



Solar water pumping makes perfect sense

Namibia has more than 40,000 boreholes in use from which water is pumped for households, farming, tourism and agriculture activities.

A study was commissioned by the Ministry of Mines and Energy (MME) through the Namibian Renewable Energy Programme (NAMREP) into the *cost effectiveness of solar water pumps in comparison with diesel water pumps*. The study was conducted by Emcon Consulting Group and the main results are presented here.

Water pumping options

Traditionally the water pumping technology of choice has been the wind pump. Wind pumps provide long lasting solutions with a basic technology which is well understood and can be maintained locally. However even wind pumps have become expensive to install and to replace.

Diesel water pumping is attractive due to the large power range of the pumps and the availability of water when it is needed. It can pump water for varying daily demands through longer operating periods (assuming sufficient borehole strength), thus allowing for the flexibility required in some applications. The technology is well understood and service for diesel engines is readily available. Recent fuel price increases and generally intensive maintenance schedules however can make diesel water pumps a costly pumping option.

Solar water pumps are often thought of as being an expensive technology, which is not able to pump enough water and which is not durable. However, solar water pumps have come a long way in 25 years and today there are solar pumps on the market which have improved on previous technology, e.g.:

- Submersible pumps which can pump up to 200m heads;
- Pumps that are able to pump larger volumes of water, e.g.:
 - At 100m, about 10,000 litres per day;
 - At 50m, about 20,000 litres per day;
 - Above performance can be doubled through dual systems (if the borehole allows this).
- Low maintenance requirements (3 to 5 years);
- Good performance which means fewer solar panels to pump the same amount of water;
- Some of the pump models can be backed-up by a genset to pump additional water with the same pump during the night or during overcast days;
- Good quality and reliability
- Simple to install



Furthermore, solar pumps are well known for having the following features:

- Require minimal attention as they are self-starting;
- Solar pumps are “good” for boreholes as they pump over the whole day;
- Weak boreholes can be used effectively with a low volume pump due to pumping 8 to 10 hours a day;
- In most cases, a solar pump offers an ideal solution to the diesel option which requires operating funds (with uncertainty about future diesel prices), time investment for operating pump (manual starting etc) and logistics for fuel, maintenance, installation and de-installation;
- Tracking arrays can be used to increase daily water pumping rates;
- Solar pumps offer clean solutions with no danger of borehole contamination.

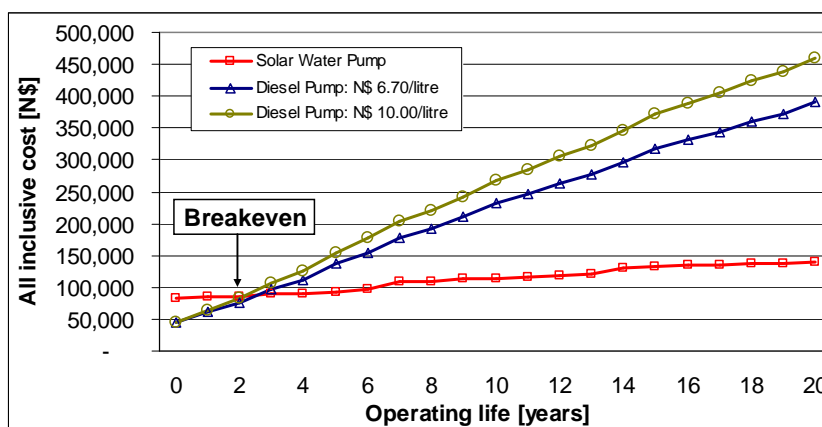
Theft of solar photovoltaic panels is a problem and one needs to look at counter measures if there is a risk of theft. Refer to web links below for more information.

Cost of solar and diesel pumps

A cost comparison was conducted for solar and diesel water pumps over a range of pumping heads (10 to 200m) and a range of daily flow rates (3 to 50m³/day). The all-inclusive costs were calculated taking into account:

- the initial upfront cost,
- the operating costs (diesel fuel for the operating life),
- maintenance costs, and
- replacement costs (diesel engine, solar submersible pump unit etc).

Calculating the all-inclusive cost is a fair way of comparing solar pumps (usually higher upfront cost) with a diesel pump (usually lower upfront cost, but with ongoing diesel and intensive maintenance costs). The all-inclusive cost takes a long term approach and is calculated over a twenty year period, which is also the minimum life expectancy of a solar panel. The cost comparisons show that diesel pumps are on average two to four times more expensive over a 20 year period than solar pumps for pumping the same average amount of water per day! Refer to costing approach in final report for more detailed information.



Another measure of comparison is the years to breakeven, i.e. After how many years does a solar pump become cheaper to run than a diesel pump? The adjacent graph shows an example for a pumping solution (80m head, 12m³/day) where the breakeven occurs after 2.6 years. The all-inclusive cost over 20

years reaches N\$ 139,000 for the solar pump and N\$ 390,000 for the diesel pump. If the diesel price increases to N\$ 10.00 per litre then the total cost will rise to N\$ 461,000.

For other operating conditions (borehole depths and daily flowrates) refer to the table below showing the years to breakeven. The yellow fields indicate that the solar solution is viable within the years stated. The main result is that all solar pumps available on the market break

even within 7 years or less! Smaller solar pumps are more cost effective (zero years to breakeven) right from the start of their operation. Note that as the years to breakeven increases the upfront cost of solar pumps increase. Fields marked with “Diesel” have no solar equivalent and diesel is the pumping system of choice.

Table: Years to breakeven – when solar becomes cheaper than the diesel option

		Daily water [m ³ /day]							
		3	5	8	10	13	17	25	50
Head [m]	20	0.0	0.0	0.0	0.2	0.2	0.6	1.3	2.8
	40	0.0	0.0	0.4	0.9	1.0	1.1	2.6	4.1
	60	0.0	0.0	0.9	1.2	1.7	2.6	3.5	5.1
	80	0.0	0.0	1.3	1.6	2.3	3.7	4.6	7.1
	100	0.0	0.1	2.3	3.1	3.7	4.6	6.1	Diesel
	120	0.0	1.1	2.4	3.9	4.4	5.7	6.5	Diesel
	160	0.0	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
	200	0.0	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

The calculations make use of the optimal solar and diesel pumping systems and assume a constant water demand. In applications where the water demand varies significantly (e.g. seasonal variations for irrigation purposes) diesel may present a more cost effective solution. Solar is cost effective when it is used on a continuous basis.

Financing solar pumps

Financing the upfront cost of solar pumps has often presented a cash flow problem to potential customers. However, a number of banks and institutions have recently started offering loans for buying solar pumps. These include:

- Konga Investments: Terms: 5% deposit, 5% interest rate and 5 year repayment: Tel 061-259961;
- Bank Windhoek: Terms: 5% deposit, interest rate at prime less 5% and 5 year repayment: Tel 061-2990380;
- AgriBank: Terms: Interest rate at prime less a fixed percentage (currently 1.5%), 15 years repayment, which is less cost effective than the other two loan schemes but represents more affordable monthly payments.
- Other banks are getting ready to offer loans too.

Additional info

For contact information on solar pump suppliers refer to the solar pumping brochure available from the above financing institutions, NAMREP, the Namibia Agricultural Union, the Namibia National Farmers Union or on the websites listed below. For more detailed information on this subject refer to the final report. Documents are available on the MME website (www.mme.gov.na) or on the Emcon website (www.emcongroup.com/emcon_downloads.htm).

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