Conclusions

This study shows that there is an excellent opportunity to move from mostly gas generation to predominantly renewable energy generation at the conclusion of the existing LNG generation contract in 2027. This will involve a mix of solar farms and rooftop PV, with relatively large amounts of battery storage.

The appropriate mixture of utility and rooftop PV for Broome cannot be determined at this stage. Further detailed analysis will need to be undertaken by Horizon Power, to determine how much rooftop PV can be effectively installed and managed. However, key to this will be the timely deployment of battery storage. Detailed planning for this should start in 2023.

Costings

We compared the costs of an 82% RE solution with replacing the gas generation facility. Total lifetime savings of $321m can be achieved by an extra up-front capital expenditure of $72m.

This would be cost effective and make a rapid and solid start on the decarbonisation journey in Broome in line with Australia's international decarbonisation commitments.

$321M
Lifetime Savings

Expenditure	82% RE solution	Replacement LNG	Difference
Capital cost (up front)	$126m	$54m	-$72m
Lifetime costs (25 years)	$636m	$957m	$321m

Recommendations

Horizon Power should:

1. perform detailed studies to determine the optimal mix of rooftop and utility PV in a high RE scenario for Broome, including the maximum amount of rooftop PV that such a scenario can accommodate.
2. design the battery plants to ultimately accommodate 160-170MWh of battery capacity.
3. engage with the Yawuru PBC for partnering opportunities
4. engage in consultation with the Broome community about how best to roll out RE.

i The technology generation cost assumptions used in this study are taken from the CSIRO/ AEMO GenCost 2020/21 study, validated by a GHD study. Capital costs have been scaled upwards by both a remoteness factor and an extreme weather factor appropriate to the Kimberley.
A relatively conservative carbon price of AU$60/tCO2-e was applied as the base case.
A range of models were run with varying amounts of PV, optimising for battery capacity to achieve the lowest LCOE for each level of PV.

ii Levelised Cost of Energy (LCOE) was used to compare various combinations of technologies across their expected lifetimes. The LCOE can be regarded as the average minimum price at which electricity must be sold in order to break-even over the lifetime of a project.

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We acknowledge the report was produced for the lands of the Yawuru Native Title holders.

Front cover image: Paul Bell

Broome Clean Energy Study

KEY FINDINGS

This report demonstrated that electricity generation in the town of Broome can be achieved with over 80% renewable energy at three quarters of the price of gas-fired (LNG) generation. This will achieve total lifetime savings of $321m.

BROOME'S Electricty Generation achieved with **>80%** Renewable ENERGY Costing less than **3/4** Price of LNG Generation

SEN
Sustainable Energy Now

Summary

Broome's clean energy future looks bright, with this new report identifying lower cost, renewable energy pathways for the Kimberley town to transition away from its current heavy reliance on LNG for generation.

The report identified that:

- The optimal cost scenario is with 60MW of solar PV (photovoltaics), achieving an average cost (LCOE) of $215/MWh which is 73% of the cost of the gas-only scenario ($293/MWh). This scenario requires 40MW/160MWh of 4 hour battery storage and leads to an 82% reduction in LNG use and associated carbon emissions.
- The remaining small amount of gas required may be replaced with hydrogen-fuelled generation once the export hydrogen industry matures.
- Gas generation costs are strongly sensitive to variations in carbon and fuel prices.
- During the Dry season, solar PV and batteries can provide almost all power needs for Broome, with a small amount of gas generation needed during the Wet season.
- It is not currently cost-effective to reach 100% renewables with just solar PV, batteries (and wind) in Broome. Seasonal factors are important, where increasing amounts of renewable energy is spilled (not used) in the Dry season.
- It is possible reach over 80% of RE through a mixture of utility and rooftop PV supported by battery plants. This will enable all Broome residents to install rooftop solar PV, supported by Horizon Power's Distributed Energy Resources Management System (DERMS) technology.

Modelling Outcomes

Powerful, new modelling software with conservative assumptions[i] was used in this study.

The modelling results were derived from optimising 4 hour battery storage with varying amounts of solar PV. There are multiple scenarios where the LCOE differs by only $8/MWh (4%) across a range of PV capacity of 40MW, 50MW, 60MW and 80MW, respectively.

Further modelling showed that there is no improvement from adding wind to the generation mix.

PV (MW)	40	50	60	80
LCOE ($/MWh)	$220	$216	$215	$223
Battery (MWh)	70	130	160	164
LNG (MW)	30	30	30	30
RE % of Total Load	58%	72%	82%	88%
Lifetime Emissions (tCO_2-e)*	44,834	32,278	24,457	20,756

* Current emissions are 95,630 (tCO_2-e)

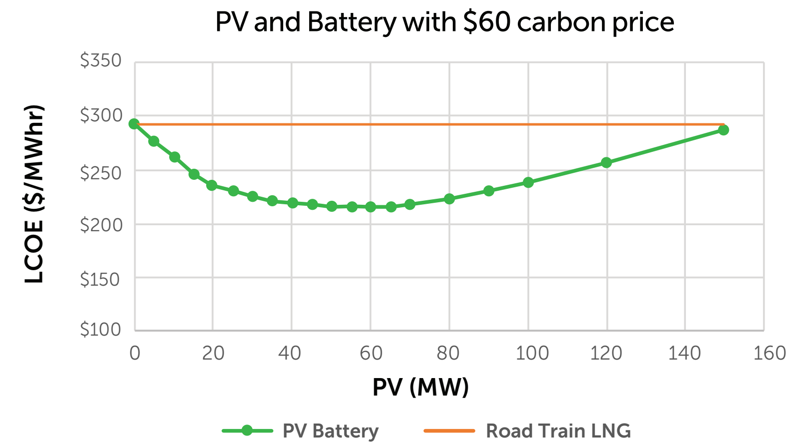
Explainer:

The costs of electricity is made up of four main components: wholesale; retail; distribution and system security.

The costs discussed here are only for wholesale electricity, expressed in $ per megawatt hour ($/MWh). $100/MWh is equivalent to 10c per unit of electricity (kilowatt hour).

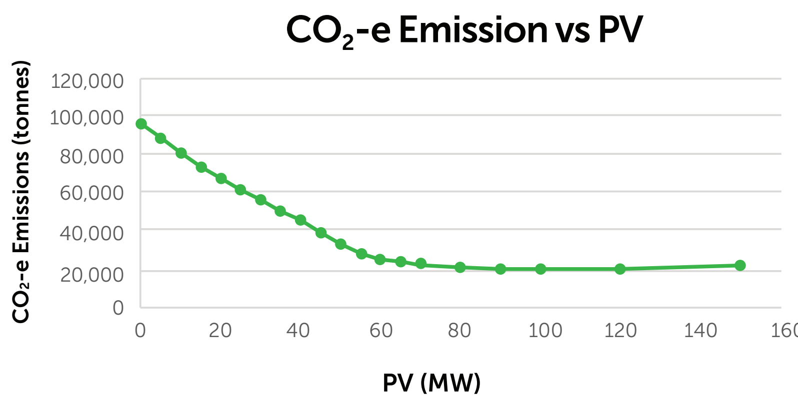
Costs are presented as the average cost over the lifetime of a plant (usually 25 years) – technically known as the Levelised Cost of Energy[ii] (LCOE).

Electricity costs in Broome are subsidised by the state government to be comparable to those in the south west.

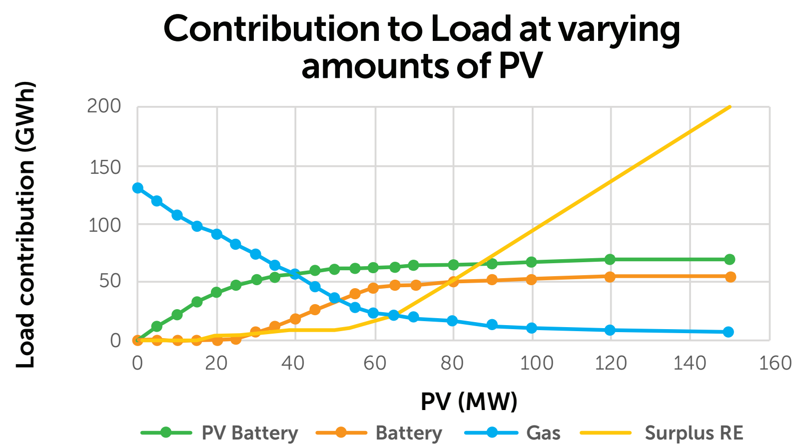


This figure shows the trend in LCOE for a range of PV capacities, with a carbon price of $60 per tonne.

It clearly shows the cost reductions compared to modelling of the existing LNG-fuelled generation – up to 27%.



CO_2 emissions reduce approximately linearly from approx. 100,000 down to around 20,000 tonnes CO_2-e as the PV capacity increases.



An electricity system has to meet the load put on it by consumers. This figure shows the contributions to meeting load across the year for PV, Battery and LNG, as well as the surplus (or spilled) generation as the amount of PV increases. Gas use decreases steeply to approximately 60MW of PV. PV's direct contribution to load increases steeply to around 20MW, after which increasing amounts are passed into the battery storage.

The amount of surplus energy increases almost linearly from around 60MW of PV. This energy is typically 'spilled', but it represents an opportunity for use in the dry season.