Centre for Energy and Environmental Markets

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Utility experiences with high PV penetrations – Australian survey results

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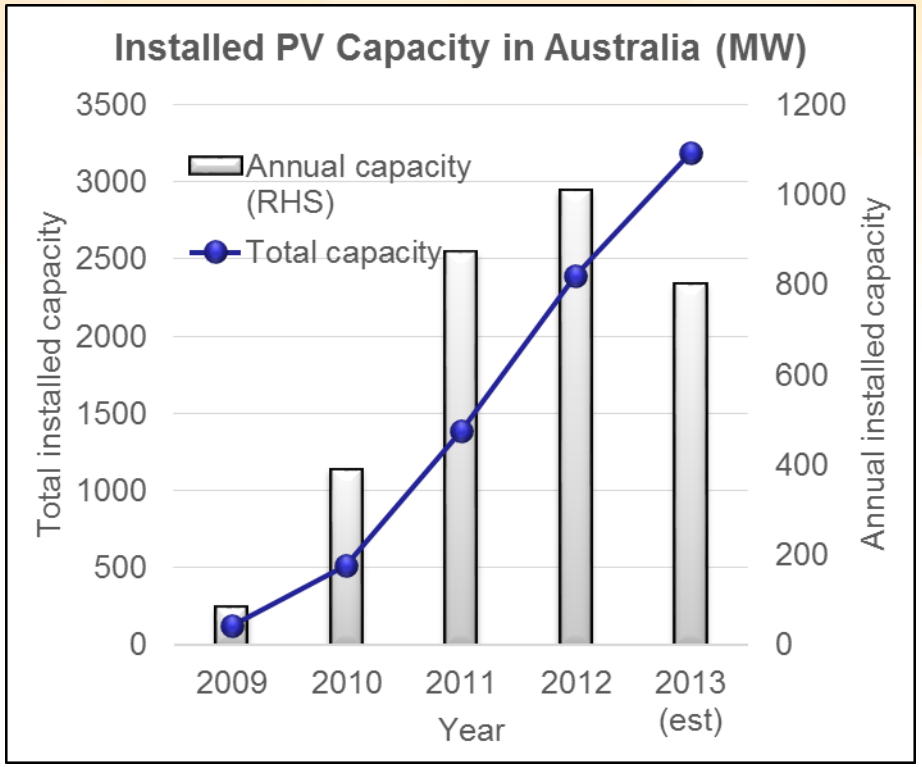
APVI Workshop – PV and the Electricity Grid
Sydney, Australia
Tuesday 26 November, 2013

Presentation outline

- Context for solar PV and Australian distribution networks
- Survey methodology
- Preliminary findings
  - Impacts
  - Management strategies
- Discussion

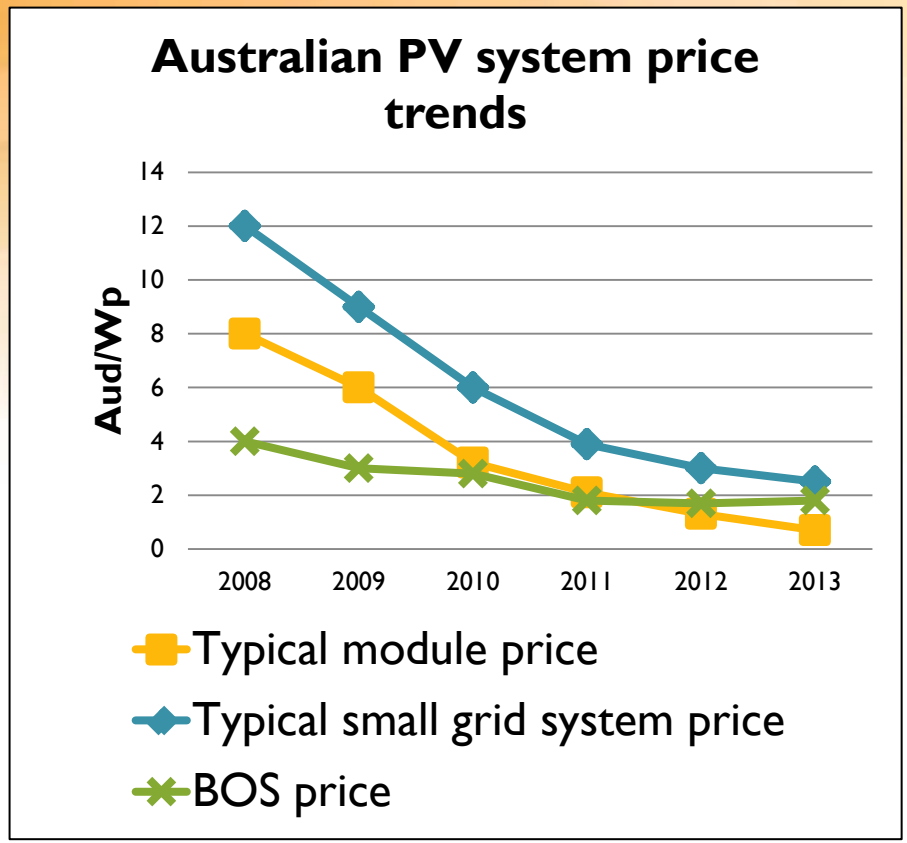
Solar PV in Australia

- 3 GW (November 2013)
- Mostly since beginning of 2009
- Estimated 1.9% of total electricity consumption
- Average system size 2.6 kW, average **new** 4 kW



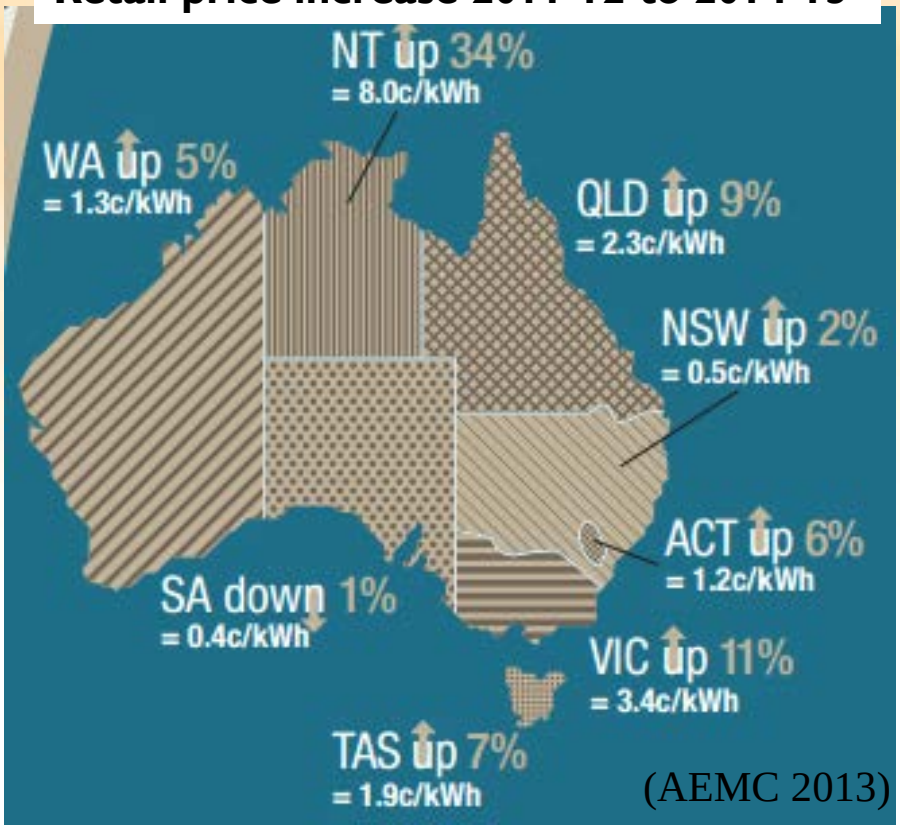
Data: (Clean Energy Regulator 2013)

Solar PV in Australia



(APVA 2013)

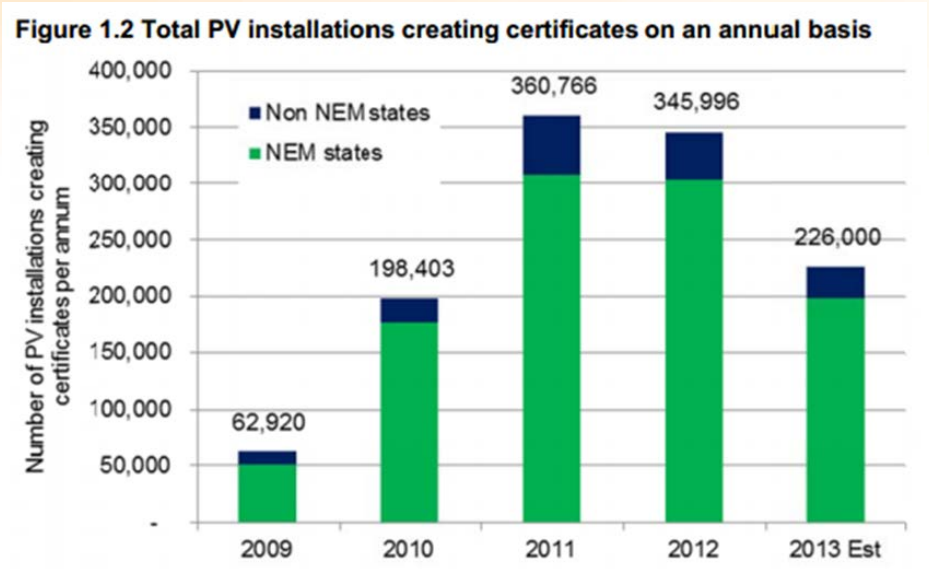
Retail price increase 2011-12 to 2014-15



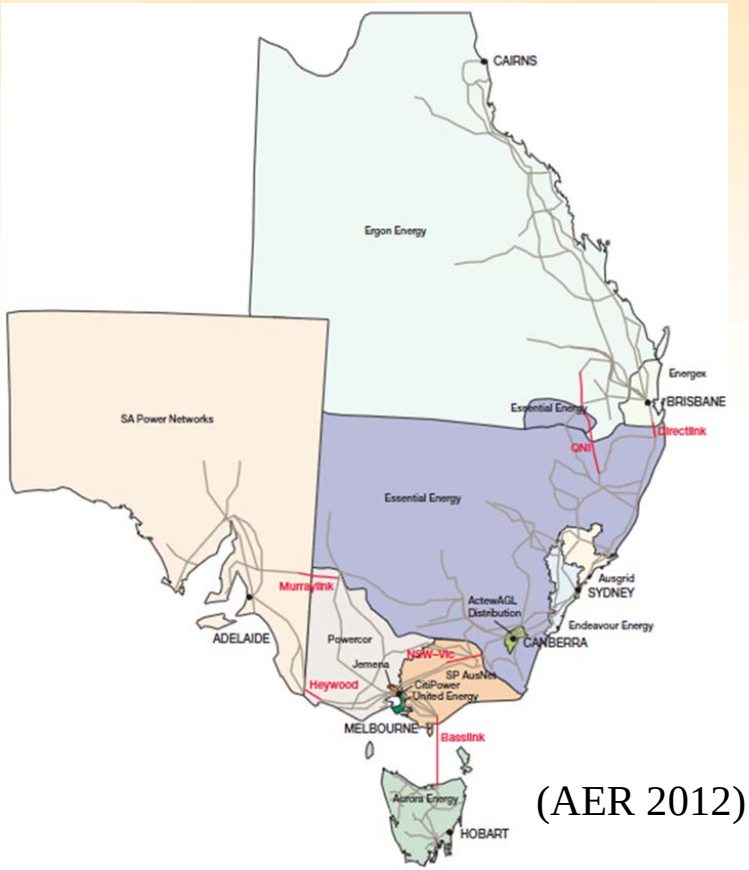
(AEMC 2013)

Solar PV in Australia

- 88% connected to the National Electricity Market
- 95% less than 5 kW
- 99% connected to LV network



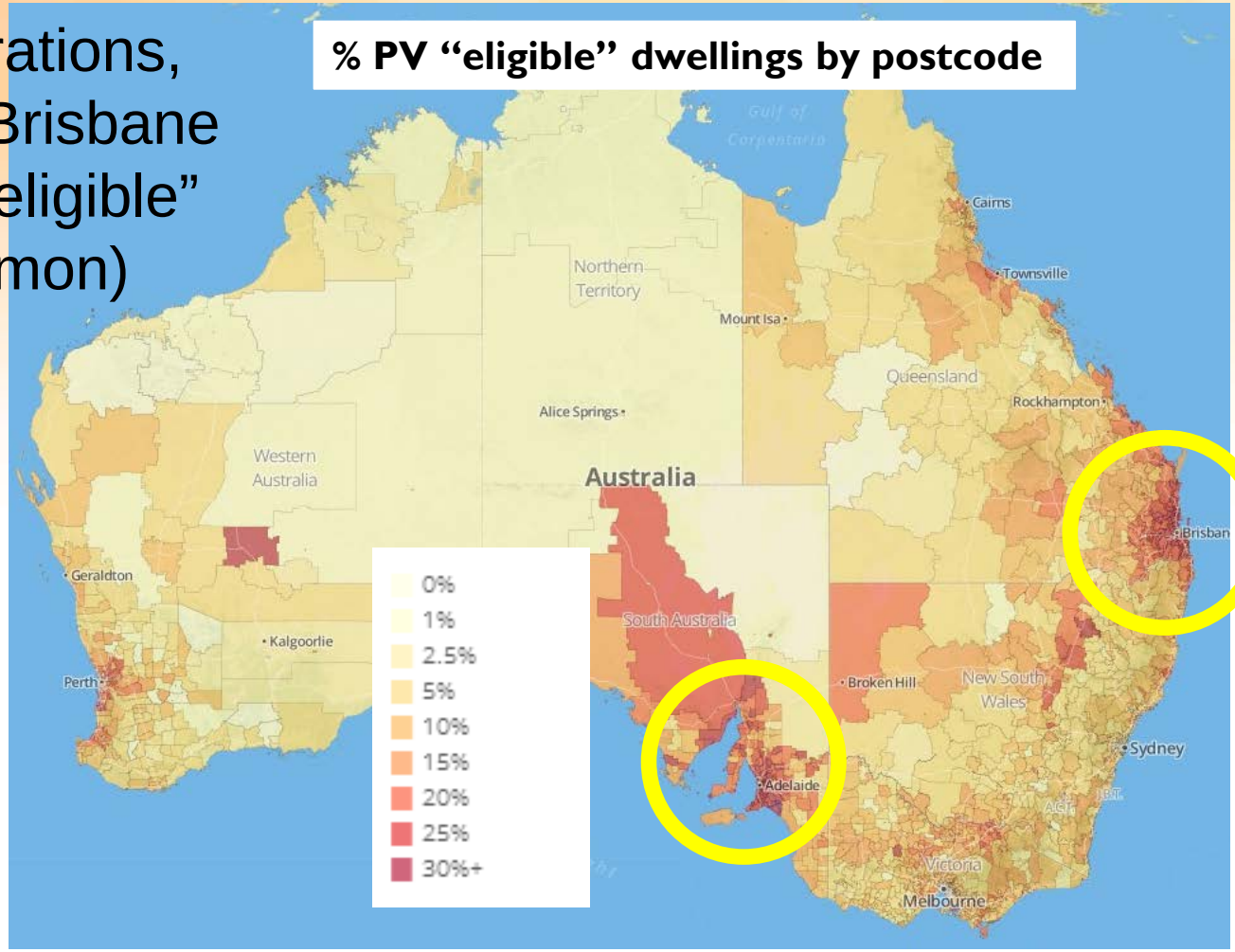
(Green Energy Markets 2013)



(AER 2012)

Solar PV in Australia

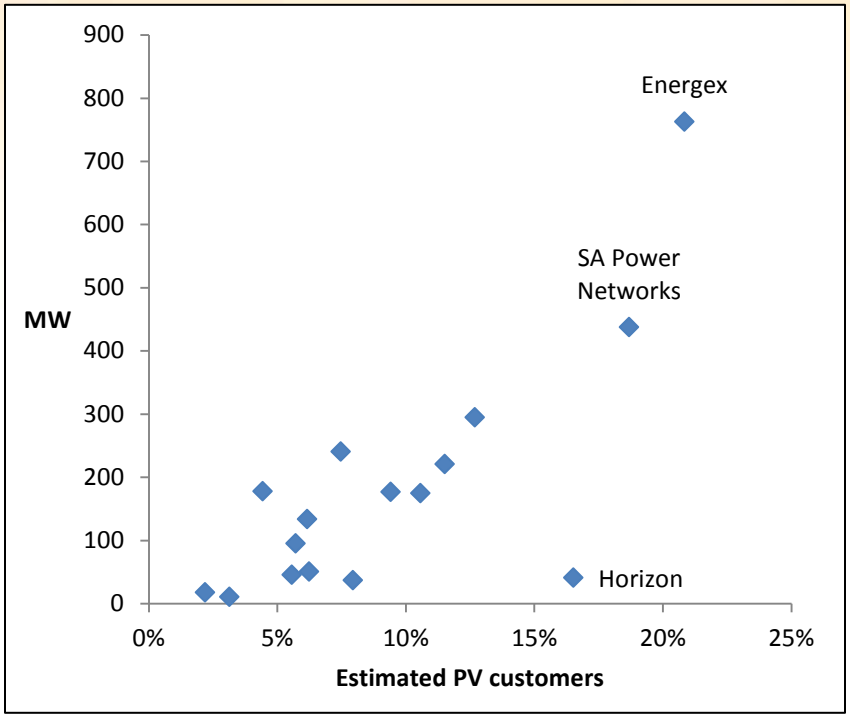
- Highest penetrations, Adelaide and Brisbane (30 – 40% of "eligible" dwellings common)
- In SA, PV can be > 20% of daytime load



DNSPs and solar PV

- 16 DNSPs, 13 in NEM. Mostly <132 kV
- 3 DNSPs with around 20% PV customers

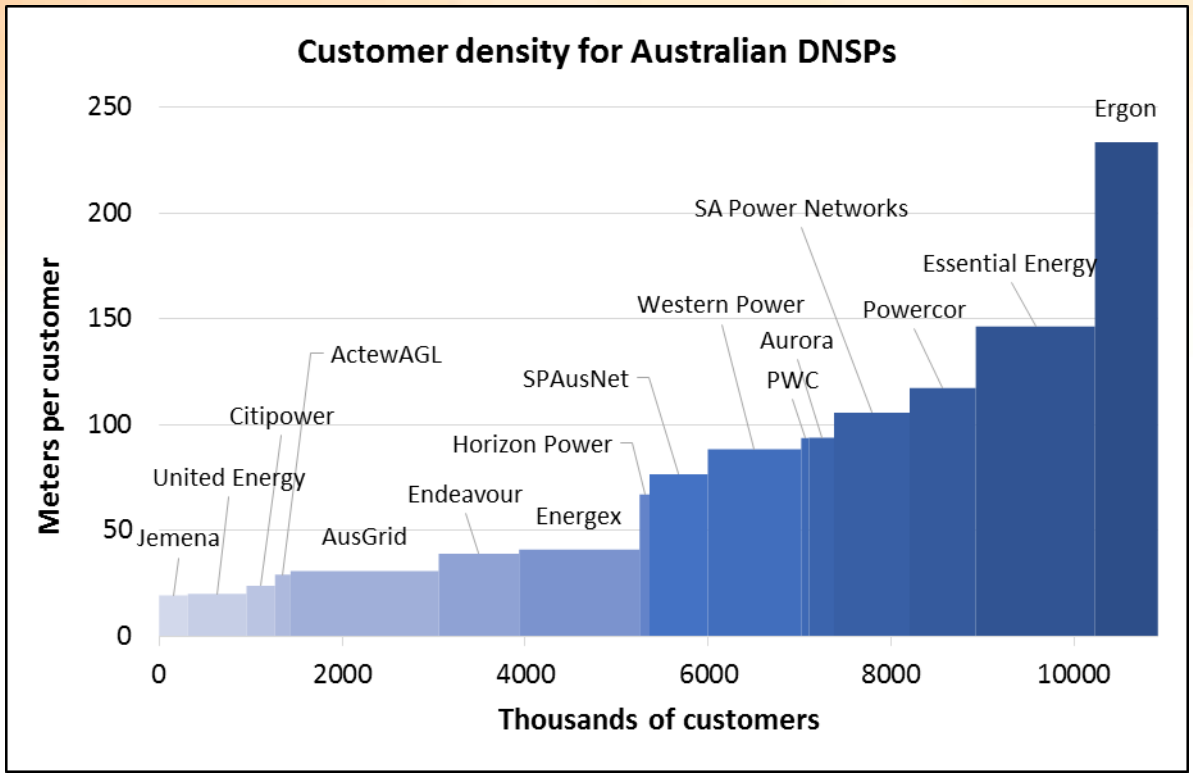
DNSP	State	Estimated PV (Nov 2013)	% PV customers
ActewAGL	ACT	37	8%
Ausgrid	NSW	177	4%
Endeavour	NSW	134	6%
Essential	NSW	240	7%
PWC	NT	10	3%
Energex	QLD	762	21%
Ergon	QLD	221	12%
SA Power Networks	SA	438	19%
Aurora	TAS	51	6%
Citipower	VIC	18	2%
Jemena	VIC	45	6%
Powercor	VIC	176	9%
SP Ausnet	VIC	175	11%
United	VIC	95	6%
Horizon	WA	41	17%
Western Power	WA	294	13%



Data: (Clean Energy Regulator 2013), (AER 2012)

DNSPs and solar PV

- Range of urban and rural networks
- 22% of line km is SWER



Data: (Energy Supply Association of Australia 2012), (AER 2012)

DNSP survey rationale

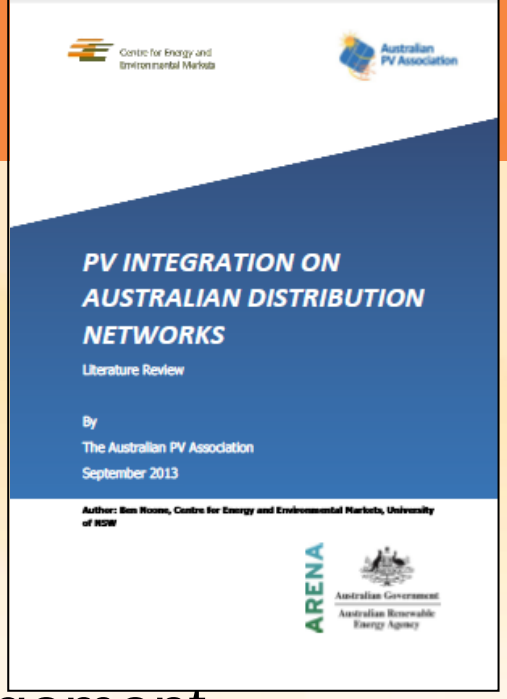
- PV a pressing topic for networks with unavoidable technical challenges
- New draft AS4777 standard for inverters
- Characterisation of the challenges
  - The “sea of anecdotes”
- Promote collaborative approach to PV integration
  - Emphasis on successful innovation
- APVI aim:

“to support the increased development and use of PV through targeted research, analyses and information sharing”

- **Contribute to IEA PVPS Task 14**

Survey methodology

- Literature review of publically available information
  - PV installed, Australian standards, power quality standards, and DNSP guidelines
  - Published September 2013 by APVI



- Excel workbook survey on impacts, management strategies, planning and analysis tools.
  - Based on IEA PVPS template
  - Short-answer questions, radio-button responses, further comments and references
- Final report (pending)
  - Charts presenting survey responses
  - Discussion and categorisation based on short-answer and comments

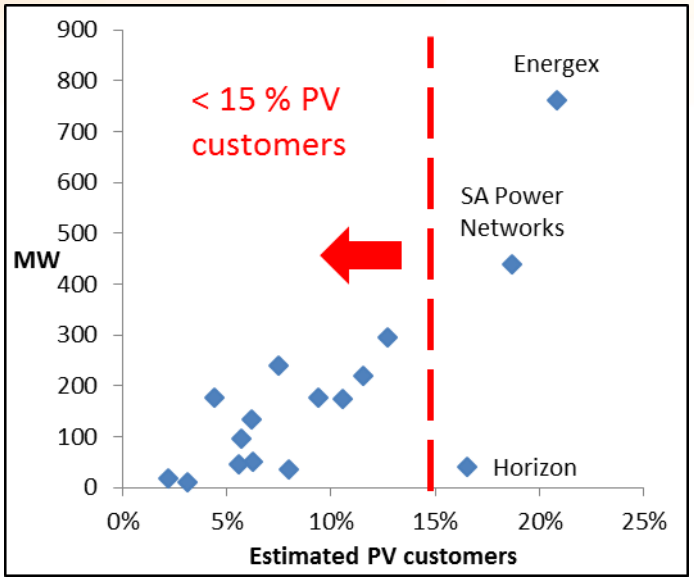
Survey methodology

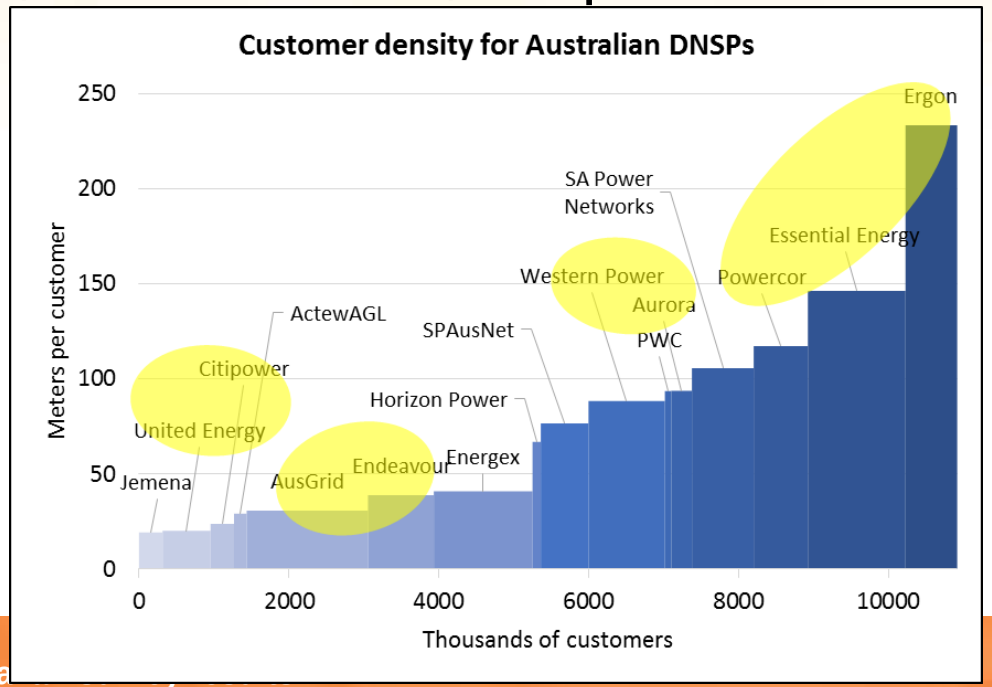
- Predetermined list of possible impacts and strategies
- Impact classification, minor → major
- Option for "under consideration"

Worksheet	Options	Clarification
Impacts	Existing – Minor	Impact is isolated and / or response required is minimal
	Existing – Moderate	A greater number of customers are affected, some response is required
	Existing – Major	Impact imposes significant cost or requires significant response activity
	Anticipated	-
	Not observed	-
	Not applicable	-
Management strategies	Existing	Currently being undertaken
	Planned	Implementation anticipated in near future
	Under consideration	Measure has been considered but may or may not be implemented
	Not planned	Measure has not been considered
	Not applicable	-
Planning and Analysis Tools	Existing	As above
	Planned	As above
	Not planned	As above
	Not applicable	-

Survey response

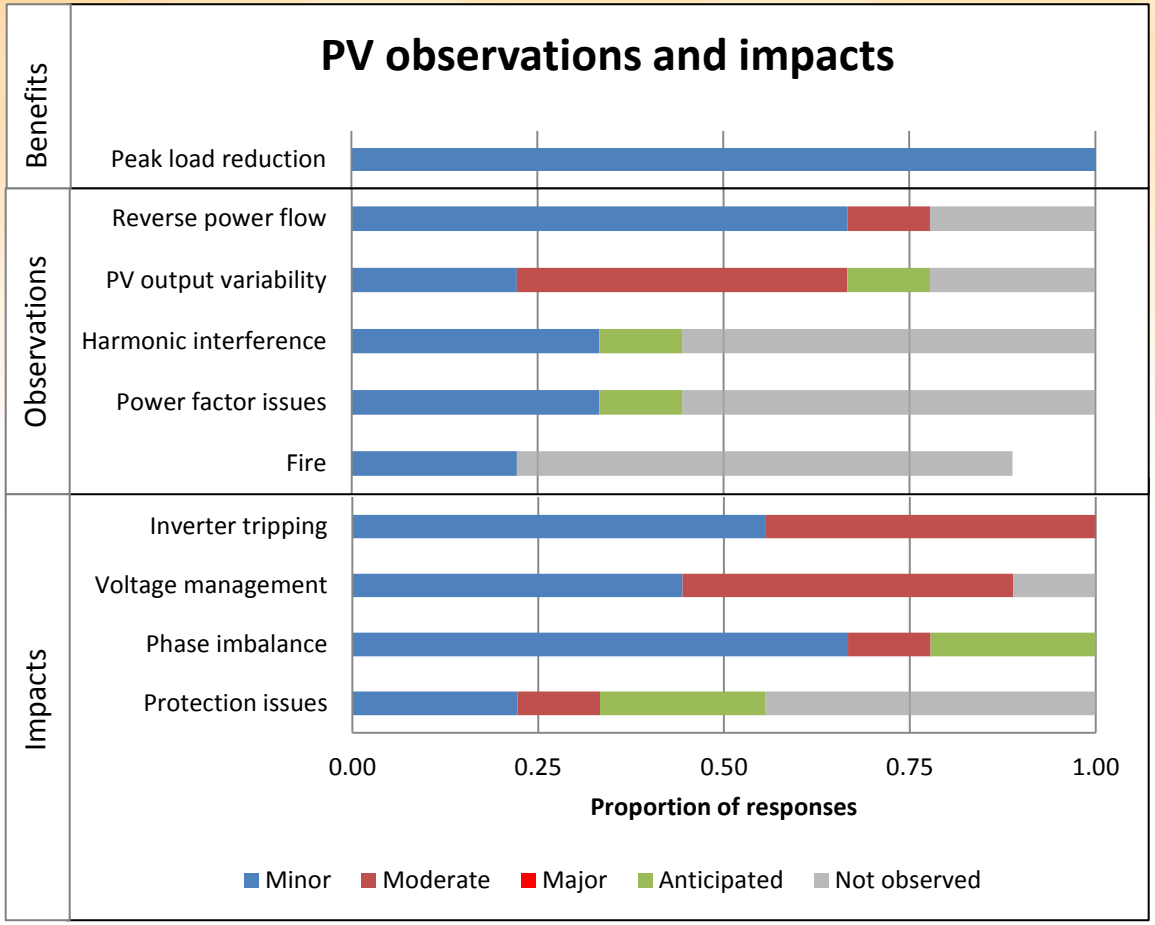
- 9 of 16 Australian DNSPs
  - Ausgrid, Endeavour, Essential (NSW)
  - Citipower, Powercor, United (VIC)
  - Aurora (TAS), Ergon (QLD), Western Power (WA)
- 70% of customers and 50% of PV capacity
- Diverse: urban and rural; climate zones; PV penetrations





DNSP observations and impacts

- Impacts versus observations
- No “major” impacts
- Caveats..
  - different circumstances
  - interpretation
  - subjectivity
  - contradictions



Management strategies

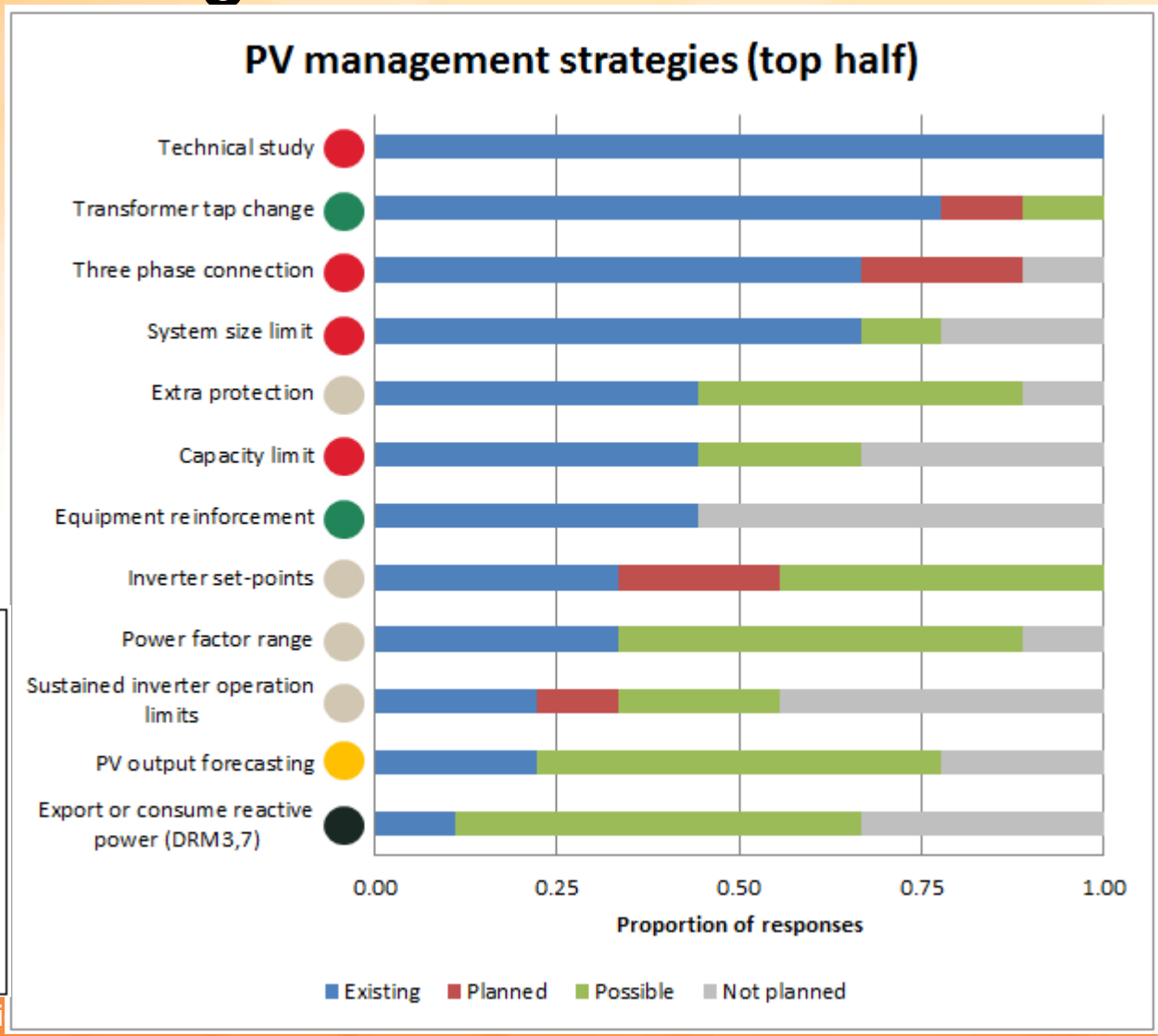
- Categorisation by management type

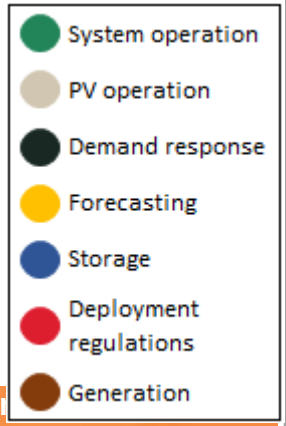
Category	Description
System operation	Activities that can be undertaken by the DNSP
PV operation	Requirements on how PV systems interact with the network
Demand response	Relating to the proposed AS4777 demand response functions or a price signal
Forecasting	Forecasting of PV system output
Storage	Energy storage by either the DNSP or the customer
Deployment regulations	Requirements pertaining to initial connection of the PV system
Generation	Applicable to mini-grid situations only

- Warning…colourful..

Management strategies

- Technical study used by all, but limited to larger systems
- 3 phase connections preferred, variation in allowable imbalance
- Forecasting mostly long-term





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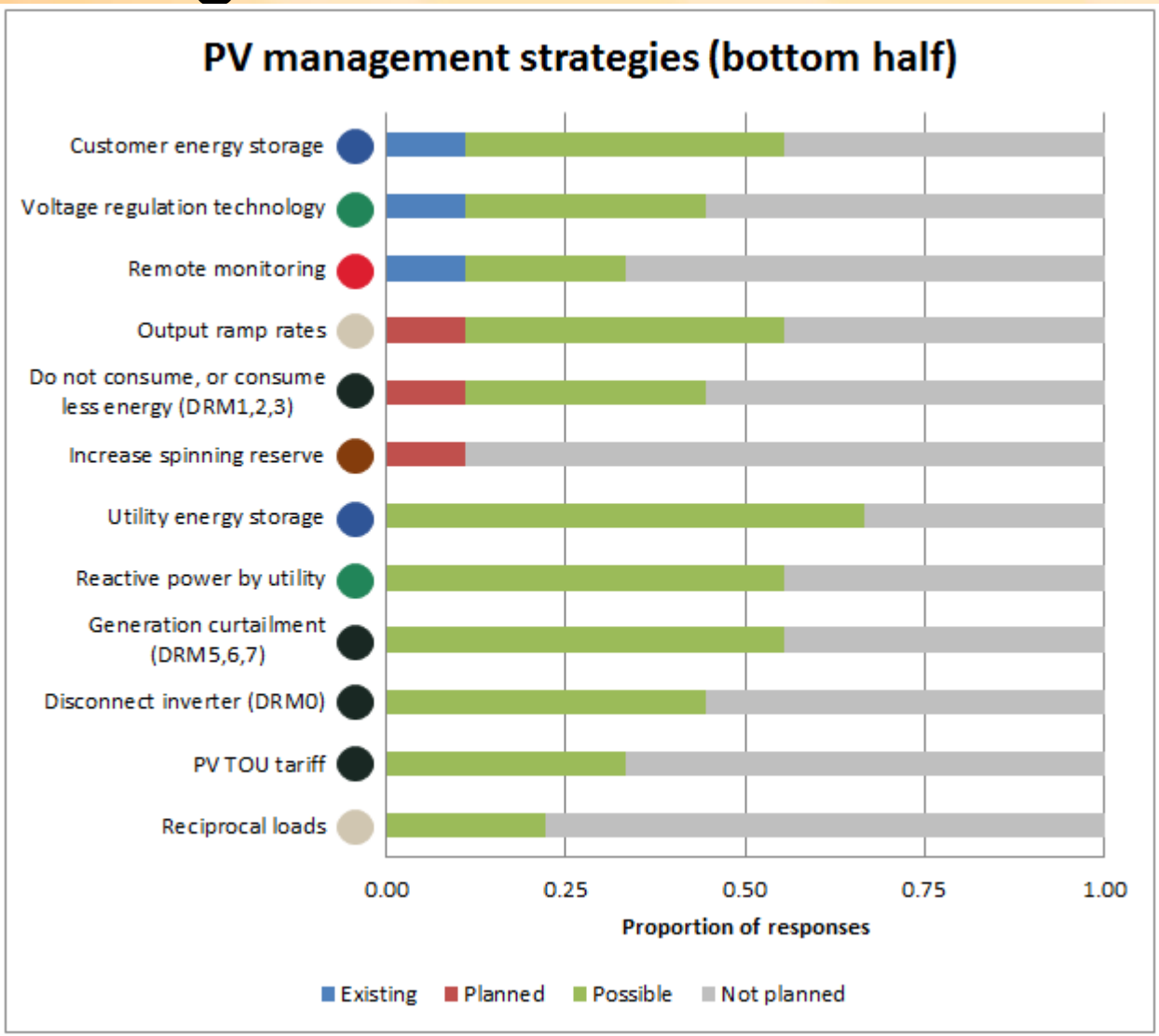
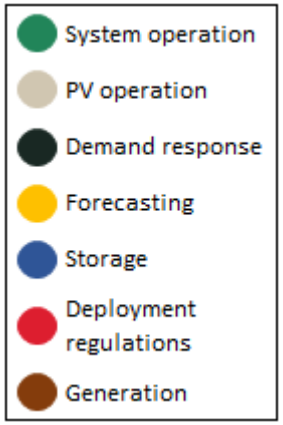
Management strategies

- More interest in storage by utility than by customer
- Reciprocal loads and remote monitoring received least interest





Discussion points

- Many data gaps
  - Some data for research, otherwise awareness through power quality investigations, and general metering
- Currently only modest interest in new inverter capabilities, demand response
- Increasing need for collective impact assessment techniques
- Trials conducted by DNSP, including utility storage and STATCOM application
- On the whole, PV unexpected, but DNSPs are coping technically (at penetrations surveyed..)

Summary

- 99% PV in Australia at distribution level, 95% <5 kW
- Penetrations of 30-40% of “eligible” households by postcode, ~20% of DNSP customers.
- DNSP survey on PV experiences – impacts, management strategies, planning and analysis.
- Response from 9 of 16 DNSPs, 70% customers, 50% PV capacity
- Preliminary results today, full report expected January 2014 on APVI website

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Thank you,

and

Questions?

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Many of our publications are available at: www.ceem.unsw.edu.au

References

- AEMC (2013). Fact Pack AEMC Price Trends Report.
- AER (2012). State of the energy market 2012.
- APVA (2013). APVA Solar Mapping Workshop. 14th March 2013.
- Clean Energy Regulator (2013). RET postcode data November 2013.
- Energy Supply Association of Australia (2012). Electricity Gas Australia 2012.
- Green Energy Markets (2013). Household Solar in Australia: State of the Small-scale Renewable Energy Scheme. Report for the REC Agents Association prepared by the Green Energy Markets Pty Ltd.

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