Fact sheet May 2022

Floating solar: a case study approach for Goondiwindi, QLD

Aim: to understand the costs and benefits of installing a floating photovoltaic (FPV) array

The benefits of on-farm energy generation from PV is known – but can FPV also save water by reducing evaporation? How do these numbers add up?

Method

Three scenarios were explored using a case study site near Goondiwindi, QLD.

- Small scale (100 kW) off-grid
- Small scale (100 kW) on-grid
- Large scale (42,000 kW / 42 MW) on-grid

Approximately 10m^2 of surface area is needed per kW of FPV. The water storage in the analysis had a volume of 1000 ML and a surface area of 42 ha. The large scale scenario was designed to cover the entire surface of the storage.

The load profile was assessed to understand the adjacent energy demands. The scenarios consider supplementing the energy for an electric 5 ML/day bore with a dynamic head lift of 35 m. PV energy would be supplemented by the grid or an existing diesel generator in the off-grid scenario. The energy use reflects pumping 24/7 from 1st August to 31st March, and a total volume pumped of 1215 ML/yr.

FPV Costs

Capital outlay for the FPV system is assumed to be $1745 /kW for on-grid and $1920 /kW in the off grid scenario (reflecting the cost of technology required for to blend co-generated energy of PV and diesel generator). An installed cost of $1255 /kW is used for the large scale FPV.

Co-Benefits of FPV

- **Evaporation savings**
  Evaporation from on farm storages is one of the most significant loss components of the on-farm water balance for cotton farms.

Avoided evaporation is estimated at 13.7m^3 of water per kW of FPV installed

- **Carbon abatement**
  When energy from the FPV is utilised, it avoids the consumption of fossil fuel and its associated emissions.
- **Avoiding use of prime land for solar**
  FPV removes the concern of converting productive agricultural land to a utility site.

Scenario 1: Small scale (100 kW) on-grid

The existing bore utilises cogenerated energy from the FPV and grid. Excess energy is sold to the grid with a feed in tariff (FIT).

Upfront investment:	\$225,240 *
Net present value:	\$100,933
Internal rate of return:	14.8%
Payback period:	7.3 years
Reduced emissions intensity:	59 kg CO_{2e} /bale lint**

**Includes; FPV, grid connection costs of \$58,000 and salvage value of the existing diesel generator -\$7,260*
***Includes offsets from grid export*

The FPV installation in this scenario successfully reduces the cost of energy, reduces evaporation and the emissions intensity of outputs produced.

Results are most sensitive to the capital cost of the installation, the projected value of the avoided diesel fuel and the value of the FIT.

Scenario 2: Small scale (100 kW) off-grid

The existing bore utilises cogenerated energy from the FPV and existing diesel generator.

Upfront investment:	\$191,950 #
Net present value:	\$27,844
Internal rate of return:	11.9%
Payback period:	8.4 years
Reduced emissions intensity:	28 kg CO_{2e} / bale lint

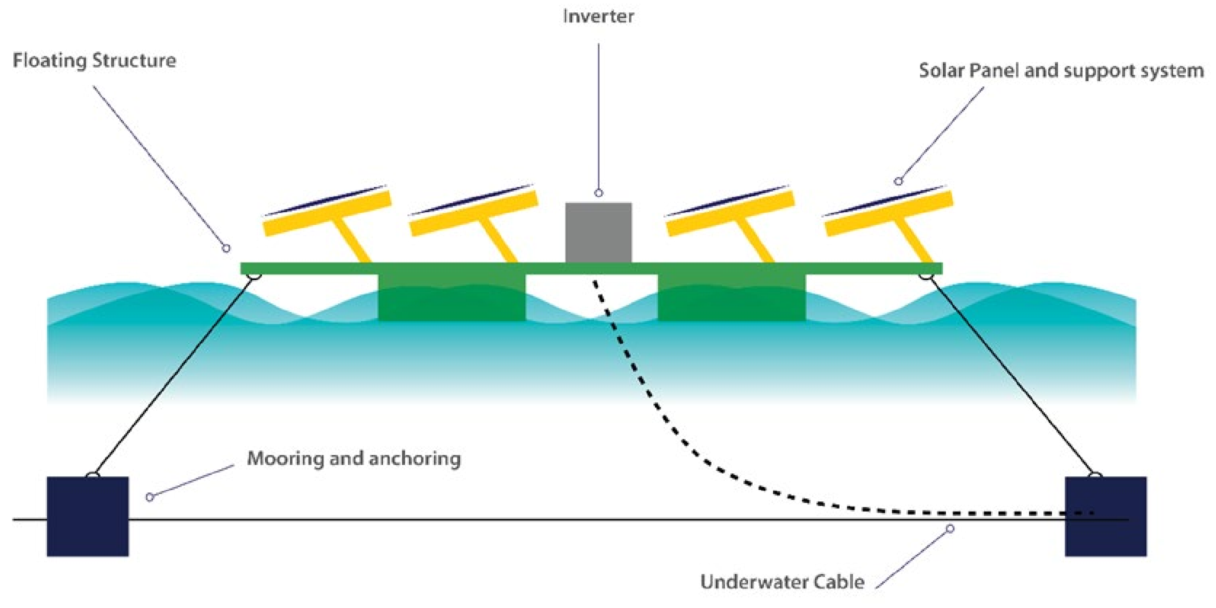
#Includes; FPV.

The inclusion of diesel energy in the off-grid FPV scenario limits emission savings. However the healthy IRR and payback period suggests it is a viable option where grid connection is not possible.

Results are most sensitive to the capital cost of the installation and the projected cost increase of diesel fuel.

Small scale (<100 kW) PV installations have the benefit (until 2030) of STCs that reduce capital costs.

Figure 1: Floating photovoltaic array



Scenario 3: Large scale (42 MW) on grid

The existing bore utilises cogenerated energy from the FPV and grid.

Upfront investment: $66 million
Evaporation savings: 575 ML/year

"A large scale FPV system requires significant capital investment, expertise and proximity to the electricity transmission network. It would likely need to be built in partnership with a renewable energy developer" *Jon Welsh*

Further factors for consideration

- The results of the small scale scenarios were not particularly sensitivity to assumptions that decreased solar yield such as the cooling effect of the water.
- Small scale scenarios are based on 8 months of daylight hours pumping, the results improve with a longer pumping window and deteriorate with a shorter pumping window.
- In the off-grid scenario, outside the pumping window FPV energy is not being utilised. As with all PV installations, economic returns increase with utilization.
- Practical considerations may be around desilting and/or ensuring the array does not get stuck in the silt of an empty storage.

For further information:

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