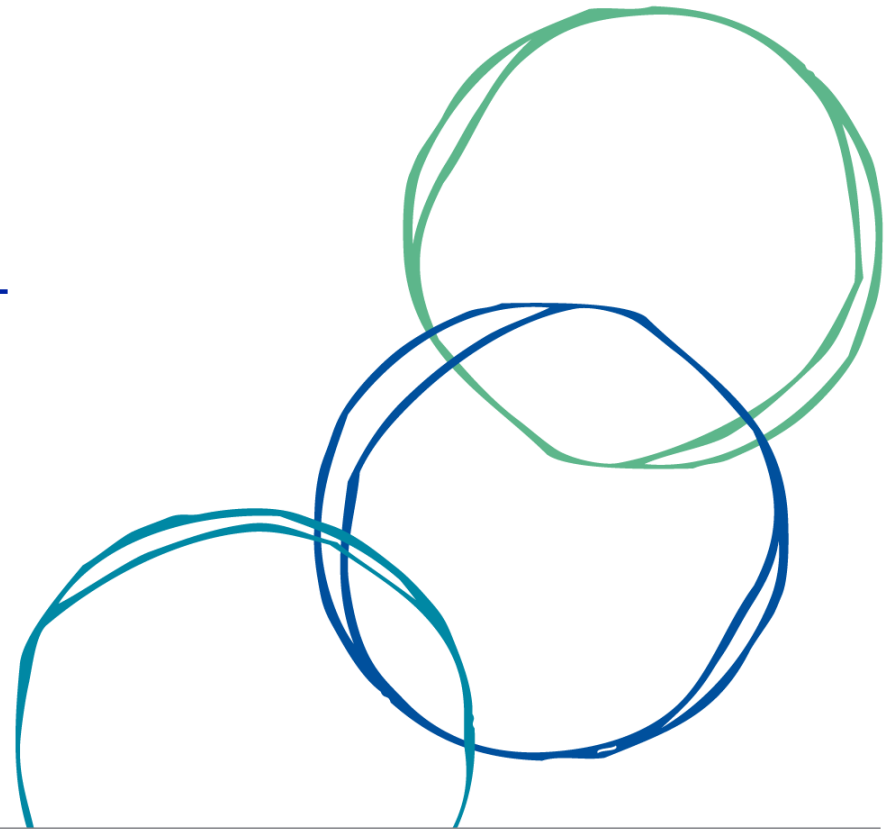


Overview

Dr Mark Diesendorf
Education Program Leader CRC LCL



Summary of issues and plan of this overview

Proposition: The transition to 100% renewable electricity (100RElec) is under way in Australia and the whole world and appears to be unstoppable.

Key questions:

- Can we transition in time to stay within our carbon budget?
- Can we transition in an affordable way, without rapid collapse of the incumbent industries, and without major blackouts?

If the answers are “yes”:

- What's our vision for an ecologically and economically sustainable electricity industry?
- What barriers are slowing the transition and how can they be overcome?

Global transition is under way



- Annual RElec generating capacity installations in 2017 were 70% of total electricity installations
- Annual investment (US\$310 billion including big hydro) in RElec in 2017 was greater than double fossil + nuclear electricity combined
- Therefore RElec is no longer “alternative energy”.
- In several regions, *unsubsidised* wind and solar PV farms are winning contracts for new power capacity against all fossil & nuclear competitors
- In many regions existing subsidies to RElec are small and declining
- Global leaders in % *variable* RElec generation in 2017: 2 North German states (100% net), South Australia (45%), Denmark (44%), Scotland (38%), Germany (26%)

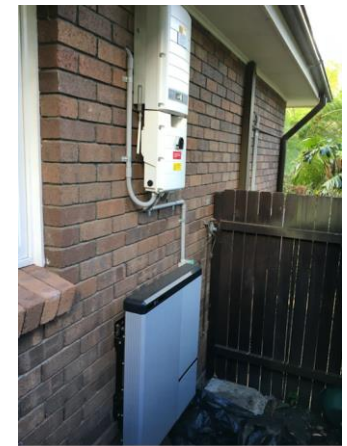
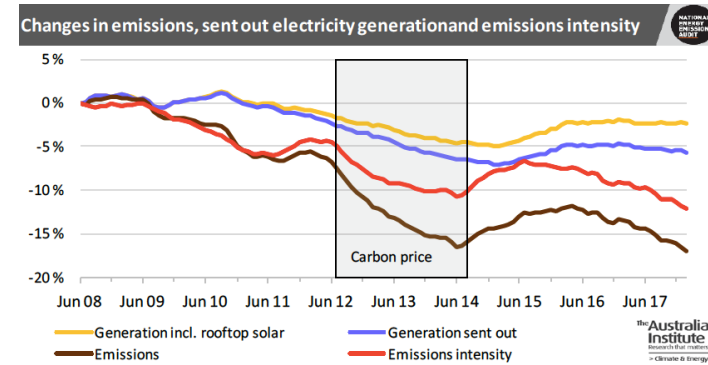
The Australian transition



- In 2017 rooftop solar PV had highest annual installation: 1.1 GW; 12% had batteries
- Now 29% of dwellings in SA and 27% in Qld have rooftop solar PV; Australia has 1.8 million systems ~20% of households
- Many medium– and large-scale solar and wind farms are under construction or advanced stage of development
- Mining companies in remote areas and even steel-making in SA are installing RElec

New technologies disrupt the old

- In wholesale market, coal power is becoming uncompetitive due to old age and Merit Order Effect
- In retail market, demand on the grid is plateauing & declining, due to solar PV, energy efficiency and loss of manufacturing → “Death Spiral”
- To delay the inevitable, some retailers are increasing the daily supply charge, thus undermining energy efficiency and RElec – the wrong kind of “solution”.
- To avoid an economically catastrophic transition, business models must change and new government policies are needed at all levels.



Forum focus on *Local Renewable Electricity*

Why local?

CRCLCL addresses households, precincts, local communities and commercial sites. Medium-scale has huge untapped potential

Why renewable?

Cleanest, least expensive, safest low-carbon sources of energy

Why electricity?

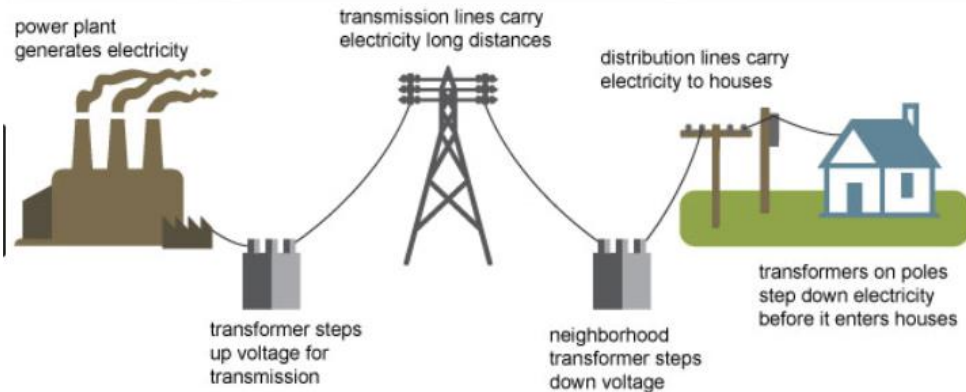
Because future renewable electricity supply will be mostly *electrical*.
Exceptions: renewable fuels for air and long-distant rural road transport; direct solar space heating and cooling

What about energy efficiency?

At least as important as renewable energy, is the main research area of CRC LCL, the subject of several other CRC National Fora & Roadshows and needs at least a whole day for partial coverage. Aspects of demand management will be addressed today.

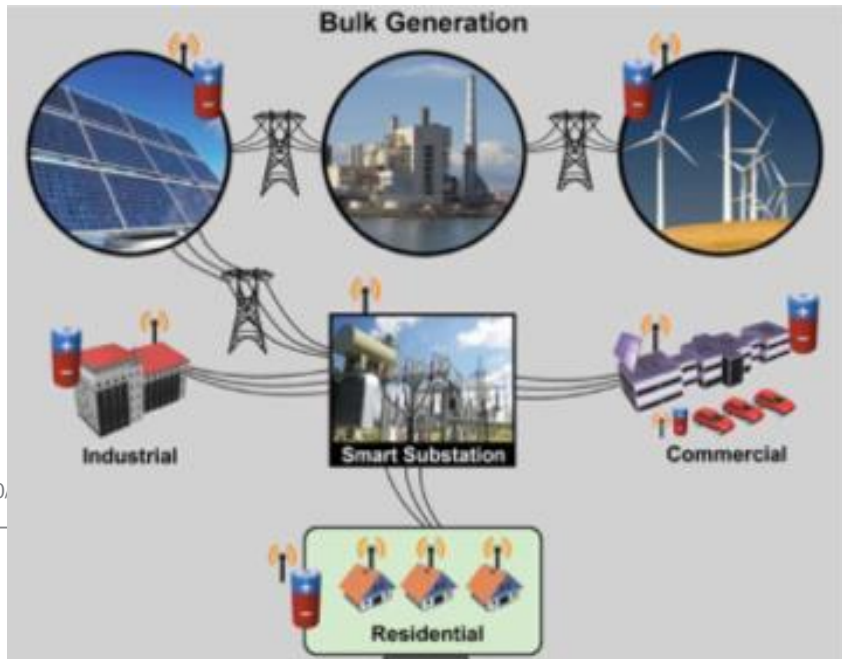
Old and new electricity systems

Electricity generation, transmission, and distribution



Old

Large central power stations sending electricity one way to consumers



New

A much more distributed system with 2-way flows; feed-in on small, medium & large scales; consumers become prosumers

Addressing the barriers

- Consider technology as hardware + software + orgware (organisational-ware = institutions = i.e. organisational structure, legislation, rules and tariffs)
- We already have most of the required hardware, although some must still be rolled out on a mass scale: e.g. really smart meters
- More effort needed on software and orgware, this Forum's focus
- Current orgware/institutions were designed for the old system
- We need new institutions to facilitate the transition smoothly, without major disruptions to electricity supply, homes, businesses, industries and employment

Elements of the solution include...

- New market rules
- Local electricity trading
- Community renewable electricity and microgrids
- Community electricity retailers
- Virtual power plants
- Project finance
- New tariffs for grid electricity
- New tariffs for feed-in to the grid
- New software for smart systems, possibly including blockchain
- Contracted demand management, especially for handling peaks in demand when wind and solar generation is low



Thank you

To find out more, contact

CRC for Low Carbon Living Ltd

Room 202-207, Level 2,
Tyree Energy Technologies Building
UNSW Sydney NSW 2052 Australia

E: info@lowcarbonlivingcrc.com.au

P: +61 2 9385 5402

F: +61 2 9385 5530

Twitter: @CRC_LCL

Demand Management

An essential complement to
renewable energy

Tweet during the talk

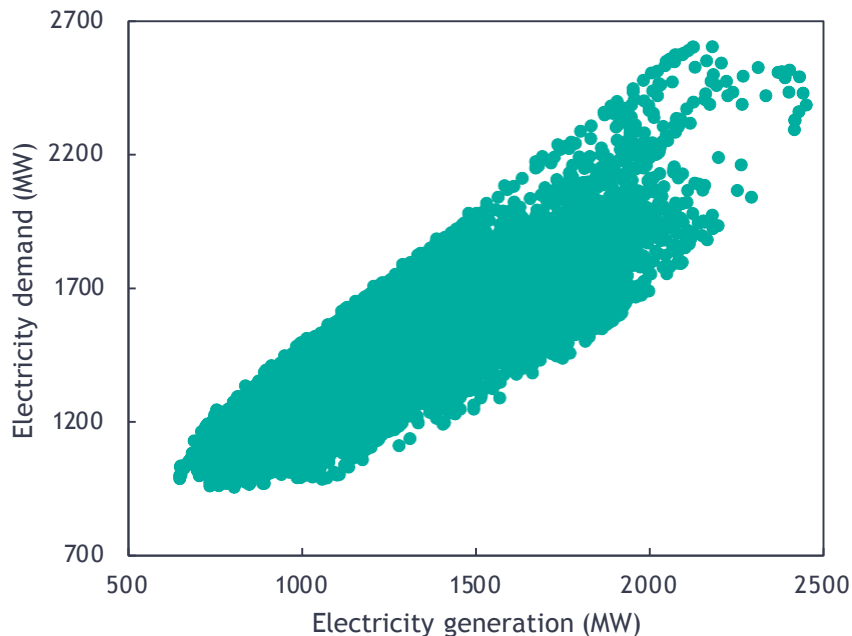
@1MarijaPetkovic

@EnergySynapse

Changing dynamic in South Australia

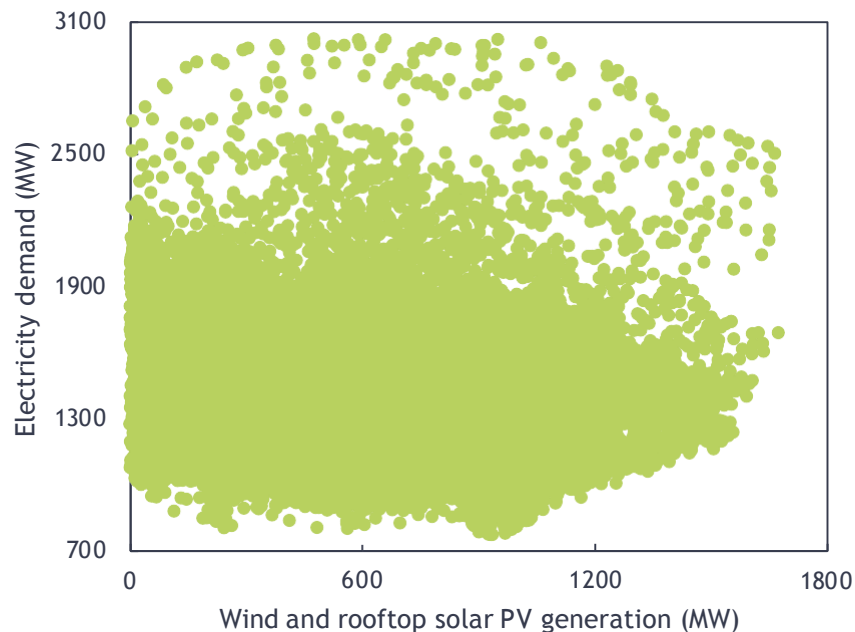
Jan-Dec 2002

Generation highly correlated with demand



June 2017 - May 2018

Zero correlation of RE with demand



Need for paradigm shift

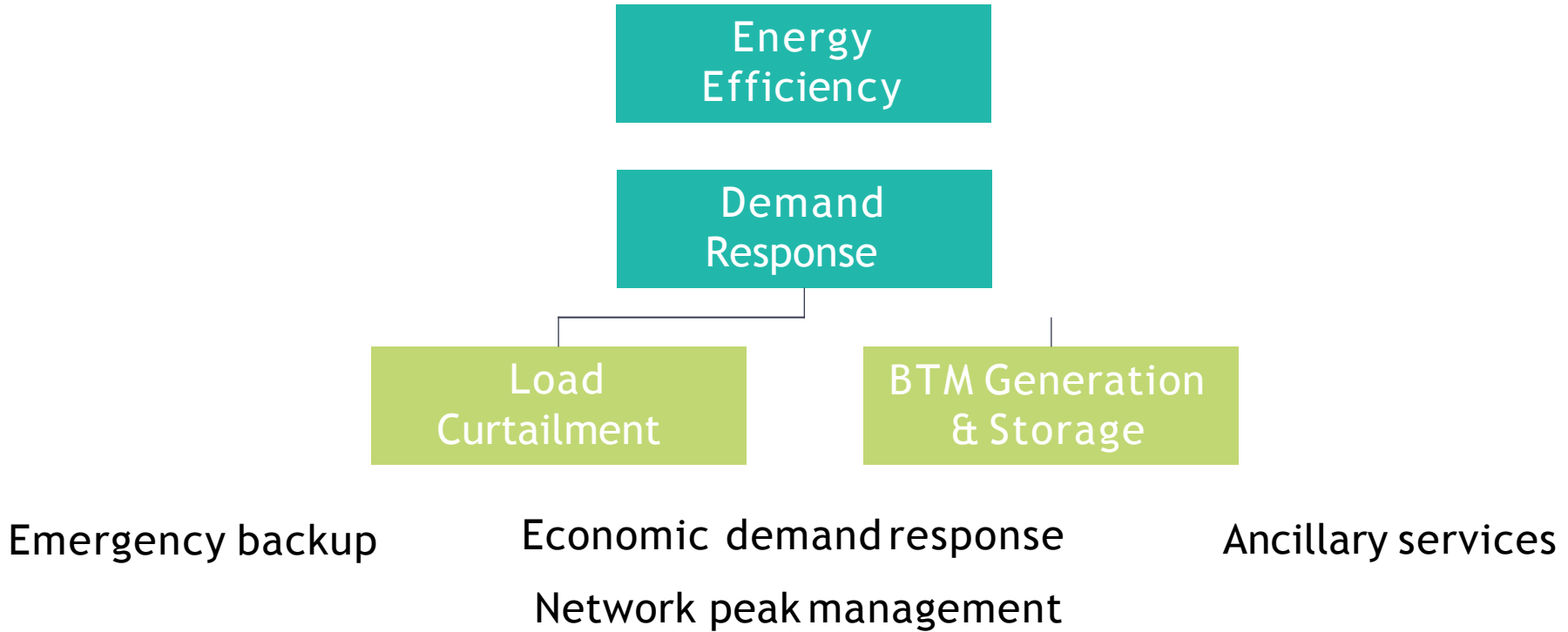
Old World
Generation
adjusts to
demand



New World
Demand
adjusts to
generation



What is demand management?



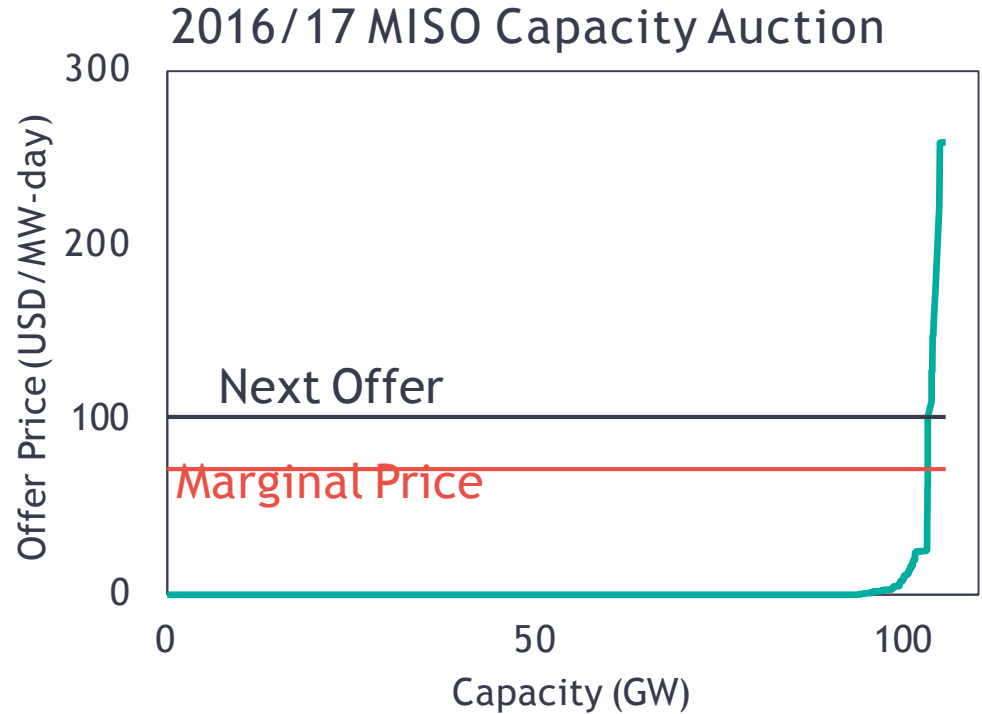
Barriers to demand response

- Lack of price signals especially for residential sector
- Accurate forecasting of spot prices
- Quality of deals on offer
- Lack of market integration
- Lack of cost reflective network tariffs

Demand competing directly with generation

Demand response = 4% of capacity offered into auction.

Demand response offer set the clearing price and saved MISO consumers USD 688 million (30%).



A photograph of a large industrial facility, likely a power plant or manufacturing plant, with a teal color overlay. The image shows complex piping, structural steel, and industrial equipment. The text "Brighter Energy Decisions" is centered in white.

Brighter Energy Decisions

Visit our website energysynapse.com.au

ENERGY SYNAPSE



Regulatory frameworks – affordability, safety, technical and consumer protection objectives

State and national work programs

Katharine Hole, Executive Director, Energy Strategy

Wednesday 6 June 2018

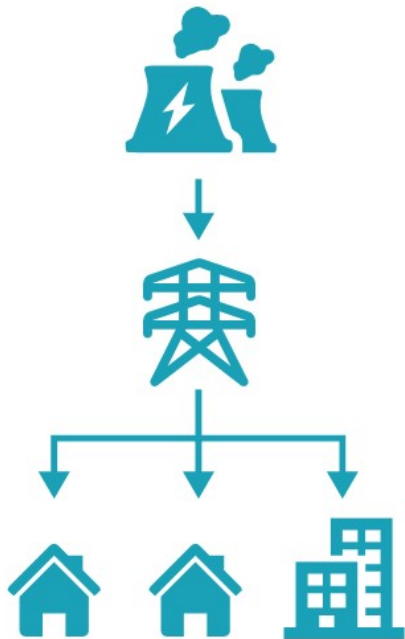
Department of Planning and Environment

Agenda

- State of the market
- Regulatory landscape
- National regulatory reforms
- NSW focus on potential gaps in four areas
 - Safety and reliability of supply
 - Affordable electricity where retail competition may not operate
 - Consumer protections where the national regime may not cover consumers
 - Vulnerable customers

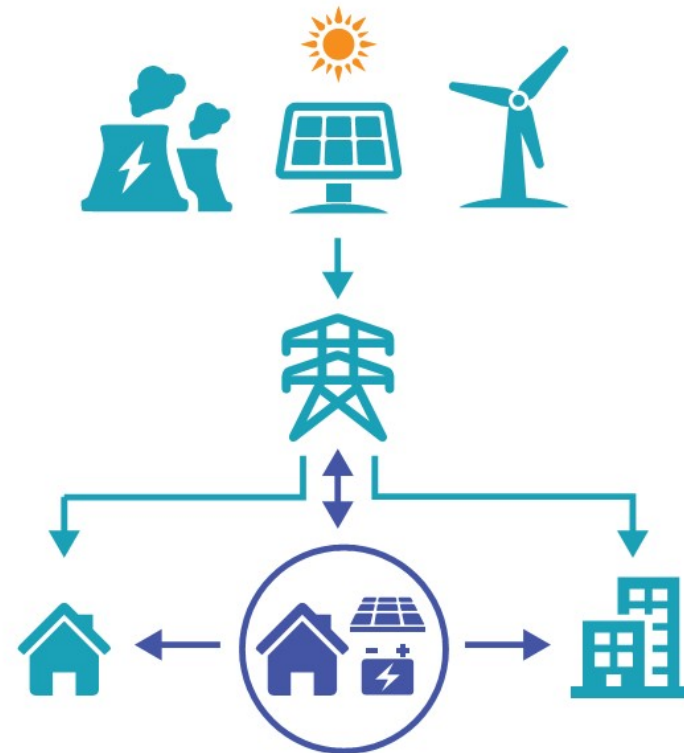
State of the market – changing structure

Recent past



In the old system, energy flowed in one direction only.

Into the future



Energy flows in two directions, and the customer is at the centre of the energy flow.

State of the market – growing numbers of customers with arrangements outside the National Energy Retail Law



Around **400,000** households with solar in NSW

Around **1,500** MW of small scale solar amongst the largest NSW power stations



AEMO predicts more than **1,000** MW of battery storage will be installed by 2035 across the NEM



AEMC estimate over **200,000** customers in embedded networks across the NEM

Exemptions for residential embedded networks across the NEM increased from **147** in 2012 to **1358** in 2016



Slide 4

KH1

update statistics

Katharine Hole, 1/06/2018

Regulatory framework is complex and overlaps

The regulatory framework which governs NSW's energy market is a complex network of responsibilities between nationally harmonised laws and NSW specific rules and standards.

National	Australian Consumer Law	National Electricity Law and Rules	National Energy Retail Law and Rules
NSW	Electricity Supply Act	Electricity (Consumer Safety) Act	Property and tenancy laws

Regulatory responsibilities are shared across national and NSW agencies – high level overview illustrates complexity

Regulatory Framework	Summary key functions for innovative energy services	Grid connected	Private distribution	Standalone	Regulator
Australian consumer law	Generic consumer protection for contracts, sales/marketing Competition	Applies	Applies	Applies	ACCC NSW Fair Trading
National Electricity Law and Rules	Connections Network revenue regulation and classification of services	Applies	Applies in part	Applies in part	AER
National Energy Retail Law and Rules	Energy specific consumer protection for contracts, sales/marketing, dispute resolution	Applies	Applies in part	Does not apply	AER
Electricity Supply Act	Network reliability, bushfire management, safety systems Price regulation	Applies	Applies in part	Does not apply	DPE IPART
Electricity Consumer Safety Act	Electrical installations Metering	Applies in part	Applies in part	Applies in part	NSW Fair Trading

National work underway

There's a lot happening in this space at the national level

- AEMC work into stand-alone power systems and embedded networks
- AEMC review of electricity network economic regulatory framework
 - This work will look at the update of distributed energy resources and its impact on the regulatory framework
 - It will consider how best to monitor and control distributed energy resources
- CSIRO and ENA Electricity Network Transformation Roadmap
- AEMO Integrated Systems Plan
- Distribution system operator

State work underway

Regulatory reforms at the NSW level

- Release of discussion paper *Protecting consumers in a changing energy world* late 2017
- Submissions strongly favoured national arrangements where possible
- Participating in national reform processes

Other projects and trials

Purpose of discussion paper

Protecting consumers in a changing energy world

Core policy considerations are unchanged, the issue is how do we continue to deliver these in a changing energy world.

Safety and reliability

Customers have a right to an electricity supply that is safe, reliable and at reasonable cost

Affordability / competition

Competitive market customers should be able to choose from a range of suppliers and move supplier if they do not like their current service

Consumer protections

A strong consumer protection regime should enable customers to participate in various new markets with confidence, support choice, and allow access to dispute resolution services

Vulnerable customers

Delivery of social policy outcomes to vulnerable consumers



Next steps

- Trials
- National regulatory reforms



Status of PV, Batteries and Software

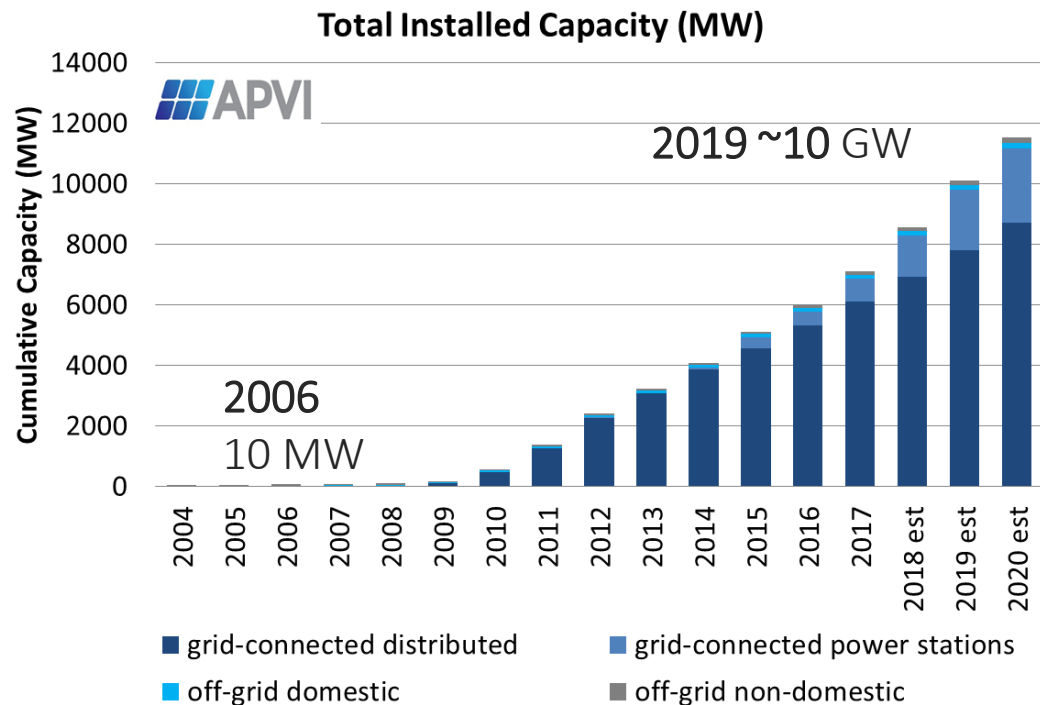
CRC Low Carbon Living Forum, June 2018

Renate Egan

Co-founder, Chair, Solar Analytics
Chair, Australian PV Institute



PV Market Statistics



end 2017

- 1.25GW installed in 2017
- 7.2 GW capacity , (7.8 end March)
- 10.0TWh (@1400MWh/MW)
- 3.9% demand (> x 10 in 5 years)

Internationally

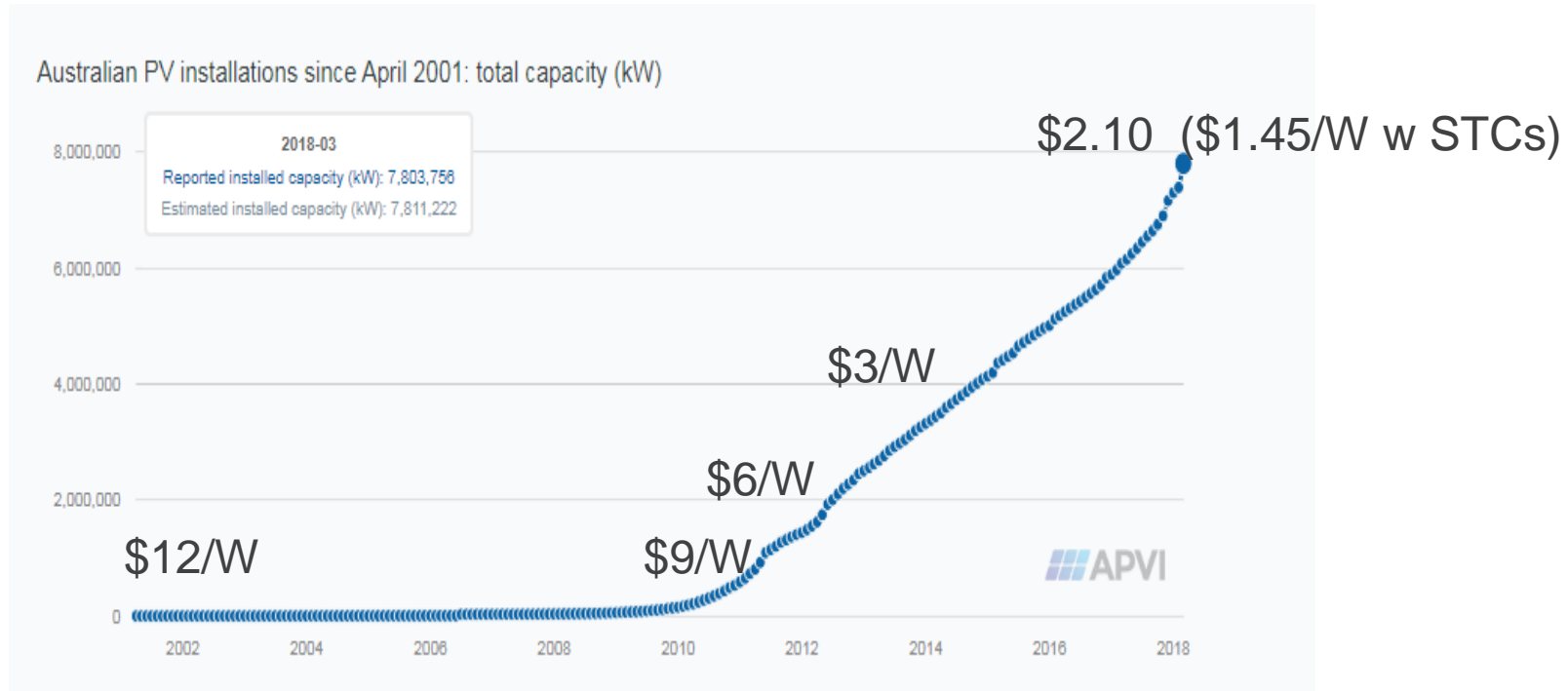
- 7th largest market (annual installs)
- 9th largest (total installed)

Value

- 2.5 Billion dollar/annum (2017)
 - >15 BAUD 2010 - 2017
- 8,300/yr direct employment (2015)
- 12,400 total employment (2015)

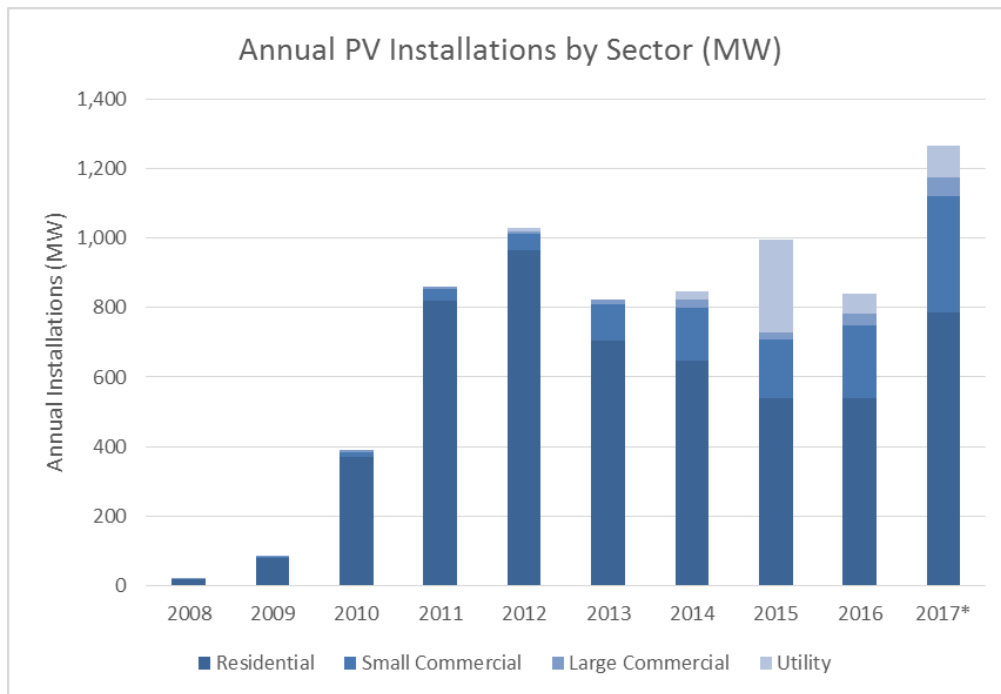
www.apvi.org.au

Solar Installs. Total Capacity and System Price



Annual Installations

2017



- Strong growth in resi and commercial markets
1.8m homes (160,000 in 2017)
>20% of homes
- Lumpy utility scale solar with >1.0GW planned for 2018-2019
- RET is the only incentive since 2013

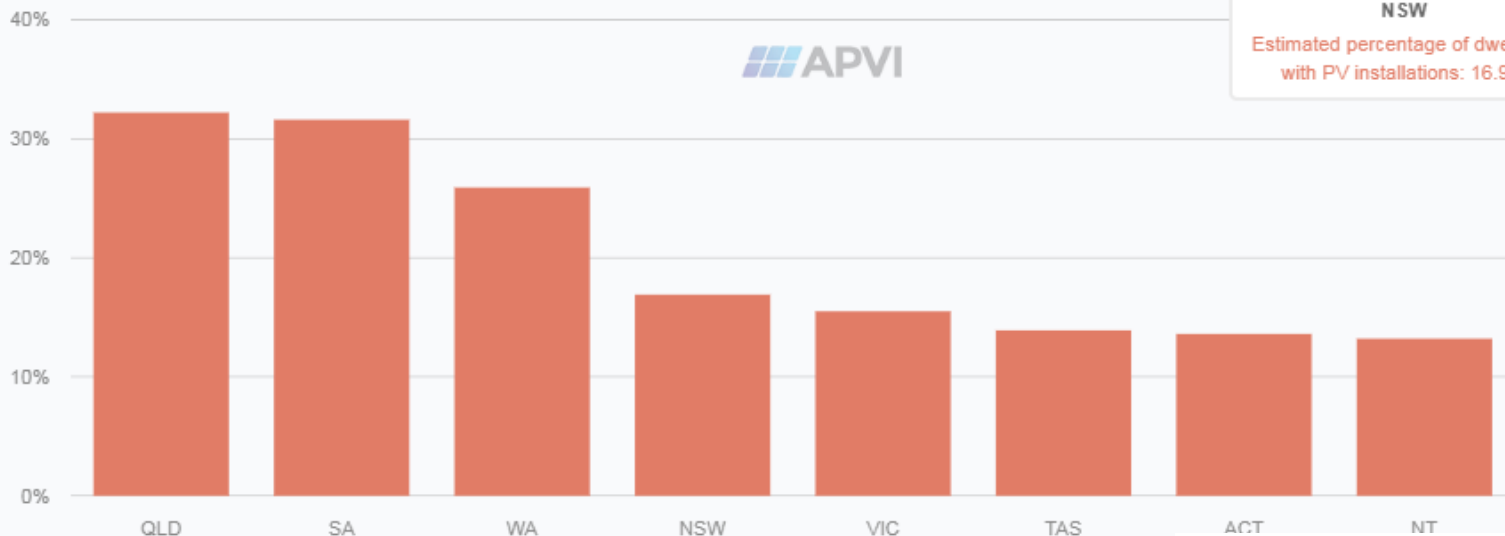
www.apvi.org.au

World Leading Rooftop Solar Market

National Average Over 20% and over 50% in some areas

Compare the Status of States and Territories

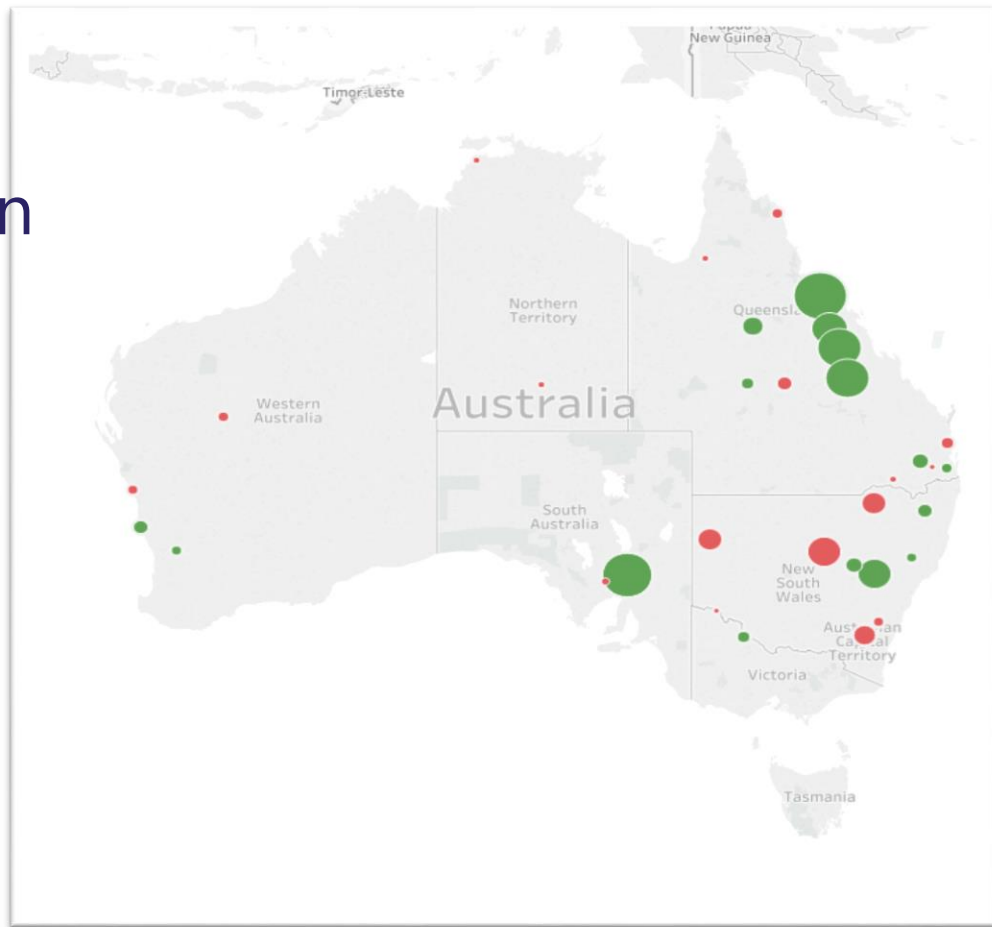
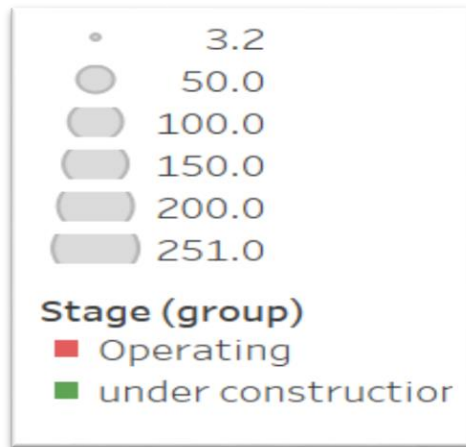
Percentage of dwellings with a PV system by State/Territory



Utility Scale

1.3GW under construction
22GW in pipeline

source: Sunwiz and reneweconomy



Utility Scale

Ganawarra Solar Farm, 60 MW



Utility Scale

Wemen Solar Farm, 110 MW



Utility Scale

Wemen Solar Farm, 110 MW



Batteries

Residential installs (not tracked)

- >7,000 in 2016
- 21,000 in 2017 (190MWh)
- 2018 ? Predictions of 33,000 / 300MWh

Utility Scale

- Hornsdale Windfarm 100MW, 129 MWh
- Gannawarra 25MW, 50MWh
- And more to come



12%

of solar installations
included batteries in 2017

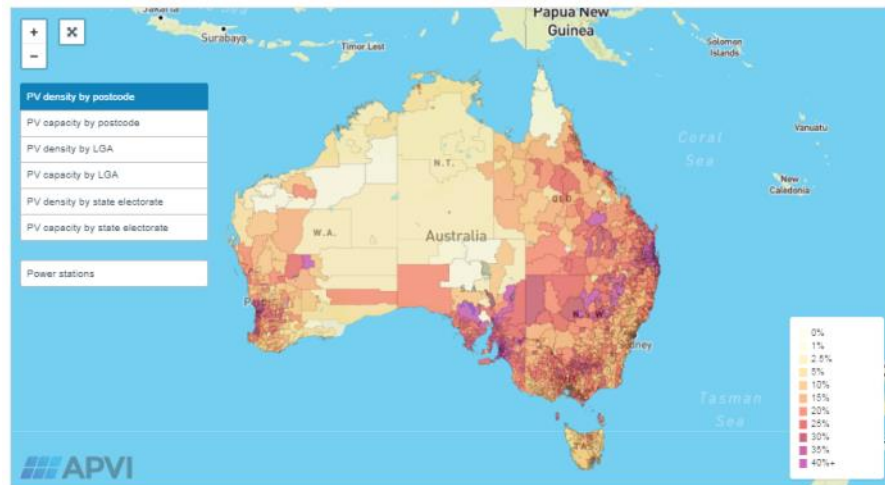
Source: Giles Parkinson.
<https://reneweconomy.com.au/solar-battery-installs-reach-33000-2018-economics-improve-89443/>

Australian Market

Unlike anywhere else in the world ...

Leading in residential, growth in utility scale solar

- High penetration distributed generation
 - Average >22% available households
 - Over 60% in some urban areas
- Isolated microgrids
- Diverse climate zones
- Engaged and informed market
- Lots of learning by doing
- Technology moving ahead of policy and regulation
- New markets, new services, new business opportunities



Solar Analytics

More Power to You

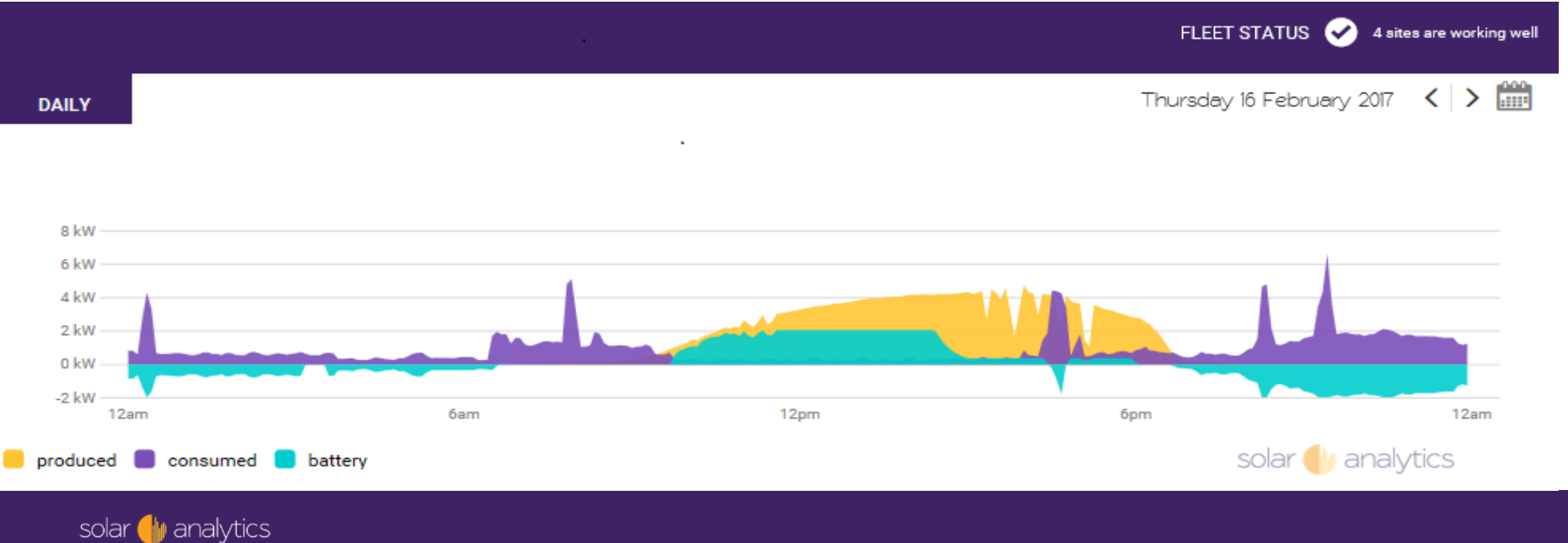
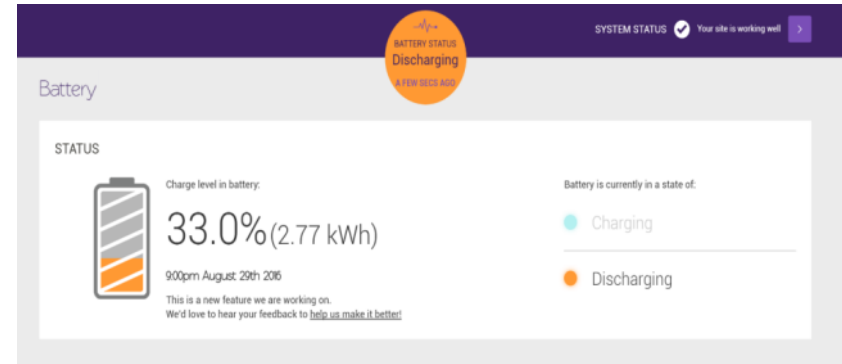
we can tell if your
solar energy system
is working as expected
and if it's not...

we can tell you what's wrong
and what to do about it.

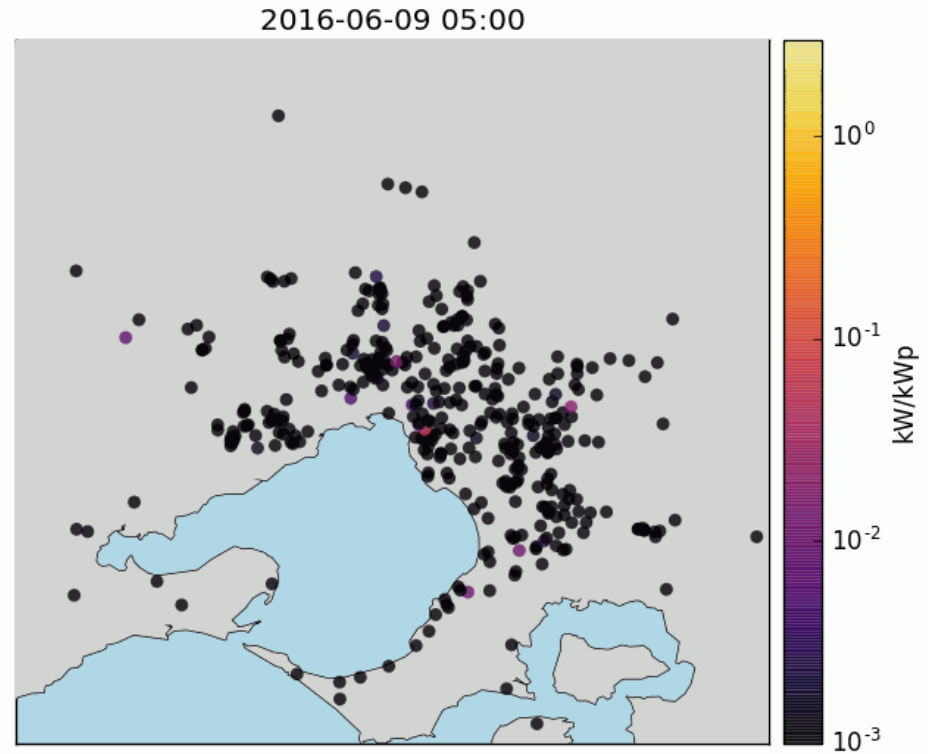


Energy Storage

- Battery sizing and monitoring



Detailed Energy Insights



Forecasting

Source: Baran Yildiz,

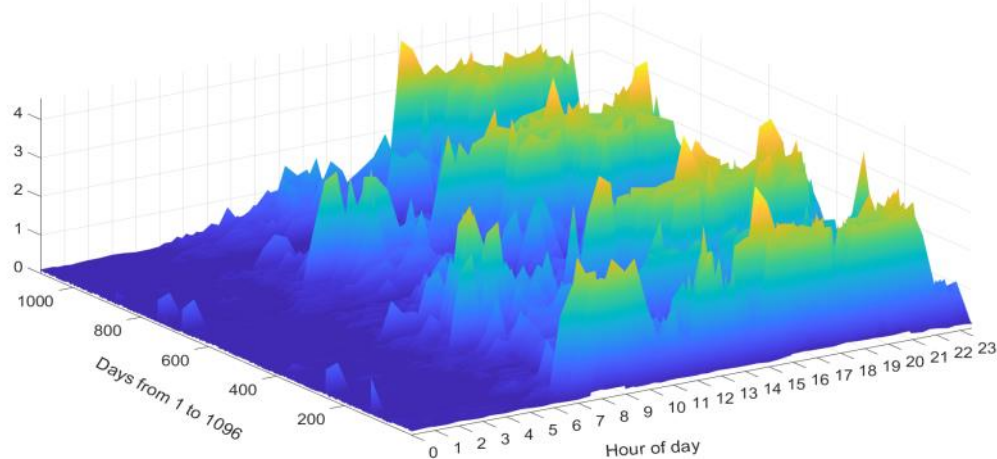
PhD Candidate

UNSW

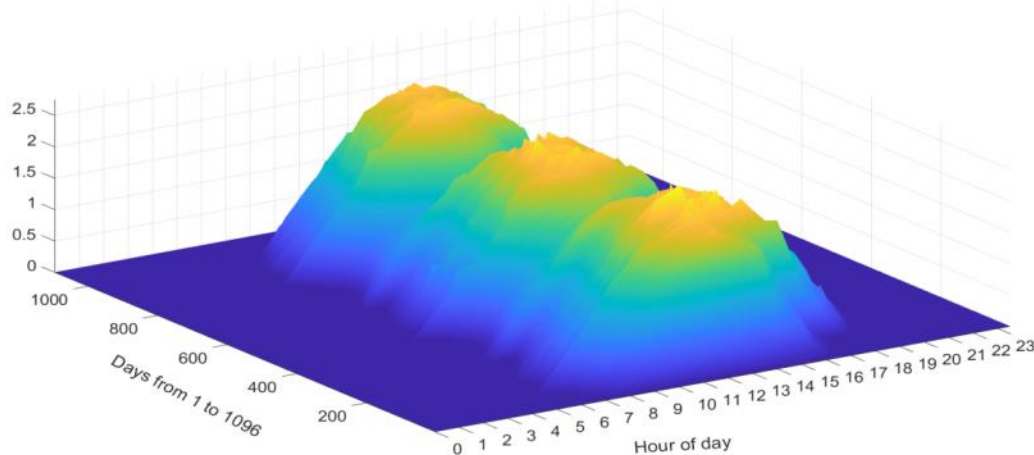
CRC Low Carbon Living

Solar Analytics Project

1096 days of electrical consumption (half hourly)



1096 days of PV generation (half hourly)



solar  analytics

more power to you

renate@solaranalytics.com



Institute for
Sustainable
Futures

Local network credits & Virtual Net Metering

Jay Rutovitz, Sebastian Oliva H., Lawrence McIntosh, Ed Langham,
Sven Teske, Alison Atherton, Scott Kelly

Content

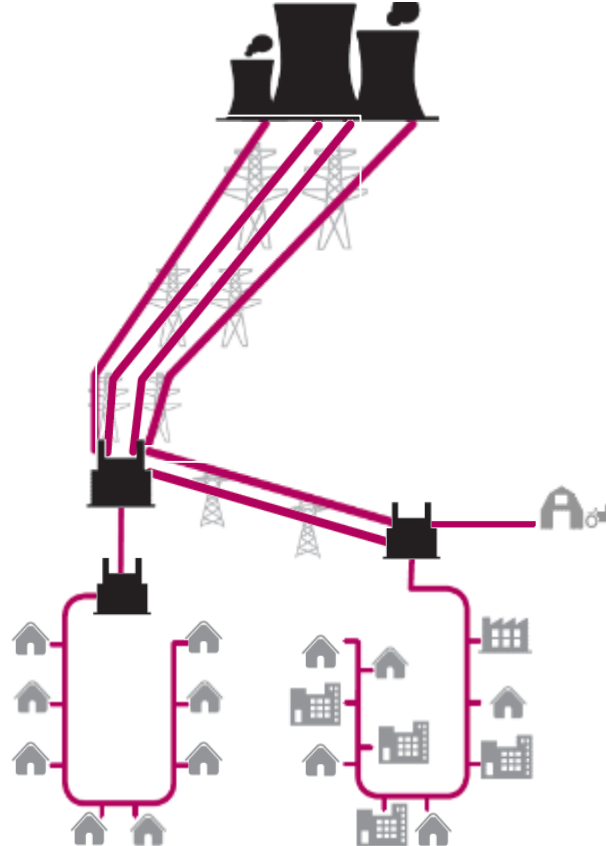
1. Context
2. Concept
3. Project Outline
4. Benefits of LNC and LET
5. Trial Results
- 6 Conclusion

The Concept: Local Network Credits

Dr. Sven Teske

Yesterday:

Highly centralised network

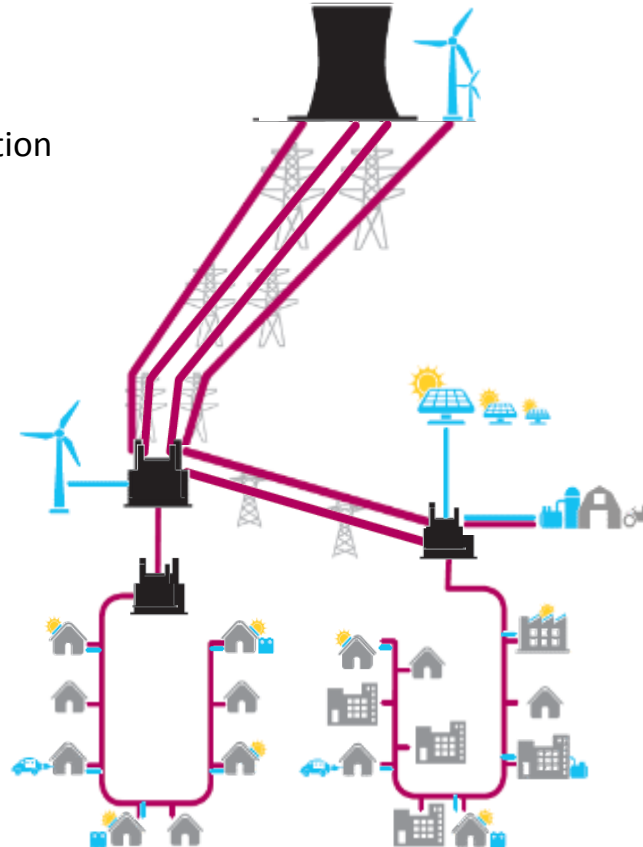


The Concept: Local Network Credits

Dr. Sven Teske

Today:

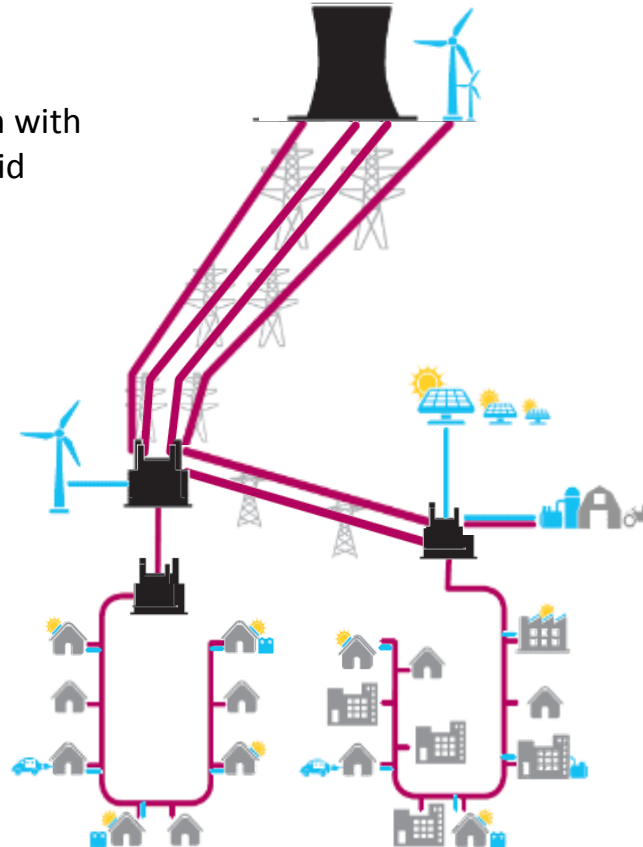
Increased decentralised generation



The Concept: Local Network Credits

Dr. Sven Teske

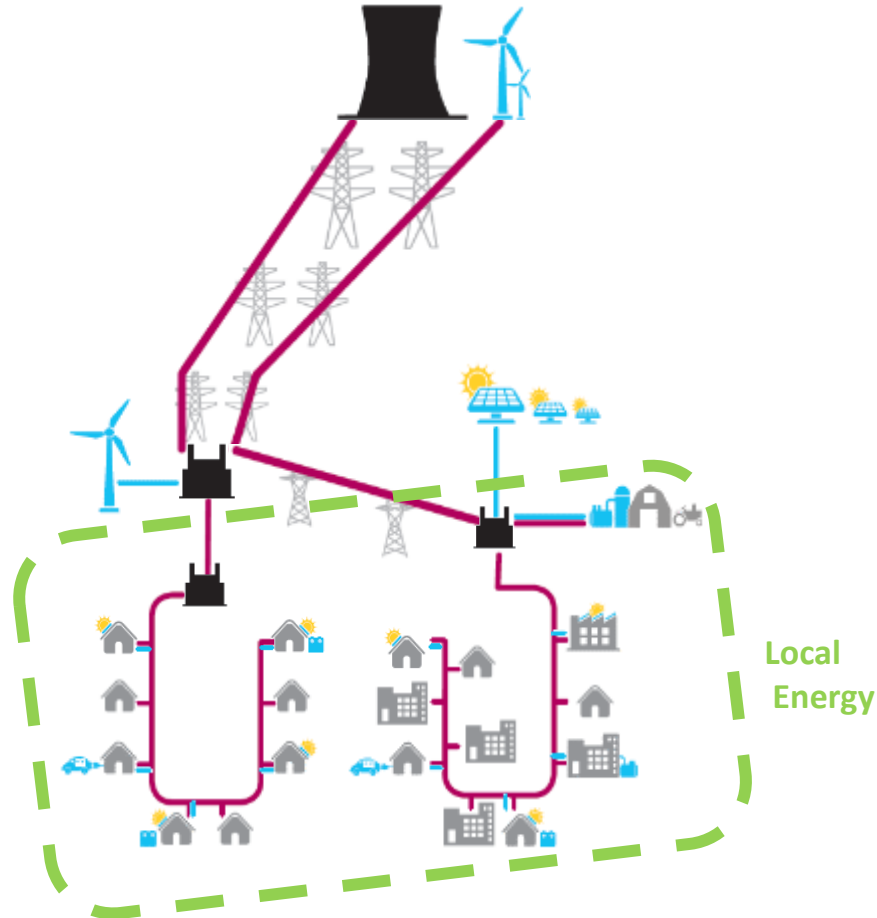
Tomorrow:
Highly decentralised generation with
“interactive” distribution grid



The Concept: Local Network Credits

Dr. Sven Teske

Local energy requires a different
market framework.
Physical flow and financial flow
continues to disconnect



Paris Agreement:

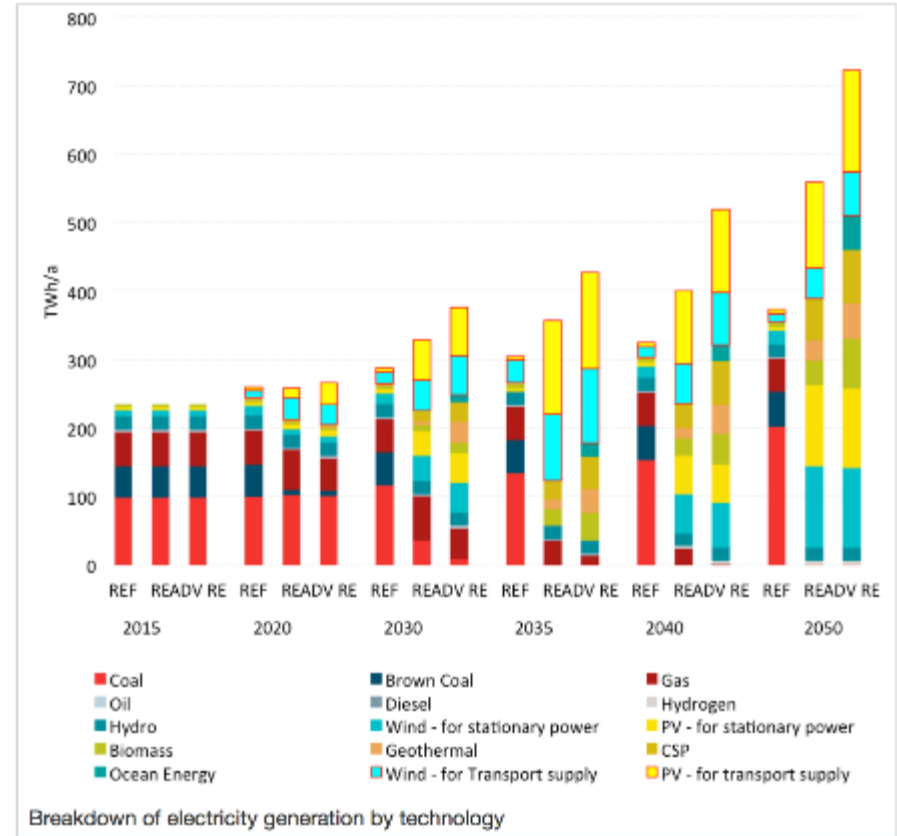
To keep global temp. rise "well below" 2°C
& "endeavour to limit" rise to 1.5°C

Net zero carbon energy sector

- Current RE: 15%
- Next generation RE 100%

Paradigm Change

Distribution Grid RE (mainly PV) and
transmission grid RE (mainly solar & wind)
change power sectors requirements –
technically and economically – and
therefore need a different market
framework.





PROJECT LEAD:



MAIN SPONSOR:



The project: Who WAS involved

Essential Energy

Ausgrid

Energy Australia

Origin Energy

Winton Council/ LGIS

Australian Energy Council

Energy Networks Association

Clean Energy Council

Coalition for Community Energy



**CITY OF
SYDNEY**



Project Outline

Dr. Sven Teske

Objective: To facilitate the introduction of

Local network charges: implemented as Local Network Credits paid to the generator; and

Local Electricity Trading: (also called Virtual Net Metering or VNM)

- Five case studies, or “virtual trials”
- A recommended methodology for Local Network Credits
- An assessment of requirements & costs for Local Electricity Trading
- Economic modelling of benefits & impacts
- Increase stakeholder understanding and support for Local Network Credit rule change

The Concepts: Local Network Credits and Local Network trading



Local Network Credits:

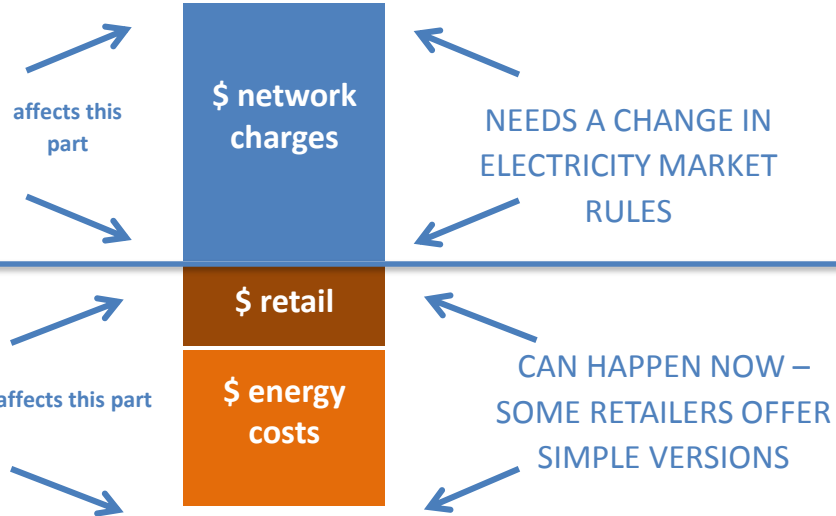
export credits for energy generated & consumed 'locally'; recognises the value in reducing future network costs



Local Electricity Trading:

Netting off generation from one site at another site on a time-of-use basis, so that Site 1 can 'sell' or assign generation to nearby Site 2

TYPICAL MAKEUP OF ELECTRICITY BILL



POTENTIAL Benefits of LET

Local Electricity Trading

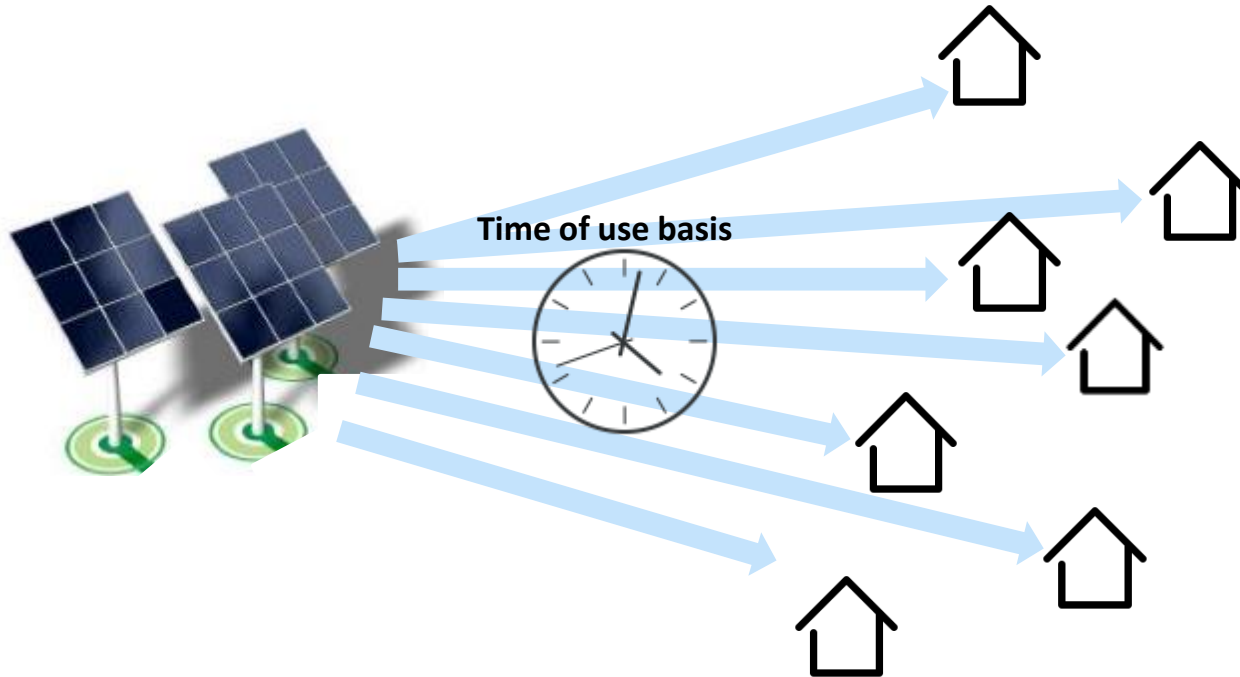
- Increase consumer choice
 - customers can choose where their power comes from, making energy ‘personal’
 - unlocks local energy projects
 - Enables stand alone community energy projects
- Competitive advantage for retailers offering LET (esp. local govt, large corporates, community energy customer groups)

Potential Benefits of Local Network Credits

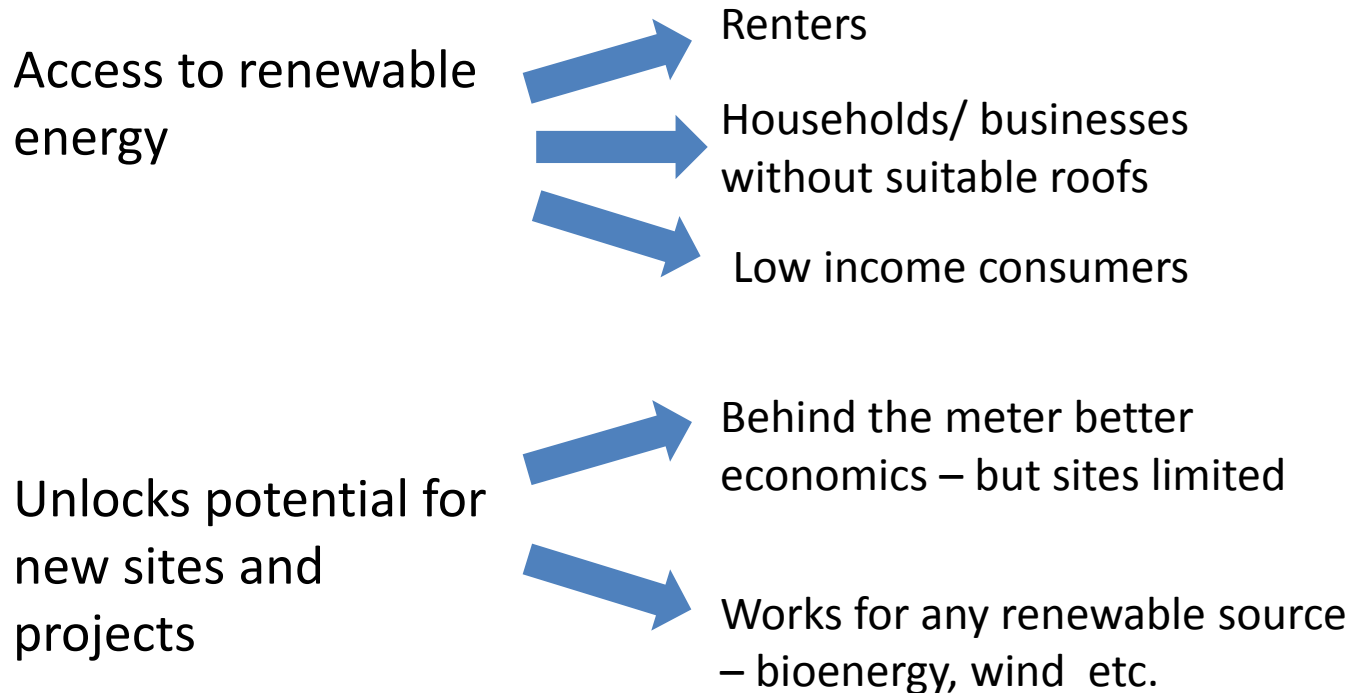
Local Network Credits

- Reduce future network costs and consumer costs
- Reduce load defection and maintain network utilisation
- Unlock new local energy projects
- Unlock new product offerings e.g. neighbourhood energy storage, LET

ONE-to-many (community solar farm)

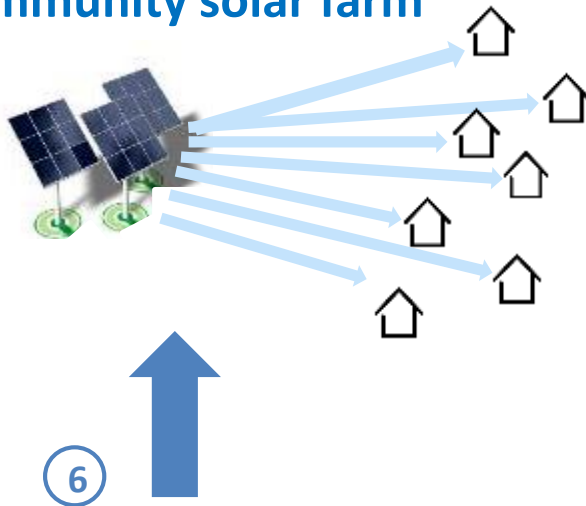


Why ARE centralised community renewables important?



How does the money work?

Community solar farm



Large-scale Generation Certificates go to management company (and some electricity output if there is a shortfall)

- 1 Households/ businesses invest in farm
- 2 Electricity “netted off” according to share of farm
- 3 If share of solar farm generation greater than house/ business consumption, electricity “exported” and gets FIT
- 4 If Local Network Credit is paid to generator, goes to each premise according to their share
- 5 Appears as credit on electricity bill

Time of use basis



Network charges etc. are paid just as normal – it is just the ENERGY portion netted off

KEY FINDINGS FROM TRIALS

Potential for distributed generation projects to meet local consumption needs, unlikely to be realised in today's market

LET (and LNC) could unlock community energy sites and increase access to renewable energy

A local network credit increases business case



Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol



Local network credits and local electricity trading: Results of virtual trials and the policy implications



Jay Rutovitz^{a,*}, Sebastian Oliva H.^b, Lawrence McIntosh^a, Ed Langham^a, Sven Teske^a, Alison Atherton^a, Scott Kelly^a

^a University of Technology Sydney, Institute for Sustainable Futures, Sydney, NSW 2007, Australia

^b Energy Centre, University of Chile, Santiago 8370451, Chile

ABSTRACT

Current charging methods for network infrastructure and recompense for distributed energy may not result in optimum system solutions. Once feed-in tariffs to support the development of renewable generation are phased out, the payment for grid exports is usually based on the wholesale energy value alone. Network charges are generally levied in full, with few attempts to offer a partial charge, or completely waived. Local Electricity Trading (LET) and Local Network Credits (LNCs) offer one approach to reforming charge structures. This paper examines the effects of LET and LNC on different stakeholders in four virtual trials of medium scale distributed generation projects around Australia, and the implications for policy. The trials found the large value gap between behind the meter systems and grid exports may lead to duplication of network assets, inefficient sizing and operation of distributed generators, and a lack of incentive for dispatchable generators to operate at peak times. The trials indicated that in most circumstances, the combination of LNC and LET addresses all four problems identified to some degree.



**Institute for
Sustainable
Futures**

Dr. Sven Teske
Research Director

sven.teske@uts.edu.au

Thank you



Network tariff design & analysis - Optimising tariffs in 'embedded networks'

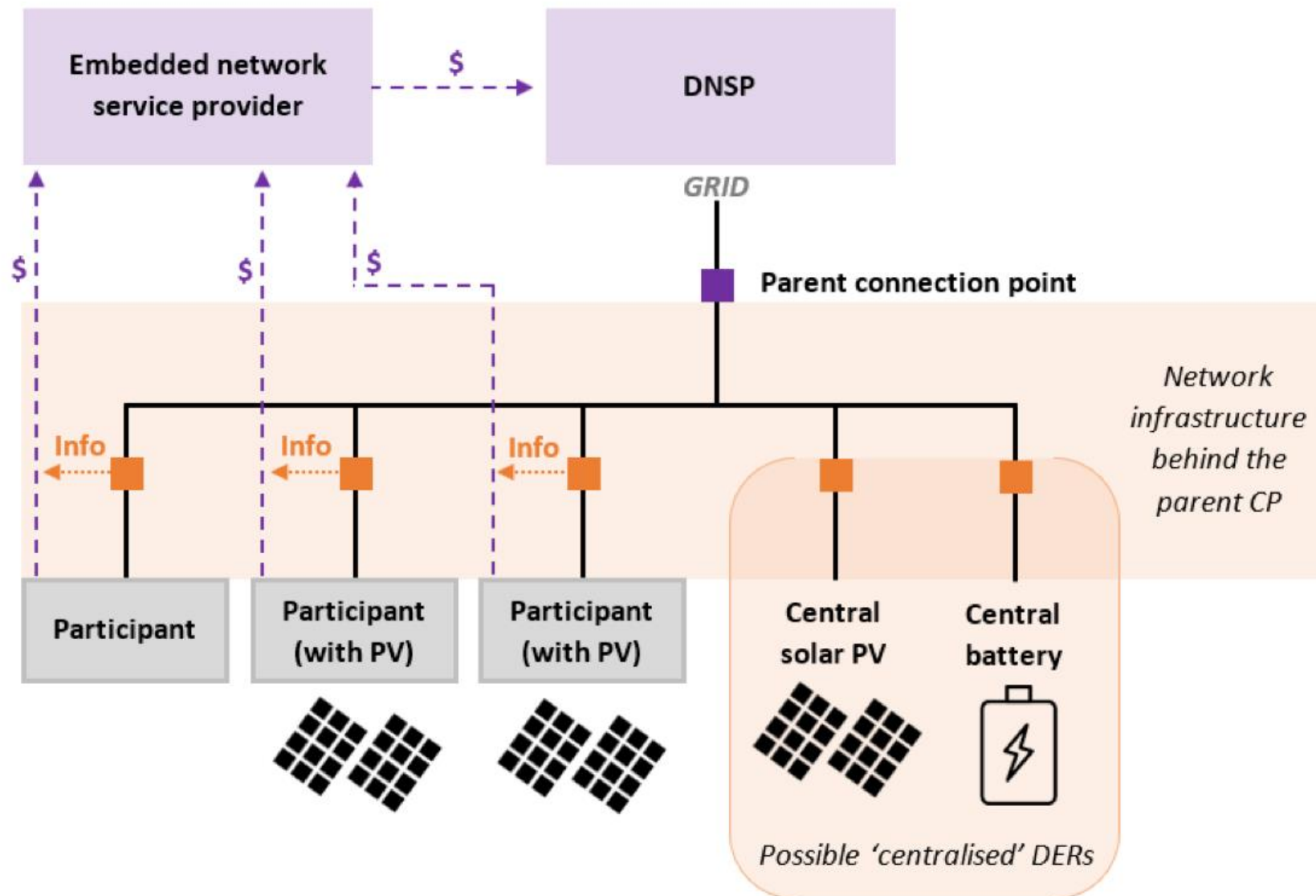
Rob Passey, Luke Marshall and Naomi Stringer

National Forum: Expanding Local Renewable Electricity for Households, Precincts and Communities

UNSW, Wed 6 June 2018 © CEEM, 2018

Embedded networks

- Increasing interest in the use of embedded networks to enable the uptake of PV, EE, load shifting etc
- May be in shopping centres, apartment blocks, retirement villages, caravan parks, Ecovillages
- A single point of connection to the main grid, network itself is not owned by the DNSP
- Advantages
 - Only a single daily connection charge spread across the customers
 - Normally \$450 to \$550 per customer
 - PV electricity exported to the EN and then used by EV customers will not pay DUOS charges
 - Instead of earning say 10c/kWh can earn say 20-25c/kWh
- But what about the rest of the grid that is owned by the DNSP?



Embedded networks

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- But what about the rest of the grid that is owned by the DNSP?

Byron Bay A&IE – ‘pseudo’ EN / minigrid

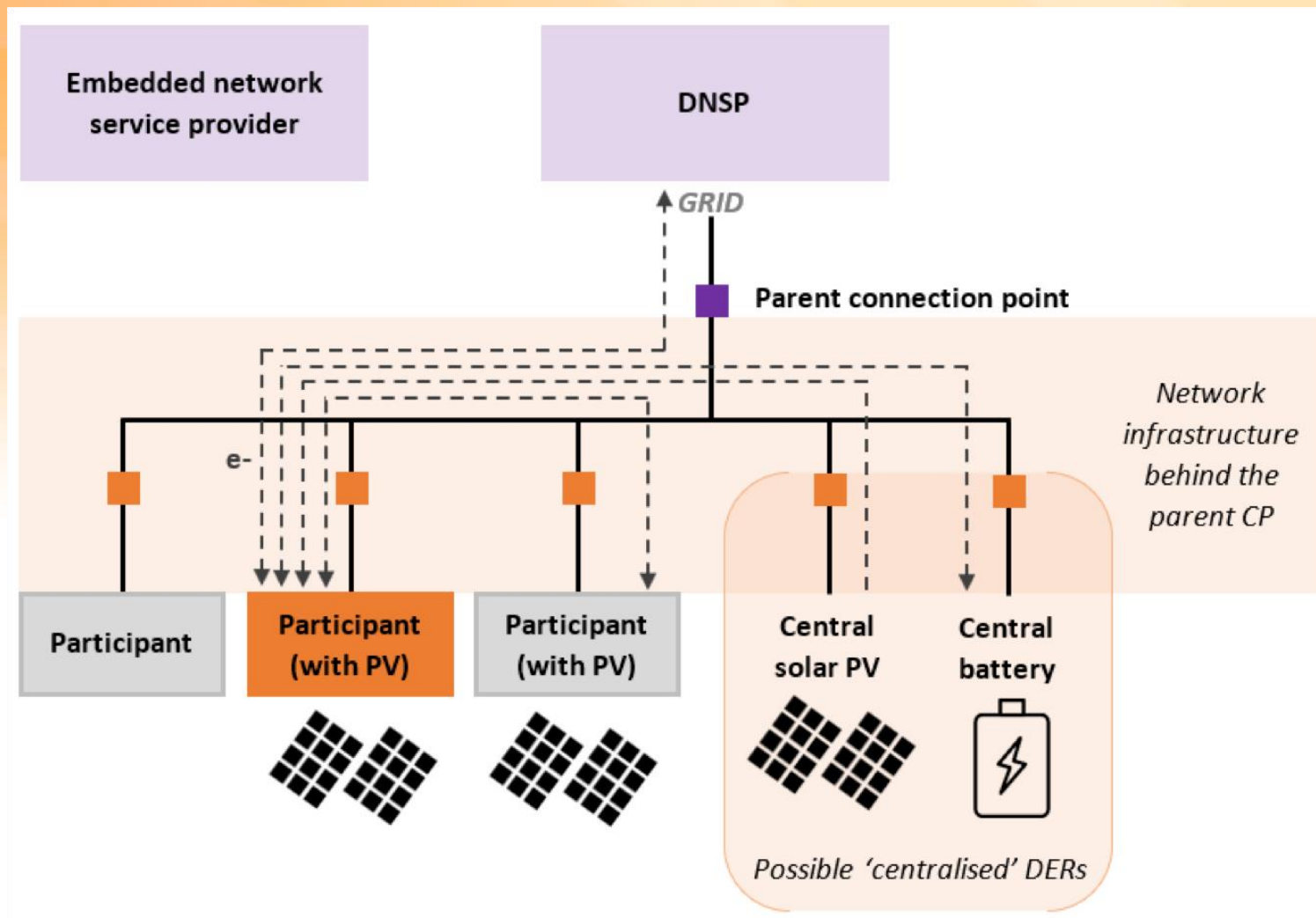
- Still a single point of connection but is owned by Essential Energy
- Enova Community Energy
 - interested in financial flows to participants, customer acquisition
- Essential Energy
 - interested in using a centralised battery to provide network support
- UNSW
 - interested in obtaining load data and interesting modelling outcomes!
- Site for a ‘pseudo’ embedded network has been selected
- To optimise design and PV, need to model the tariffs within the EN
 - Solar export and use
 - Centralised battery use and export
 - Decrease DUOS and retailer margin (offset by other values)

Enter Luke and Naomi!



PhD students and programmers extraordinaire!

Luomi Model Schematic



Luomi Model Logic Flow

- PV owner
 - PV electricity first used onsite
 - Excess is then distributed amongst other customers
 - Then to the battery
 - Then exported to the wider grid

- Consumer
 - Uses local solar first
 - Then battery electricity
 - Then from the wider grid

Model Outputs

- For each customer (half hourly, electricity and financial)
 - Solar export revenue
 - Solar import cost
 - Fixed daily charge
 - TUOS payments
 - DUOS payments
 - NUOS payments (TUOS + DUOS + environmental fees)
 - Variable costs (NUOS + retailer costs)
 - Central battery payments

- Utilities
 - TNSP revenue
 - DNSP revenue
 - Retailer revenue
 - Battery revenue

Tariffs

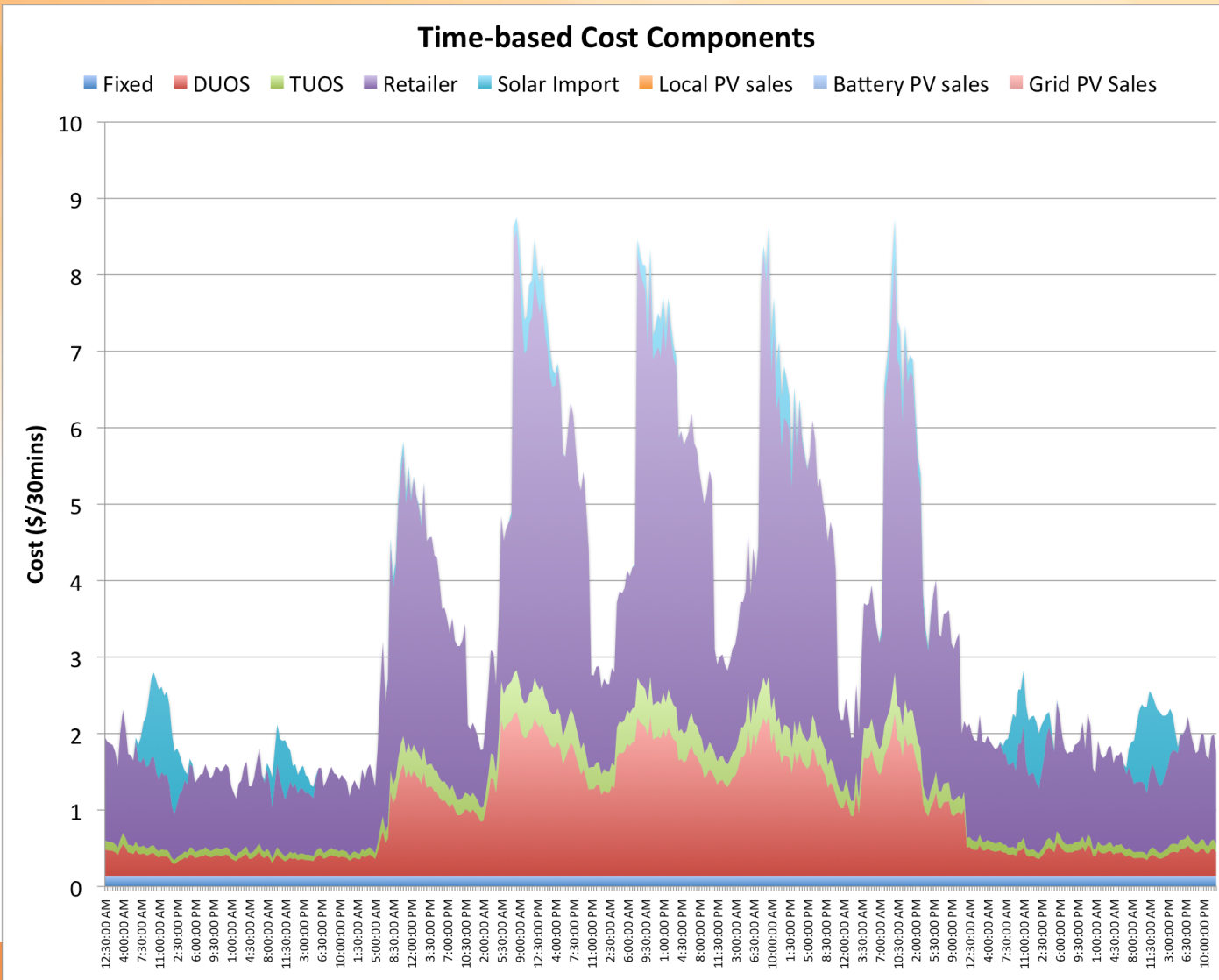
- Tariff for grid electricity is standard Enova business tariff

	TUOS	DUOS	Env	Retailer	Total
Fixed (\$/day)	0	0.7789	0	0.988	1.6877
Usage (c/kWh)	1.9286	11.2383	2.6127	20.6004	36.38
Solar export (c/kWh)	0	0	0	9	9

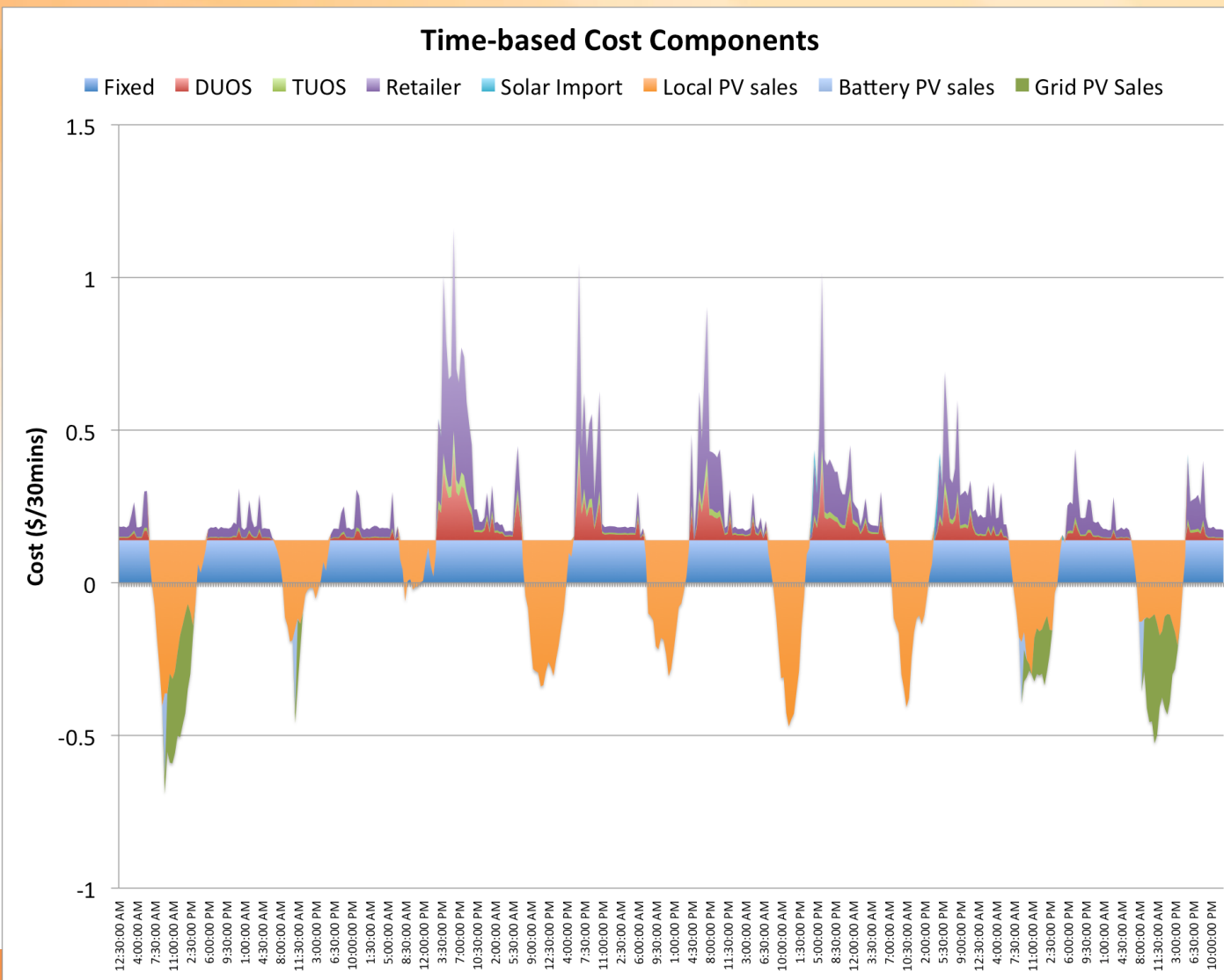
- Usage tariffs for electricity from local solar and battery

	TUOS	DUOS	Env	Retailer	PV owner	Cust (c/kWh)
Local Solar/ Battery (c/kWh)	0	11.2383	2.6127	13.529	9	36.38

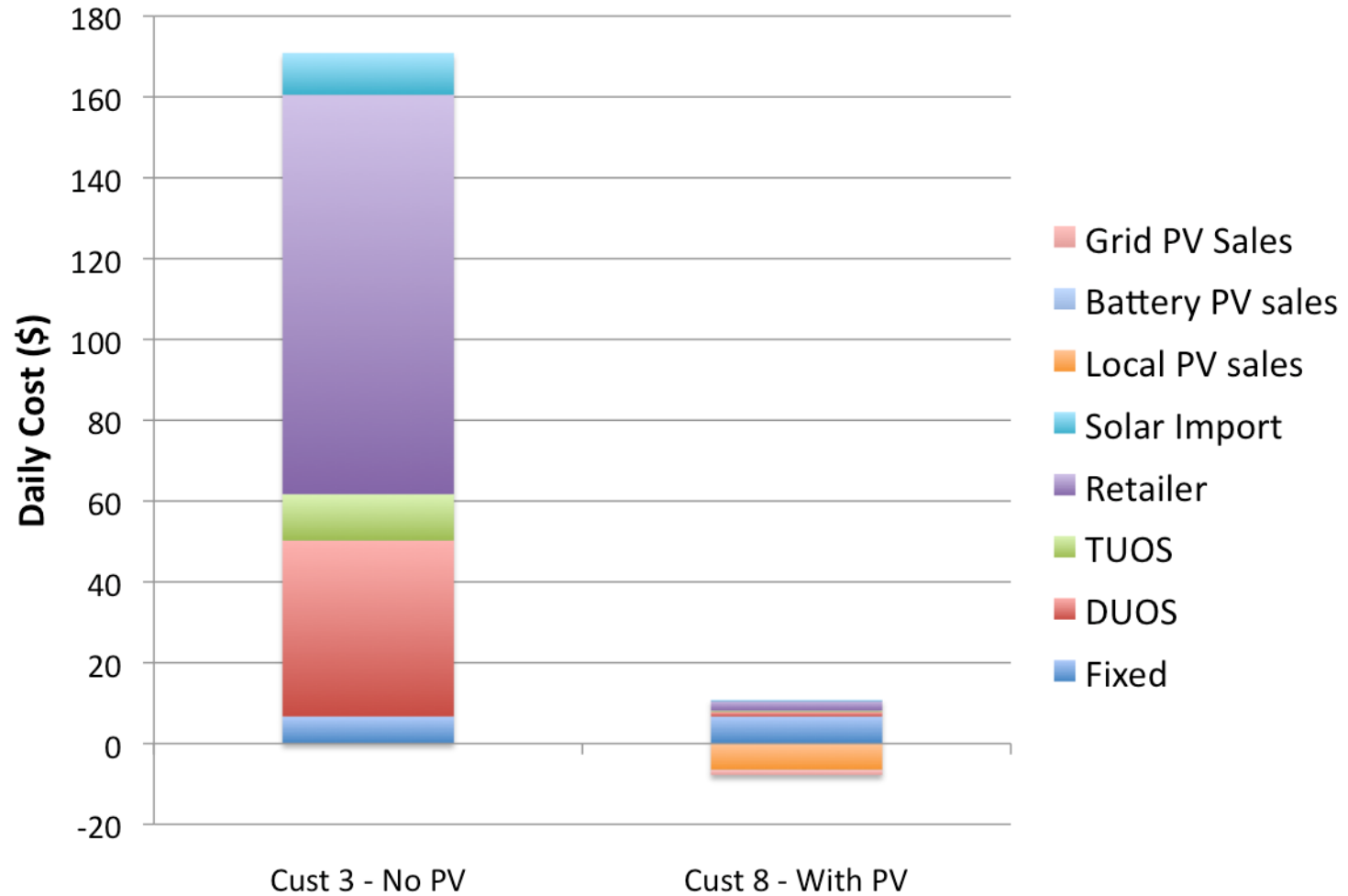
Customer 3 – no solar PV



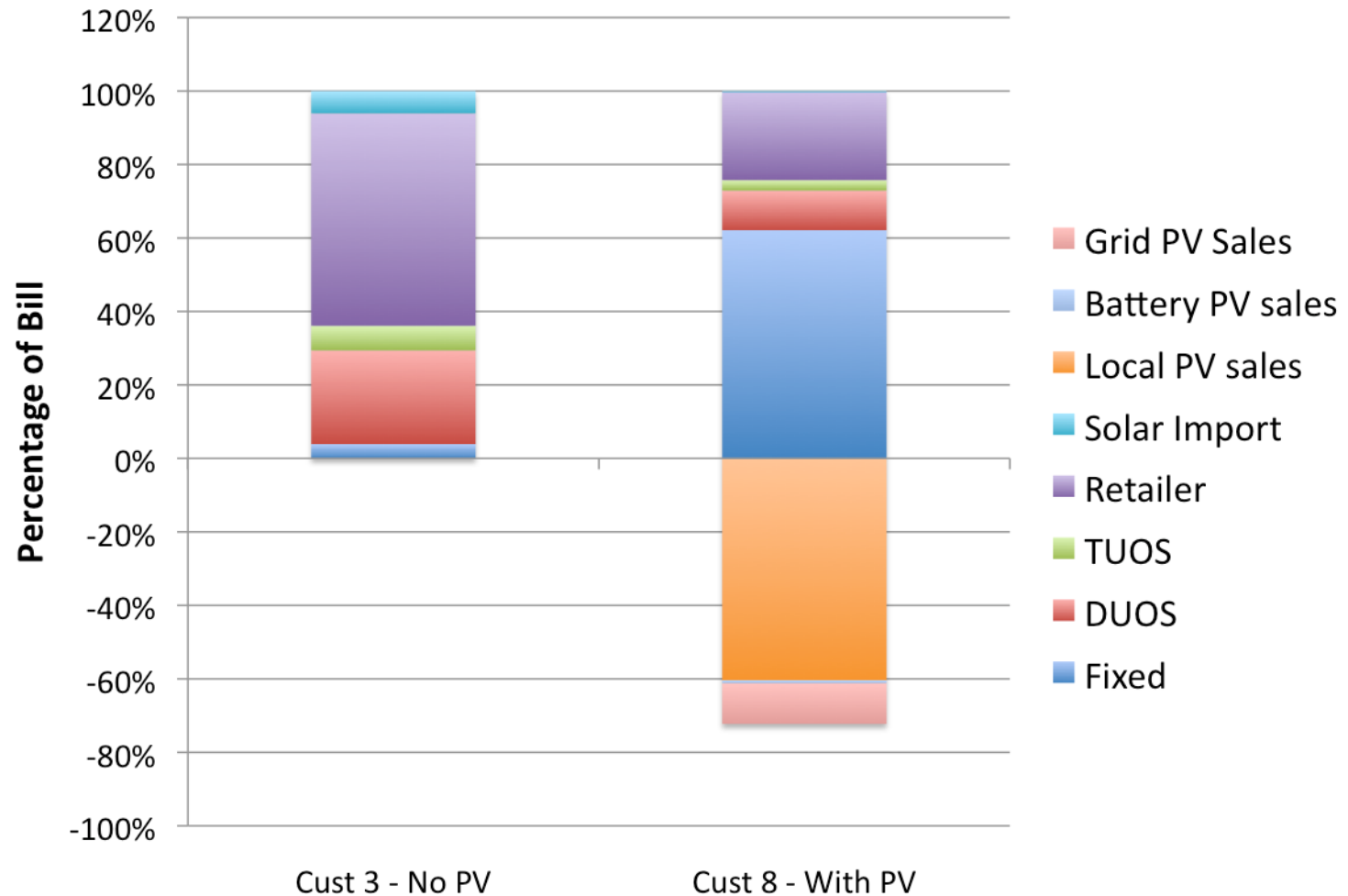
Customer 8 – with solar PV (27.5kW)



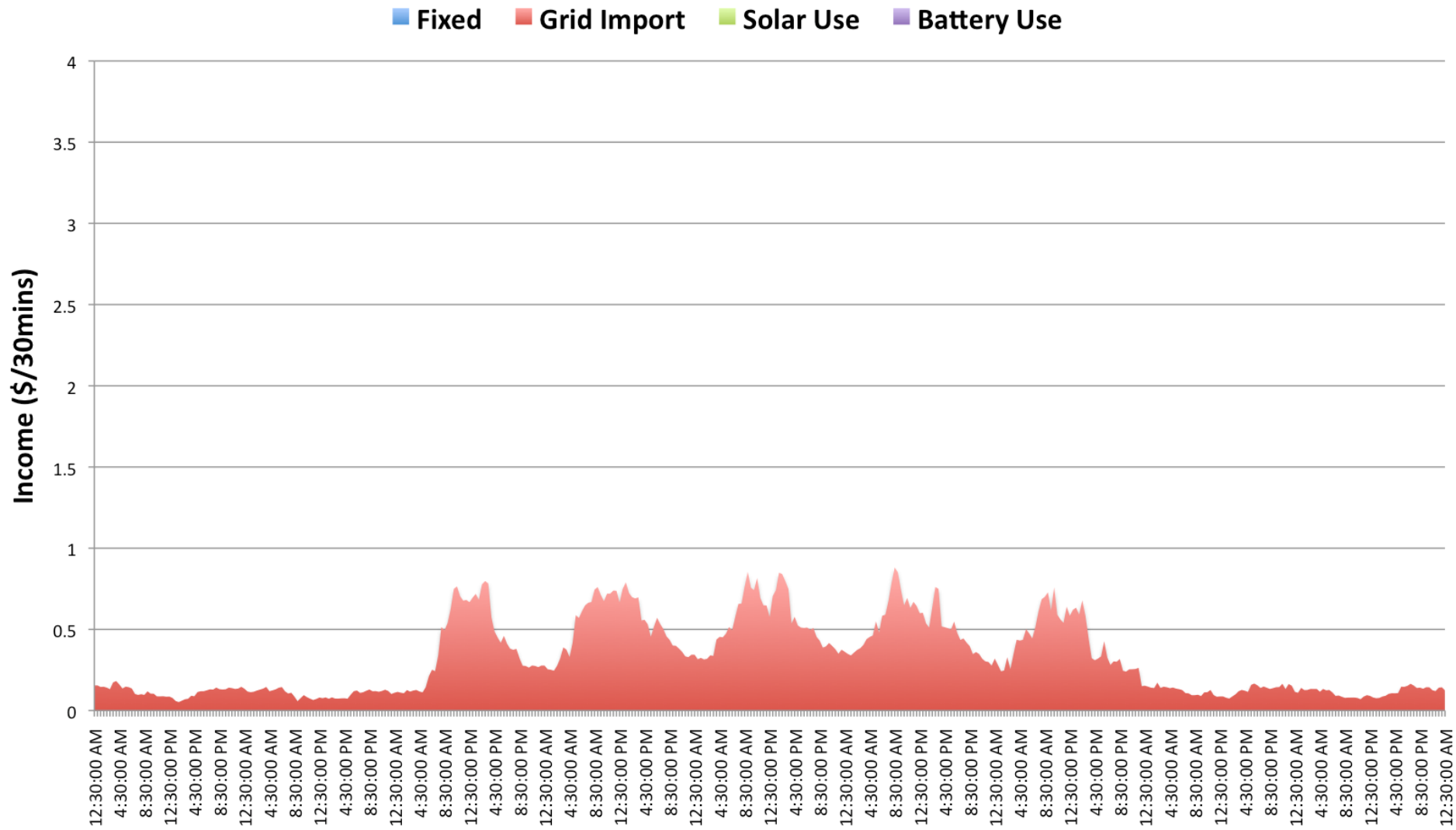
Bill Cost Components



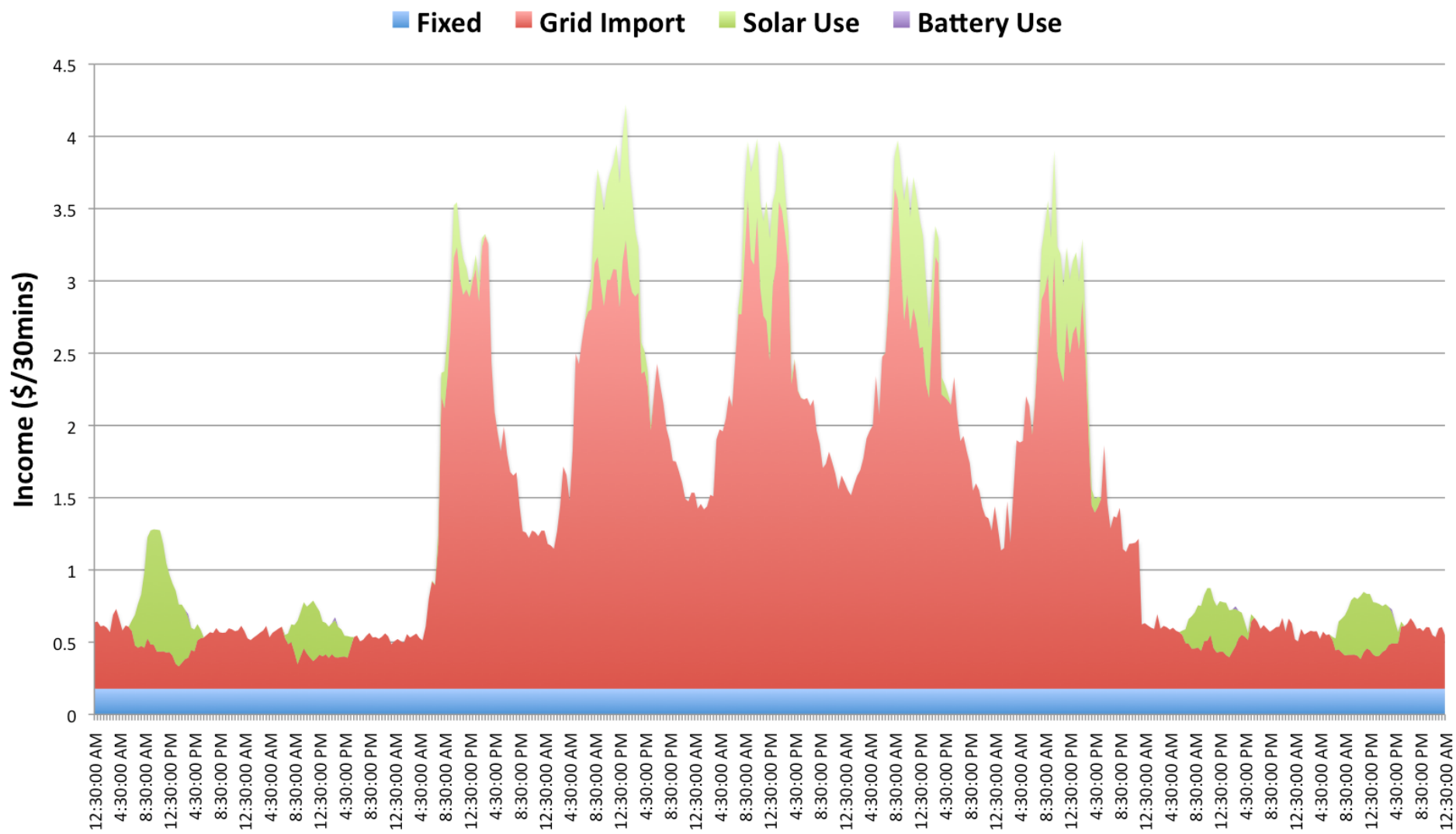
Bill Cost Components



TNSP Revenue Components



DNBP Revenue Components



Impact of changing local solar & battery tariffs

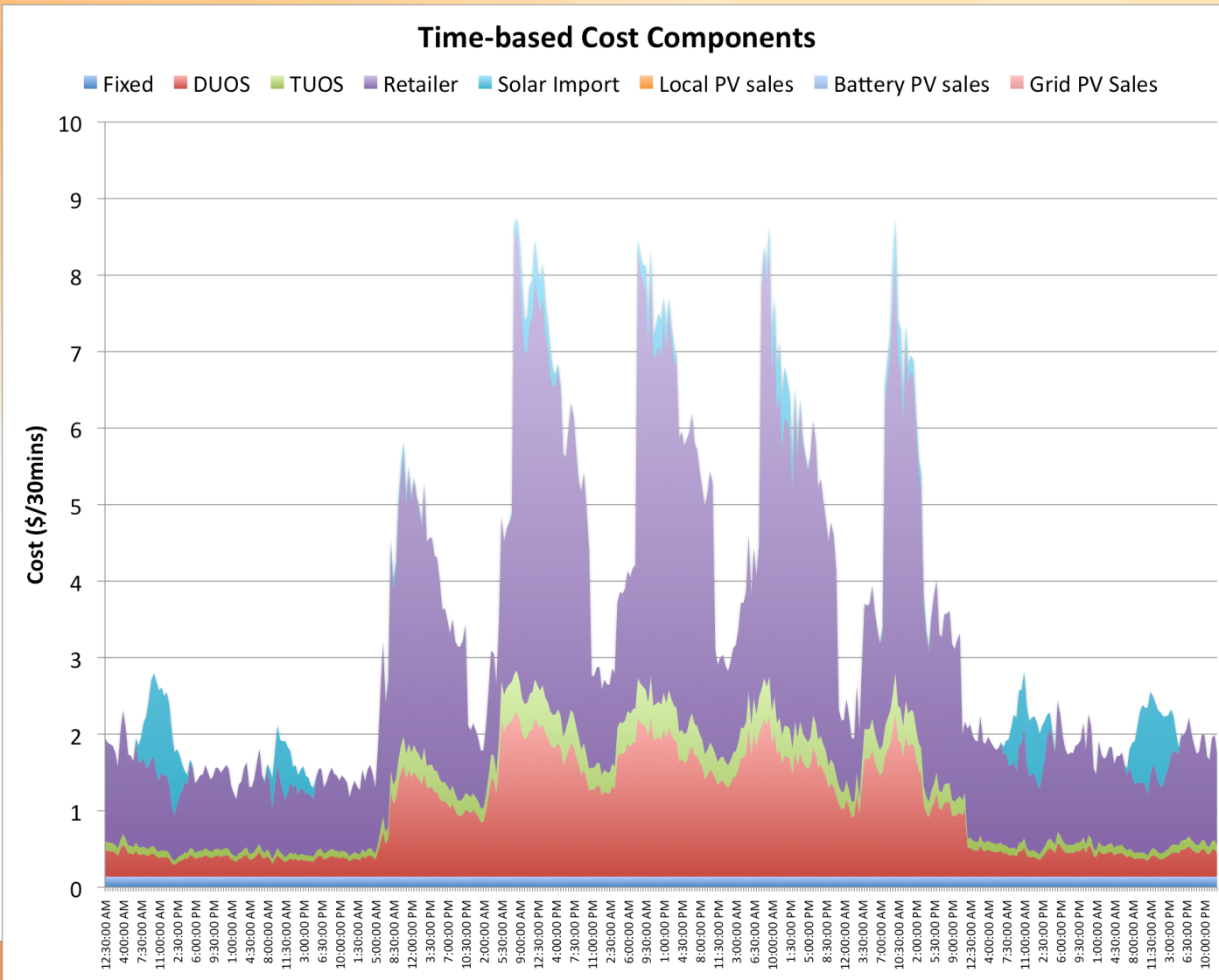
- Original tariffs for use of exported solar

	TUOS	DUOS	Retailer + Env	PV owner	Cust (c/kWh)
Local Solar/ Battery (c/kWh)	0	11.2383	16.1417	9	36.38

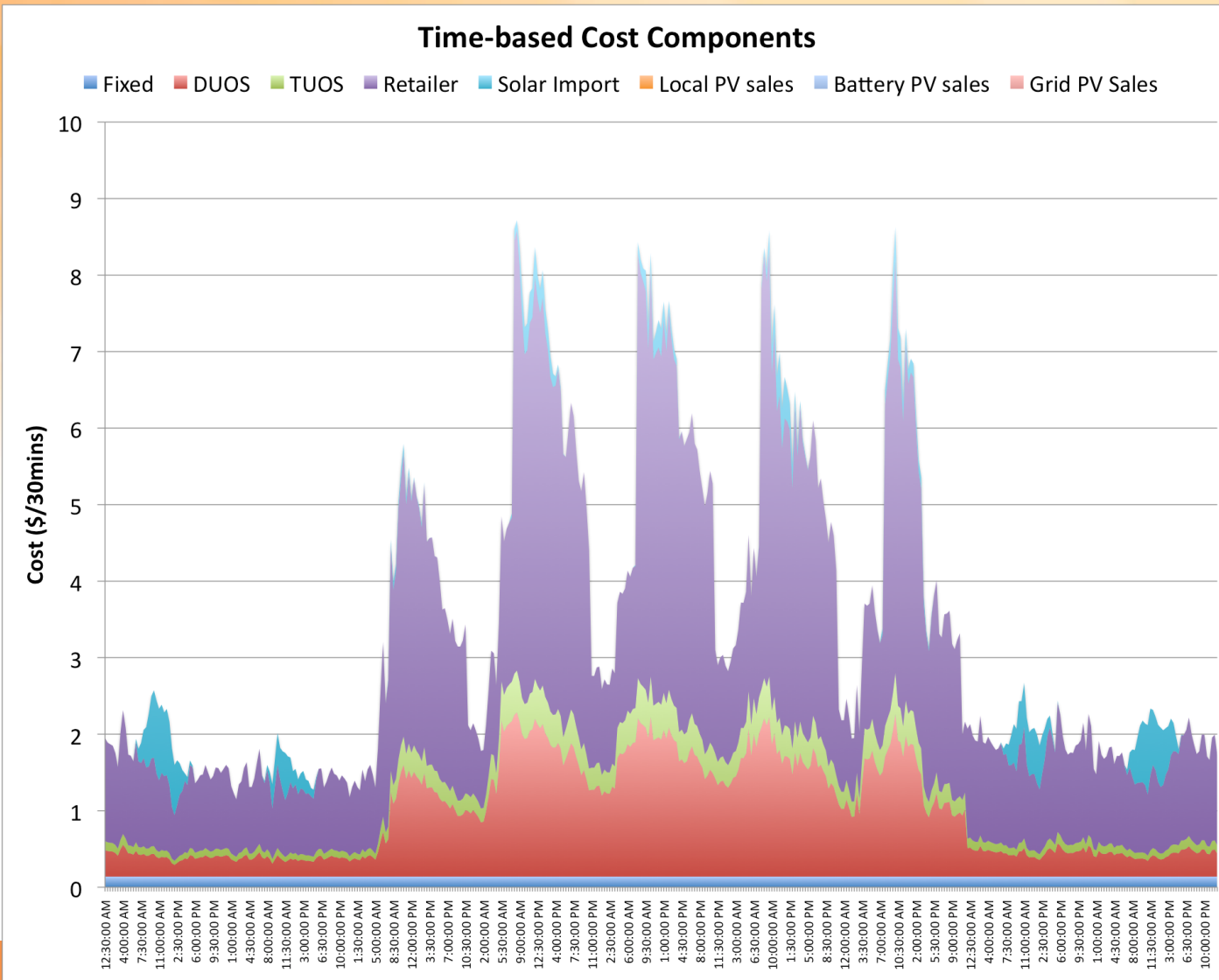
- New tariffs

	TUOS	DUOS	Retailer + Env	PV owner	Cust (c/kWh)
Local Solar/ Battery (c/kWh)	0	8	9	12	29

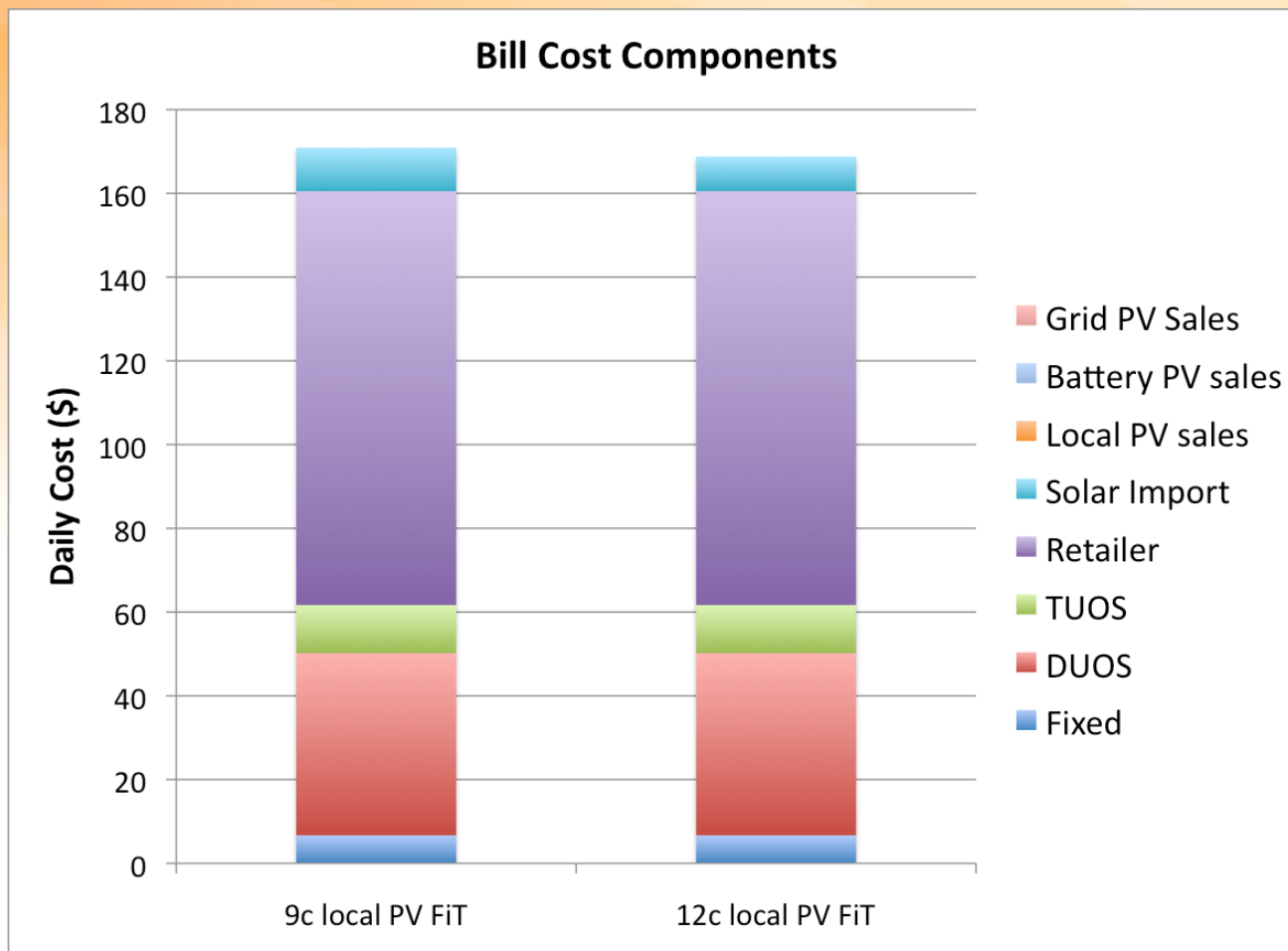
Customer 3 –with solar PV 9c local FiT (36c retail)



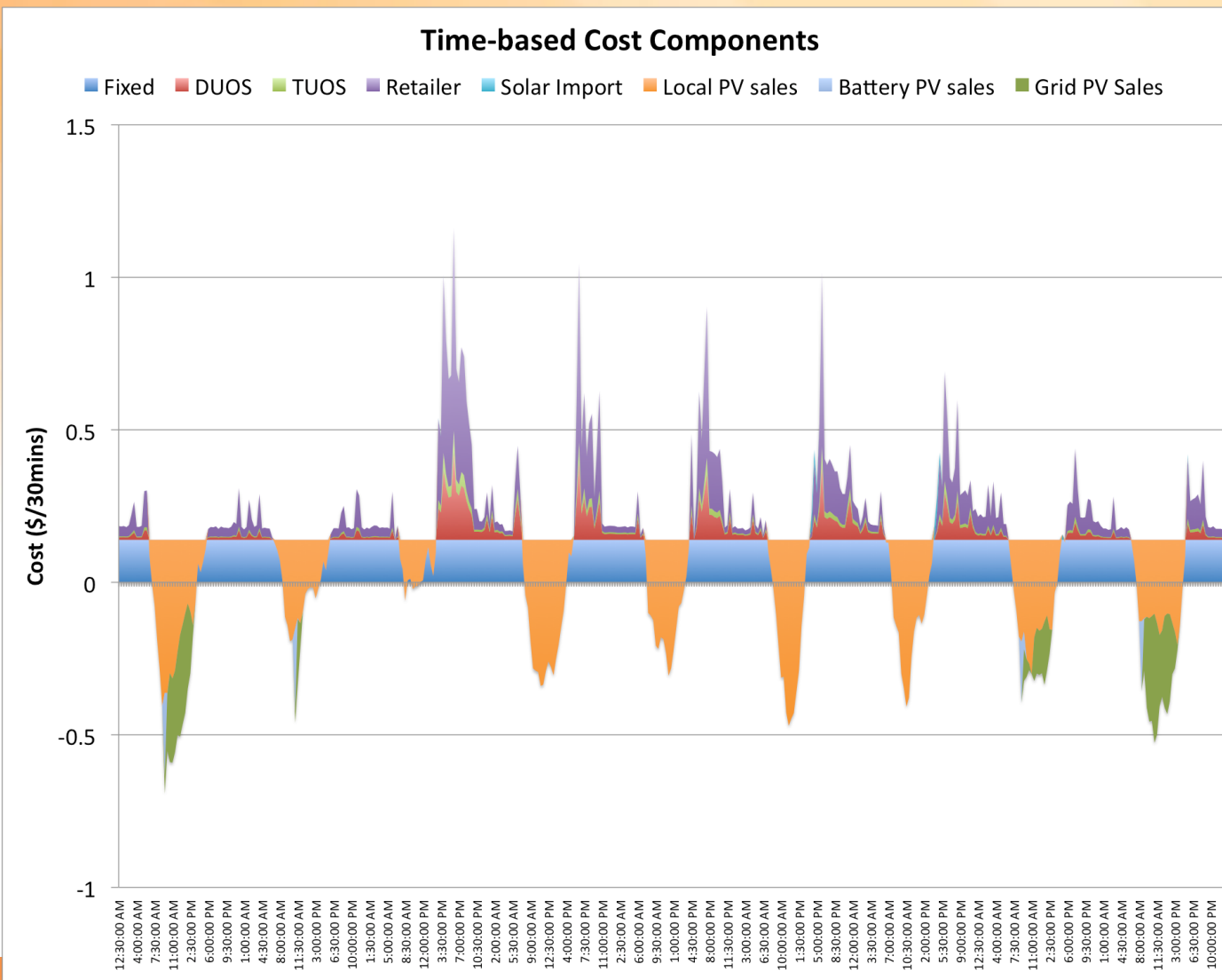
Customer 3 –with solar PV 12c local FiT (28c retail)



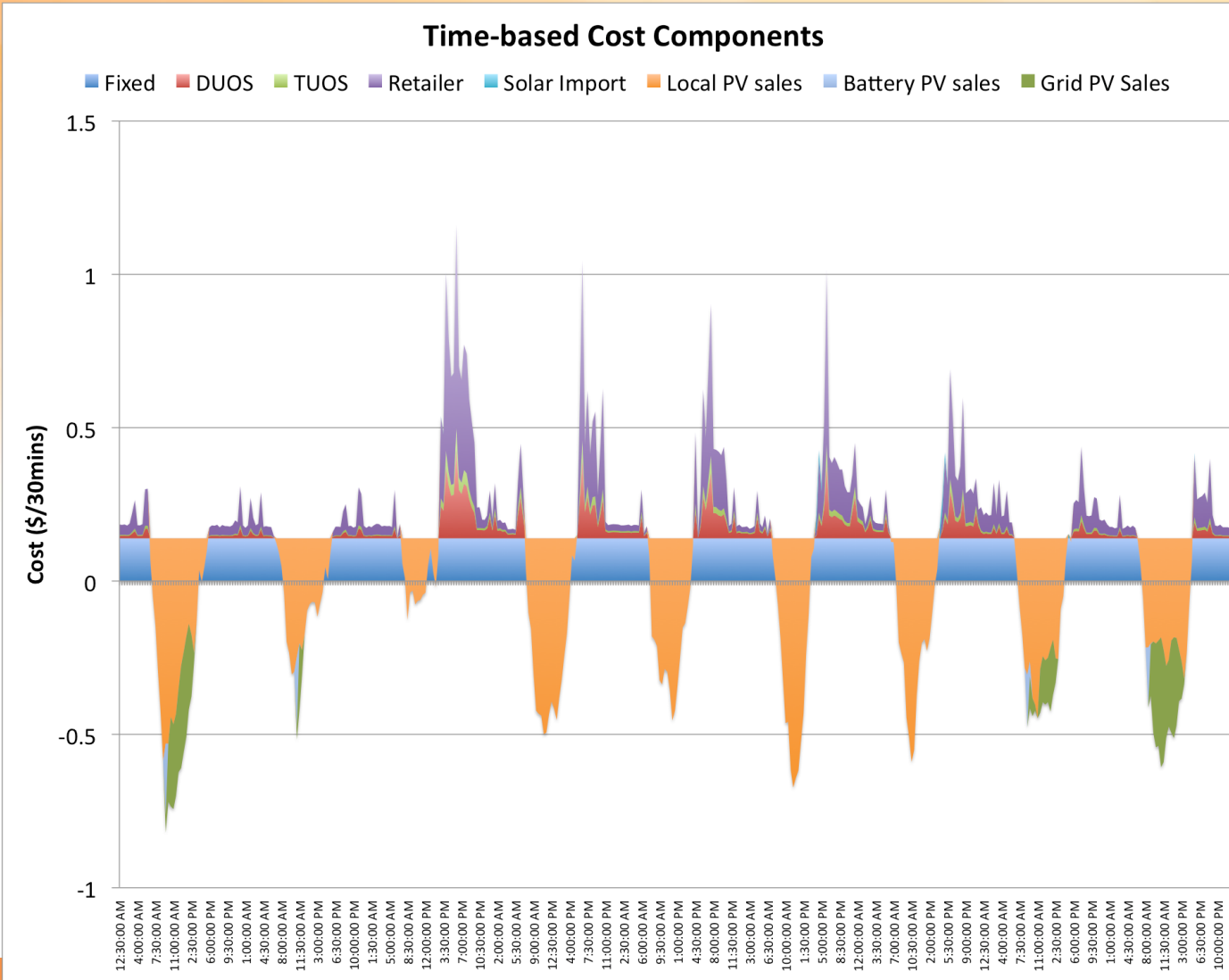
Customer 3 - Change in cost with higher local FiT



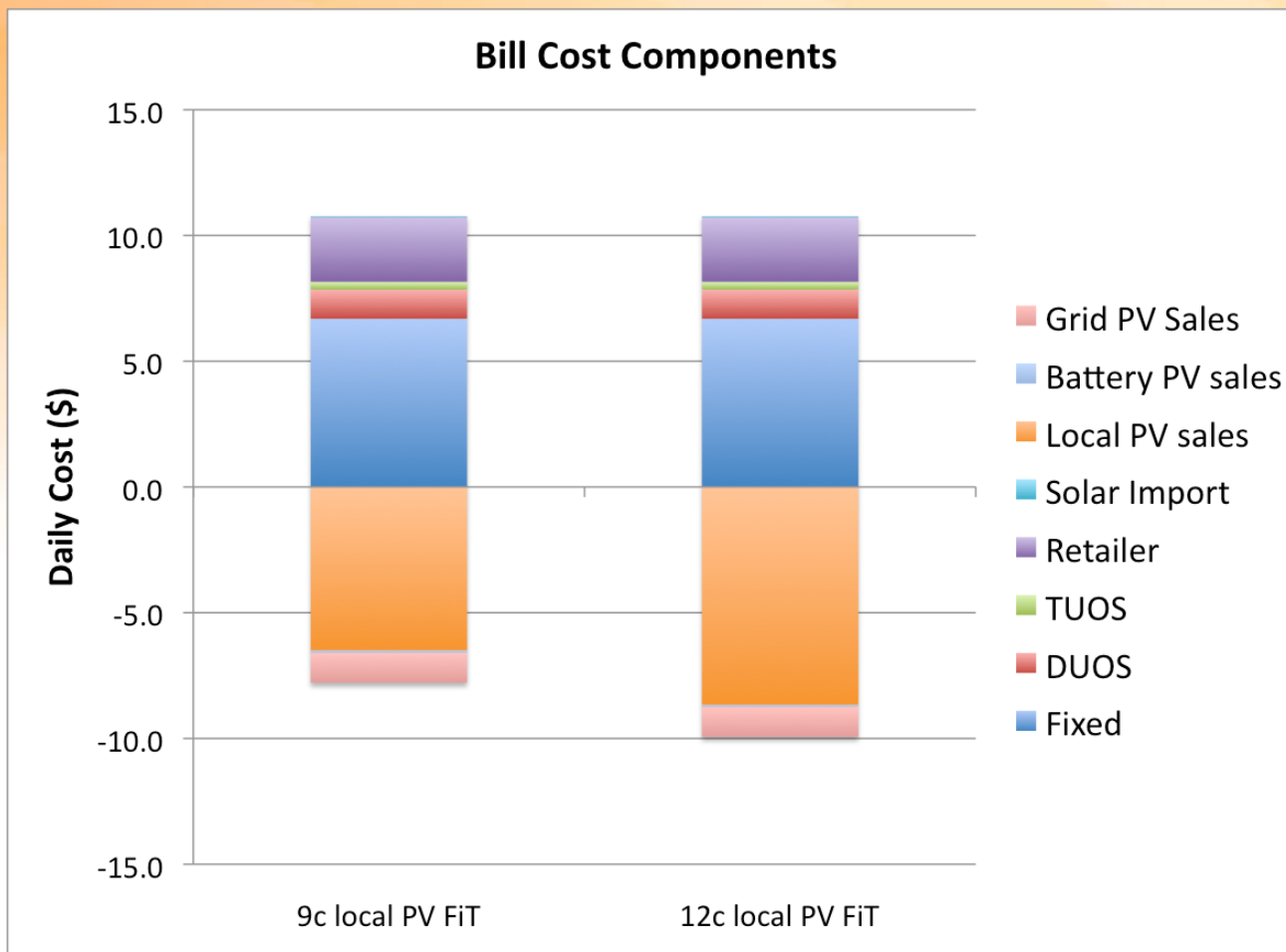
Customer 8 – with solar PV 9c local FiT



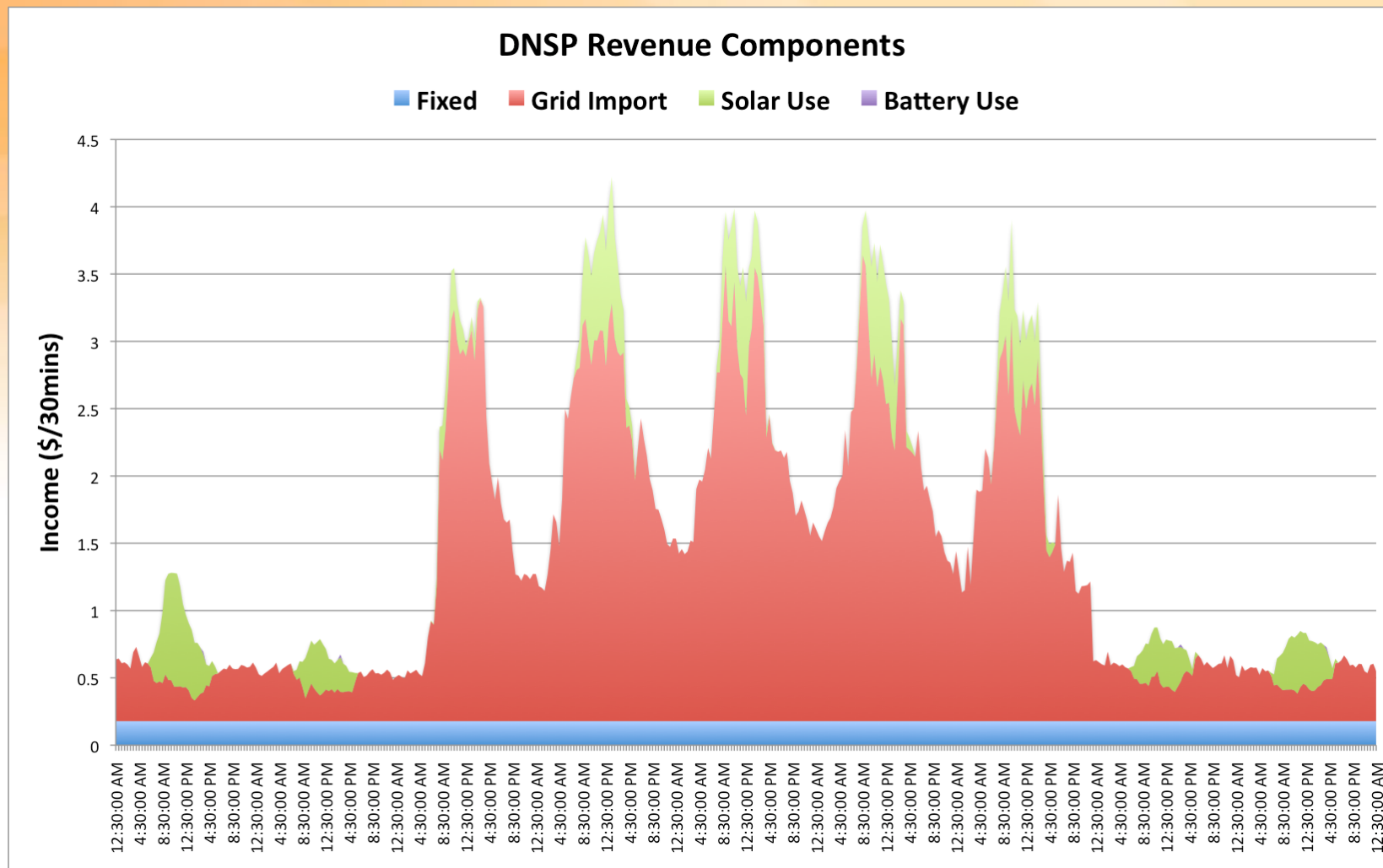
Customer 8 – with solar PV 12c local FiT



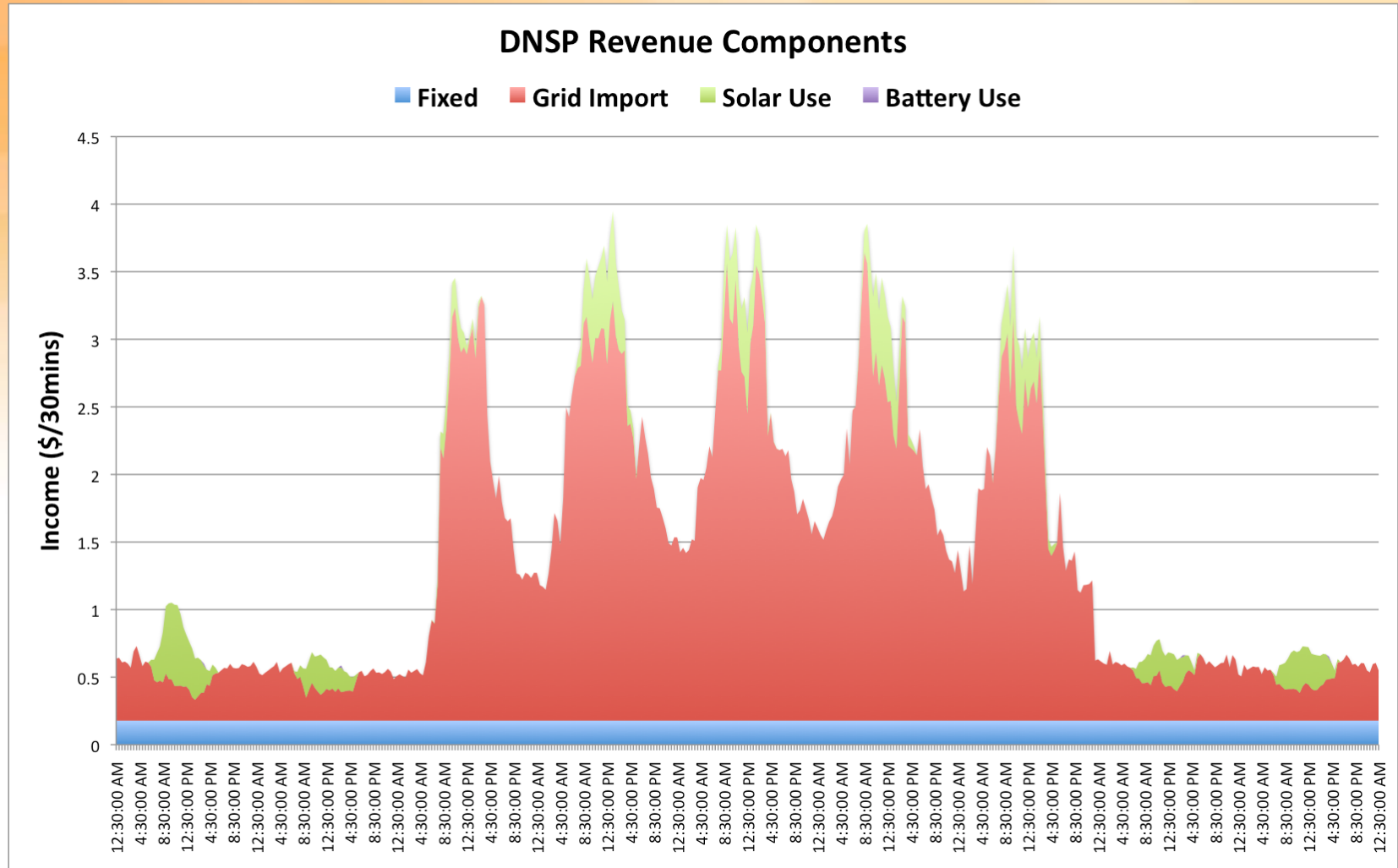
Customer 8 - Change in cost with higher local FiT



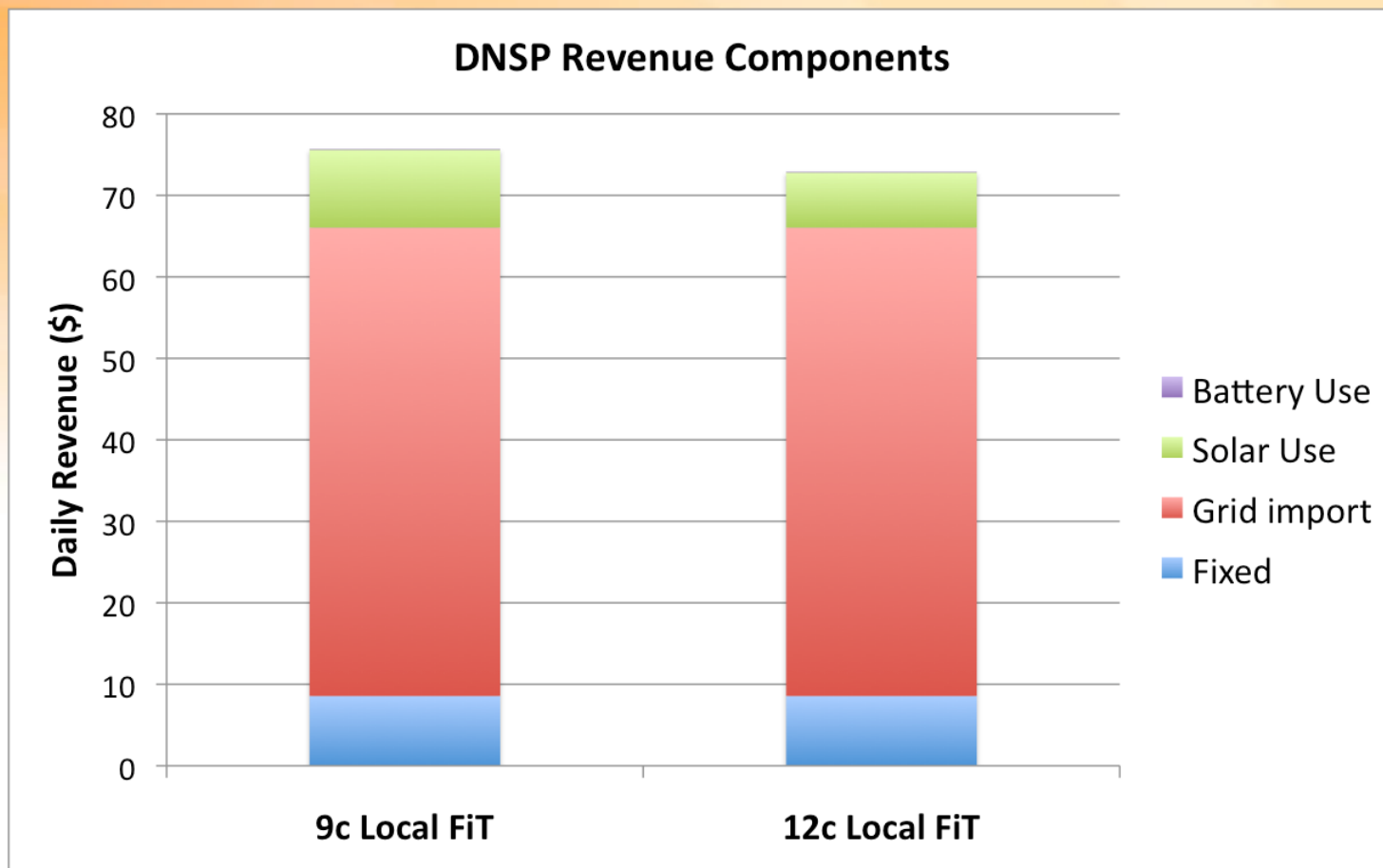
DNSEP revenue – 9c local solar FiT



DNSEP revenue – 12c local solar FiT



Change in DNSP revenue – 12c to 18c solar FiT



Summary

- Outputs
 - Electrical flows & outcomes
 - Financial flows & outcomes
- Separately for
 - TNSP
 - DNSP
 - Retailer
 - Each customer
 - Battery owner
- Very useful for optimising ‘pseudo’ embedded networks / minigrids
 - Fringe of grid areas & constrained networks
 - Optimise technologies (distributed generation, batteries, DSM etc)
 - Tariff design to drive uptake and optimise operation for all stakeholders



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Thank you... and *questions*

Many of our publications are available at:

www.ceem.unsw.edu.au

AUSTRALIA'S FIRST COMMUNITY OWNED ENERGY RETAILER

Felicity Stening, Operations Manager

6 June 2018



WHY ENOVA EXISTS?

Established as a **Social Enterprise** to:

- Assist the community to reduce carbon emissions
- Benefit the community



Meet Your New
Energy Supplier:
YOU !

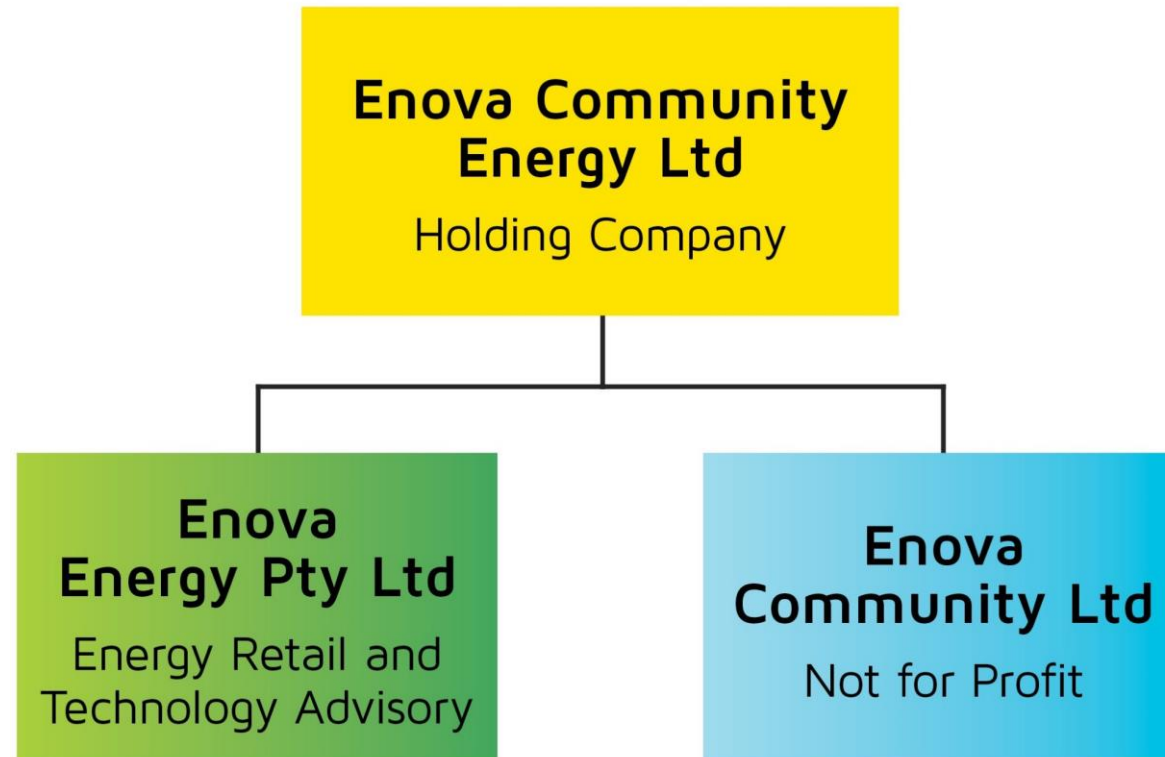


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ENERGY





HOW WE BENEFIT COMMUNITIES

- Retain profits and over time local energy production in regions
- Create direct and indirect employment
- Returns to the community & shareholders when profitable
- Social benefit projects to assist all access renewable energy
- Community-owned model as a stand-alone model or in partnership with other communities



CHALLENGES

- Highly volatile energy market since Feb 2017
- Small scale creates difficulty in purchasing either appropriate hedges or PPAs
- Increasing regulation and compliance costs
- Market competitiveness difficult for any non vertically integrated companies



THE WAY FORWARD FOR ENOVA

- Move into Sydney, Newcastle, Wollongong
- Explore and potentially partner with others in the renewable technology space to increase scale and financial backing
- Enter PPAs with new renewable energy providers
- Implement first solar gardens, micro-grid & embedded network, and VPP
- Enter partnerships with other regional communities & interest groups



REGIONAL ENERGY SYSTEMS

- De-centralised, Distributed, Digital, Democratic
- Locally generated, stored and distributed renewable energy
- Self sufficient regional energy systems
- Partnership between customers (prosumers), retailer and network
- Smart technology managing network peaks
- Micro-grids & embedded networks
- Customers benefitting from the savings of a lower cost network and services



ENOVA'S REGIONAL ENERGY SYSTEM

- Micro-grid for Byron Bay Arts & Industrial Estate in partnership with Essential Energy
- Solar Garden model for renters
- Virtual Power Plant
- Embedded Networks in residential estates
- Energy Efficiency Education
- **Local, community owned**
- **Growth in other communities**



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Questions?



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Financial impacts of solar PV & air-conditioners on Australian households

Anna Bruce

Senior Lecturer, School of PV and RE Engineering
Engineering Research Coordinator, CEEM

CRC LCL National Forum 2018
Expanding Local Renewable
Electricity for Households,
Precincts and Communities



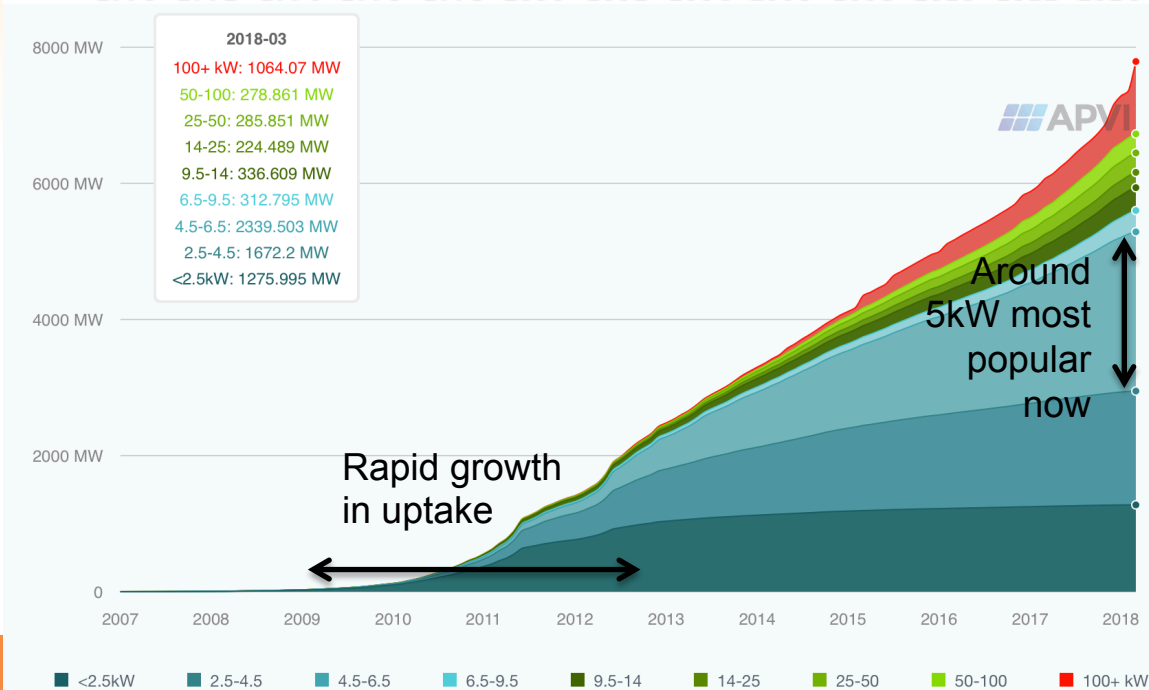
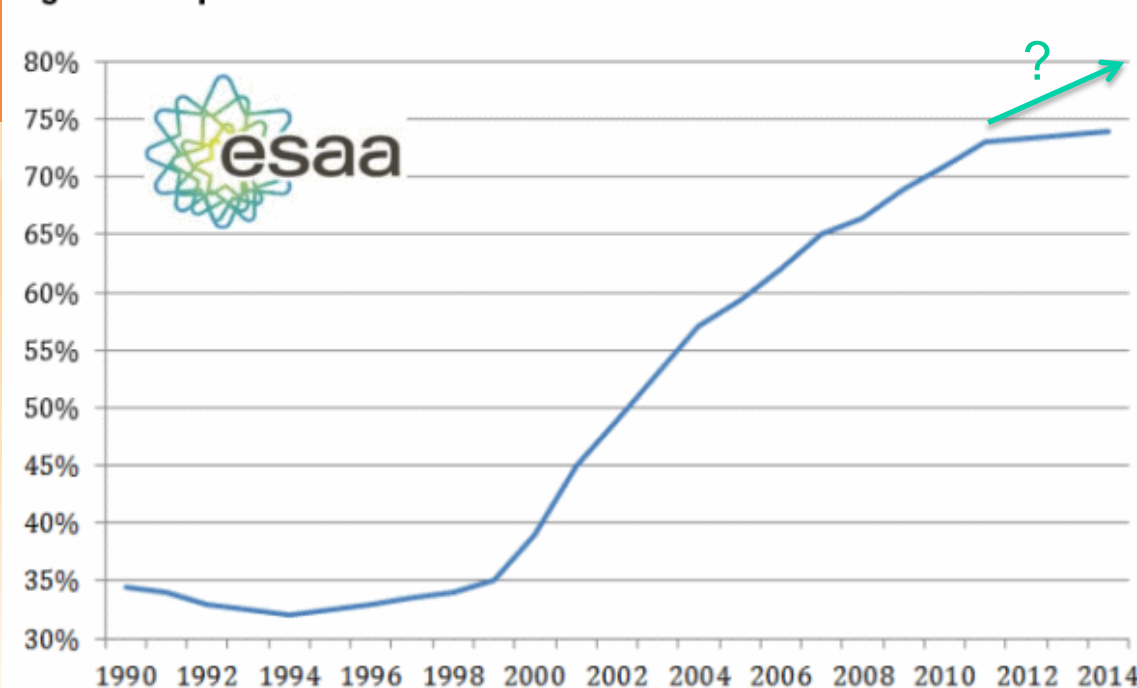
Context

- High residential electricity prices
- Changing demand profiles

Behind this:

- High household uptake of A/C
- And later, high uptake of household PV
- What are the financial impacts on households?

Figure 2: Proportion of Australian Households with air conditioners 1990-2014^{vii}



Impact of PV and AC on Household Bills

- PV: analysis of Ausgrid 300 Solar Households
- AC: analysis of Smart Grid Smart Cities households
- Using Origin, AGL and Energy Australia ToU and Flat Jul/Aug 2017 market offers (no discounts)

Offer	FiT	All usage	Daily supply	Peak	Shoulder	Off peak
	c/kWh	c/kWh	c/day	c/kWh	c/kWh	c/kWh
Origin Flat	9.00	31.372	91.729			
Origin TOU	9.00		106.535	58.311	26.169	15.862
EA Flat	12.50	32.285	92.51			
EA ToU	12.50		106.04	60.39	27.456	16.764
AGL Flat	11.10	31.9	92.4			
AGL ToU	11.10		105.6	59.4	25.3	16.5

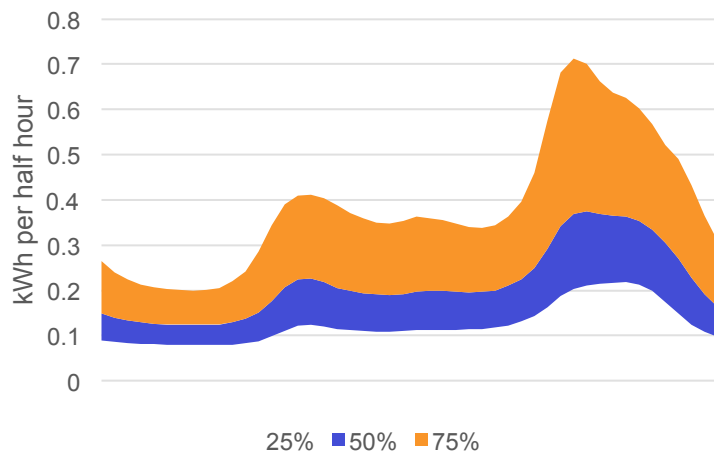
Analysis by Navid Haghdadi using the CEEM Tariff Tool:

<http://www.ceem.unsw.edu.au/cost-reflective-tariff-design>

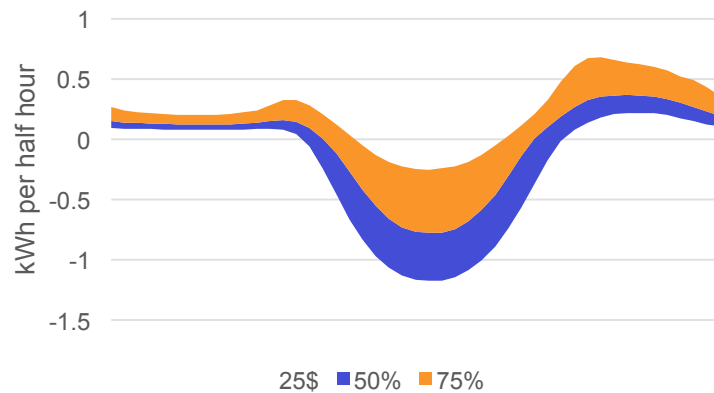


Household Bill Impact - PV

Average daily load profile (no PV)



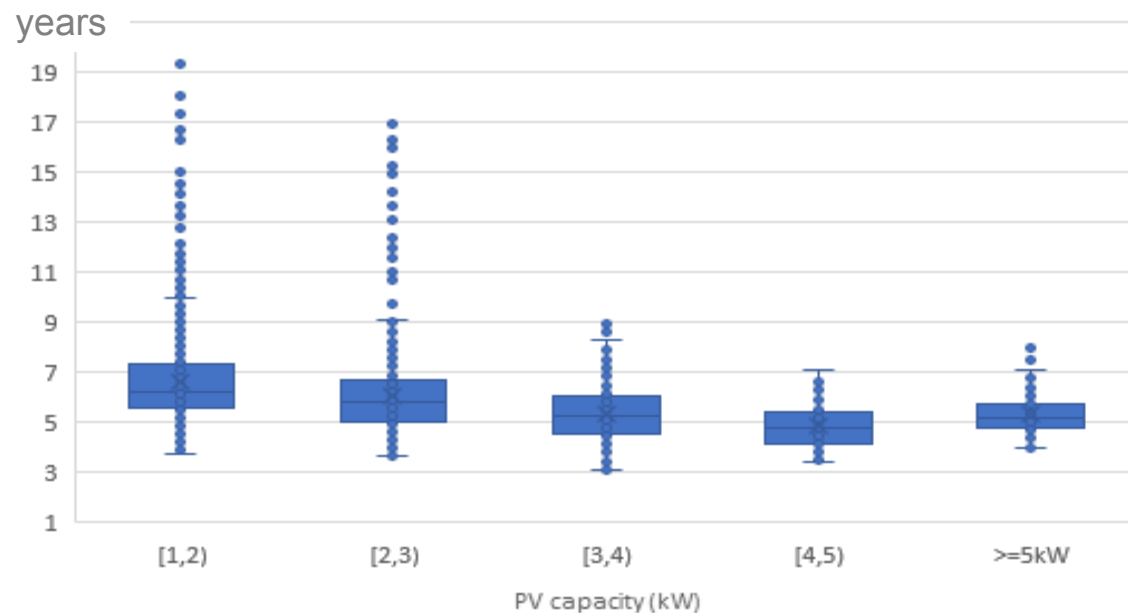
Net with PV (PV scaled to 4kW)



Annual Saving (\$)

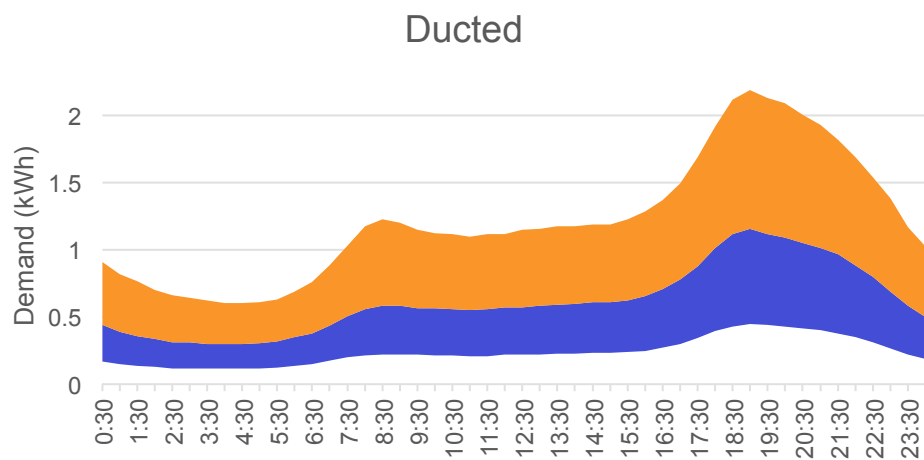
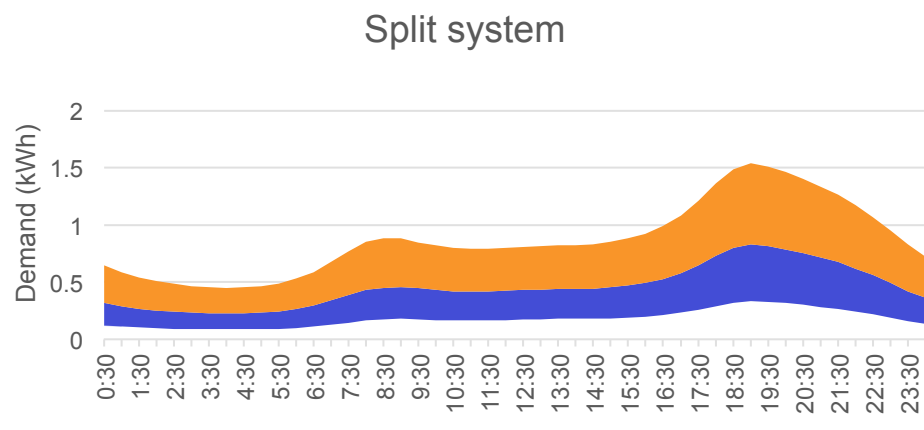
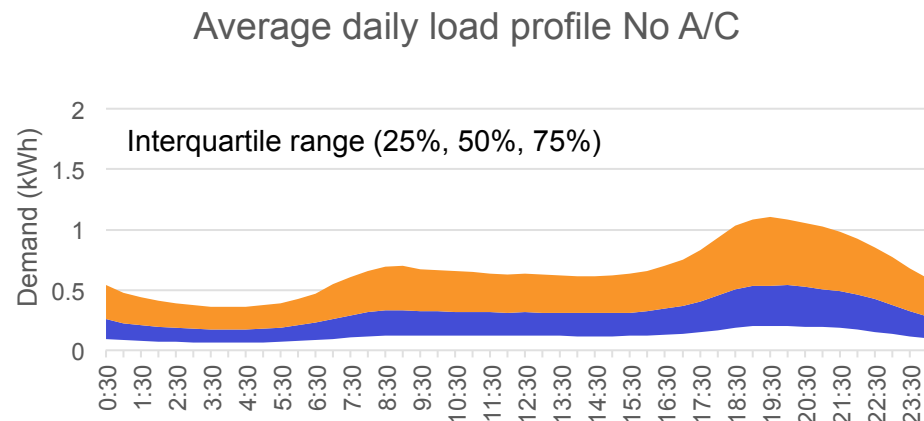
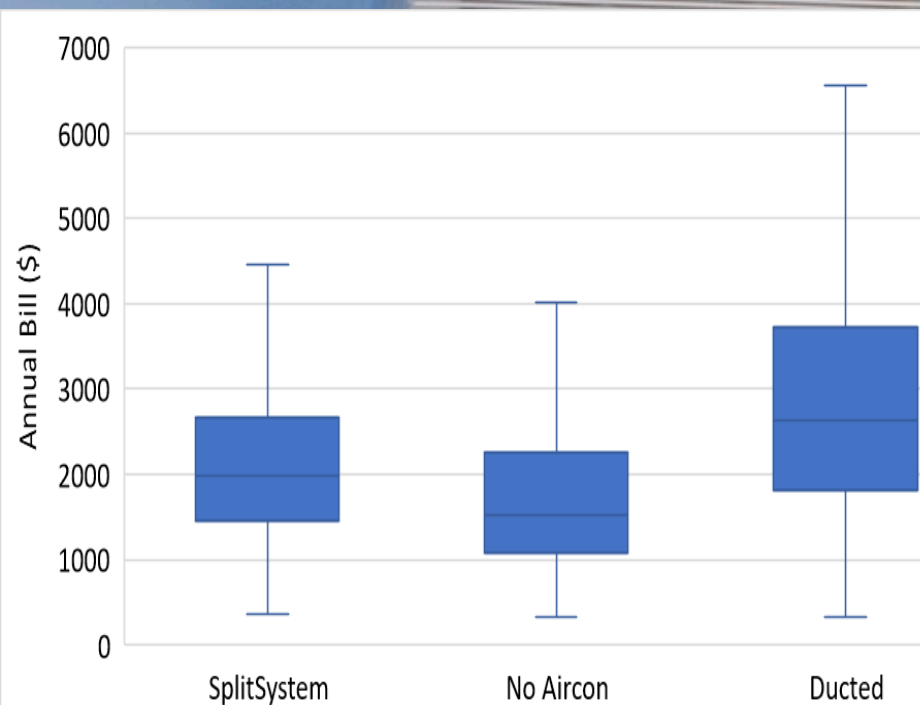


Pay back period



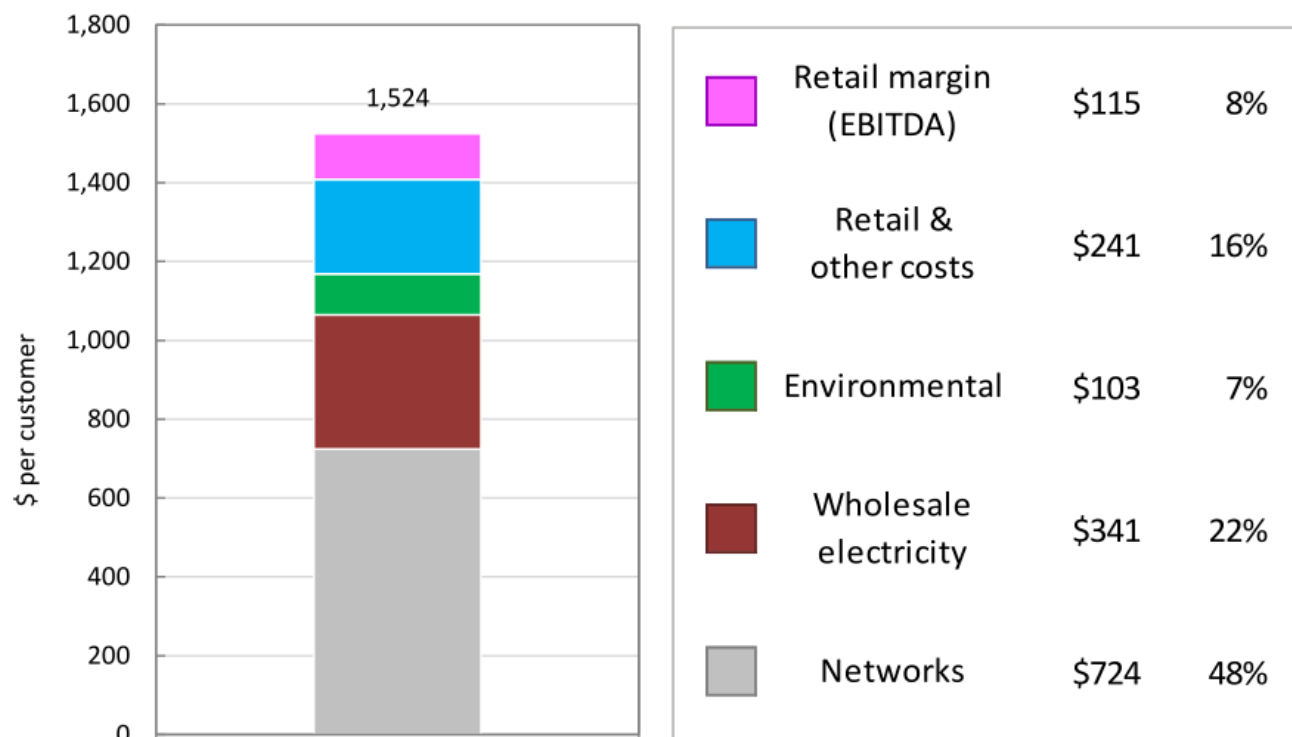


Household Bill Impact - AC



Impacts of PV and AC on bills of other households

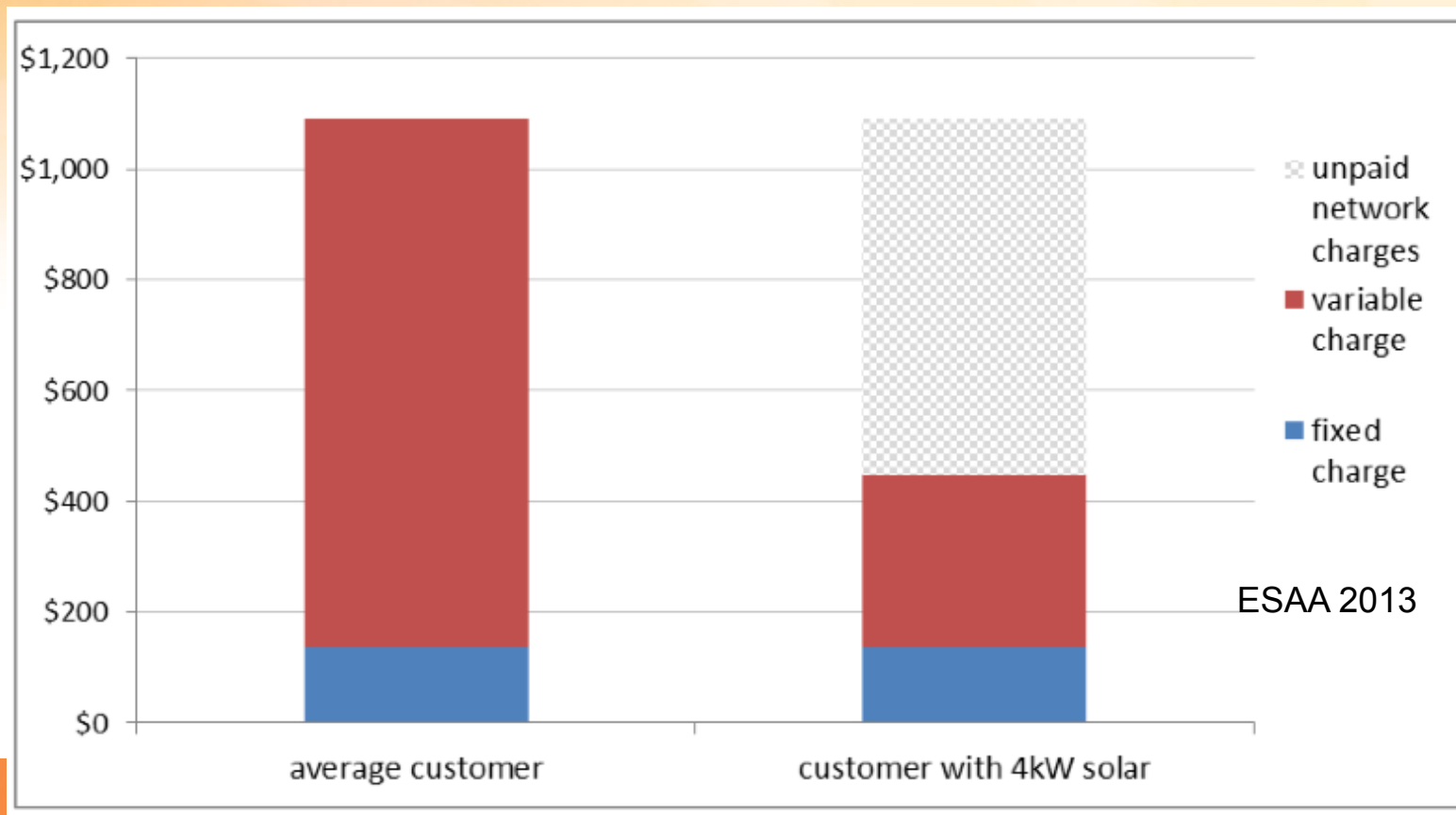
Figure 2.1: Components of an average residential customer bill across the NEM (excluding Tasmania) (2015/16, \$ per customer,) excluding GST



- Network revenue impact (2nd order)
- Network investment impact (3rd order)
- Wholesale price impact

Network Revenue Impact

- 2nd order impact on households as networks adjust tariffs under a revenue cap
- Incumbents argued the cost of providing the network for PV and non-PV customers essentially the same

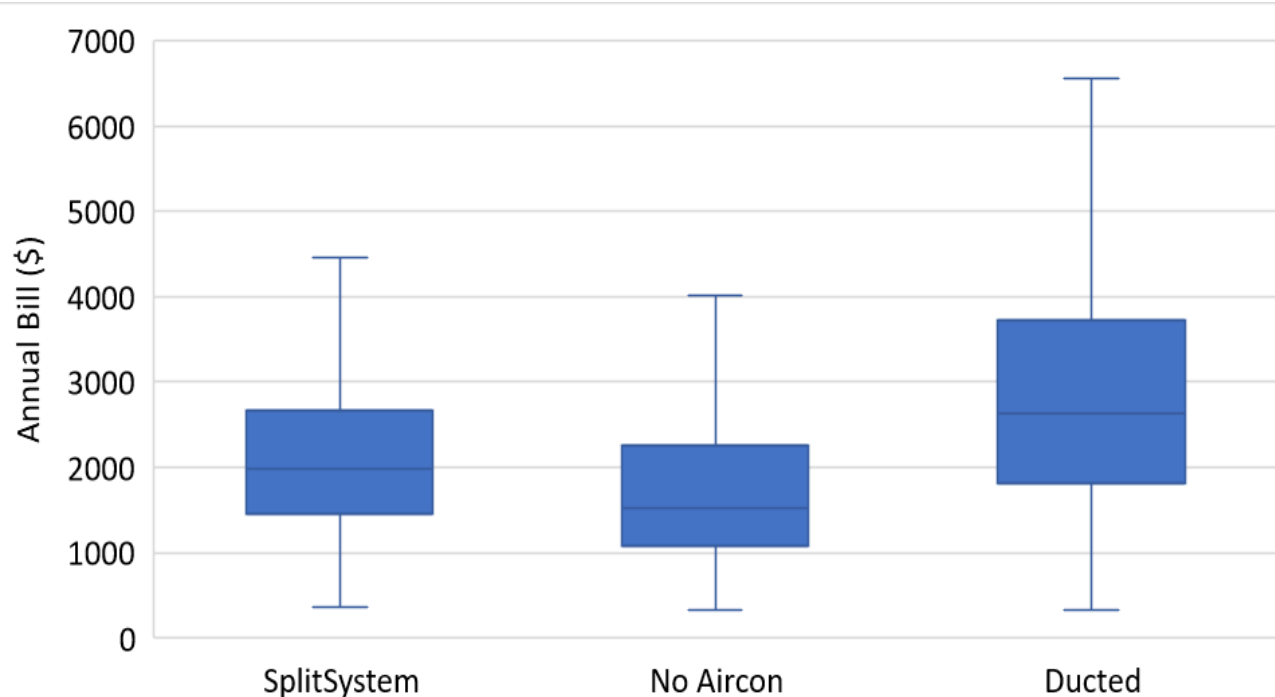
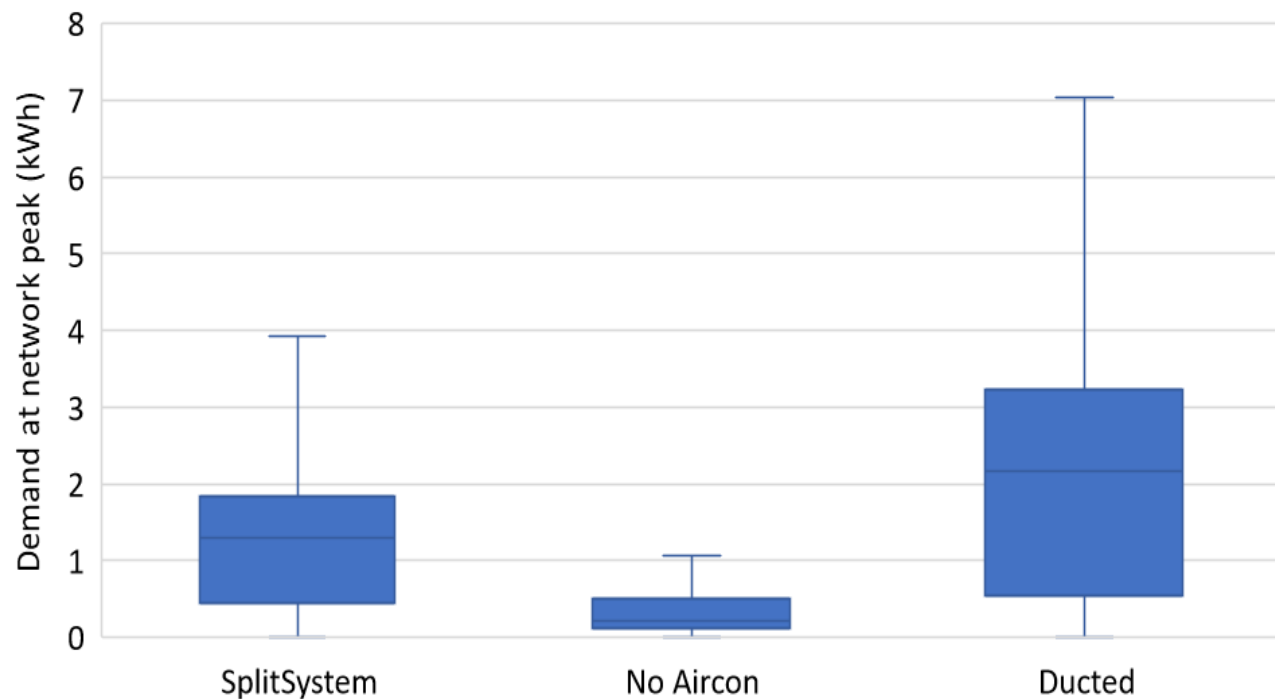




Network Investment Impact - AC

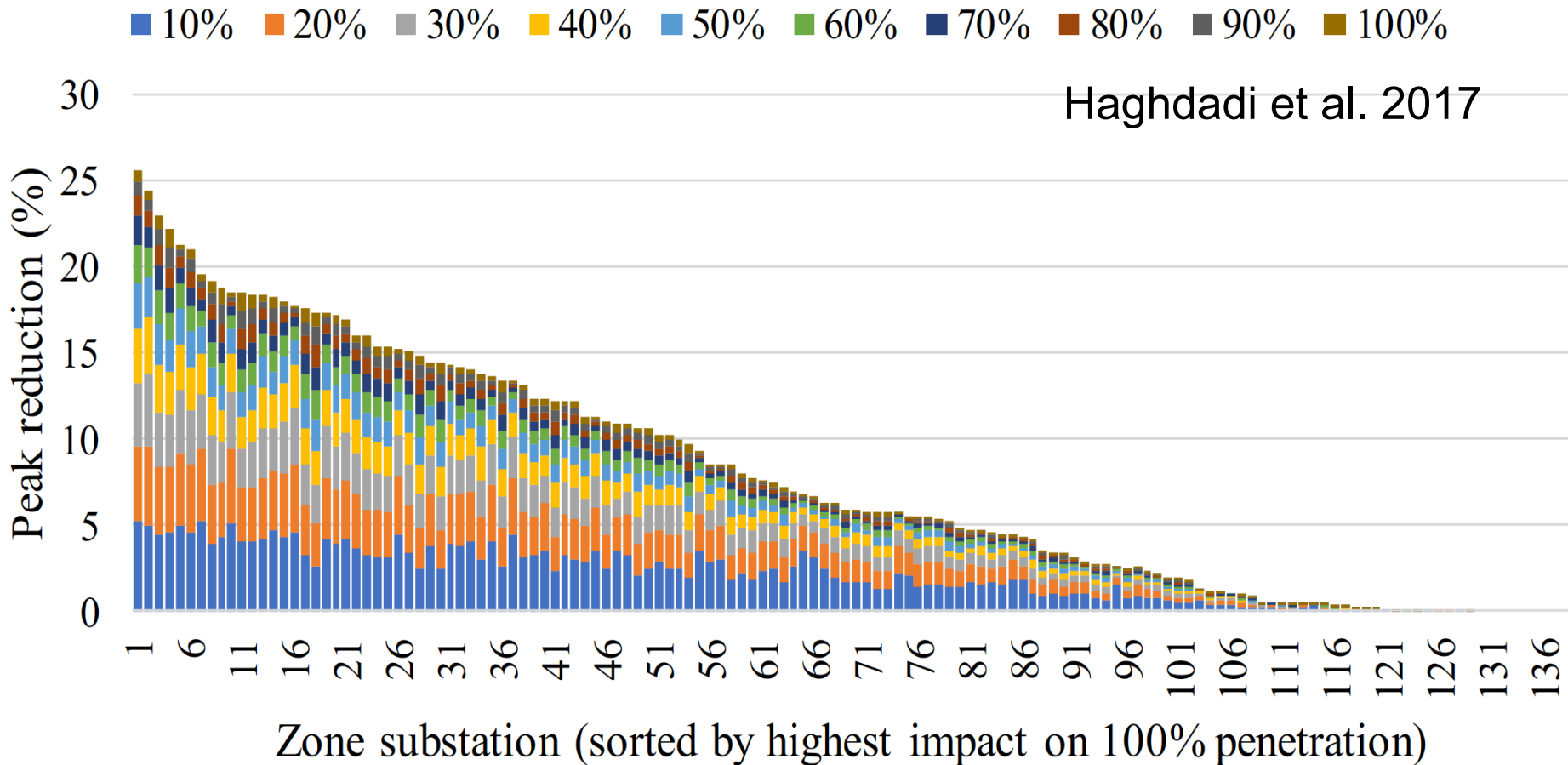
3rd order impact

- What of subsidies that go to AC customers?
- Or existing locational cross subsidies?



Network Investment Impact - PV

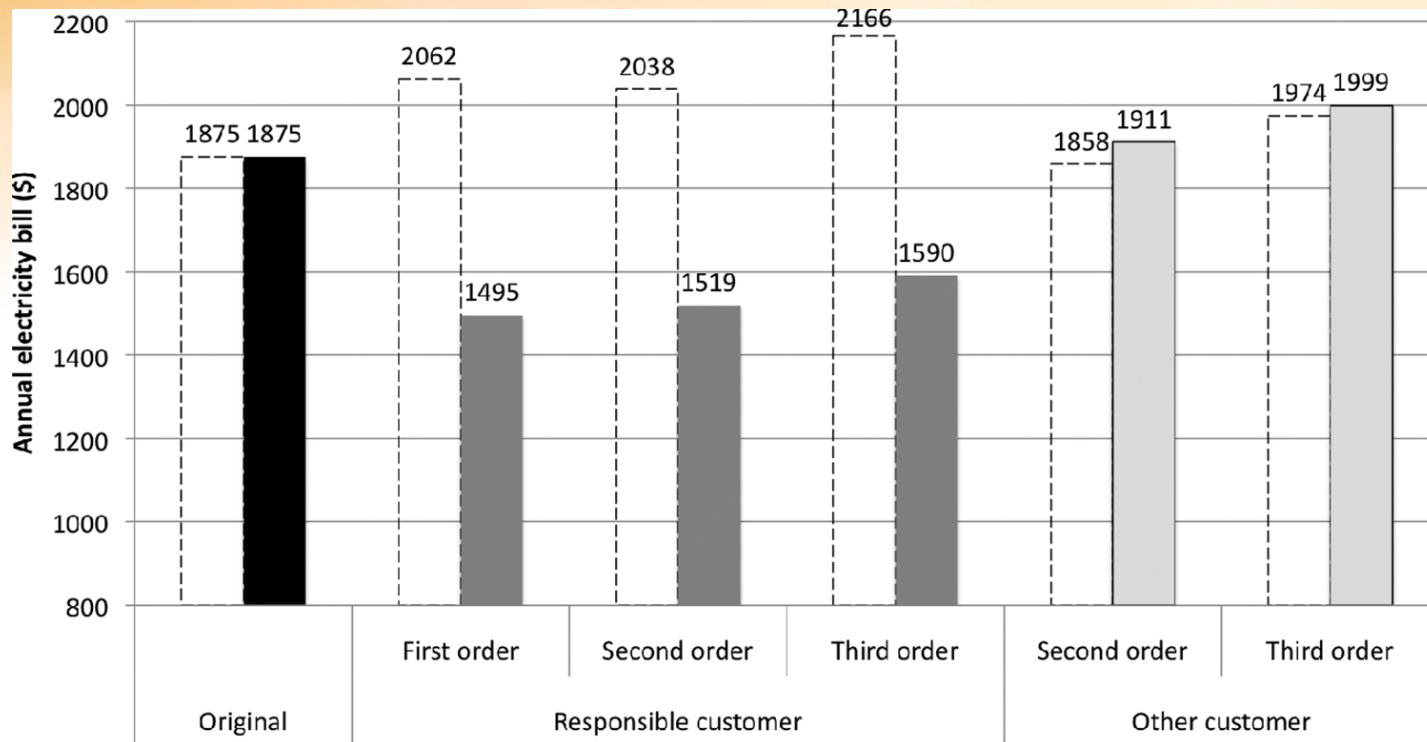
3rd order impact



- PV provides benefits, but these are location specific

Overall Bill Impacts of PV and AC

- 3rd order impacts include 2nd order impacts (network bill adjustments to maintain revenue) plus bill impacts of reduced network costs due to peak demand changes

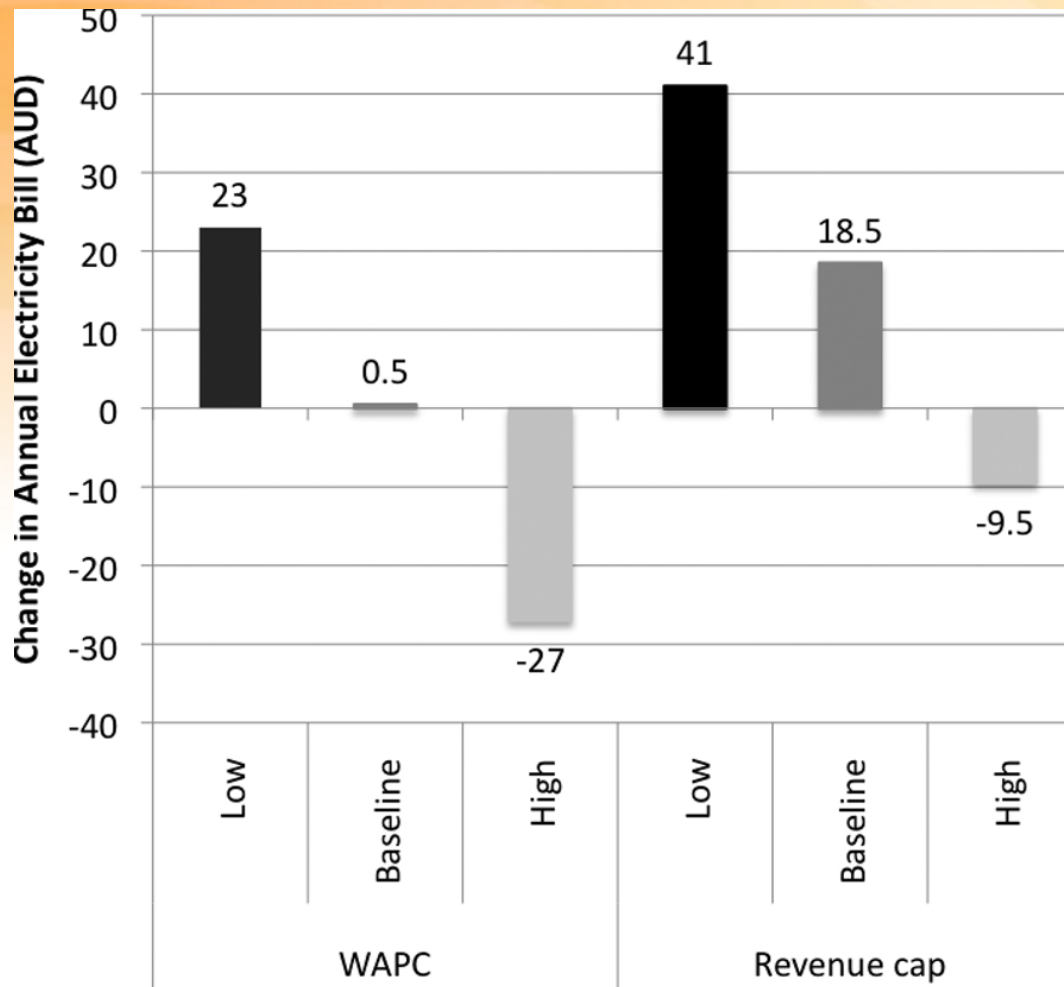


- Calculated as a per kWh decrease based on published average Ausgrid LRMC

**Based on
20% uptake
under 2014
flat tariff**

Figure: Impact of 20% AC uptake (dotted lines) and 20% AC + PV uptake (solid) on HHs

Third Order Impacts of PV on Other HHs



- Impact depends on availability of PV during demand peaks.

	Tx	Dx
Low	20%	10%
Med	56%	17%
High	70%	40%

(% of rated capacity)

Figure: Bill impacts on other HHs: 20% PV uptake with different PV availability

Network tariff changes to slash rooftop solar uptake by half

27

By [Giles Parkinson](#) on 27 October 2015

Queensland pushes through massive rises in fixed electricity charges

41

By [Giles Parkinson](#) on 19 June 2015

Cost-reflective tariffs will do little to reduce network costs

19

By [Rob Passey](#) and [Navid Haghdadi](#) on 18 February 2016

The majority of the distribution network operators develop what they call 'cost-reflective' tariffs that charge customers based on their monthly peak demand, but it can readily be shown that this isn't what causes the annual network peak. The annual network peak is important because it determines the possible need for network augmentation, and so determines the capital costs faced by the network.



RenewEconomy 2015/2016

Wholesale Price Impact

- Distributed PV merit order effect
- Impacting FiT outcomes



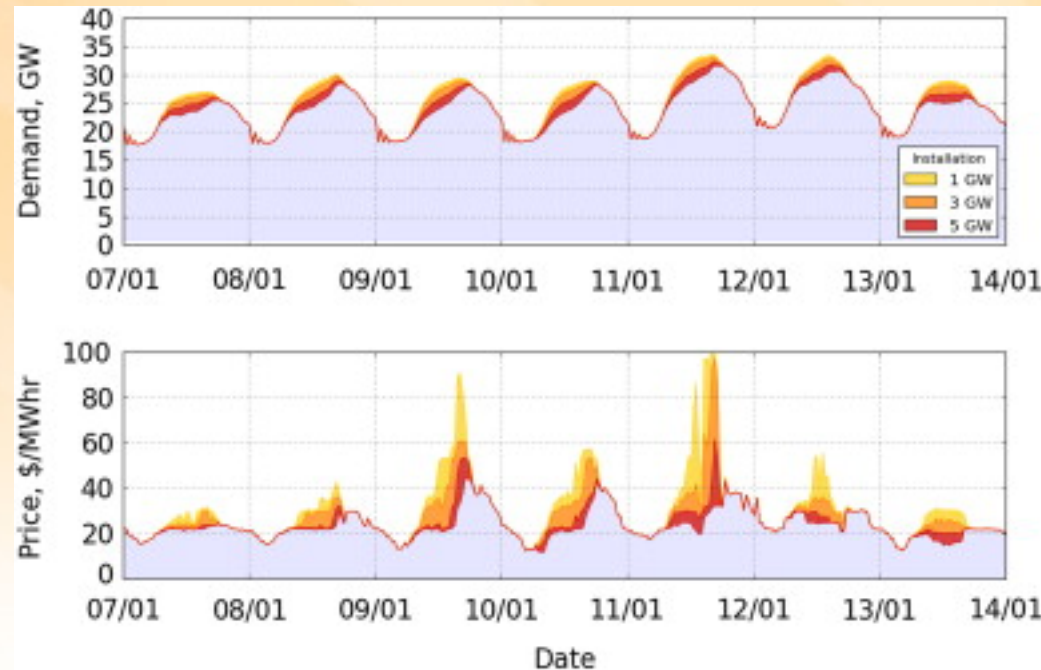
Independent Pricing and Regulatory Tribunal
New South Wales

In NSW, retailers can choose whether or not to offer solar feed-in tariffs to their customers, and decide the level of the solar feed-in tariff that they offer. However, to help guide retailers and customers, each year IPART recommends a benchmark for solar-feed in tariffs.

Our draft all-day solar feed-in tariff benchmark for 2018-19 is **7.5 cents per kilowatt hour** (c/kWh).

This is lower than our current benchmark for 2017/18 of **11.9 to 15.0 c/kWh**.

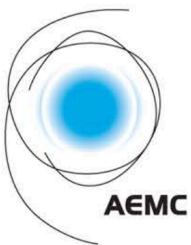
This year we have also been asked to set time-dependent feed-in tariffs to take into account the different values of solar exports at different times of the day.



Avg Wholesale Value 4.4-5.3c/kWh in solar production times

Conclusions

- Cross subsidies exist between HHs with different technologies and in different locations in the network. This is complex and there are equity considerations.
- Emerging tariffs limit HH engagement and ability to reduce bills.
- Consumers are using network in new ways. How to accommodate AC and PV? Role of price signals?
- Growing interest in inverters/DERs ability to provide network services, demand response. How will DERs be compensated?



Distribution Market Model Final report

The AEMC's final report delivers a number of findings which are considered pre-conditions for the development of distribution level markets.

Context for the project

The uptake of rooftop solar photovoltaic systems, battery storage, electric vehicles, smart energy appliances and other technologies at the distribution level are having a significant impact on the way that consumers use electricity.

Questions?



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