PACIFIC POWER ASSOCIATION

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Rooftop PV in the Efate Grid, Vanuatu A Preliminary Study

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Project Consortia





Australian Government

Department of Climate Change, Energy, the Environment and Water









Collaboration on Energy and **Environmental Markets**

1. Advise on the development of appropriate Standards and Connection Agreements

Scope

- 2. Examine tariff design approaches to encourage the adoption of rooftop solar PV and manage associated risks
- 3. Undertake a high-level assessment of the technical potential for generation from rooftop PV





Existing rooftop PV

Created a Google Map of all the rooftop systems in Vanuatu

Created a spreadsheet estimating the total capacity

- About 530kW residential (up to 650kW)
- About 1.28MW commercial (up to 1.32MW)
- Total about 1.8MW (up to 2.0MW) about 7% of total capacity

One <u>estimate</u> of the potential for all Vanuatu is about 33MW rooftop solar PV, which could generate about 28GWh/year This does not take into account network restrictions! Also limited by quality of roof structure Estimated total generation (assuming no curtailment)

- About 434MWh residential (up to 506MWh)
- About 1,036MWh commercial (up to 1,061MWh)
- Total about 1,470MWh (up to 1,570MWh) about 1.6% of total generation

However, some of this would be curtailed and so the actual % would be lower



Data collection

Voltage impacts

Network voltage is unknown, as is the impact of rooftop PV systems on Voltage Need to assess V at different parts of the network (top, middle and end of feeders) and at different times of the day Install Dataloggers (As part of detailed Study) Develop a LV network map using DIGSilent Power Factory Can the DOE request Voltage data from Utility



Financial impacts

Impact of rooftop PV systems on Utility revenue is unknown Obtaining load and PV generation data from ~50 PV systems, possibly more Calculate impacts of different tariffs, including on revenue



Regulatory issues

1 Subsections 1B(1) and (2)

Repeal the subsections, substitute

- "(1) A concessionaire must receive the supply of electricity from an independent power producer or a person under section 4A.
- (2) A concessionaire in receiving the supply of electricity under subsection (1), must enter into a power purchase agreement with the independent power producer or a person under section 4A."



Rooftop PV Fluctuations

• Solar PV generation can vary during the day due to cloud cover, which can increase the variability of the load as seen by centralised diesel generation.

• Shows the solar generation from a rooftop solar PV system on the same days



Clement_July 2024 Voltage Distribution

10 11 12 13 14 15 Hour of Day

Tivr_July 2024 Voltage Distribution

ChrisGauthierColes_July 2024 Voltage Distribution

RockyTangop July 2024 Voltage Distributio



01/08 14/07 20/07 26/07 MacleanHavannah July 2024 16/07 21/07 26/07 31/07 ODC_July 2024 14/07 20/07 26/07 01/08 TalBijouterie_July 2024 14/07 20/07 26/07 01/08 SamLewis- July 2024 14/07 20/07 26/07 01/08 Preston July 2024

Grid Voltage and Frequency

Voltage for each customer varies through the day on average for July 2024.

Although in some cases the voltage is highest during solar generation hours, in many cases it is highest between 11pm and 6am, presumably because of low loads

Grid operator has not reported any issues with frequency, which is stable at 50Hz +/-5%.

Tariff Design

Gross FiT	Net FiT
Simplest structure and automatically avoids loss of income for the utility if FiT payments are less than or equal to avoided	More complex structure and unless load and PV generation are separately metered for each customer, loss of income for
(fuel) costs.	the utility associated with behind the meter (btm) consumption of solar must be estimated based on the size of the solar system and an assumed usage profile.
Would require either new meters or changes to existing ones	May be able to use existing meters (although, may require
that would require site visits, increasing costs.	changes to allow export of excess solar electricity).
Customer can't directly offset their consumption by using their	Allows customer to directly offset consumption with their
own solar electricity.	own solar electricity and therefore provides an incentive to
	maximise self consumption (e.g. by shifting loads to the solar
	period) and minimise less valuable solar exports.
Would increase payback period	Would increase payback period
Is not compatible with btm batteries. A customer could only	Is compatible with btm batteries (provides an incentive for
use a btm battery to reduce their underlying consumption and	batteries to be used to maximise solar self consumption by
associated usage payments; but not to maximise self	charging during the solar window and discharging when load
consumption of solar and minimise solar exports (by charging	exceeds solar), but if not separately metered, may require
batteries during the solar period and discharging them when	calculation of the avoided usage charges associated with
load exceeds solar – e.g. during the evening peak). This reduces	solar generation used btm. Noting that the benefits of btm
the incentives for batteries to be installed and used to reduce	batteries in reducing demand peaks and therefore network
the customer impacts on both peak and minimum demand.	investment may need to be taken into consideration when
	calculating any solar service charge.

Draft recommendations & next steps

Data Collation

- Create a database of all gridconnected rooftop PV systems (PV size, battery size, address).
- Targeted audits of suitable sample size, say 5-10% of gridconnected rooftop PV systems to assess compliance with standards, especially islanding/ safety, assess roof integrity and wiring.
- Undertake collection of load and generation data to inform scenario modelling.

Regulatory

 Redefinition in the proposed regulatory amendment could simply be paid a feed-in tariff.

Tariff & Connection Agreement

- Undertake modelling of different tariffs to assess the impact on all stakeholders of different tariff designs and rates.
- Develop a standardised grid connection process and agreement that is compulsory for all new PV systems. It should be simple and transparent.

Community Awareness

 Conduct an education campaign to raise awareness around the impacts of rooftop PV and the new grid connection process.

Technical & Network

- Develop a LV network map using DIGSilent Power Factory to better understand the technical impacts of rooftop PV penetration in various part of the network, and where there is the potential to add more rooftop PV before reaching the network limits.
- Investigate reasons why the capacity factors are so low.
- Investigate the reasons for the sudden Voltage deviations
- Possibility of reviewing the standard voltage.



Reach out to provide feedback or ask any questions!

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