UNSW AUSTRALIA

Never Stand Still

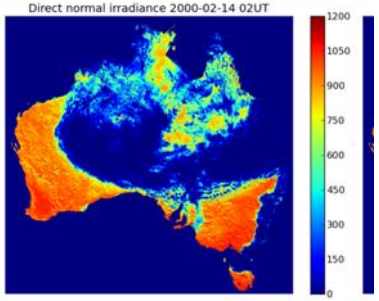
School of Photovoltaic and Renewable Energy Engineering

PV energy systems and energy efficiency research at SPREE: a snapshot

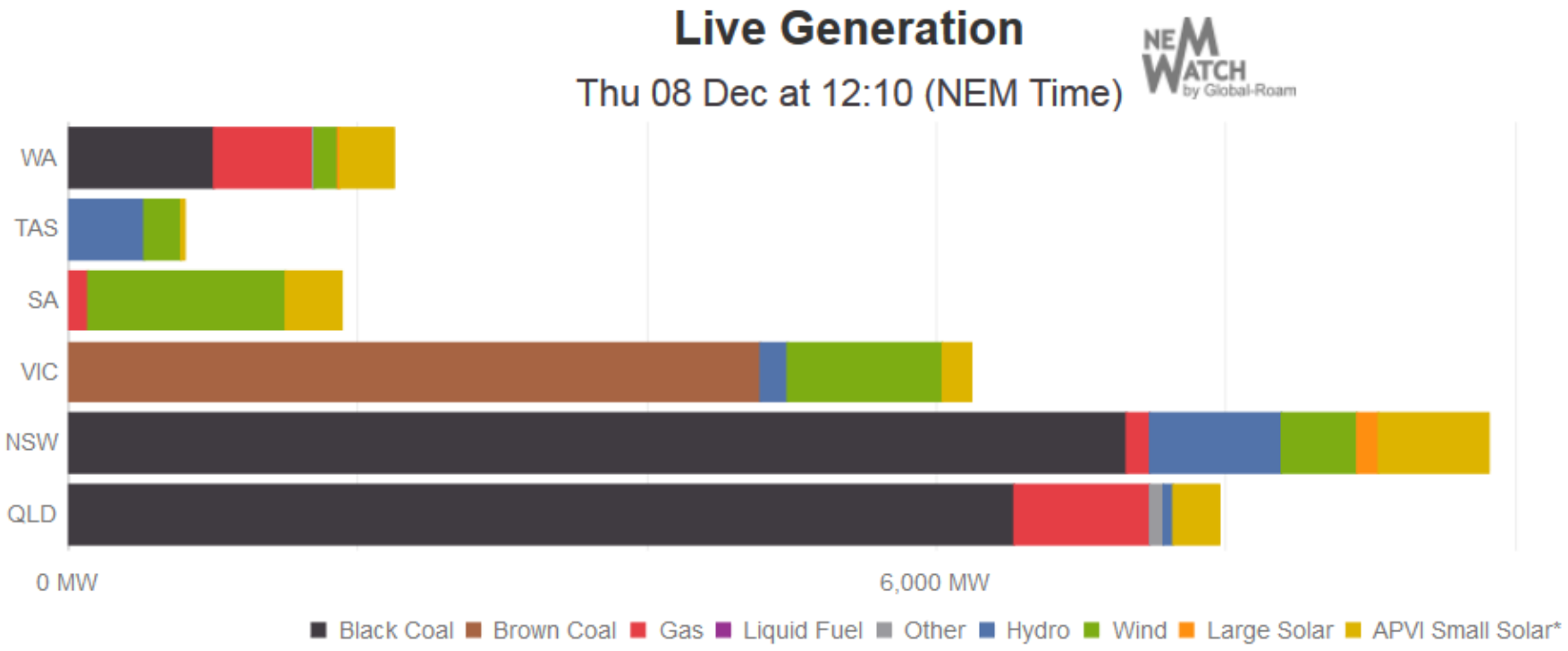
Alistair Sproul

SPREE

University of New South Wales

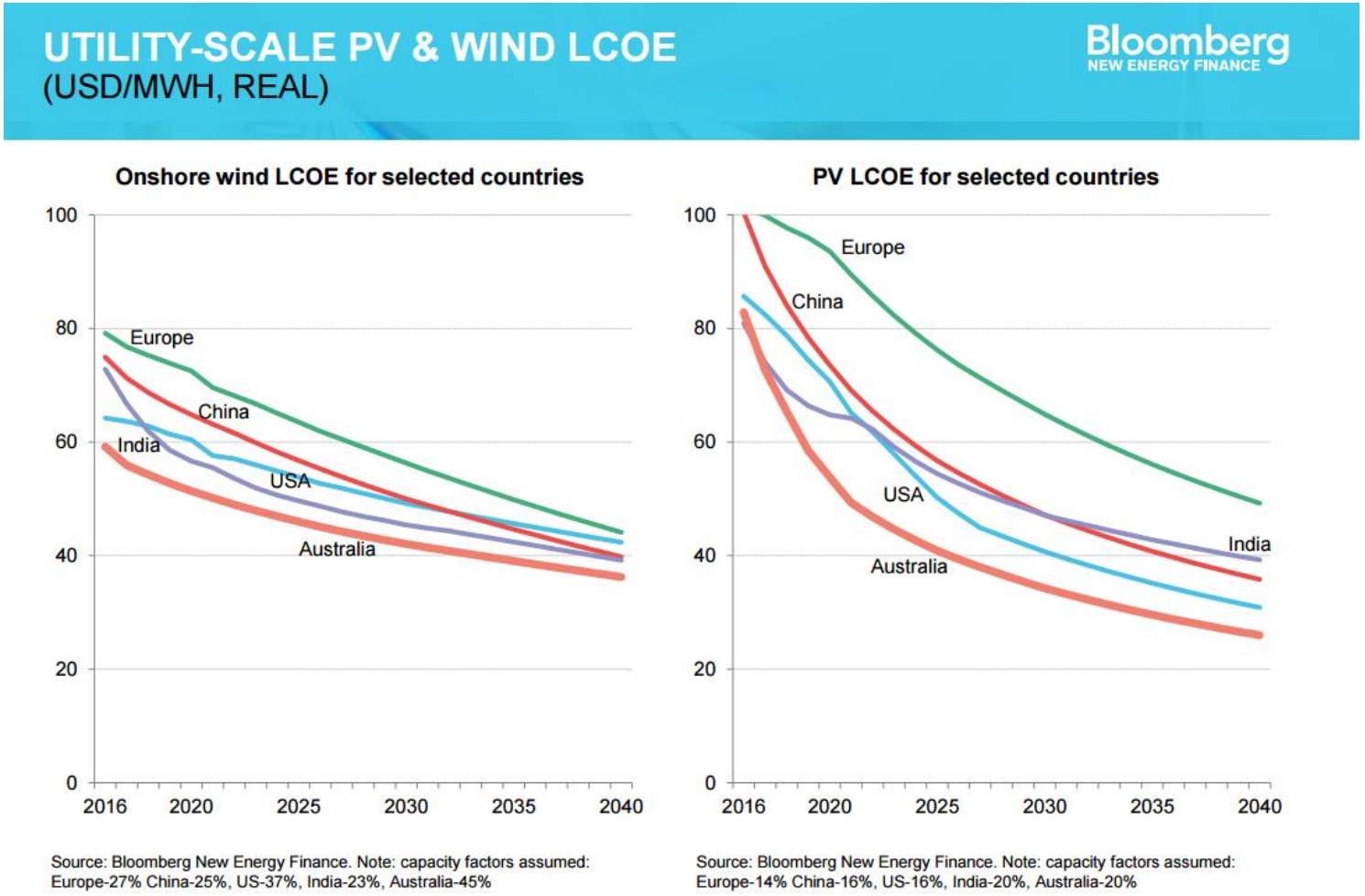


National Electricity Market



Australia has ~5 GW of photovoltaics
About 90% are small residential systems (< 5 kW)

PV and Wind LCOE

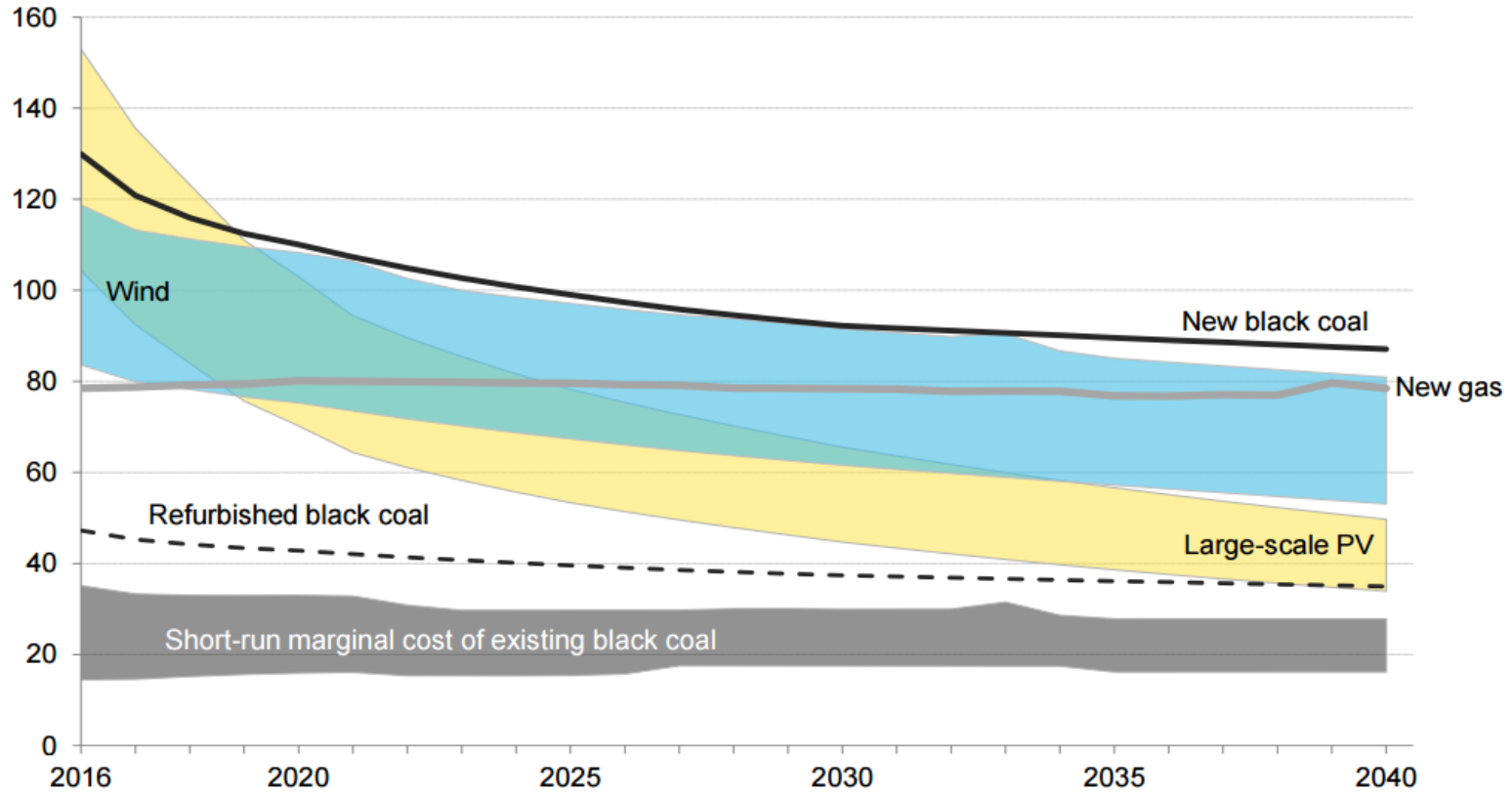


http://www.smh.com.au/environment/climate-change/seven-energy-charts-that-will-cheer-and-frighten-about-australia-and-the-world-20161206-gt53fq.html

EXISTING COAL WILL CONTINUE TO HAVE A COST ADVANTAGE OVER ANYTHING NEW IN AUSTRALIA

Bloomberg NEW ENERGY FINANCE

Levelised cost of generation (real 2016 AUD/MWh)



Note: assumes coal refurbishment capex is 25% of new build cost. Short-run marginal cost includes fuel, fixed and variable costs, assuming 83% capacity factor. Capacity factor of utility-scale PV: 15-22%; wind: 27-45%, New gas (CCGT): 85%.
For details see: New Energy Outlook 2016: Australia Seminar

Source: Bloomberg New Energy Finance

DECEMBER 6 2016

Households to power up to half Australia, zero emissions within reach: CSIRO

Adam Morton

As the Coalition backs away from a pledge to consider a climate change policy that the energy industry says it needs, a new study is projecting a rapidly growing mass electricity generator for Australia in the decades ahead: the public.

Consumers using rooftop solar panels and batteries will produce

MOST POPULAR

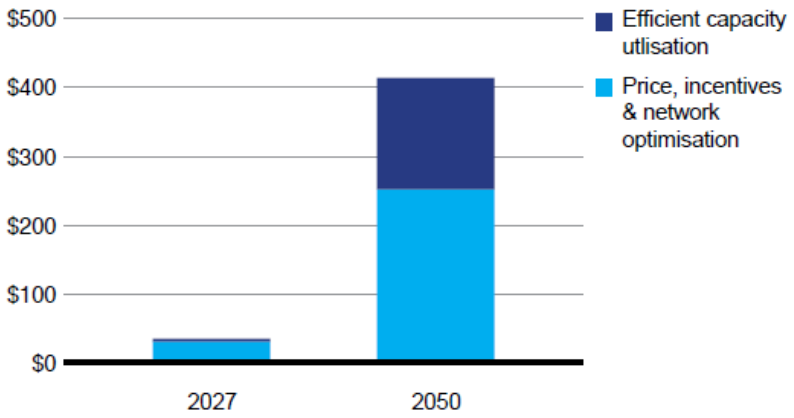
1 Capitulation on climate ignores evidence and will come at a cost

2 Government accused of forcing up power prices through climate backdown

Rooftop PV – considerable role to play and makes dollars and sense

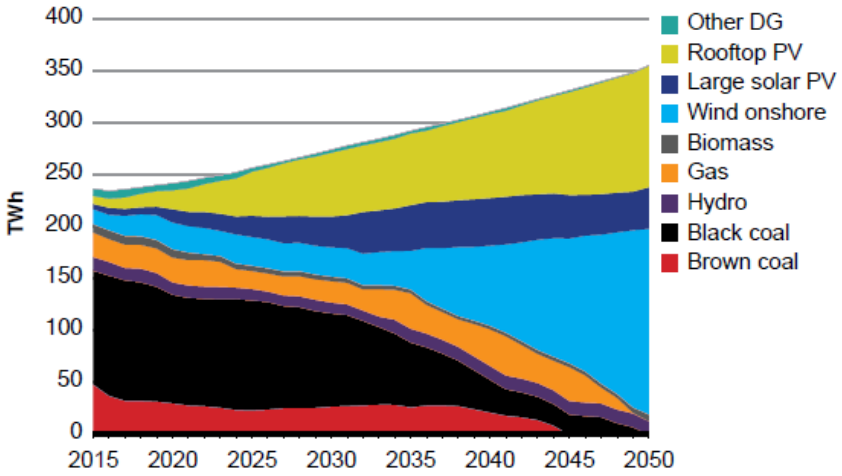
Savings for customers

Projected savings in average residential bills (in real terms) under the Roadmap scenario

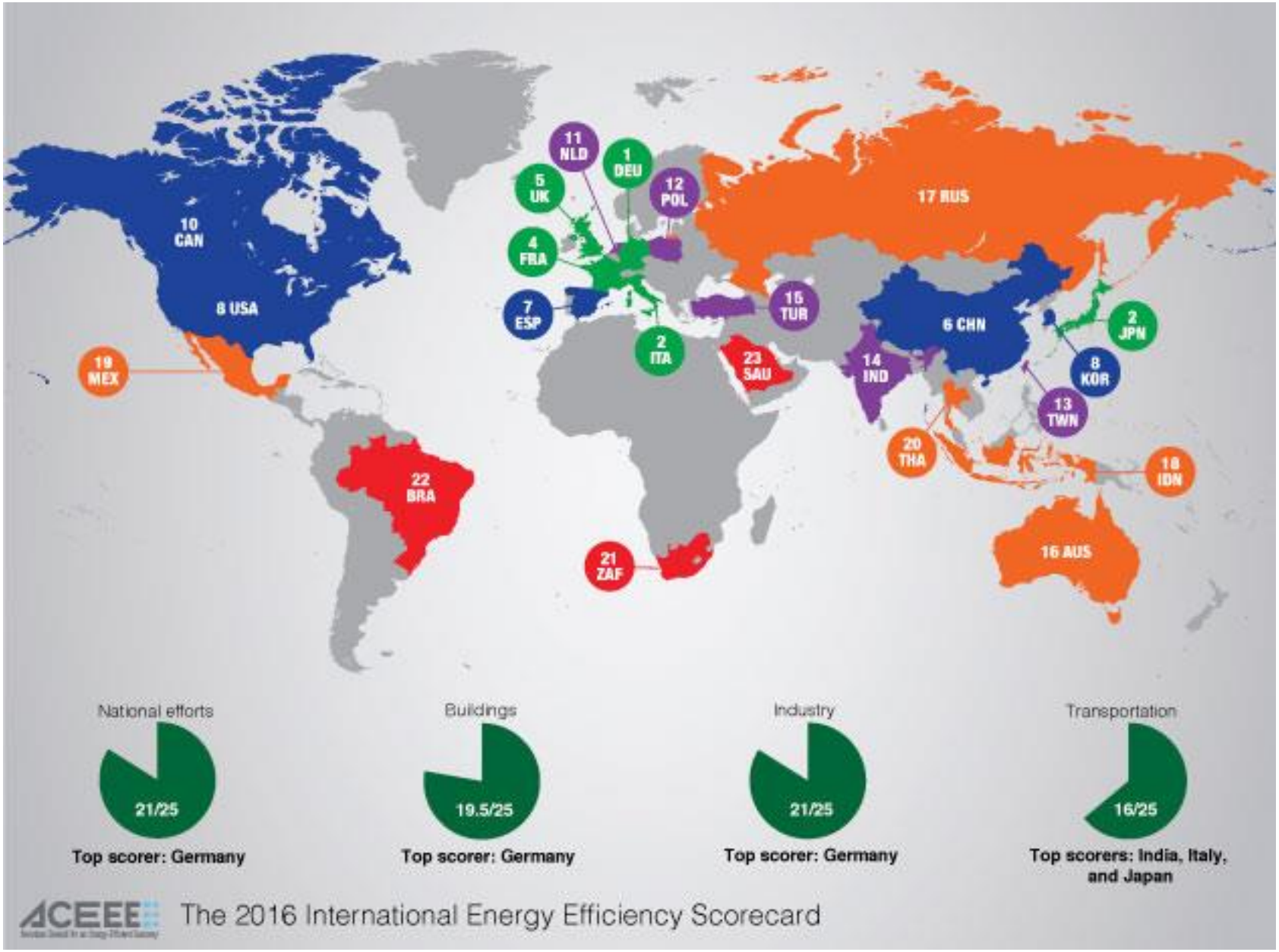


Electricity generation mix

Projection of Australia's changing electricity generation mix to 2050



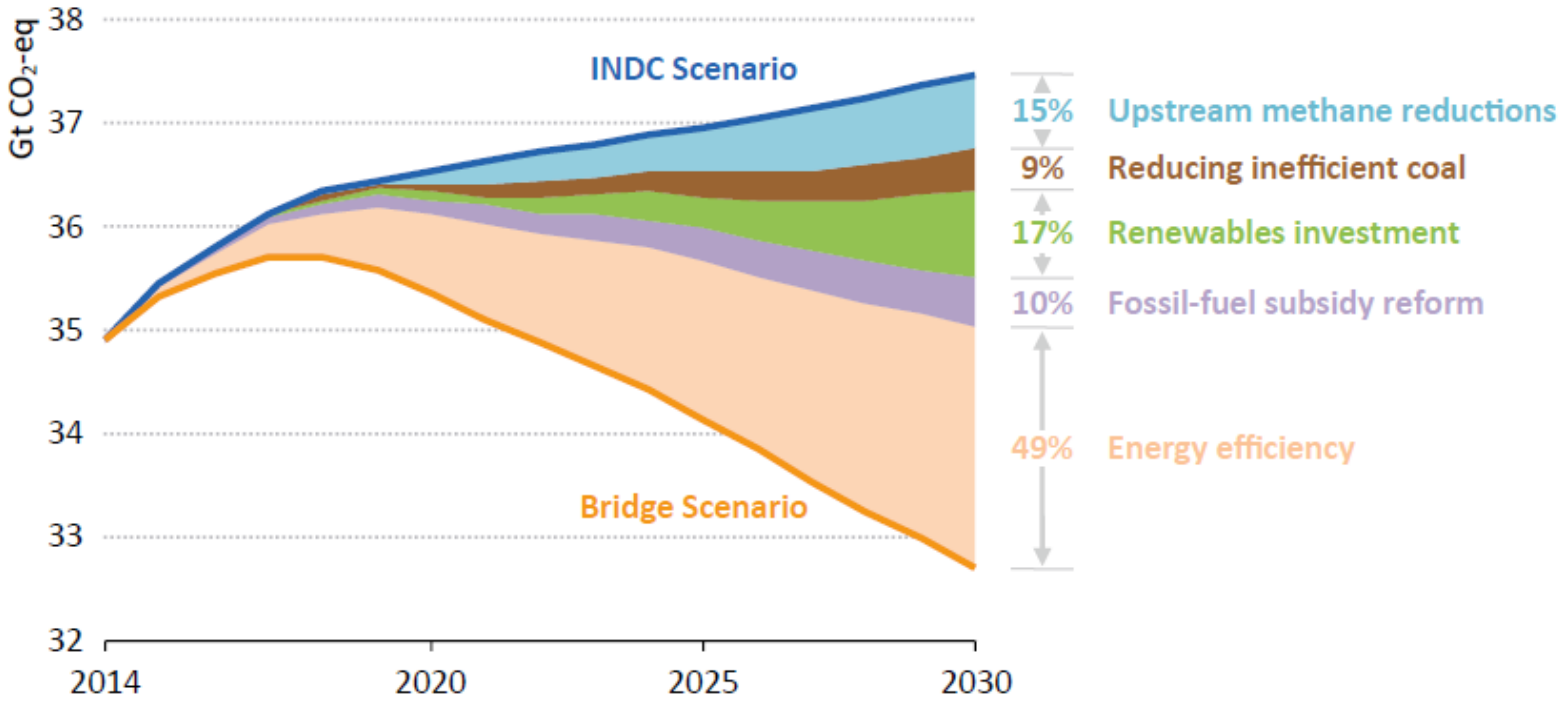
http://www.energynetworks.com.au/sites/default/files/summary_key_concepts_report_2016.pdf



http://aceee.org/portal/national-policy/international-scorecard

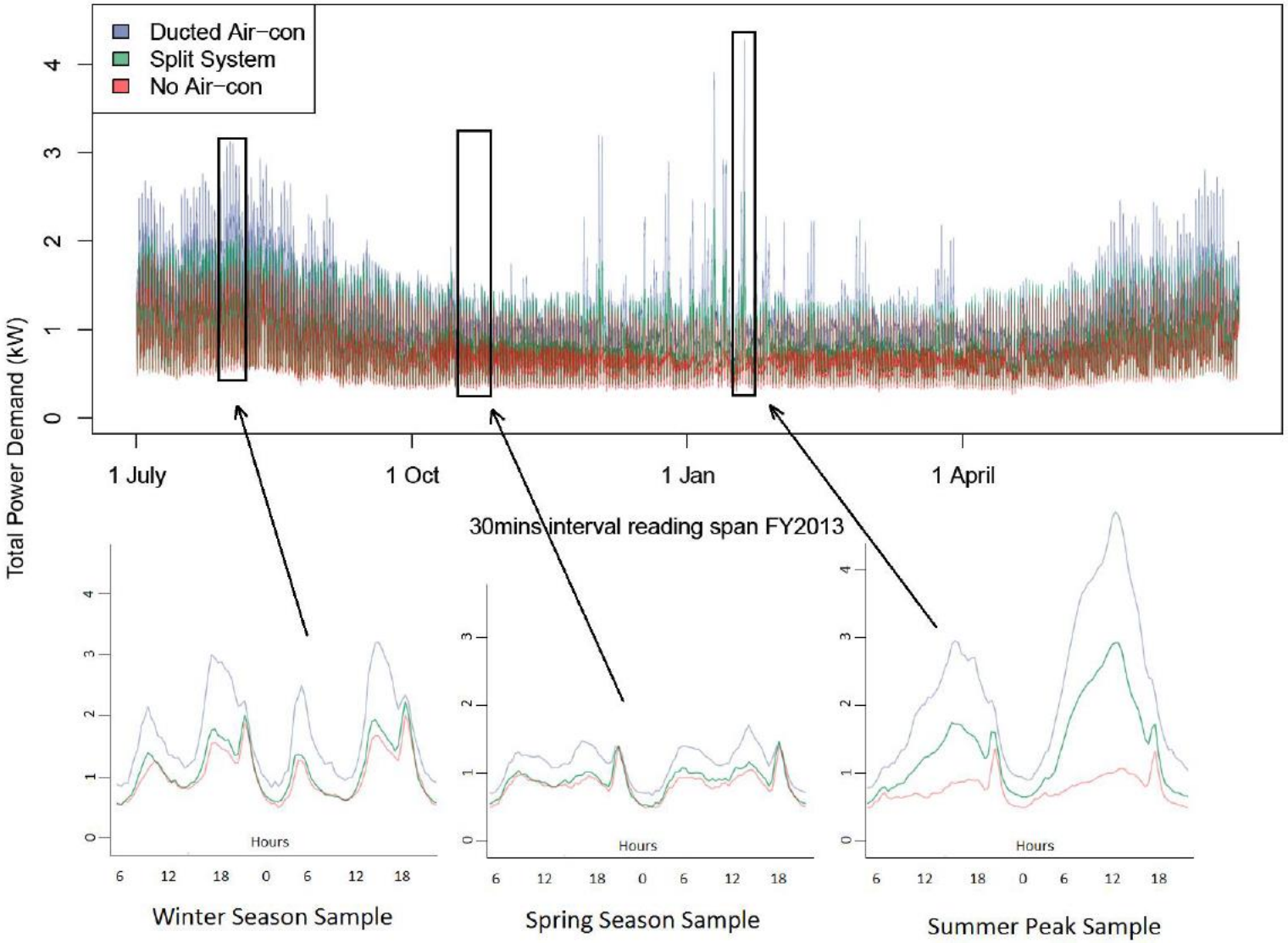
Energy efficiency can reduce CO_2 even further

Figure 3.2 ▷ Global energy-related GHG emissions reduction by policy measure in the Bridge Scenario relative to the INDC Scenario



https://www.iea.org/publications/freepublications/publication/WEO2015SpecialReportonEnergyandClimateChange.pdf

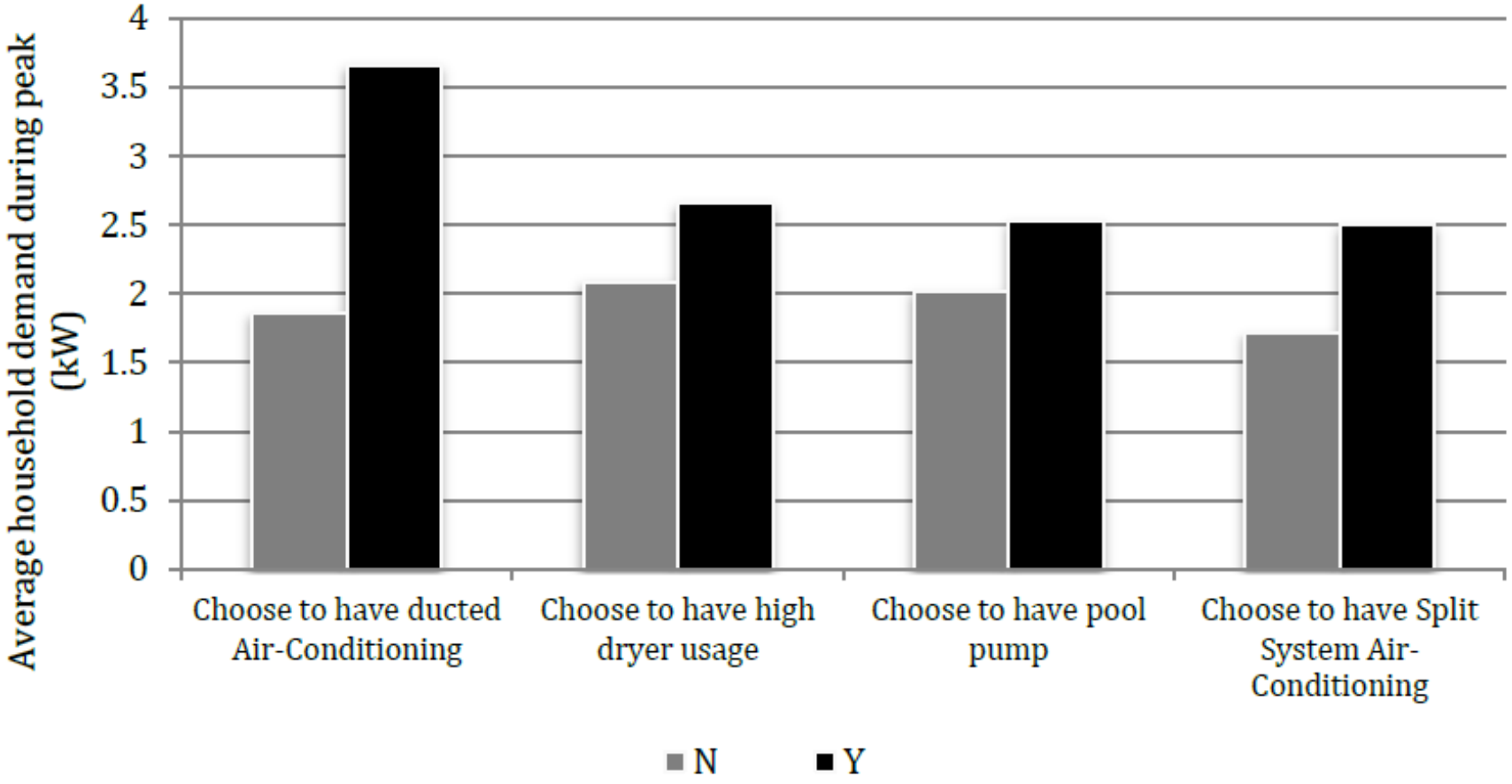
Peak residential electricity usage



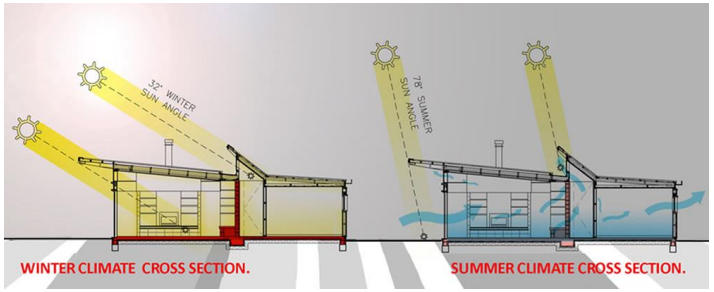
Statistical Analysis of Drivers of residential peak electricity demand

H. Fan[a], I.F. MacGill[b], A.B. Sproul[a]

Drivers of summer peak demand



Zero energy, Passive solar, PassivHaus for Australia or something else?

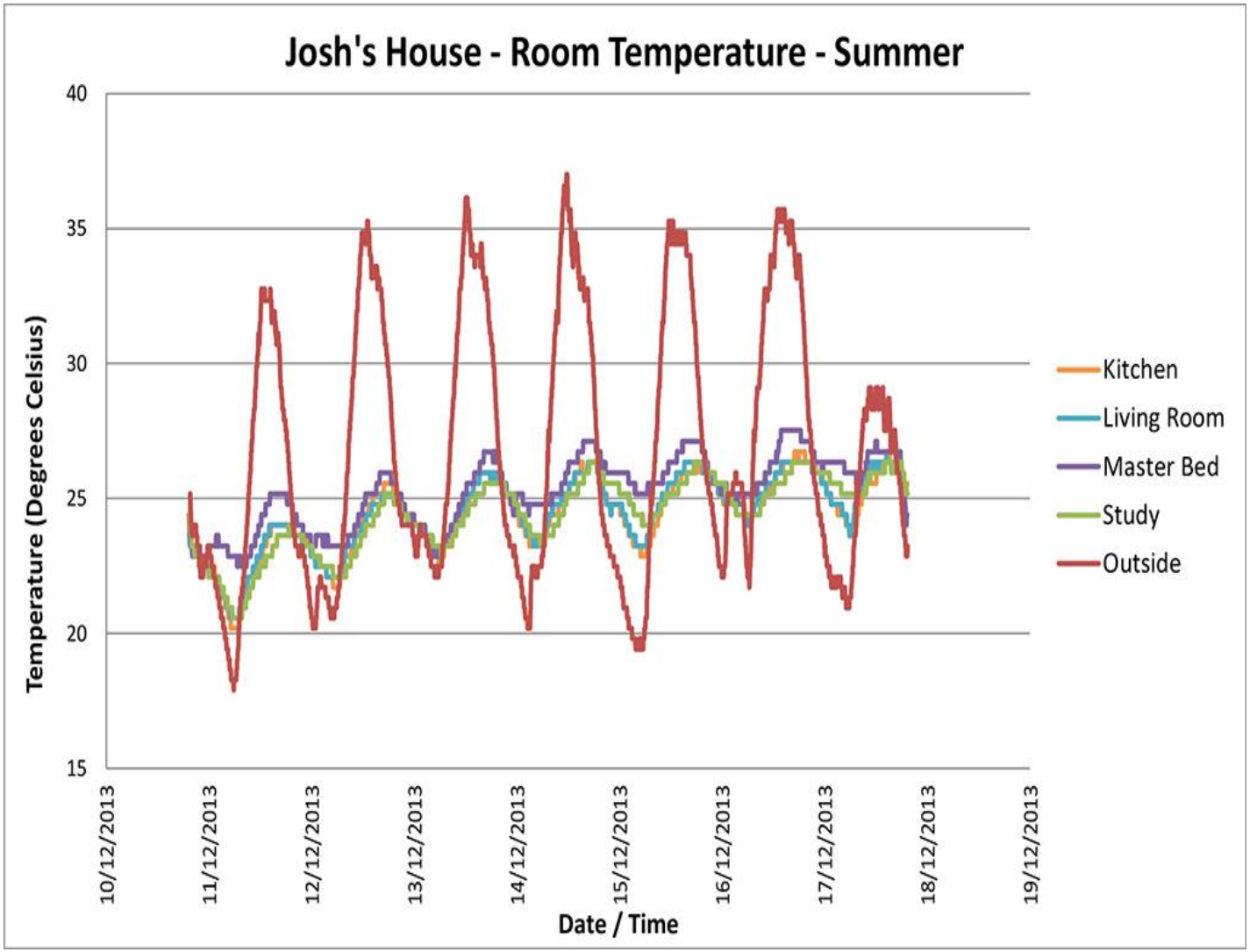


Living Laboratory

- Award winning 10 Star Josh's House in Fremantle
- How well does the house perform?

http://joshshouse.com.au/

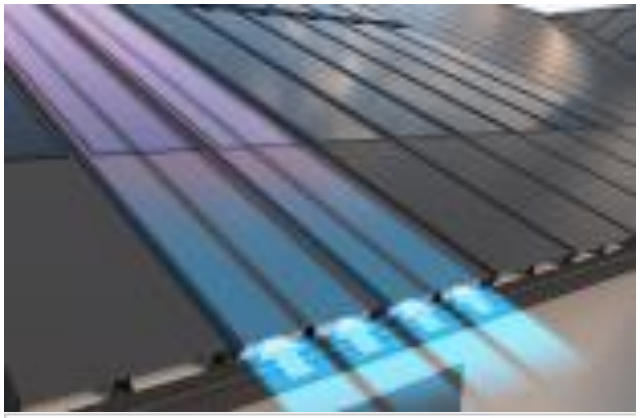
Monitoring - summer

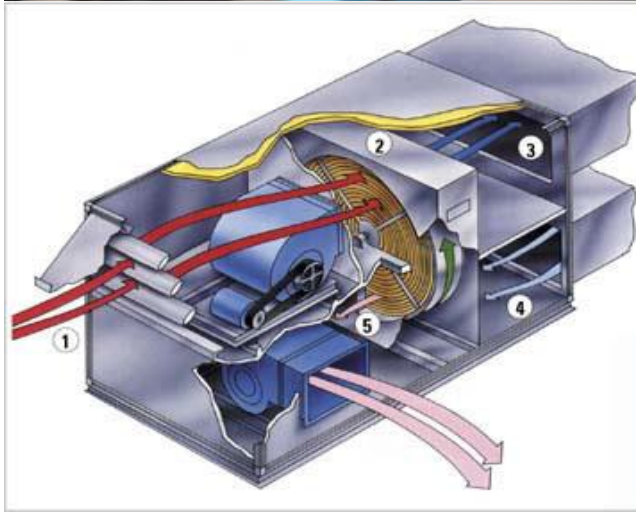


Heat Control - Insulation

RP1015 - Combining a building integrated PVT system with a low temperature desiccant cooler to drive affordable solar cooling

- The motivation here is that as the price of PV continues to fall, rooftop PV becomes a very cost effective option.
- This project aims to integrate PVT roofing system with desiccant cooling systems.
- BIPV/T cannot produce temperatures high enough to drive an absorption cooling cycle.
- However BIPV/T in many Australian climates can potentially produce thermal energy at a temperature that can drive a low temperature desiccant cycle





UNSW AUSTRALIA CSIRO BLUESCOPE STEEL

UNSW/Solar analytics
PV & Building load prediction algorithms

Ausgrid [2] data from 8000 solar PV systems shows that approximately 51.8% are not performing to capacity

This is a new project that builds on a previous successful project.

Aim now is to improve algorithms for predictions with a view for developing accurate storage models.

Energy Meteorology

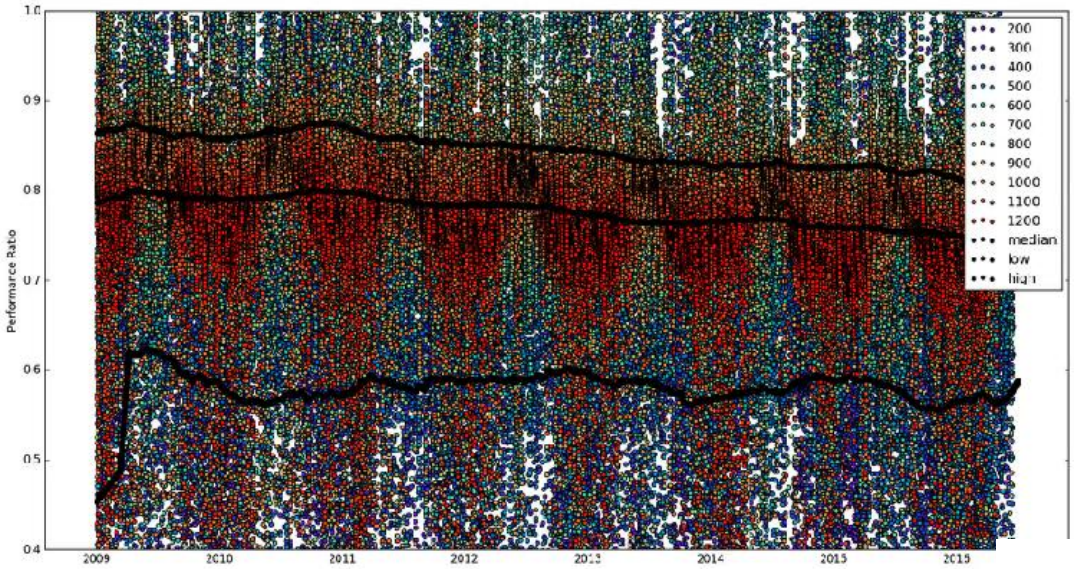
- **Energy Forecasting investigates how climate and weather influence the energy sector. My research group uses the connection between energy and meteorology to develop models that lead to promotion of cost-effective and sustainable weather and climate risk management strategies for the Energy industry**
  - **Resource assessment**
  - **Siting and planning**
  - **Forecasting and optimisation**
  - **Assist in technology design**
  - **Building optimisation**

Projects at UNSW

- **Forecasting and Characterising Grid Connected Solar Energy and Developing Synergies with Wind**
  - Project Members: Merlinde Kay (UNSW), Armin Dehghan (UNSW), John Boland (Uni SA), Iain MacGill (CEEM -UNSW), Steve Sherwood (CCRC – UNSW), Muriel Watt (APVI) and Martin Poole (Epuron)

- **Australian Solar Energy Forecasting Scheme (ASEFS) – Phase 1**
  - UNSW Project Members: Merlinde Kay (SPREE), Rob Taylor (Mech Eng), Abhnil Prasad (SPREE), Edward Law (SPREE)

PV Performance



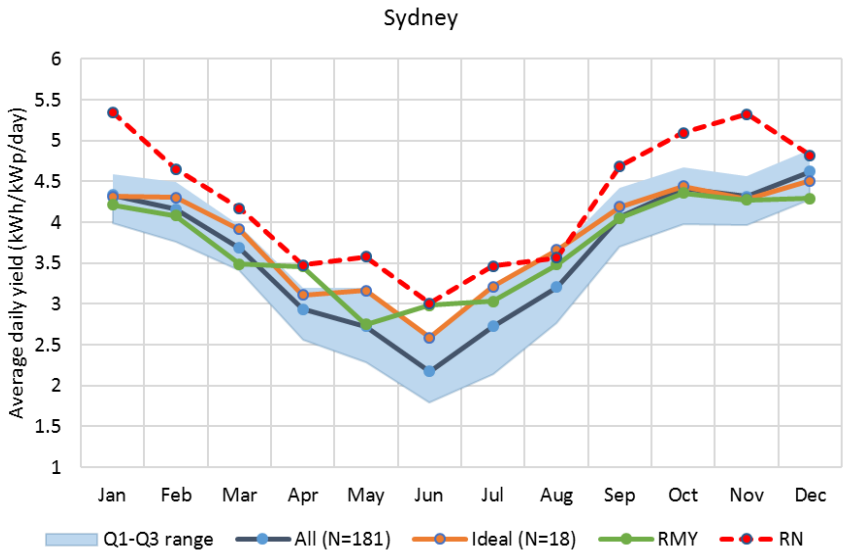
Calculation of PV Degradation Rates in an Australian Desert Climate

- Jessie Copper, Anna Bruce

Distributed PV Performance

How well are distributed PV systems in Australia performing compared to models?

- Navid Haghdadi, Jessie Copper, Anna Bruce

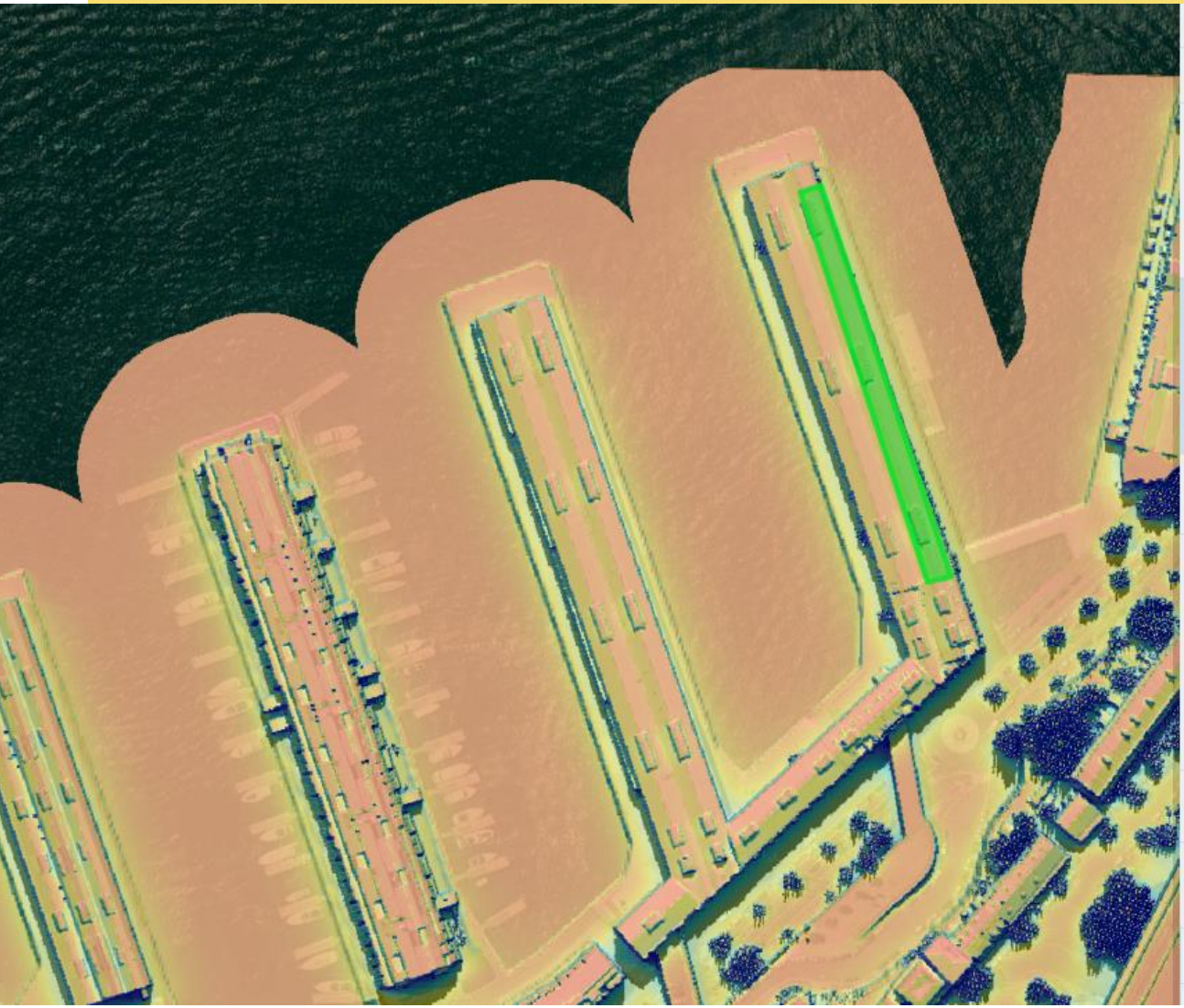


Mapping Solar Potential

New methods for estimating PV output on urban rooftops using low quality spatial data

UNSW AUSTRALIA

Mapping Solar Potential



Approximate area 1,169.52m²

Insolation	Orientation	Tilt
4.14 kWh/m²/day	76°	28°

OPTIONS

Flush mounted | Roof tilt is unsuitable for rack mounting

Flush mounted system size 182.5 kW

AC power output per month

Annual AC output	212,295.07 kWh
Annual output per kW of installed capacity	1,163.26 kWh/kW
Estimated annual saving ?	Annual CO_2 offset

UNSW AUSTRALIA

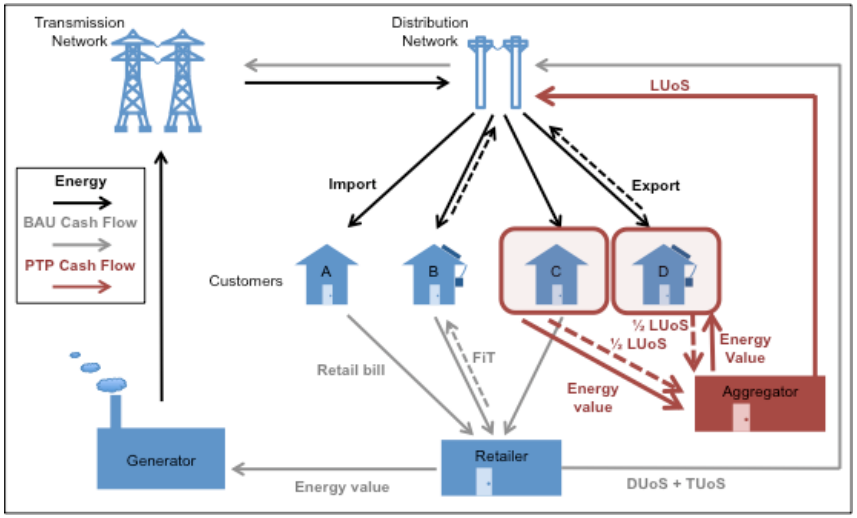
Policy and Markets

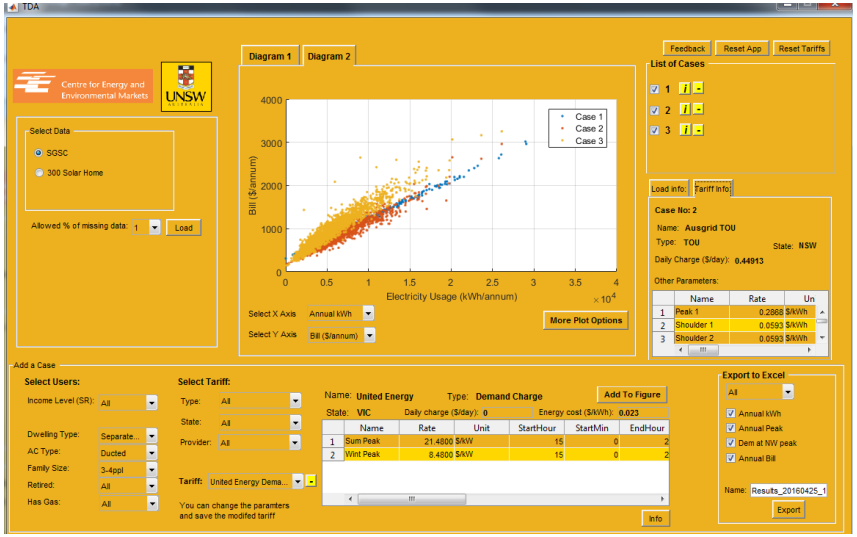
New Retail Models for RE

- Off-site RE purchasing models for Large Energy Users
  - Emily Mitchell & Anna Bruce
- Community Energy & Embedded Networks, Peer to Peer Trading, PV on Apartment Buildings
  - Mike Roberts, Johanna Bowyer, Anna Bruce

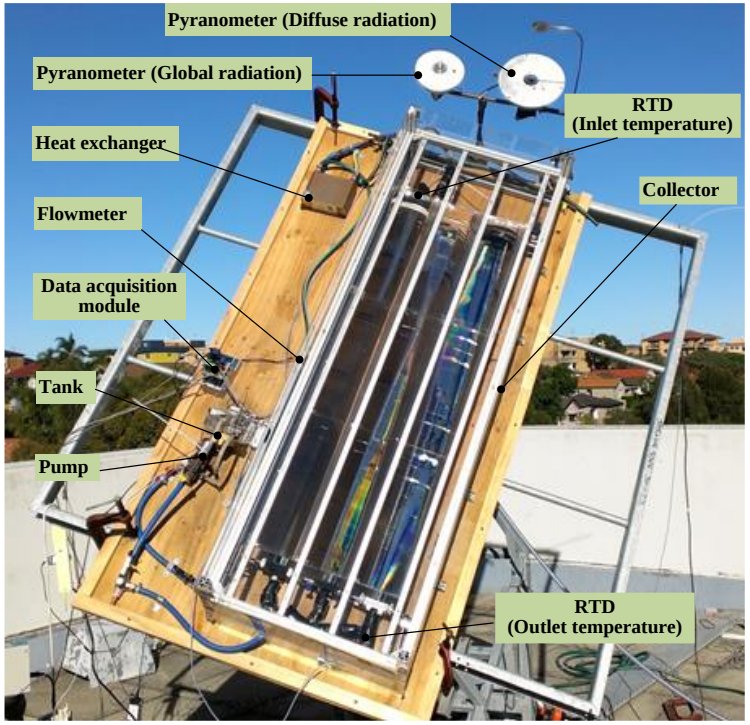
Network Tariff Design

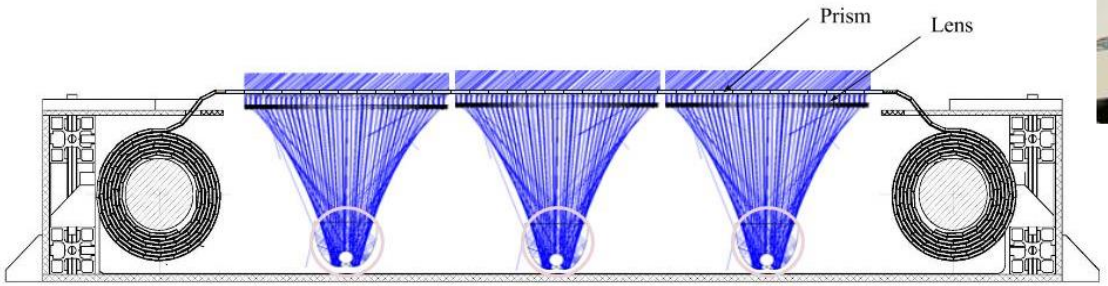
- New open source analysis tool
- Submissions to Regulatory Processes
  - Anna Bruce, Sharon Young, Navid Haghdad, Rob Passey, Muriel Watt





Aim #1 = New Solar Collectors for Factory Rooftops





*From the work of Qiyuan Li and Felipe Crisostomo (who submitted their PhDs in August)

UNSW AUSTRALIA

Acknowledgements

- Thanks to inputs from Anna Bruce, Muriel Watt, Merlinde Kay, Jessie Copper, Jose Bilbao and Rob Taylor and their teams.

UNSW AUSTRALIA