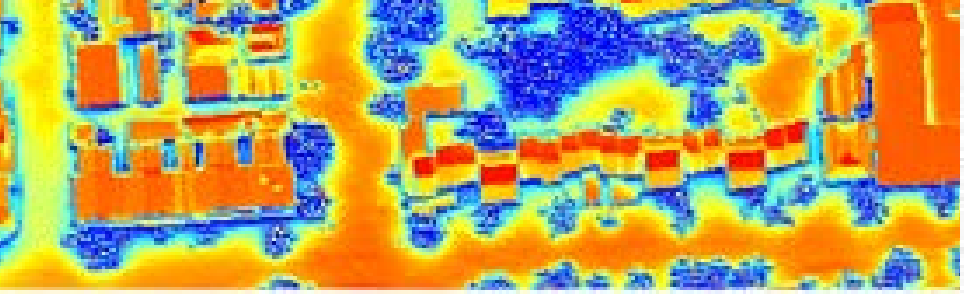

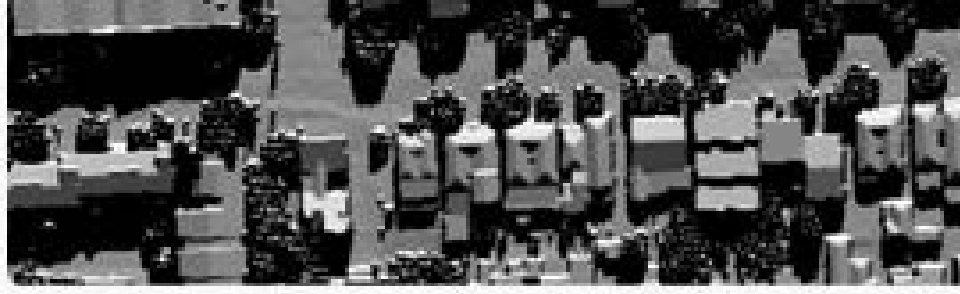

Mapping the Impact of & Investment in PV in Regional Australia

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Australian Solar Map

Anna Bruce, Jessie Copper, Mark Snow (UNSW)

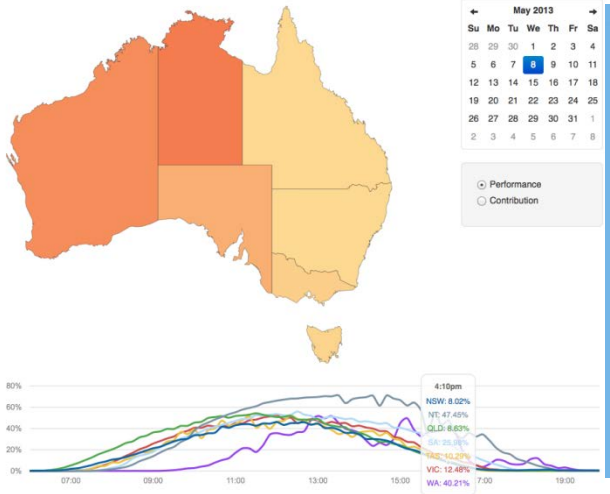
Warwick Johnson (Sunwiz)

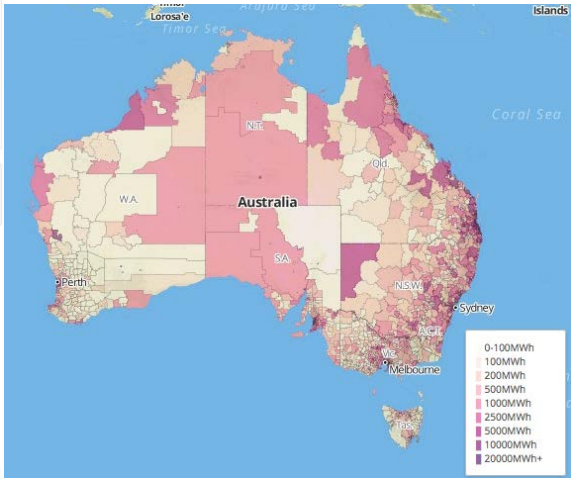
sunwiz SOLAR INDUSTRY INTELLIGENCE

ARENA

Australian Government

Australian Renewable Energy Agency





The APVI – who we are

- Our Objective:
  To support the increased development and use of PV via research, analysis and information

- Our Members:
  Businesses, researchers, government agencies, individuals with an interest in PV

- Our Work:
  Independent, apolitical and widely cited by the PV sector, governments and stakeholders

Solar Map project partners and data providers:

UNSW
THE UNIVERSITY OF NEW SOUTH WALES

SMA

CUNY The City University of New York

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

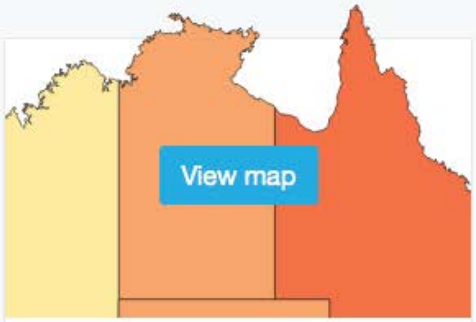
ICE LAB
EST. 2008 CBR.AU

PVOutput

sunwiz
SOLAR INDUSTRY INTELLIGENCE

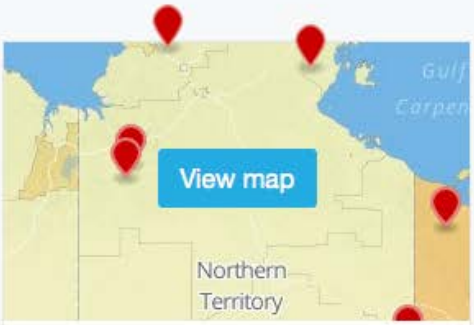
Australian Government
Clean Energy Regulator

AUSTRALIAN PV INSTITUTE



Live Solar PV

Live performance data from nationwide PV installations, with total electricity demand and PV contribution



Solar PV Status

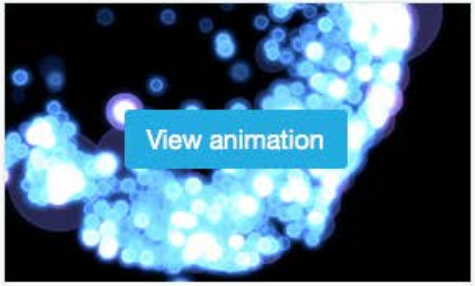
Estimated percentage of dwellings with PV systems and total installed capacity, by postcode

Market Analyses

Charting per-month PV installations registered under the Commonwealth Government's Renewable Energy Target

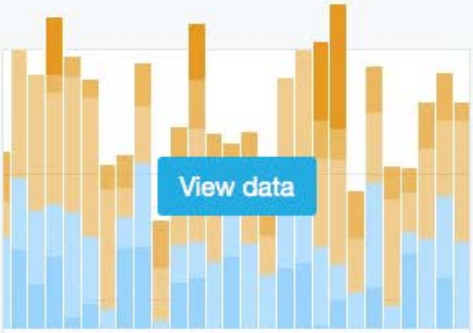
Solar Potential

Rooftop solar mapping tool using 3D data, for assessing annual and per-month PV potential in urban environments



Solar Animation

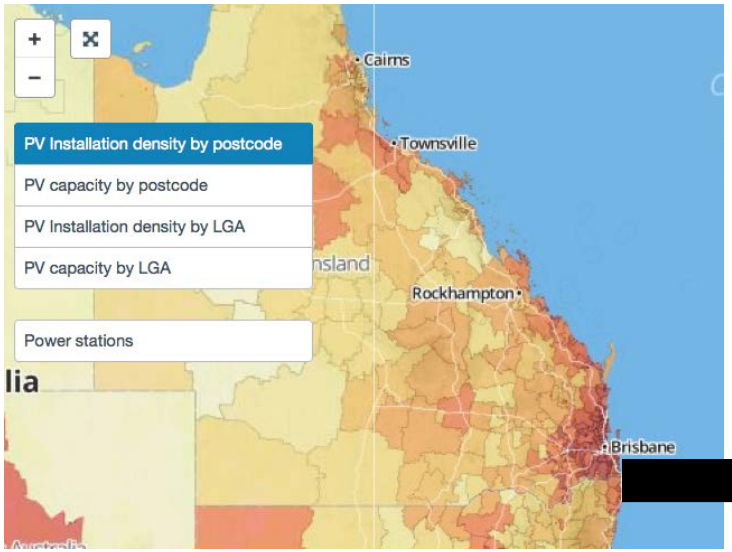
Visualise per-postcode PV installations across Australia since January 2007, by average system size and PV penetration



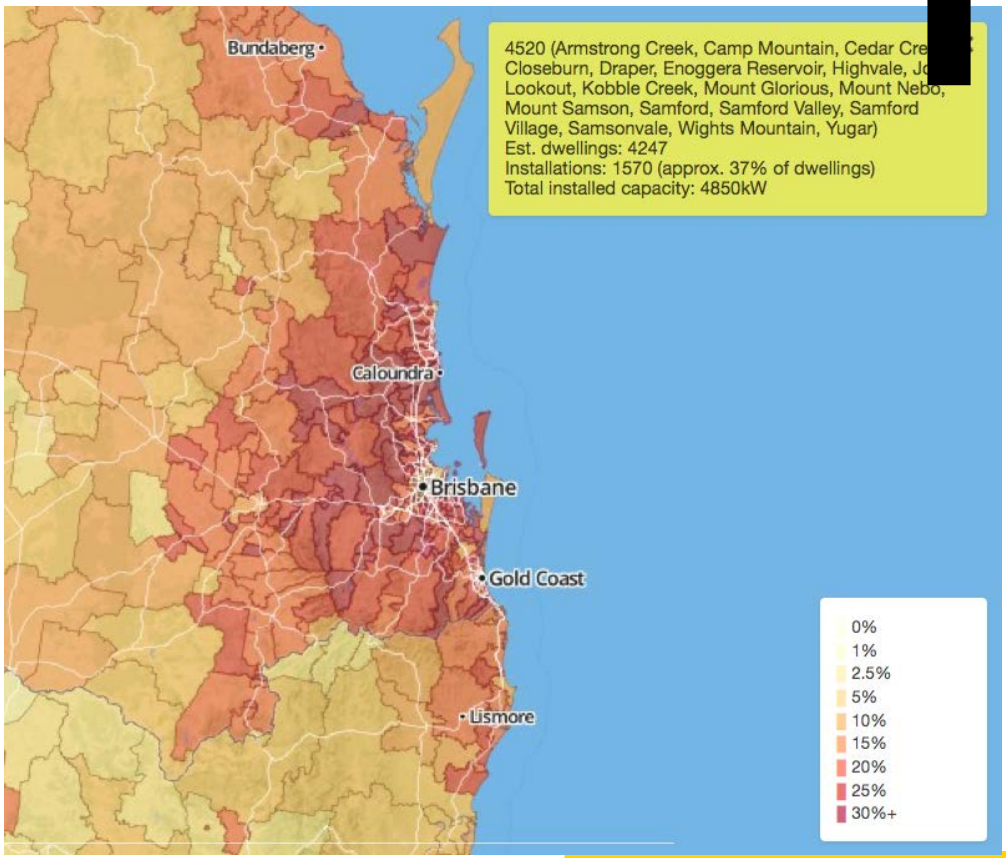
PV Postcode Data

Explore PV installations by postcode and system size, with per-month installation figures since 2007

Solar PV Status Map



4520 (Armstrong Creek, Camp Mountain, Cedar Creek, Closeburn, Draper, Enoggera Reservoir, Highvale, Jollys Lookout, Kobble Creek, Mount Glorious, Mount Nebo, Mount Samson, Samford, Samford Valley, Samford Village, Samsonvale, Wights Mountain, Yugar)
Est. dwellings: 4247
Installations: 1570 (approx. 37% of dwellings)
Total installed capacity: 4850kW



Postcode and LGA statistics

- PV installations and capacity data from CER
- Dwellings from ABS
- Annual energy based on REC multiplier regions

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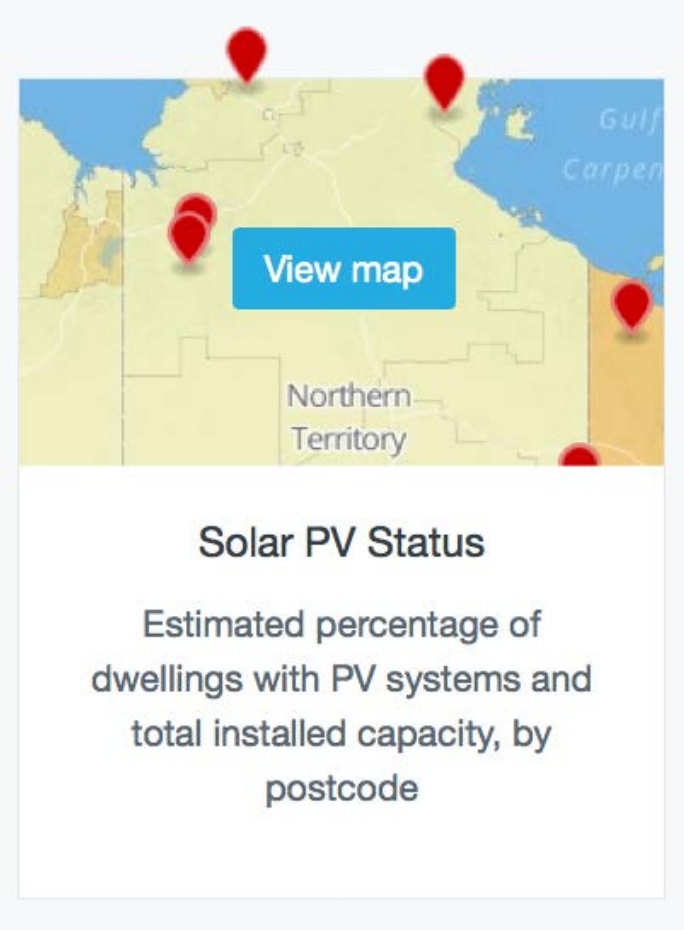
Solar PV Status Map



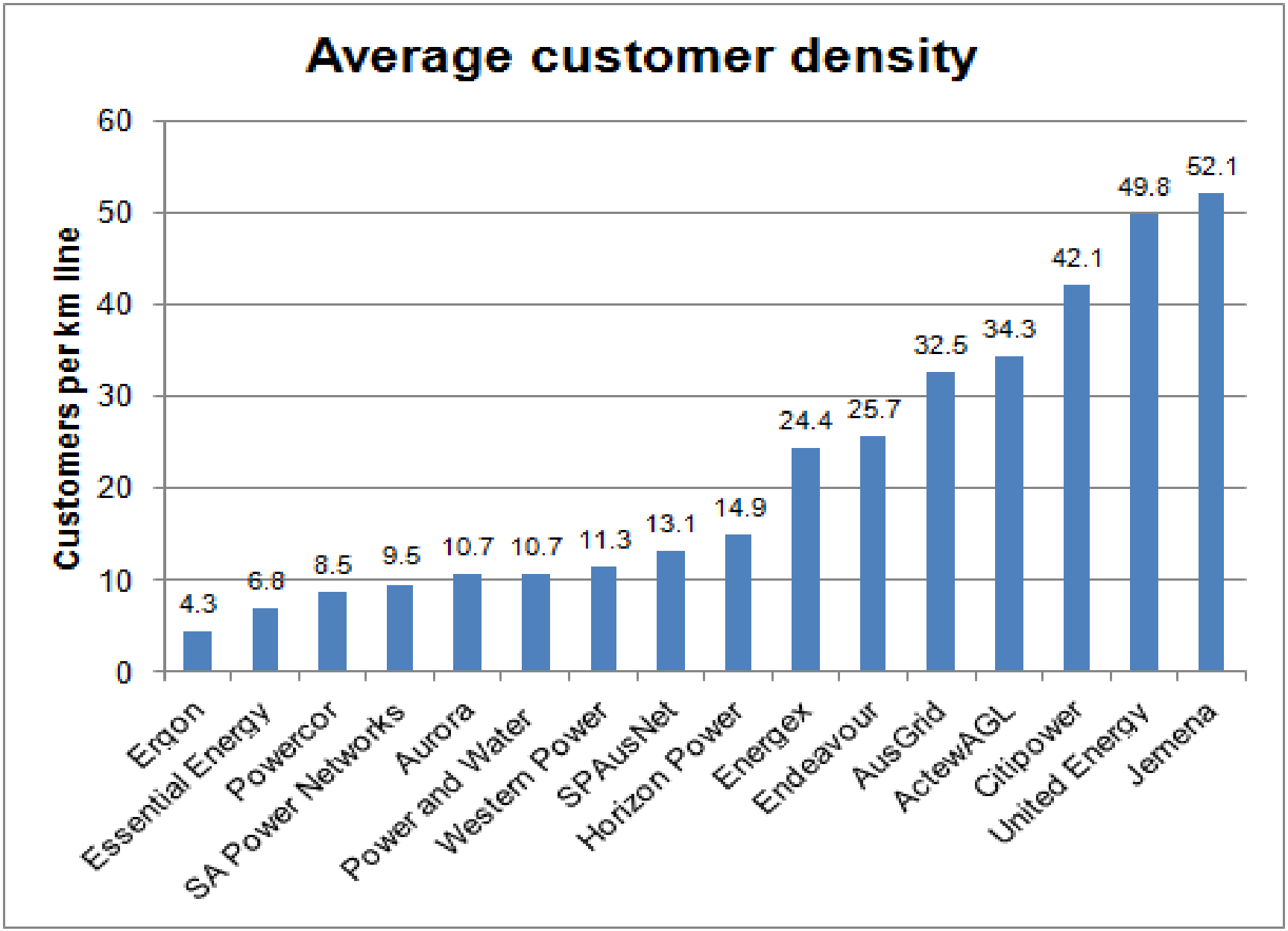
Understanding the uptake and impact of PV

Power Stations

- Data from CER
- Pin indicating relative size

Data mapped by postcode:

- PV Installed capacity based on all systems that have claimed RECs/SGCs/LGCs from Clean Energy Regulator (CER) Database
- Estimated annual output for systems based on REC zone multipliers
- Mapping of SGU data onto LGA according to ABS correspondences
- PV systems/dwelling
  - Dwelling data from ABS includes houses and other one-storey dwellings

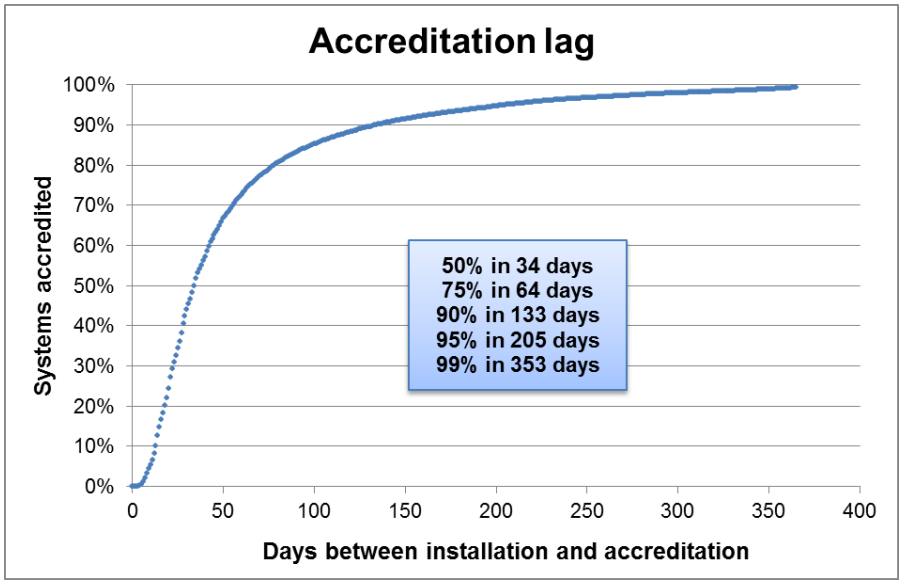


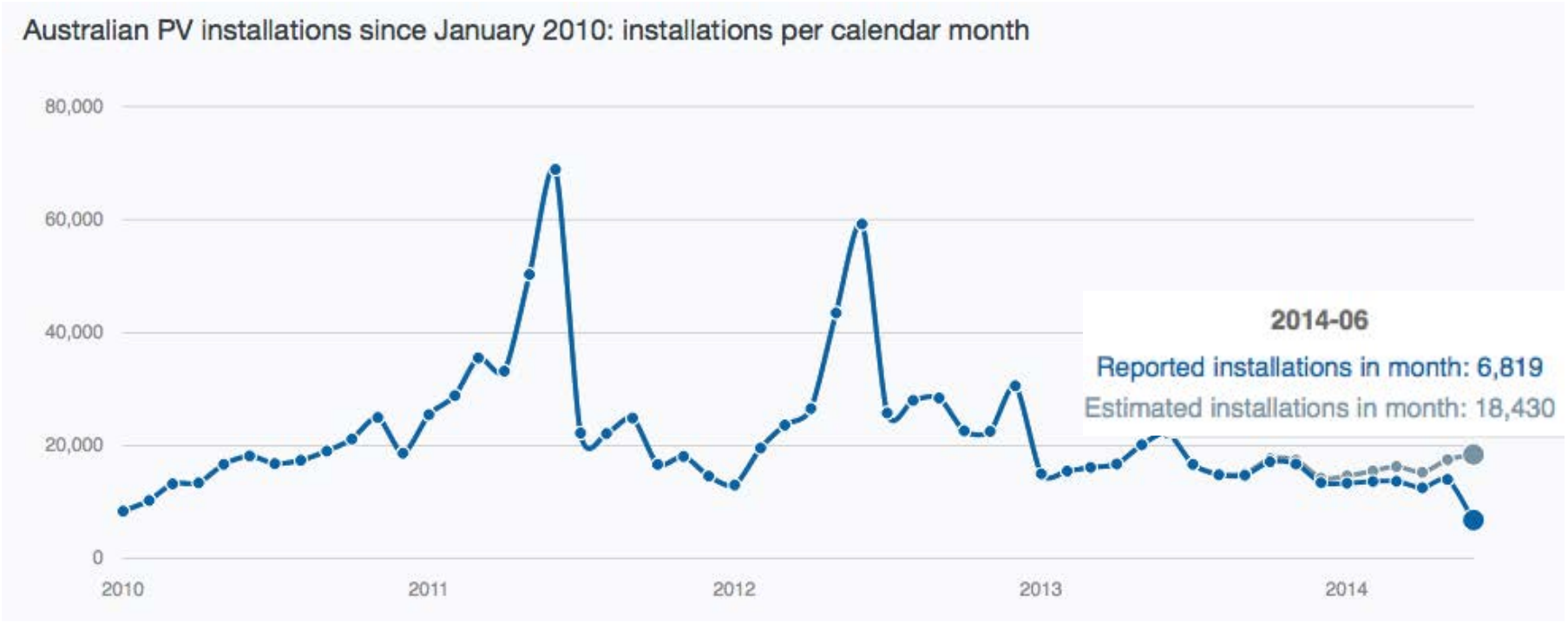
Data source: Australian Energy Regulator. State of the energy market 2012, http://www.aer.gov.au/node/18959

Noone et al, 2014

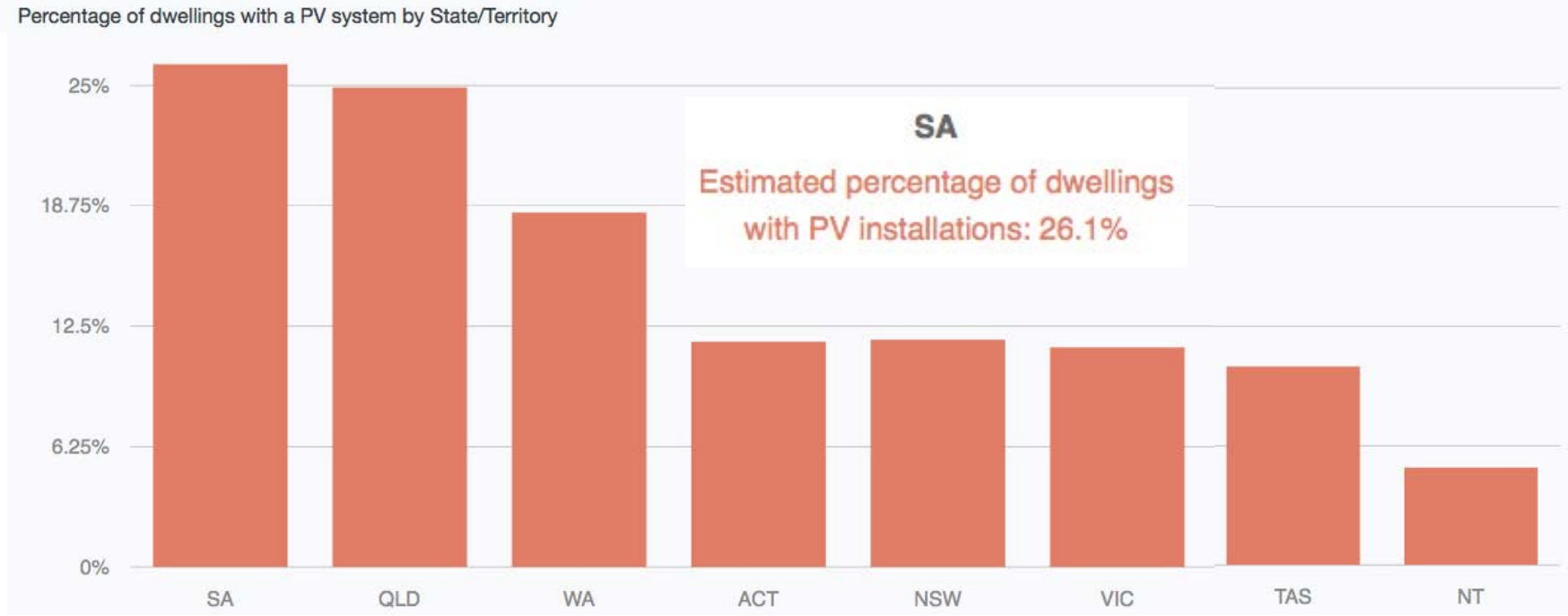
Market Analyses

- Total installations, installed capacity, and estimated annual generation
- Graphs of per month and cumulative installations
- Estimation to account for lag between installation and accreditation with CER

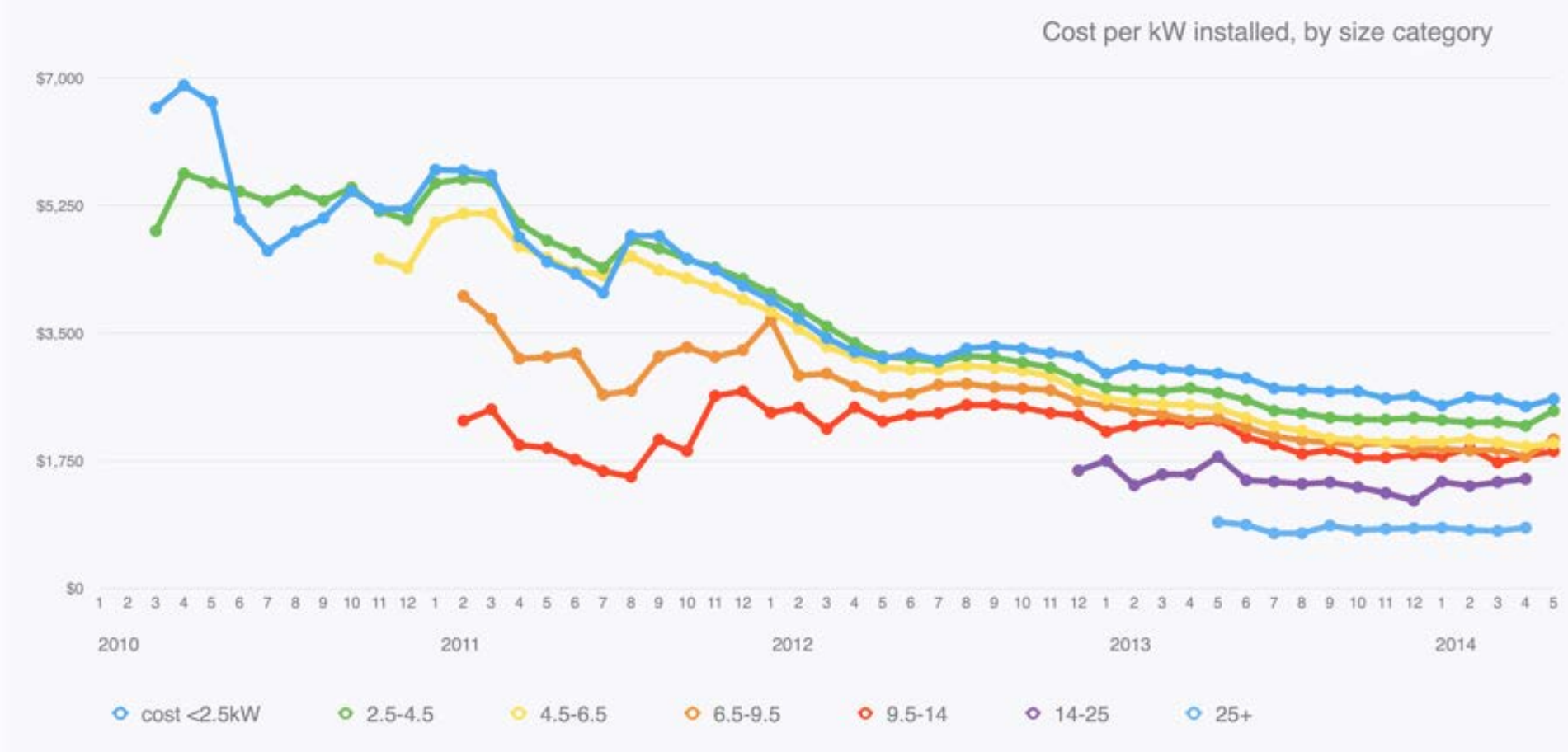





Australian PV installations since April 2001: total capacity (kW)
4,000,000
3,000,000
2,000,000
1,000,000
0
2014-06
Reported installed capacity (kW): 3,572,520
Estimated installed capacity (kW): 3,690,858
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014


Percentage of dwellings with a PV system by State/Territory
25%
18.75%
12.5%
6.25%
0%
SA
Estimated percentage of dwellings with PV installations: 26.1%
SA
QLD
WA
ACT
NSW
VIC
TAS
NT

Cost Evolution



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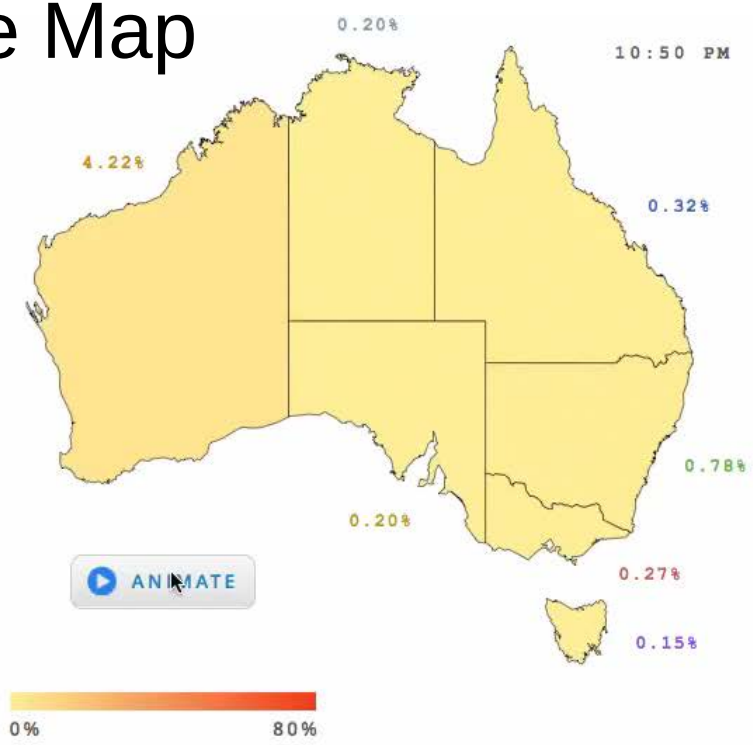
Live Map



«	January 2014					»
Su	Mo	Tu	We	Th	Fr	Sa
29	30	31	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	1
2	3	4	5	6	7	8

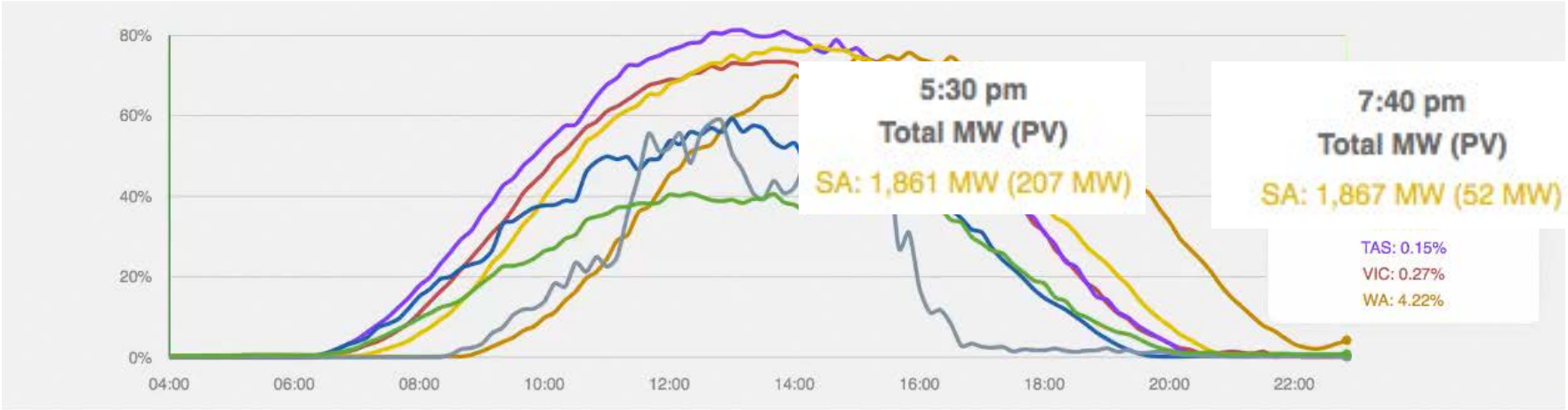
Top Days

- » 29th Dec 2013
- » 6th Dec 2013
- » 2nd Dec 2013

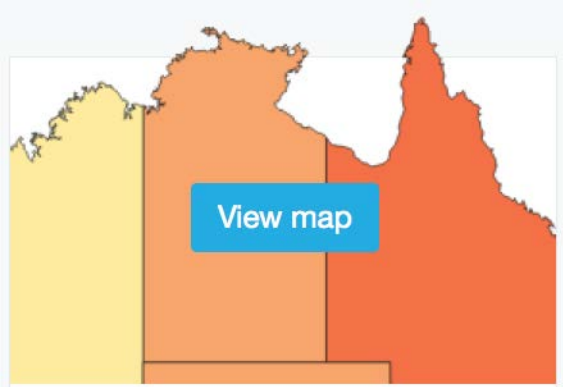
Bottom Days

- » 7th May 2013
- » 12th Jun 2013
- » 1st Jun 2013

- ◉ **Performance**
  Estimated photovoltaic output as a percentage of its maximum capacity in each state.
- ○ **Contribution**
  Estimated percentage of electricity demand being met by photovoltaics in each state. Currently unavailable in the NT.
- ○ **Total Demand + PV Generation**
  Total electricity demand in each state combined with the amount generated by PV.



Filter chart by state: ☑ NSW ☑ NT ☑ QLD ☑ SA ☑ TAS ☑ VIC ☑ WA



Live Solar PV

Live performance data from nationwide PV installations, with total electricity demand and PV contribution

	No. of PVOutput systems	Capacity CER systems (MW)	Capacity PVOutput systems (MW)	% of installed capacity
NSW	512	775.3	2.43	0.31%
VIC	384	624.6	1.49	0.24%
QLD	1092	1151.2	5.78	0.50%
TAS	74	72	0.35	0.48%
SA	310	533.1	1.47	0.28%
WA	193	397.8	0.81	0.20%
NT	7	15.1	0.03	0.21%
TOTAL	**2572**	**3569.1**		

Real-time estimates of electricity generated by PV systems and impact on load in the NEM and the SWIS.

- Live PV performance and contribution to load
  - Performance = output / capacity of systems reporting in the period (%)
  - PV generation = performance (%) x installed capacity
  - Contribution to load using NEM (AEMO) data for NSW, QLD, SA, TAS, VIC and SWIS (IMO) data for WA (90% of the Western Australian power market)
- To be enhanced with SMA and solarschools.net data
  - Sunny Portal and solarschools.net each have 1000s of Australian systems

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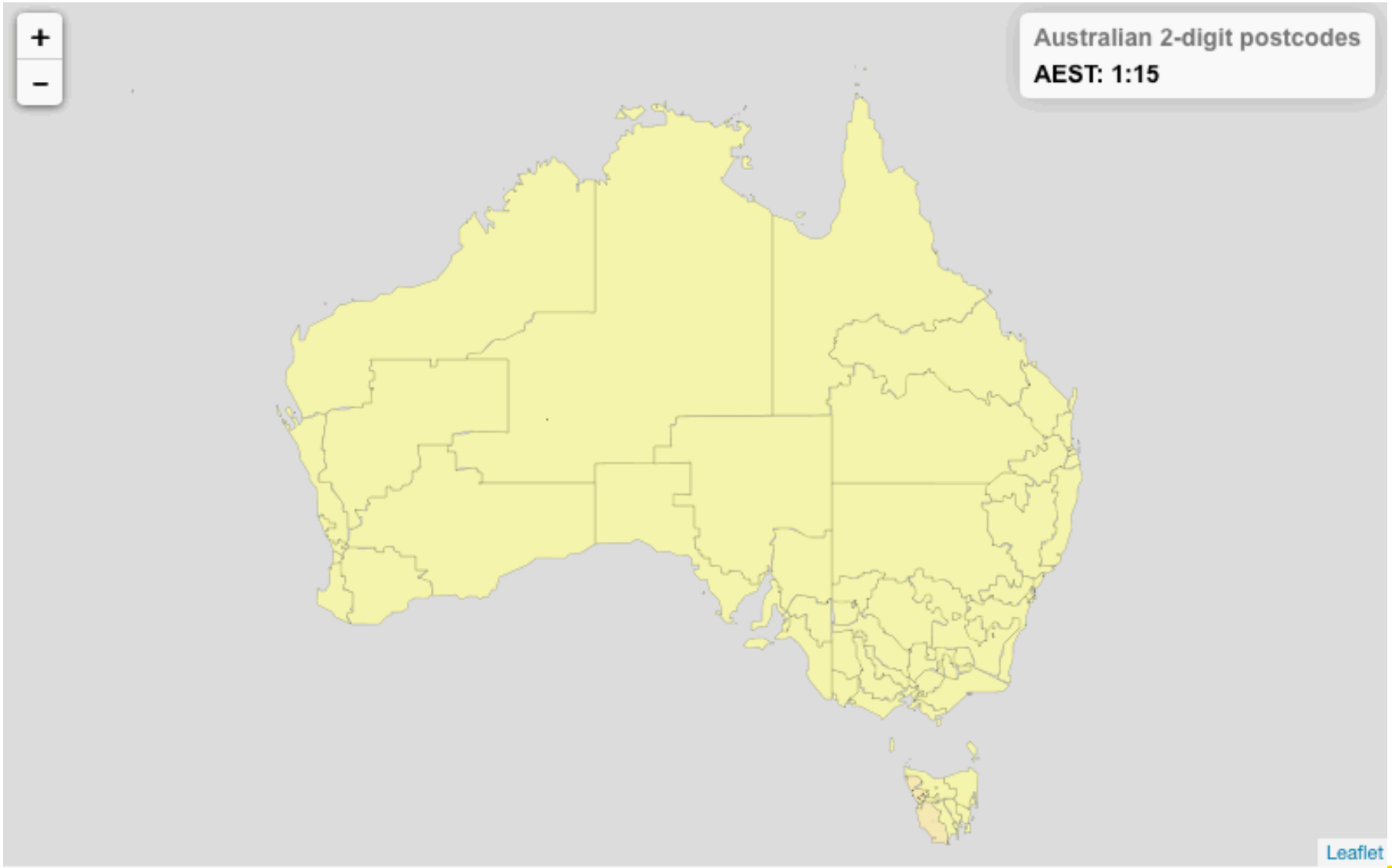
PREVIEW: Enhanced Live Solar Map



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2-digit postcode spatial resolution

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Solar Potential Tool

Data was generated as follows:

- Three types of digital surfaces models (DSMs) (3D building models, XYZ vegetation points and 1m ESRI Grids), supplied by geospatial company AAM, were used to model the CBDs of Sydney, Melbourne, Brisbane, Adelaide, Perth and Canberra.
- These DSMs were used as input to ESRI's ArcGIS tool to evaluate surface tilt, orientation and the annual and monthly levels of solar insolation falling on each $1m^2$ unit of surface.
- Insolation values output by the ArcGIS model were calibrated to estimates of insolation from NREL's System Advisor Model (SAM) using Typical Meteorological Year (TMY) weather files for each of the capital cities
- SAM has been extensively tested and SAM results were also validated for this project against measured output from PV systems in Sydney and Brisbane

- DC system size is calculated by multiplying the projected roof surface area (m^2) by a DC size factor (DC_{factor}) in W/m^2

$$DC_{size} = round\,multiple\left(\frac{A_{proj} \times DC_{factor}}{1000}, 0.25\right) \qquad \mathrm{A_{proj}} = \frac{\mathrm{A_{flat}}}{\cos\beta}$$

  - For a flush-mounted system the DC size factor is 250 $W/1.6m^2$ to reflect a typical module
  - For a rack mounted PV system the DC size factor is calculated by
    - Considering tilt, orientation and spacing required to avoid self-shading

- Values of insolation at the default tilt and orientation retrieved from a database of SAM outputs calculated at every 1° of tilt and orientation are used to adjust the insolation value at the surface

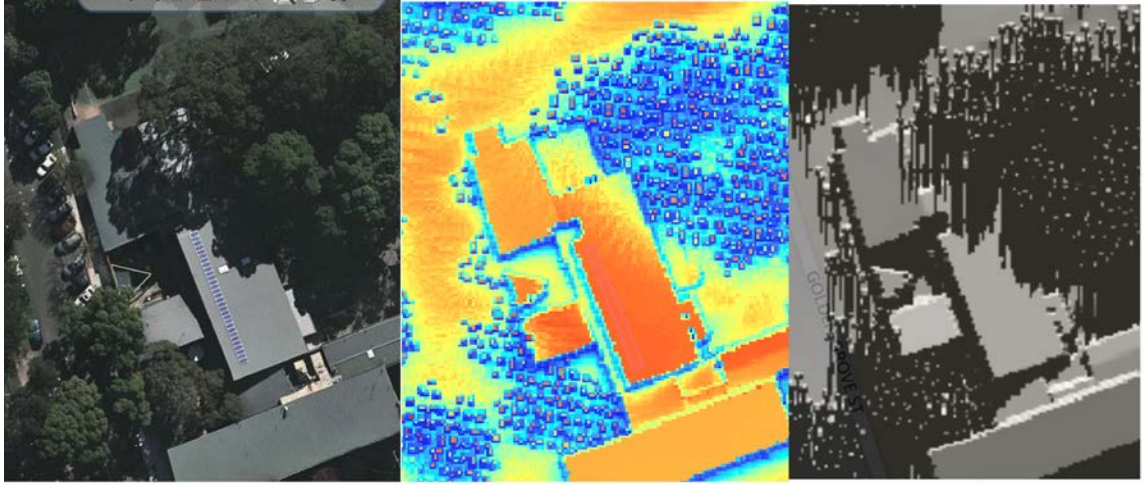
Solar Potential Tool

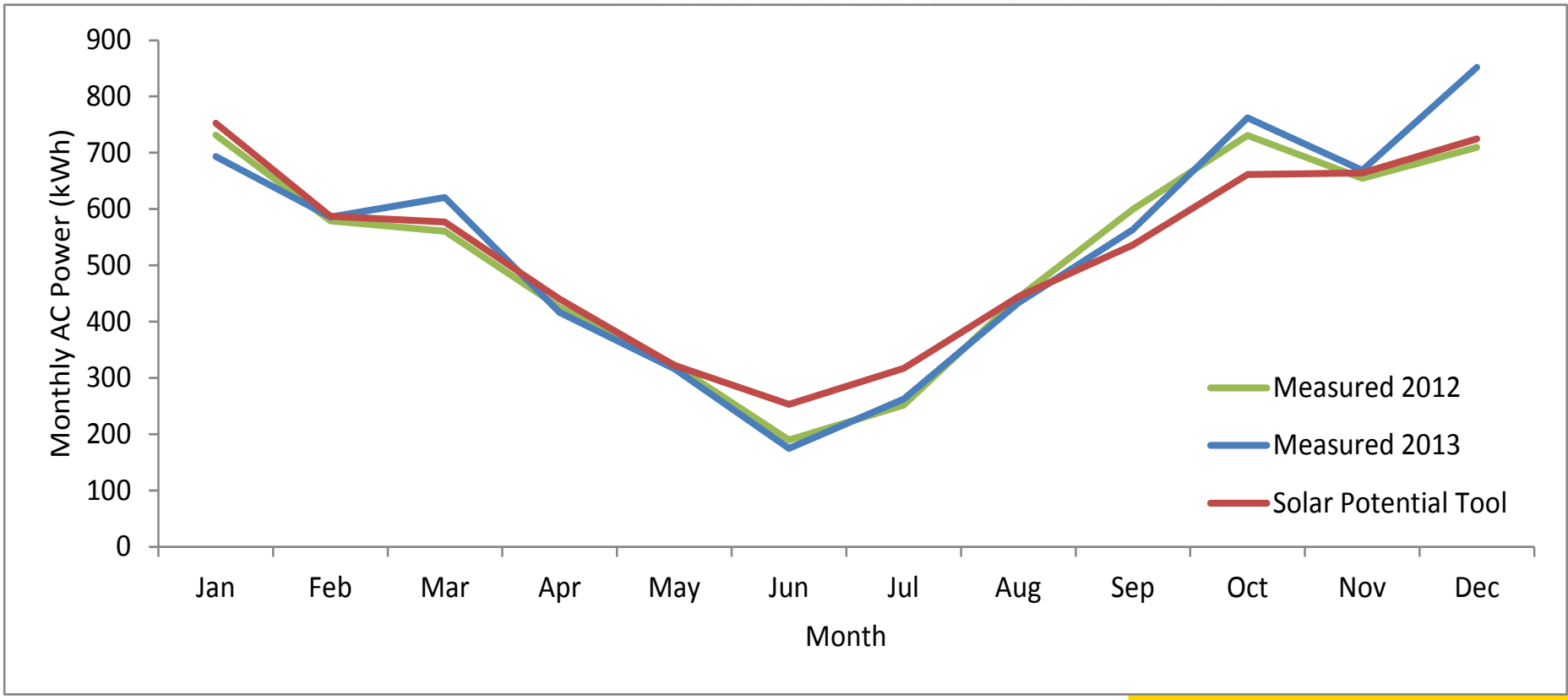
- The Solar Potential Tool facilitates:
  - Planning and design of incentives by local governments,
  - PV installer businesses system design,
  - Investment in PV
  - PV potential to be included in forward projections by planners and electricity utilities.

- New methods are being explored to accept different types of GIS data, andexpand the Solar Potential Tool beyond the inner city regions of major cities.

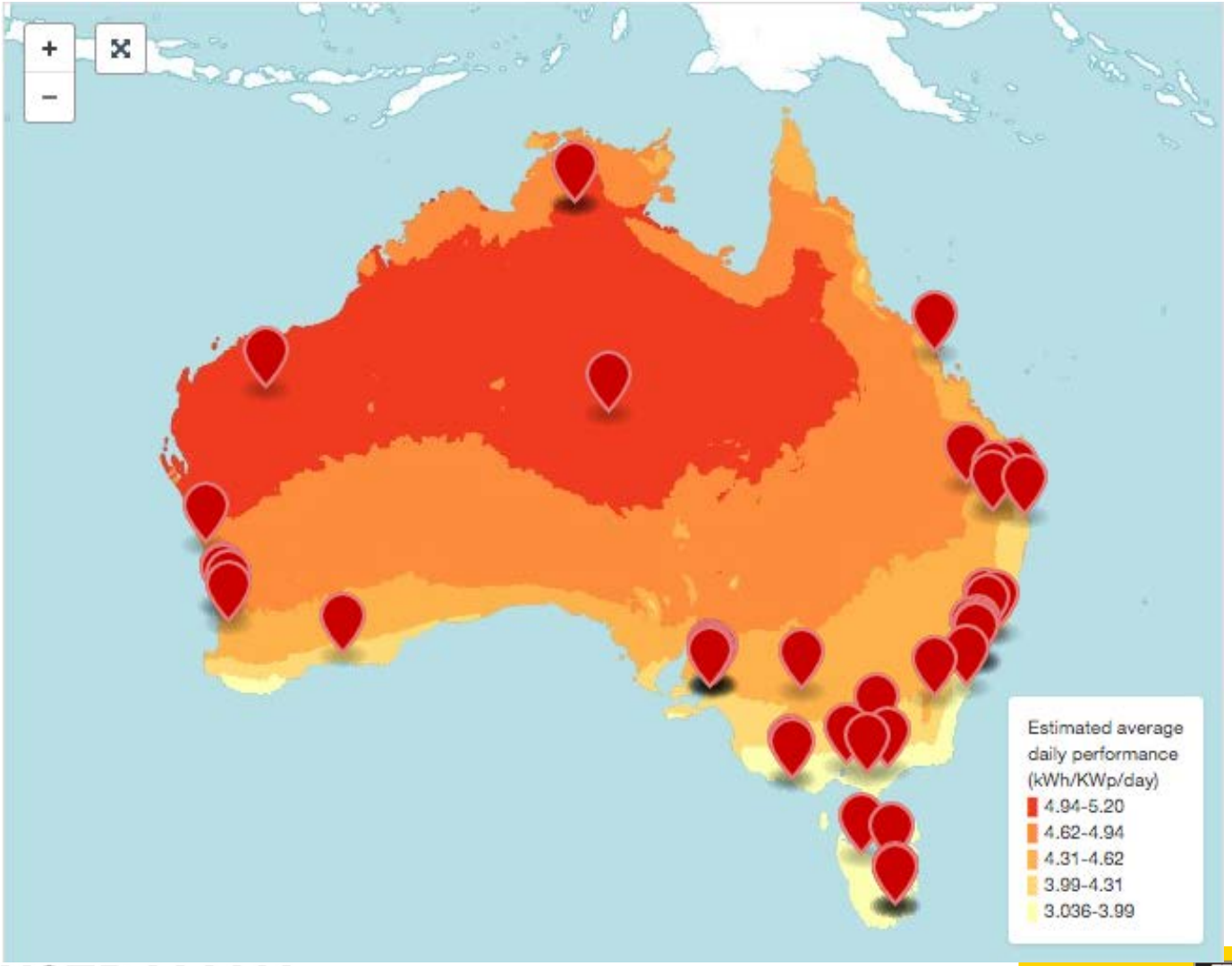
Solar Potential Tool Validation

- Darlington Public School





PV Performance by Climate Region



PV Performance by Climate Region

- Performance data from PV systems that received funding under the National Solar Schools Program (NSSP) to be visualised, compared, aggregated and downloaded.
  - PV systems are mapped by PV performance climate region
  - Incorporates onsite weather measurements, including irradiance, ambient temperature, and in some cases, wind speed.
- Development and mapping of PV-System expected daily performance (kWh/kWp/day) climatologies based on Australian Bureau of Meteorology gridded weather data and validated by PV system output data. The method is under review for journal publication.
- Provides data for detailed studies
  - PV system performance and reliability in different weather conditions, climate types, and across different technologies.

Market Evolution Animation

PV in Regional Australia

- Despite direct support frameworks for renewables being removed, strong PV deployment continues
- Areas of high and growing PV penetration behind the meter
  - Significant impacts on peaks and times of peaks
  - Some technical challenges (especially on rural feeders), but much less significant than a/c impacts
  - Main issue is reduced revenue for DNSPs
  - Challenges will be broader than PV – storage, controllable loads, engaged customers
- Regulatory frameworks and current electricity market models are presenting barriers
  - Barriers to PV erected to maintain status quo
- Need new market models and business models to facilitate clean energy transition
  - Fair and transparent allocation of costs and payment for services
  - Temporal and locational value to incentivise efficient investment
  - Competition
- Mini & micro-grid options, especially in low density / high grid cost regional areas
  - Cheaper and more efficient than maintaining centralised grids
  - Can reduce significant cross subsidies
  - More flexibility and competition in energy service provision
  - Potentially safer and more reliable (e.g. extreme weather, bushfire)

This project has been funded by:

ARENA

Australian Government

Australian Renewable Energy Agency

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2014 Asia-pacific solar research conference

2014 ASIA-PACIFIC SOLAR RESEARCH CONFERENCE

8-10 Dec 2014, UNSW, Sydney

- Australian PV Institute
- 9th Aseanian Conference on DSC & OPV
- CRC for Low Carbon Living
- Solar Thermal Electricity
  with
- 2nd Annual Conference of Australian Centre for Advanced PV

- http://apvi.org.au/solar-research-conference/

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