Mike B Roberts, Gareth Huxham, Anna Bruce and Iain MacGill

Photovoltaics and Common Property Demand in Apartment Buildings

UNSW AUSTRALIA

Never Stand Still | Faculty of Engineering | School of Photovoltaic and Renewable Energy Engineering

Photovoltaics and Common Property Demand in Apartment Buildings

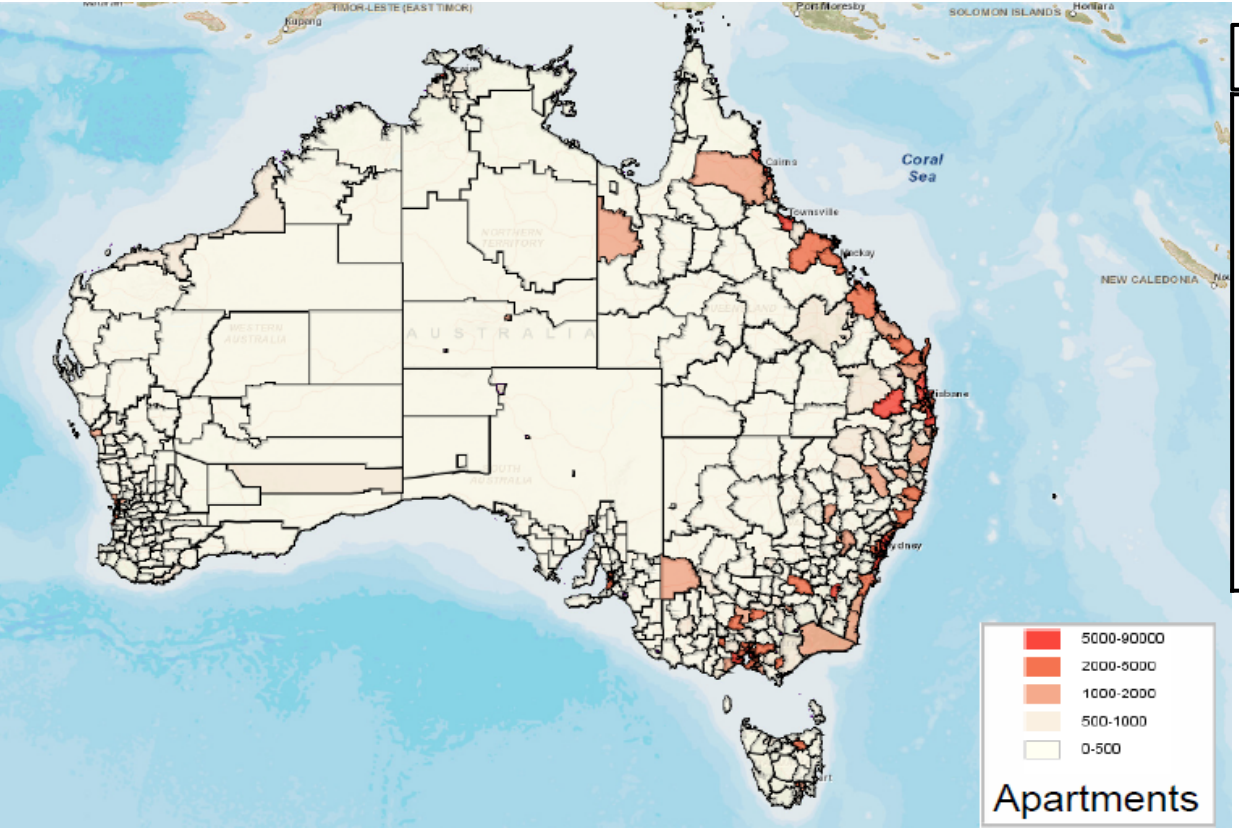
- Opportunities for PV in Apartments – an Overview
- Common property (CP) load profiles
- The potential impact of photovoltaics
- Conclusions & Further Research

The Opportunity

- 1.5 million residential PV systems in Australia, penetration of 40% in some cities
- Apartments have relatively low PV penetration are left behind
- Apartments house 14% of Australians [1] (1.3 million people)
- Apartments comprise 32% of new residential development[2]
- High proportion young, single, overseas born[3] and low income[4] (equity issue)
- Potential benefits for household economies, emissions reduction and networks
- Multiple Barriers (Governance, Finance, Network, Regulation and Knowledge Issues) [5]

1. ABS, *Census of Population & Housing*. 2011, Australian Bureau of Statistics.
2. ABS, *Monthly Building Approvals Statistics*. 2015, Australian Bureau of Statistics.
3. Randolph, B. and H. Easthope, *'Governing the Compact City': The governance of strata title developments in Sydney*
4. ABS, *Household Energy Consumption*. 2012, Australian Bureau of Statistics
5. Roberts, M. B., A. Bruce and I. MacGill, *PV in Australian Apartment Buildings – Opportunities and Barriers*. 2015 , Asia Pacific Solar Research Conference. Brisbane

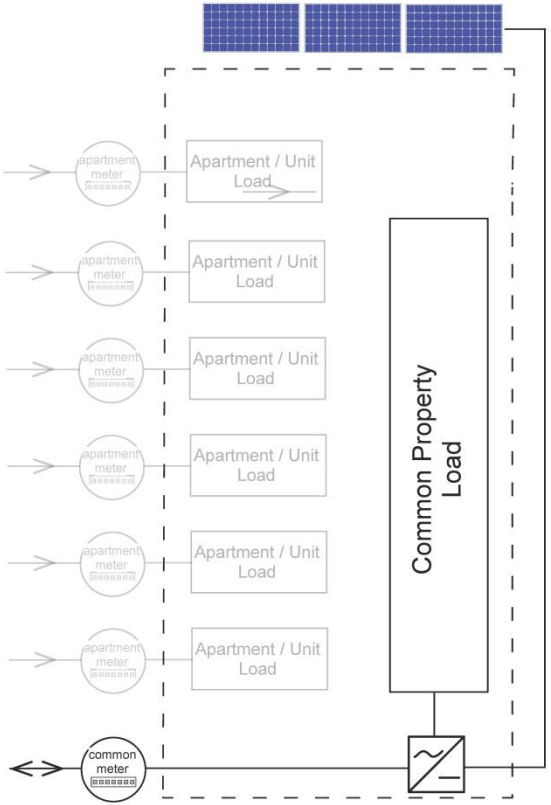
The Opportunity



Apartments as % of Residences[1]		
Melbourne	79%	**42361**
Sydney	75%	**70634**
North Sydney	72%	**25265**
⋮	⋮	⋮
Gold Coast	24%	**53300**
Brisbane	20%	**86428**
⋮	⋮	⋮
Shark Bay	0.4%	4
⋮	⋮	⋮

1. ABS, *Census of Population & Housing*. 2011, Australian Bureau of Statistics.

PV Implementation Models



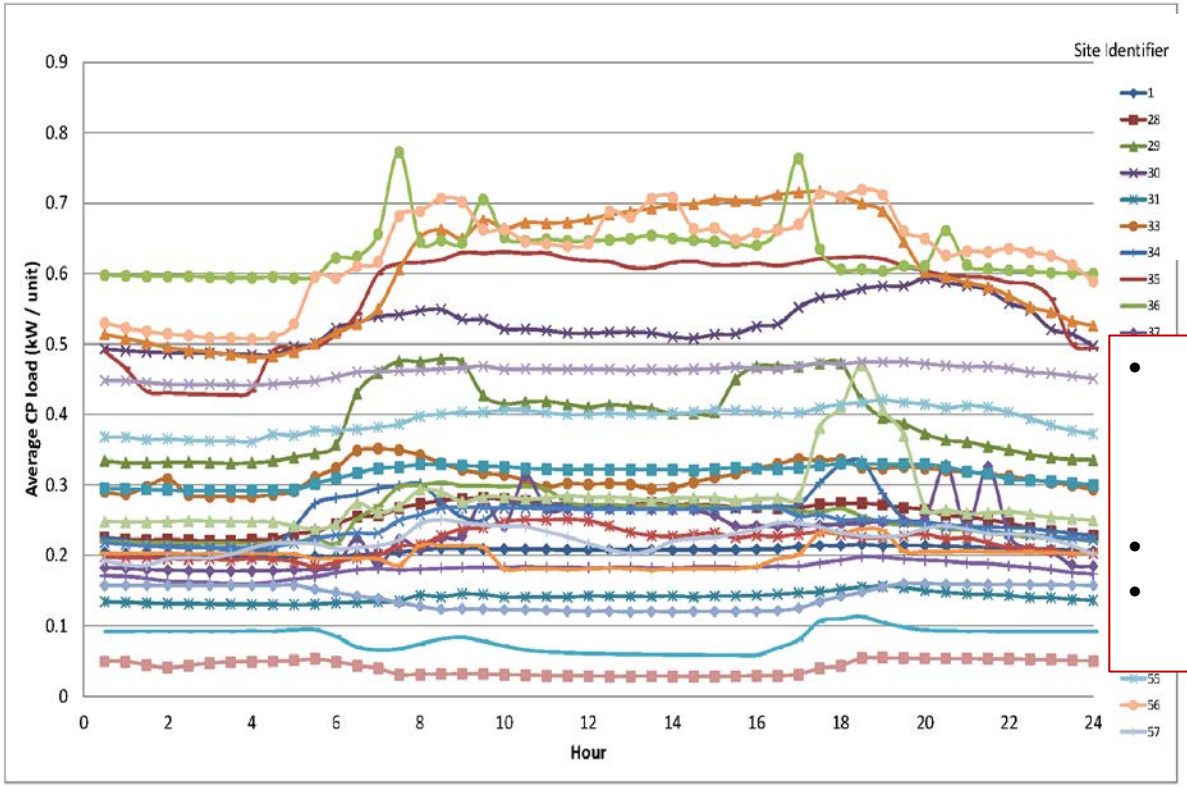
		Governance of PV	
		Individual	**Shared**
Demand Met	**Apartments / Units**	Individual PV for Apartments	Shared PV distributed via Embedded Network or Virtual Net Metering
	Common Property		Shared PV to supply Common Property

- Most common arrangement
- Simplest technical solution
- Costs & benefits both accrue to Owners Corporation / Body Corporate

Common Property Load

- Common property (CP) load can include
  - Lighting of stairwells, foyers, garages, etc.
  - Ventilation / Extraction
  - Lifts
  - Centralised hot water systems
  - Centralised heating / cooling
  - Pools
- Can be up to 60% of building load
- Highly Variable

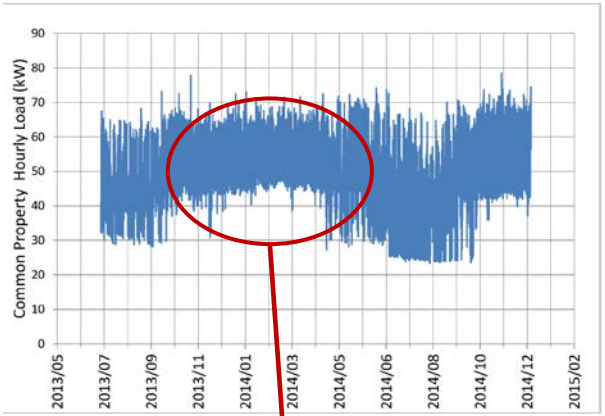
Common Property Load



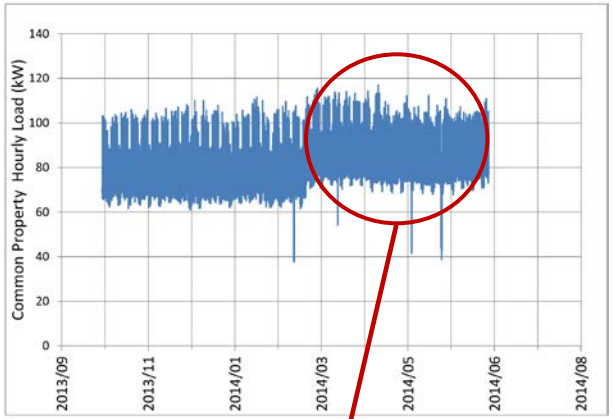
- Common property load for 25 apartment buildings in Sydney area
- Normalized for the number of units (residential & commercial) in the building
- Varied building types

- Load is highly variable and depends on:
  - Building type
  - Common property facilities
  - Demand management (or lack of it!)
- Morning and evening peaks are typical
- Some significant daytime loads

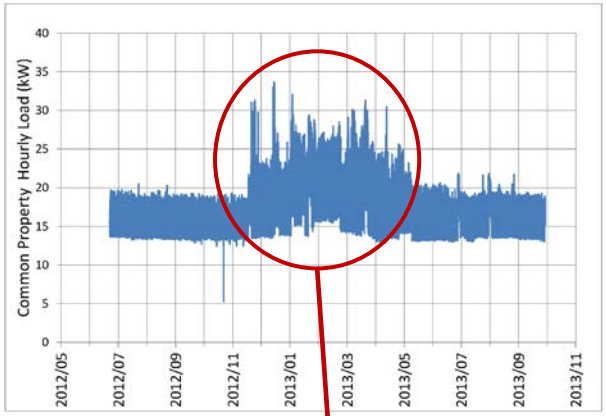
Common Property Load
Seasonal Variability



Summer air conditioning and pool pumping loads



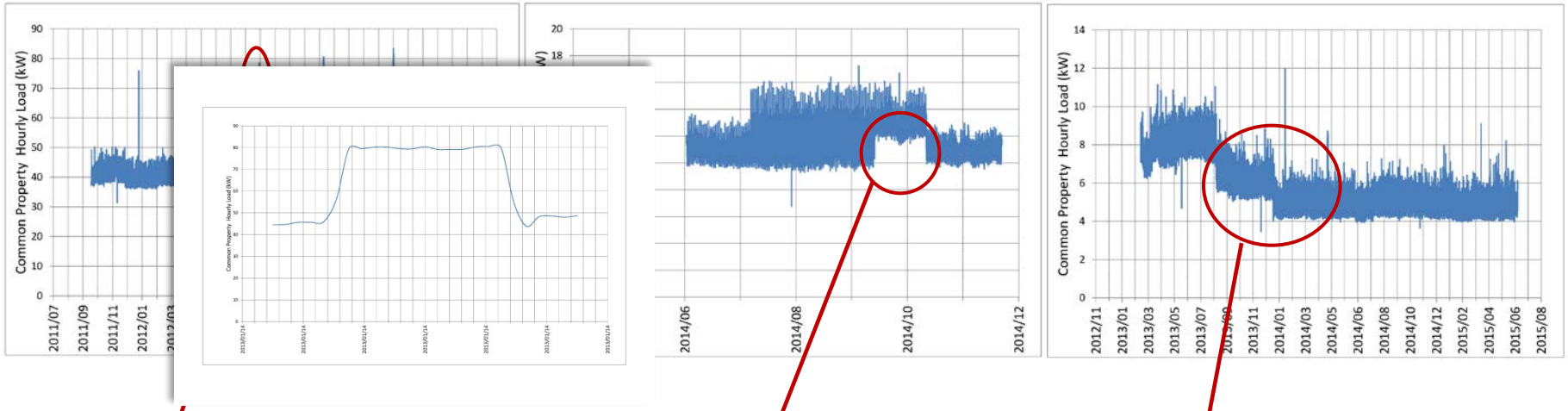
Winter heating load



Summer carpark ventilation for air conditioning heat exchangers

Common Property Load
Control Issues & Demand Management

Sharp peaks in load are common in this dataset, symptomatic of control issues



Ventilation fans for sewerage issues

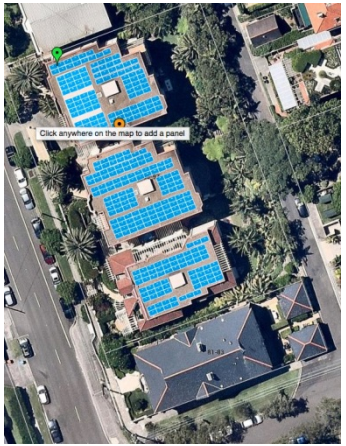
Faulty timeclocks

Energy efficiency measures (LEDs, motion sensors)
Carpark lighting can be up to 50% of load

PV to meet Common Property Load

Preliminary results (18 buildings) of a study matching PV to common property loads

Modelled 2 sizes of flush mounted PV system for each building:



Site 53
Whole Roof 79kWp
Zero Export 8kWp

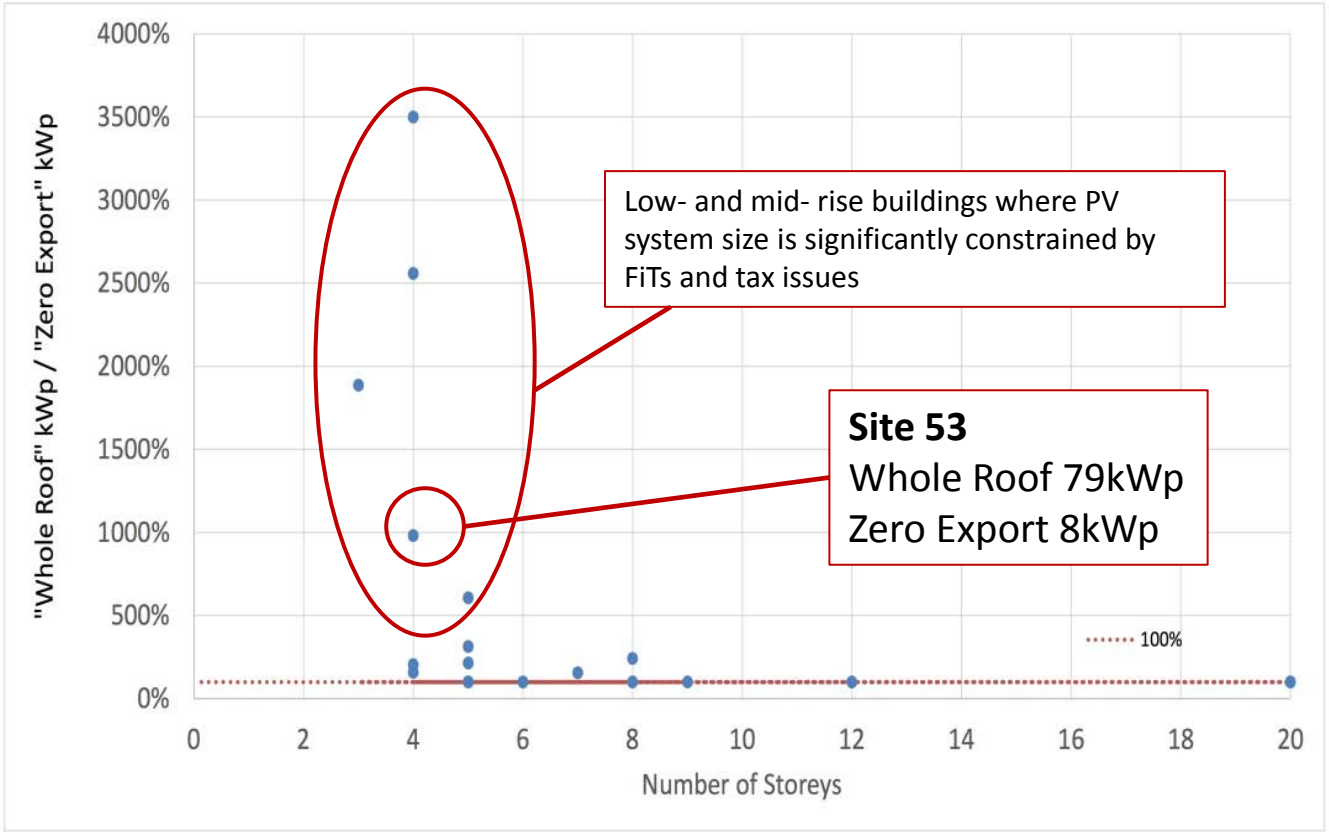
"Whole Roof"

- maximum possible PV that can be accommodated on unshaded roof area

"Zero Export"

- Sized to avoid export of PV generation
- Typical of real world Common Property systems
- Low Feed in tariff (typically 5.1c / kWh compared to 19c – 48c for peak consumption)
- TR 2505 / TR 2015 Tax Rulings

PV to meet Common Property Load



Economics

Tariffs:

- Mix of residential & commercial tariffs
- Of 18 sites, 13 have demand charges
- Variety of supply tariffs and discounts

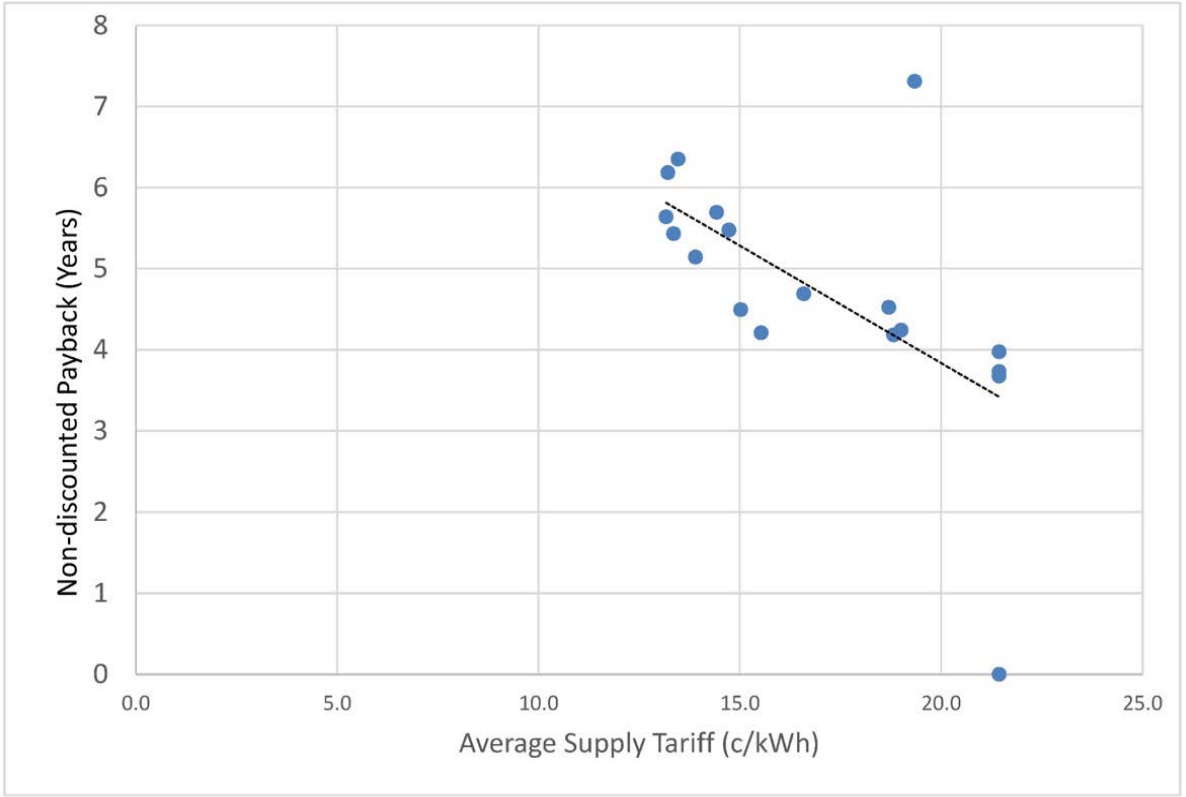
Household Savings

- “Zero Export” System:

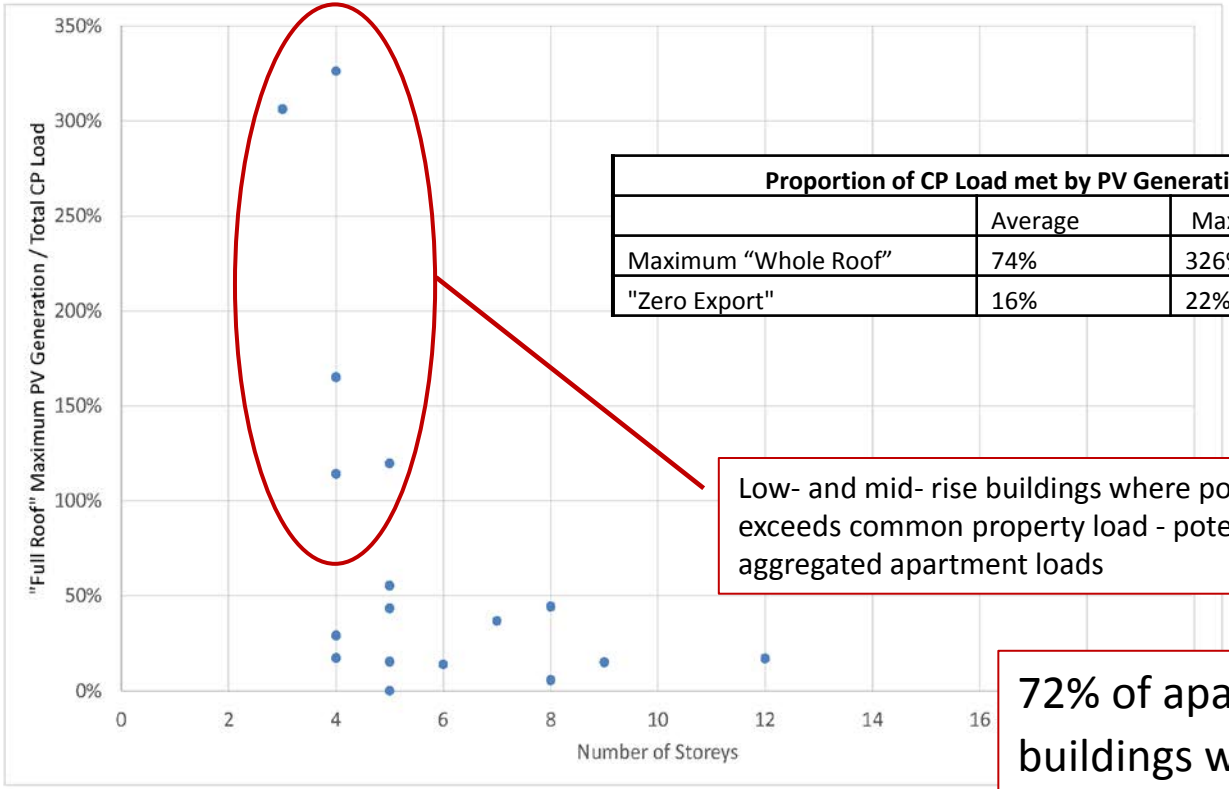
- Average savings $77 / unit / year
- Max Savings $180 / unit / year

Payback:

- Average simple payback 5.0 years
- Largely dependent on supply tariff (more data required)



PV to meet Common Property Load



Proportion of CP Load met by PV Generation			
	Average	Max	Min
Maximum “Whole Roof”	74%	326%	0%
"Zero Export"	16%	22%	3%

Low- and mid- rise buildings where potential PV generation exceeds common property load - potential for using PV to meet aggregated apartment loads

72% of apartments are in buildings with 3 floors or less [1]

1. ABS, *Census of Population & Housing*. 2011, Australian Bureau of Statistics.

Ongoing & Future Research

- Extending common property study to include greater sample size for a range of building types and Australian climate regions, with analysis of sensitivities to a range of tariff structures and rates
- Study of interval data for apartment loads, modelling embedded networks across whole buildings with PV generation and storage
- Assessment of the size of apartment rooftop PV opportunity in Australian cities (GIS combining 3-D mapping, council rates databases & planning zones)
- How can different financial, organisational and regulatory arrangements help realise the potential benefits of apartment PV?

Thank you!

Never Stand Still | Faculty of Engineering | School of Photovoltaic and Renewable Energy Engineering

Roberts, M. B., G. Huxham, A. Bruce and I. MacGill (2016). *Using PV to help meet Common Property Energy Demand in Residential Apartment Buildings*. Australian Summer Study in Energy Productivity. Sydney.

Roberts, M. B., A. Bruce and I. MacGill (2015). *PV in Australian Apartment Buildings – Opportunities and Barriers*. Asia Pacific Solar Research Conference. Brisbane.

Mike Roberts
School of Photovoltaic and Renewable Energy Engineering
UNSW
m.roberts@student.unsw.edu.au