

Residential tariff design to improve the technical and economic integration of distributed energy options in the electricity industry

Never Stand Still

Sharon Young

October 2018



Thank you

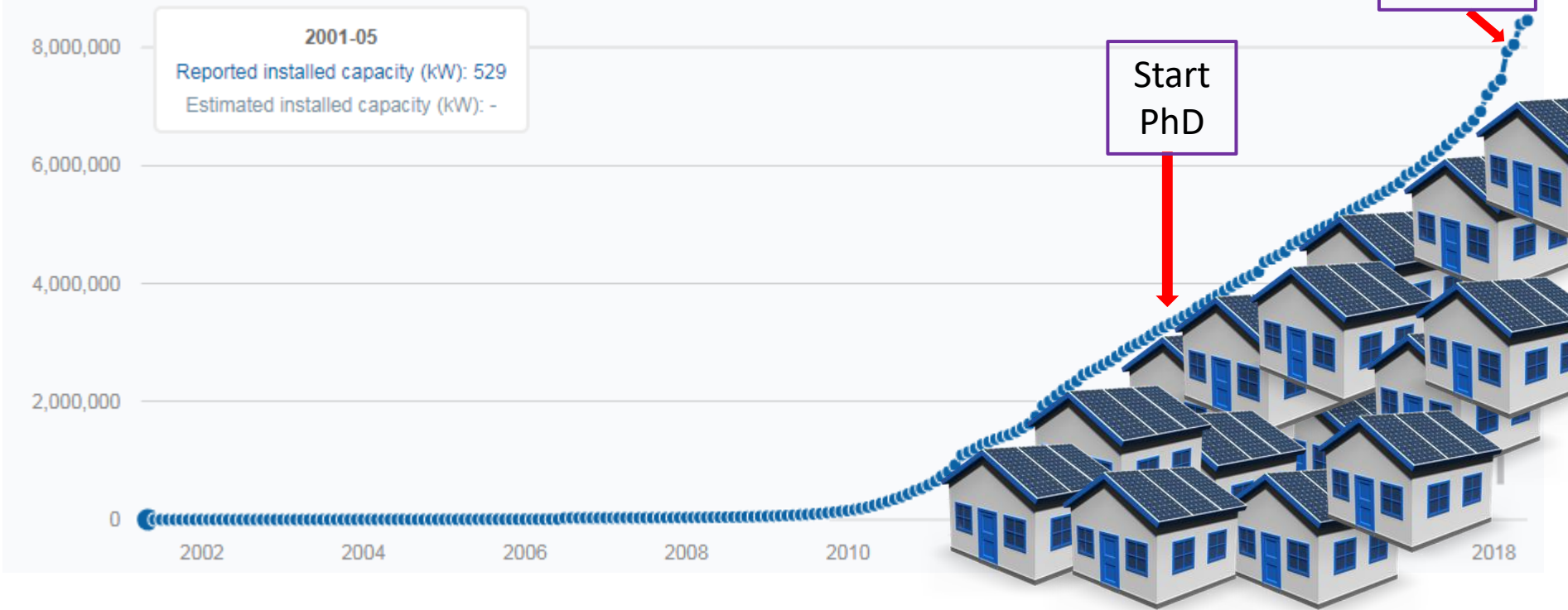




The Big Question...

**What's going to
happen next?**

Australian PV installations since April 2001: total capacity (kW)



How much could household actions add up?

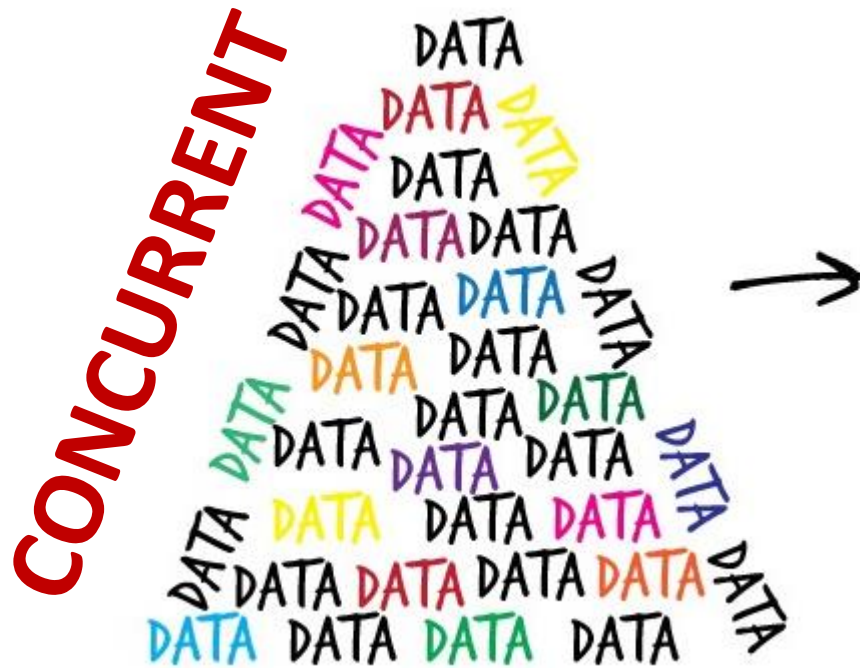
What happens if these homes get batteries?

How would it affect the rest of the industry?



Prediction is very
difficult, especially
about the future.

Niels Bohr



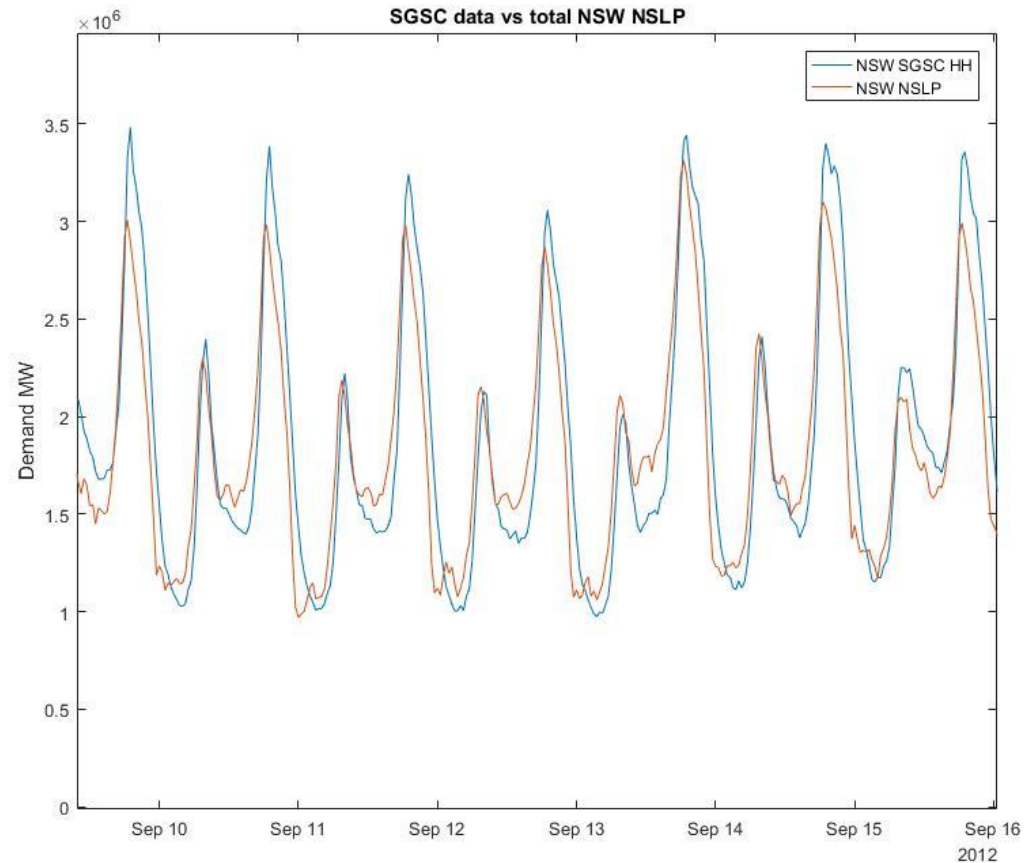
- Smart Grid, Smart City
- Ausgrid solar homes
- NEM Load data
- NEM Price data
- Net System Load Profile (NLSP) data

Household Data

Tested NSLP data
against scaled SGSC
data

Correlation: 0.96

Use SGSC data to
model state
scenarios



All models are wrong,
but some are useful.

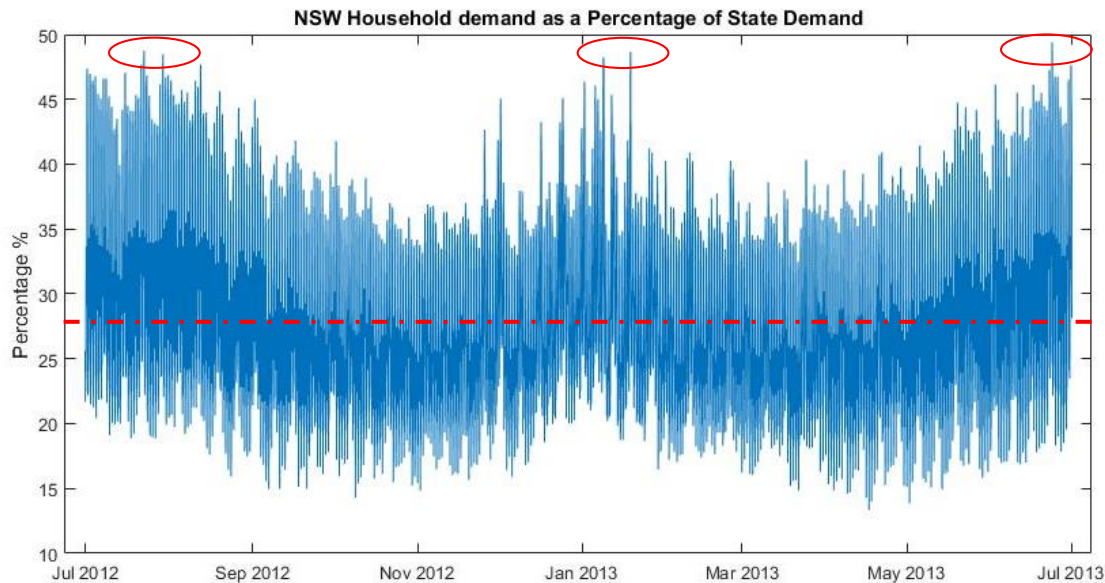
George E. P. Box

quote fancy

Questions

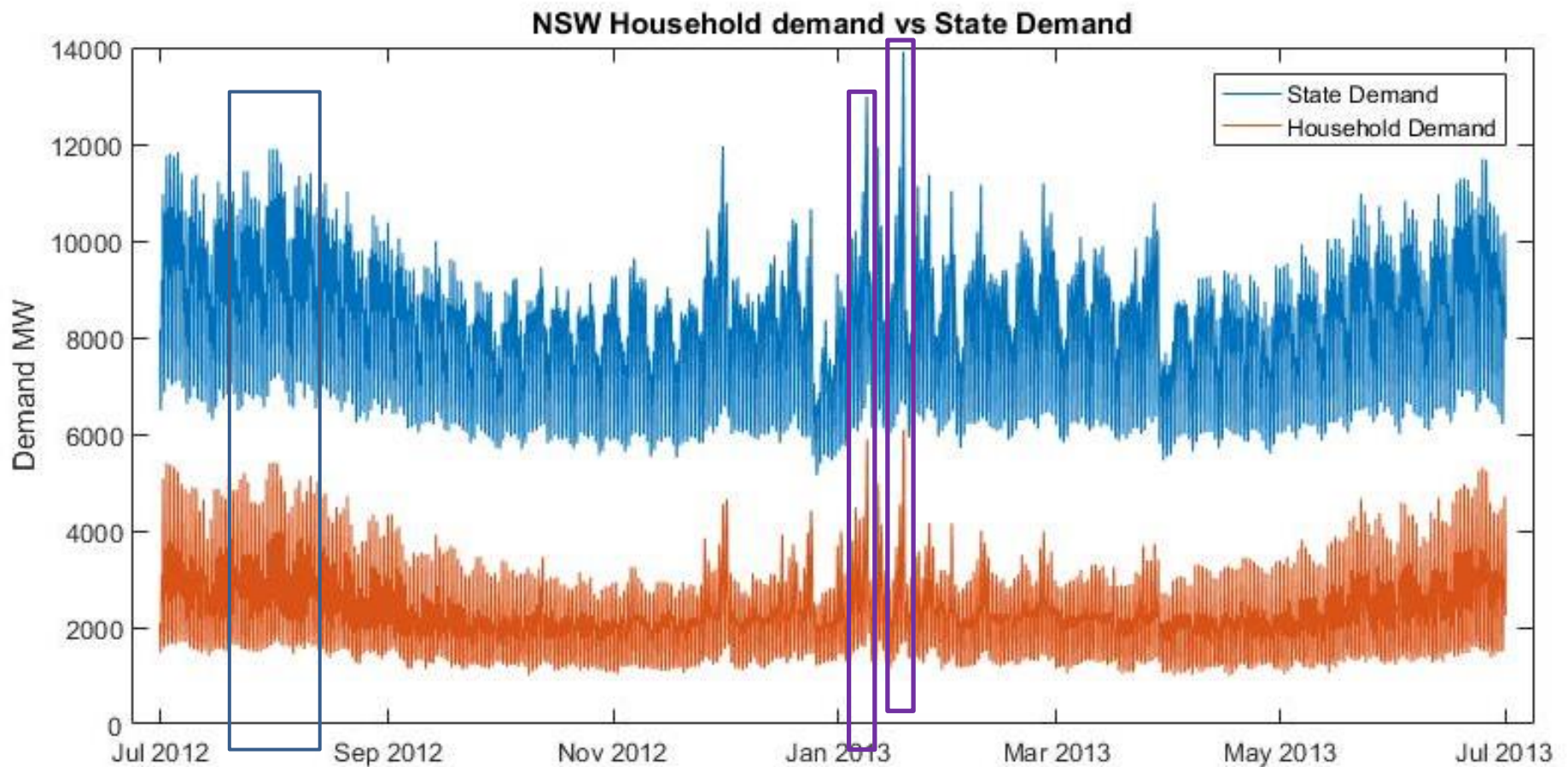
- How much do household actions add up?
- What if homes get storage?
- What are the effects on the rest of the industry?
- Can new tariffs improve the outcome?

Household contribution to demand



Mean Contribution	27.44%
Minimum %	13.34%
% at Winter peak	48.76%
% at Summer peak	48.67%
Standard Deviation	6.36%

In other words, what households do, does matter!



Seasonal correlation evident

Peak demand correlation visible

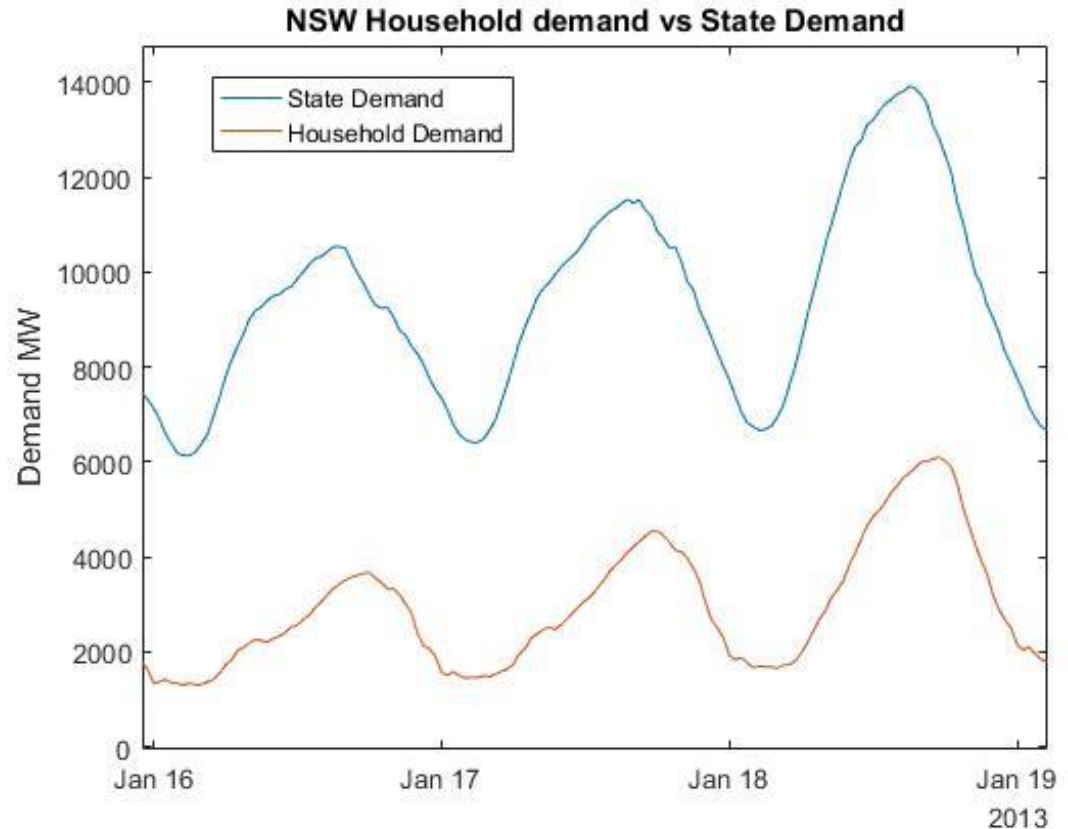
Peak demand

State peak: 15:30

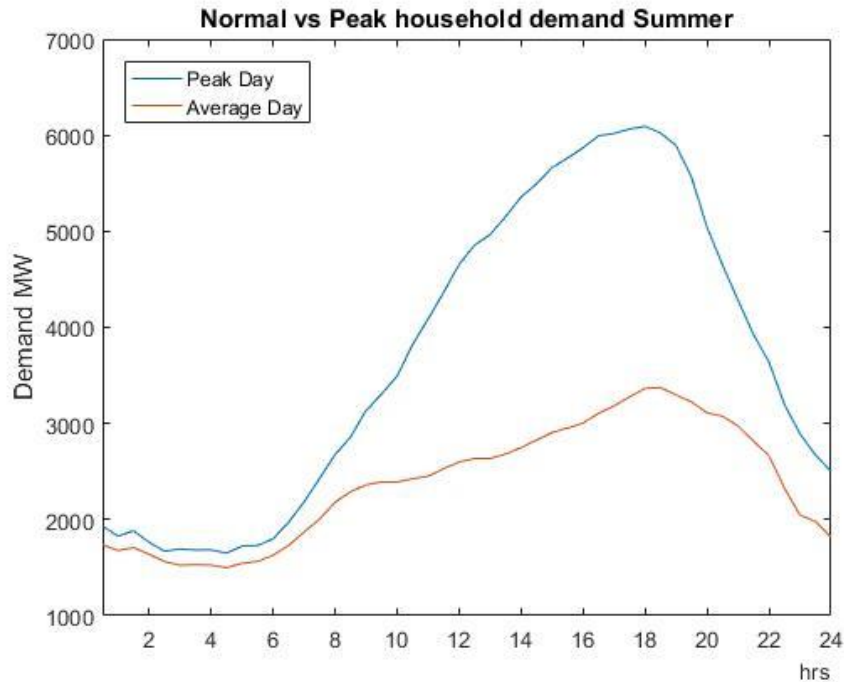
Residential Peak
18:00

Normal summer HH
peak = 3GW

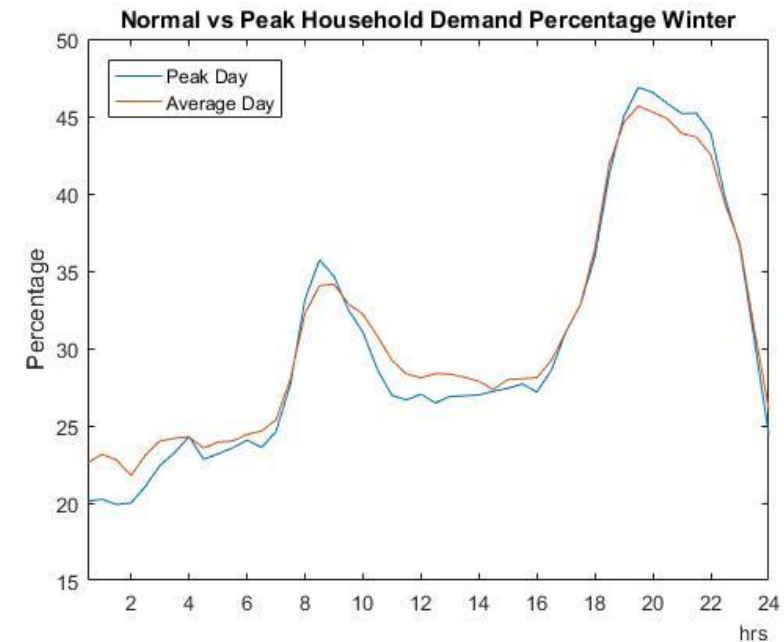
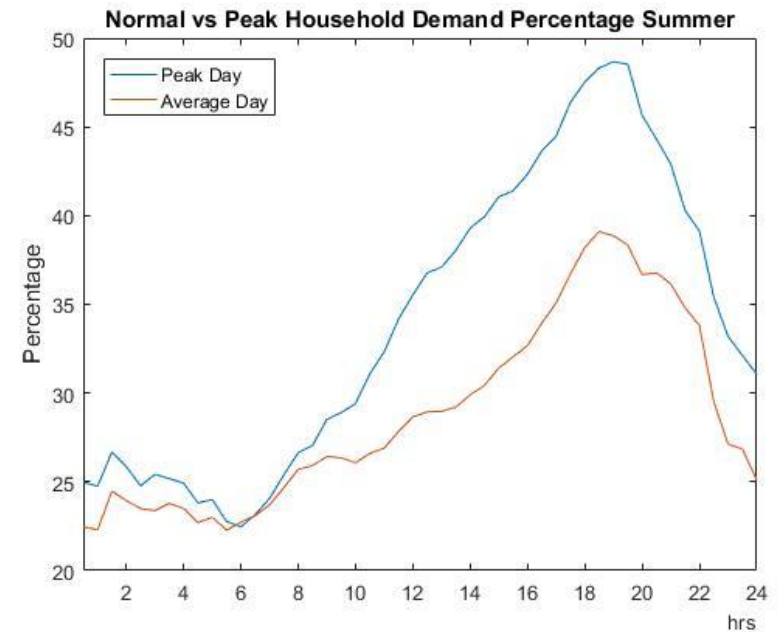
45.8C day, HH peak
= 6GW



NSLP data



Household
contribution to peak
demand



Questions

- How much do household actions add up?
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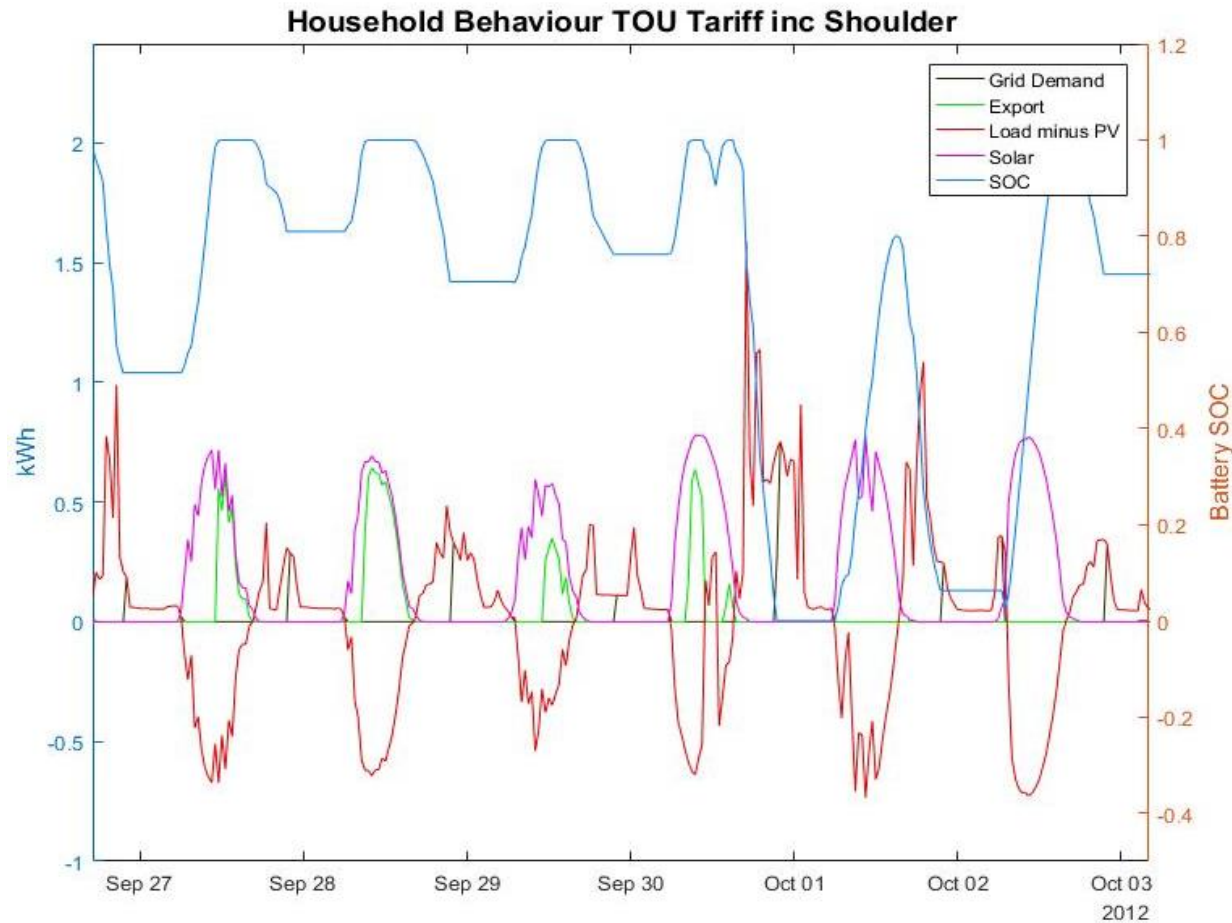
Modelling batteries

Sizing

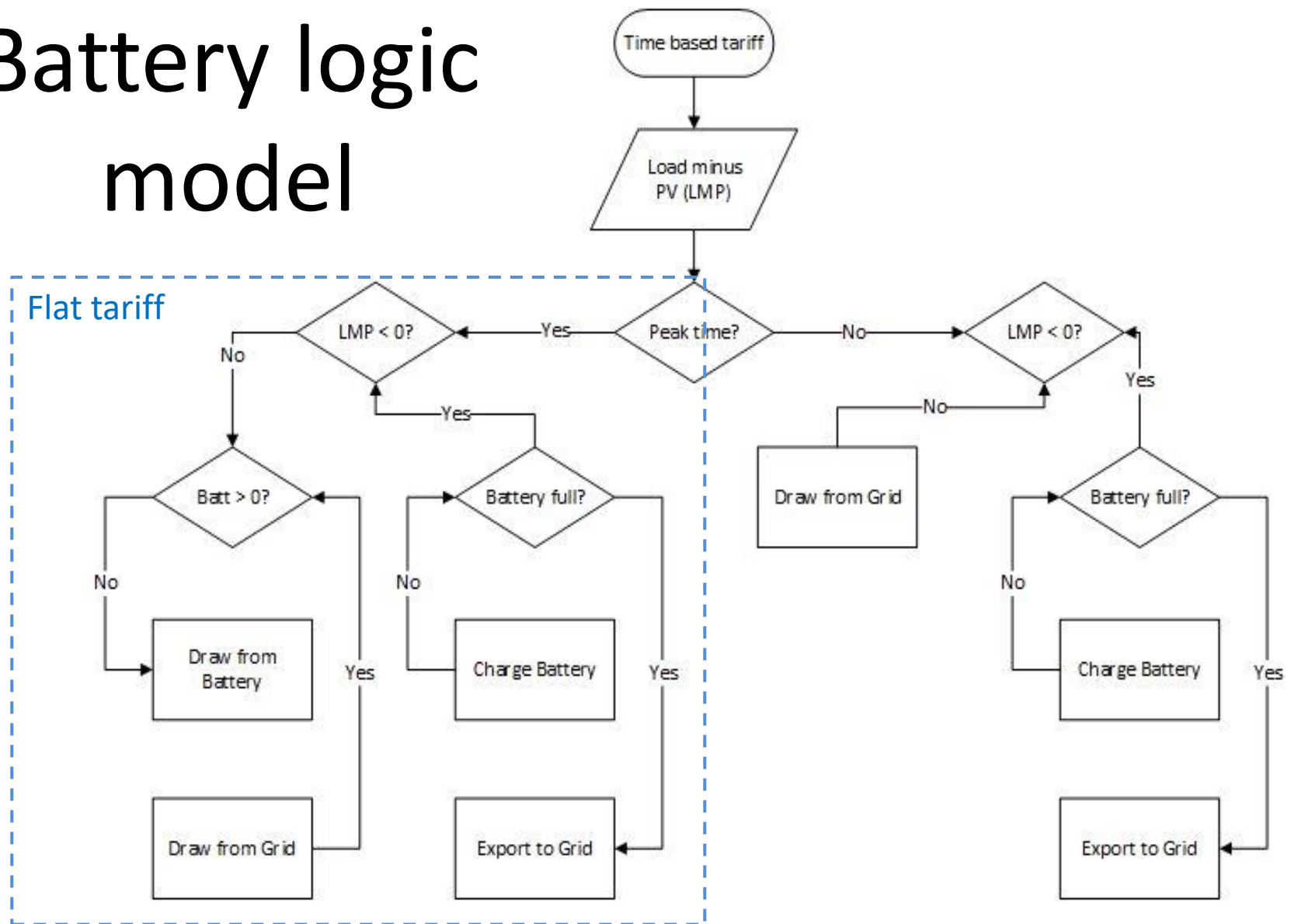
Tariff type

Battery Limitations

PV & load data

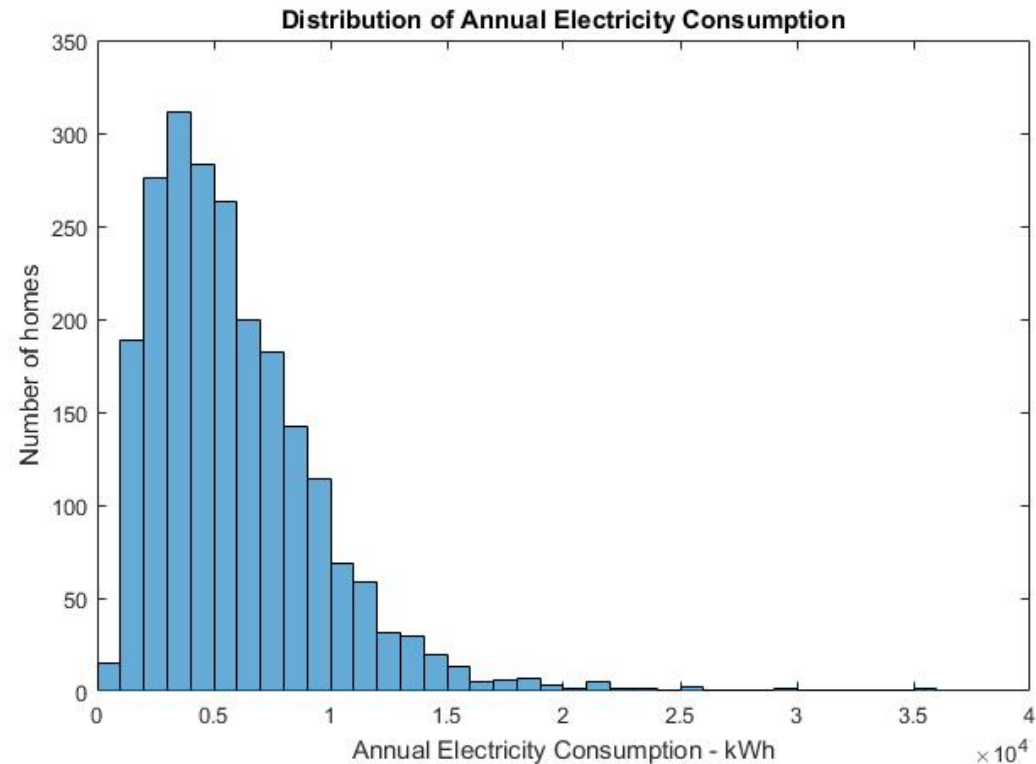


Battery logic model



System allocation according to sizing

System details	Small	Medium	Large
Annual Household Consumption	< 3200kWh	3200 - 7700kWh	> 7700kWh
Median PV size	2.25kWp	3.0kWp	4.25kWp
Available battery capacity	6kWh	8kWh	10kWh
Battery maximum discharge rate	3kW	4kW	5kW
Battery cycle efficiency	94%	94%	94%



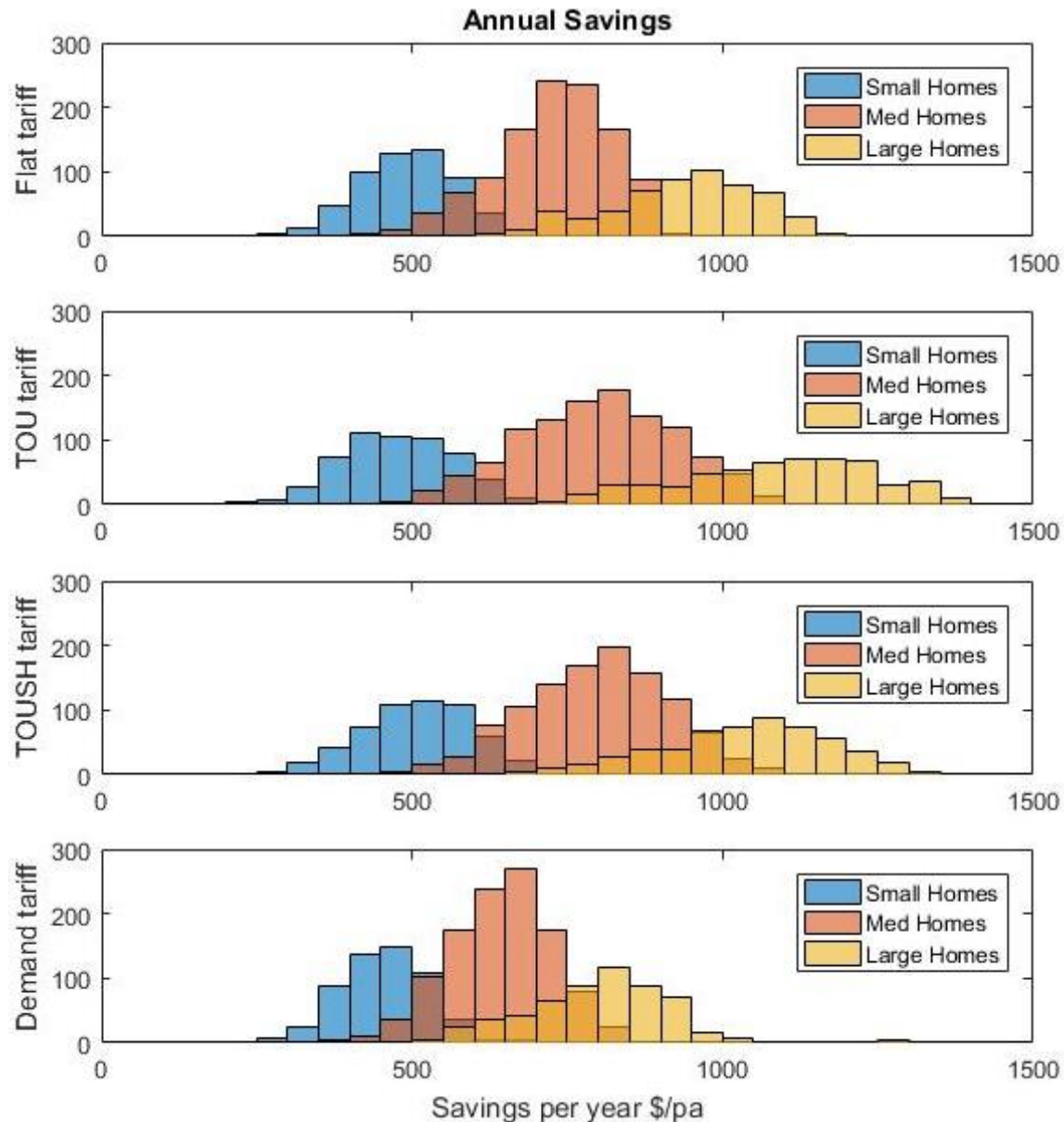
Bill Savings

Depend a little
bit on the tariff

And a lot more
on:

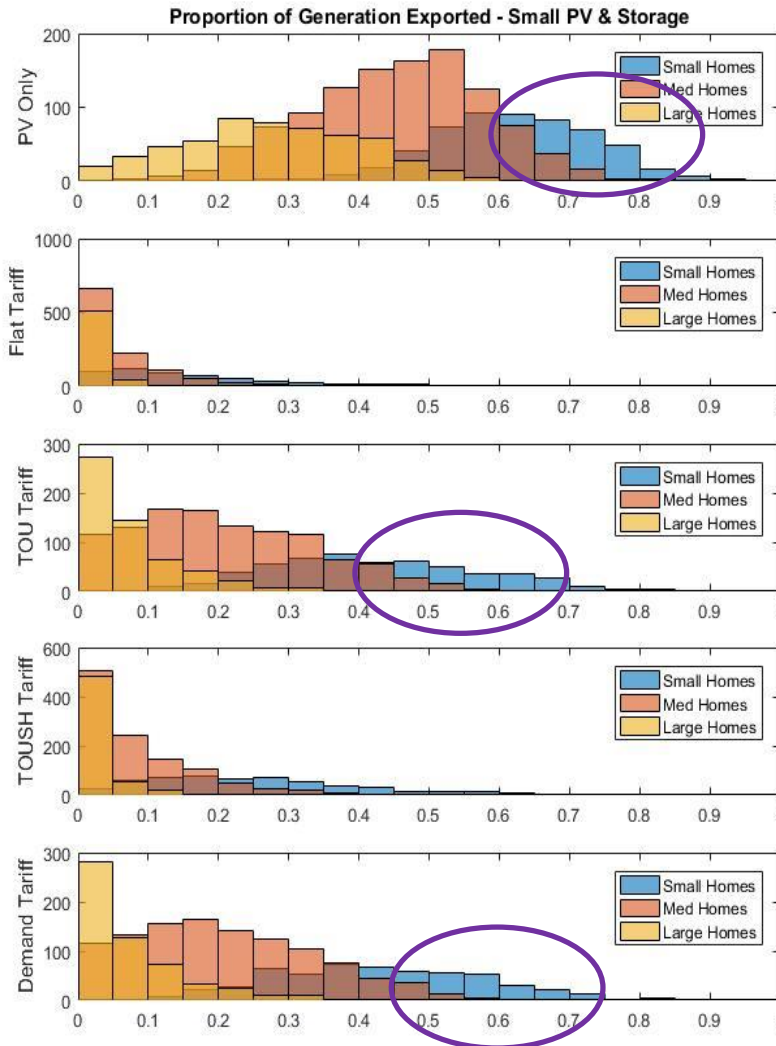
How much
energy is used

What the system
setup is



Savings per annum for medium PV and medium storage scenario

System Setup (1)



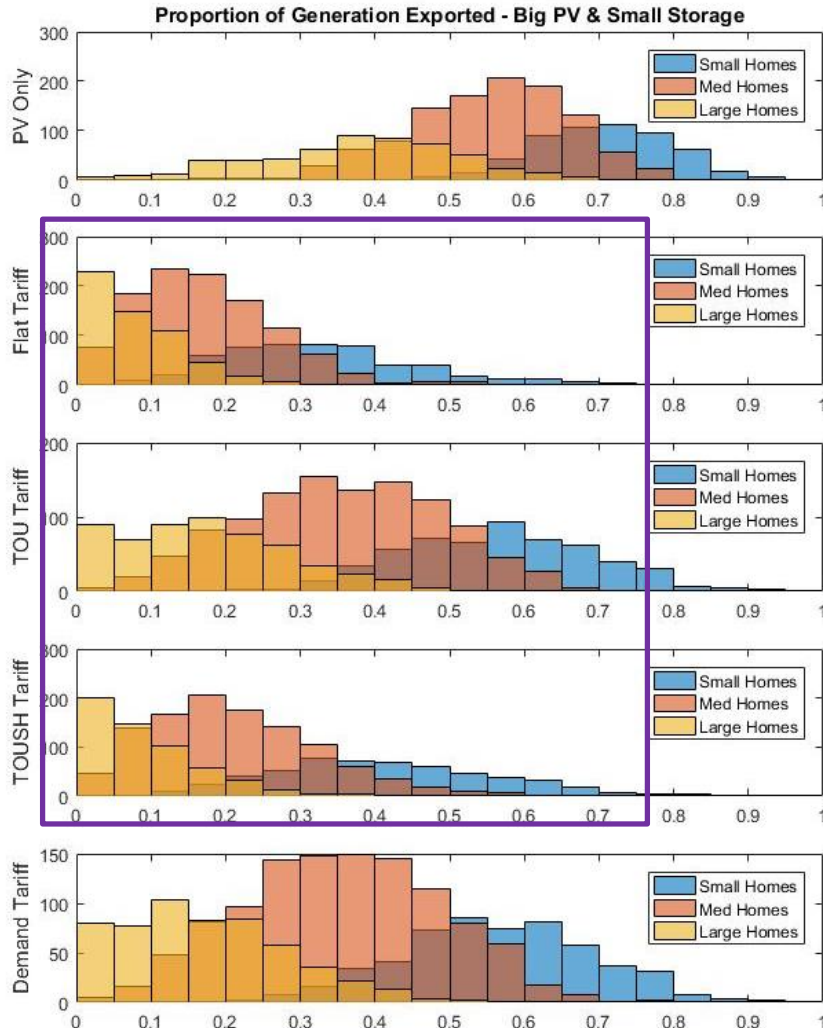
Homes with low energy consumption frequently export PV generation

Even with small PV

System Setup (2)

It doesn't take a lot of storage to make a big difference to exports

It's about how you use the storage



Payback times (1)

Scenario	Small Homes		Medium Homes		Large Homes	
	PV Only	PV with BES	PV Only	PV with BES	PV Only	PV with BES
Sm PV / Sm Batt		11.45		9.3		9.09
Sm PV / M Batt	5.91	18.74	5.07	15.03	4.38	13.96
Sm PV / Lge Batt		25.82		19.76		17.57
M PV / Sm Batt		10.98		8.76		8.15
M PV / M Batt	6.31	17.47	5.29	13.72	4.51	12.06
M PV / Lge Batt		23.97		17.76		15.04
Lge PV / Sm Batt		10.77		8.56		7.58
Lge PV / M Batt	6.51	16.63	5.56	12.75	4.71	10.72
Lge PV / Lge Batt		22.52		16.58		13.54

If you only have PV, the smaller, the better.

BUT

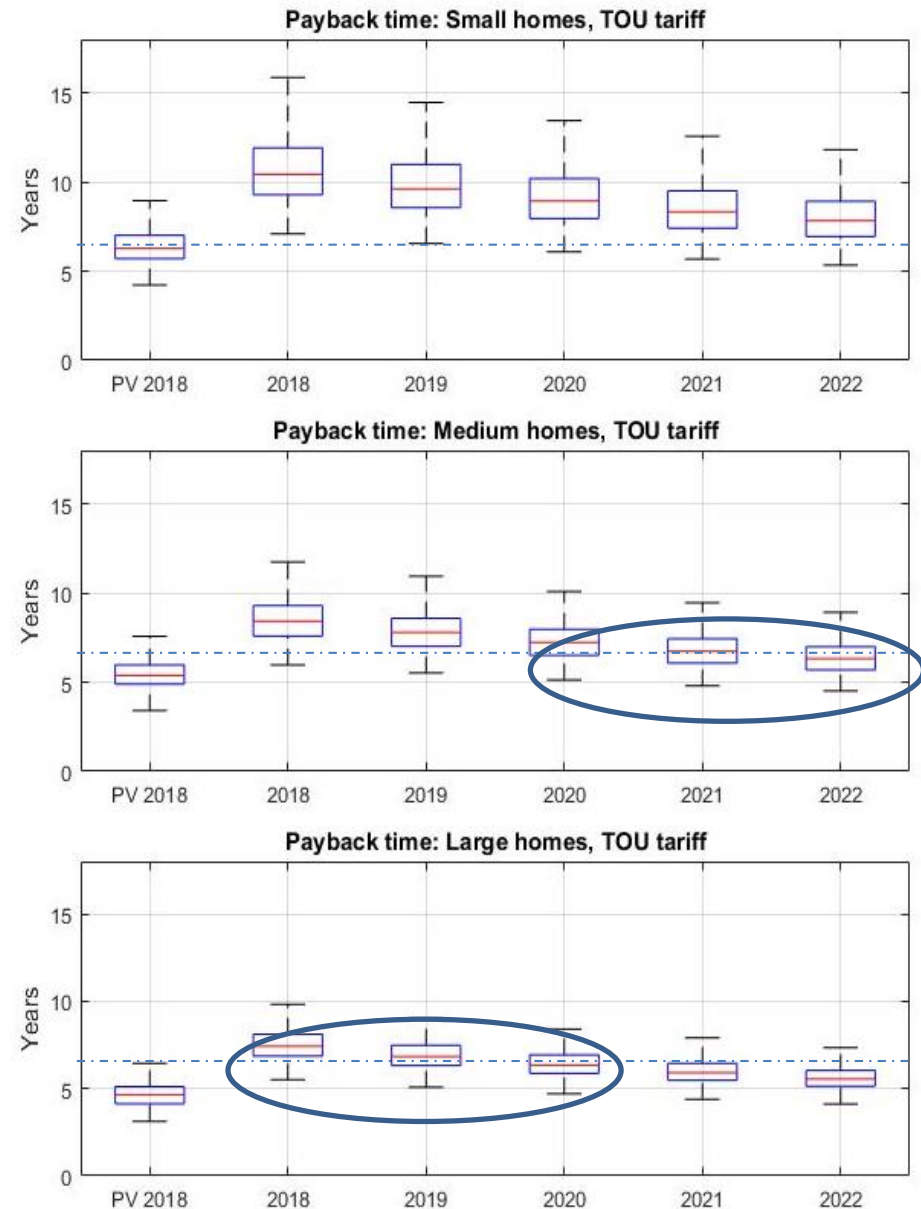
If you have storage, the more PV, the better!

Average simple payback time in years according to scenarios for homes on the TOU tariff

Payback times (2)

With the optimal setup
payback doesn't take
long

And rapid household uptake in
coming years is highly likely



Payback times for homes on a TOU tariff with a large PV system and a small battery

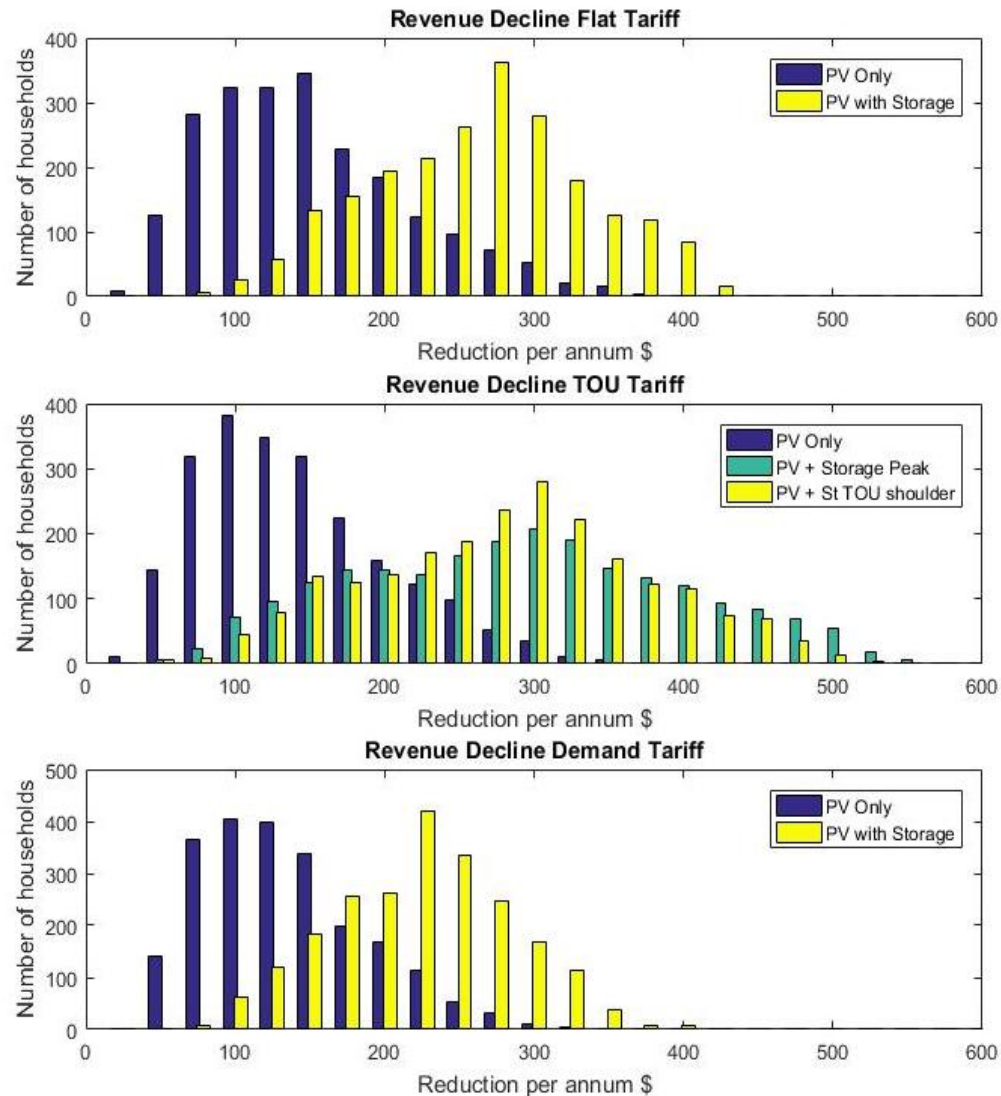
Questions

- How much do household actions add up?
- What if homes get storage?
- What are the effects on the rest of the industry?
- Can new tariffs improve the outcome?

What happens to the networks?

They don't get as much revenue

Tariff	Base revenue	Revenue drop per 1% of homes with PV	Revenue drop per 1% of homes with PV + storage
Flat	\$2044.34m	\$3.83m	\$6.96m
TOU			\$7.65m
TOU incl Shoulder	\$1920.23m	\$3.56m	\$7.46m
Demand	\$2042.46m	\$3.35m	\$5.85m



...but peak demand drops

Scenario	25% PV, 20% subset have storage		40% PV, 50% subset have storage	
	Local	State	Local	State
PV Only	67kW (2.77%)	803MW (5.78%)	87kW (3.58%)	1198MW (8.61%)
Flat	84kW (3.47%)	878MW (6.31%)	142kW (5.87%)	1345MW (9.67%)
Time of Use	99kW (4.11%)	912MW (6.56%)	179kW (7.38%)	1658MW (11.92%)
Time of Use (inc shoulder)	88kW (3.65%)	851MW (6.12%)	161kW (6.65%)	1470MW (10.57%)
Demand	102kW (4.24%)	905MW (6.51%)	177kW (7.30%)	1664MW (11.96%)

Peak demand reductions

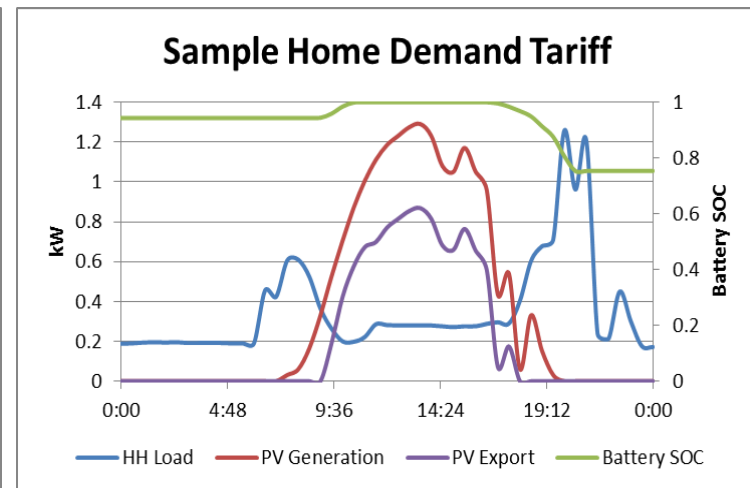
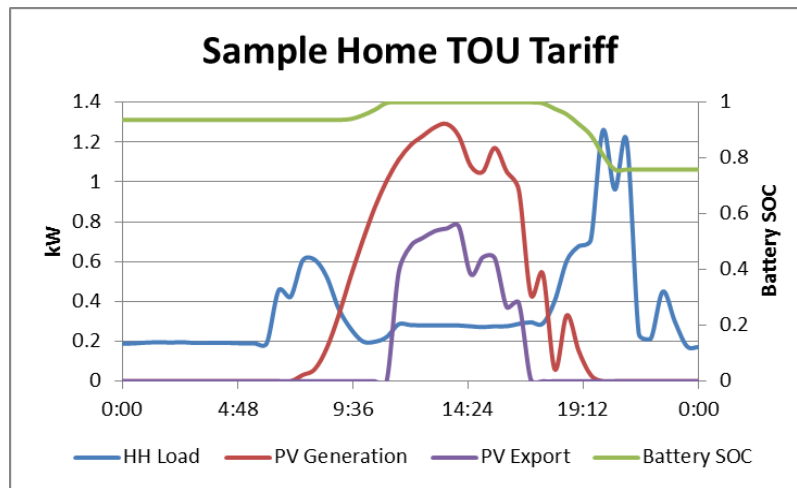
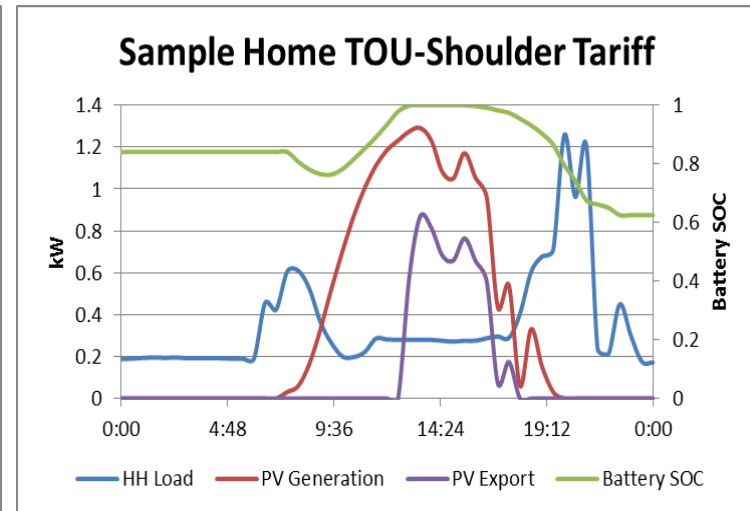
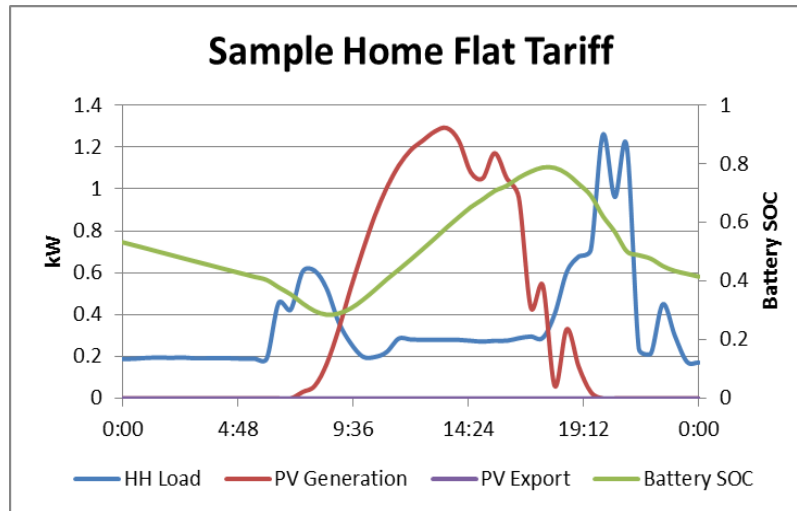
Augmentation cost reductions

Scenario	25% PV, 20% subset have storage		40% PV, 50% subset have storage	
	Local	State	Local	State
PV Only	\$11,000	\$131.7m	\$14,241	\$196.5m
Flat	\$13,799	\$144.0m	\$23,335	\$220.5m
Time of Use	\$16,332	\$149.6m	\$29,346	\$272.0m
Time of Use (inc shoulder)	\$14,513	\$139.6m	\$26,422	\$241.2m
Demand	\$16,840	\$148.4m	\$29,021	\$272.8m

All the
homes
stack up
and the
effects start
to merge

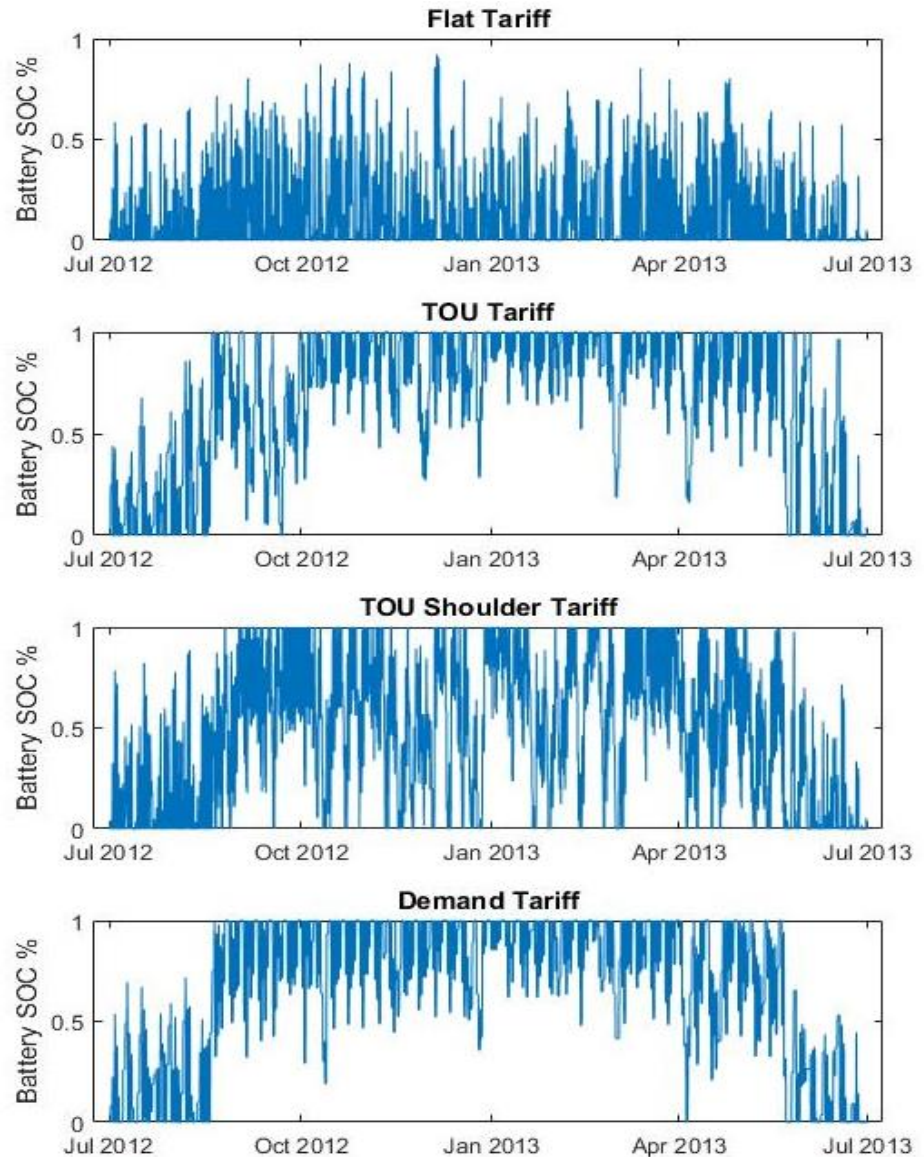


It starts with the individual homes

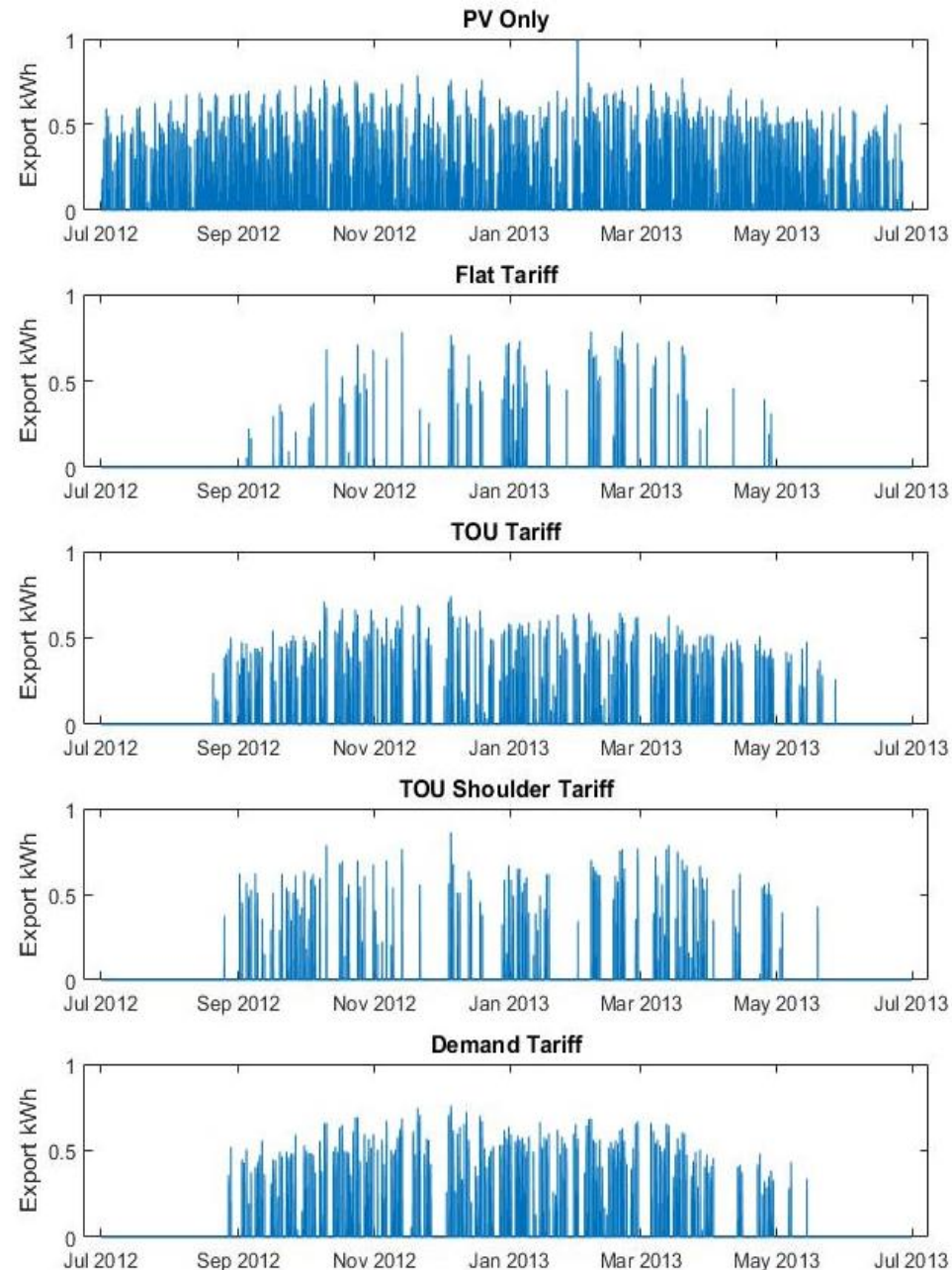


How the battery
behaves depends on
the tariff

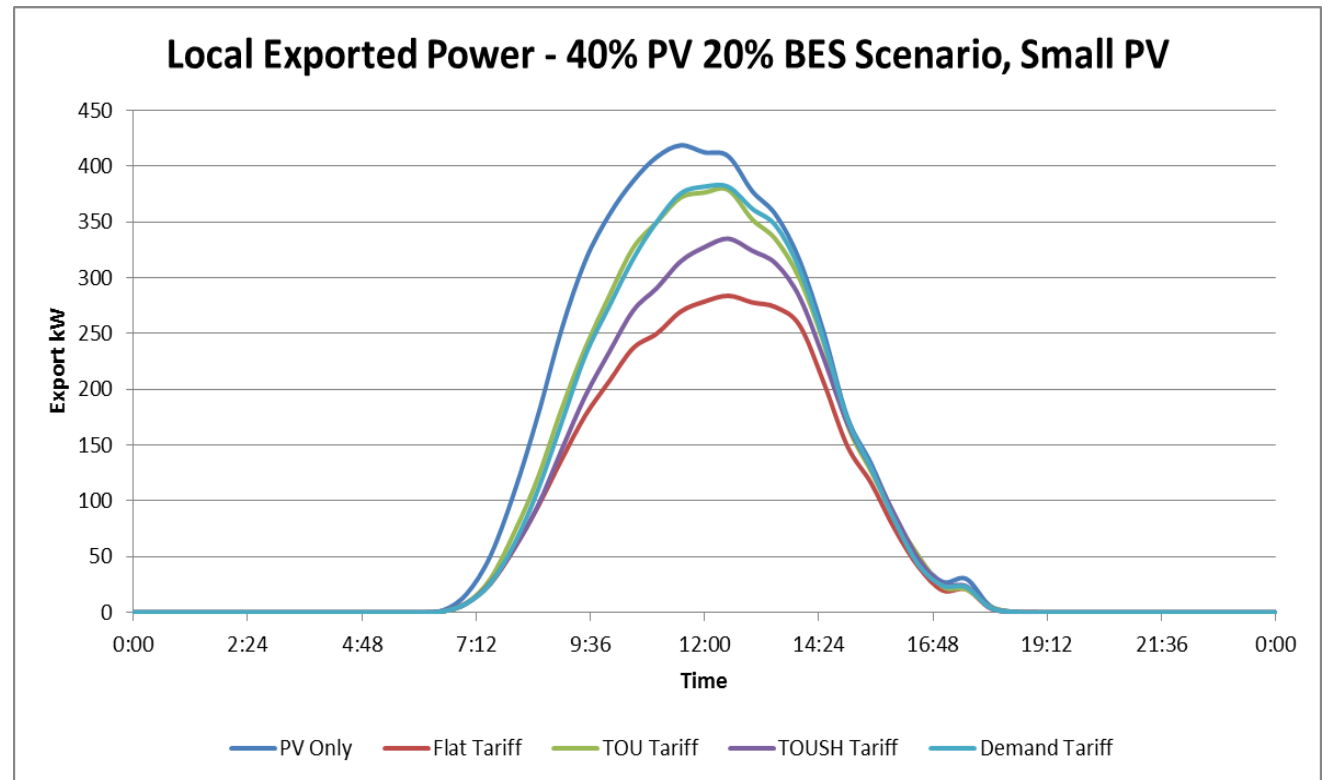
and the SOC has a
BIG impact on the
exports



And surprisingly,
it's the exports
that have the
biggest knock-on
effects



Exports
will
depend
on the
battery,
PV size
and on
the tariff

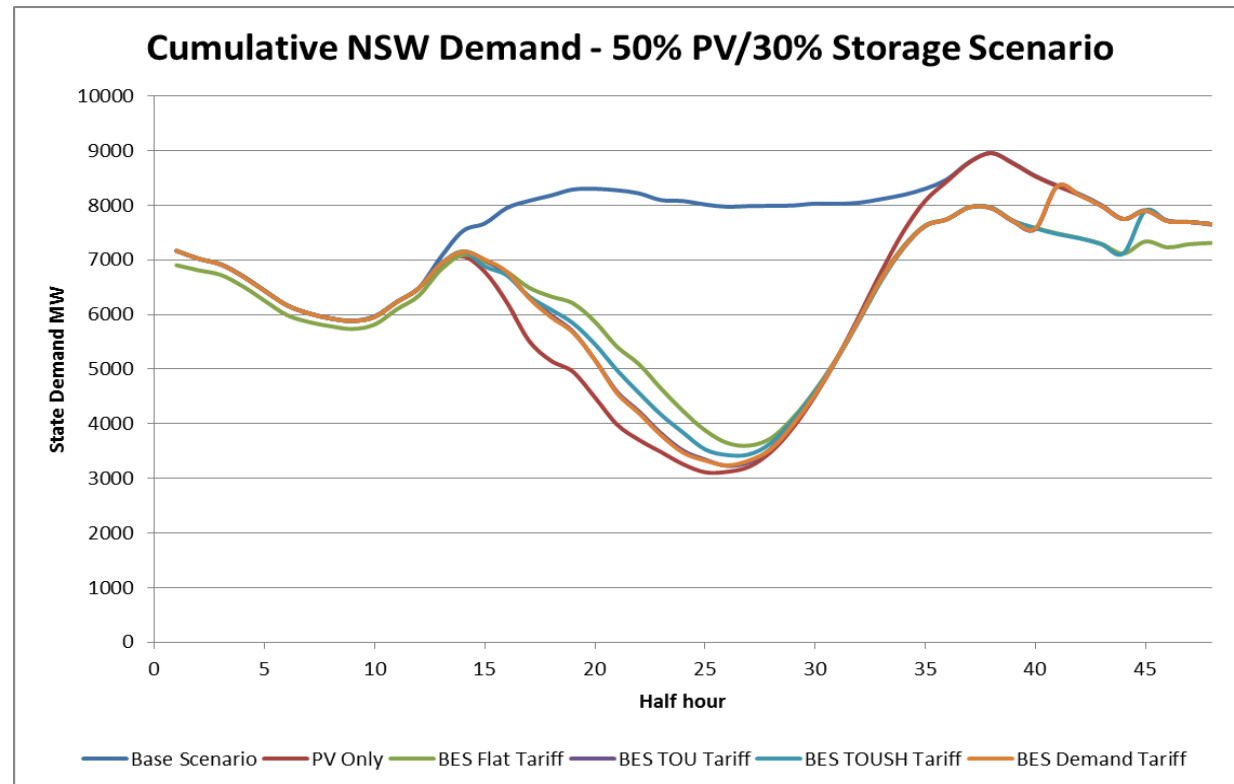


It all adds up at state levels

PV capacity
dominates the
effects

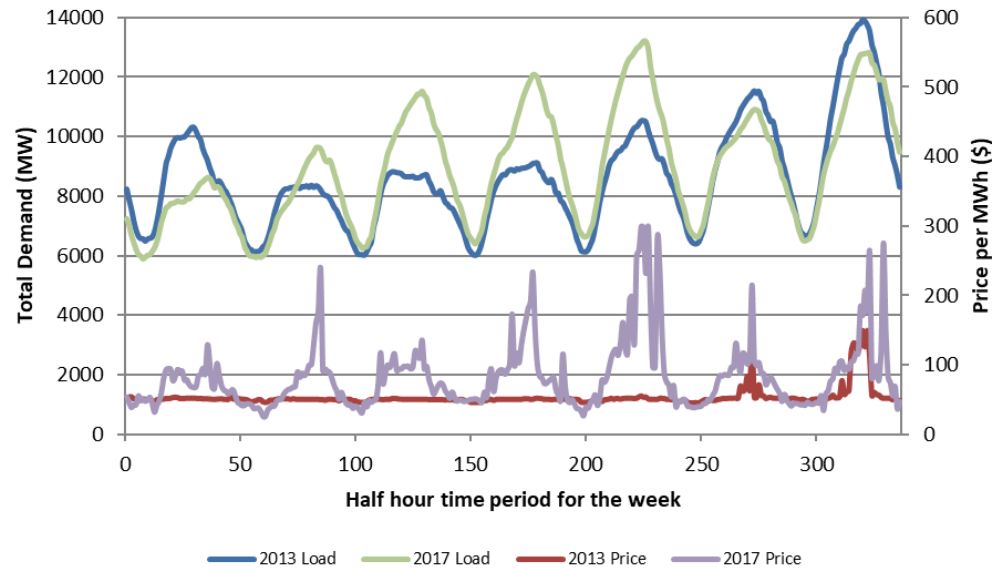
Battery reduces
peak demand

Battery tariff
shapes the export
profile

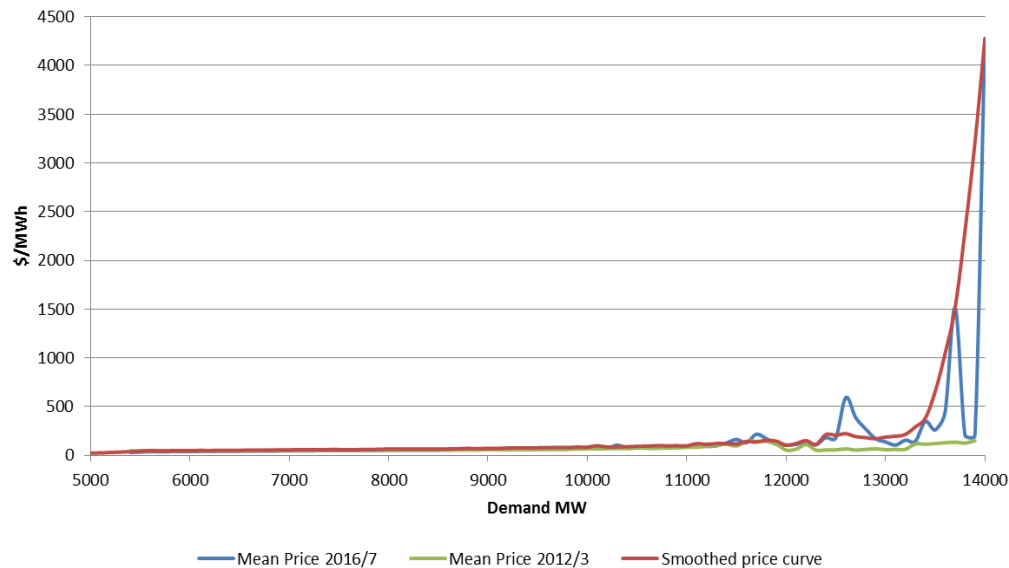


Tariff type does not make a significant difference to peak demand

Price and Demand in January



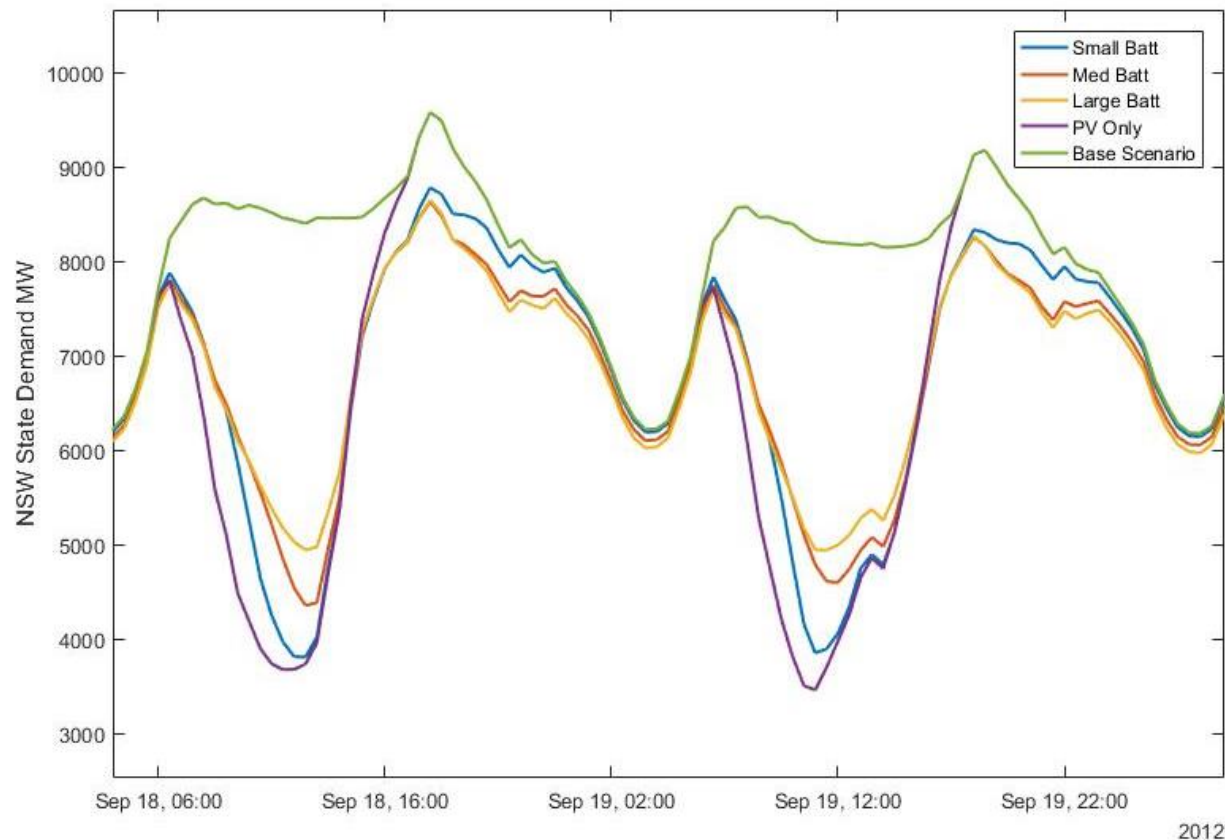
NSW Wholesale Market Price vs Demand



Determining the price for wholesale demand is not easy

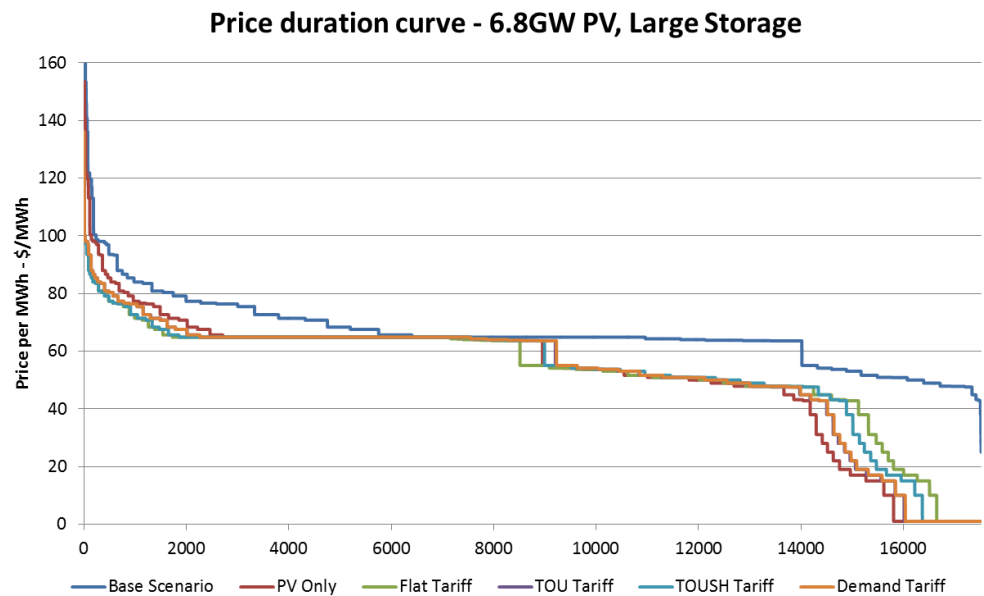
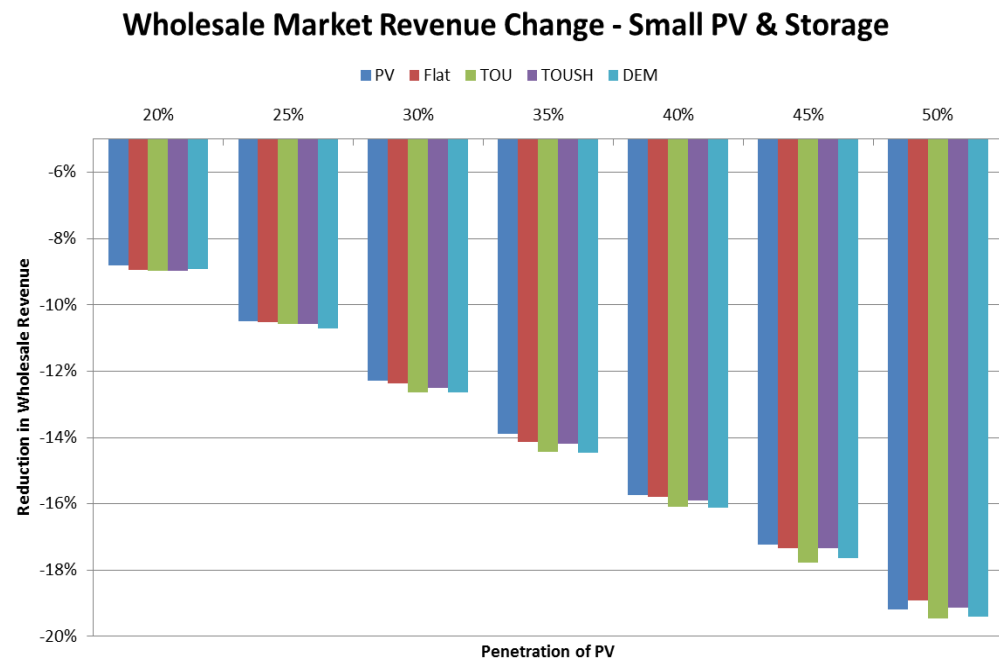
Battery capacity has an effect on profile

But it's PV size that dominates economic impacts



Scenario	Annual State NEM Revenue	Change from Base
PV Only	\$7.446bn	- 24.66%
Small size BES	\$7.435bn	- 24.77%
Medium size BES	\$7.412bn	- 25.00%
Large size BES	\$7.420bn	- 24.91%

PV
dominates
revenue
reduction;
tariff
dictates
the details



Questions

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- What if homes get storage?
- What are the effects on the rest of the industry?
- Can new tariffs improve the outcome?

Cost reflective tariffs are hard to balance

Accurately
reflective tariffs

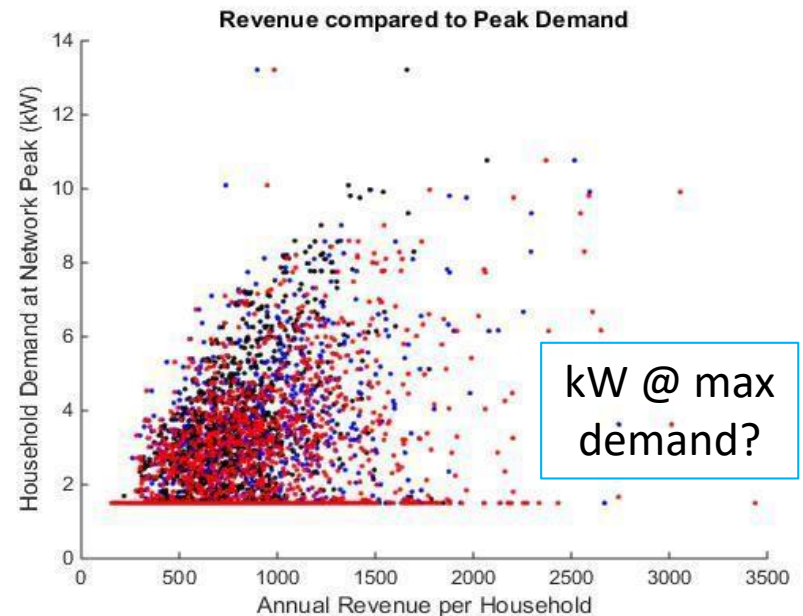
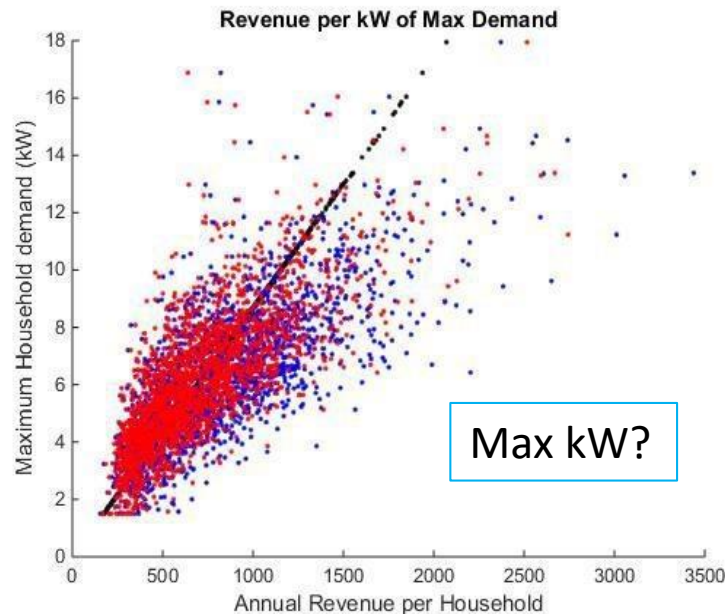
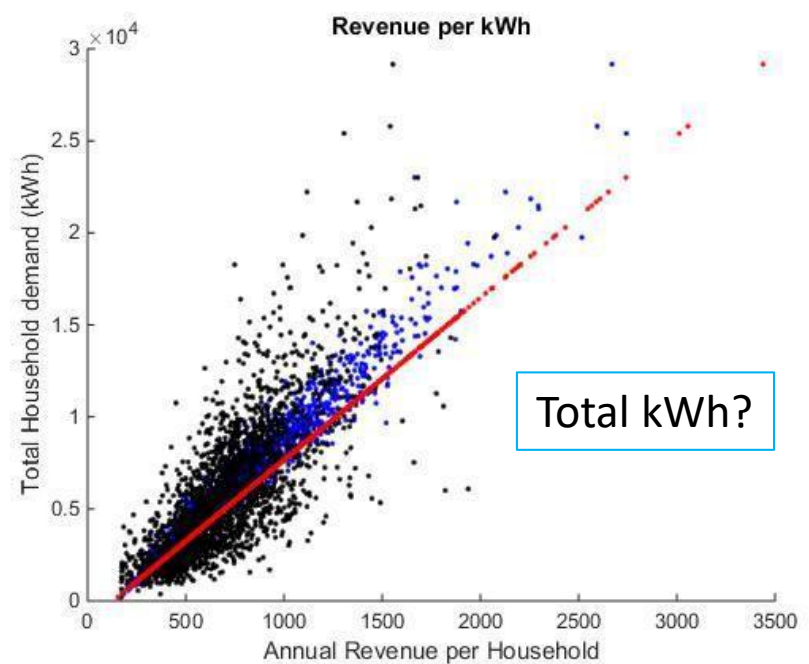
Understandable
tariffs

Revenue certainty
for providers

Consumer ability to
respond to price signal



Reflecting which cost?



Flat tariff

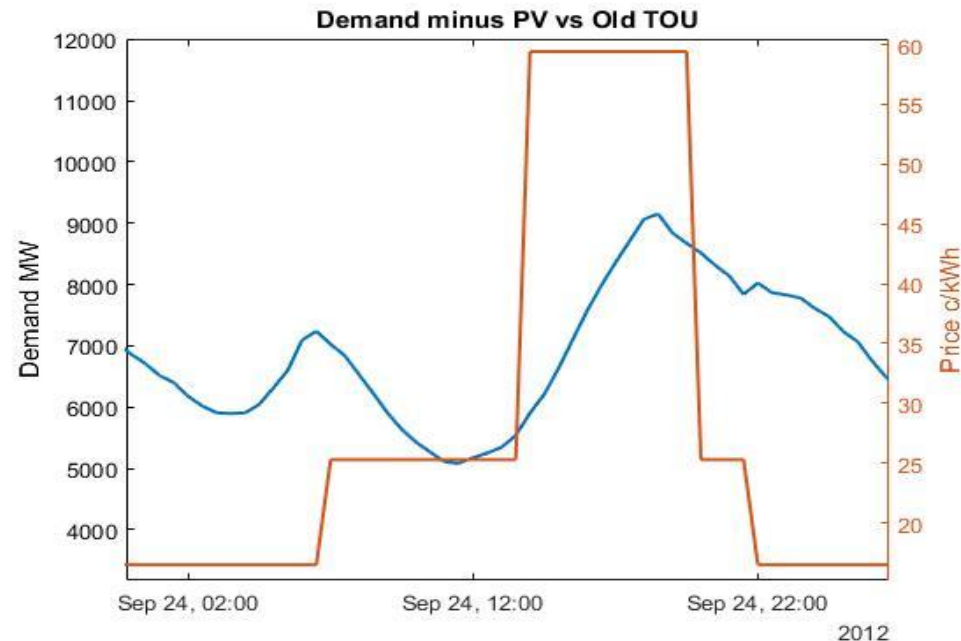
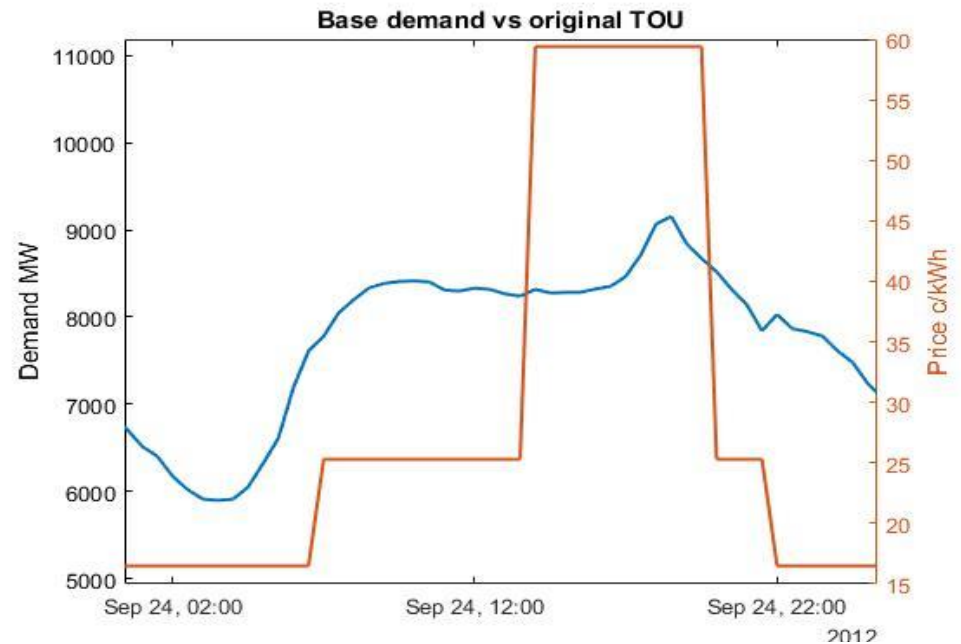
TOU
tariff

Demand
tariff

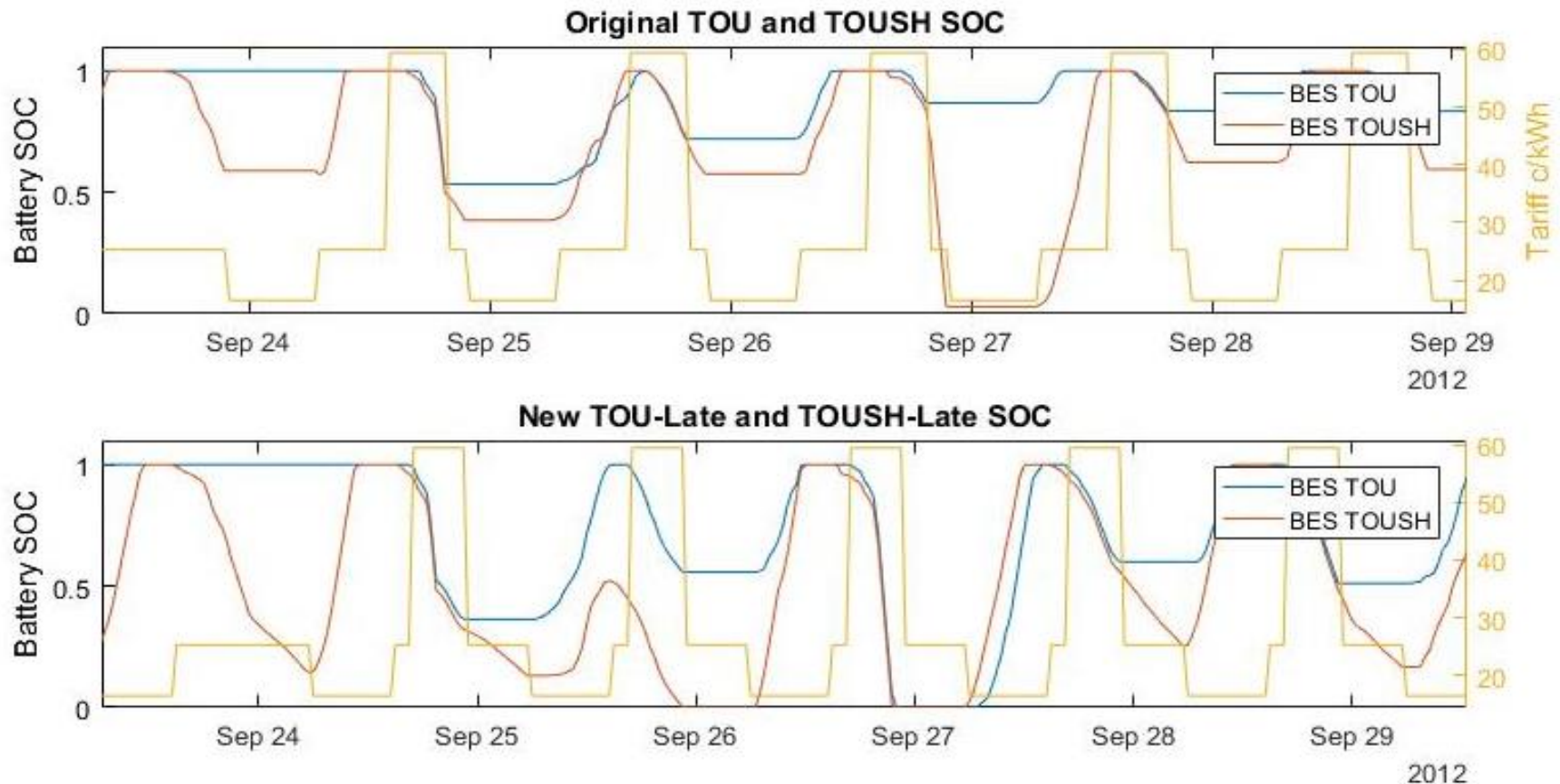
Wholesale demand

TOU pricing can be an approximate reflection of daily demand

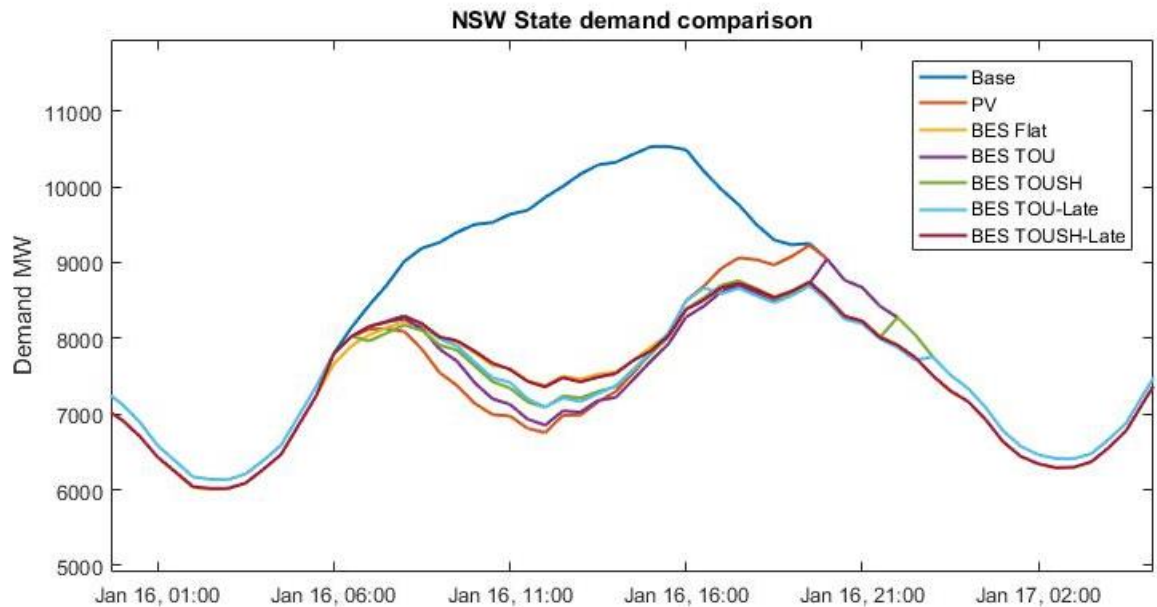
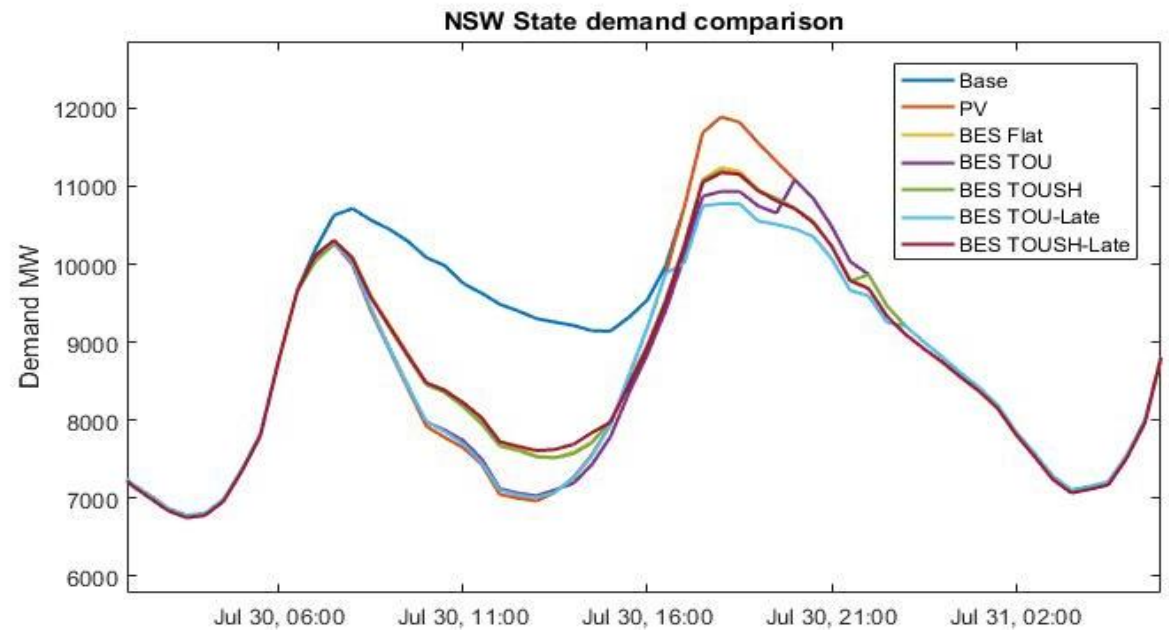
... but it may need to change



Change tariff to change battery use



Smoother
peak
demand by
tariff?



2013

That's all Folks!

