

The system operator's solar PV investigation

26 October 2017

Note: This paper has been prepared for the purpose of the Security and Reliability Council (SRC). Content should not be interpreted as representing the views or policy of the Electricity Authority.

Background

The Security and Reliability Council (SRC) functions under the Electricity Industry Act 2010 (Act) include providing advice to the Electricity Authority (Authority) on reliability of supply matters.

The system operator has an Emerging Energy Technology Programme which includes investigations of the potential implications of solar and energy storage technologies on the system operator's principal performance obligations (the PPOs)¹. The system operator offered to present to the SRC as its findings from a solar PV investigation were recently finalised.

The SRC Chair accepted the offer to present the findings. The system operator's presentation slides are attached as an appendix to this paper. Representatives from the system operator will attend the meeting to present the slides and answer the SRC's questions.

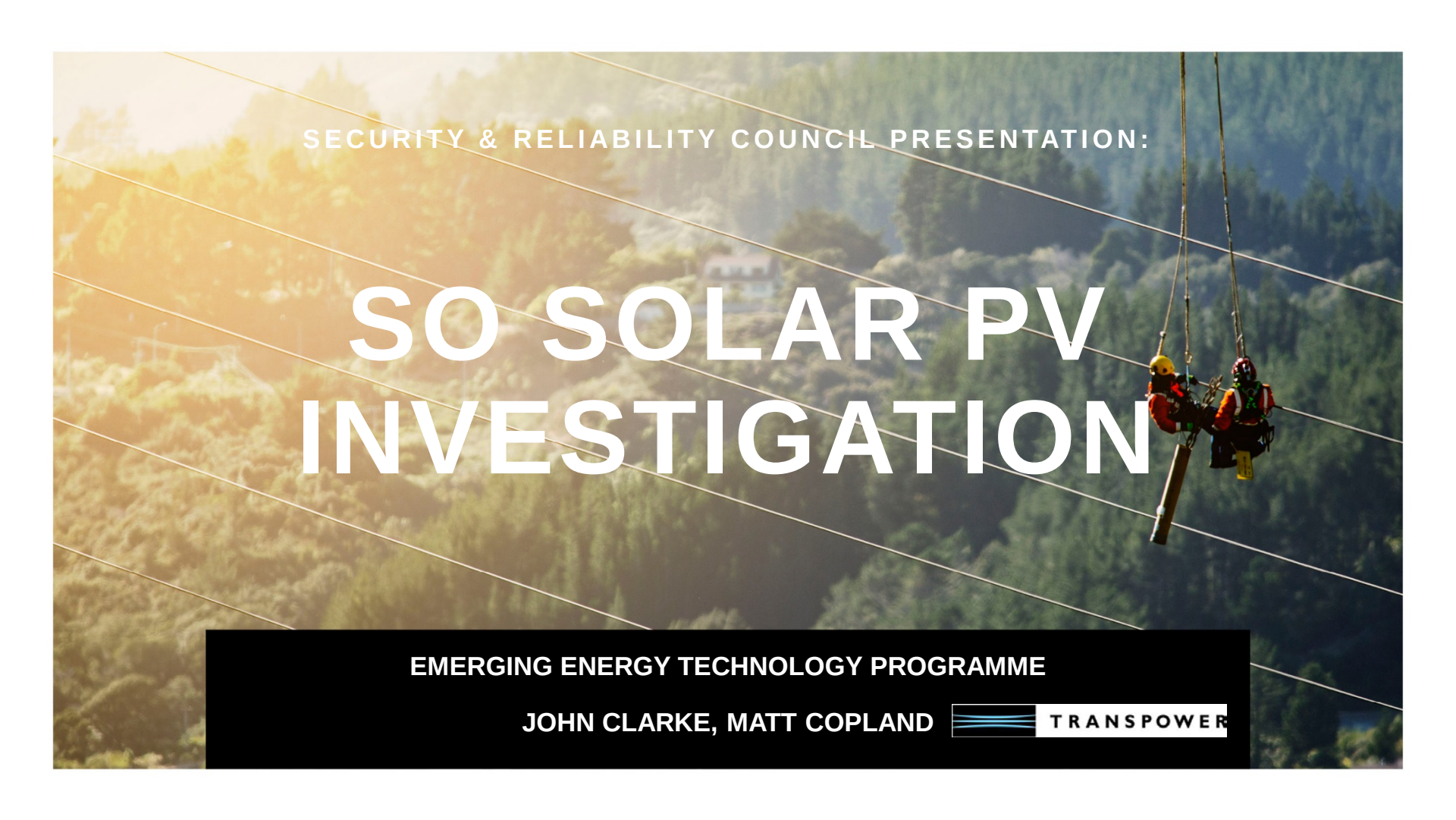
The system operator's investigation addresses many the overseas issues identified in the *Overseas examples of edge technologies affecting security or reliability* paper the SRC discussed at its 21 June 2016 meeting.²

The SRC may wish to consider the following questions.

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| <p>Q1. What further information, if any, does the SRC wish to have provided to it by the secretariat?</p> <p>Q2. What advice, if any, does the SRC wish to provide to the Authority?</p> |
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¹ The PPOs are contained in clause 7.2 of the Code, and include avoiding cascade failure and maintaining system frequency in the normal band (49.8Hz to 50.2Hz)

² Available from <http://www.ea.govt.nz/development/advisory-technical-groups/src/meeting-papers/2016/21-june-2016/>

The background of the slide is a photograph of a dense green forest. Several power lines run diagonally across the frame from the top left towards the bottom right. On the right side, two people wearing safety gear and harnesses are suspended on a zipline, moving through the air. The lighting is bright, suggesting a sunny day, with some lens flare visible in the upper left.

SECURITY & RELIABILITY COUNCIL PRESENTATION:

SO SOLAR PV INVESTIGATION

EMERGING ENERGY TECHNOLOGY PROGRAMME

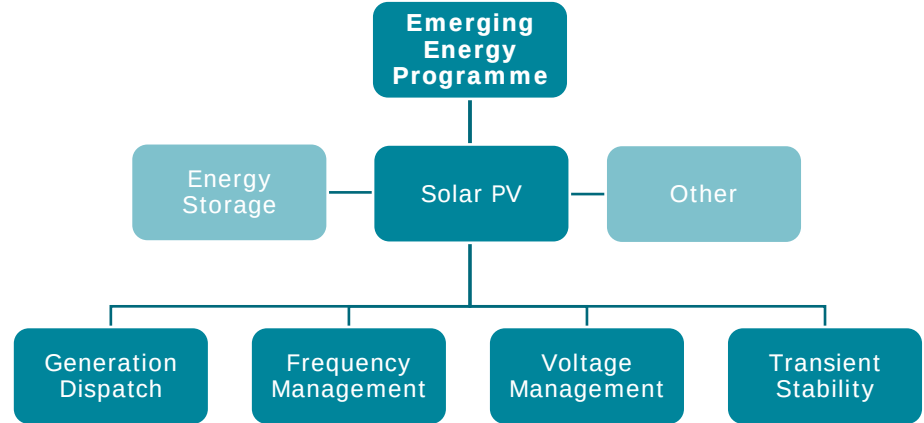
JOHN CLARKE, MATT COPLAND



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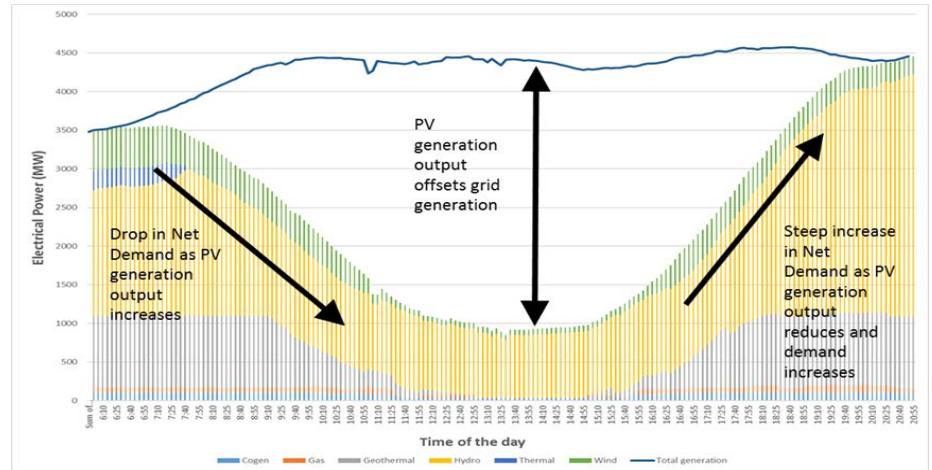
INVESTIGATION PURPOSE & SCOPE

- Emerging Energy Programme:
 - Aligned with Transmission Tomorrow.
 - Aims to investigate potential impacts of emerging technologies on our ability to meet our PPOs and identify possible changes to performance objectives or asset standards.
- This investigation focused on embedded Solar PV generation.
 - Up to 4GW of embedded Solar PV generation was included to the current dispatchable generation mix in order to stress the system.
 - The study did not incorporate the impact of other emerging energy technology such as batteries.



KEY FINDINGS

- The New Zealand power system, when considered with the existing dispatchable generation mix and regional demand profiles, can comfortably accommodate up to 2GW of distributed Solar PV capacity without impacting on our PPOs.
- At 2-4GW of distributed Solar PV in addition to the current generation mix, the operational management of the power system is impacted and requires active management by the system operator, and the potential investment in reactive power support in order to maintain our PPOs.
- Generation Dispatch
 - Larger synchronous generators were displaced off the system during the day, which reduced system inertia.
 - Existing dispatchable generation had sufficient ramping capacity to be able to balance load and demand due to rapid changes in Solar PV generation.



KEY FINDINGS (CONTINUED)

- Frequency Management
 - Frequency performance will be acceptable in most likely scenarios.
 - The rate of change of frequency will increase with Solar PV, which will likely require modifications to underfrequency event management objectives and controls such as AUFLS/extended reserves.
- Voltage Management
 - Above 2GW of Solar PV, more active high voltage management will be required during the day.
 - Inverter technology must comply with AS/NZS 4777.2 and be able to ride through power system events. One common inverter modelled was non compliant in this regard.
- Transient Stability
 - The transient stability of the power system will be as good if not better than the existing system.

RECOMMENDATIONS

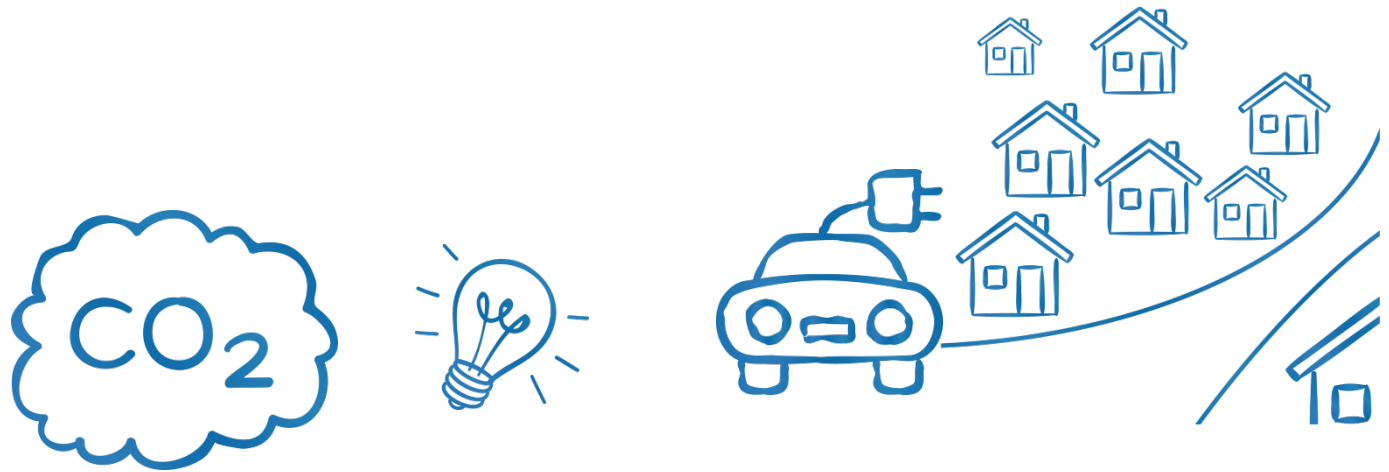
Based on the investigation findings, the following recommendations have been made by system operations:

1. Undertake additional investigation at key Solar PV generation uptake milestones, 1GW and then 2GW in order to:
 - To assess any impact due to material changes in the base dispatchable generation mix, regional demand and the uptake of other emerging energy technologies such as batteries.
 - To ensure system operator's practises remain effective in managing PPOs and recommend any changes to PPO's and Asset performance objectives.
2. Update our load and generation forecasting capability to account for Solar PV generation variability.
3. Update our power system strategies, operational and monitoring practises to account for the system wide changes that large amounts of Solar PV generation will introduce.
4. Promote change in the way the industry engages and shares information, for example:
 - Active participation by the industry in regards to ensuring installed Solar PV inverter voltage ride through capability is adequate.
 - Provide visibility of real-time operational data at critical nodes within distribution networks to enable effective forecasting as well as voltage and system management practices.

NEXT STEPS

- We will continue to monitor the uptake of Solar PV generation and follow through on our recommendations as appropriate.
- Work has commenced on the next investigation within the Emerging Energy Programme, “Energy Storage” (scheduled for completion in 17/18).
- Transpower will publish the following reports which contain more detail on the investigation findings:
 - Effects of PV Generation on the New Zealand Power System: Summary Report
 - Effect of PV on Generation Dispatch in New Zealand
 - Effect of PV generation on Frequency Management in New Zealand
 - Effect of PV generation on Voltage Management in New Zealand
 - Effect of PV generation on Transient Stability in New Zealand

QUESTIONS AND DISCUSSION





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