



## Hybrid energy solutions by Sunnytek



### Why a hybrid power solution from Sunnytek?

In large areas of earth there is a dry season that is very sunny and a rain season with lots of rain and less sun. This limits capabilities of systems based on only solar power and water power in several ways. Large parts of Africa have this situation

Sunnytek hybrid solutions is here a very suitable solution that mix the best features of different ways to create energy in the way. By a combination of solar energy by panels and hydro power by water and if suitable wind power by wind we can get a solution that match the local demands in the best way. Hybrid systems can be all from very small systems of a few KW up to MW range and very large dams.

### The simple concept with water battery charging

When sunny we use solar panels as much as we can and at days we tune down the hydro power system with its dam and let the water surface raise. When we have no sun we open the turbines and they handle the power and the dam surface will go down as we do not have enough of water when it is to dry. Next day we do the same so the power we store in day time in water in the dam acts as a storage battery.

Water is much cheaper than alternative energy storage and here we have a function to match the expected sunshine and rain with what is best consumer profile in the area. All grids have typical peaks and they can here be optimised for best god function.

Solar system and hydro power s always supporting the grid in best ways.



In windy area we have one parameter more to use. In most area wind differs during day and when there are large water areas with close by land the sun will create on land and off land winds that are very reliable in time and strength. The evening on shore wind is often well located with when people come home for the evening and the power peak they create in the grid. When area is windy a triple system can be very attractive.

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### Solar panel solution in a hybrid concept.

In most cases the thin film silicon panels is the best if we can accept a pay off time of 5 years. Crystalline panels are cheaper but in African conditions they produce less power so after some years thin film gives more output in KWH / year. After 10-25 years operation the difference is considered in favour of the thin film panels. Output is between 10% and 20 % better than standard crystalline panels in most cases.



Solar trackers with one axis tracker function. The tracker follows sun and by this we get about 25% more KWH in output. Complexity is higher but produced power is a lot more so in long run this option is very favourable with a good pay off time. Quality is based on German technology. Functions are automatic and there is a web interface for trackers + panels. Inverters is the key component in a reliable system

and we use best European brands with lots of references in tropical areas. We have all from small inverters of 1.5 KW up to 1 MW container solutions with extra step up transformers to connect to a high voltage grid. All installations have a special solution for lightning problems and transients. African high lands are one of most active areas for under bolts.



### Hydro Power solution

Hydro power is based on a suitable turbine solution that needs some care when selected. For larger installations as 500KW and more we prefer a turbine system from Norway/ Sweden of highest quality and with longest life time. Smaller systems up to 1MW can be installed in a 40 feet container and here very simple to handle and have their own housing in the container. On site works are here very short and transports cheapest. Larger system from 1 MW to 20 MW per turbine is here more conventional. For hilly areas with large water head we have the unique Brekke turbine that handle 100-1000 meter with markets highest efficiency and power up to 20MW. Smaller turbines are from 1 KW to 50 KW is an upgraded simpler solution where we add quality and changes before delivery.



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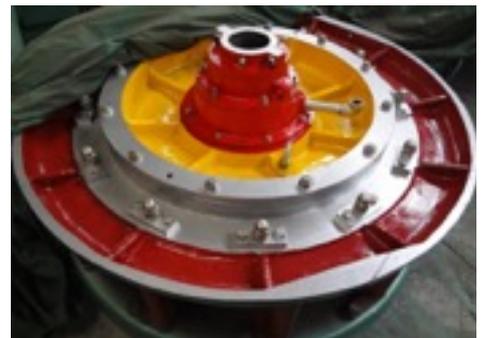


Pelton system 1.8MW with 400 meters water head installed in Norway. System is automatic and have a web interface for remote control



Kaplan turbine with 10KW output designed for 5-15 meters water head. This is a reasonable priced system for smaller hybrid installations.

Right side we have a Francis turbine for 20-200 meters water head and about 100 KW output. These have a very good adaptive control for different load and water flow. Generator is now showed but is on top.



**Water dam and energy storage**

We have a dam as water storage and to act as a "battery" we use to control the daily power cycle. Here we have a low dam that can be used for a Kaplan turbine.



Volume and the variations over day gives an idea about how much energy we can store in a dam. In areas as Rift valley there are many canyons with a river where it is very easy to build a dam and combine with solar or wind power. Often are these areas not used for farming so they are empty and easily available with limited conflicts to local farmers.



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Wind farms in a hybrid installation.



There are many areas with good wind characteristics like shores to larger lakes and mountain areas. Here the possibility to add a wind turbine can be of interest as it adds power under the evening hours when sun is down and people are not sleeping. Here kitchen works and TV

etc consumes a lot of power in most areas. Wind will in many cases be a good combine action with hydro and solar systems.



Hybrid inverters

This is a system that collect the different power sources and feed the power into grid or a off grid solution. They are always computerised and see how much power is available and share with best ways of max output. Here output can be from 300W to MW range depending on what is used. Larger systems are typically European brands.

The dam = the battery of power.

The dam can be all from a small earth dam for a few meter in height and up. All depends on storage capacity of water. Height + volume gives a number of stored KWH that is used to balance the daily cycle of power. We can assist these calculations in a feasibility study we can make when there is an interest.

