Solar Water Pumping

Technical, Operational and Financial Considerations

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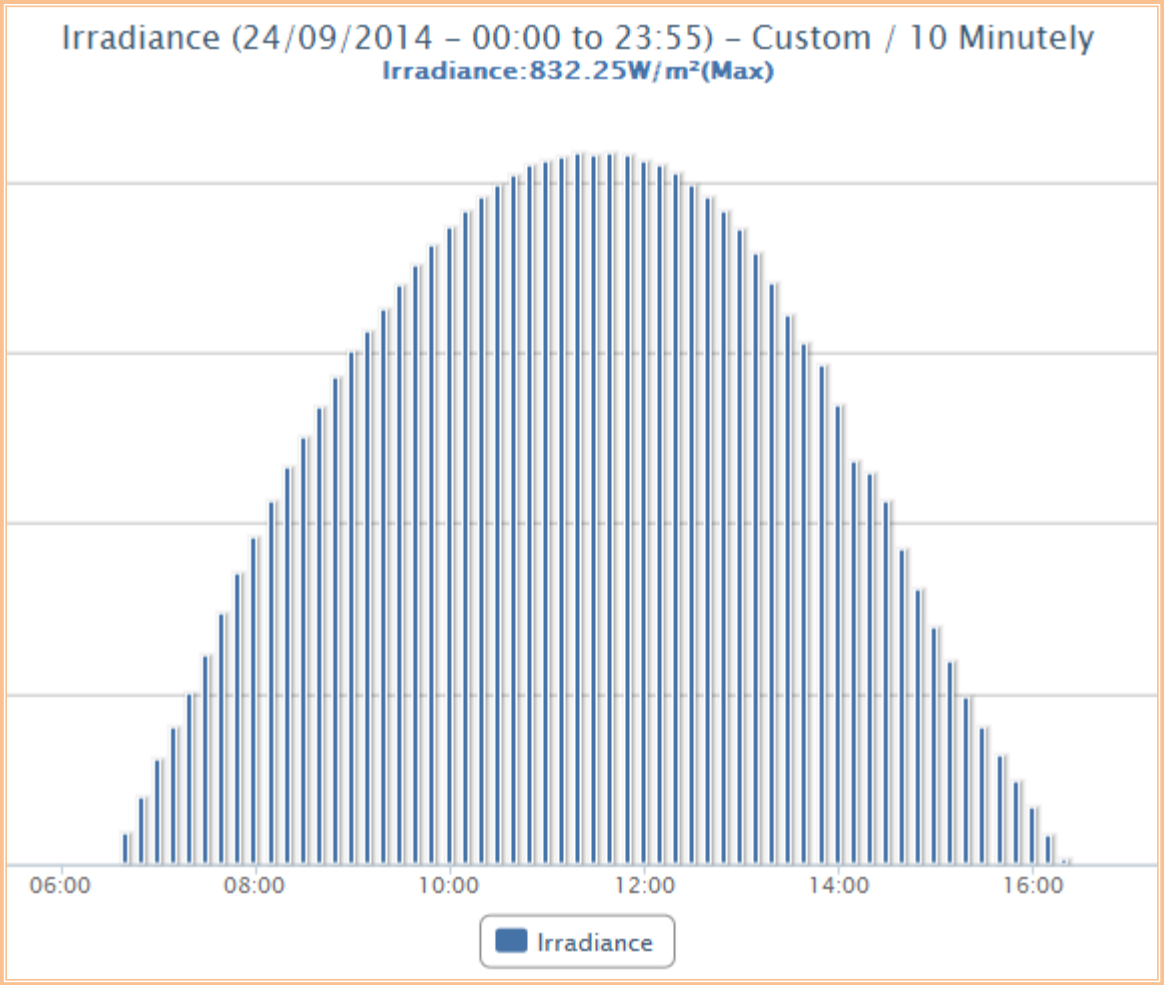
This Activity received funding from the Department of Industry and Science.

The sun's power is called Irradiance



- A clear sunny day
- Vertical axis is Irradiance as received by a solar panel parallel to the ground
- Horizontal axis is time
- Energy accumulates with Irradiance over time and is the area under the curve
- Solar panel output is a directly proportional to Irradiance
- The unit for Irradiance is the Watt per square meter W/m²

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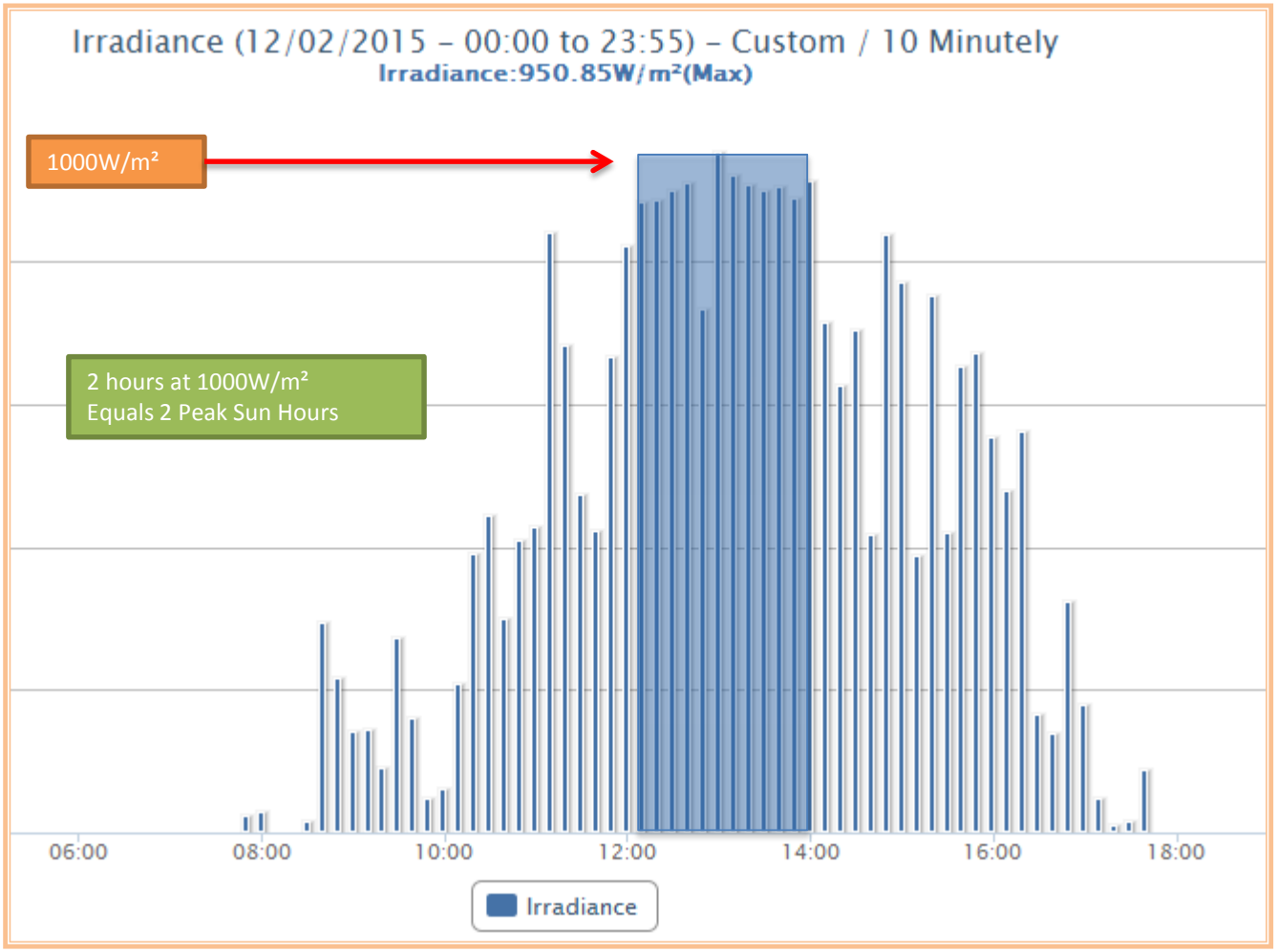
Peak Sun Hours



- Daily Irradiance is subject to seasonal variation and cloud cover.
- This Irradiance curve is a cloudy day
- Bunching the area under the Irradiance curve into an equivalent rectangle with a peak of 1000W/m² creates Peak Sun Hours (PSH)
- In this example 2 hours at 1000W/m2 is 2PSH
- PSH give us a number we can use to determine the solar resource at the site
- Solar panels are rated at 1000W/m². With PSH we can then work out how much water we can pump seasonally

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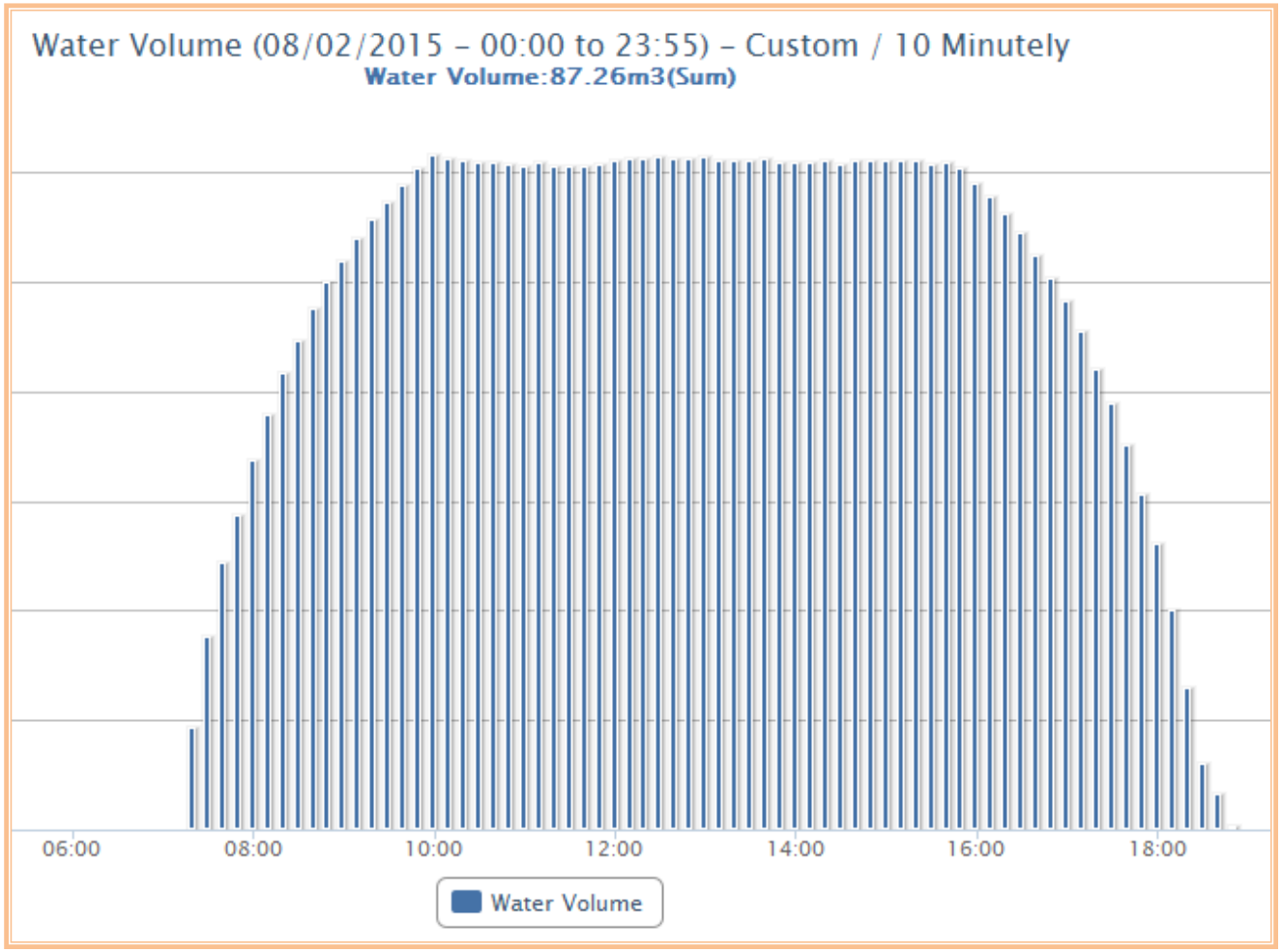
Pumping with the Sun



- Clear sunny day
- Water volume is directly proportional to Irradiance.
- Pump speed is varied by the drive inverter so as to match the most efficient solar panel operating point
- Once the pump is running at maximum RPM, the flow rate becomes constant
- In this case, the pump is running at maximum RPM from 10am to 4pm

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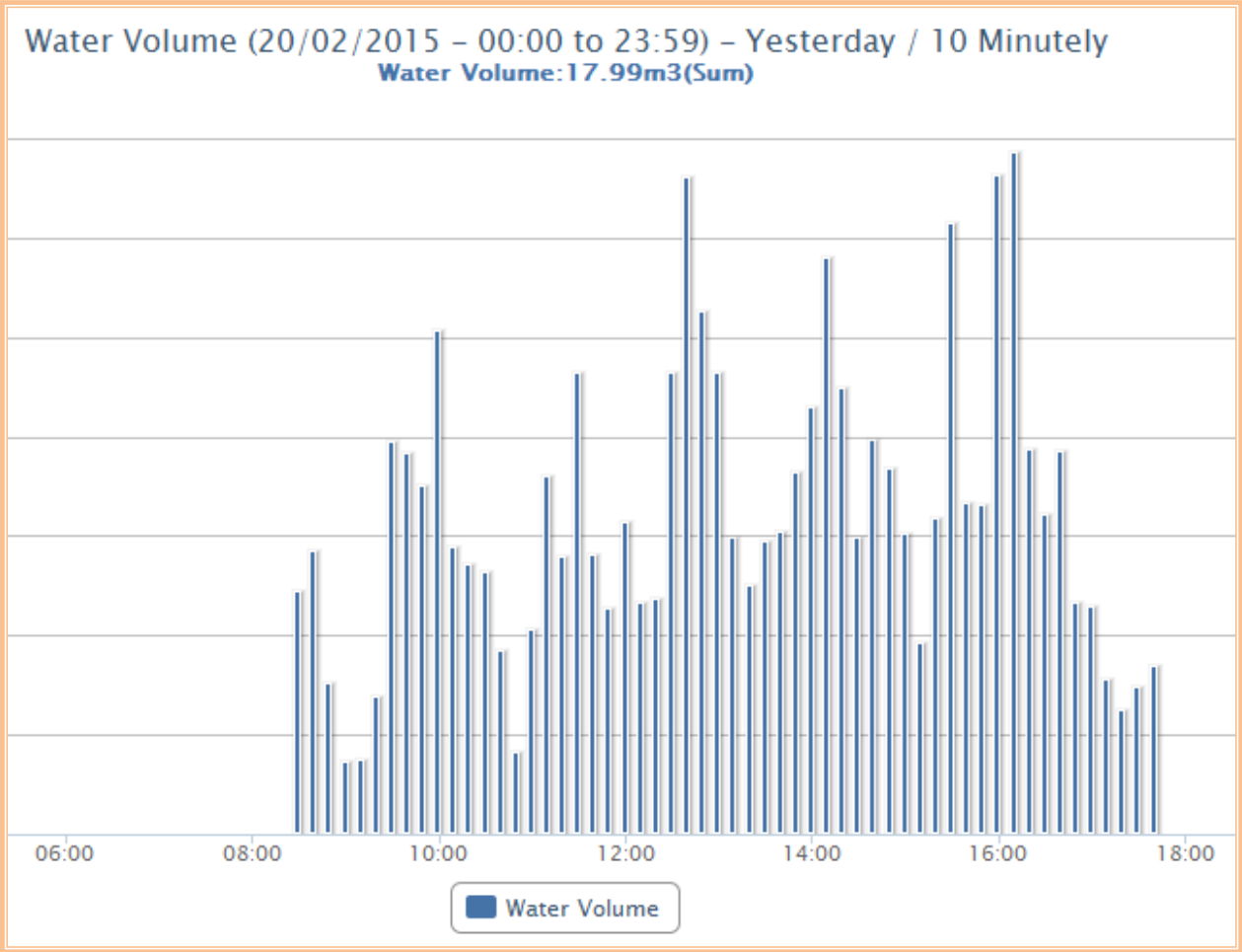
Pumping on a Cloudy Day



- Extreme cloudy day – 20Feb15 – with Cyclone Marcia remnants across Northern NSW
- Water volume is 18m³ which is around 20% of the normal volume pumped on a clear day
- Often, the heavy cloud brings rain anyway
- Solar panels lose power under clouds, but can still pump plenty of water
- Pump pressure is maintained, but flow rate drops as Irradiance drops.

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Trial Site – Bowraville - NSW

5.5kW Three Phase Pump – 60mtr Head – 600mtrs Distance – 7.2kW Solar Panel Array

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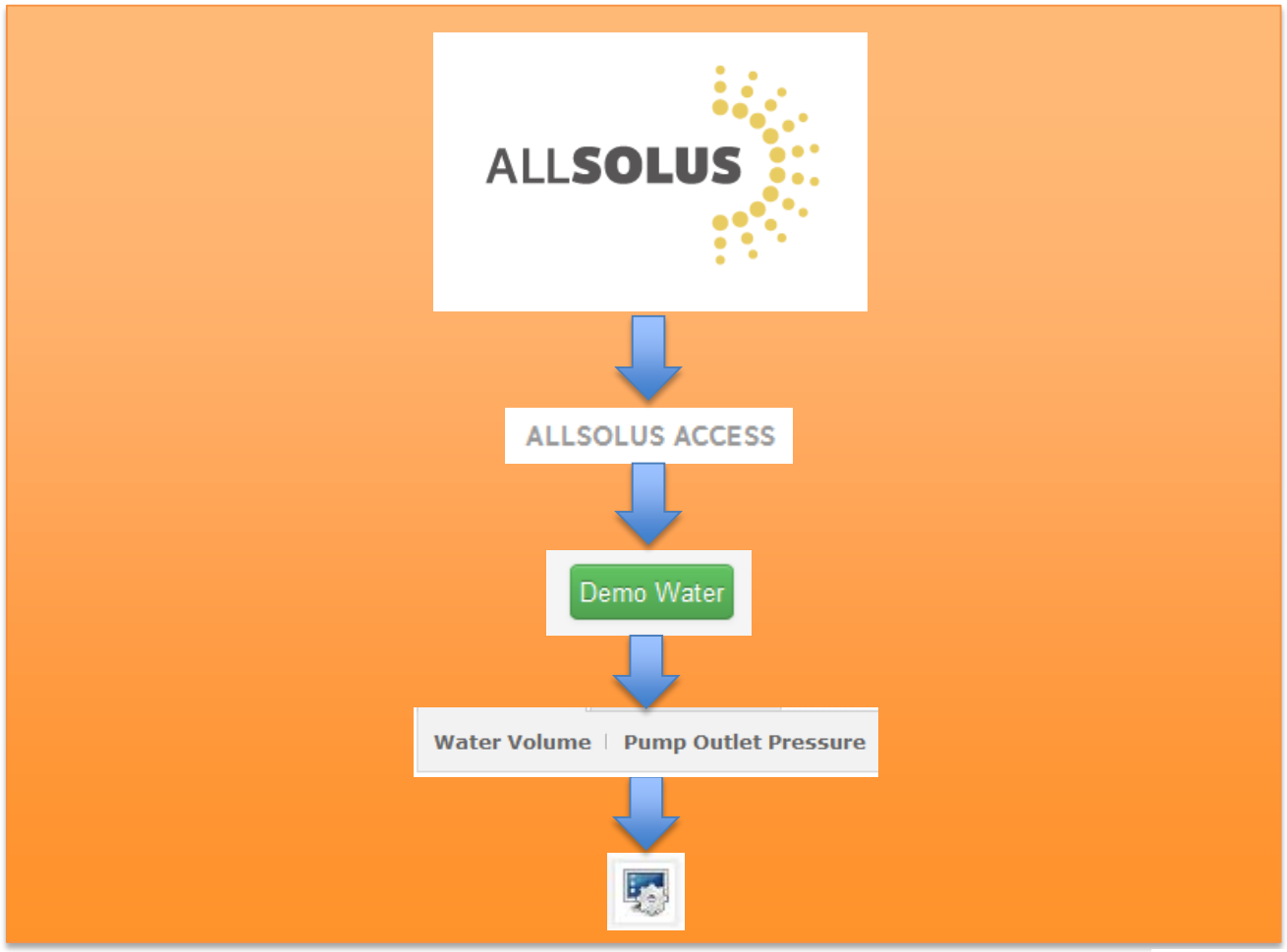
Live Performance Data Online



- Visit www.allsolus.com
- Click on Allsolus Access
- Click on Demo Water
- Click on the Dashboard to see various parameters
- Click on the Chart Period Selector to choose different days, weeks, or custom times.

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Will Solar Pumping Suit my Operations ?

- Key questions must be asked
- Will daytime pumping match the required cropping water profile?
- Maximum RPM pump output can be extended with single axis solar panel trackers
- Will a lower volume of water be acceptable on cloudy days?
- Is there a tank or reservoir available to store water to smooth out irrigation supply over the full 24 hours

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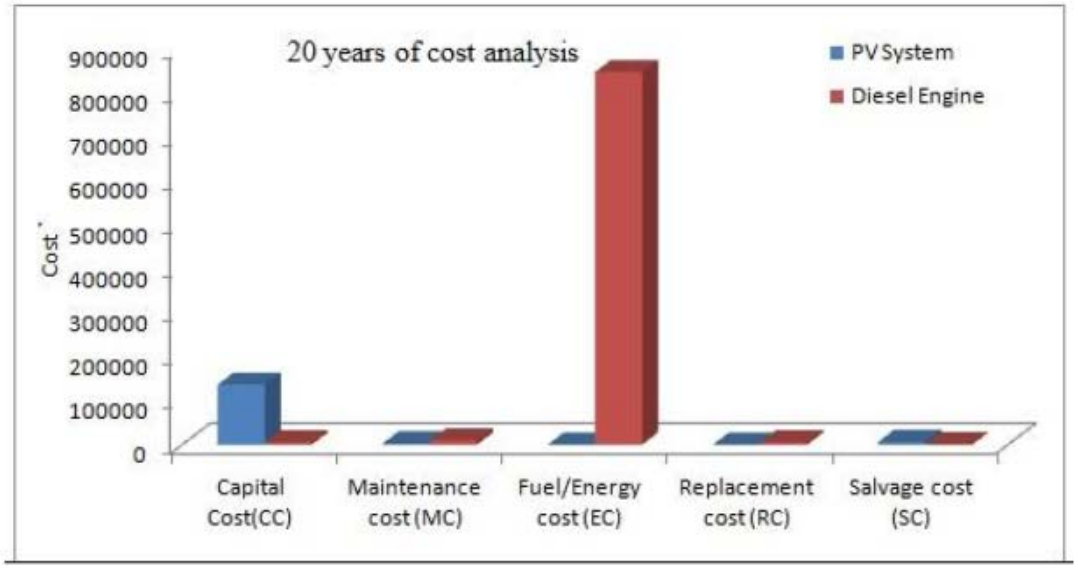
Financial Return

LCC = CC + MC + EC + RC - SC

- Life Cycle Cost = (Capital Cost + Maintenance Cost + Energy Cost + Replacement Cost) - (Salvage Cost)
- No contest in comparison to diesel, but remember that solar pumping is limited to 8 hours per day during the growing season so system sizing is critical and affects the LCC



Financial Return

- 20 year Life Cycle Cost Assumptions are:
- 8 hours pumping per day - 100 Days per Year - 20 Years
- 50kW electric motor - 50kW Caterpillar Diesel (17ltrs/hour at 100% load) - 65kW Photovoltaic Array
- Operating life of diesel is 10 years, operating life of solar is 20 years
- 20c per kWH grid electricity cost - $1.20 litre diesel cost - 70c per Watt STC government solar rebate
- Solar Pumping LCC is approximately 75% less than diesel and 50% less than grid pumping
- Critical point is the ZERO ENERGY COST with solar pumping

Cost Type	Diesel	Grid	Solar
Capital Cost (CC)	40,000	20,000	117,000
Maintenance Cost (CC)	40,000	400	23,40
Energy Cost (CC)	326,400	160000	0
Replacement Cost (RC)	40,000	0	0
Total Cost	446,400	180400	119,340
Salvage Cost (SC)	8,000	4,000	11,700
Life Cycle Cost (LCC)	$438,400	$176,400	$107,640

Summary

- Solar pumping is time restricted, daily requirement must be delivered in approximately 8 hours
- Tanks or reservoirs can shift irrigation time of day and smooth supply
- Electric pumps up to 375kW can be powered by solar panels
- The technology drives standard 3 phase 400 Volt AC electric pumps making retro fit to existing systems possible
- Extremely low Maintenance Cost and zero energy costs
- Brand new technology only available past 18 months
- Extremely low cost of high quality solar panels coupled with our new technology presents a significantly lower cost alternative than conventional diesel or grid pumping

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