



Centre for Energy and
Environmental Markets

UNSW
THE UNIVERSITY OF NEW SOUTH WALES
SYDNEY • AUSTRALIA



Community microgrid model and UI

Rob Passey, Luke Marshall and Naomi Stringer

Workshop on Embedded Network and Community Microgrid Models

Thurs 30 May 2019 © CEEM, 2019

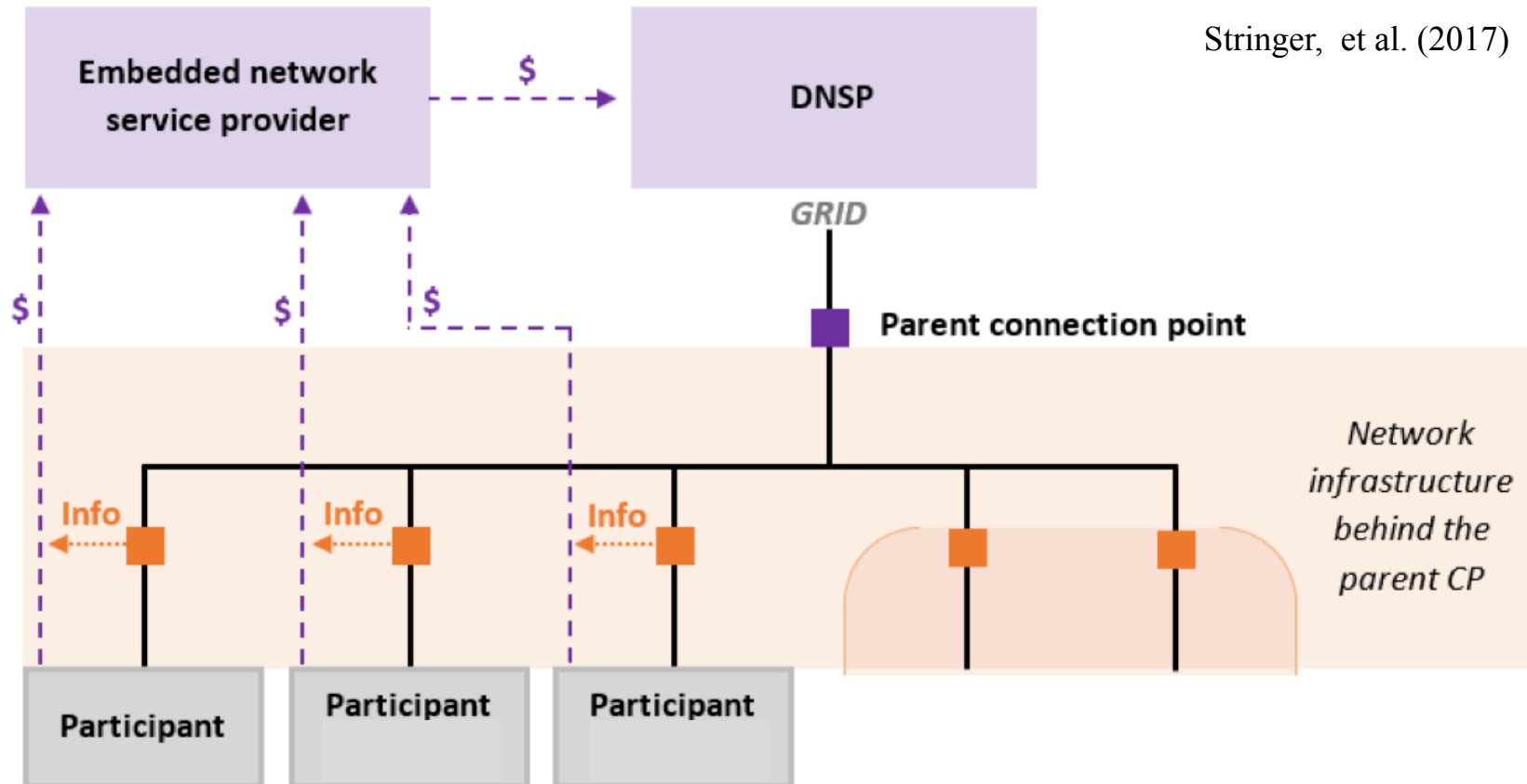


Embedded networks

- May be in shopping centres, apartment blocks, retirement villages, caravan parks, greenfield developments such as 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 per year
 - Purchase of electricity at commercial rates



Stringer, et al. (2017)



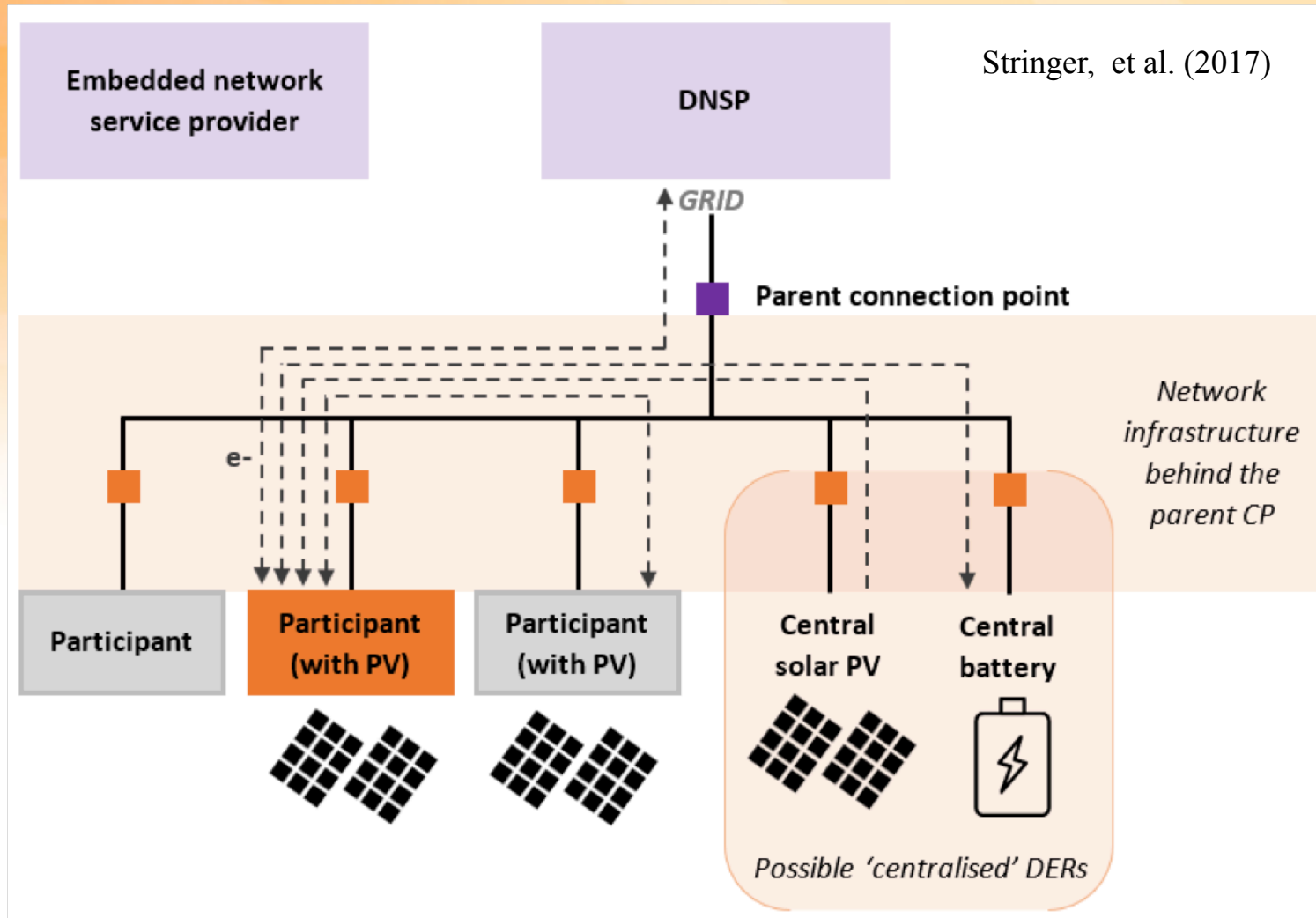


Embedded networks

- May be in shopping centres, apartment blocks, retirement villages, caravan parks, greenfield developments such as 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 per year
 - Purchase of electricity at commercial rates
- Increasing interest in the use of embedded networks to enable the uptake of PV and batteries
 - PV electricity exported to the EN and then used by EN customers will not pay DUOS charges
 - Instead of earning say 10c/kWh can earn say 20-25c/kWh
- Local Energy Trading (P2P) can be used to facilitate this



Luomi Model Schematic



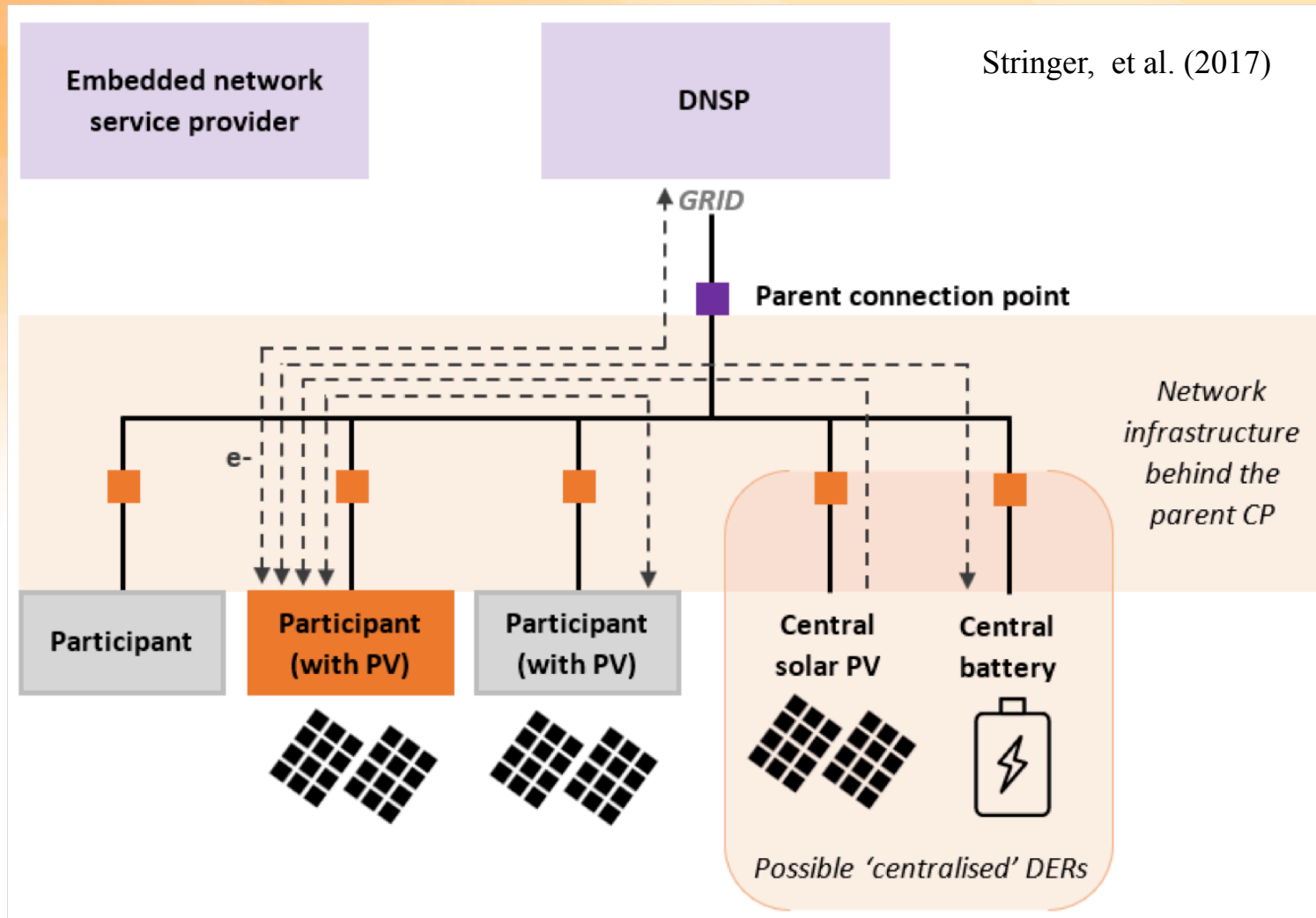


Embedded networks

- May be in shopping centres, apartment blocks, retirement villages, caravan parks, greenfield developments such as 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 per year
- Increasing interest in the use of embedded networks to enable the uptake of PV and batteries
 - PV electricity exported to the EN and then used by EN customers will not pay DUOS charges
 - Instead of earning say 10c/kWh can earn say 20-25c/kWh
- Local Energy Trading (P2P) can be used to facilitate this
- But what if the EN is owned by the DNSP?



Luomi Model Schematic





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, customer acquisition is well underway
- 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 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

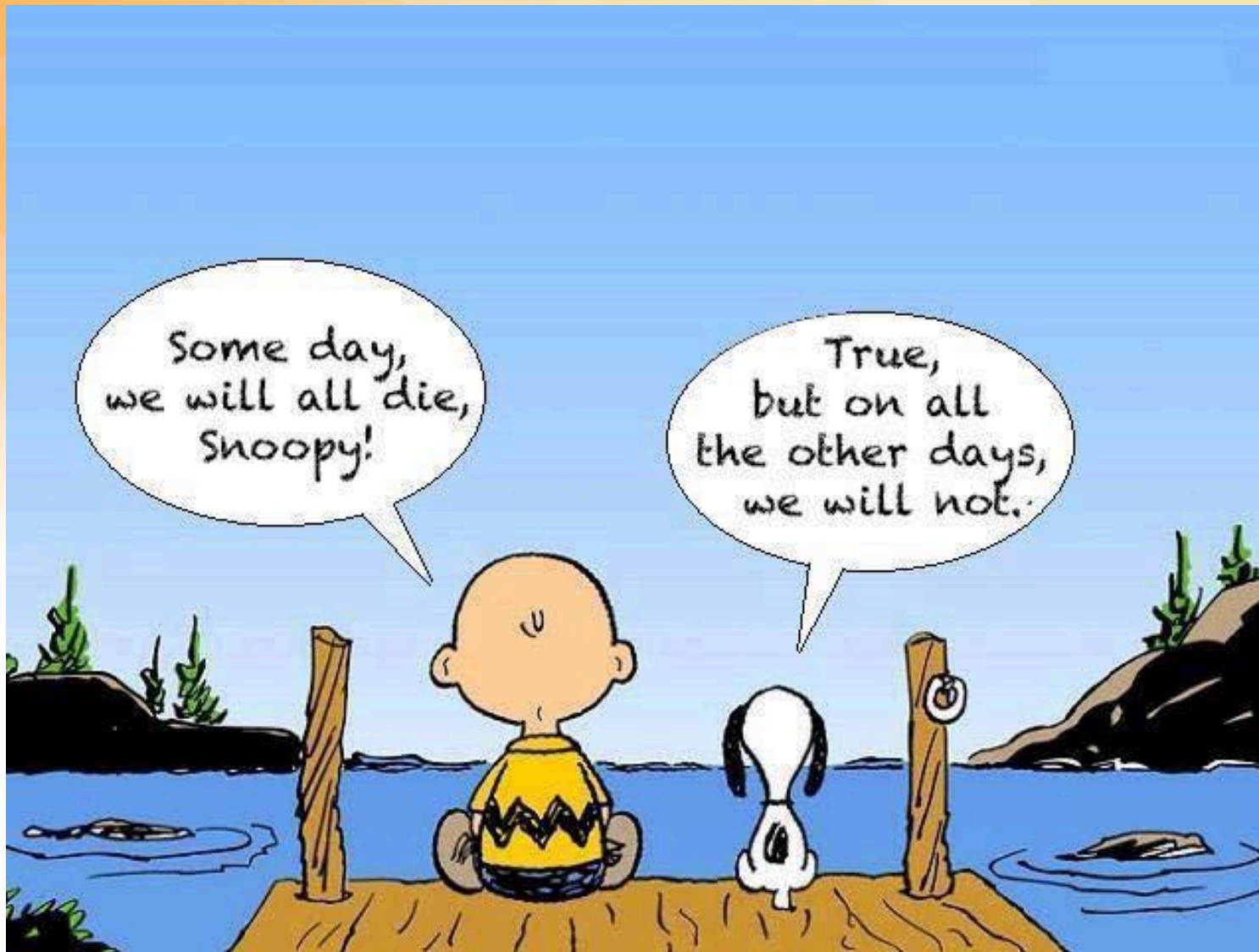
- Consumer
 - Uses local solar first
 - Then battery electricity
 - Then from the wider grid



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

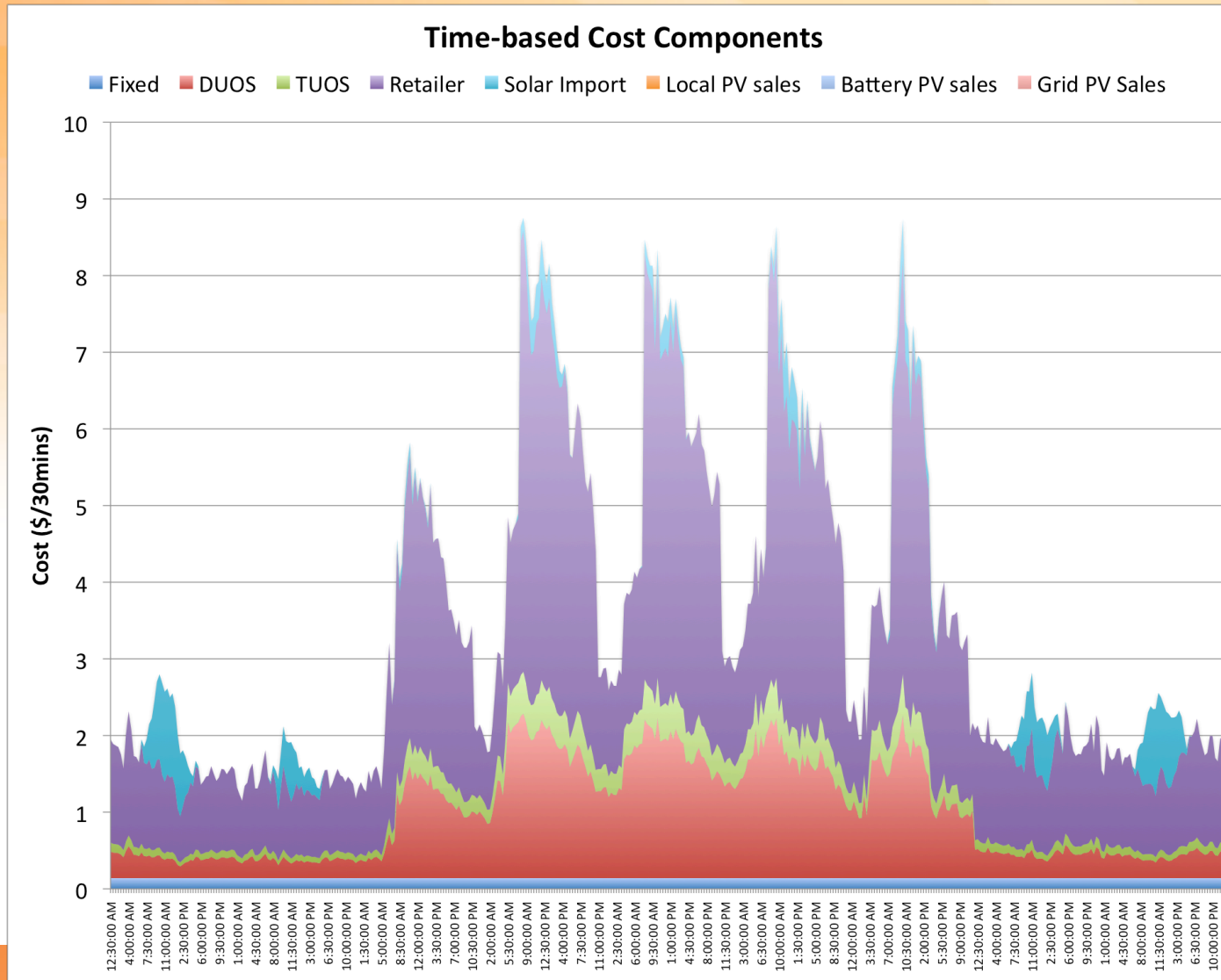
	TUOS	DUOS	Env	Retailer	Total
Fixed (\$/day)	0	0.7789	0	0.988	1.6877
Usage (c/kWh)	1.9286	11.2383	2.6127	20.6004	36.38
Solar export (c/kWh)	0	0	0	9	9

- 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

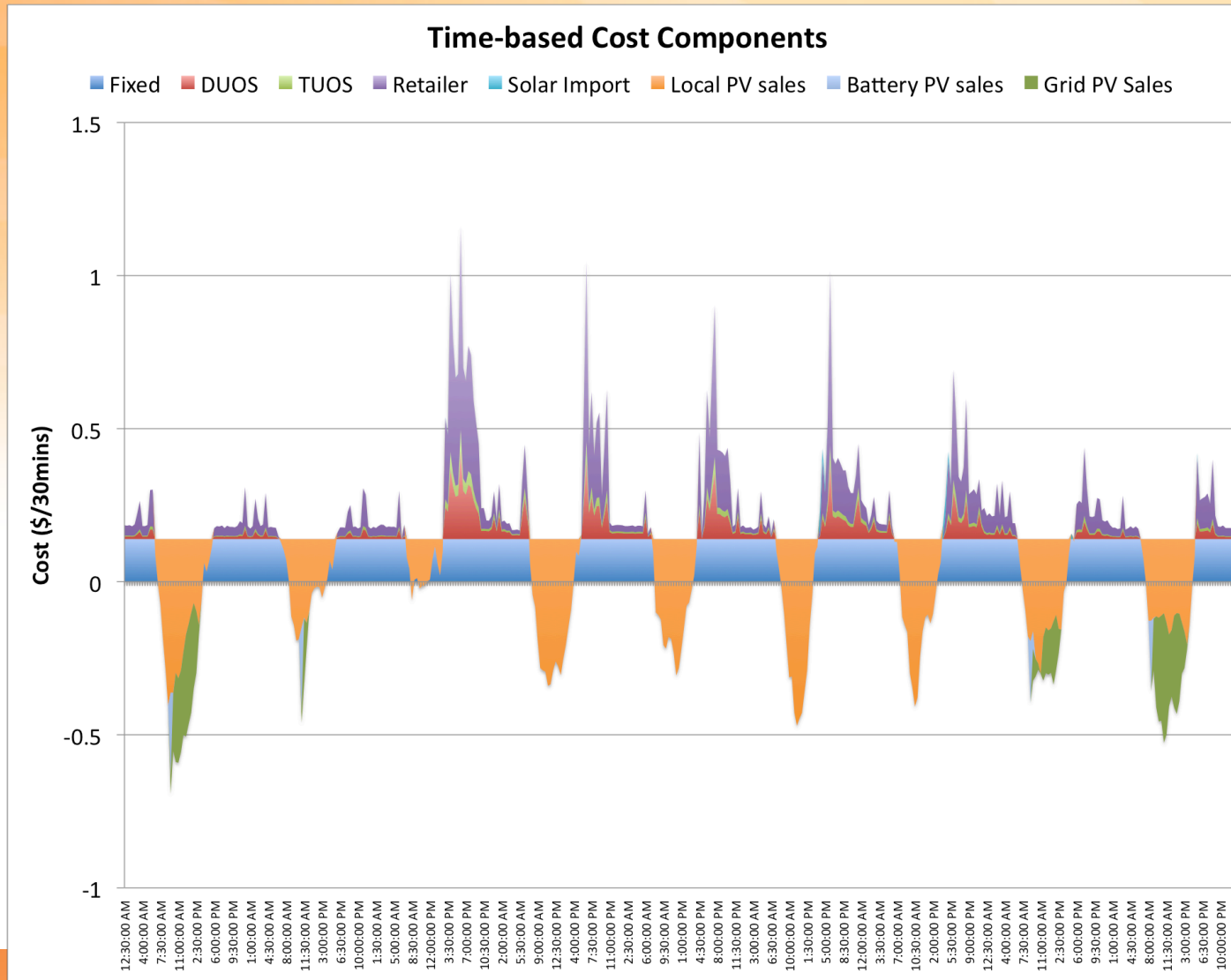


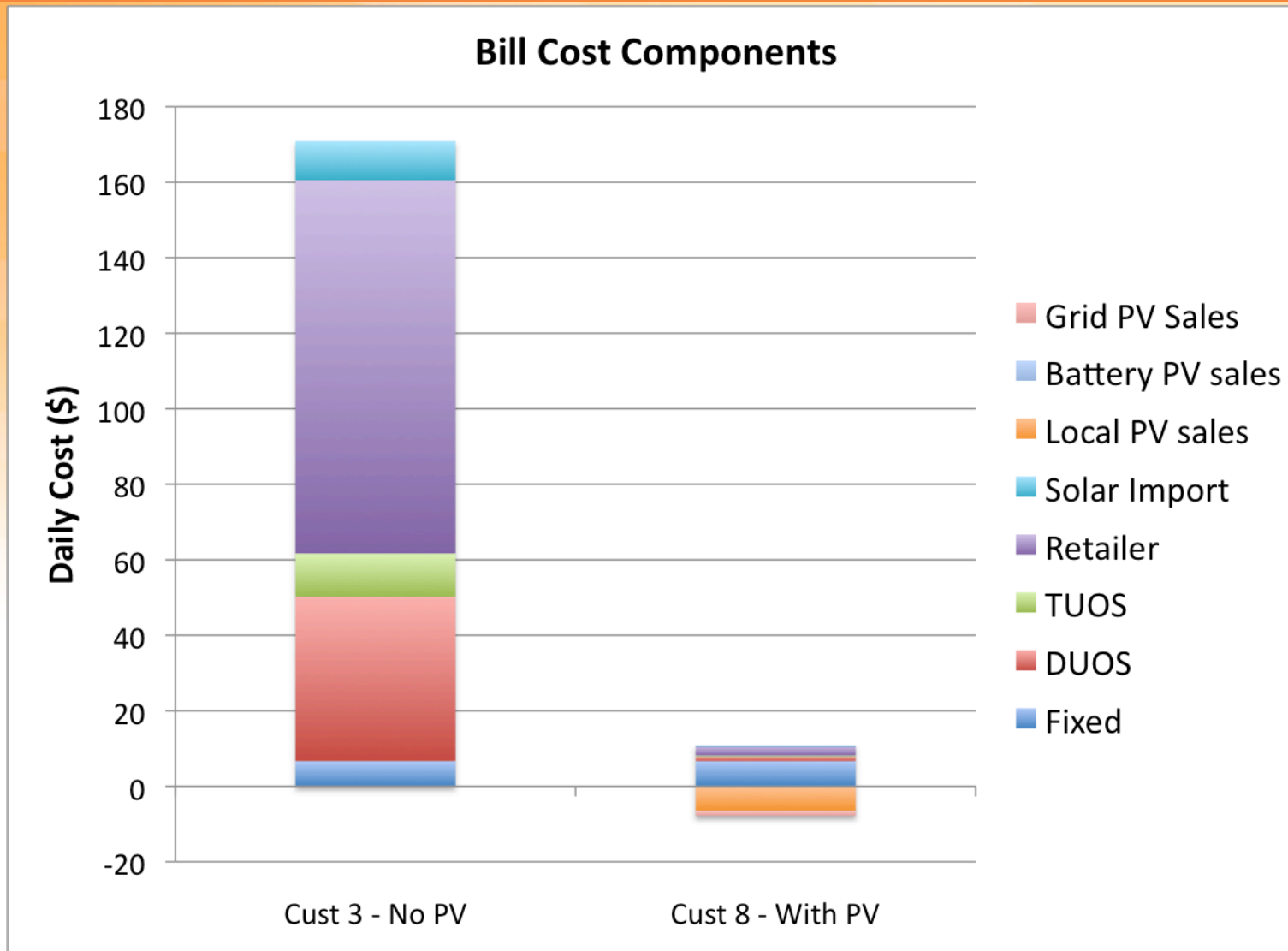
Customer 3 – no solar PV

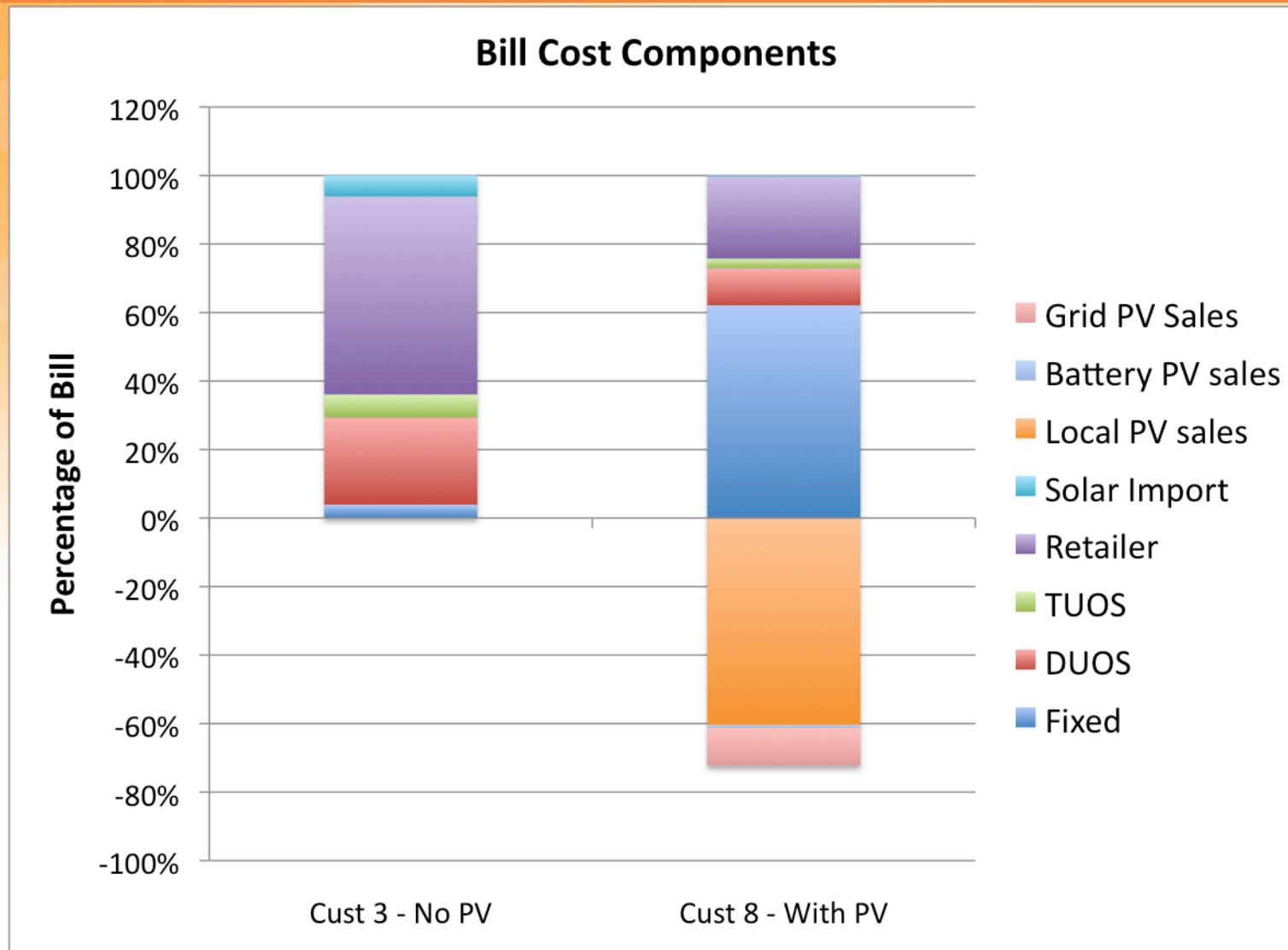




Customer 8 – with solar PV (27.5kW)



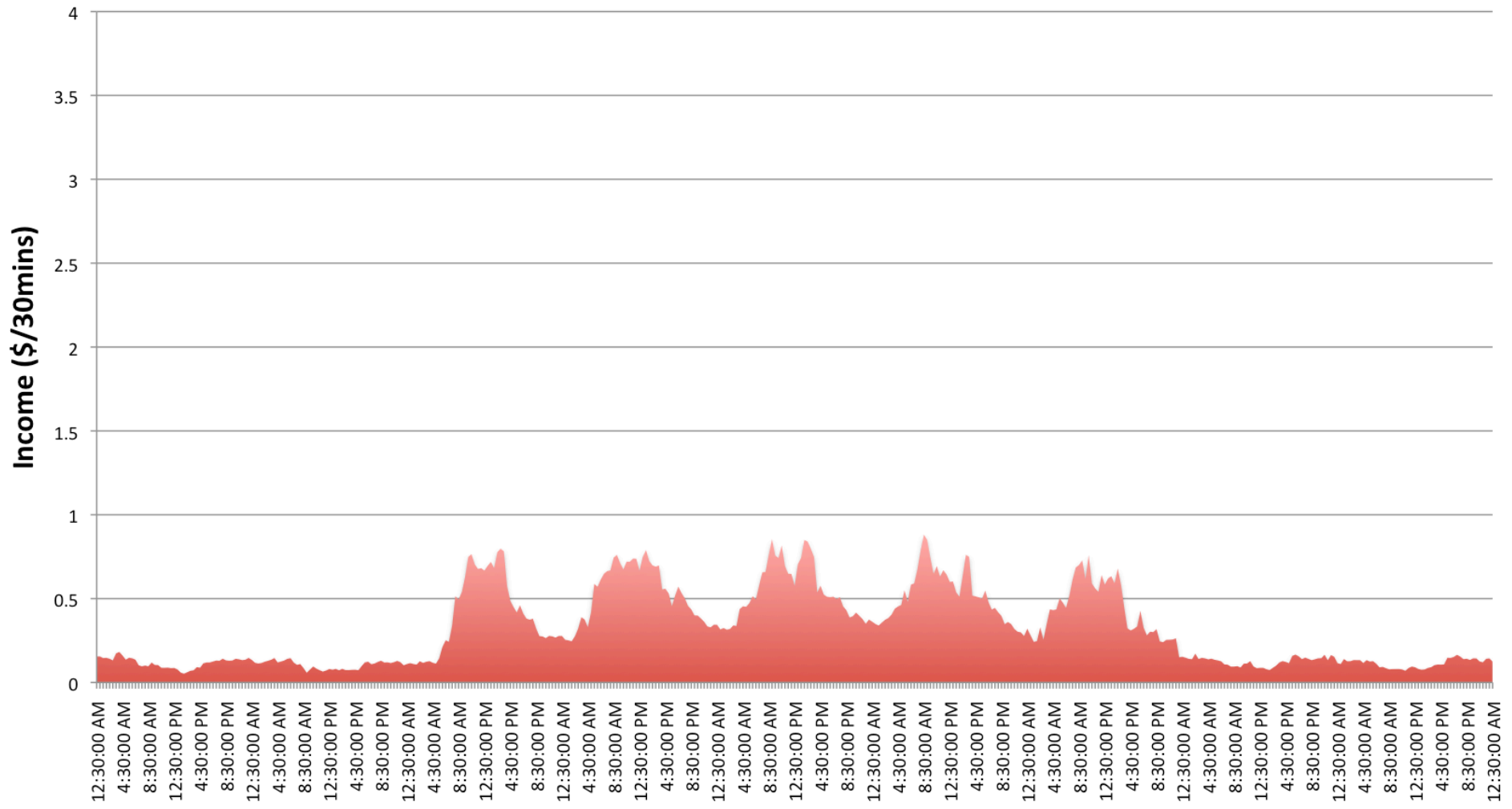






TNSP Revenue Components

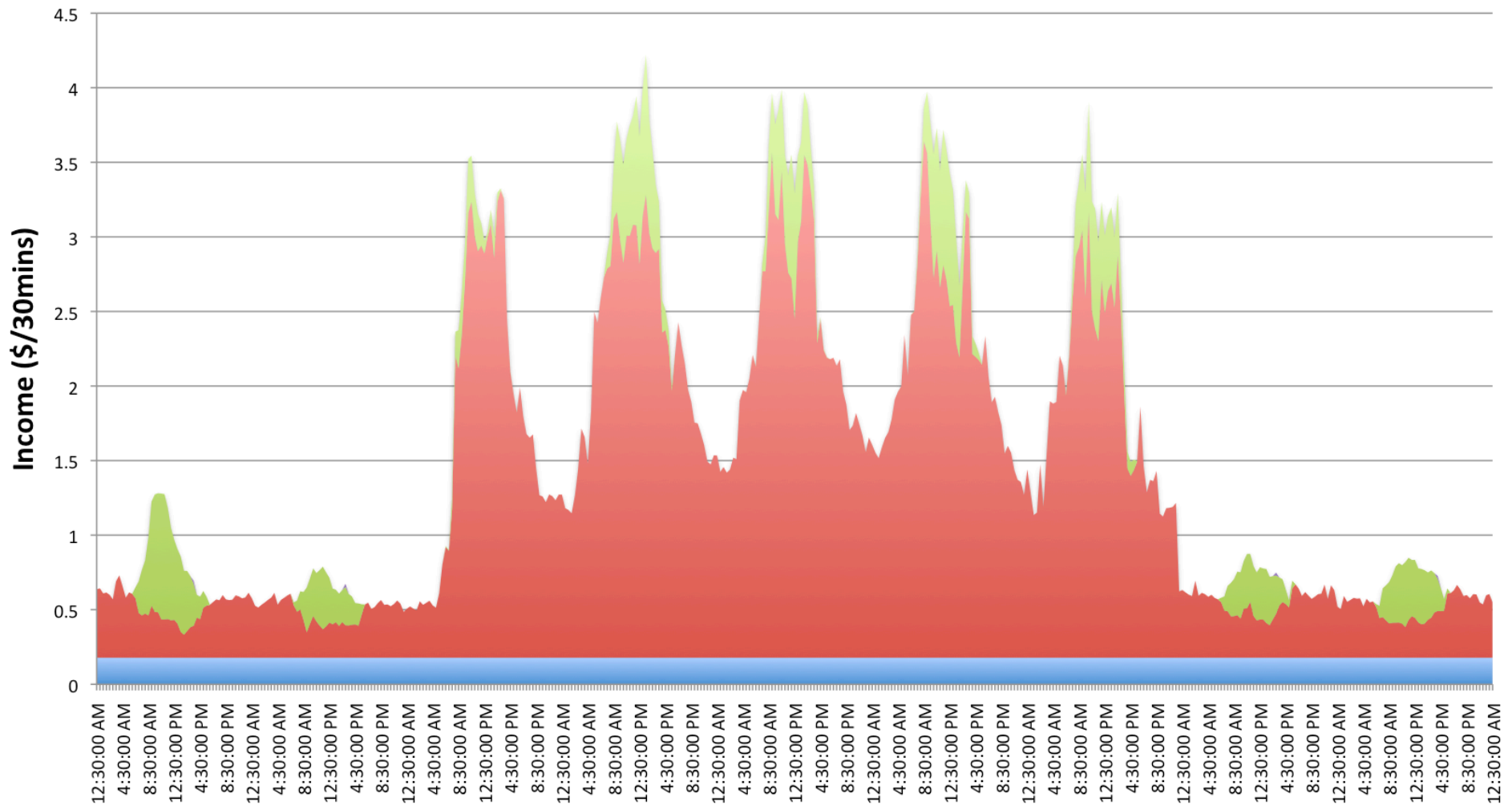
■ Fixed ■ Grid Import ■ Solar Use ■ Battery Use





DNBP Revenue Components

■ Fixed ■ Grid Import ■ Solar Use ■ Battery Use





Impact of changing local solar & battery tariffs

- Original tariffs for use of exported solar

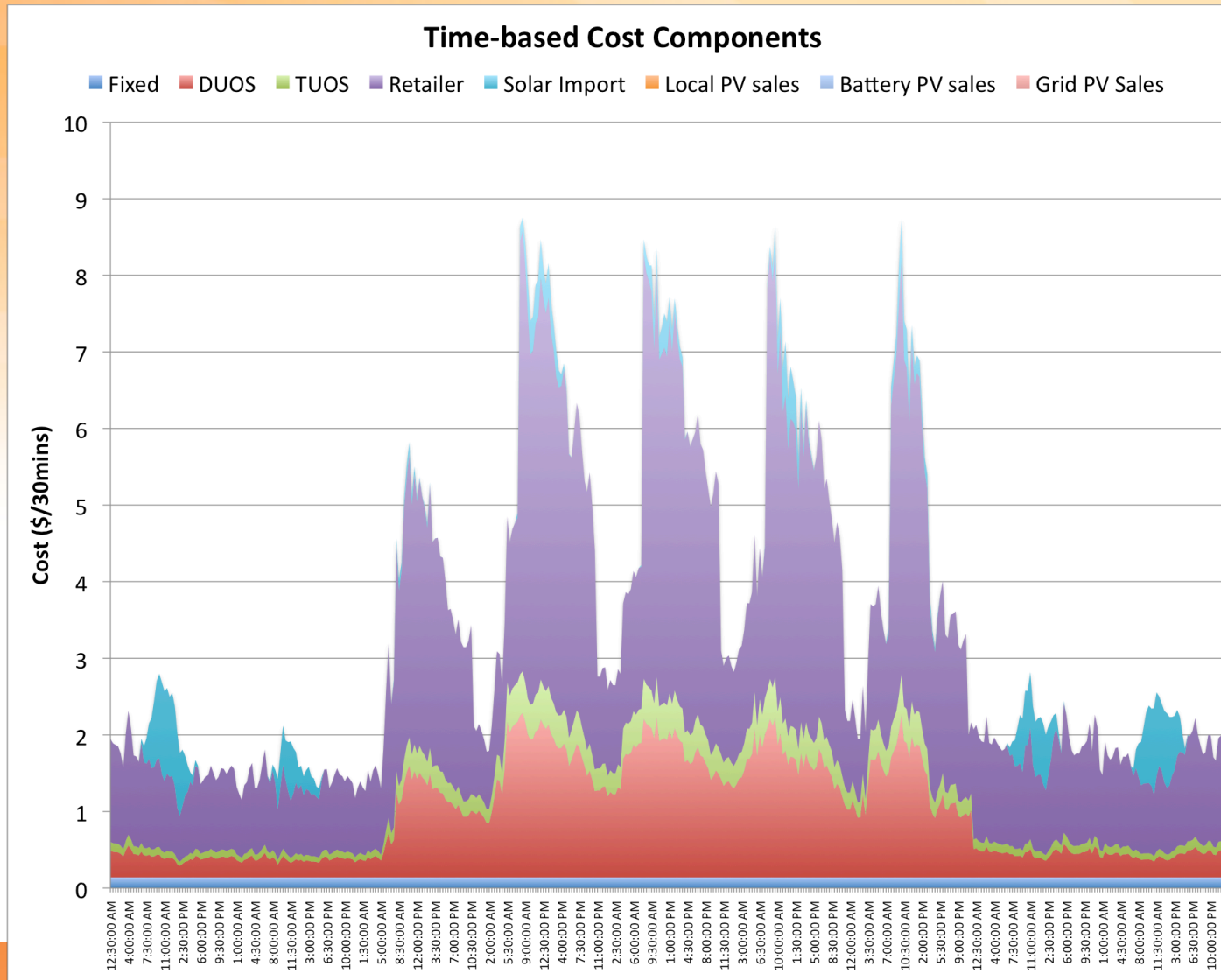
	TUOS	DUOS	Retailer + Env	PV owner	Cust (c/kWh)
Local Solar/ Battery (c/kWh)	0	11.2383	16.1417	9	36.38

- New tariffs

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

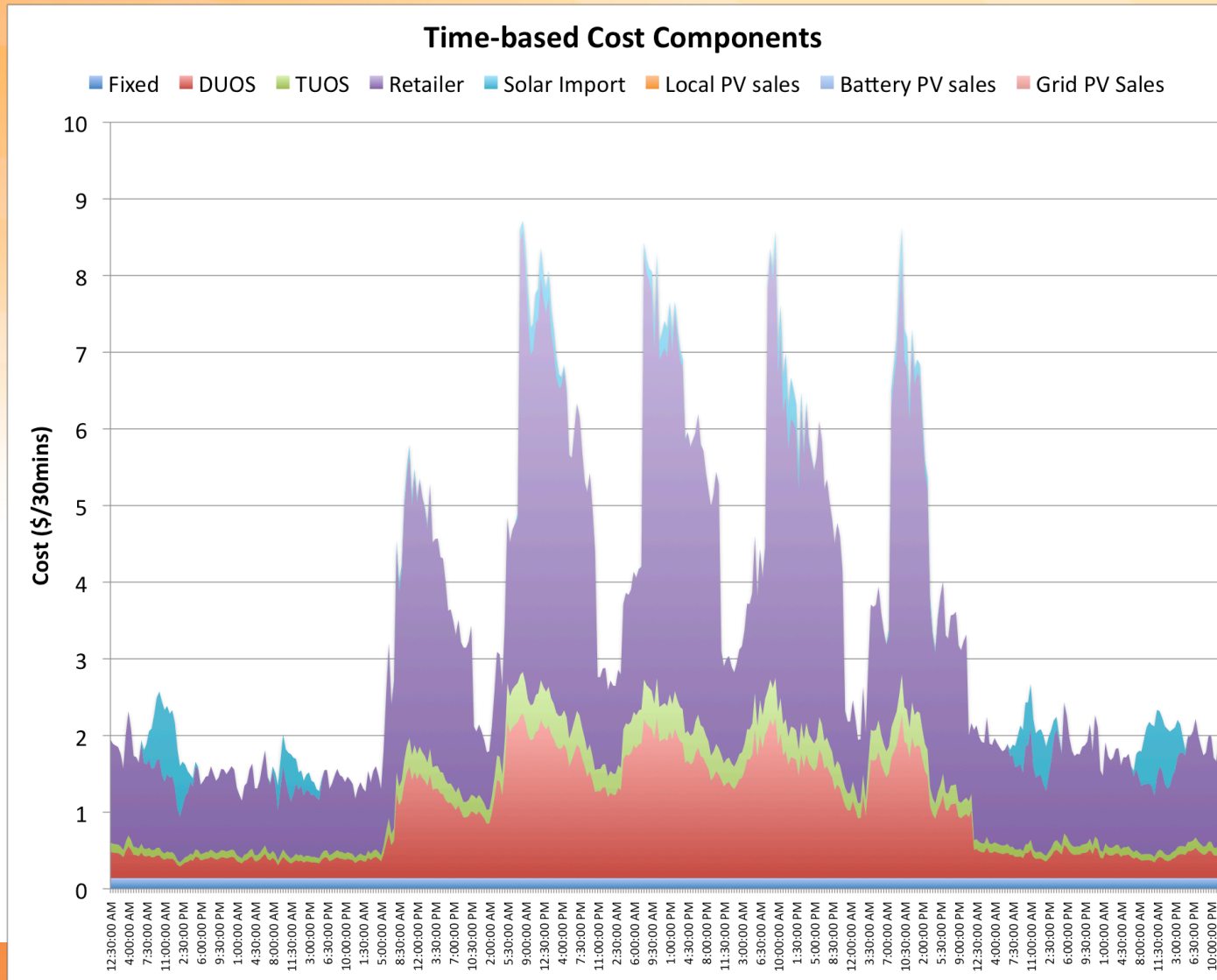


Customer 3 –with solar PV 9c local FiT (36c retail)



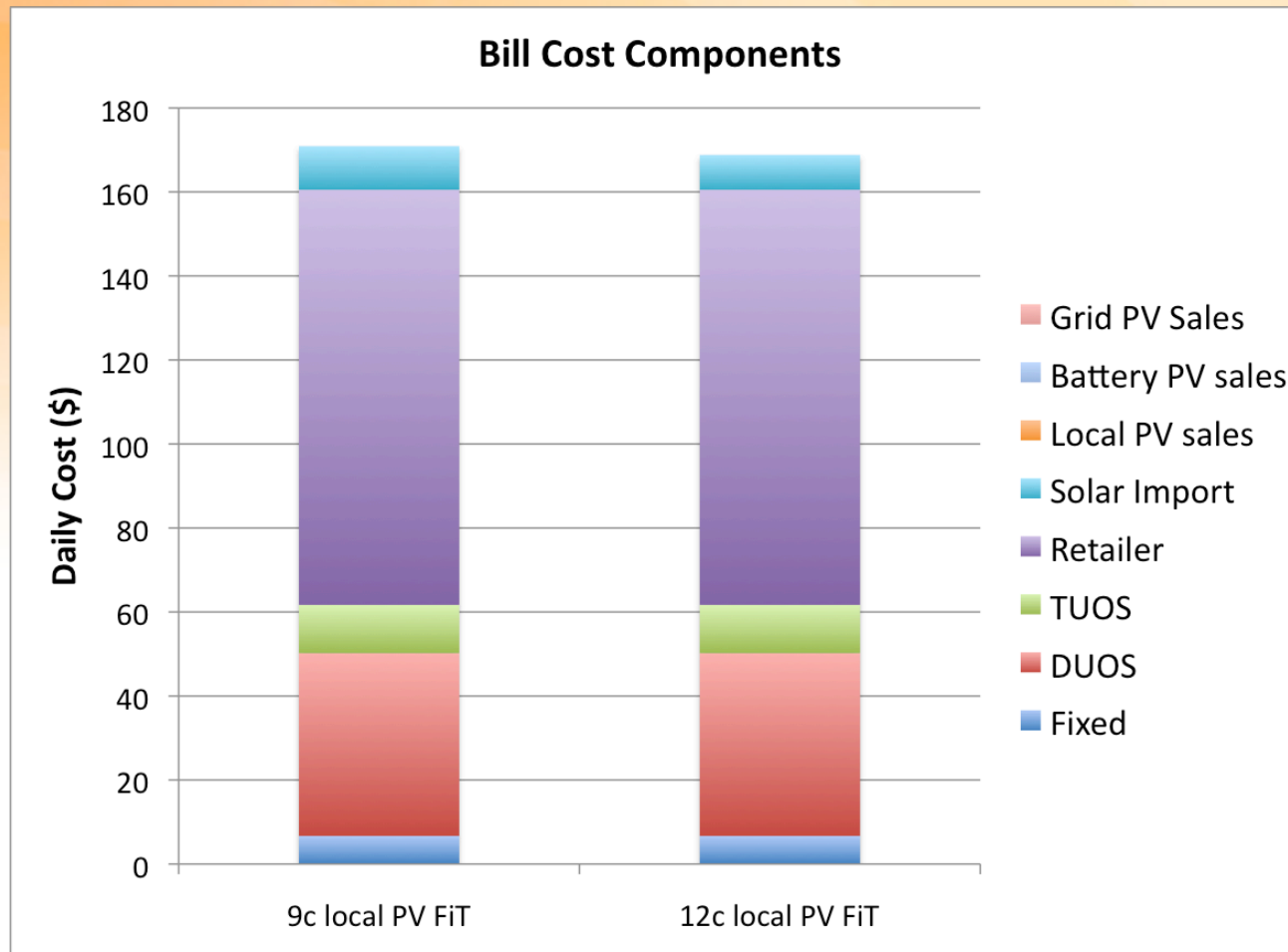


Customer 3 –with solar PV 12c local FiT (28c retail)



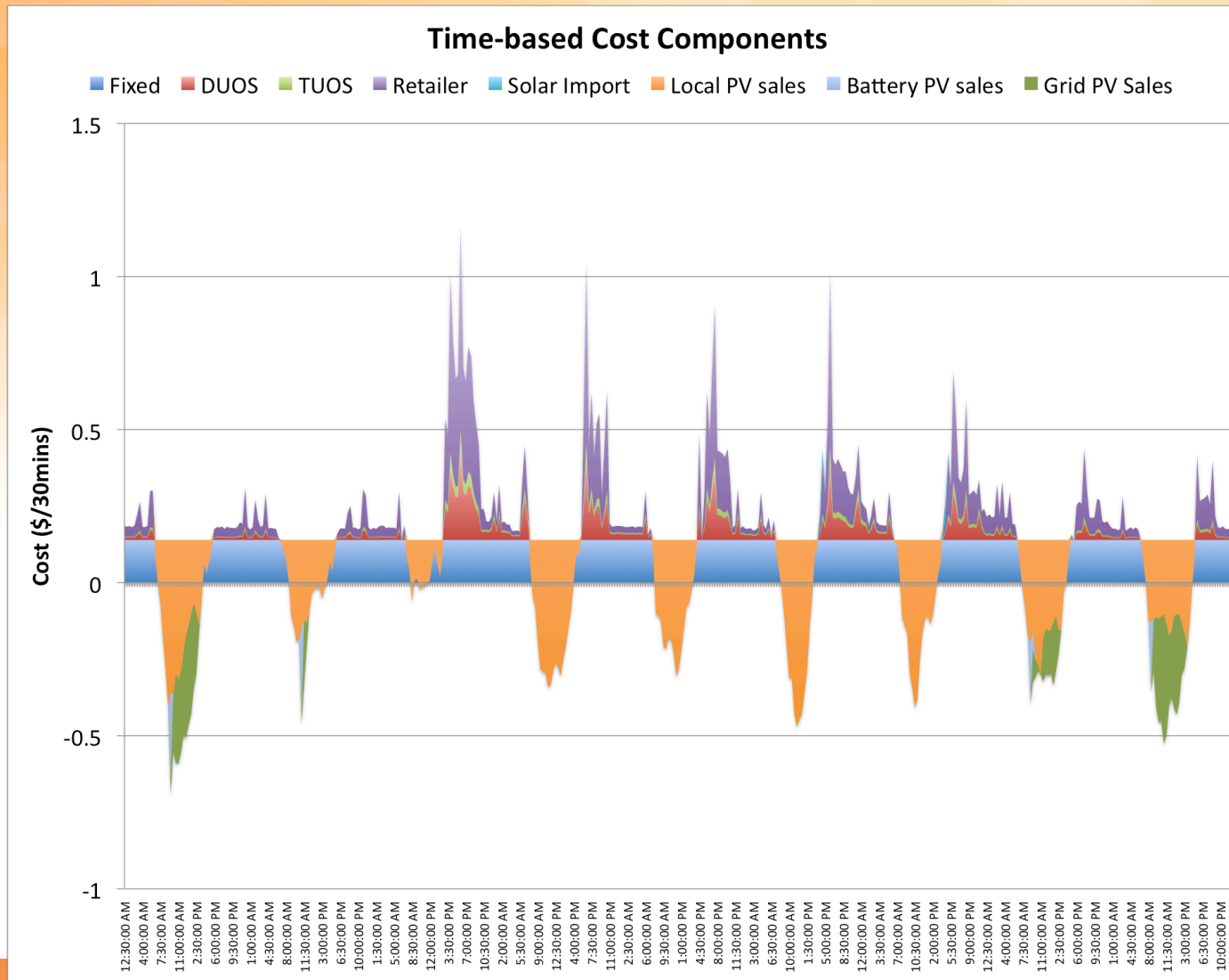


Customer 3 - Change in cost with higher local FiT



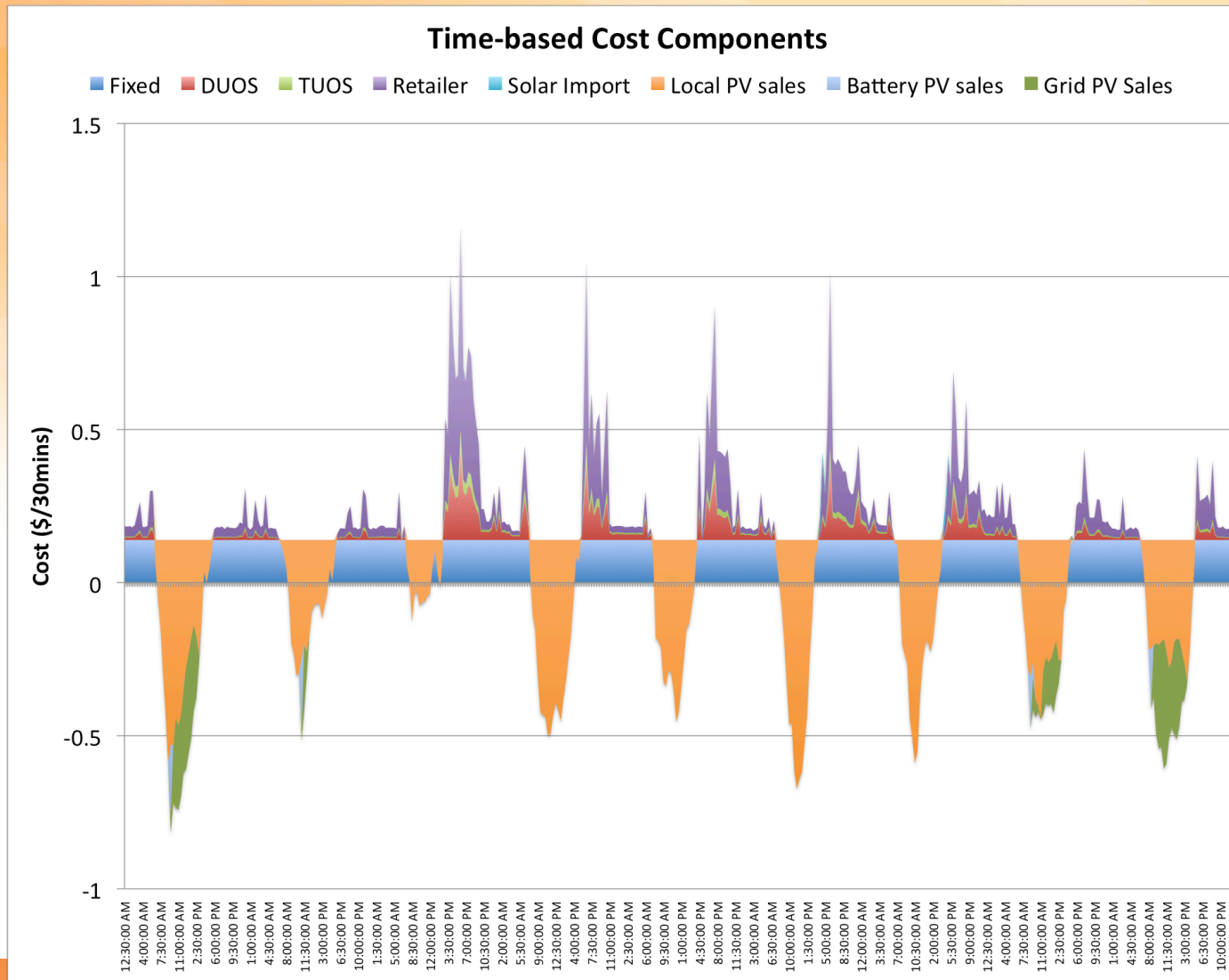


Customer 8 – with solar PV 9c local FiT



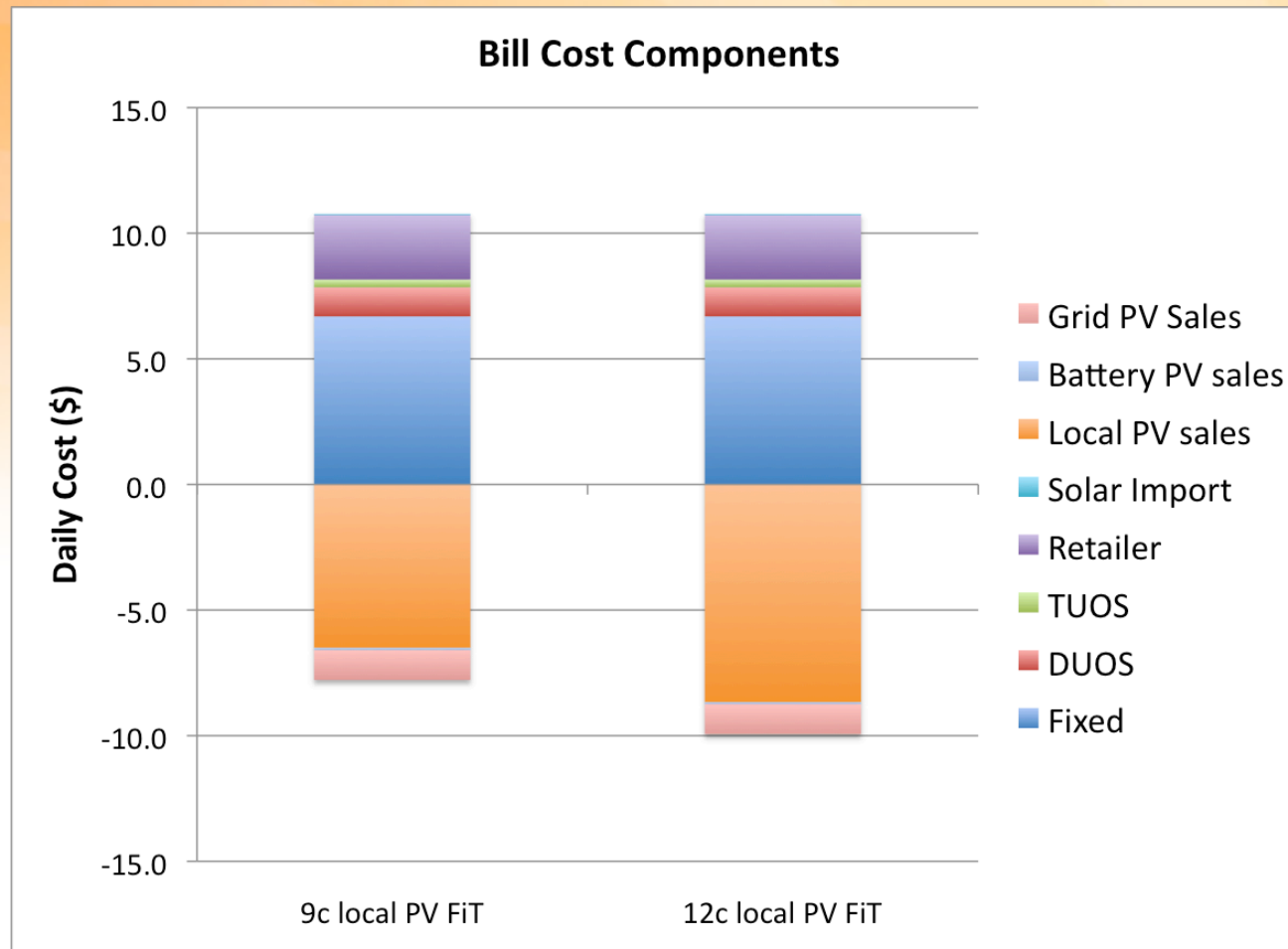


Customer 8 – with solar PV 12c local FiT



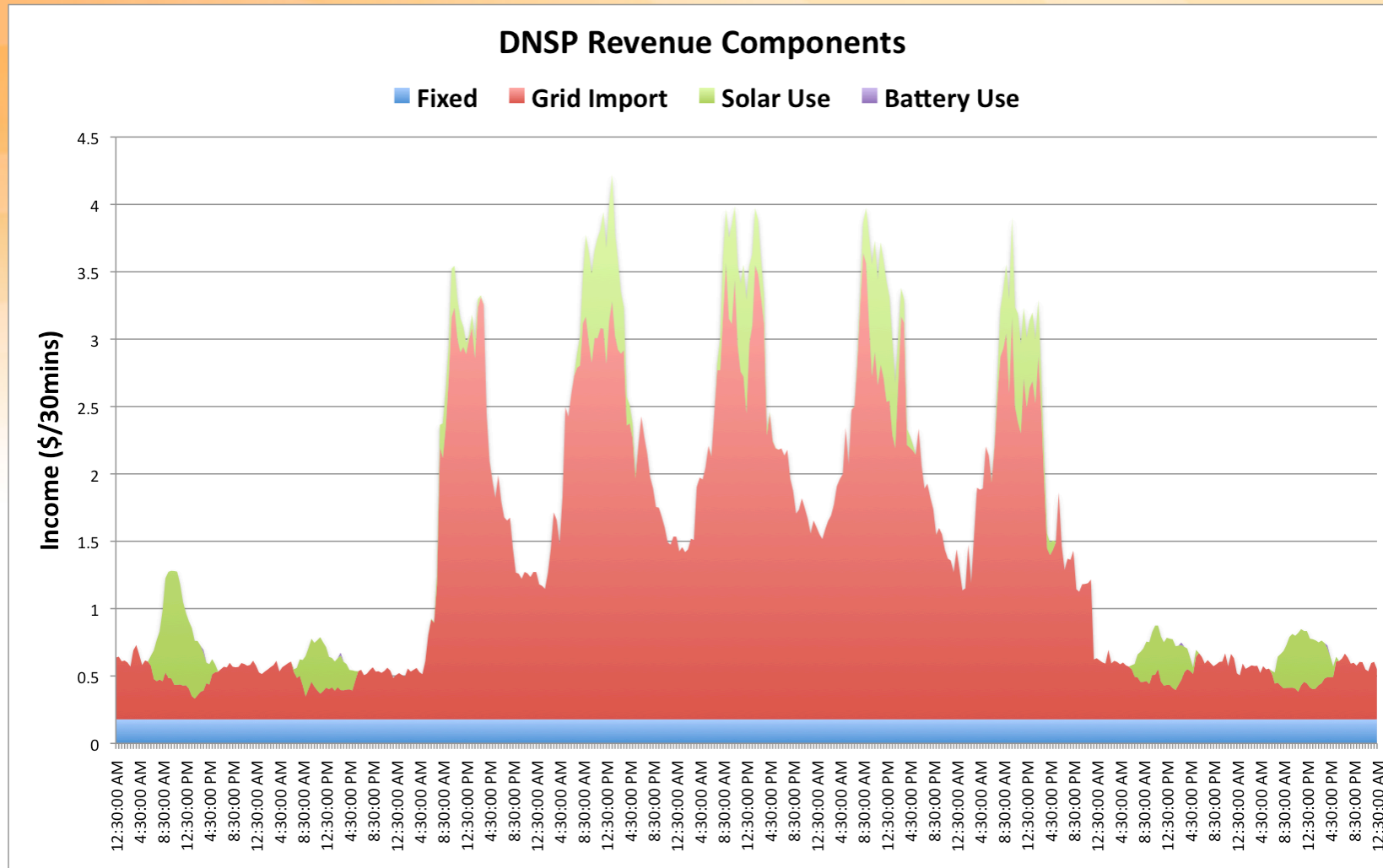


Customer 8 - Change in cost with higher local FiT



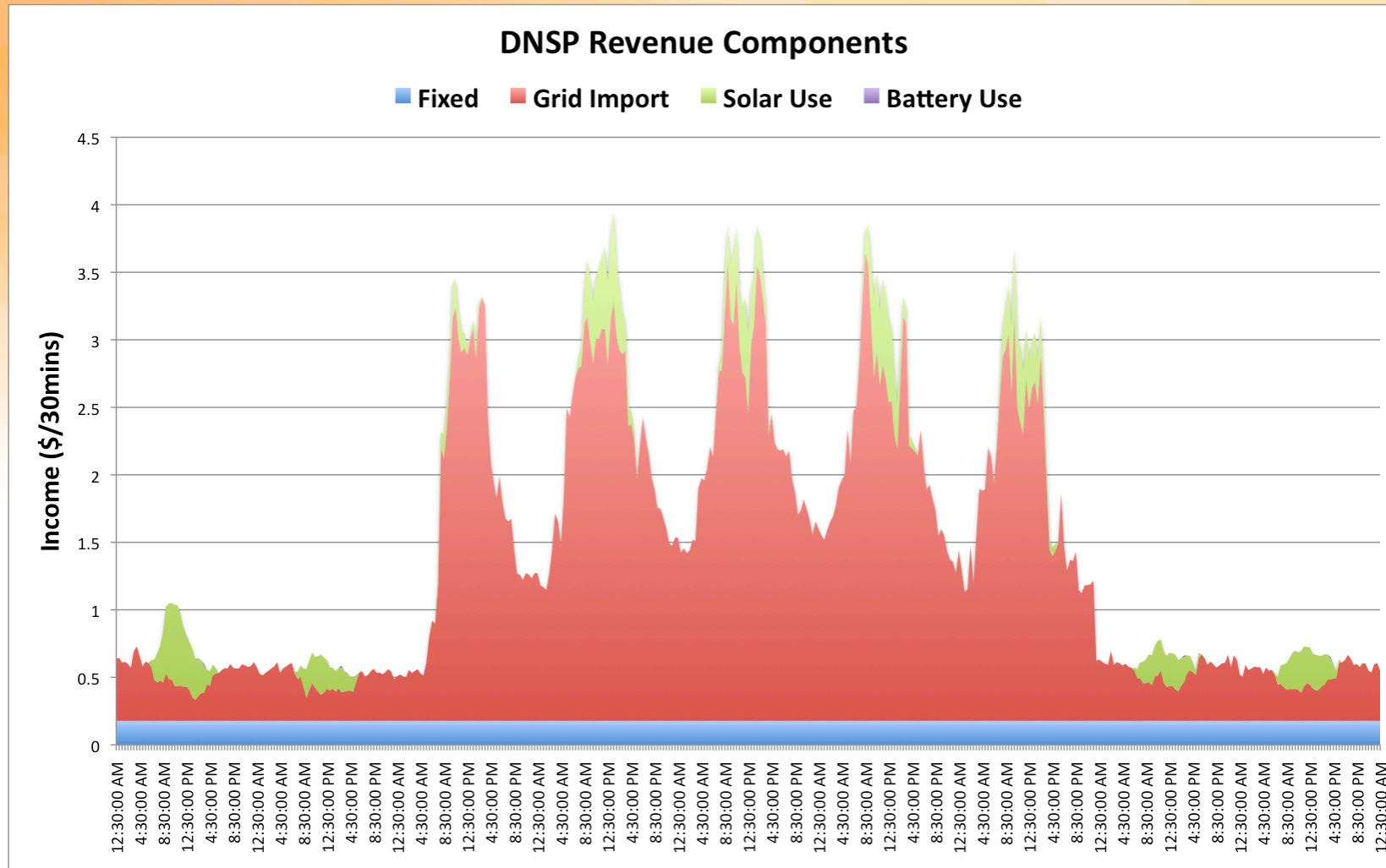


DNSEP revenue – 9c local solar FiT



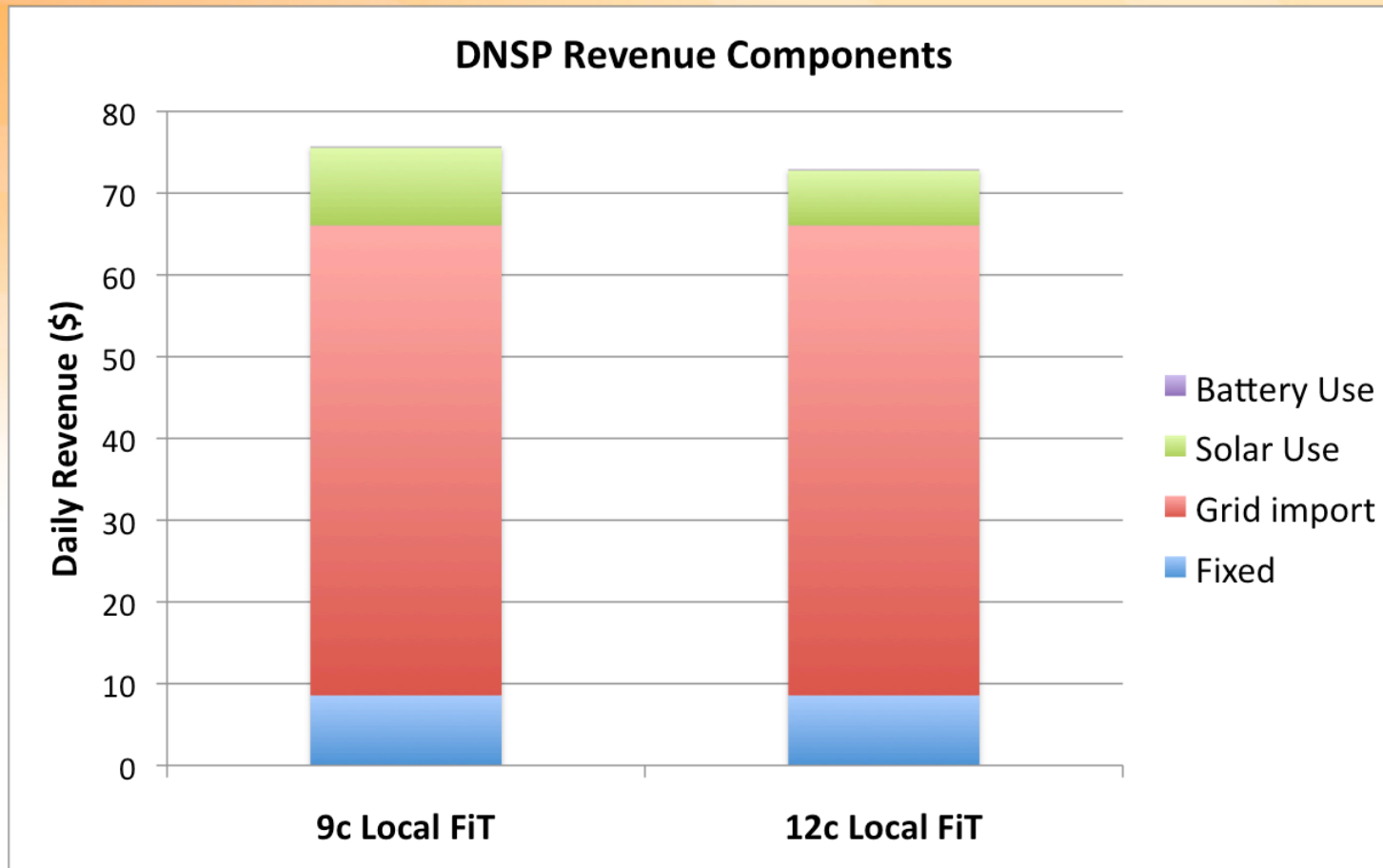


DNISP revenue – 12c local solar FiT





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



Reference

- Stringer, N., Marshall, L., Passey, R., Bruce, A. and MacGill, I. (2017) 'Open Source Model for Operational and Commercial Assessment of Local Electricity Sharing Schemes in the Australian National Electricity Market', Asia-Pacific Solar Research Conference 2017, Melbourne, Australia.



Centre for Energy and
Environmental Markets

UNSW
THE UNIVERSITY OF NEW SOUTH WALES
SYDNEY • AUSTRALIA

Thank you... and *questions*

Many of our publications are available at:

www.ceem.unsw.edu.au