SMARTA makes simple solar powered pump design and selection a reality

Background

When CLV veggies contacted Smarta 15 months ago two questions were on the table.

Figure 2 King Arthur red peppers under shade netting. Photo: Courtesy of Pepper Valley

What was the capacity and/or condition of the borehole supplying a very successful tunnel farming operation and secondly, what can be done to secure water and power independence from a potentially insecure infrastructure council services perspective? The initial discussions considered all the possible options of installing borehole monitoring equipment and a solar powered pumping system at the time. However, uncertainty with respect to the water and power needs resulted in the installation of a Smarta management, monitoring and protection system on the borehole to determine borehole characteristics, water needs and collect data for approximately one season, making an informed decision with respect to the potential replacement of the grid connected pumping system with a solar powered pumping system possible. It is 15 months later - the data is available, and it is time to install the cost saving and power and water secure solar powered pumping system. But how does SMARTA make such informed decisions possible and eliminate any guess work or simple clever salesmen talk?

Water consumption analysis

It is always difficult to determine how much water a specific farming activity requires but with SMARTA logging all the relevant information this question is simplified considerably. Since all information logged is stored in a cloud historian dedicated to the site specifically, data is available at any time. In this case the data was accessed only 15 months after first installation. Data was downloaded in csv format, collated and analysed to obtain all the necessary information, including the amount of water pumped daily without any ambiguity or uncertainty. Figure 1 shows the logged data which make it possible to determine daily water requirements, as well as borehole water levels and borehole recharge behaviour. From the data logged the following information is obtained that makes it possible to size, design and provide the optimal solar powered pumping system solution for the application.

Pumping patterns, infrastructure and the existing borehole pump characteristics

The logged data (see Figure 1) shows that an average of 55kl per day is required during the high production months (November to March 2017/2018). Additionally, the dynamic borehole water level averages 45m below ground level.

The difference between the borehole static and dynamic levels indicate that the borehole is capable of supplying in the water demand without the risk of deterioration.

When considering the pump duty curve logged by SMARTA daily (see Figure 3), the total dynamic head (TDH) of the pump is determined to be 44 m whilst delivering 56 litres per minute. This information makes it possible to select the correct solar pump so that the required 55kl/day can be pumped, demanded during the peak periods. Previously the uncertainty associated with borehole performance and characteristics made it difficult to determine all the necessary parameters required to make an informed decision and select and design the correct solar powered pump.

With the SMARTA data now available factors such as long-term water levels, average water volumes required, peak demand and peak demand levels need not be guessed.

Other details required for the selection of the optimum solar pump configuration include of the number of peak solar hours (PSH) available per day, available storage capacity, availability of grid power, future expansion plans and/or expectations and available location for the erecting of the solar module array and mounting of solar control gear. For the area where the farm is located the PSH is 6.5 hours, storage of approximately 75-100kl

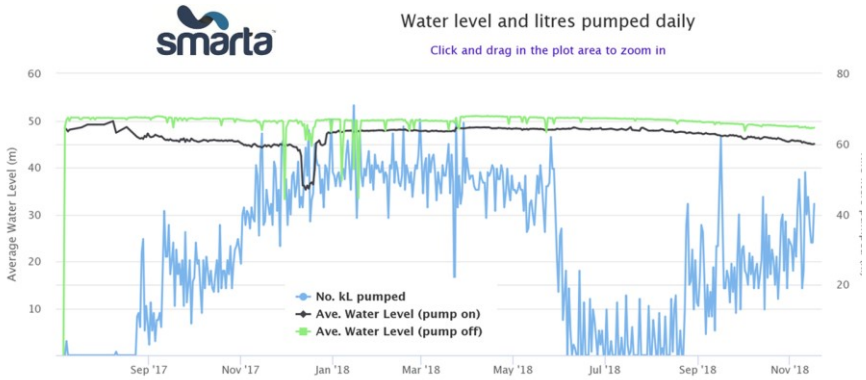

Figure 1 SMARTA logs water volumes pumped and borehole water levels from farm borehole

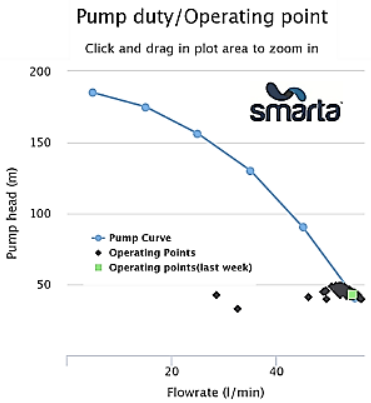

Figure 3 Pump duty points indicate selection criteria for solar pump

is required, three-phase power is available and the possibility of increased water demand need to be considered.

Why consider solar powered water pumping and why now?

The advent of solar power and other renewable power sources in the last couple of decades have seemingly complicate the user's life in deciding why, how and when to consider renewable power options. If you do not consider it, it seems that you are contributing to the planetary greenhouse destruction and if you do it costs a lot of money which does not seem recoverable. To top it all, no clear facts and measurable numbers regarding consumption, costs, operation and needs were available. That has all changed with the advent of SMARTA and the application of SMARTA technology to collect the right information at the right time. Not only is the past now clearly visible but the future and the viability of solar power (and other renewable energy options) are now becoming obvious.

The realisation that solar power and other

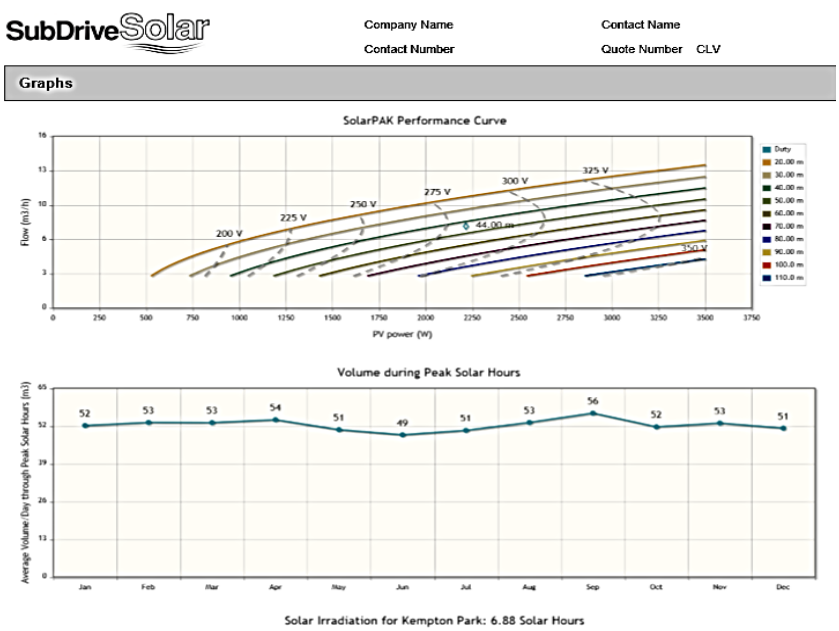

Figure 4 Solar pump selection

renewable application are already paid for (or shall we say "paid forward") simplifies the decision making considerably. What this means is that you now can own a solar powered pumping system *free of charge*! Correct, *free of charge*… how is this possible?

Consider the facts:

- You are already footing the electricity bill to ESKOM
- Solar power modules prices' have plummeted over the last decade
- SMARTA now shows you the way – past, present and future.

Solar pump selection and design

With a solar insolation of 6.5 PSH available the selected solar pump is required to deliver approximately 7.5kl/h at a TDH of 44m. A suitable solar powered pump was selected, making use of a selection programme to identify the correct pump, motor, controller and solar module array, as depicted in Figure 4. The selected pump pumps approximately 8kl/h at midday against a total dynamic head (TDH) of 44m and requires 2250W of input power. A suitable solar array was selected, made up of 265Wp solar modules.

The system is designed to supplement additional pumping time, should it be required, by making use of grid power. The redundancy incorporated in the design ensures that water required is always available, including periods of inclement weather. This approach makes the sizing, cost and return on investment optimal as well as ensuring independence of the grid and possible energy supply insecurity.

The envisaged solar powered pumping system is designed ensure maximum performance and reliability by making use of equipment (pump, motor and control gear) based on reliable borehole pumping equipment, supplied by reliable manufacturers and technology.

Installation will be done by a qualified installer, making the overall purchase experience completely turn-key and hassle-free.

Since the entire system is supplied by a single supplier, warranties and guarantees offered can be relied on allowing for financing and third-party insurance where and when required.

Cost of power and the return on investment (ROI) calculation

When it comes to the nuts and bolts SMARTA really stands and delivers. With the logged data it is possible to determine the actual cost of supply to the last cent. Over the lifetime of the system (from July 2017 to Nov 2018) the total electricity cost amounted to R17 734.85. This equates to a monthly cost (averaged over 12 months) of R1 071.00 per month. See Figure 5. This information can now be used to discount ongoing electricity cost against the cost of the envisaged solar powered pumping system to determine actual payback or return on investment (ROI).

A quotation, including ancillaries and installation was obtained, amounting to approximately R75 000.00 (excluding VAT). Considering only the cost of electricity, the CLV investment in the solar system will be paid off in 4-6 years, depending on how it is financed. See Figure 6.

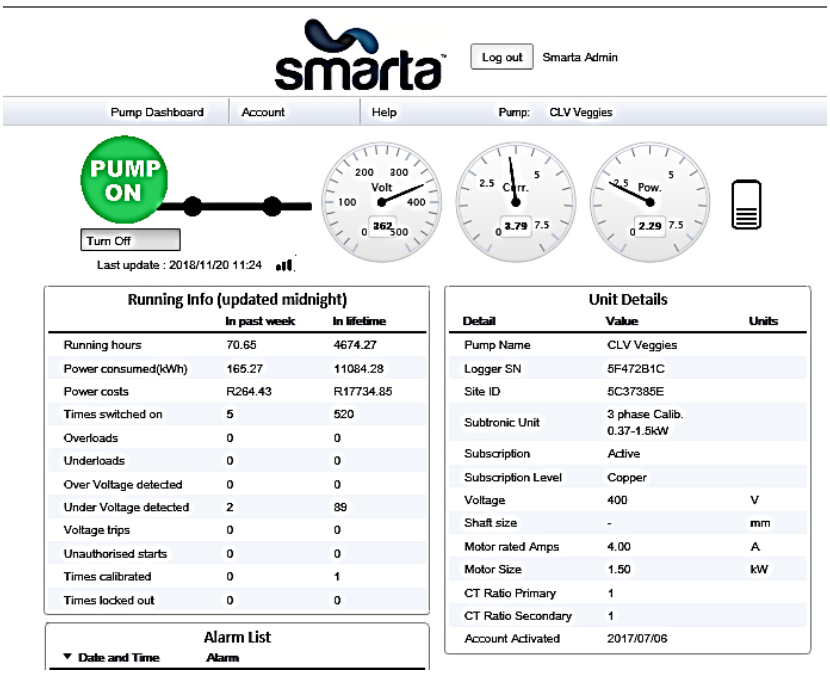

Figure 5 Cost of pumping water - return on investment calculation

Renewable energy system pays for itself		
Monthly cost of electricity		R 1 071
Yearly electricity cost increase		17%
Home loan interest rate		10.0%
Cost of PV system		-R 90 000

	Internal rate of return (IRR) when investing own capital		Internal rate of return (IRR) when using loan or home loan access bond	
	-R 90 000		-R 90 000	
Year 1	R 12 852	-171%	R 3 852.0	-191%
Year 2	R 15 037	-51%	R 6 036.8	-72%
Year 3	R 17 593	-27%	R 8 593.1	-48%
Year 4	R 20 584	-11%	R 11 583.9	-30%
Year 5	R 24 083	0%	R 15 083.2	-17%
Year 6	R 28 177	7%	R 19 177.3	-7%
Year 7	R 32 967	13%	R 23 967.5	0%
Year 8	R 38 572	16%	R 29 572.0	5%
Year 9	R 45 129	19%	R 36 129.2	9%
Year 10	R 52 801	21%	R 43 801.2	12%

Figure 6 Internal rate of return (IRR) calculations

For more information concerning your perfect water management system solution, call Pedri de Villiers on cell number 076-432-3013 or contact him by email on pedri@smarta.co.za