Centre for Energy and Environmental Markets

UNSW SYDNEY

Solar Apartments

Opportunities for deploying PV on multi-occupancy residential buildings

Mike Roberts, CEEM / SPREE, UNSW Sydney

Dr Anna Bruce

Associate Professor Iain MacGill

ENERGY CONSUMERS AUSTRALIA

ASIA-PACIFIC SOLAR RESEARCH CONFERENCE

AUSTRALIAN PV INSTITUTE

Solar Apartments - Workshop

Centre for Energy and Environmental Markets

UNSW SYDNEY

Our task today: *Identify some key findings and policy approaches to highlight in the final report*

12:15 – 1:00 Overview of project findings

1:00 – 1:15 Grab a Sandwich

1:15 – 1:35 Panel Contributions:

Lynne Gallagher : Energy Consumers Australia
Chris Byrne : Green Strata
Murray Hogarth : Wattwatchers
Gareth Huxham : Energy Smart Strata

1:35 – 1:55 Group Discussion

1:55 – 2:00 Summary

ENERGY CONSUMERS AUSTRALIA

Green Strata

wattwatchers DIGITAL ENERGY

EnergySmartStrata

Centre for Energy and Environmental Markets

UNSW SYDNEY

Centre for Energy and Environmental Markets

UNSW SYDNEY

Why?

How much?

What for?

Where & how?

What's it worth?

What's stopping us?

What is to be done?

Centre for Energy and Environmental Markets

UNSW SYDNEY

Why?

How much?

What for?

Where & how?

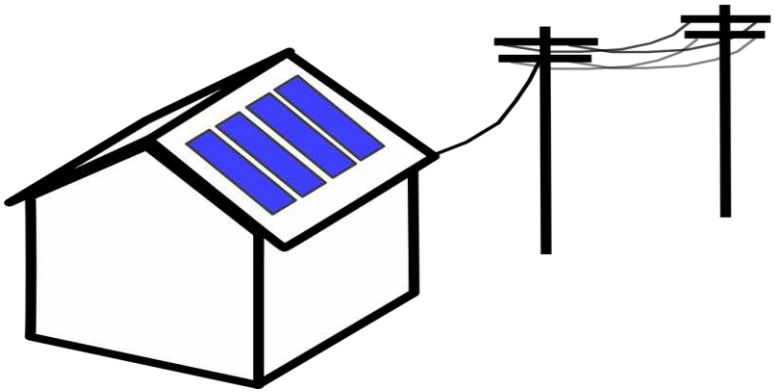
What's it worth?

What's stopping us?

What is to be done?

Why Solar Apartments?

GHI: Australia: 0.7 – 2.7 MWh/m² /year
Sydney: 1.7 MWh/m² /year



2 million solar households
(23% penetration, 50% in some areas)

10% of Australians live in 1.4 million apartments / units

Why Solar Apartments?

Centre for Energy and Environmental Markets

UNSW SYDNEY

For households

- Clean electricity
- Lower bills
- Increased energy independence

For society

- Low cost generation
- Reduced fossil fuel reliance
- Reduced CO_2 emissions
- Energy Equity

For networks

- Reduce network demand
- Generation close to (commercial) loads
- Defer network augmentation

An opportunity for a clean energy community?

Centre for Energy and Environmental Markets

UNSW SYDNEY

Why?

How much?

What for?

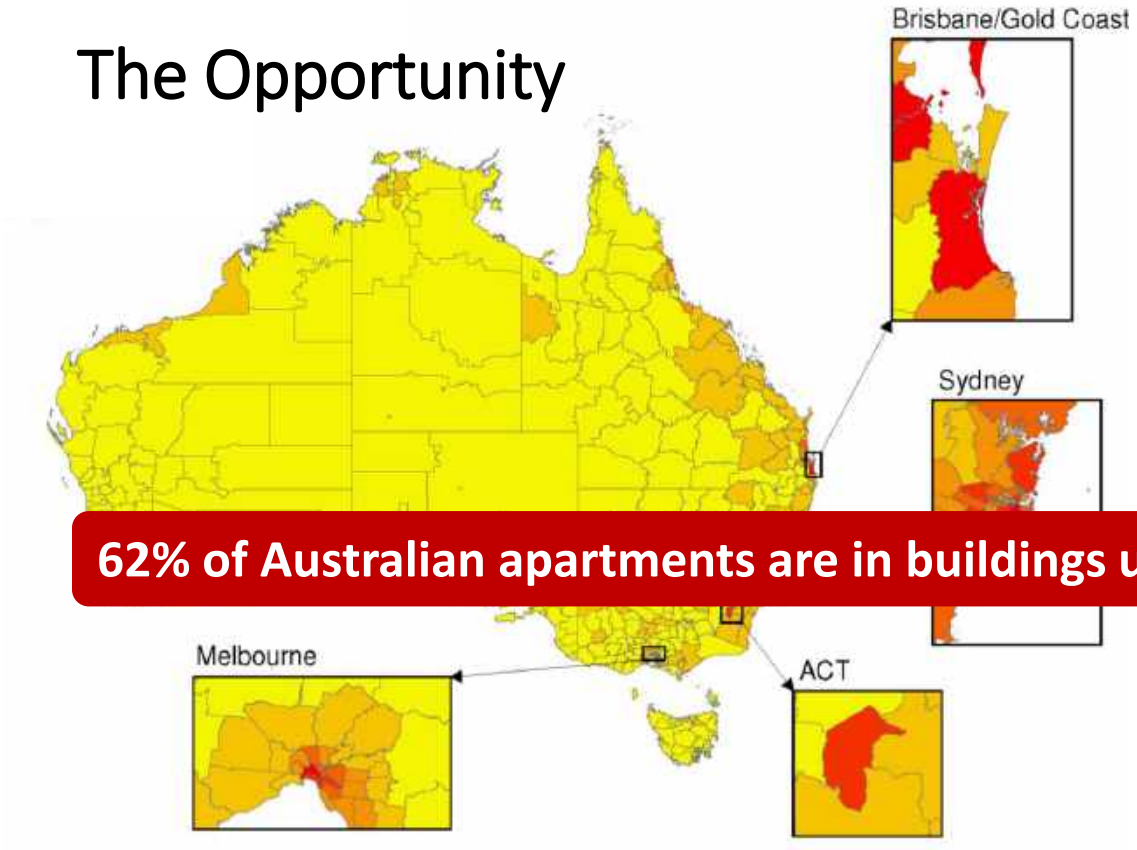
Where & how?

What's it worth?

What's stopping us?

What is to be done?

The Opportunity



Centre for Energy and Environmental Markets

UNSW SYDNEY

62% of Australian apartments are in buildings under 4 storeys

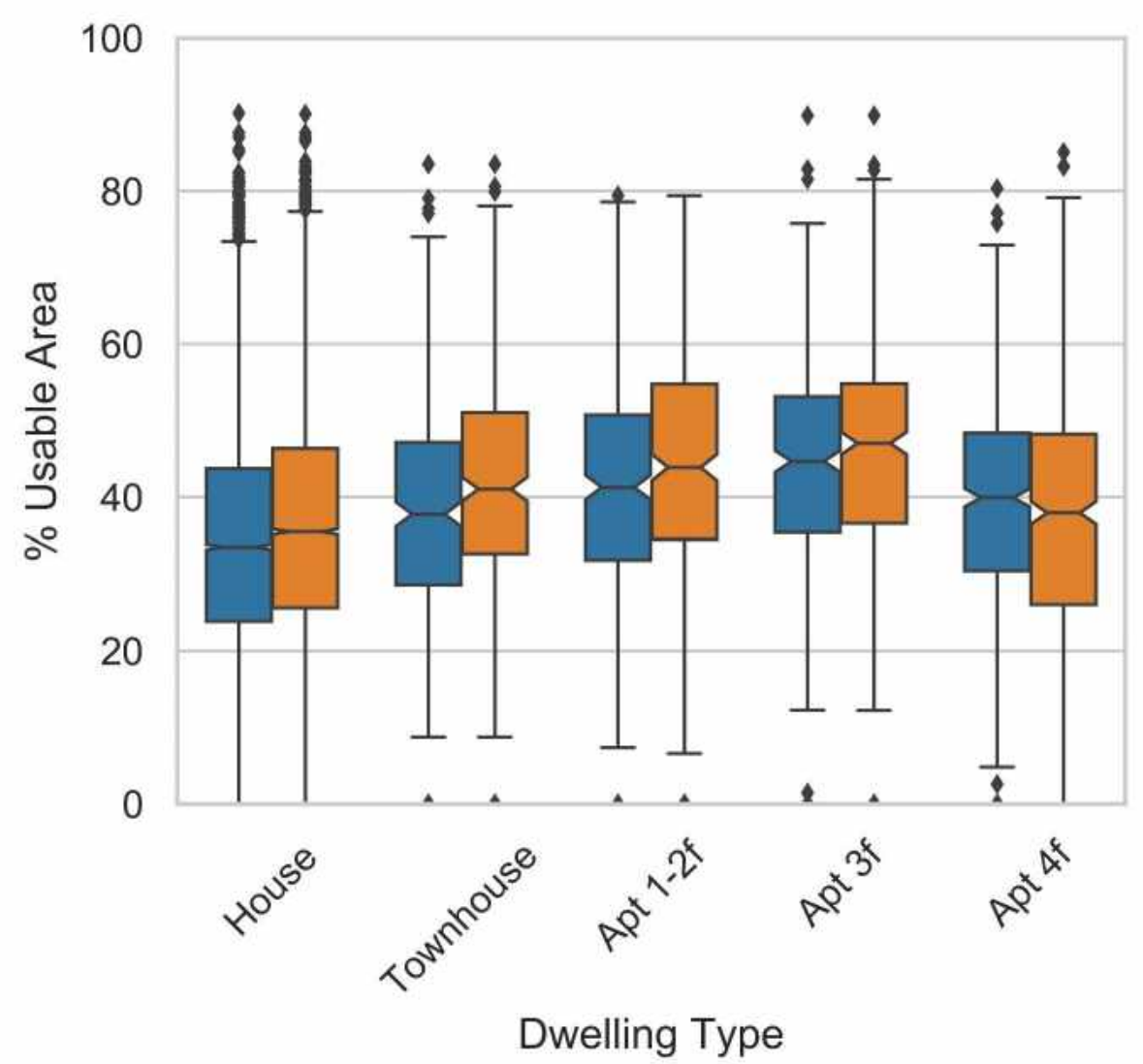
1.4 million apartments

Housing 10% of Australians

Up to 70% in some LGAs

A third of new dwellings

The Solar Opportunity



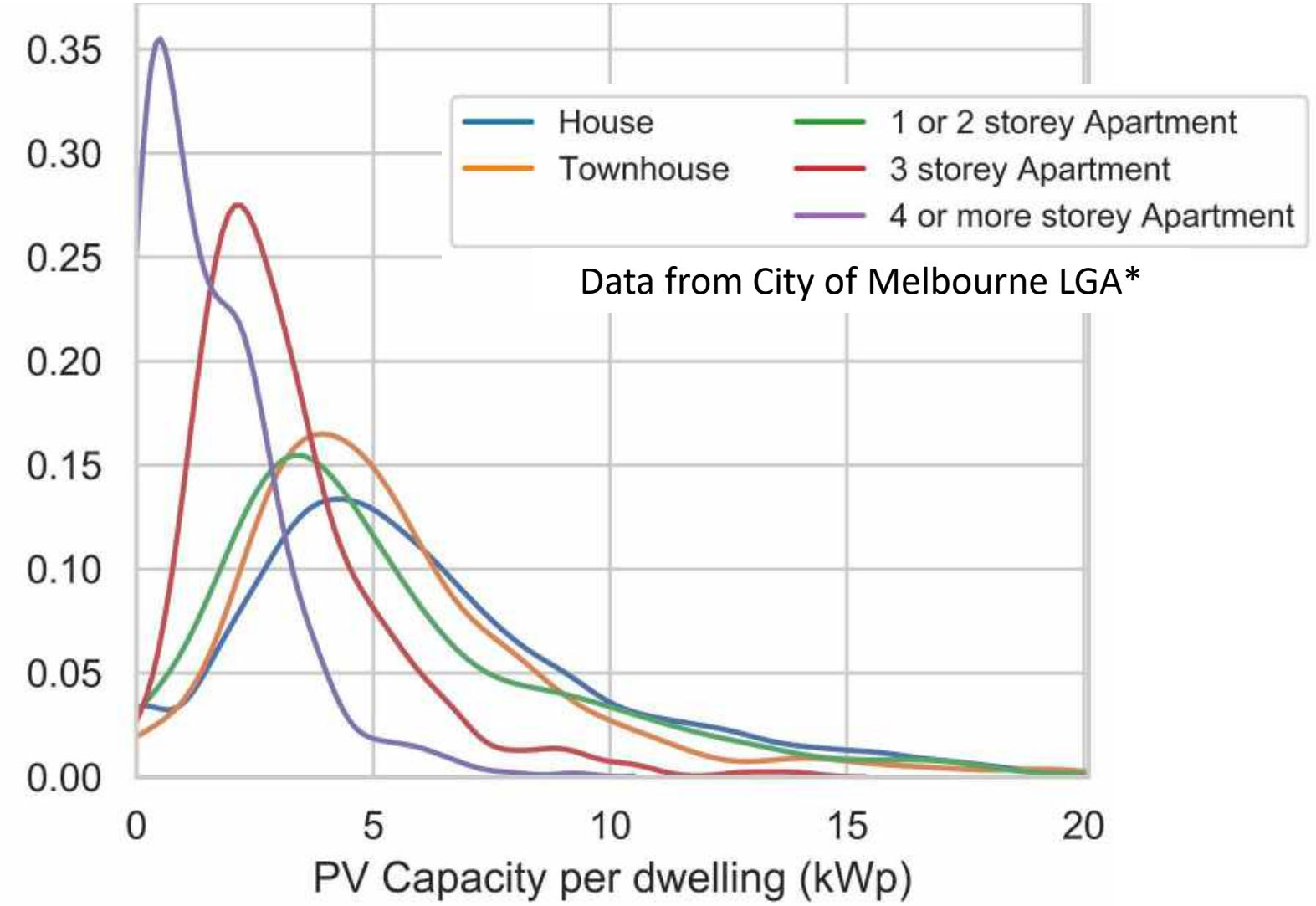
Based on 3D model of
City of Melbourne
LGA, with 2 methodologies*

* Roberts, M., J. Copper, and A. Bruce, *An analysis of Australian rooftop solar potential on residential buildings*, in *Asia Pacific Solar Research Conference*. 2018: Sydney.

The Solar Opportunity

Centre for Energy and Environmental Markets

UNSW SYDNEY



Data from City of Melbourne LGA*

Roberts, M., J. Copper, and A. Bruce, *An analysis of Australian rooftop solar potential on residential buildings*, in *Asia Pacific Solar Research Conference*. 2018: Sydney.

Rooftop Issues

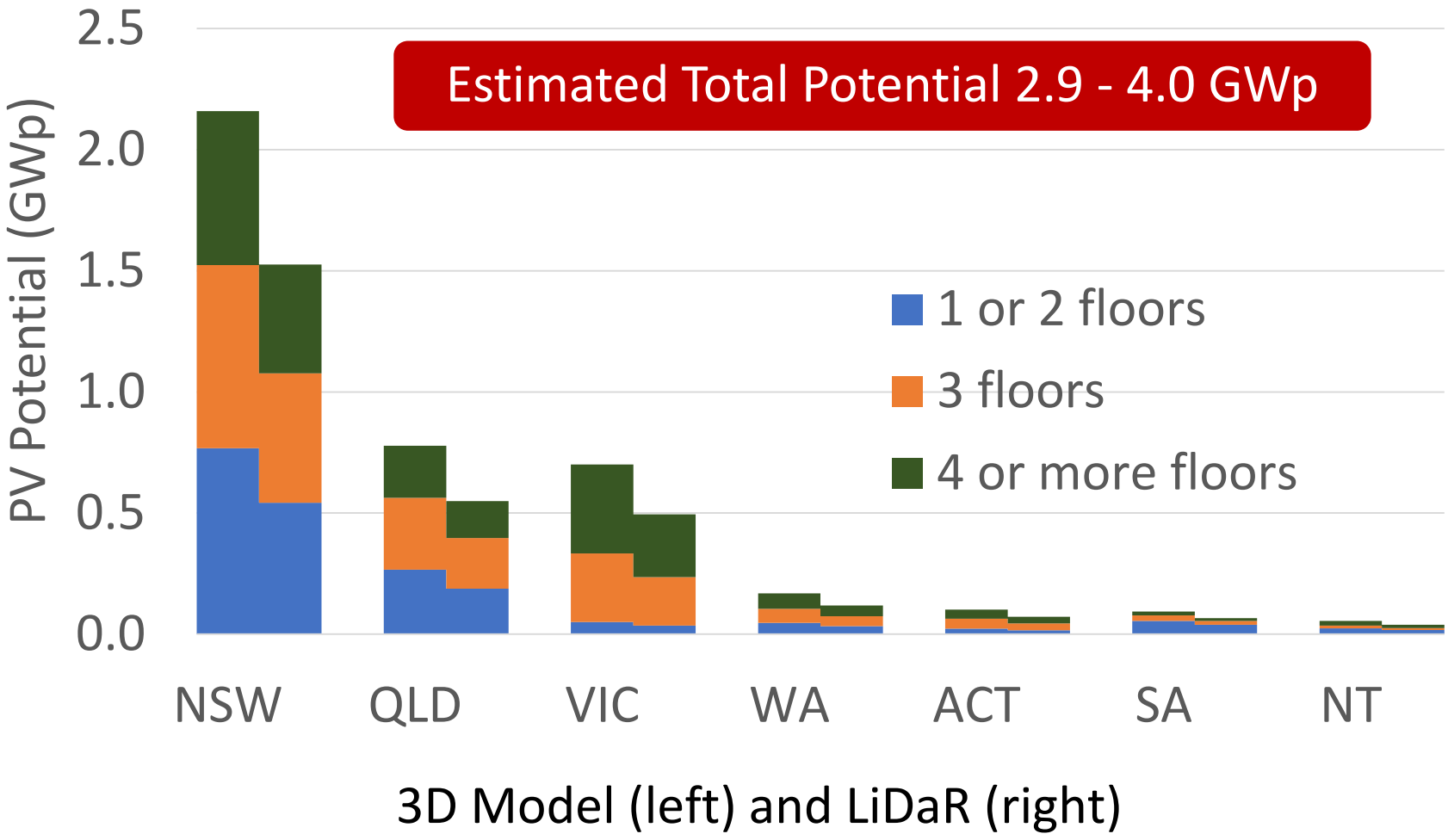
Centre for Energy and Environmental Markets

UNSW SYDNEY

The Solar Opportunity

Centre for Energy and Environmental Markets

UNSW SYDNEY



Roberts, M., J. Copper, and A. Bruce, *An analysis of Australian rooftop solar potential on residential buildings*, in *Asia Pacific Solar Research Conference*. 2018: Sydney.

Centre for Energy and Environmental Markets

UNSW SYDNEY

Why?

How much?

What for?

Where & how?

What's it worth?

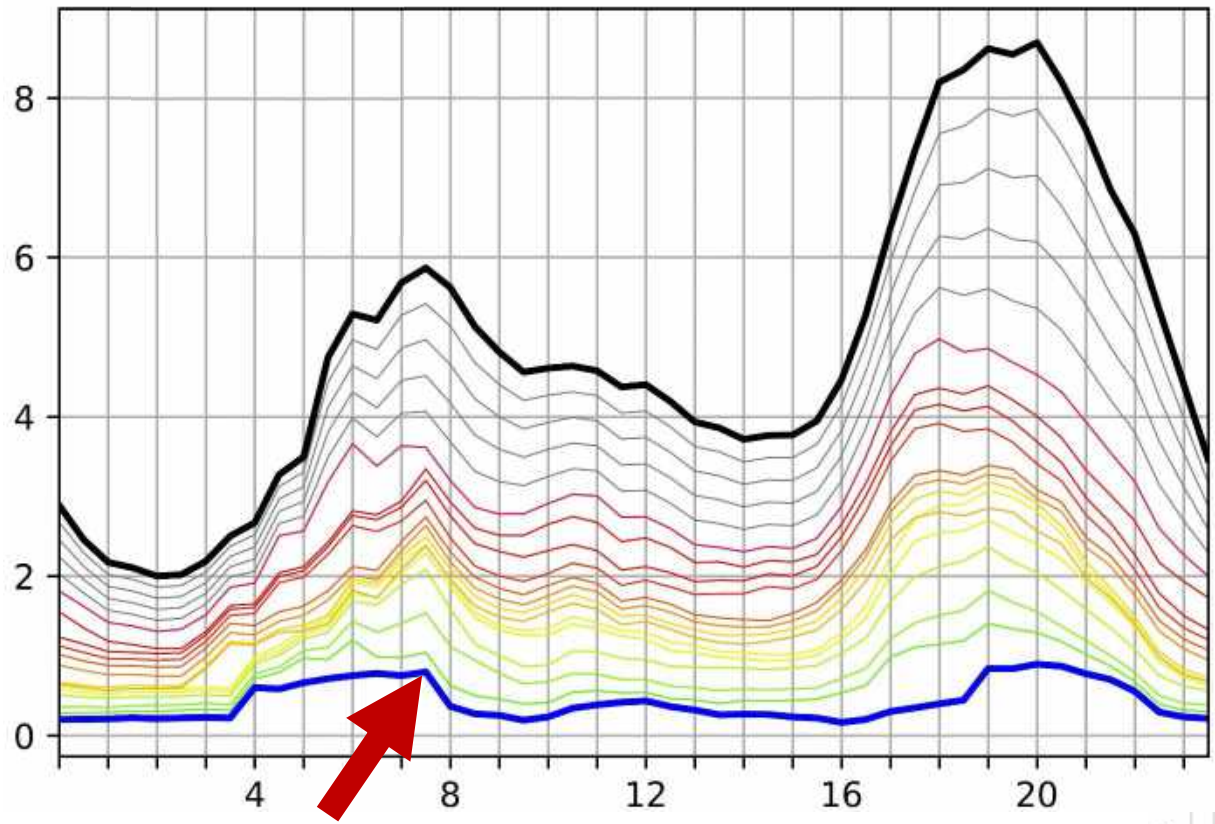
What's stopping us?

What is to be done?

Apartment Electricity Loads

Centre for Energy and Environmental Markets

UNSW SYDNEY



Average Energy 41% compared to houses

Average energy per occupant 79% of houses

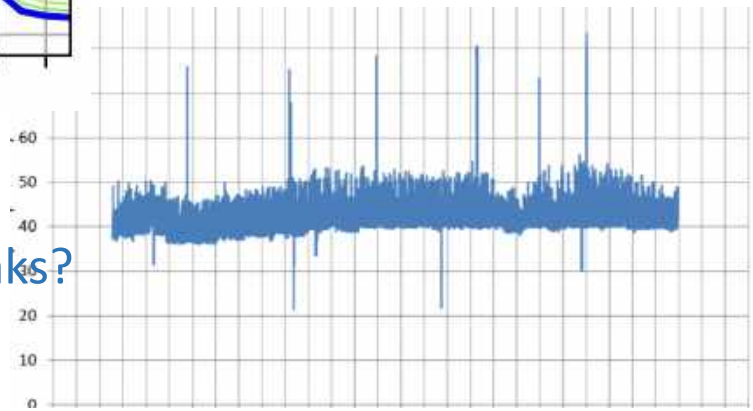
Higher daily variability

Common Property

Highly diverse

5% → 60% of building load

- Daytime load?
- High demand peaks?
- Control issues?

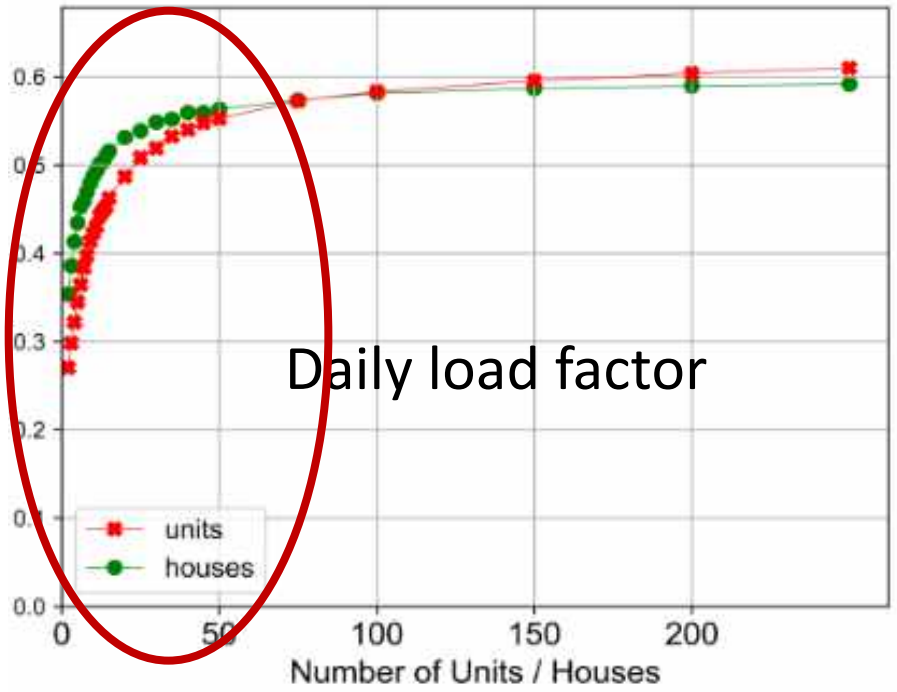


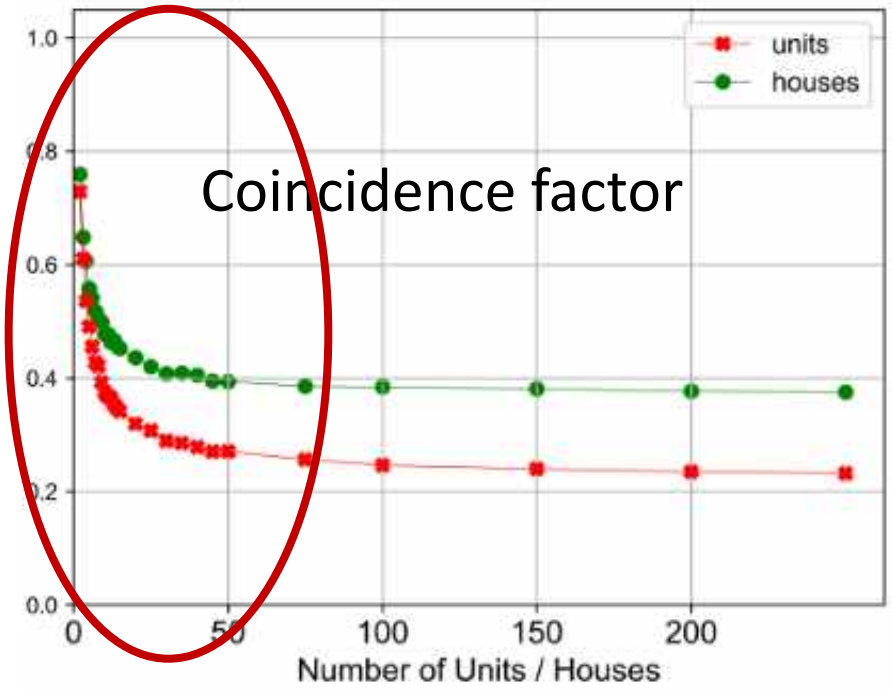
Roberts, M.B., et al., *Using PV to help meet common property energy demand in residential apartment buildings*. *ASSEP*, 2016: Sydney.

Aggregating Loads

Centre for Energy and Environmental Markets

UNSW SYDNEY





Lower load factor
Higher variability

Lower coincidence factor
Greater diversity

Greater benefits from aggregating diverse loads

Roberts, M.B., et al., *Cluster-based characterisation of Australian apartment electricity demand and its implications for low-carbon cities*, (under review).

Centre for Energy and Environmental Markets

UNSW SYDNEY

Why?

How much?

What for?

Where & how?

What's it worth?

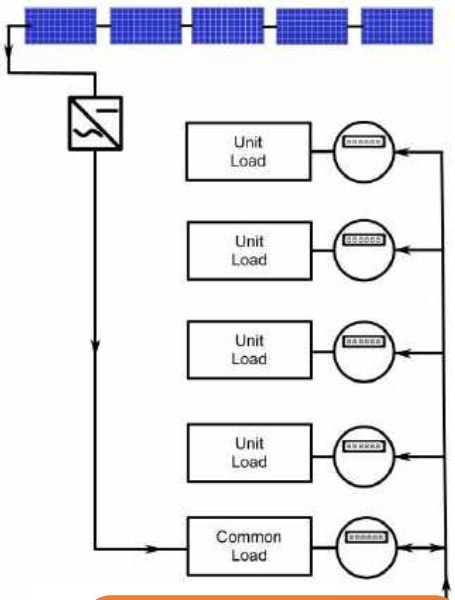
What's stopping us?

What is to be done?

PV Technical Arrangements

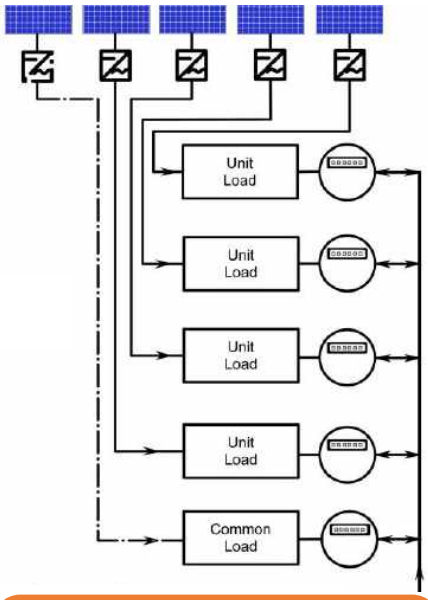
Centre for Energy and Environmental Markets

UNSW SYDNEY



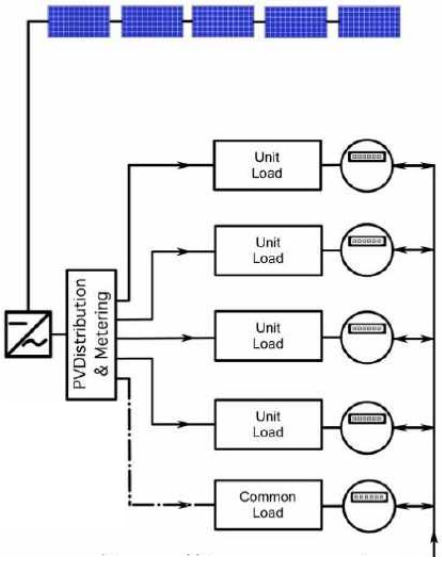
Common Property Only

cp_only



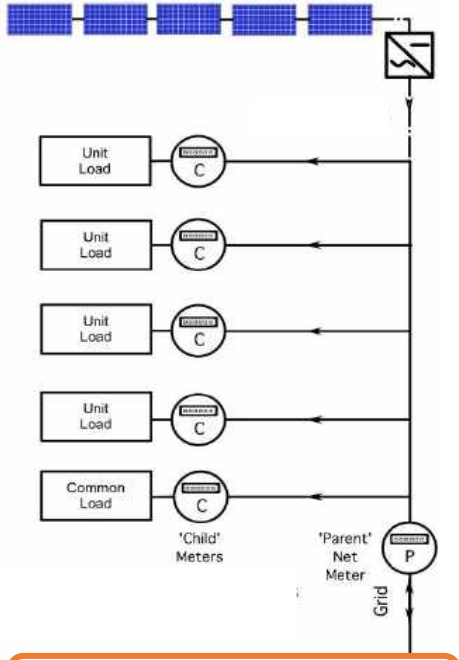
Individual Behind the Meter

btm_i



Shared Behind the Meter

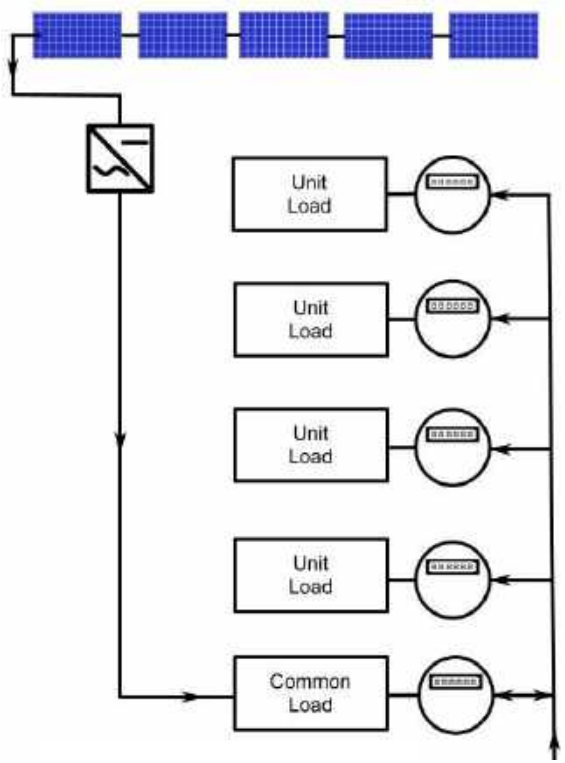
btm_s



Embedded Network

en_pv

Common Property Only (cp_only)



Common system on common roof applied to common load

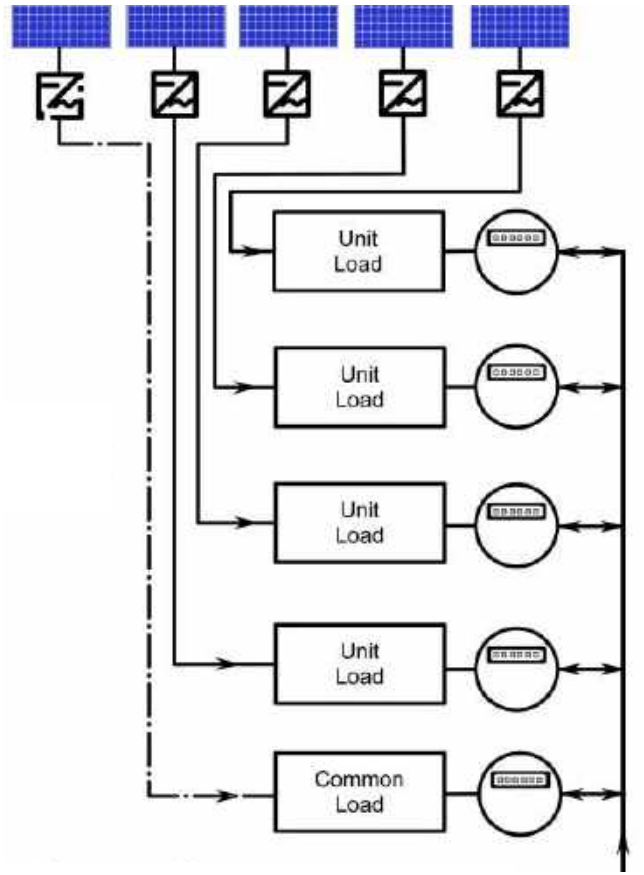
For high-rise, high self-consumption

Low self-sufficiency

For low-rise, unutilised roof space

~~Tax issues for FiT~~

Individual Behind the Meter (btm_i)



Choice rests with each apartment owner

Owner occupier can be investor and beneficiary

Individual system on common roof - bylaw

Low self-consumption

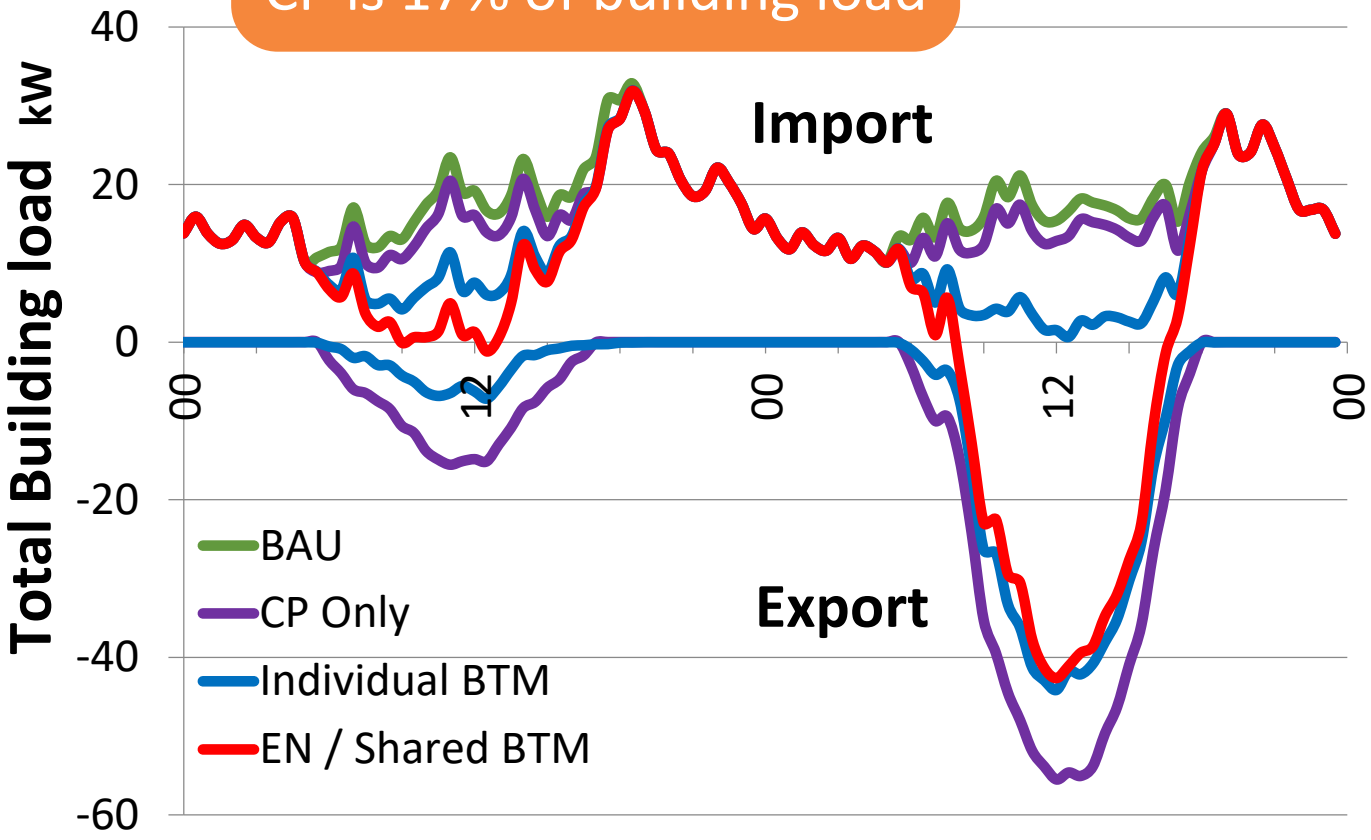
Landlord / tenant Split incentives

PV Self-Consumption

Centre for Energy and Environmental Markets

UNSW SYDNEY

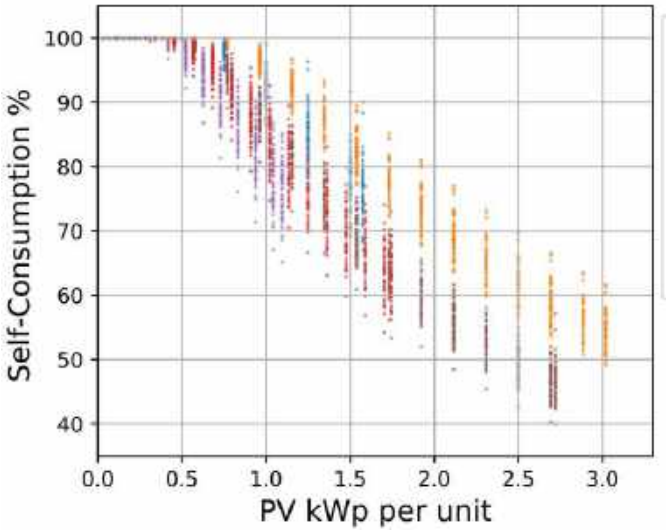
44 apartments
PV = 77kWp
CP is 17% of building load

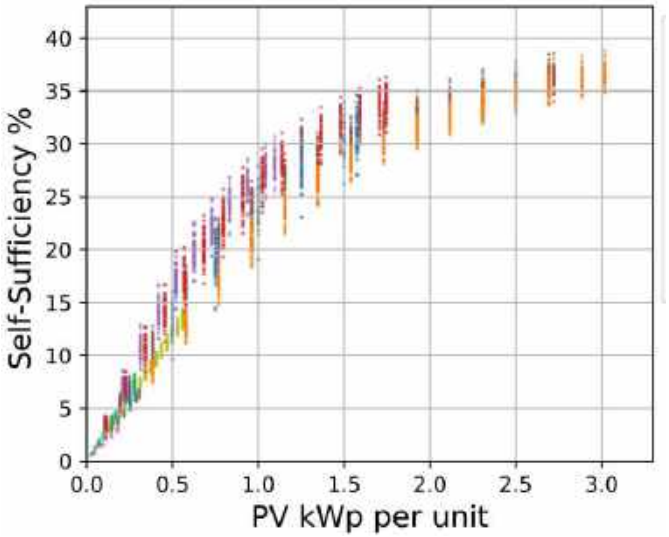


Self-Consumption and Self-Sufficiency

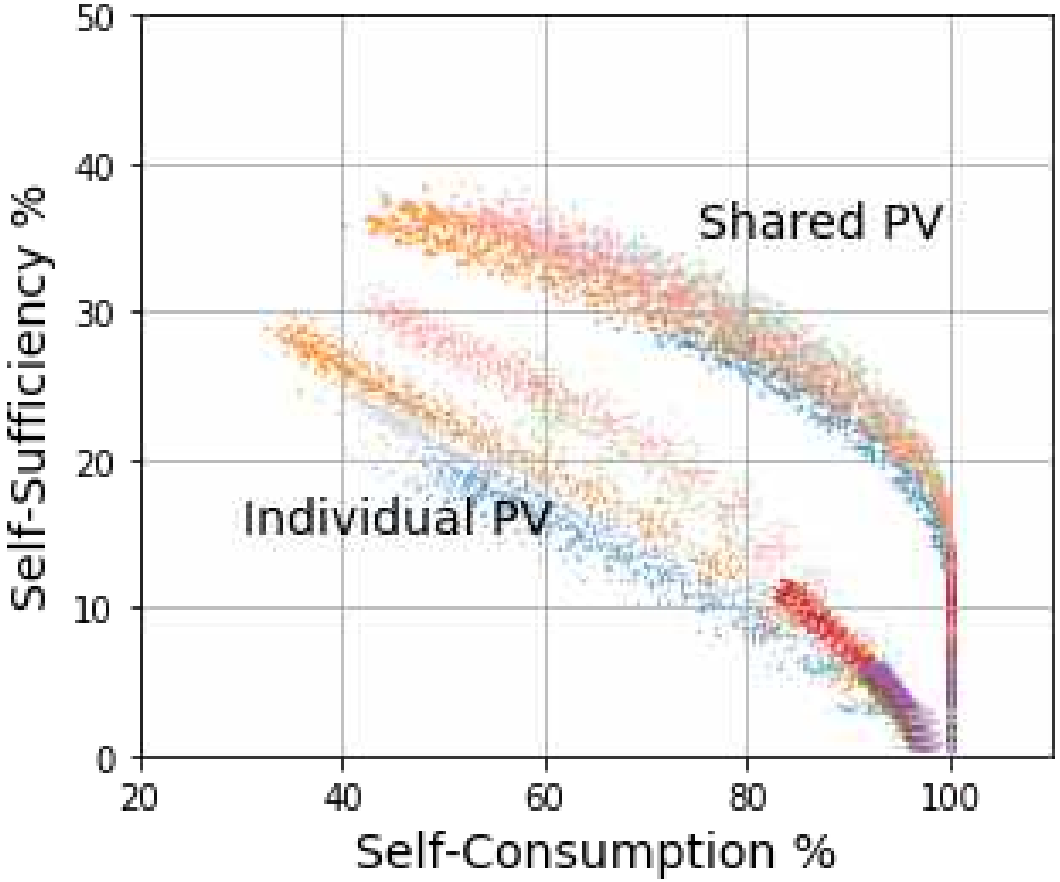
Centre for Energy and Environmental Markets

UNSW SYDNEY



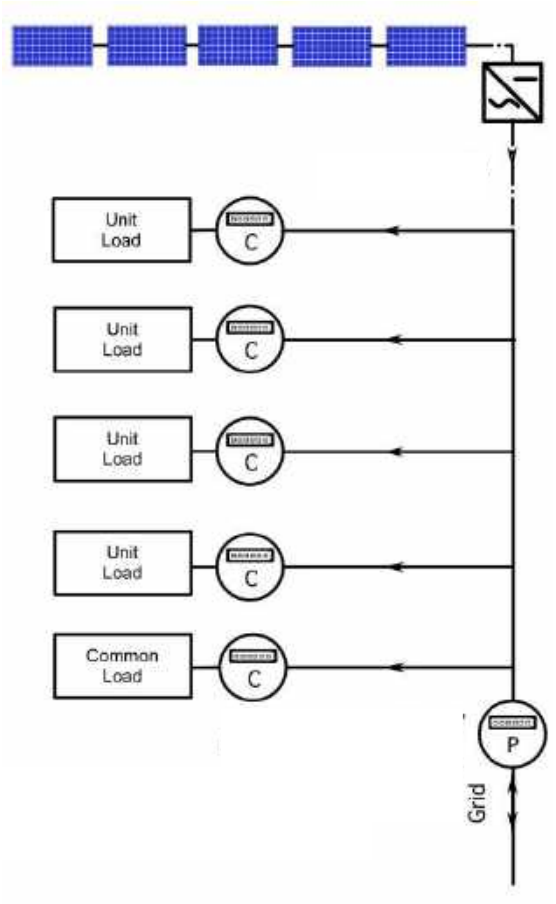


…increased by aggregating loads



Roberts, M.B., A. Bruce, and I. MacGill, *A comparison of arrangements for increasing self-consumption and maximising the value of distributed photovoltaics on apartment buildings* (forthcoming)

Embedded Network (EN)



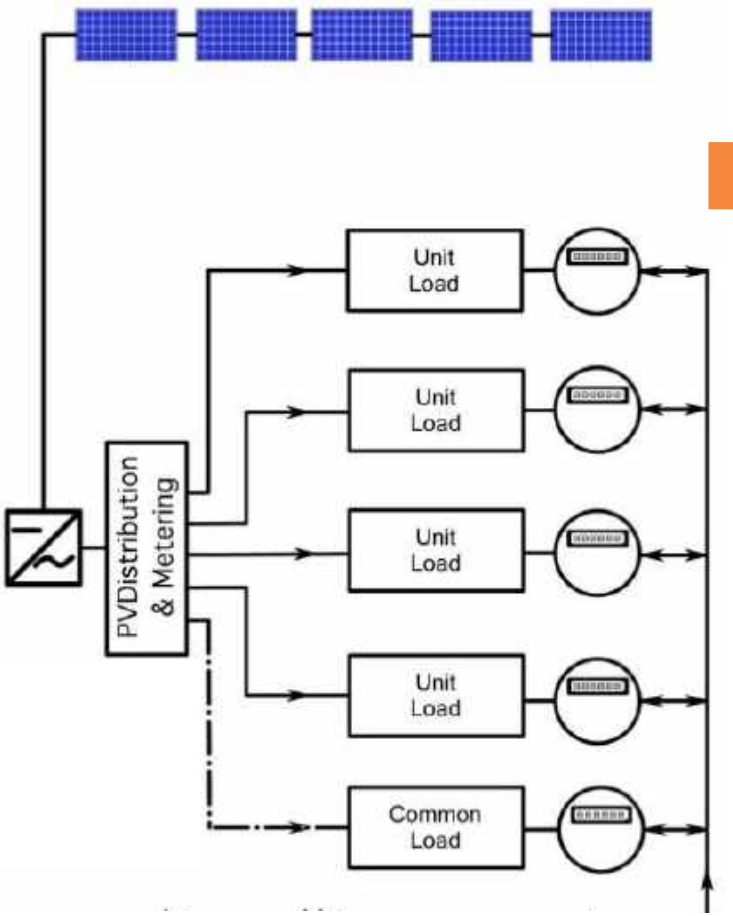
- Shared PV system / shared roof
- Maximise Self-Consumption
- Economies of Scale – PV Capex
- Access Commercial Tariffs

- Split Incentives
- EN Installation Costs
- Regulatory Barriers
- Finance Issues

Shared Behind the Meter

Centre for Energy and Environmental Markets

UNSW SYDNEY



- Maximise Self-Consumption
- Avoids EN Costs
- Economies of Scale – PV Capex
- Avoids EN Regulatory Issues

- Two Bills
- EN Installation Costs
- No bulk buy benefits

Centre for Energy and Environmental Markets

UNSW SYDNEY

Why?

How much?

What for?

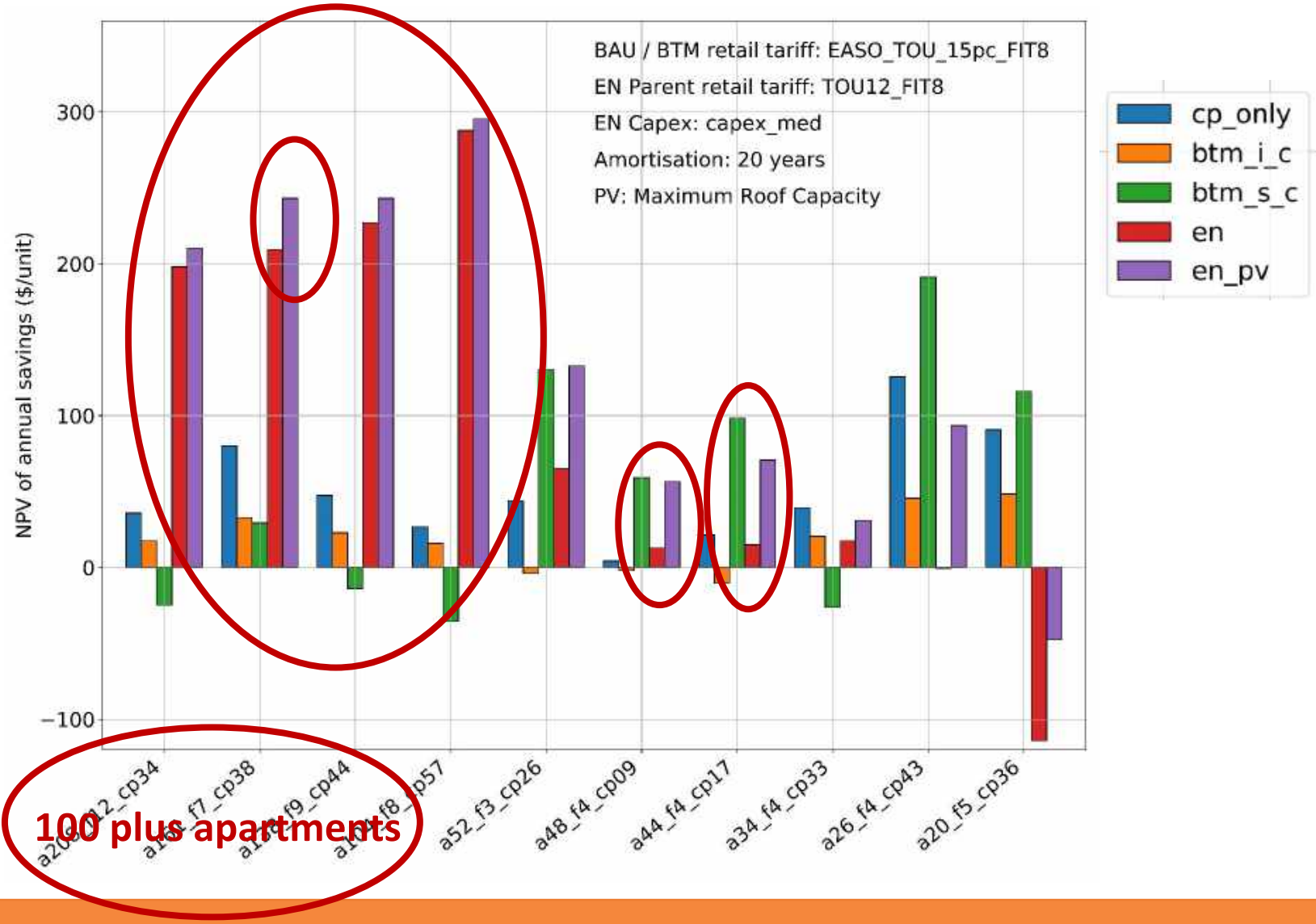
Where & how?

What's it worth?

What's stopping us?

What is to be done?

Savings for whole building

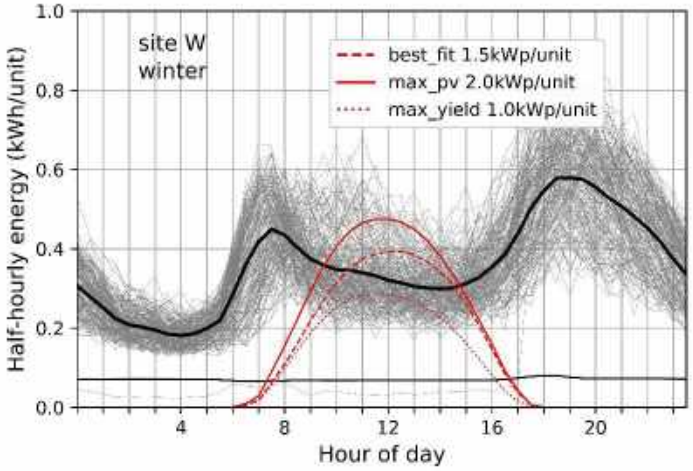


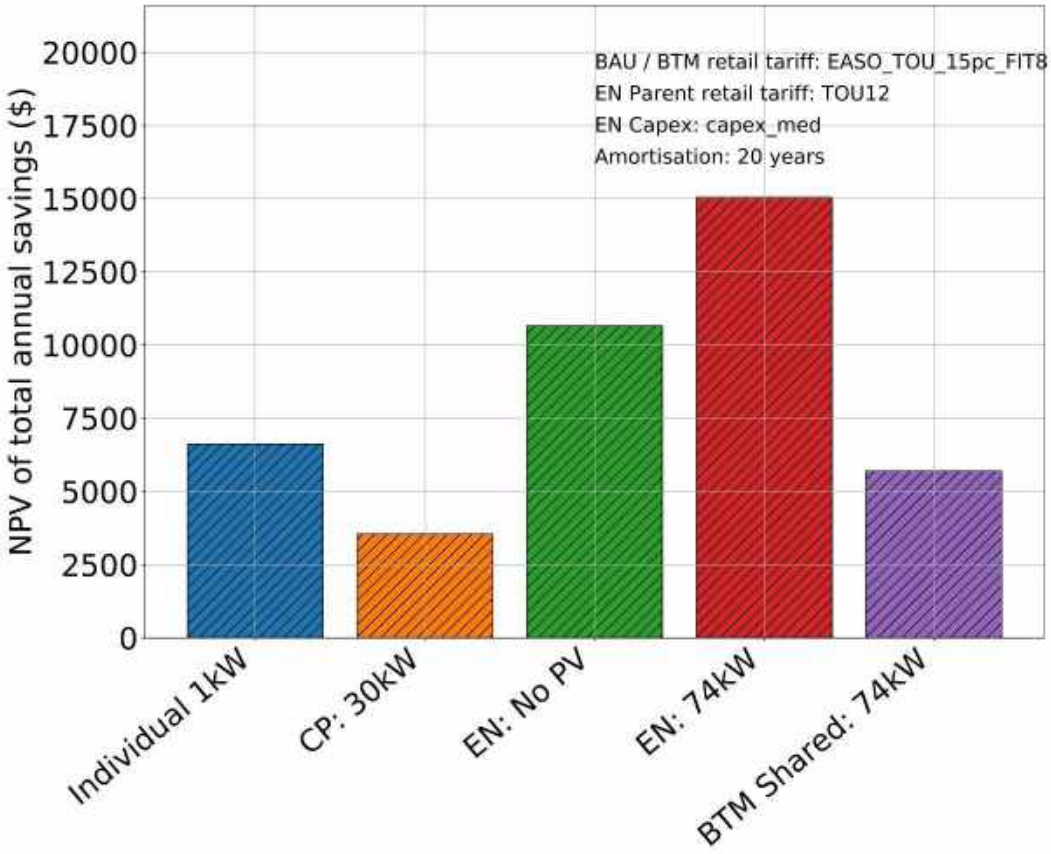
Case Study W

Centre for Energy and Environmental Markets

UNSW SYDNEY

72 apartments
3 floors
Lifts, carparks, etc
CP is 22% of load



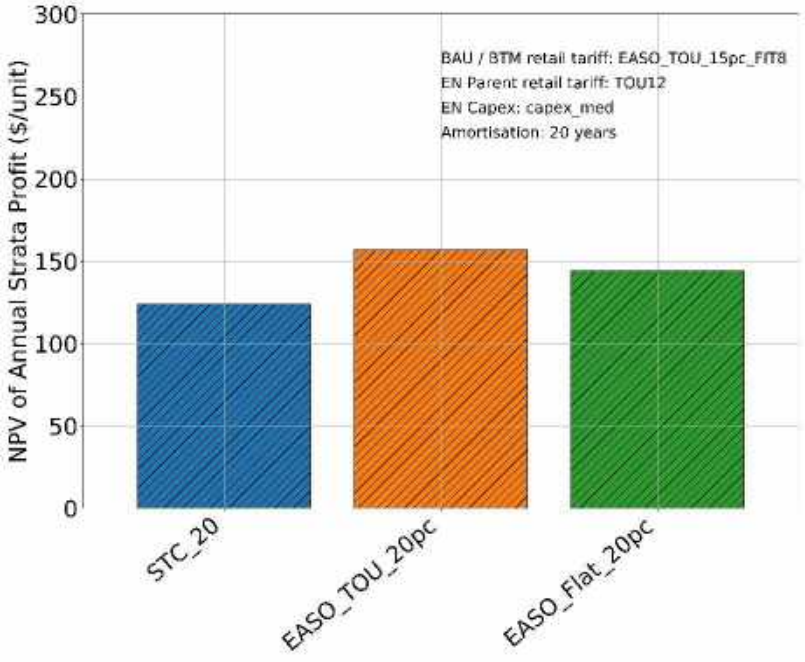


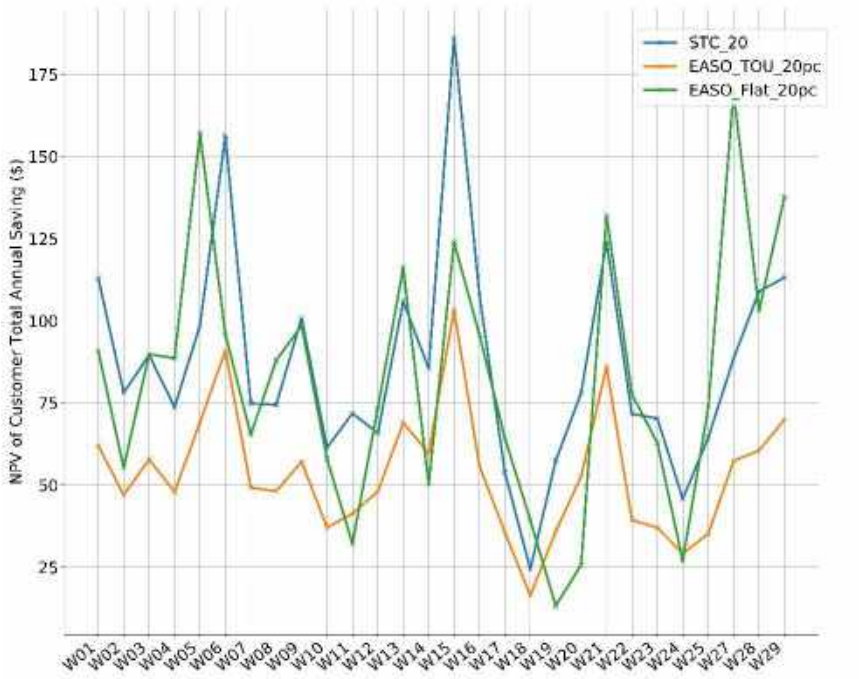
wattwatchers DIGITAL ENERGY

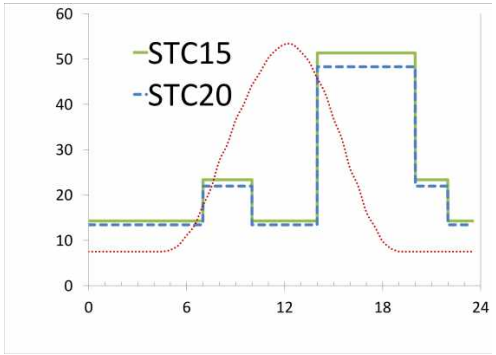
Case Study W – Embedded Network

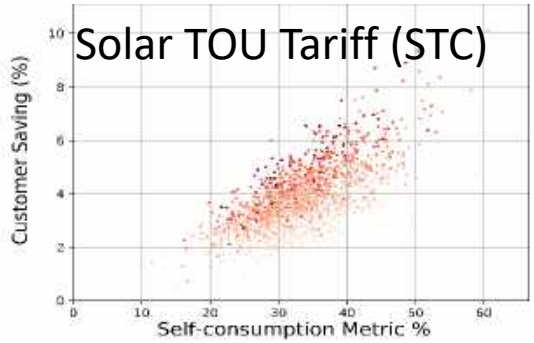
Centre for Energy and Environmental Markets

UNSW SYDNEY





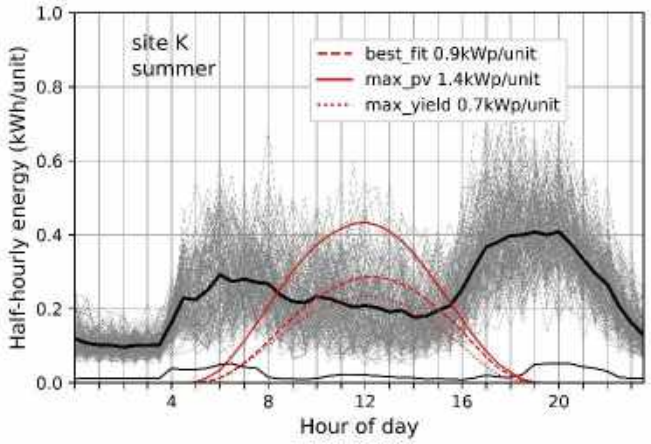


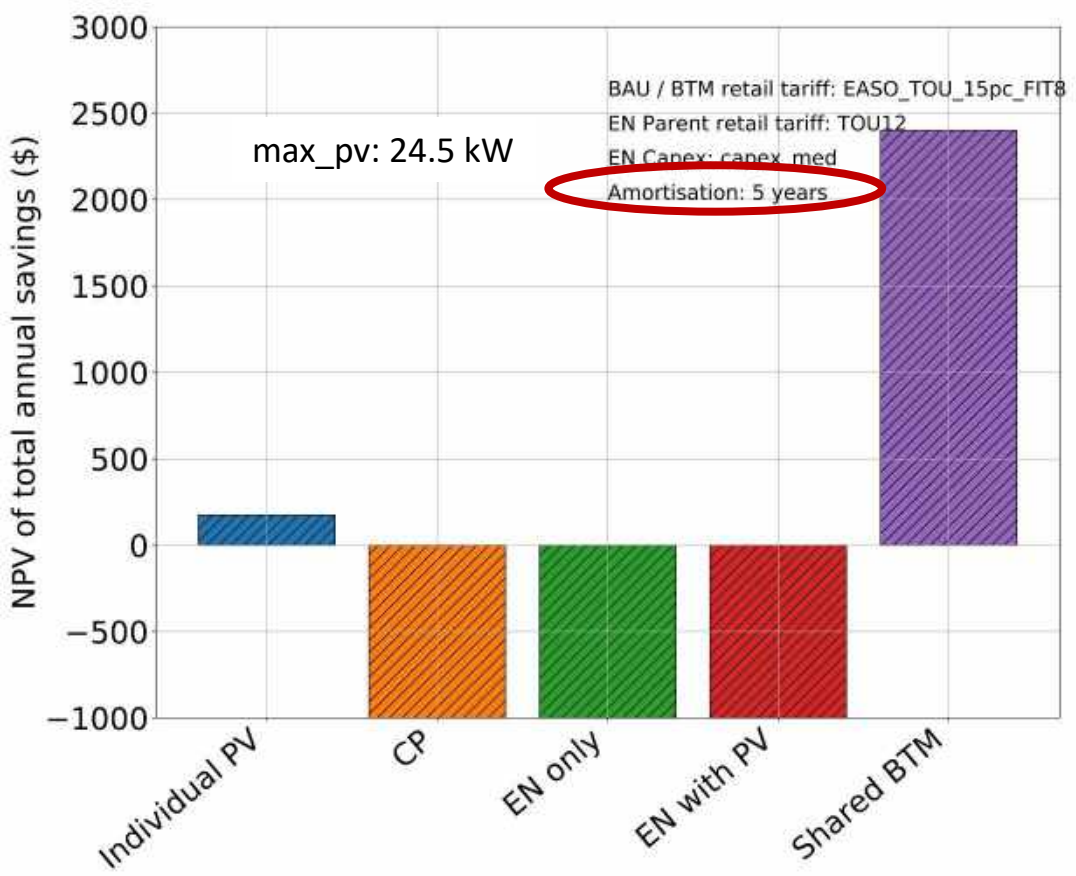


wattwatchers DIGITAL ENERGY

Case Study K

18 apartments
3 floors
CP is 9% of load





Embedded Networks

Centre for Energy and Environmental Markets

UNSW SYDNEY

Capital Costs

- Parent meter
- Child meters ($200- $300)
- Meter Abolishment ($300-$400)
- Switchboard and wiring upgrades
- Highly variable for brownfield sites

Business Models

- Strata Body owns EN pays ENM / ENO for service
- Strata / ENO share risks and benefits
- Third Party

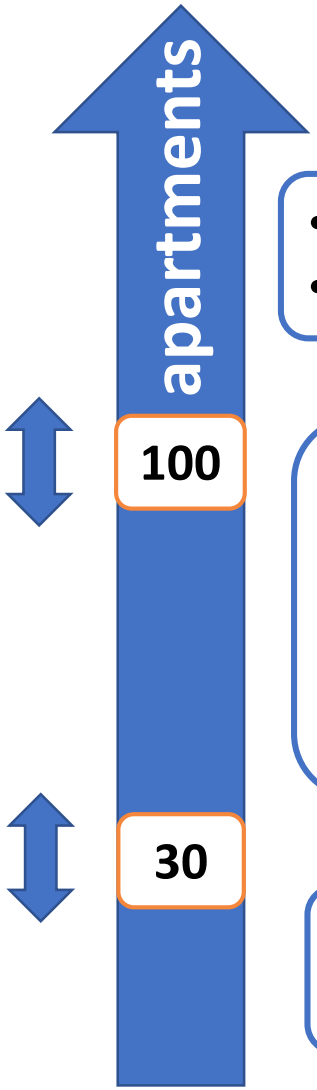
Operating Costs

- Parent tariffs (9c-15c/kWh?)
- Billing ($15 - $35 /meter /month)
- Metering (~$3 /meter /month)
- Compliance (~$2/meter/month)

Finance

- Sinking Fund
- Strata levy
- Finance: @ 7%—11% ?
- May need longer term (10-20 years) to repay capex

Some Generalisations:



- Greatest $ benefits are from EN & commercial tariffs
- For hi-rise, PV best suited for Common Property

- EN viability is site-dependent
- PV (1.0 – 1.5kW/unit) may add value to EN
  With cost recovery in 10 years (with FiT) or 20 years without
- Shared BTM of 1-1.5kW / unit can also be competitive

- Retrofit EN unlikely to be viable (but PV may help)
- Shared BTM may increase value of PV

Battery Storage (BES) for ENs

Centre for Energy and Environmental Markets

UNSW SYDNEY

Parent Tariff	Control Strategy
High Demand Charge	Peak Demand Shaving
No / low Feed-in Tariff	Increase Self Consumption
High peak / Off-peak Ratio	Demand Shifting

	Individual PV and BES	EN, shared PV and BES
Optimum size	3 – 4 kWh / apartment	~ 1 kWh / apartment
Threshold capex	~ $750/kWh	~ $400/kWh

Current Capex ~ $1000 / kWh BUT:

- Government Incentives (e.g. QLD, VIC, federal ALP…)
- Decreasing Capex?
- Increasing Tariffs
- Potential Network Benefits

Roberts, M.B., A. Bruce, and I. MacGill, *The impact of aggregated battery storage on photovoltaic self-consumption and customer value in apartment buildings.*

Centre for Energy and Environmental Markets

UNSW SYDNEY

(Any questions?)

Centre for Energy and Environmental Markets

UNSW SYDNEY

Why?

How much?

What for?

Where & how?

What's it worth?

What's stopping us?

What is to be done?

Some of the barriers

Centre for Energy and Environmental Markets

UNSW SYDNEY

Embedded Network Regulation

- Administrative complexity
- Exemption Framework -> Authorised Retailers
- Small ENO's, Community, Strata squeezed
- VIC: "Abolish Embedded Networks" (but Microgrids)

Embedded Network Costs

- Meter contestability reducing costs, but:
- Unnecessary meter churn
- Meter abolishment charges
- Switchboard upgrades

Organisational

- Split Incentives
- Communication
- Apathy
- Lack of information

Finance

- Strata access to finance

Centre for Energy and Environmental Markets

UNSW SYDNEY

Why?

How much?

What for?

Where & how?

What's it worth?

What's stopping us?

What is to be done?

Potential Policy Approaches

Centre for Energy and Environmental Markets

UNSW SYDNEY

Embedded Networks

- Is market access the only solution?
- Is the "Power of Choice" restricting choice?
- Better regulated Embedded Networks:
  - Constraints on developer incentives
  - *Meaningful* tariff controls
  - Recognition of customer benefit
  - Contract time limits

Strata Law

- Sustainability Exemptions (e.g. ACT, QLD)
- Tenant involvement

Incentives

- State & Federal PV / Battery Grants -> Strata Bodies
- Feasibility Grants (every building is different)
- Project Grants

Metering

- Customer ownership
- Simplify meter transfer

Network Charges

- Cost-reflectivity
- Local Generation Credits

Finance

- Low-cost strata finance for sustainability (not EUAs)
- Rationalise strata tax rules

What are the key findings to highlight in the project report?

What policy approaches would most increase PV deployment on apartment buildings?

What future work is needed in this space?

ENERGY CONSUMERS AUSTRALIA

Centre for Energy and Environmental Markets

ASIA-PACIFIC SOLAR RESEARCH CONFERENCE

AUSTRALIAN PV INSTITUTE

UNSW SYDNEY

Key outcomes from discussion

- Apartments don't have the same access to solar as stand alone housing
- Lack of information/motivation, cost/payback/other priorities are key barriers
- Embedded networks are challenging – need to work for residents
- Solar enables ENs and vice versa (depending on scale and solar penetration)
- Metering and regulatory issues are barriers to choice despite opportunities presented by DERs
- Tax on revenue is an issue

Policy approaches

- Stop objections within strata organisations from restricting solar
- Need specific policies and support for apartments, community energy
- Removal of strata law barriers

Future work

- Disseminate info and help apartment owners to help decision making (not a role for solar installers). Currently need tailored solutions. Can they self assess, or do they need assistance? Role for user-friendly tools, step by step guide for apartment solar.
- EVs – complexities around fleet cars, different business models
- Compare with other options e.g. off-site