Is There a Role for Offshore Wind Power in Renewable Hydrogen Production in Australia?

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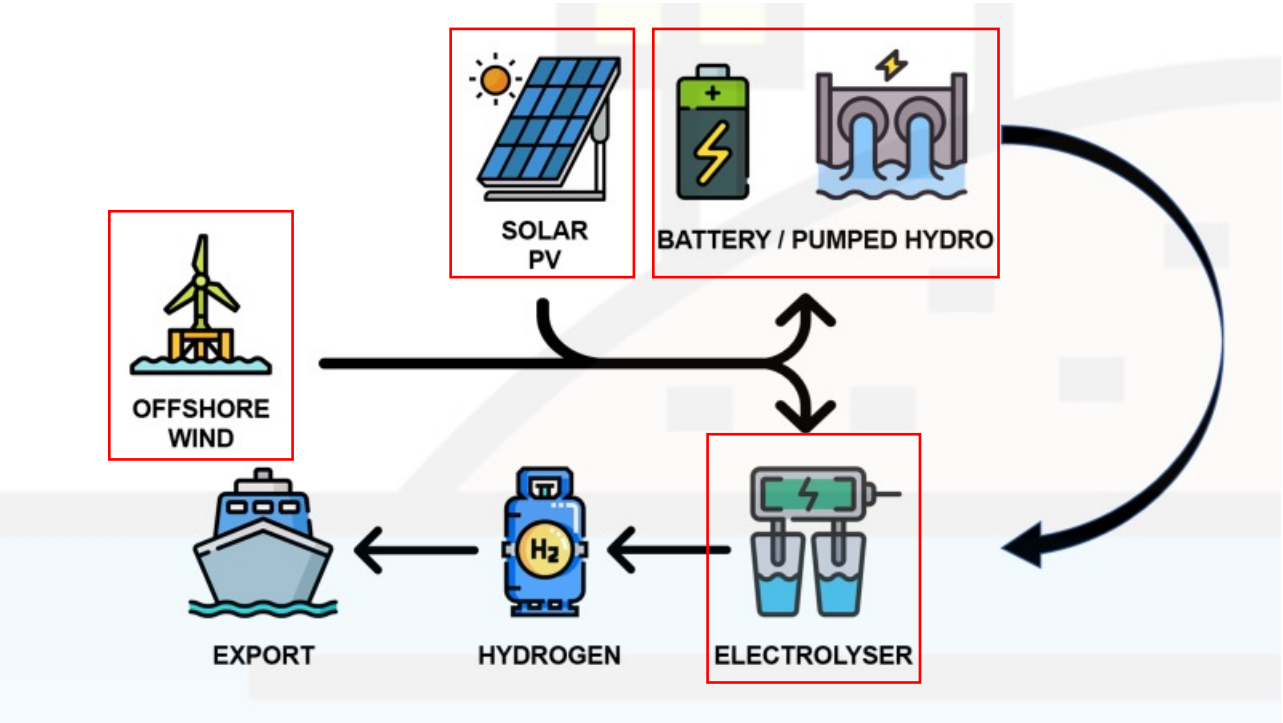
The Hydrogen Production System

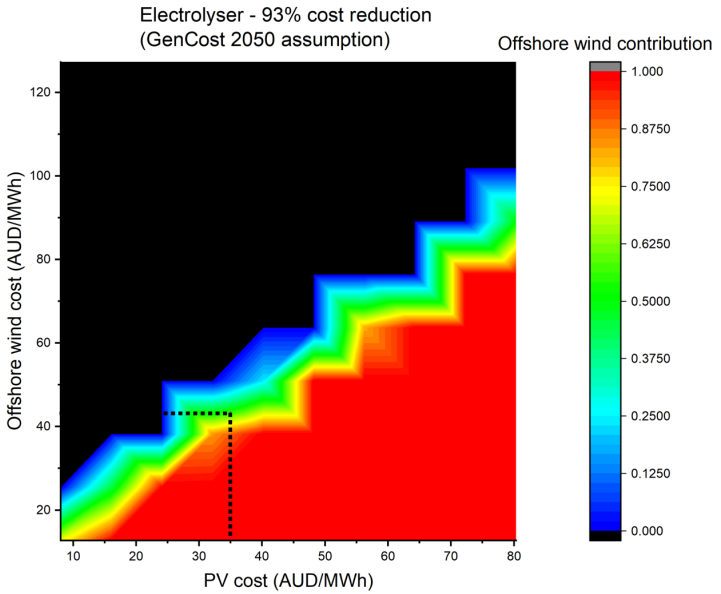


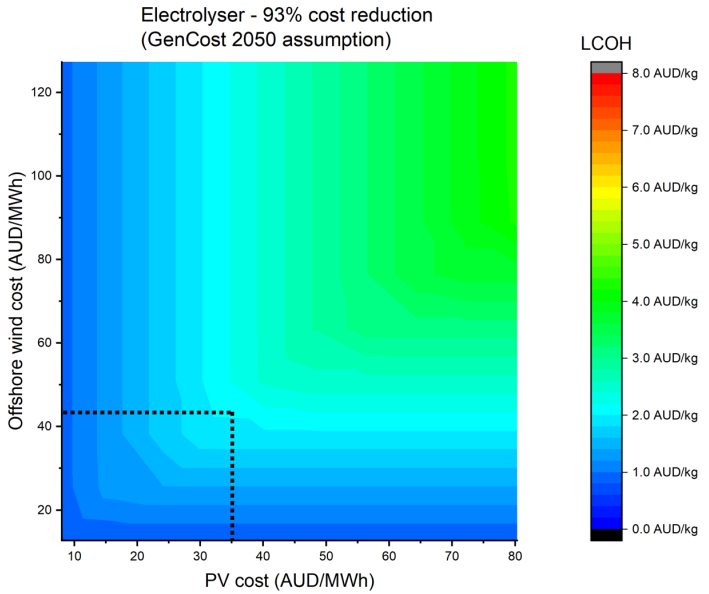
- Off-grid system
- Offshore wind and onshore solar PV supply electricity
- Battery / pumped hydro as electrical storage
- Located near ports for export purpose
- Optimizes offshore wind, solar PV, storage and electrolyser capacity for least-cost hydrogen production

Varying-costs scenario

- Assumption-free analysis covering a wide range of future cost reduction scenarios
- Electrolyser cost reduction: 20%, 40%, 60%, 80%, 93% from 2020 level

AUD2/kg can be achieved with solar PV costing AUD35/MWh and offshore wind costing AUD43/MWh





Conclusions

- Reducing electrolyser costs is crucial to reduce the cost of green hydrogen sufficiently to enable it to compete on international markets.
- Offshore wind has a potentially useful role to play in supporting hydrogen production.
  - Potential land use or other above ground factors that limit solar PV (or onshore wind) deployment.
  - Offshore wind can smooth out variable generation from solar PV because they are usually negatively correlated.
- The role for offshore wind falls with lower electrolyser costs, because it is of increasingly less value to maintain high electrolyser capacity factor.

Annex: Modelling assumptions

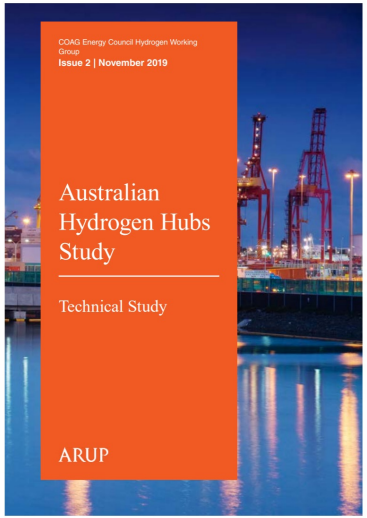
GenCost Assumptions:

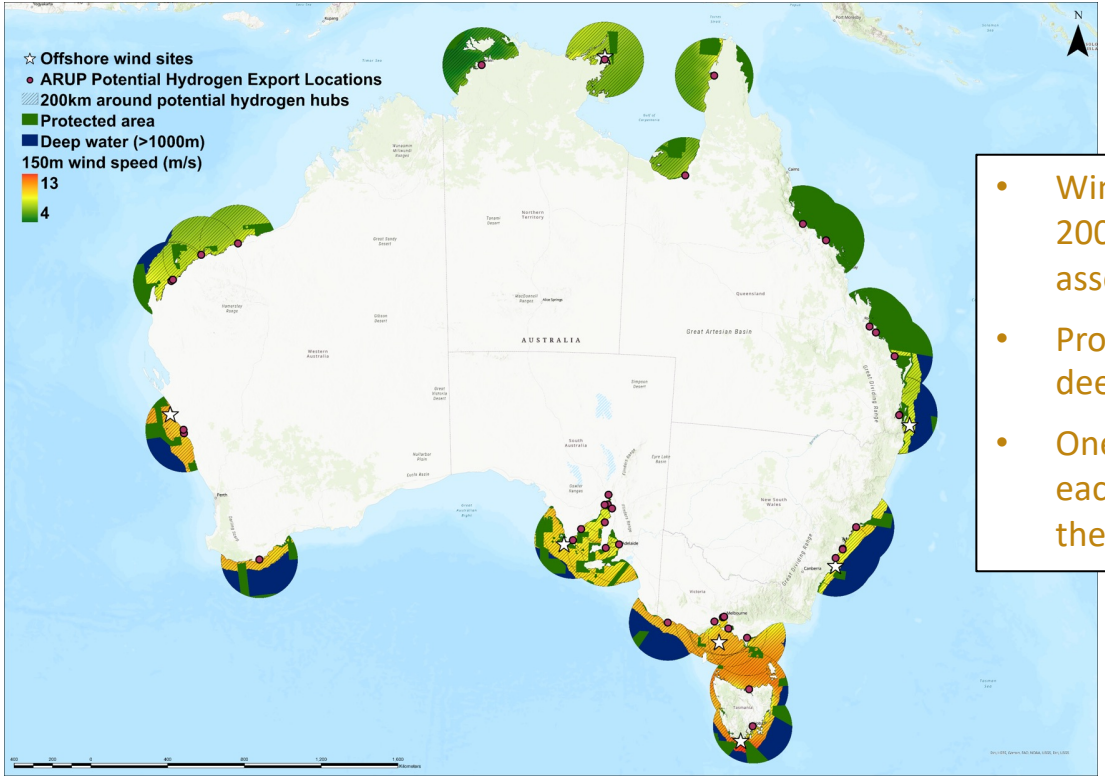
	Capital (AUD/kW)	Fixed O&M (AUD/kW p.a.)	Variable O&M (AUD/MWh p.a.)	Economic life (years)
2020				
Large scale solar PV	1,505	17	-	25
Offshore wind	5,771	158	-	25
PEM electrolyser	3,510	105	-	25
2030				
Large scale solar PV	824	17	-	25
Offshore wind	2,336	64	-	25
PEM electrolyser	923	28	-	25
Real discount rate: 6%				

Electrolyser efficiency: 62kWh/kg in 2030

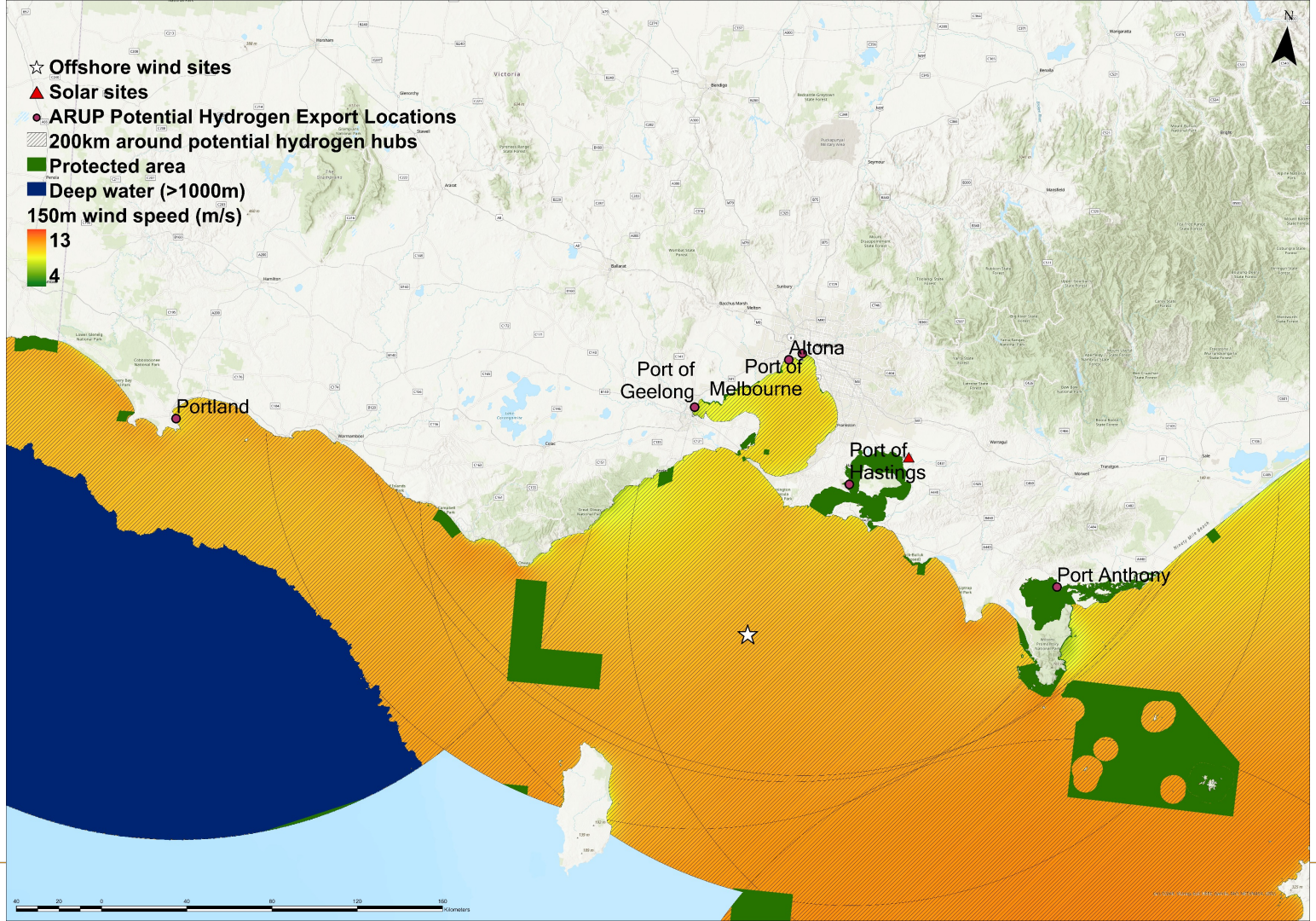
(linearly increasing from 70kWh/kg in 2020 to 45kWh/kg in 2050)

Annex: Site Selection





- Wind resource within 200km of each ports is assessed
- Protected areas and deep water removed
- One site selected for each state excluding the ACT


Offshore wind sites
Solar sites
ARUP Potential Hydrogen Export Locations
200km around potential hydrogen hubs
Protected area
Deep water (>1000m)
150m wind speed (m/s)
13
4
N
Altona
Port of Geelong
Port of Melbourne
Portland
Port of Hastings
Port Anthony
Victoria
Ballarat
Bendigo
Hamilton
Warrnambool
Colac
Sale
Traralgon
Wangaratta
Seymour
Melton
Sunbury
Kilometers

State	Port name	Offshore wind				Solar PV	
		Lat	Lon	Water depth (m)	Port distance (km)	Lat	Lon
NSW	Port Kembla	-34.82	150.95	98	41	-34.47	150.89
NT	Gove (near town of Nhulunbuy)	-12.05	136.69	24	16	-12.23	136.51
QLD	Brisbane (Gibson Island)	-27.81	153.76	95	76	-27.43	153.14
SA	Port Lincoln	-34.91	135.37	88	50	-34.72	135.83
TAS	Hobart	-43.65	146.72	29	98	-42.88	147.30
VIC	Port of Hastings	-39.05	144.77	70	85	-38.23	145.52
WA	Oakajee	-27.81	114.01	46	106	-28.60	114.61

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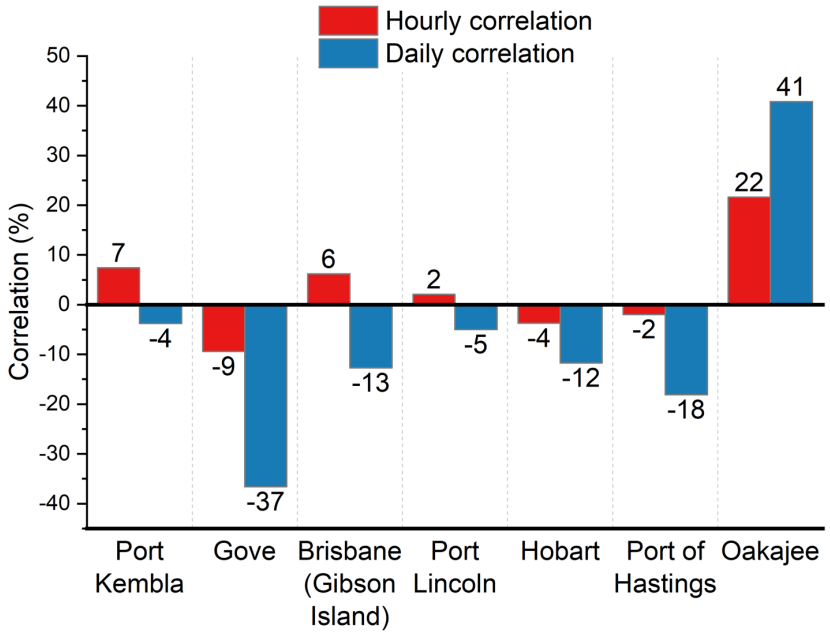
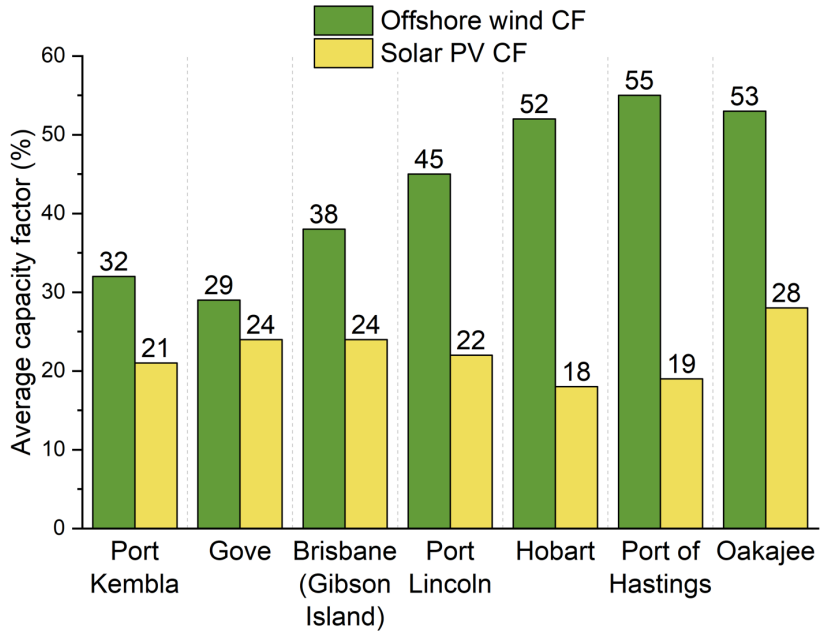
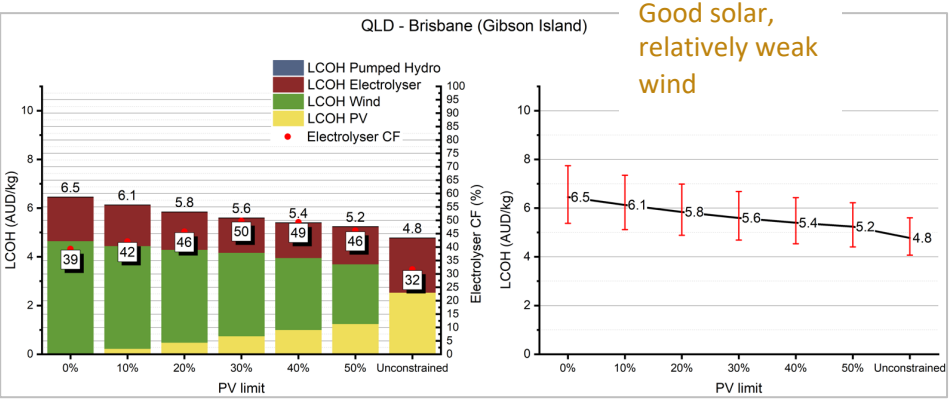
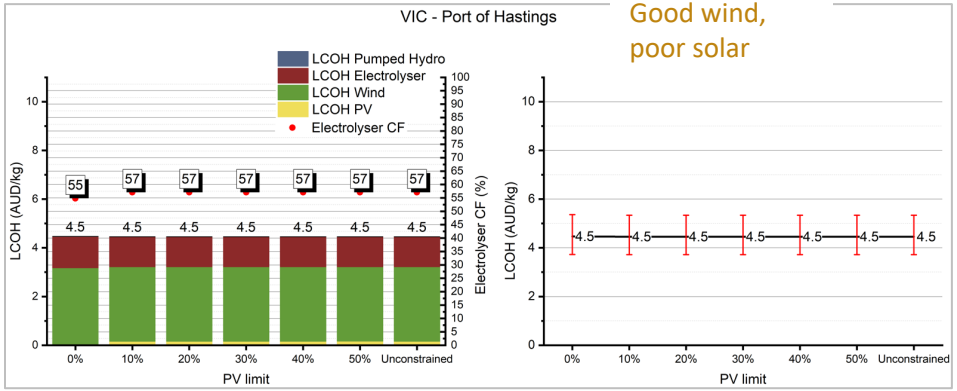




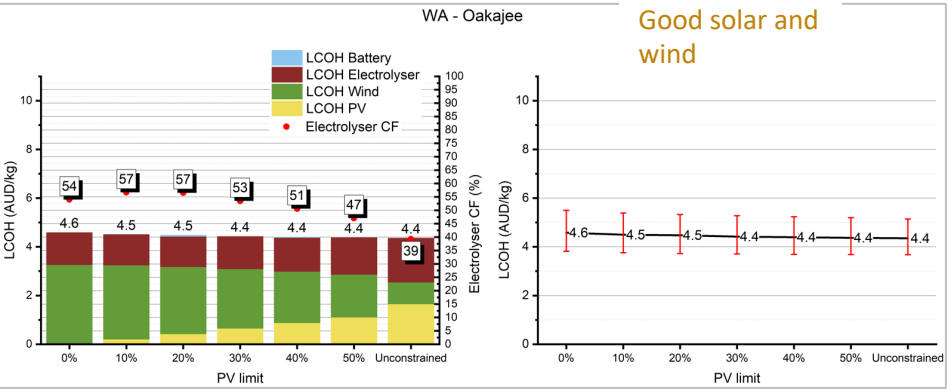
Annex: 2030 PV-Constrained scenarios



Good solar, relatively weak wind



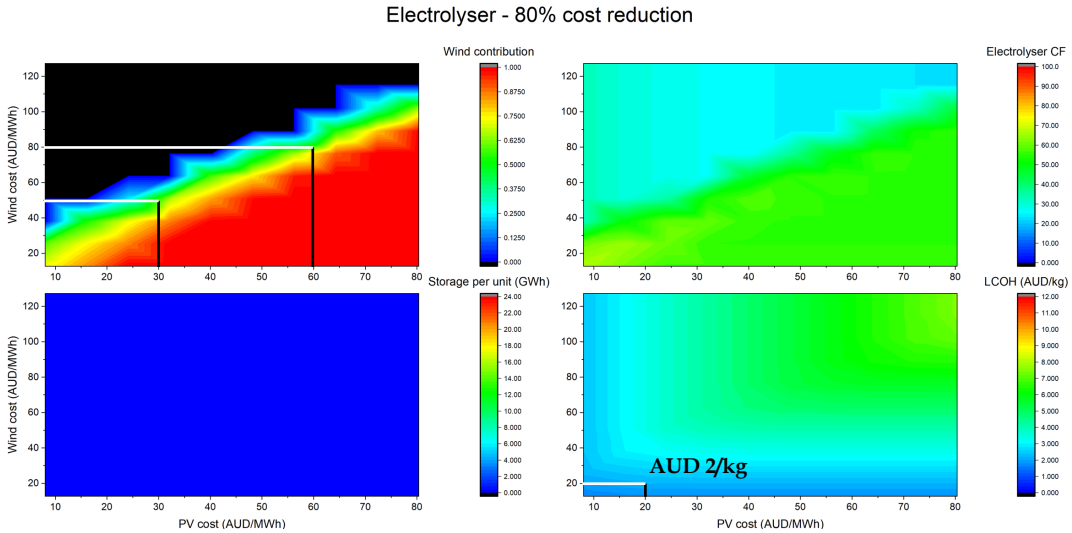
Good wind, poor solar



Good solar and wind

- Offshore wind has an useful role to play in regions with good offshore wind resources (CF > 45%).
- Challenging for offshore wind in regions with poor to moderate offshore wind resources (CF < 40%).
- LCOH in the unconstrained systems ranges between AUD4.4–5.5/kg across sites

Annex: Varying-costs scenarios



- The role for offshore wind falls with lower electrolyser costs
- In the ‘worst-case’ for offshore wind: it need to reach AUD50-80/MWh to achieve 40%-60% contribution, for a solar PV cost ranging between AUD30-60/MWh
- Both offshore wind and solar PV need to reach AUD20/MWh to achieve AUD2/kg

Annex: Simulation