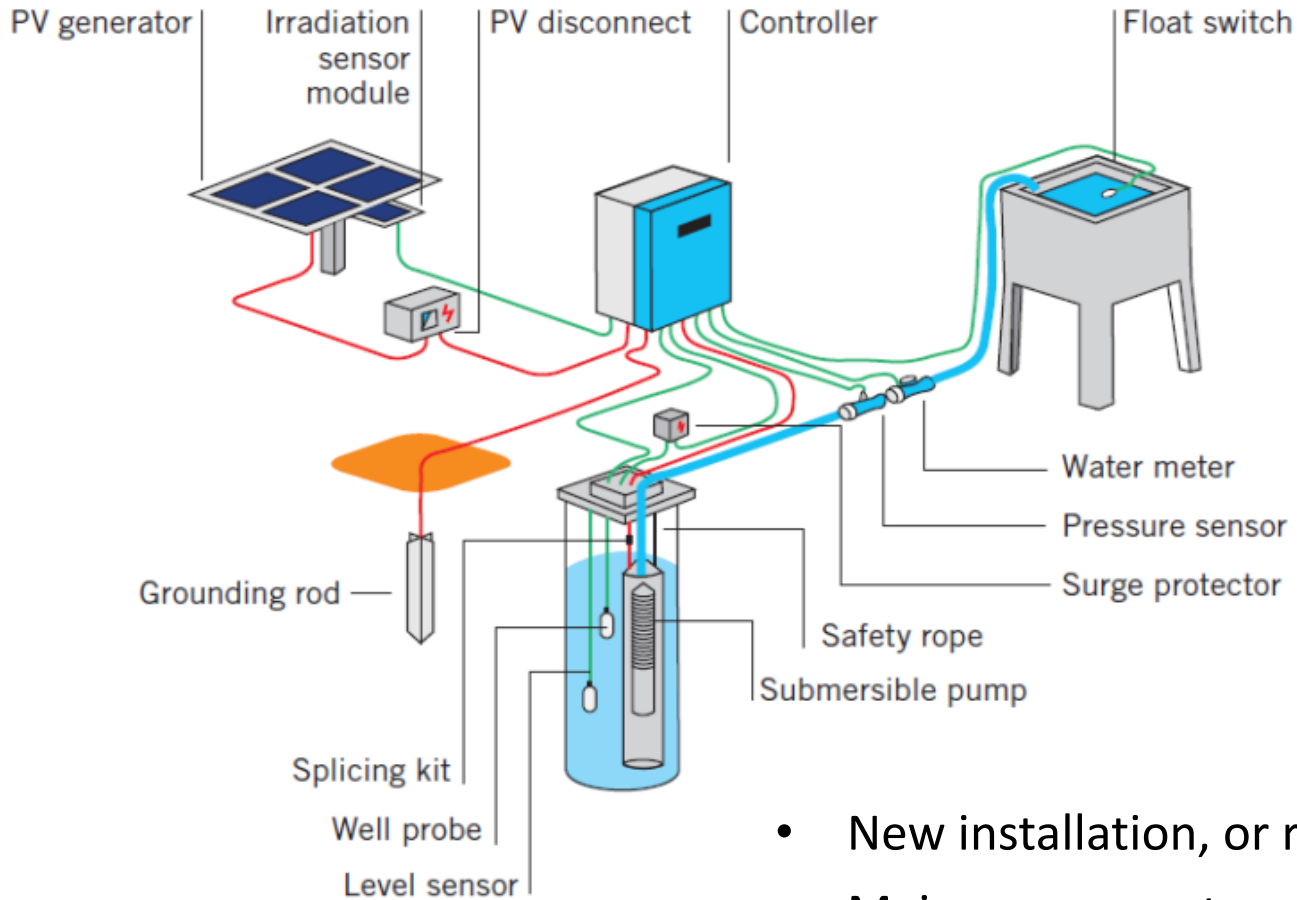
Submersible motopump

Main tank

distribution

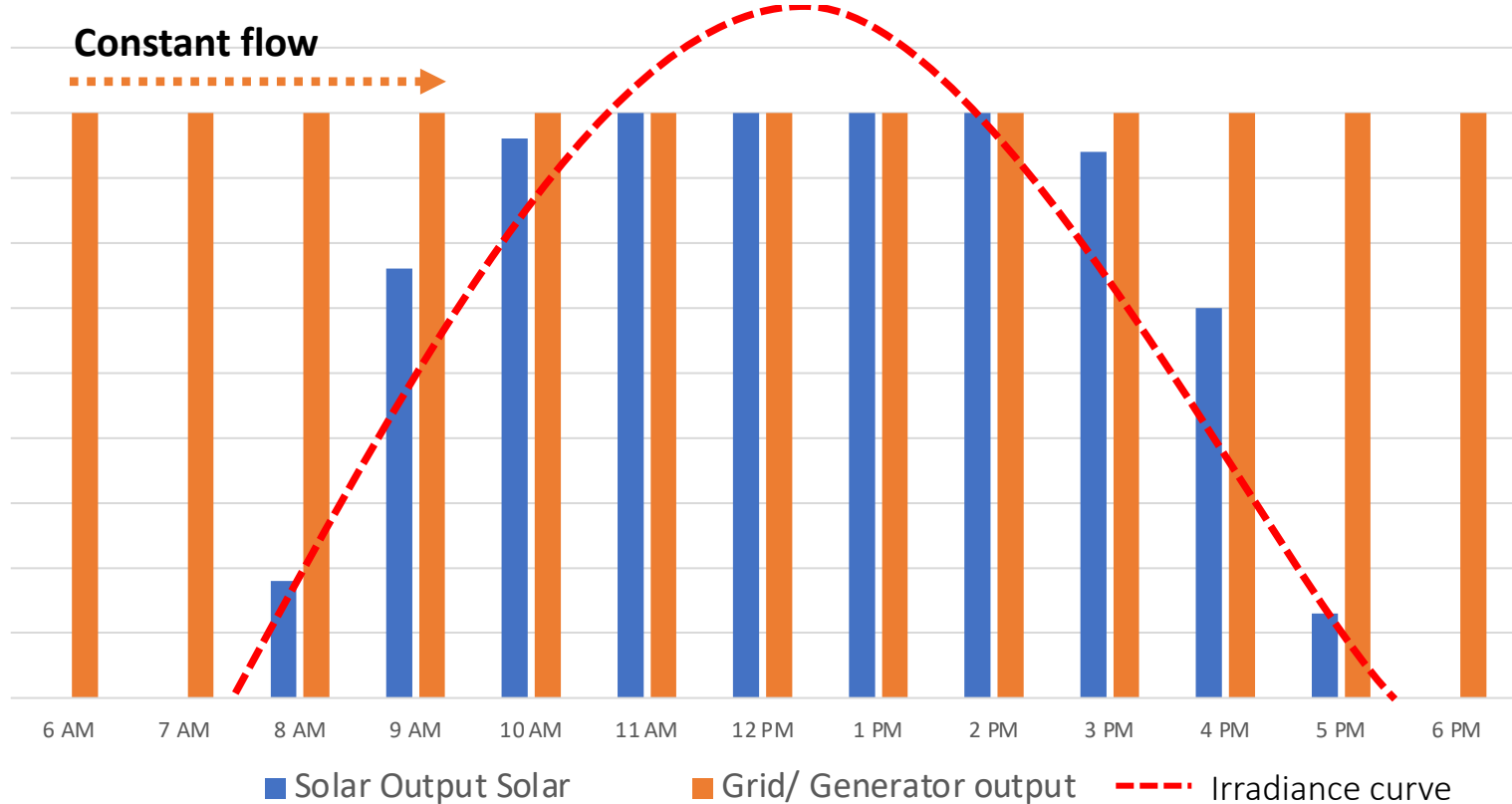


...CONTINUED



- New installation, or retrofitted
- Main components
- BoS components

SOLAR vs generator/grid operation



- Pump + solar (+ optional stand-by power). No batteries!
- Store water in an elevated tank, rather than storing energy

DC vs AC pumps/controllers



DC system

- pump coupled to a DC motor + DC controller + PV generator
More efficient, last longer, compared to equivalent AC
- Used in smaller applications
- Less than 4kW, lower VDC input

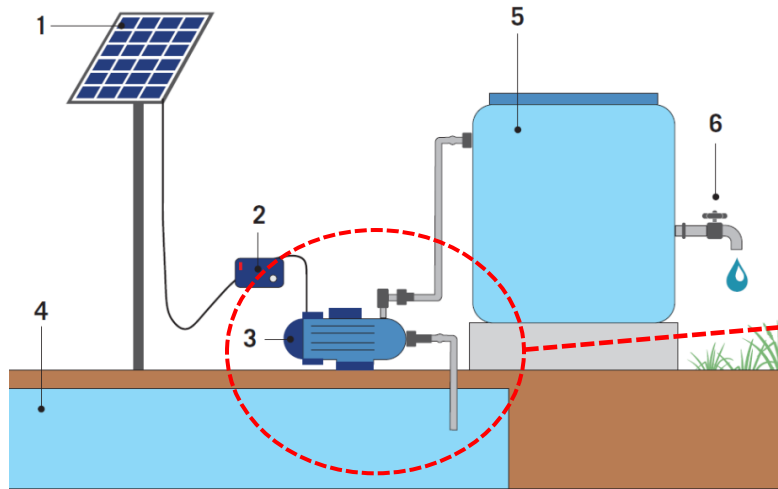


AC system

- pump coupled + AC motor + DC-AC inverter + PV generator
- The inverter can be inbuilt into the pump or mounted on the surface
- Used in large applications
- As large as 250kW, high VDC input, three phase AC output

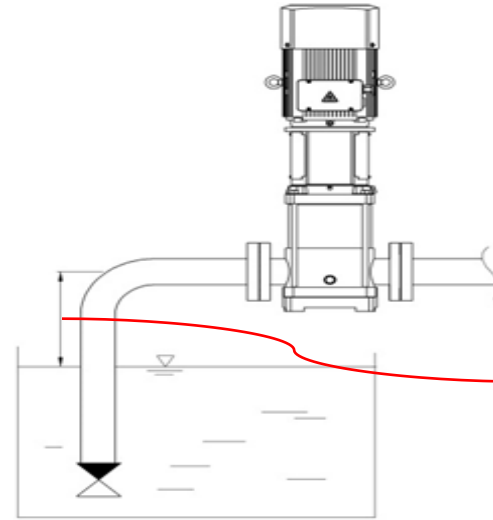


Submersible vs surface pumping systems



Surface

- More complicated to design
- Require more knowledge
- Pros: higher flows, simpler service



Maximum suction head (H) is measured from top of water level to centre of pump inlet pipe

Submersible

- Better efficiency of operation
- Simpler, quiet operation
- Cons: More expensive

FLOATING INSTALLATION

Surface pumps can also be installed floating in a surface water source

- Water source is far from pump location
- Where water levels fluctuate
- Flooding is expected



...continued

A submersible pump can also be installed floating



solar Standalone vs hybrid systems

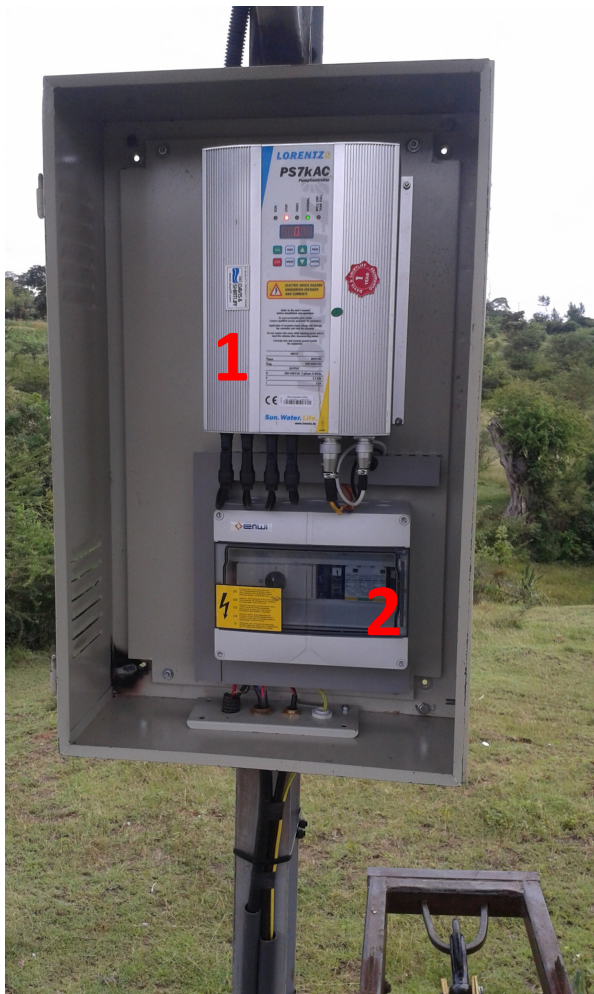
Solar standalone: Single power source from solar to meet full demand

Hybrid: Solar plus stand-by power source (majority in humanitarian is fossil based - diesel).





**Controls in a
STAND
ALONE
SYSTEM**

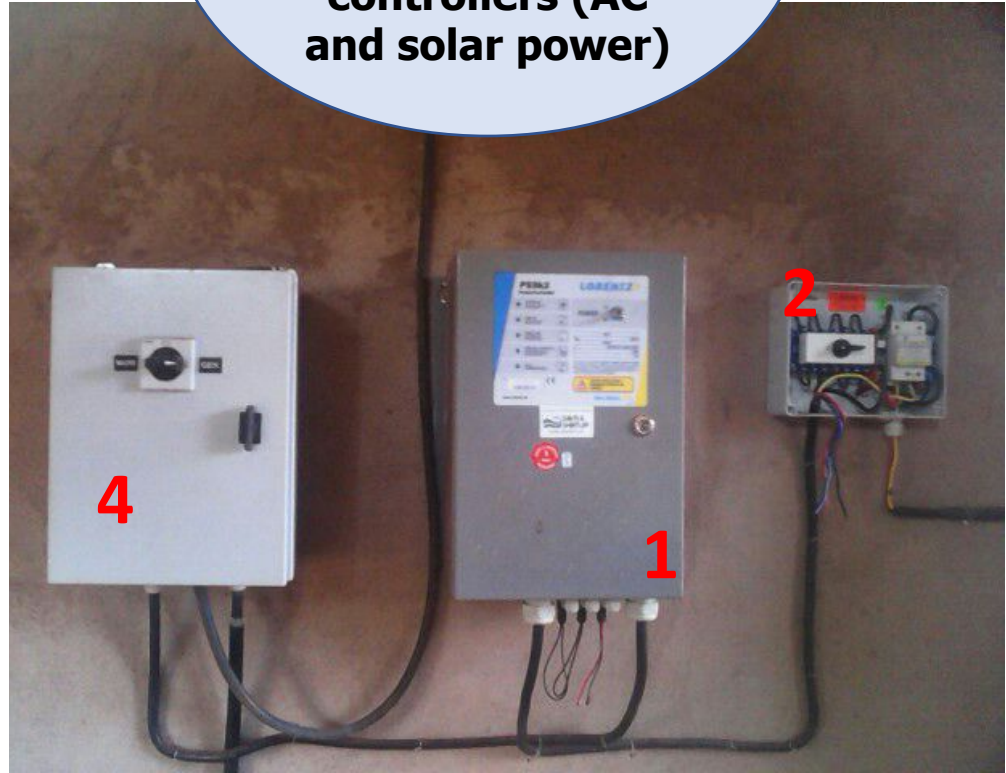


- 1 – DC or AC controller
- 2 – DC Isolation switches
- 3 – GPRS communicator (optional)



- 1 – DC-AC inverter
- 2 – DC Isolation switches
- 3 – AC control panel
- 4 – Manual Changeover switch

**Controls in a
HYBRID SYSTEM:
Manual operation
between 2
controllers (AC
and solar power)**



**Controls in a
HYBRID
SYSTEM:
Manual
operation with
one controller
for both solar
and AC power**



- 1 – DC-AC inverter
 - 2 – DC Isolation switches
 - 3 – Surge protection
- *note changeover switch
not captured in the picture
(mounted elsewhere)



Controls in a
HYBRID
SYSTEM:
automatic/
power blending



selecting the right configuration



- 1) Submersible vs surface:
Dictated by the application
- 2) DC vs AC:
DC pumps for small applications, AC for larger applications
- 3) Standalone vs hybrid:
multiple criteria, more insights



...Continued

Judgment for hybrid should be based on

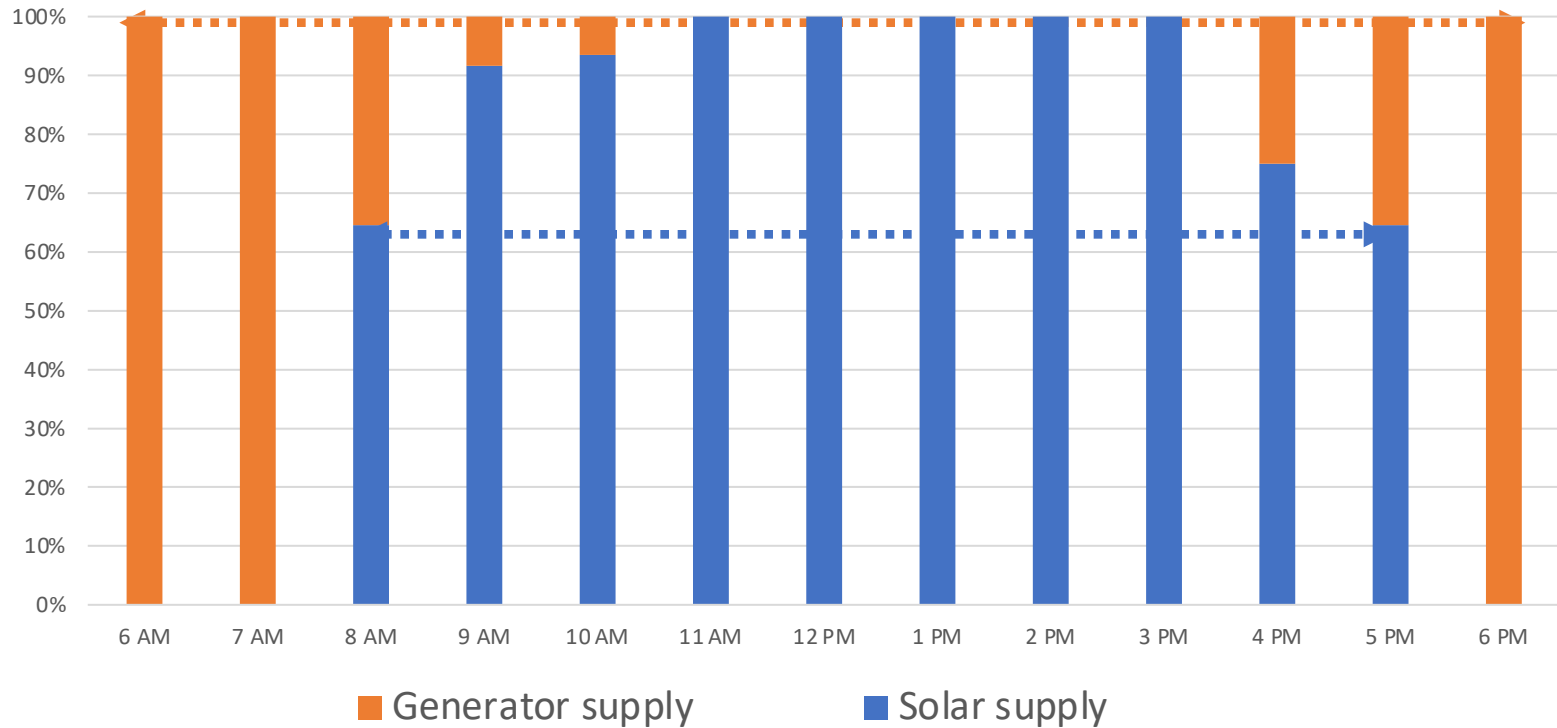
- a) Water demand, solar resource and water source capacity
- b) Availability of data
- c) Possibility of fluctuations in population
- d) Prevailing weather conditions and topography
- e) Criticality of the water supply
- f) *Humanitarians interventions....*

Other considerations:

- social aspects
- contextual reasons
- economic reasons



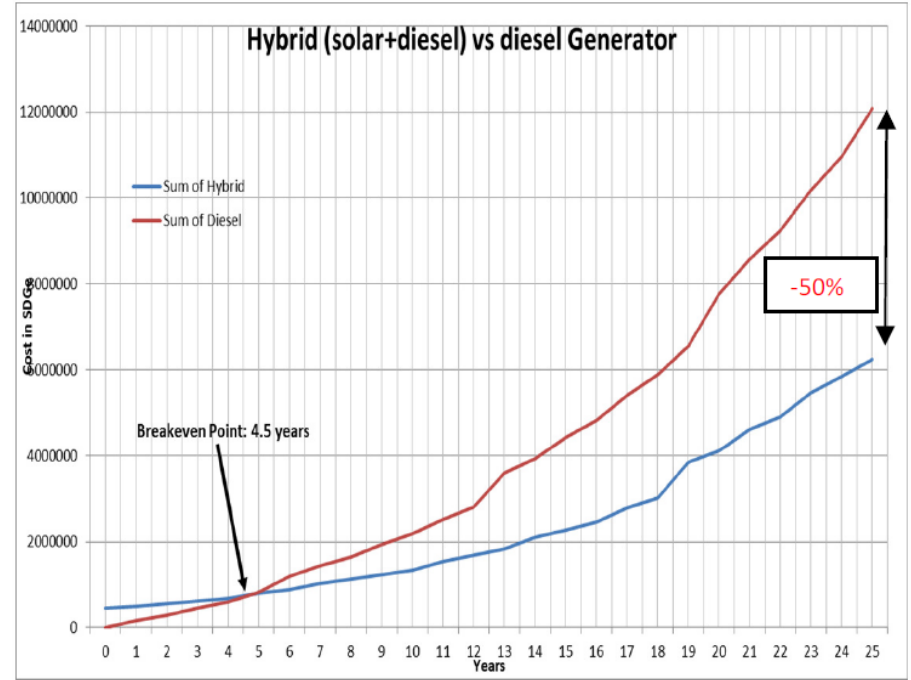
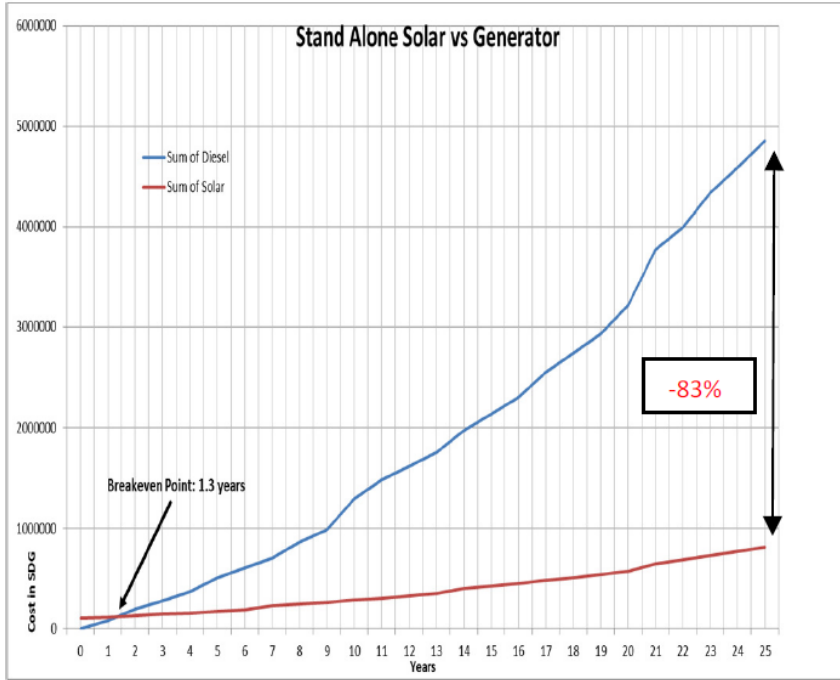
...CONTINUED



Solar standalone: Single power source from solar to meet full demand

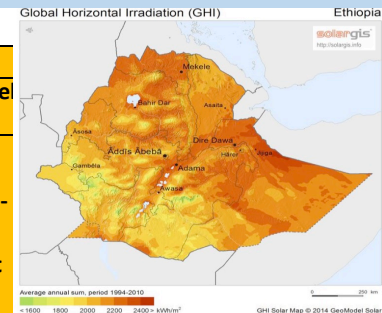
Hybrid: Solar plus stand-by power source (majority in humanitarian is fossil based - diesel).

...CONTINUED



- Economic analysis for decision making
- Consider all other factors

Some rationale for choice of size/configuration (Ethiopia)



| No. | Technical Design | | | | | Water Output | | | Economic/Life Cycle Analysis | | | | | | Remarks |
|-----|---------------------|-----------------------------|------------|------------------------|---------------------------|---|---|--------------------------------|------------------------------|----------------------------|-----------------------------|----------------------------|--|------------------|--|
| | Tested yield [m3/h] | Daily water Demand (m3/day) | or TDH (m) | Proposed Power Pump kW | Proposed Solar Power Size | Daily Output Solar (m ³ /day) in month with least output | Daily Output Generator or (m ³ /day) | Combined Daily Output (m3/day) | Generator stand alone | | Solar stand alone or Hybrid | | Hybrid/Solar - Diesel Comparison | | |
| | | | | | | | | | Initial cost (USD) | Cost over Life Cycle (USD) | Initial cost (USD) | Cost over Life Cycle (USD) | Reduction of expenses Hybrid/Solar vs Genset | Break-even point | |
| 1 | 5.4 | 100.0 | 140 | 4.0 | 7,500 | 41.2 | 58.8 | 100.0 | 17,812 | 271,946 | 24,309 | 193,828 | -29% | 2.1 years | Hybrid (demand almost same as no. 3 but borehole is constrained, so smaller pump requiring hybrid) |
| 2 | 10.8 | 84.0 | 248 | 9.2 | 18,750 | 57.1 | 26.9 | 84.0 | 35,117 | 274,631 | 52,819 | 149,845 | -45% | 1.75 years | Hybrid (demand is same as no.9 but borehole yield is smaller, so smaller pump requiring hybrid) |
| 3 | 25.2 | 104 | 123 | 9.2 | 18,750 | 127.7 | 0.0 | 127.7 | 32,657 | 200,914 | 50,359 | 70,599 | -65% | 1.8 years | Stand alone (retrofitted into a pump of high capacity thus solar pumping more than the demand) |
| 4 | 54 | 120 | 146 | 22.0 | 41,250 | 263.8 | 0.0 | 263.8 | 50,824 | 402,900 | 90,386 | 114,136 | -72% | 1.75 years | Stand alone (demand lower than pumped flow. Decided to extract full potential of the well) |
| 5 | 18 | 100 | 217 | 15.0 | 22,500 | 105.8 | 0.0 | 105.8 | 43,783 | 296,606 | 62,433 | 84,255 | -72% | 1.2 years | Stand alone (Less output than no. 3 but higher head requires more power) |
| 6 | 7.2 | 100 | 217 | 7.5 | 11,250 | 41.4 | 58.6 | 100.0 | 29,579 | 377,048 | 39,537 | 263,924 | -30% | 0.9 years | Hybrid (same reason as no. 1 above) |
| 7 | 10.8 | 100 | 147 | 5.5 | 11,250 | 61.7 | 38.3 | 100.0 | 23,034 | 254,363 | 34,319 | 141,393 | -44% | 1.1 years | Hybrid (same reason as no. 1 above) |
| 8 | 4.68 | 90 | 144 | 4.0 | 5,250 | 27.0 | 63.0 | 90.0 | 17,189 | 301,214 | 19,732 | 226,655 | -25% | 0.5 years | Hybrid (same reason as no. 2 above) |
| 9 | 18 | 84 | 175 | 11.0 | 18,750 | 99.2 | 0.0 | 99.2 | 34,163 | 208,692 | 46,867 | 67,832 | -67% | 1.3 years | Stand alone |

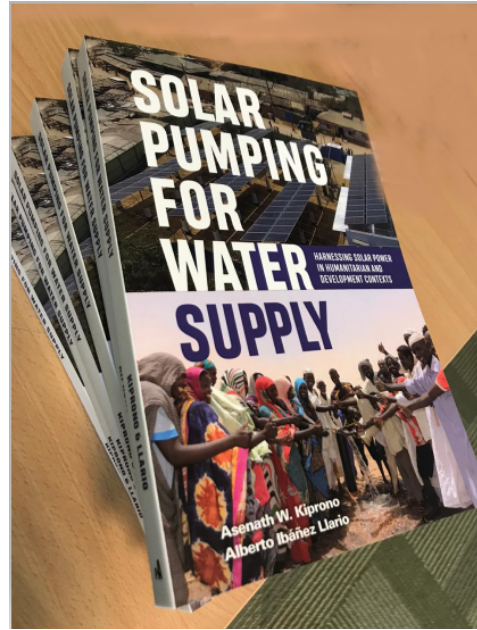
GSWI FINDINGS in 8 countries

140 systems assessed in 8 countries

| | | | |
|-----------------------------------|----------------------------|----------------|---|
| Configuration | Stand alone | 46% | |
| | Hybrid | 54% | |
| Scale *motor size | Largest | 37kW | Hybrid (760m3/day from solar) |
| | Smallest | 1.4kW | Stand alone 17-27m3/day |
| Size range *motor size | 0 - 4kW (10-220m3/day) | 47% | 65% of all systems within 1.4-7.5kW range |
| | 5.5 – 37kW (36-1298m3/day) | 53% | |
| Life cycle costs | Stand alone | -65% reduction | 0 to 2 years payback period |
| | Hybrid | -45% reduction | 2 to 4 years payback period |

- ✓ Active, experienced private sector
- ✓ Quality products
- ✓ NGOs, UN working with private sector
- ❖ Importance of building organisational capacity

Technical resources – book



[Read it open access](https://practicalactionpublishing.com/book/2507/solar-pumping-for-water-supply) or [order a copy](https://practicalactionpublishing.com/book/2507/solar-pumping-for-water-supply) on Practical Action Publishing Website

<https://practicalactionpublishing.com/book/2507/solar-pumping-for-water-supply>

Technical resources – online course

SOLAR POWERED WATER SYSTEMS

 From: 09/09/20 |  until: 11/29/21 |  Virtual campus |  On-line

Pre-registration from 07/09/20



UNIVERSITAT
POLITÈCNICA
DE VALÈNCIA

Promoted by:

Interuniversity Research Institute for Molecular
Recognition and Technological Development

Responsible for the activity:

Salvador Seguí Chilet

Registration →

<https://www.cursofotovoltaica.com/solar-powered-water-systems/>

Technical resources – onsite course



The advertisement features a dark blue background on the left and a photograph of a black solar water pump with blue caps on the right. A white circle with a red border is overlaid on the pump. The Strathmore University Energy Research Centre logo is in the top left, and the course title is in the middle left.

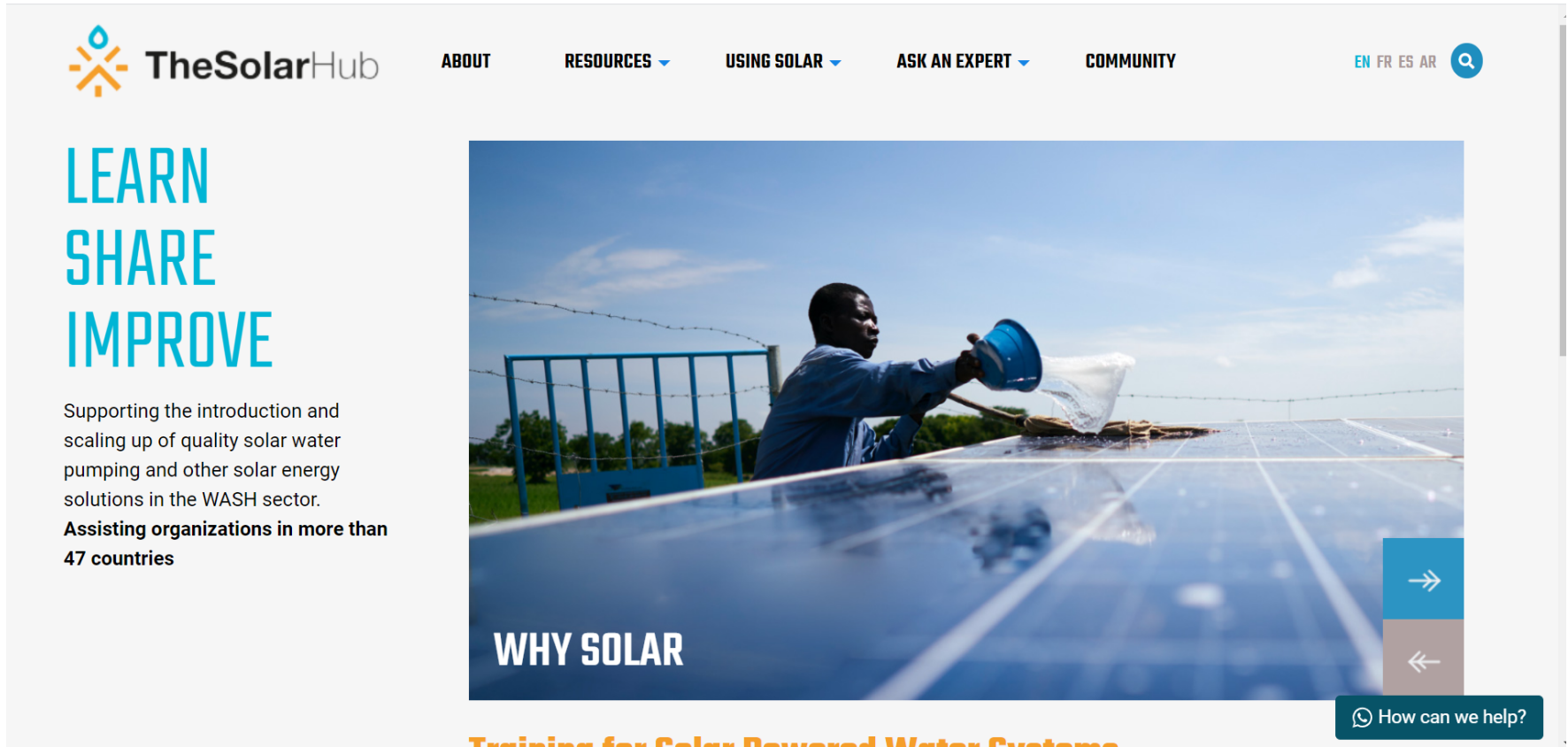
 **Strathmore University**
Energy Research Centre

Solar Water Pumping Course

Available onsite at Strathmore University, Nairobi

<https://www.strathmore.edu/serc/solar-water-pumping-training/>

Technical resources – solar pumping website

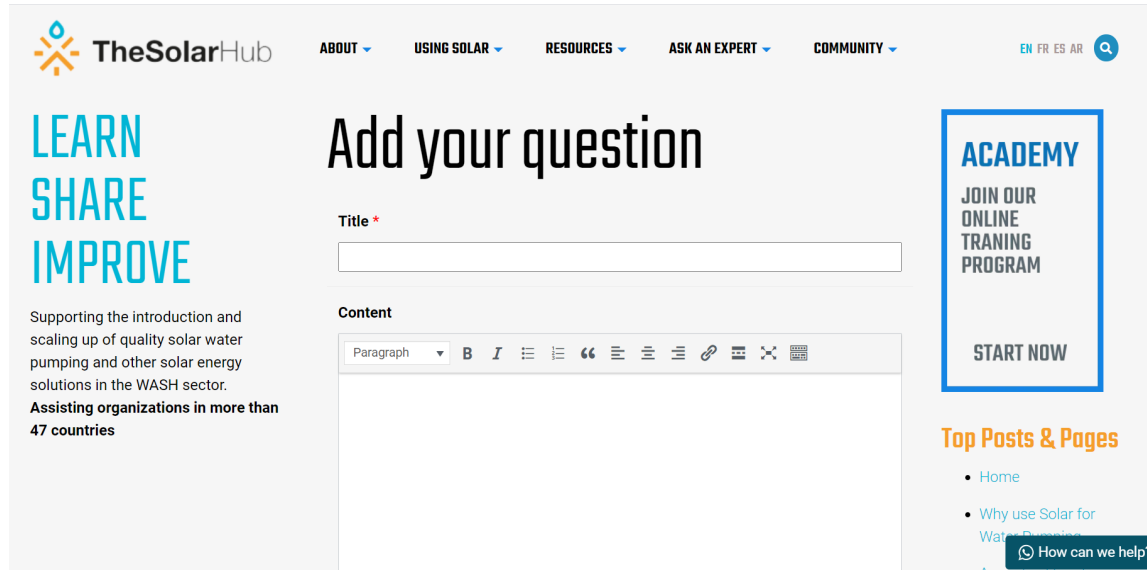


The screenshot shows the homepage of TheSolarHub. At the top left is the logo, which consists of a stylized sun with a water drop above it, followed by the text "TheSolarHub". To the right of the logo are navigation links: "ABOUT", "RESOURCES" (with a dropdown arrow), "USING SOLAR" (with a dropdown arrow), "ASK AN EXPERT" (with a dropdown arrow), and "COMMUNITY". Further right are language options "EN FR ES AR" and a search icon. Below the navigation is a large banner area. On the left side of the banner, the text "LEARN SHARE IMPROVE" is stacked vertically in large, blue, sans-serif font. Below this text is a paragraph: "Supporting the introduction and scaling up of quality solar water pumping and other solar energy solutions in the WASH sector. Assisting organizations in more than 47 countries". To the right of the text is a large photograph of a man in a blue shirt pouring water from a blue bucket into a white net on a solar panel array. The text "WHY SOLAR" is overlaid in white on the bottom left of the photo. At the bottom right of the photo are two navigation arrows: a blue one pointing right and a grey one pointing left. Below the photo is a dark blue button with a white speech bubble icon and the text "How can we help?". Below the banner, the text "Training for Solar Powered Water Systems" is partially visible in orange.

<https://thesolarhub.org>

Technical resources - helpline

Email: solarquery@iom.int



The screenshot shows the 'Ask an Expert' page on TheSolarHub. The page features a navigation bar with links for 'ABOUT', 'USING SOLAR', 'RESOURCES', 'ASK AN EXPERT', and 'COMMUNITY'. A search bar is located in the top right corner. The main heading is 'Add your question'. Below this, there is a 'Title' field and a 'Content' field with a rich text editor. The rich text editor includes a dropdown menu set to 'Paragraph' and various formatting options like bold, italic, bulleted list, numbered list, quote, link, unlink, and table. On the left side, there is a sidebar with the text 'LEARN SHARE IMPROVE' and a description: 'Supporting the introduction and scaling up of quality solar water pumping and other solar energy solutions in the WASH sector. Assisting organizations in more than 47 countries'. On the right side, there is a blue-bordered box for 'ACADEMY' with the text 'JOIN OUR ONLINE TRAINING PROGRAM' and a 'START NOW' button. Below this, there is a section for 'Top Posts & Pages' with a list of links: 'Home', 'Why use Solar for Water Purification', and 'A cost-effective...'. A dark green button with a magnifying glass icon and the text 'How can we help?' is positioned at the bottom right of the page.

<https://thesolarhub.org/ask-an-expert>