SOLARENERGY
& BATTERY STORAGE SOLUTIONS

# PROJECT CASE STUDY

# SOLAR PHOTOVOLTAIC ENERGY

# FOR WATER PUMPING

August 2020

## INTRODUCTION

Water pumping and irrigation on the farms represent perfect reliable applications to use Solar Photovoltaic Power. This is particularly true if one can rely completely on the sun to perform the task. Load matching, that's matching the load characteristic and the source of power, is the core of this successful flawless application. In this case the amount of water pumping can vary with the amount of incident solar radiation. The need for energy storage can be replaced with storing water in reservoirs or in dams for use at night and on cloudy days.

Many irrigation and pumping systems in Australia and around the world rely on solar power to accomplish them reliably, efficiently and at fraction of the costs of utility power or diesel generators. Small systems can use direct current (DC) produced by PV panels whereas most large systems use alternating current (AC) to run an AC motor coupled to a pump. Advances allowed the use of inverter - controller to convert DC current (and voltage) from the PV array to variable frequency AC supply. Special three phase motors coupled to special pumps can operate at variable voltage and variable speed. This is particularly advantageous to match the amount of power generated by the PV panels.

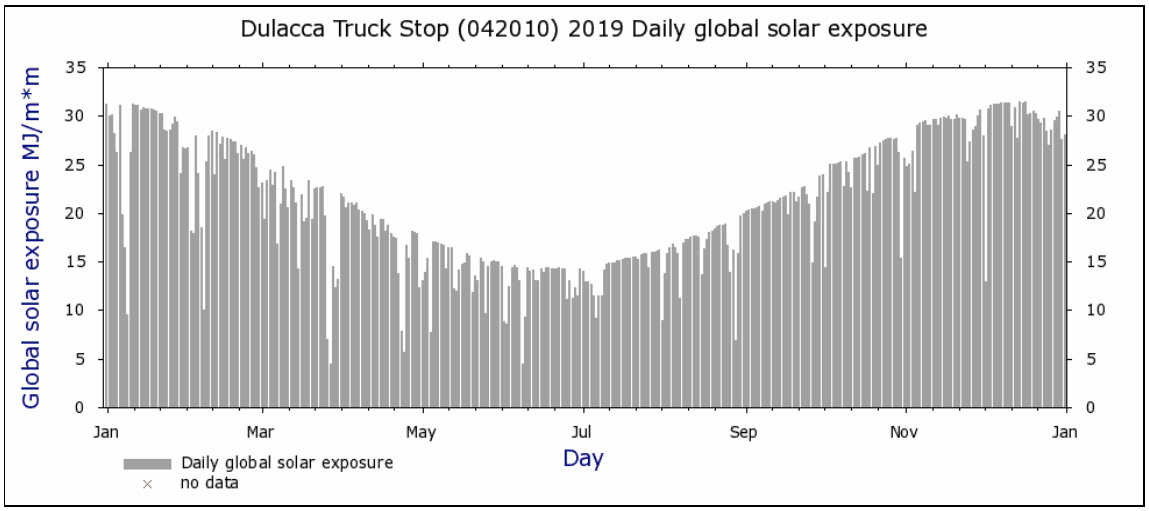
This report describes a case study of using a photovoltaic power system on a cattle farm to run a bore pump in Dulacca (26.6$^{o}$ S 149.7$^{o}$ E), Queensland.

## SYSTEM DESCRIPTION

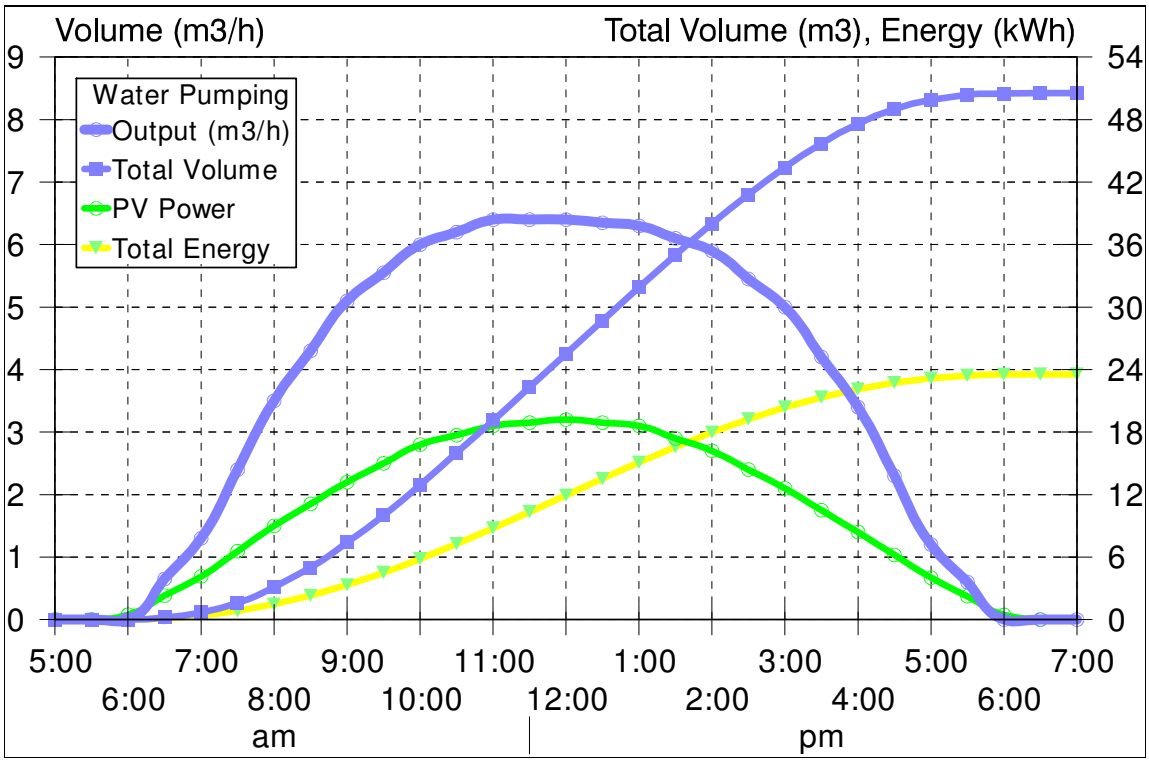
The solar pumping system is located in Dulacca and outputs 51 m$^3$ water per day (average) from a bore 53 m deep. The system is composed of a submersible pump driven by a 4 kW 3-ph motor. AC power is supplied to the motor via an inverter that converts DC power from a 4.32 kW PV array. The array comprises 16 PV panels 270 W each. The system stores enough water for four days.

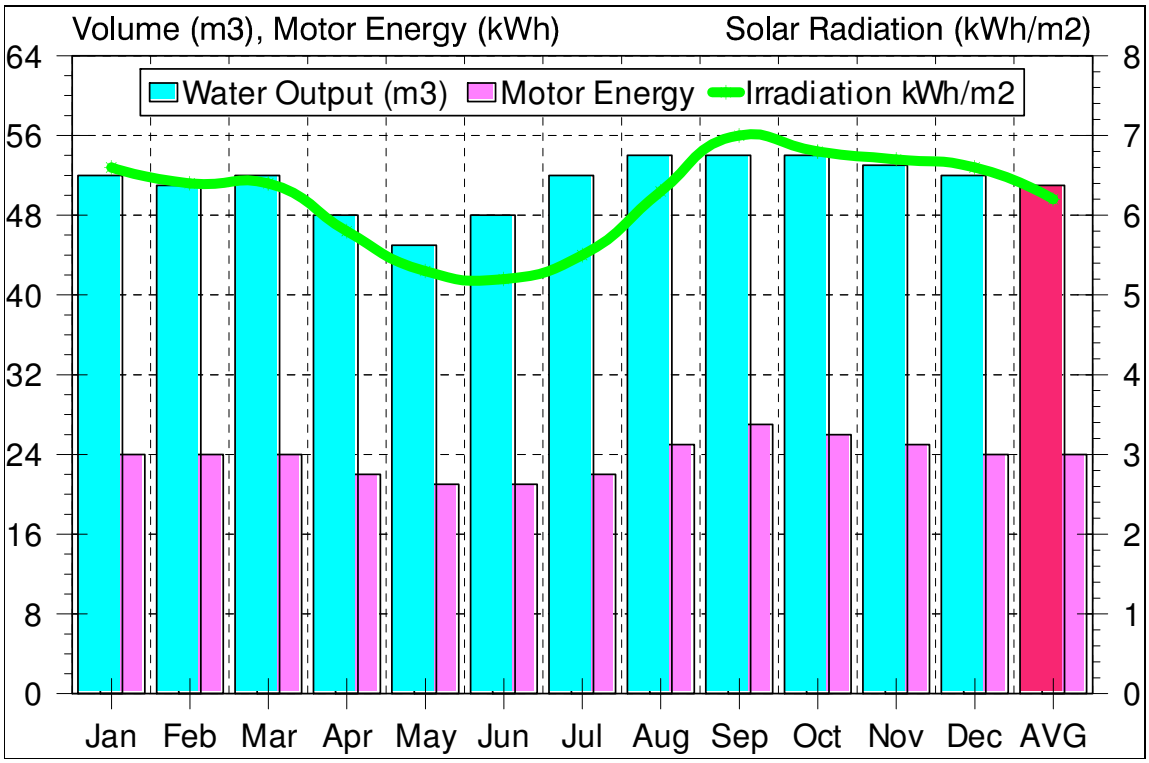
### Solar Radiation Data

The Bureau of Metrology gives the annual average global solar radiation at 5.8 to 6.0 kWh/m$^2$ for Dulacca (1990 to 2019). The annual average data are shown below in MJ/m$^2$.



The 4.32 kW power system produces an average 23.75 kWh. The following graphs give the performance of the system on average daily basis as well as the monthly average.



## CONCLUSIONS AND RECOMMENDATIONS

The performance of a solar water pumping system is amongst the highest in solar photovoltaic applications. Using Photovoltaic Energy for water pumping and irrigation makes perfect sense because of the inherent matching between the load (water pumping) and source (availability of solar radiation).

A backup generator can be incorporated if required for the purpose of night irrigation. In this case the system will switch automatically to a diesel generator to run the motor when there is insufficient PV output.

Experiences showed that a battery is generally not required with direct coupled variable speed motor-pump. A good approach is to oversize the PV system to supply and store sufficient for few more days depending on the solar radiation at the site.