


Sharing the load

Understanding consumer outcomes of network tariff reform


Tariffs Project II
FINAL REPORT
April 2018

Document Information

Document Version	Date	Prepared By	Reviewed By	Comments
ATA Cost-reflective Tariffs Project - DRAFT Report v0.1	16 April 2018	Dean Lombard – Senior Energy Analyst Damien Moyse – Policy & Research Manager	Damien Moyse – Policy & Research Manager	Initial Version
ATA Cost-reflective Tariffs Project - DRAFT Report v0.2	20 April 2018	Dean Lombard – Senior Energy Analyst Damien Moyse – Policy & Research Manager	Damien Moyse – Policy & Research Manager	Penultimate draft
ATA Cost-reflective Tariffs Project - DRAFT Report v0.3	22 April 2018	Dean Lombard – Senior Energy Analyst	Damien Moyse – Policy & Research Manager	Final draft
ATA Consumer outcomes of tariff reform	22 April 2018	Dean Lombard – Senior Energy Analyst	Damien Moyse – Policy & Research Manager	Final version

Prepared for Energy Consumers Australia

ATA Energy Projects Team

Prepared by: Dean Lombard, Damien Moyse

Cover photograph: ATA

Alternative Technology Association

Level 1, 39 Little Collins St, Melbourne VIC 3000

+61 3 9639 1500

+61 3 9639 5814

www.ata.org.au

Promoting Renewable Energy, Energy Efficiency and Water Conservation since 1980

This project was funded by Energy Consumers Australia as part of its grants process for consumer advocacy projects and research projects for the benefit of consumers of electricity and natural gas. The views expressed in this document do not necessarily reflect the views of Energy Consumers Australia.

Contents

1 Executive summary 5
2 Introduction 6
3 Why reflect network costs? 6
3.1 What costs should be reflected? 7
3.2 How should household usage be measured for billing? 8
3.3 What should users pay for? 9
3.4 What we need to see 10
4 Insights from analysis of the customer impact of tariffs 10
4.1 Impact of different types of tariffs on different load profiles 10
4.2 Household types and load characteristics 11
4.3 Price outcomes for different household types 14
4.4 Demand tariffs and rooftop PV cross-subsidisation 29
5 Conclusions 29

1 Executive summary

Distribution pricing rules require that distribution network charges paid by households and businesses must better reflect the different ways they use electricity and the costs of providing it to them.

In an energy market framework that seeks equitable cost and service outcomes for consumers and embodies the principle that no consumer should forego supply due to inability to pay, allocation of costs proportionately to how they are incurred is fundamental. Cost-reflective network tariffs are a key element in achieving this.

It is generally recognised that network charges for small consumers based on energy throughput (i.e. kilowatt hours) does not reflect the true cost of providing network capacity, especially at times of peak demand. Networks are built to support expected demand, irrespective of volume, over a defined period. This suggests that pricing based on demand rather than consumption would be more reflective of both sunk and future costs.

In principle, ATA believes that small energy consumers should pay for:

- a fair share of ongoing costs (i.e. sunk costs, operation, maintenance); and
- a fair share of future network augmentation.

This implies different approaches for addressing network critical peaks and network daily demand.

Our analysis of customer load profiles shows that, for almost all households, annual peak demand was between 2.5 and 6 times average daily peak demand, with a median and mean of 3 times average daily peak demand. **Under most DNSPs' current and proposed demand tariffs, households would be charged according to their outlier peaks on a handful of days per year (maximum monthly or quarterly demand), instead of their typical peaks.** This has a significant impact on the final kilowatt-based charge applied to these households, and in our view is not an accurate reflection of households' impact in the network.

In developing cost-reflective tariffs, DNSPs need to clearly demonstrate the relative contribution to network costs of annual and daily peak demand, and then develop tariffs that properly reflect those costs.

ATA also believes that regulators and network businesses are still yet to properly define the objective of cost-reflective network pricing (CRNP). NEM participants should have a clear view on what CRNP policy is trying to achieve in any jurisdiction or network area – i.e. is the objective:

- efficient allocation of costs; or
- consumer behaviour change?

Obviously these two are interrelated – cost changes influence behaviour – but the approach to implementation will differ depending on the overwhelming purpose.

Analysis of several DNSPs' cost reflective tariffs' actual impact on a large cohort of residential customer shows that while there are winners and losers among all household types, demand-based tariffs as currently comprised are more likely to increase prices for many low-consumption households and reduce them for high-consumption households. Thus, whatever negatively impact eventuates will hit lower income households disproportionately. This should be addressed in the first place by ensuring the consumer impact principle is properly applied during tariff design; which should include consumer consultation and customer detailed impact assessment during the design phase. It also demands targeted assistance to vulnerable households as part of broader social policy programs, and highlights the value of assisting vulnerable households with demand management.

The analysis also shows that demand-based tariffs can help ensure households with solar PV and other energy generation and storage technology pay their fair share of network charges. At the same time, DNSPs should ensure that these households are fairly rewarded for their contribution to reducing network costs.

2 Introduction

From 2017, as a result of the AEMC's Power of Choice[1] reforms, new distribution pricing rules[2] require that distribution network charges paid by households and businesses must better reflect the different ways they use electricity and the costs of providing it to them.

According to the AEMC, the new "Cost Reflective Network Pricing" (CRNP) rules are designed to give consumers the option of reducing their peak demand to save money or continuing to use electricity at those times when the value they place on that use outweighs the costs.

Effectively managing energy demand contributes to reducing the cost of supply. A shift in usage away from peak periods or a general reduction in consumption can delay investment in generation and networks (poles and wires), reducing overall cost and ultimately lowering prices for everyone.

The package of reforms delivered as part of Power of Choice will support the electricity market in meeting consumer needs over the next 15 to 20 years.

ATA understands the primary objective of CRNP to be:

- equity in the allocation of the costs, benefits and risks to supply electricity network services to small consumers (i.e. the removal of cross subsidies).

As at April 2018, there have been two rounds of CRNP Tariff Structure Statements developed by DNSPs and assessed by the AER. Residential and small consumer CRNP tariffs now exist both at a distribution level across the NEM, and, to a lesser extent, at a retail level. Work is ongoing regarding the development and cost-reflectivity of each DNSP's response to the new CRNP Rule.

In principle, ATA believes that from a consumer perspective, the costs, benefits and risks of CRNP must be efficiently and equitably allocated:

- among consumer groups;
- between consumers and energy businesses; and
- where payments to consumers are involved (such as for embedded generation and demand response), between participants and other consumers.

ATA understands that the implementation of this objective will necessarily mean that those small consumers whose electricity usage imposes a higher cost on the provision of network services will ultimately pay more for those services – and vice versa.

ATA also understands that in the transition towards CRNP, consumer impacts must be given primary consideration – particularly in the context of tariff design, tariff levels and the speed of transition.

The impacts on different consumers, particularly vulnerable and disadvantaged, and those in rural and regional areas, must also be properly understood and their needs accommodated.

3 Why reflect network costs?

In an energy market framework that:

- seeks equitable cost and service outcomes for consumers; and
- embodies the principle that no consumer should forego supply due to inability to pay;

allocation of costs proportionately to how they are incurred is fundamental. Cost-reflective network tariffs are a key element in achieving this.

[1] https://www.aemc.gov.au/our-work/our-current-major-projects/power-choice

[2] https://www.aemc.gov.au/rule-changes/distribution-network-pricing-arrangements

Charging prices to customers that reflect their contribution to system costs limits inequitable cross-subsidies – where some customers pay share of costs caused by other customers – and sends the right investment signals to customers with regard to on-premises energy equipment.

If a customer's energy usage patterns are driving costs in the network or market, they either face that higher cost or they invest in their own equipment to reduce their costs, thus reducing their impact on network or market costs.

However, economic equity is only one part of equitable cost outcomes from infrastructure. Social equity is also important. This is particularly relevant to electricity networks, where so many costs are fixed.

In a hypothetical network with no capacity limitations, costs might be almost entirely fixed. From an economic equity perspective, this could mean that all small-to-medium customers pay the same fixed charge to access the network. However, this would seem inequitable from a social standpoint, with very small users paying the same as quite large ones. Thus, is seems appropriate that the sharing of fixed costs also reflects the degree to which customers use the network.

The Distribution Pricing Principles in the National Energy Rules support this approach, since they require that tariffs reflect long-run marginal costs, but also consider customer impacts.

One concern of the tariff reform process has been potential impacts on customers vulnerable to financial hardship.

Undoubtedly, some vulnerable customers will experience price shock if they are moved to cost-reflective tariffs. Equally, some will experience price reductions. Tariff structures cannot in themselves address financial hardship.

While tariffs based on actual network costs may more harshly penalise financially vulnerable customers with high-demand usage patterns (perhaps due to poor quality heating and thermally-poor housing), non-cost-reflective tariffs based primarily on volume already more harshly penalise other vulnerable customers with high consumption but moderate demand.

In ATA's view, cost-reflective tariffs that balance economic and social equity by allocating network costs in proportion to how they are being driven and sharing fixed costs in proportion to value derived from the network, provide the greatest fairness for most users.

Acute and chronic affordability problems should be addressed in a systematic and targeted way as a shared responsibility of market participants backed up by strong government social policy. This is necessary now and will continue to be necessary under any tariff framework.

3.1 What costs should be reflected?

This is a key question and can only be answered with a thorough understanding of what the biggest drivers of network costs are.

It is generally recognised that network charges for small consumers based on energy throughput (i.e. kilowatt hours) does not reflect the true cost of providing network capacity, especially at times of peak demand. Networks are built to support expected demand, irrespective of volume over a defined period. This suggests that pricing based on demand rather than consumption is more reflective of both sunk and future costs.

But what aspect of demand should pricing be based on? In some networks, it is clear that peak demand on the highest demand days of the year drive significant augmentation costs, to build extra capacity for those few days each year when it is needed. In other networks, there are no such capacity constraints; but the network still embodies considerable investment that has given it the capacity it has and requires ongoing maintenance expenditure to maintain that capacity.

Our analysis of eight distribution networks' pricing proposals in Victoria and NSW gives some indication of how operating and capital expenditure compare:

- Of the total spent on capital and operating expenditure, 50–70 per cent is capital expenditure;
- 25–55 per cent (mean: 42) of capital expenditure is for repairs/replacements and maintenance to maintain existing capacity; and
- 10–30 per cent (mean: 16) of capital expenditure is for augmentation works and upgrades, generally to increase capacity.

This suggests that while augmentation costs are significant, capital expenditure is driven more by maintaining everyday demand than meeting demand growth. Cost-reflective pricing should target both, but probably in different ways.

The University of New South Wales' Centre for Energy and Environmental Markets' analysis of customer loads in relation to network peaks[3] makes a strong case for coincident peak pricing on annual critical peak demand days. We agree that this is the best way to reflect augmentation costs. However, as noted above, the considerable sunk and ongoing cost associated with maintaining everyday capacity still needs to be paid for by end-users; and it is more equitable to allocate these proportionately based on users' everyday demand, rather than being shared evenly among all customers, large and small. Demand-based pricing *outside of critical peak demand pricing* should be allocated between and within customer classes proportionately to their contribution to the sum total of everyday demand.

3.2 How should household usage be measured for billing?

Whilst the principle of reflecting some costs based on demand is sound, the challenge is in defining what constitutes demand for a small consumer. When using targeted pricing to reflect the augmentation costs of accommodating critical peaks, maximum demand measured during actual critical peaks is clearly the most appropriate. But in reflecting the costs of investment in and maintenance of everyday capacity, a variety of approaches are possible:

- weekly, monthly or quarterly peak demand during daily peak periods;
- average annual or seasonal peak demand during peak periods; or
- average daily peak demand, measured annually, seasonally, monthly, or weekly.

Alternatively, is there a fairer way to allocate costs than demand-based charges?

3.2.1 What do customer loads like, and what does this mean for demand measurement?

As part of this project, ATA analysed 18 consumption datasets (48 x 365 profiles) from our own collection of demographically-annotated Victorian and South Australian households, and a further 3,663 from Ausgrid's Smart Grids Smart Cities project, using a tariff assessment tool developed by UNSW's Centre for Energy and Environmental Markets. The purpose of this exercise was to consider the impact of DNSP-proposed cost-reflective tariffs on household loads typical of different types of households.

Of note: for almost all households, annual peak demand was between 2.5 and 6 times average daily peak demand, with a median and mean of 3 times average daily peak demand. **Under most of the networks' demand tariffs, households would be charged according to their outlier peaks on a handful of days per year (maximum monthly or quarterly demand), instead of their typical peaks.** This has a significant impact on the final kilowatt-based charge applied to these households, and in our view is not an accurate reflection of households' impact in the network.

A network's daily peaks are comprised of demand from individual nodes summed together, and the daily peak of each node is comprised of the highest sum of demand from individual users on that node, each of which may or may not be at their own peak demand. The demand at each node reflects each user's typical daily peak demand more than their individual highest demand in any

[3] Robert Passey, Navid Haghdadib, Anna Bruce, Iain MacGill: 'Designing more cost reflective electricity network tariffs with demand charges', Energy Policy Volume 109, October 2017, Pages 642-649

given time period. This suggests that, outside of critical peak demand pricing, household demand pricing is better based on typical or average demand during high demand periods, rather than individual peaks.

3.3 What should users pay for?

In principle, ATA believes that small energy consumers should pay for:

- a fair share of ongoing costs (i.e. sunk costs, operation, maintenance); and
- a fair share of future network augmentation.

Much of the commentary around the need for cost-reflective network pricing (CRNP) has centred on inequitable cross-subsidies between consumers.

For example, in an addendum to its recent Tariff Structure Statement, Ausnet Services noted that volumetric network tariffs led to a number of distortions:

- *Overcharging customers who place lower than average demands on a distribution network during system peak demand periods to cover some of the costs of those customers that place higher than average demands on a distribution network during those system peak demand periods;*
- *Overcharging customers who consume a higher than average amount of energy across the year relative to a customer with who places the same demand on the network at times of system peak demand but who happens to consume a lower than average amount of energy from the network. (We note there may be good reasons other than network costs to discourage higher than average consumption.);*
- *Undercharging for the network costs imposed by appliances that increase the network peak (e.g., air-conditioners);*
- *Undercharging for the network costs imposed by appliances or technologies that reduce energy throughput across the year, or large parts of the year but do not reduce consumption at peak times (e.g., photovoltaic systems);*
- *Discouraging behaviour or investment in appliances or technologies that reduce a customer's demand during system peak demand times (e.g. such as more insulation or control systems that cycle air-conditioners off and on at peak times); and*
- *Discouraging investment in appliances or technologies that would reduce the need to distribute energy through the network during system peak demand times (e.g., a battery system in support of a photovoltaic system that stores energy at off peak times and exports energy at peak demand times).*[4]

Pricing that minimises these cross-subsidies would provide a more equitable distribution of costs.

This is clearly the principle behind The AEMC's requirement that CRNP reflect the *Long Run Marginal Cost* to supply network services to relevant consumer classes. However:

- What actually constitutes LRMC is very broad – and can include augmentation costs, replacement capital costs and operational costs, for which changes in a customer's energy usage patterns changes the timing or cost of the network expenditure. Cost-reflective tariffs need to reflect this reality; and
- A good test of the effectiveness of CRNP in addressing these cross-subsidies is that their effectiveness in doing so can be demonstrated. If it is true that "households with an air-conditioner and a solar PV unit… [are] beneficiaries of a -28.1% hidden subsidy… [and] network charges for households without an air-conditioner and without a solar PV unit… [are] +$295 or +39.5% higher than they should be"[5], then cost-reflective network tariffs should increase and decrease the network charges of these different household types accordingly.

[4] AusNet Services, Addendum to Approved Tariff Structure Statement 2017-20, September 2017.

[5] Paul Simshauser, Network tariffs: resolving rate instability and hidden subsidies: A paper for the SAP Advisory Customer Council - Utilities, Heidelberg, Germany, 16 October 2014: p. 32

3.4 What we need to see

ATA believes that regulators and network businesses are still yet to properly define the objective of cost-reflective network pricing. NEM participants should have a clear view on what CRNP policy is trying to achieve in any jurisdiction or network area – i.e. is the objective:

- efficient allocation of costs; or
- consumer behaviour change?

Obviously these two are interrelated – cost changes influence behaviour – but the approach to implementation will differ depending on the overwhelming purpose. For example, there are many other ways to influence consumer behaviour besides price signals.

ATA also believes that in developing cost-reflective tariffs, DNSPs need to clearly demonstrate the relative contribution to network costs of annual and daily peak demand, and then develop tariffs that properly reflect those costs.

Of course, one tariff solution could be based on "average" demand with a critical peak price or rebate aspect to specifically target areas or times of network constraint.

Such an approach should include granular analysis of customer impacts, including identification of systemic impacts and strategies for dealing with consumer impact issues.

4 Insights from analysis of the customer impact of tariffs

ATA used UNSW's Tariff Design and Assessment (TAD) tool to analyse the load profiles of 3,663 residential customers and the price impact on these customers of cost-reflective tariffs offered by networks in Victoria, Tasmania, ACT, NSW, South Australia, and Queensland.

The customer load profiles had detailed demographic information including income, household size, dwelling type, fuel mix, and presence and type of air conditioning. This enabled impact assessment on these household types.

Importantly, the customer cohort was located across Ausgrid's network zone in NSW. This means that tariff impacts for all other networks are indicative only, rather than definitive, because each network's tariffs will be designed differently in response to its own unique circumstances and loads – which could differ markedly due to climate and demographic mix. Nevertheless, ATA believes the results are useful in understanding the way different tariffs deliver prices to different types of households. Further tariff assessment based on representative customer samples from each network would add value to this work.

4.1 Impact of different types of tariffs on different load profiles

Different types of tariffs produce different price outcomes on different load profiles. In general:

- Flat tariffs, being based on volume, price proportionately to consumption; though the fixed charge means effective unit pricing is higher for low-volume users and lower for high-volume users.
- Time of Use (ToU) tariffs deliver prices on a similar basis to flat tariffs but skewed according to usage pattern over the course of the day. Price outcomes are similar to demand tariffs in that a load profile that peaks during the peak pricing period (typically the afternoon) will deliver a higher price than a similar volume used more evenly across the day.
- Demand tariffs tend to give higher prices to households with peaky loads and lower prices to ones with smoother loads, though the magnitude of variance can depend on whether there is also a volumetric component and its scale.

Because network tariffs are just one component of the end price facing consumers, they are not necessarily an accurate indication of the actual or relative price different consumers will face. For example, a household with very high consumption but a relatively low peak will still pay a high price due to the volume of energy purchased from their retailer. But when we are looking at the impacts of consumers transitioning from one tariff type to another, the change in network tariff gives a good indication of the change in their overall price.

4.2 Household types and load characteristics

Although it is well-known that some vulnerable households have high energy bills because of high consumption due to reasons largely or entirely outside their control – such as poor housing quality, poor quality appliances, and/or chronic health conditions that require energy-intensive equipoment or temperature control – it is widely considered that, in general, low-income households have relatively low energy usage, while high-income households have high usage. Similarly, it is often assumed that low-income households generally have lower peak demand than high-income households.

Looking at different household cohorts *en masse*, these assumptions seem to be broadly accurate. Our analysis of around 3,600 Ausgrid customer profiles shows that average consumption and demand are lower for low-income and higher for high-income households. Similar trends are evident for other ways of categorising households – such as number of people, dwelling size or type, and even type of air-conditioning – usually in predictable directions. Small dwellings and households have lower usage and peaks than larger ones. Air conditioners lead to higher peaks, especially ducted systems. Interestingly, households aged 70+ have higher usage but lower peaks than small households generally.

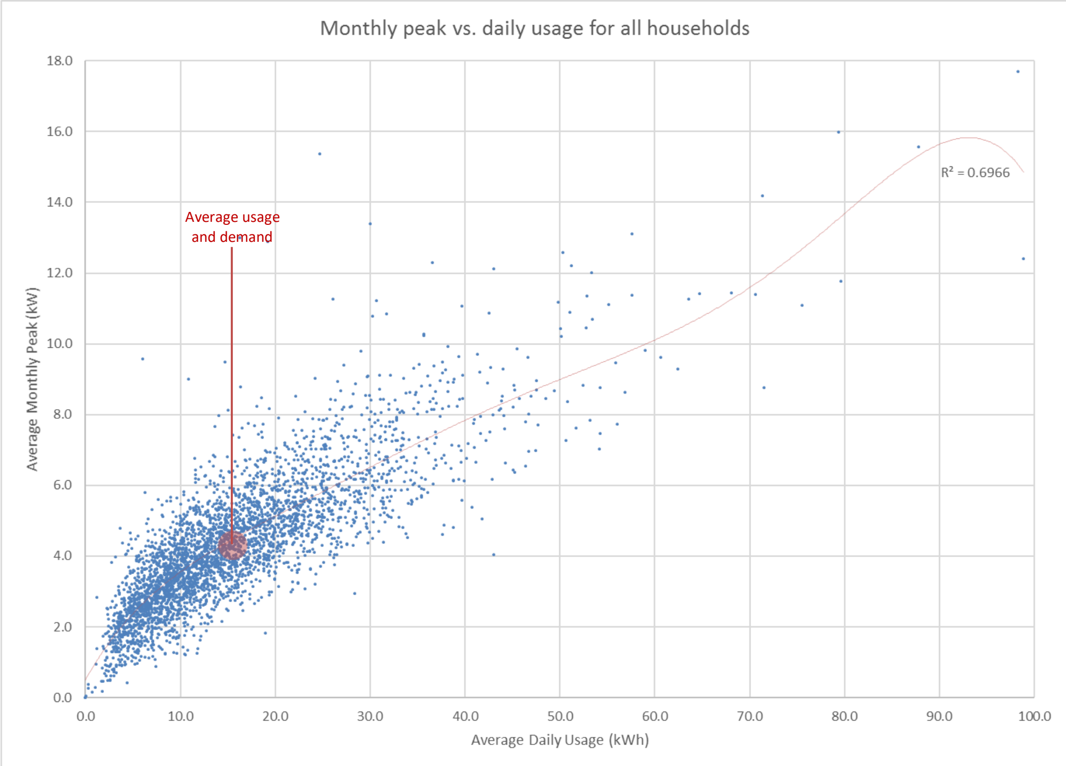
We also measured 'utilisation' a simple measure of the relationship between average and peak daily demand. Low utilisation indicates 'peaky' loads, where peaks are much higher than underlying usage; high values show more consistent usage with less 'peakiness'. Most households' utilisation is between 10 and 35 per cent. In this dataset, average utilisation for all household types is close to the average for the whole group, but the degrees of divergence are revealing: low divergence between income groupings, higher divergence between household and dwelling size.

Table 1: Average consumption, demand, and utilisation of different household types (Ausgrid)

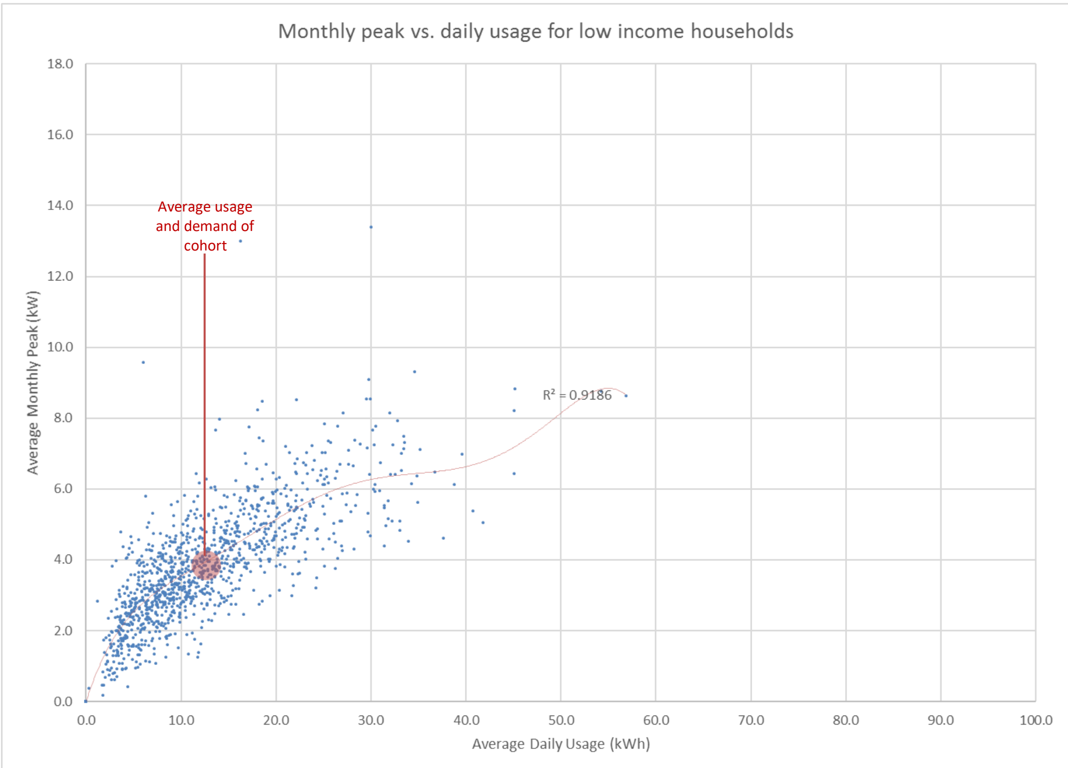
	Average Annual Usage (kWh)	Average Annual Peak (kW)	Average Monthly Peak (kW)	Average Daily Usage (kWh)	Average Daily Peak (kW)	Average Utilisation (%)
INCOME						
low income	4633	5.4	3.8	12.7	2.0	26%
medium income	5252	5.8	4.1	14.4	2.2	27%
high income	6844	6.8	4.8	18.8	2.7	28%
HOUSEHOLD SIZE						
small household (1–2 ppl.)	4091	5.2	3.7	11.2	1.9	25%
medium household (3–4 ppl.)	6620	6.5	4.7	18.1	2.7	29%
large household (5+ ppl.)	8417	7.4	5.4	23.1	3.1	31%
AGE						
70+ y.o. household	4180	5.1	3.5	11.5	1.8	26%
DWELLING TYPE						
unit	3453	4.8	3.4	9.5	1.9	23%
semi-detached house	5350	5.8	4.1	14.7	2.3	27%
detached house	6323	6.4	4.6	17.3	2.5	29%
AIRCON TYPE						
no aircon	4608	5.1	3.6	12.6	2.0	26%
ducted aircon	8244	8.4	6.1	22.6	3.2	28%
split-system aircon	5700	6.0	4.3	15.6	2.3	28%
ALL HOUSEHOLDS	**5665**	**6.0**	**4.3**	**15.5**	**2.3**	**27%**

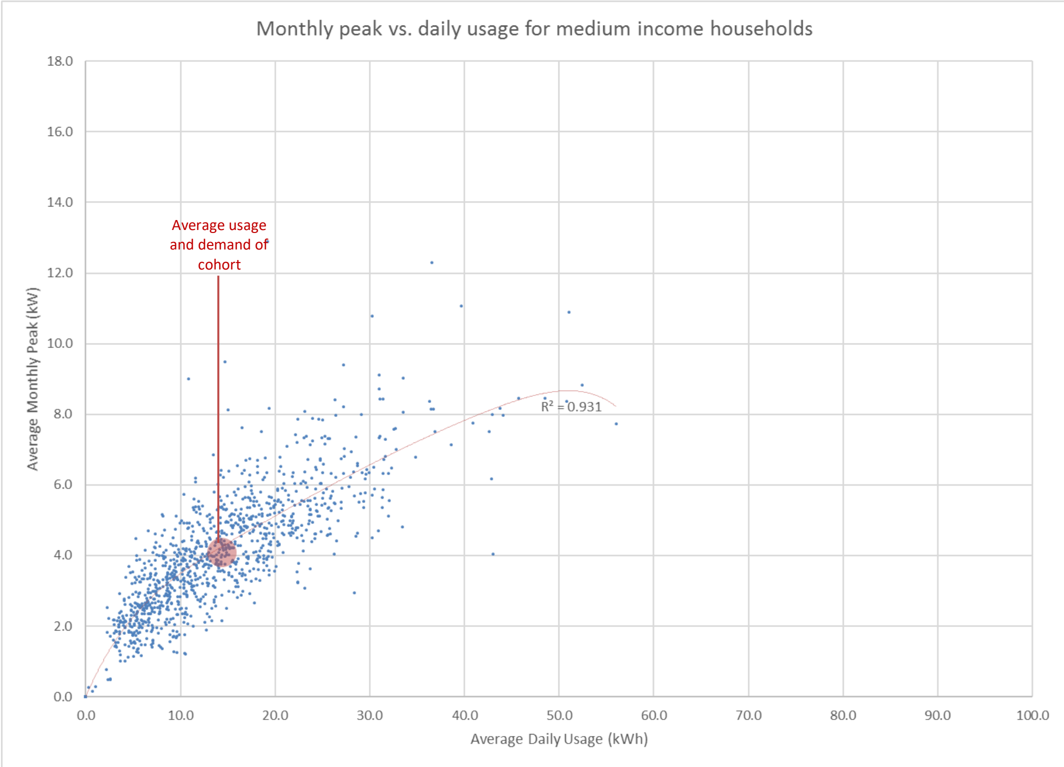
Note: Green values are lower, and red values higher, than the average for all households

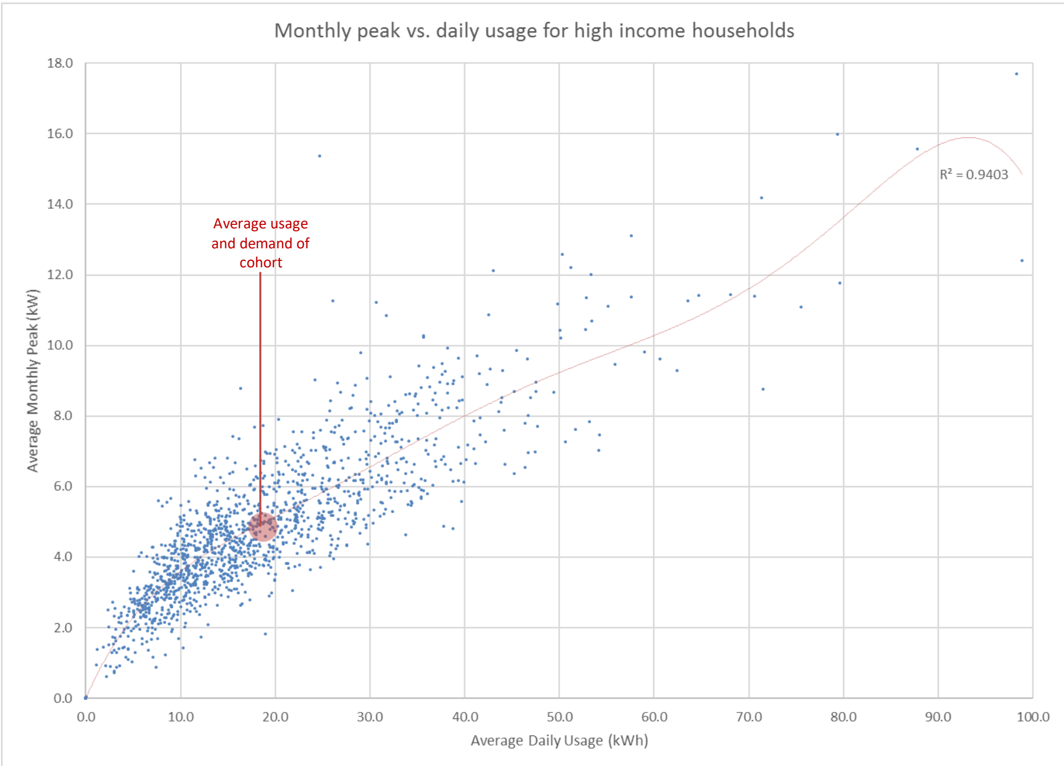
While differences in average peaks and utilisation between household types are relatively small, there is significant variation *within* groups. The Ausgrid data shows that demand is in fact only loosely correlated with both income level and usage. While high-usage households generally have higher peaks than low-usage ones, they're not very much higher, proportionately. Very low consumption households have low peaks, very high consumption ones have high peaks, but most everyone else has peaks within the same intermediate range.



Comparison of the spread of monthly peaks among different income groups shows very little difference.



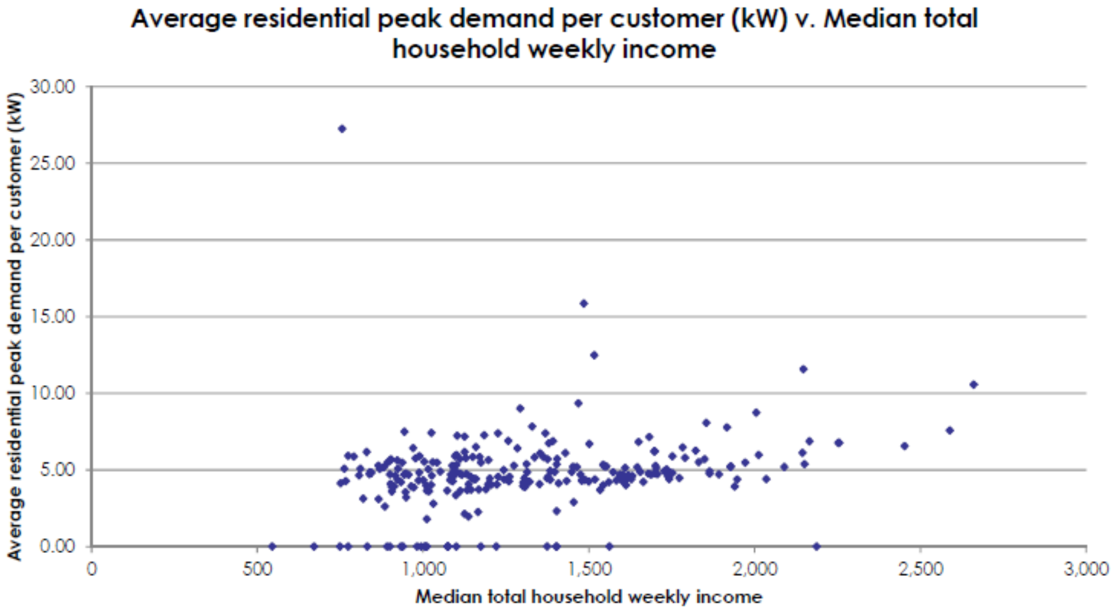




These charts show quite clearly that while peaks to tend to increase with consumption:

- Even for low consumption, peaks are quite dispersed;
- For average consumption, peaks are widely dispersed;
- As consumption gets higher, while peaks remain dispersed they increase at a lower rate than consumption; and
- Differences in consumption are evident between different income groups, but peaks are similar across all groups

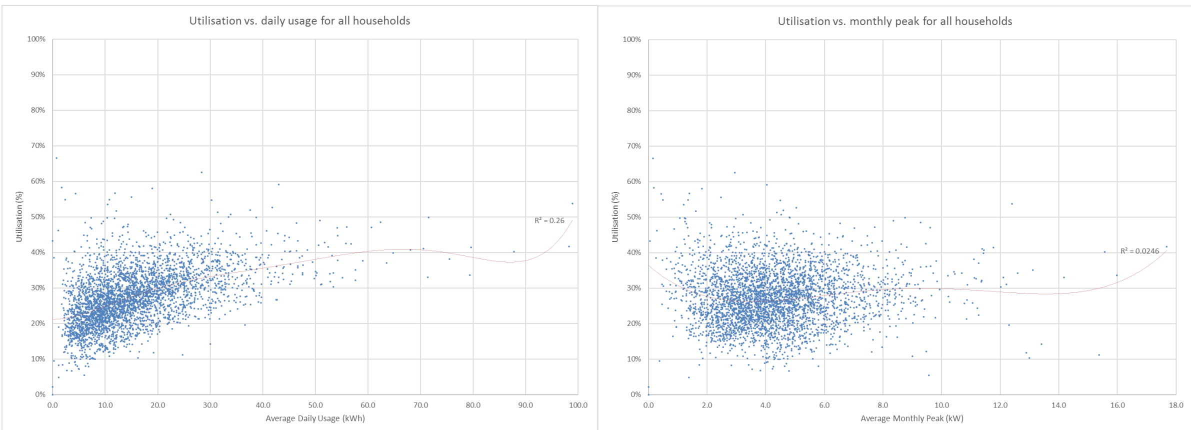
Overall, these findings align with analysis of AusNet Services customer loads that shows there is very little relationship between income level and peak demand.



Source: AusNet Services presentation to VicUtilities, 22 March 2018

Similar dynamics are evident when comparing household or dwelling sizes. Usage is lower in smaller households and smaller dwellings, higher in larger ones; but peaks vary widely between households with similar usage, and while the highest consuming households usually have higher peaks than others, they are less than proportionately higher.

The relationship between underlying and peak usage and can be measured as a ratio converted to a percentage, called 'utilisation'. This essentially expresses what percentage underlying usage is of peak usage. The lower the percentage, the higher the peaks compared to underlying usage (i.e. the 'peakier' the load). As the previous discussion would suggest, utilisation is very loosely related to most other measures of energy usage but has a small tendency to be higher with higher consumption.

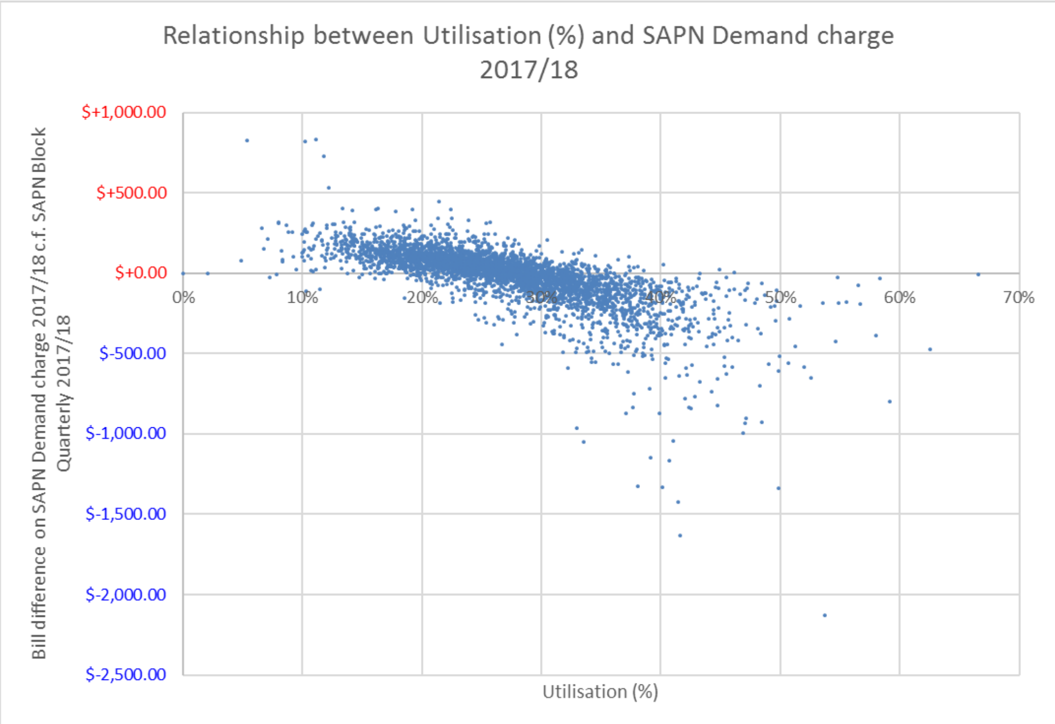


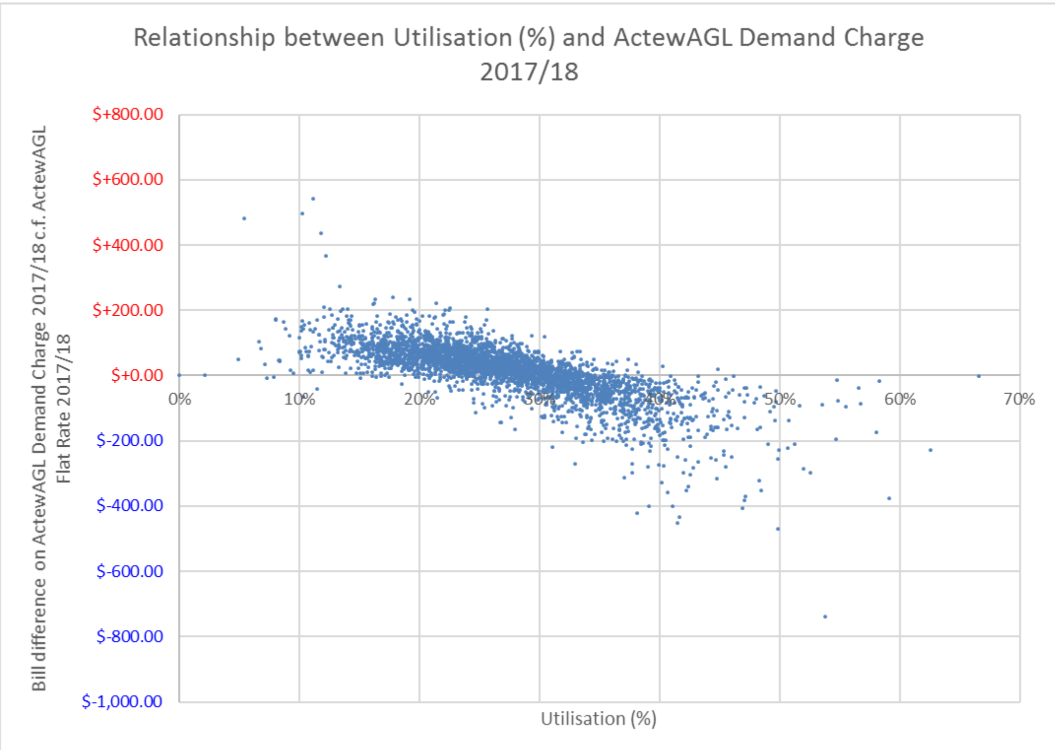
4.3 Price outcomes for different household types

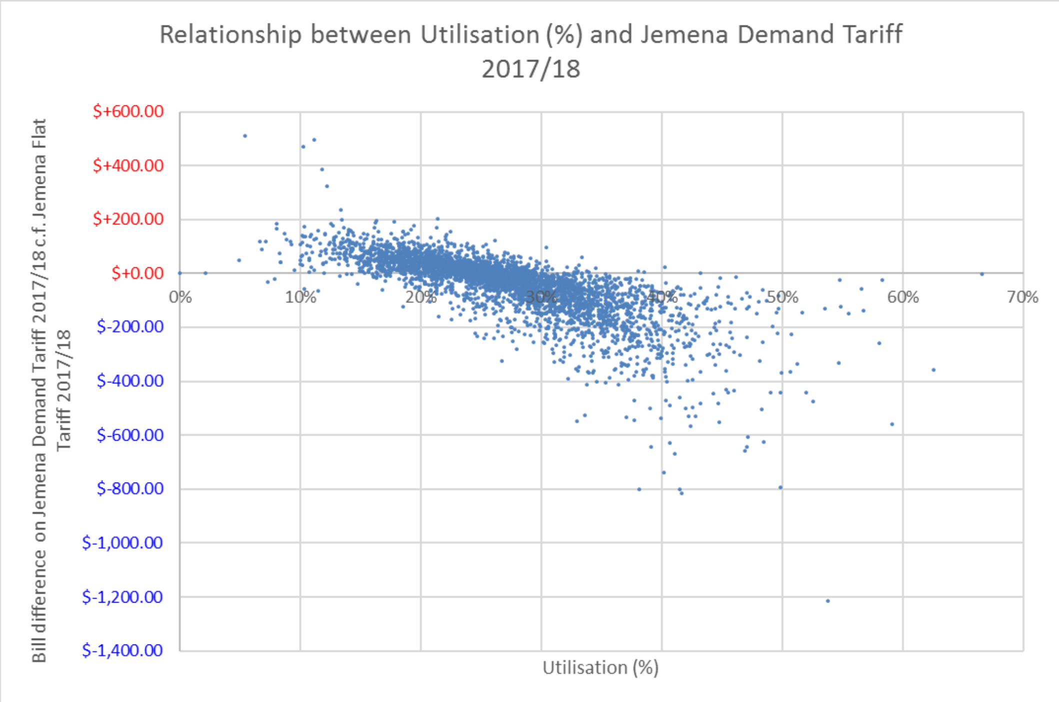
There are several different ways to assess the price impact of tariffs on different types of loads. We have looked at how different types of tariffs (paying particular attention to demand tariffs) have different financial outcomes depending on utilisation, volume, and across a range of different household and demographic indicators.

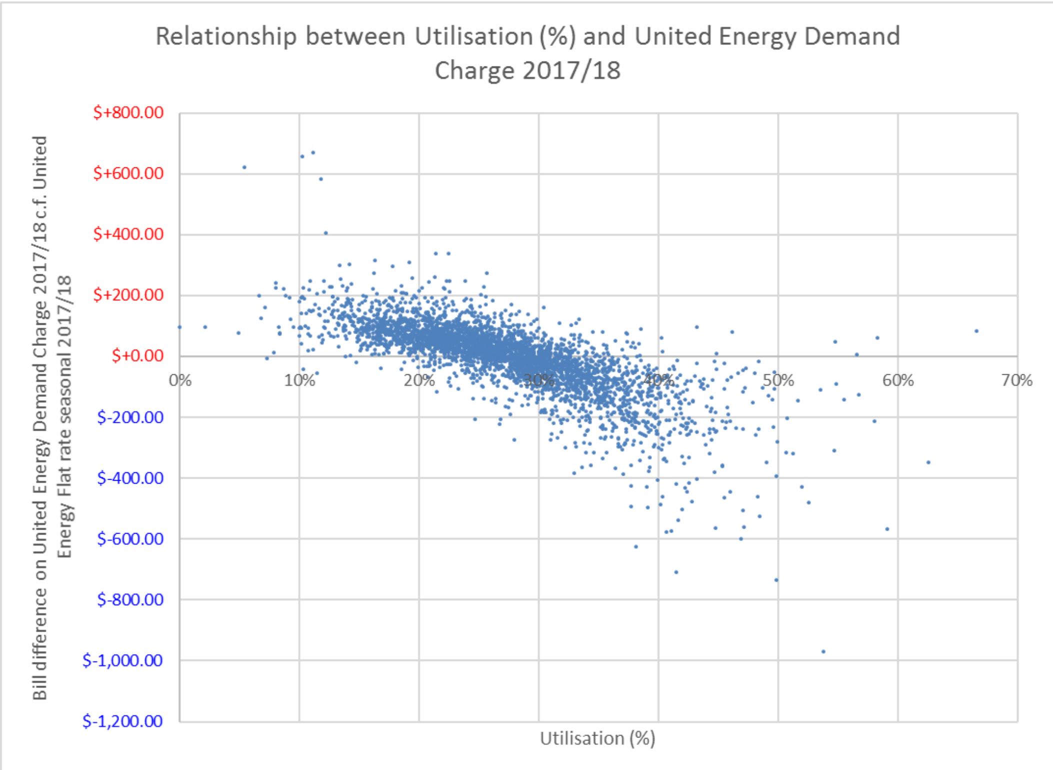
4.3.1 Impact of utilisation on demand vs. flat tariffs

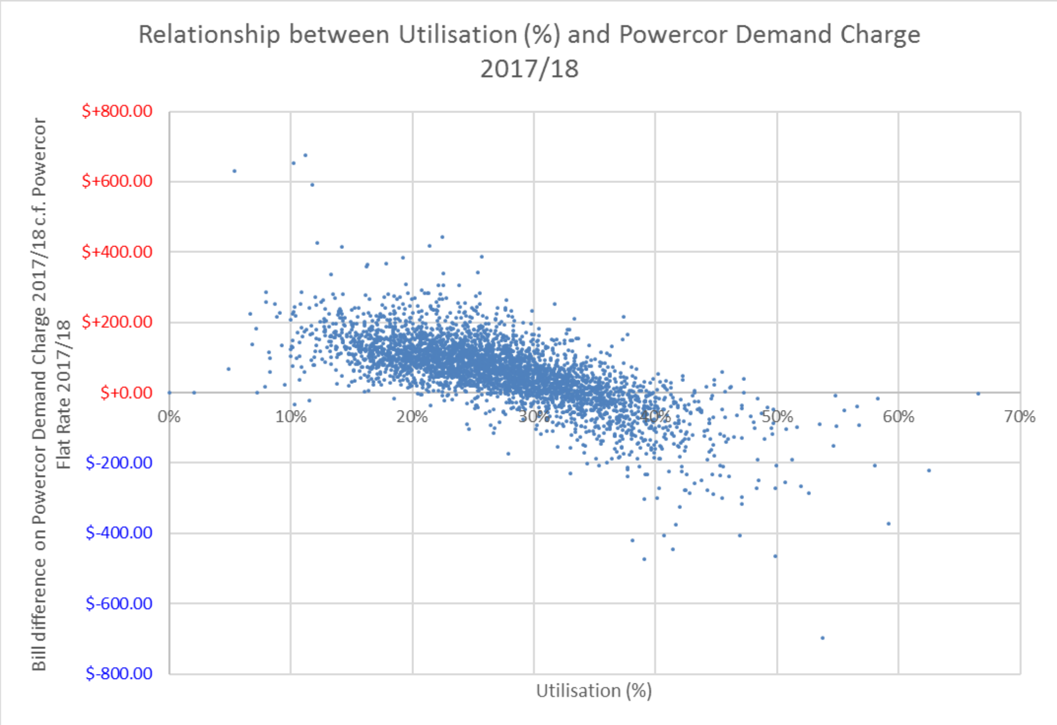
Utilisation is a useful concept in assessing demand-based tariffs because a household with low utilisation will be more likely to pay more on a demand tariff than a flat tariff, than one with high utilisation but the same peak would. This is evident when looking at the relationship between utilisation and bills generated from various DNSPs' demand and flat tariffs. The trends are very similar, though the financial outcomes and the level of utilisation around which outcomes differ varies between networks. These differences may reflect differences in conditions in the different networks, or significant differences in customer loads (considering that the customer dataset used in all the analysis is the same group of Ausgrid customers that may not be representative of other DNSPs' customers). Each dot is one household.

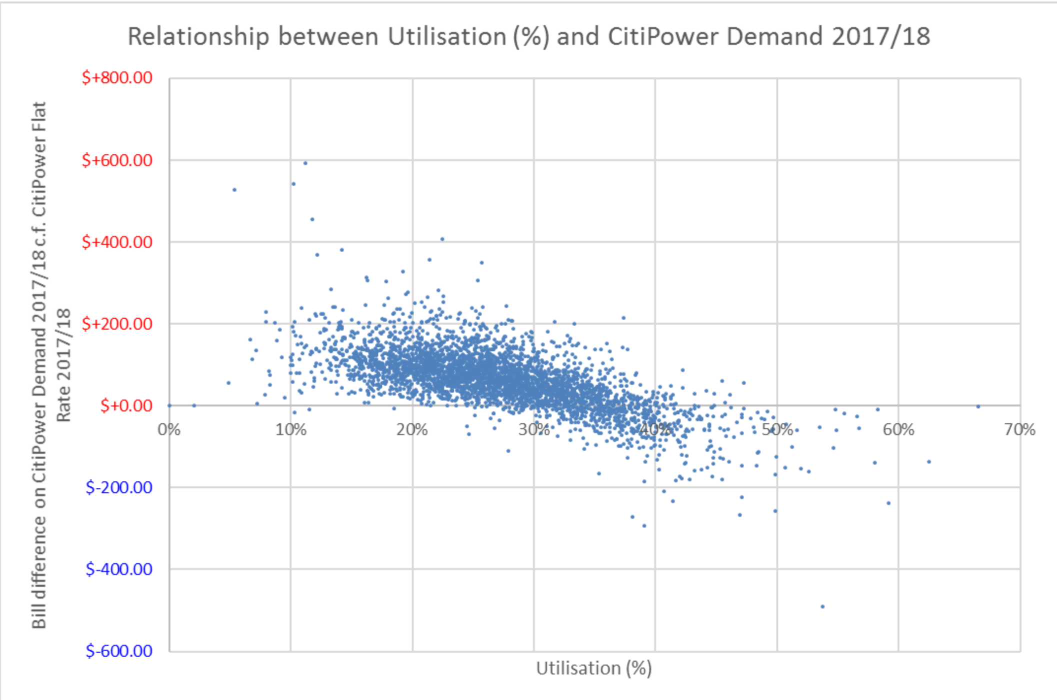


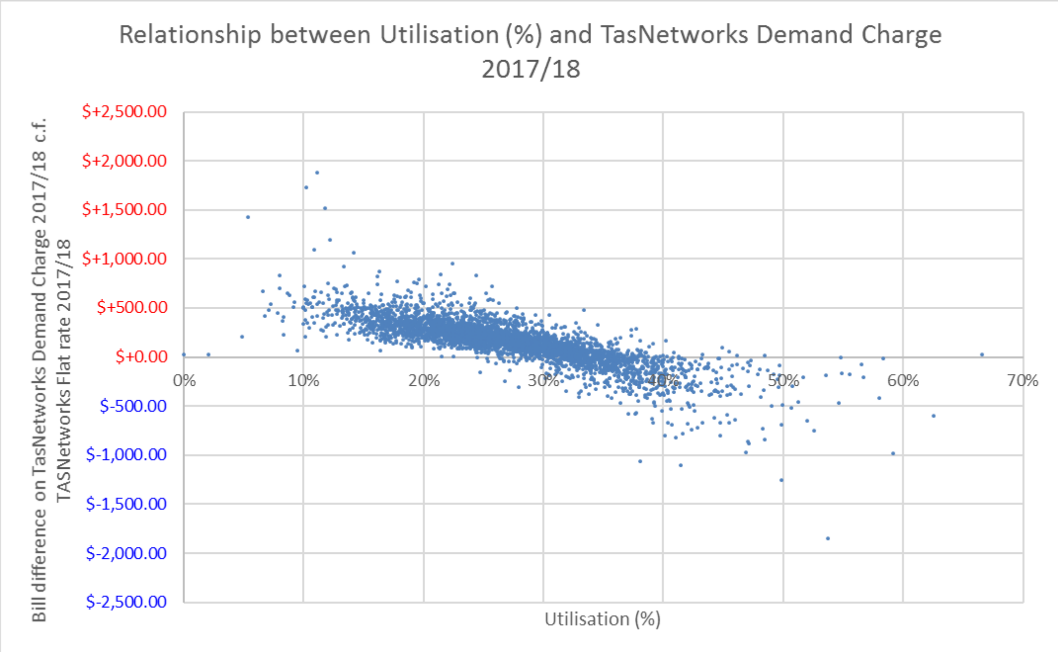


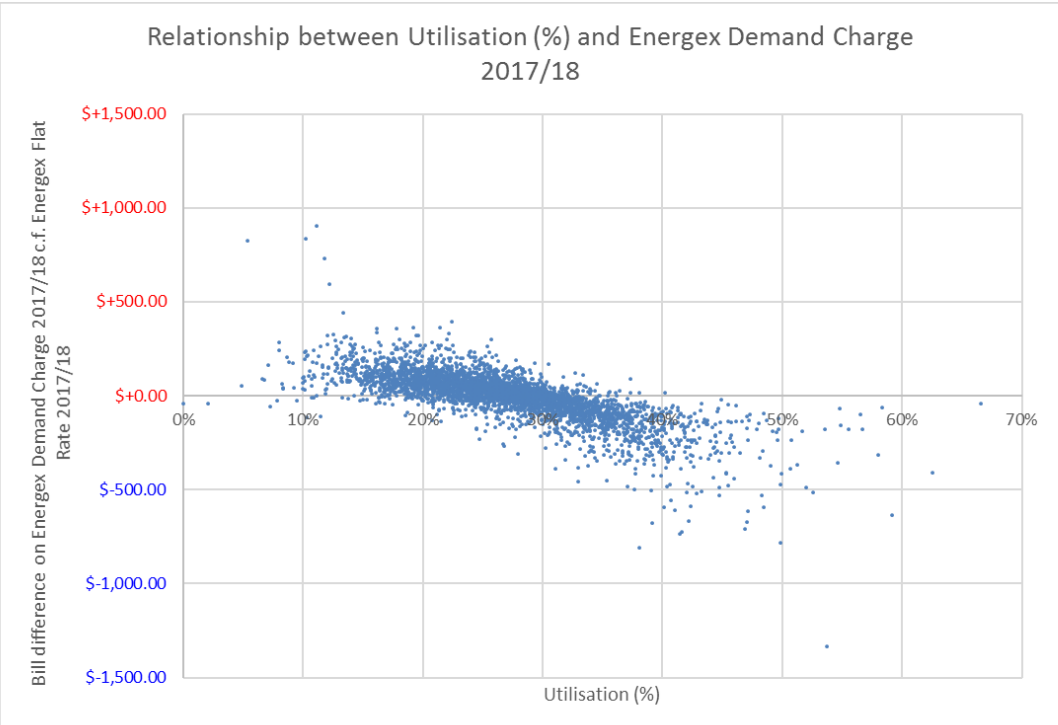

Relationship between Utilisation (%) and Jemena Demand Tariff 2017/18
Bill difference on Jemena Demand Tariff 2017/18 c.f. Jemena Flat Tariff 2017/18
$+600.00
$+400.00
$+200.00
$+0.00
$-200.00
$-400.00
$-600.00
$-800.00
$-1,000.00
$-1,200.00
$-1,400.00
0%
10%
20%
30%
40%
50%
60%
70%
Utilisation (%)


Relationship between Utilisation (%) and United Energy Demand Charge 2017/18
Bill difference on United Energy Demand Charge 2017/18 c.f. United Energy Flat rate seasonal 2017/18
$+800.00
$+600.00
$+400.00
$+200.00
$+0.00
$-200.00
$-400.00
$-600.00
$-800.00
$-1,000.00
$-1,200.00
0%
10%
20%
30%
40%
50%
60%
70%
Utilisation (%)


Relationship between Utilisation (%) and Powercor Demand Charge 2017/18
Bill difference on Powercor Demand Charge 2017/18 c.f. Powercor Flat Rate 2017/18
$+800.00
$+600.00
$+400.00
$+200.00
$+0.00
$-200.00
$-400.00
$-600.00
$-800.00
0%
10%
20%
30%
40%
50%
60%
70%
Utilisation (%)


Relationship between Utilisation (%) and CitiPower Demand 2017/18
Bill difference on CitiPower Demand 2017/18 c.f. CitiPower Flat Rate 2017/18
$+800.00
$+600.00
$+400.00
$+200.00
$+0.00
$-200.00
$-400.00
$-600.00
0%
10%
20%
30%
40%
50%
60%
70%
Utilisation (%)

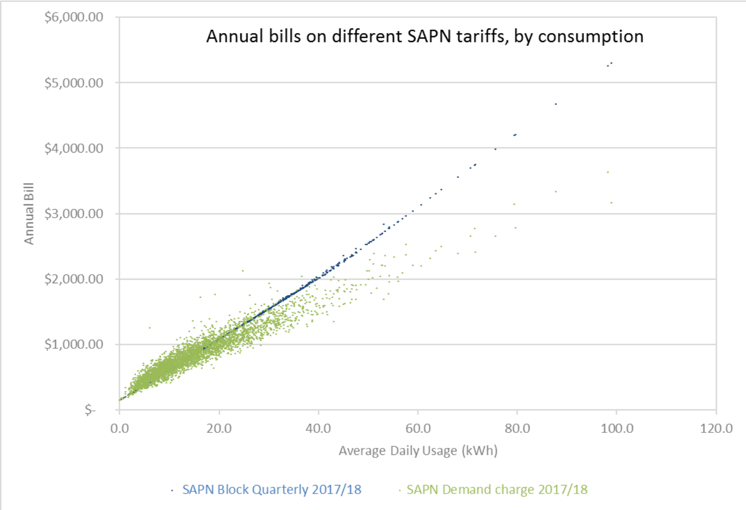


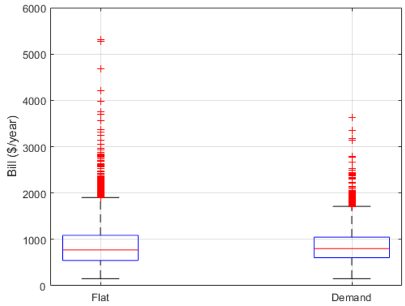


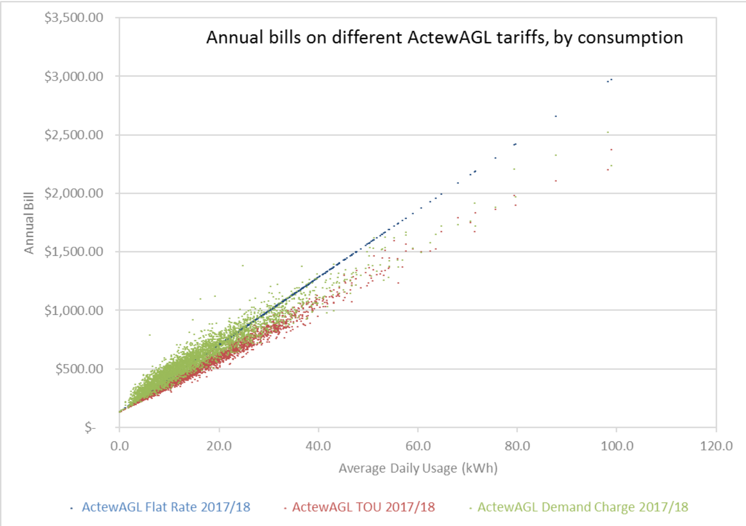
These results clearly show that while actual financial outcomes vary according to tariff structure, households with less peaky loads (higher utilisation) pay less on demand tariffs than flat tariffs, while those on peakier loads pay more. This suggests that demand management would be a useful tool to help vulnerable households who are disadvantaged by demand-based tariffs.

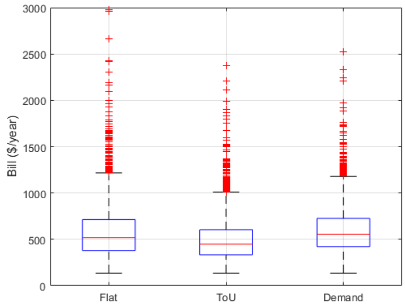
4.3.2 Impact of different tariffs according to volume

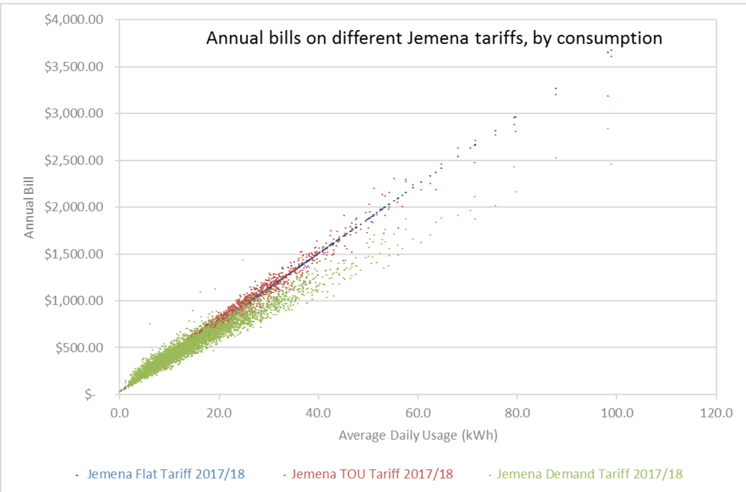
Households with similar volume may have wildly different usage patterns. The Ausgrid dataset is large enough to contain a good mix of different load profiles, showing the general impact of different DNSPs' tariffs across a range of households with different usage patterns and volume. Each dot is one household. Boxplots adjacent to the charts show the range of price outcomes for each tariff.

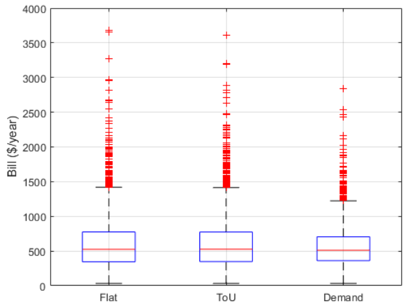

Annual bills on different SAPN tariffs, by consumption
Annual Bill
$6,000.00
$5,000.00
$4,000.00
$3,000.00
$2,000.00
$1,000.00
$-
0.0
20.0
40.0
60.0
80.0
100.0
120.0
Average Daily Usage (kWh)
SAPN Block Quarterly 2017/18
SAPN Demand charge 2017/18

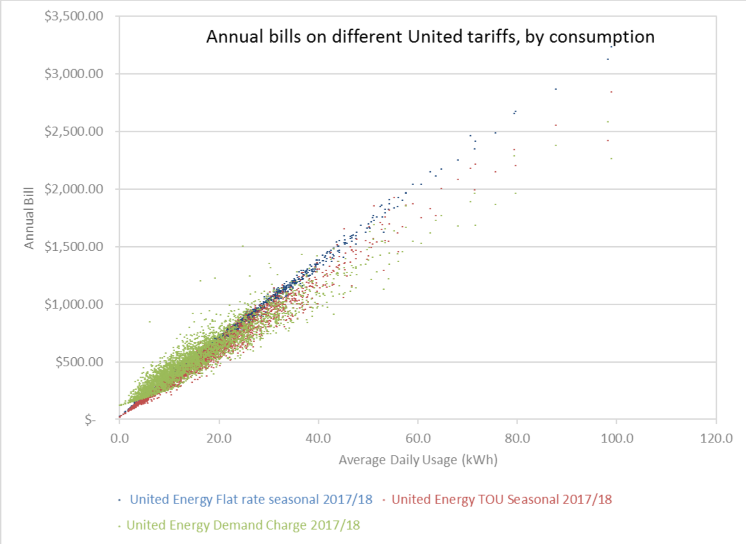

Bill ($/year)
6000
5000
4000
3000
2000
1000
0
Flat
Demand

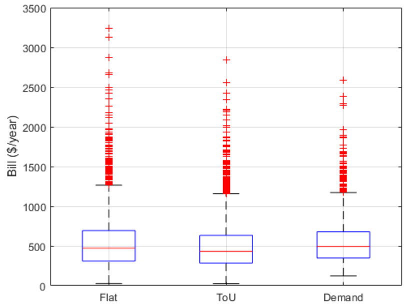

Annual bills on different ActewAGL tariffs, by consumption
Annual Bill
$3,500.00
$3,000.00
$2,500.00
$2,000.00
$1,500.00
$1,000.00
$500.00
$-
0.0
20.0
40.0
60.0
80.0
100.0
120.0
Average Daily Usage (kWh)
ActewAGL Flat Rate 2017/18
ActewAGL TOU 2017/18
ActewAGL Demand Charge 2017/18

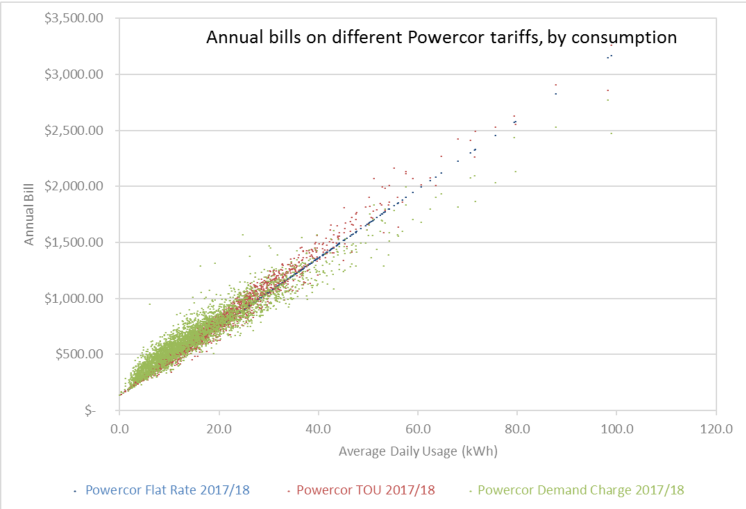

Bill ($/year)
3000
2500
2000
1500
1000
500
0
Flat
ToU
Demand

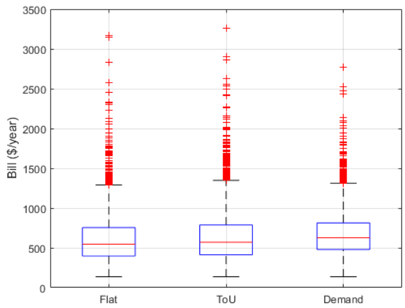

Annual bills on different Jemena tariffs, by consumption
Annual Bill
$4,000.00
$3,500.00
$3,000.00
$2,500.00
$2,000.00
$1,500.00
$1,000.00
$500.00
$-
0.0
20.0
40.0
60.0
80.0
100.0
120.0
Average Daily Usage (kWh)
Jemena Flat Tariff 2017/18
Jemena TOU Tariff 2017/18
Jemena Demand Tariff 2017/18

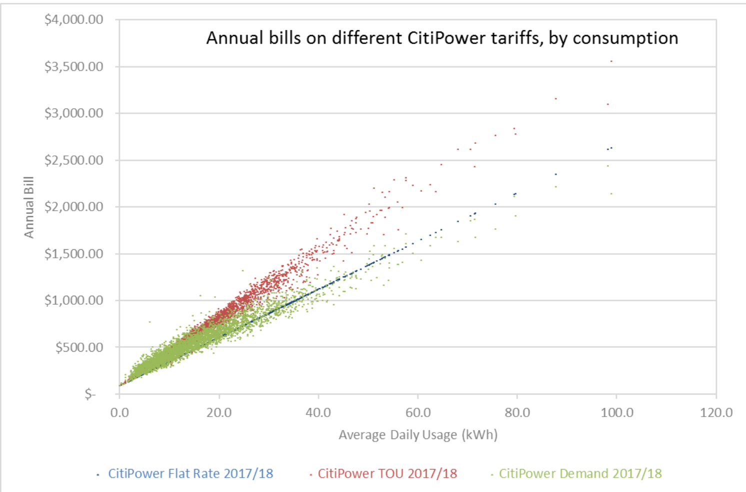

Bill ($/year)
4000
3500
3000
2500
2000
1500
1000
500
0
Flat
ToU
Demand

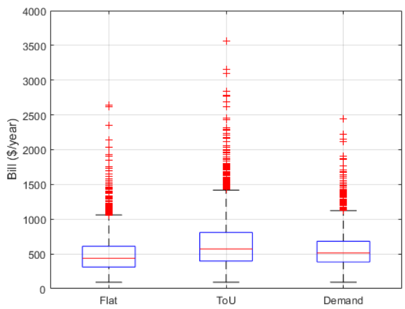

Annual bills on different United tariffs, by consumption
Annual Bill
$3,500.00
$3,000.00
$2,500.00
$2,000.00
$1,500.00
$1,000.00
$500.00
$-
0.0
20.0
40.0
60.0
80.0
100.0
120.0
Average Daily Usage (kWh)
United Energy Flat rate seasonal 2017/18
United Energy TOU Seasonal 2017/18
United Energy Demand Charge 2017/18

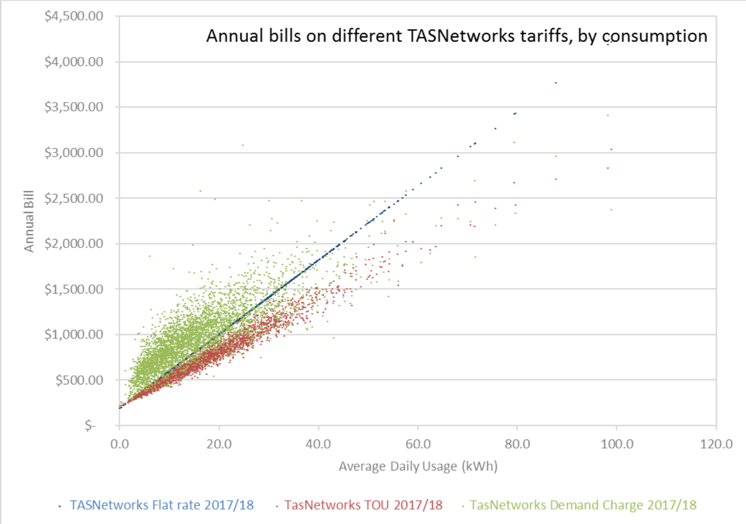

Bill ($/year)
3500
3000
2500
2000
1500
1000
500
0
Flat
ToU
Demand

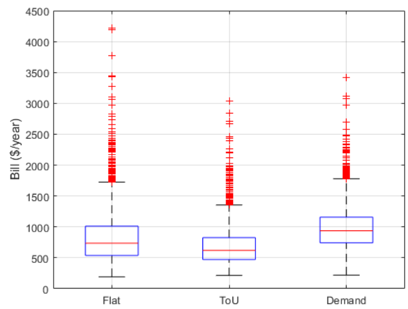

Annual bills on different Powercor tariffs, by consumption
Annual Bill
$3,500.00
$3,000.00
$2,500.00
$2,000.00
$1,500.00
$1,000.00
$500.00
$-
0.0
20.0
40.0
60.0
80.0
100.0
120.0
Average Daily Usage (kWh)
Powercor Flat Rate 2017/18
Powercor TOU 2017/18
Powercor Demand Charge 2017/18

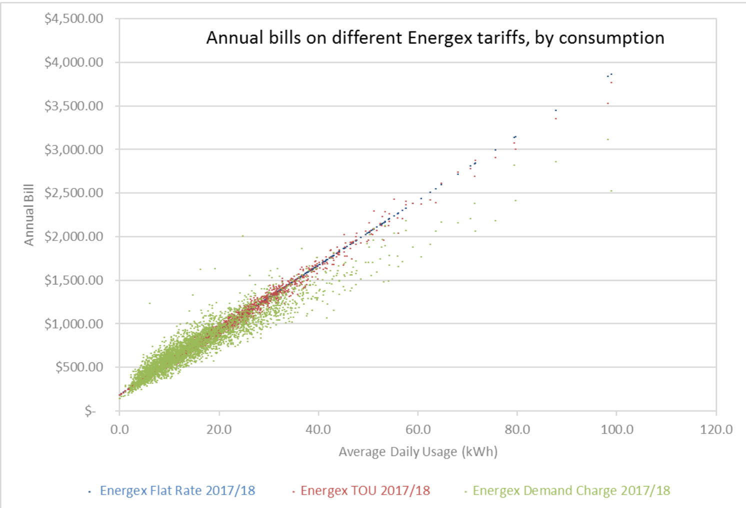

Bill ($/year)
3500
3000
2500
2000
1500
1000
500
0
Flat
ToU
Demand

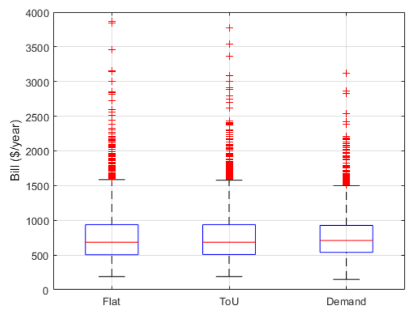

Annual bills on different CitiPower tariffs, by consumption
Annual Bill
$4,000.00
$3,500.00
$3,000.00
$2,500.00
$2,000.00
$1,500.00
$1,000.00
$500.00
$-
0.0
20.0
40.0
60.0
80.0
100.0
120.0
Average Daily Usage (kWh)
CitiPower Flat Rate 2017/18
CitiPower TOU 2017/18
CitiPower Demand 2017/18


Bill ($/year)
4000
3500
3000
2500
2000
1500
1000
500
0
Flat
ToU
Demand









These results mostly show the general relationship between demand and flat tariffs of lower prices on demand tariffs than flat tariffs for higher volume households, and higher prices for lower volume ones. This is usually because the lower volumetric rate on demand tariffs works to offset higher demand charges, and is also helped by the observation noted above that demand usually increases at a slower rate than volume as households use more and more electricity.

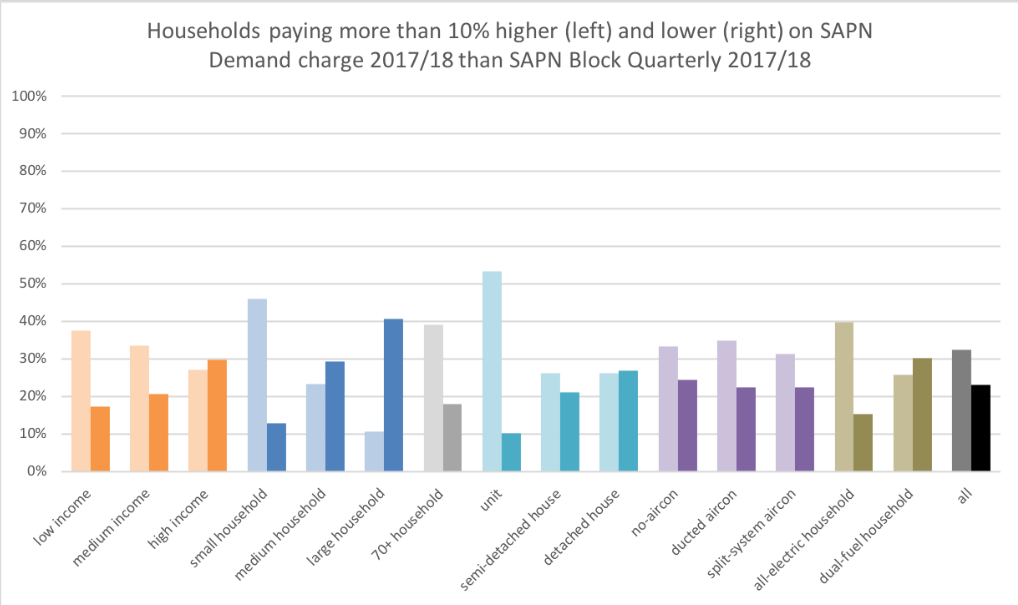
They also show the similar tendency in some ToU tariffs. This is for similar reasons – high usage implies high underlying usage, which is likely to leads to a greater proportion of consumption occurring during off-peak times.

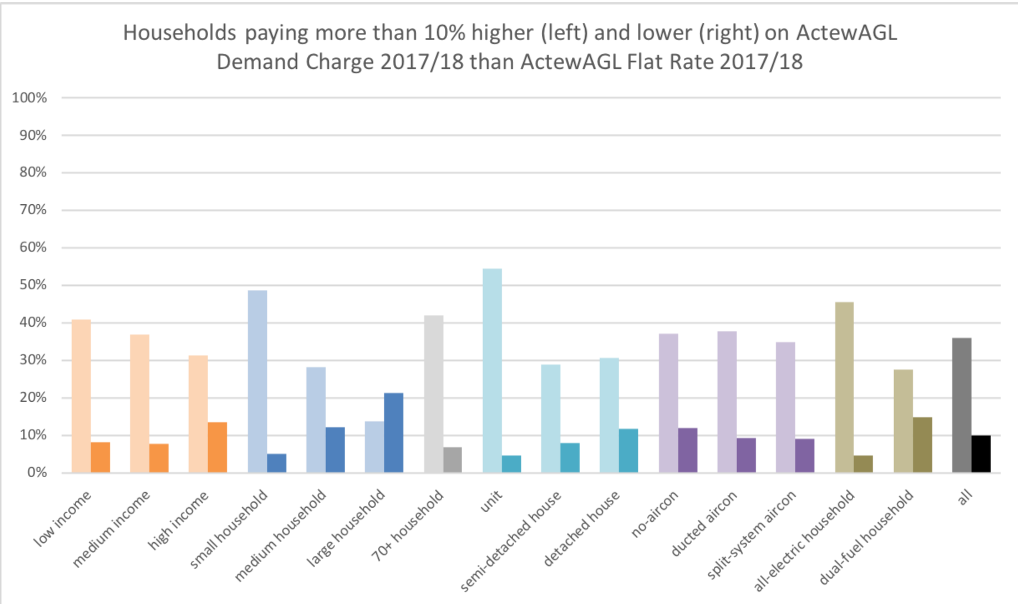
The boxplots show another feature of demand tariffs that is also evident from examining the scatter-charts: that the range of prices is usually smaller with demand tariffs compared to flat and ToU tariffs, even when the average is higher.

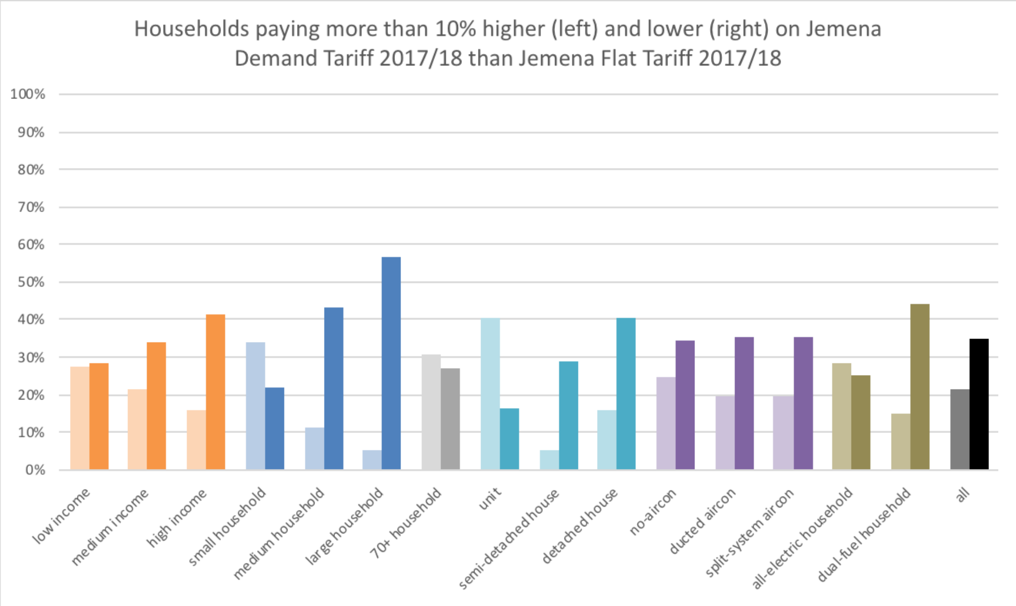
The CitiPower and TasNetworks results deserve special consideration. Their results are out of step with the others and this is probably due to their actual customer base having significantly different usage patterns to the Ausgrid dataset. CitiPower and TasNetworks both have relatively small customer bases that also have unique qualities: CitiPower's being disproportionately inner urban, and TasNetworks being in a cold climate with little gas penetration and particularly high electricity consumption. DNSPs' tariffs are tailored to their specific customer bases, and while the Ausgrid data's diversity makes it useful for general tariff analysis, it is less suited to these less heterogenous populations.

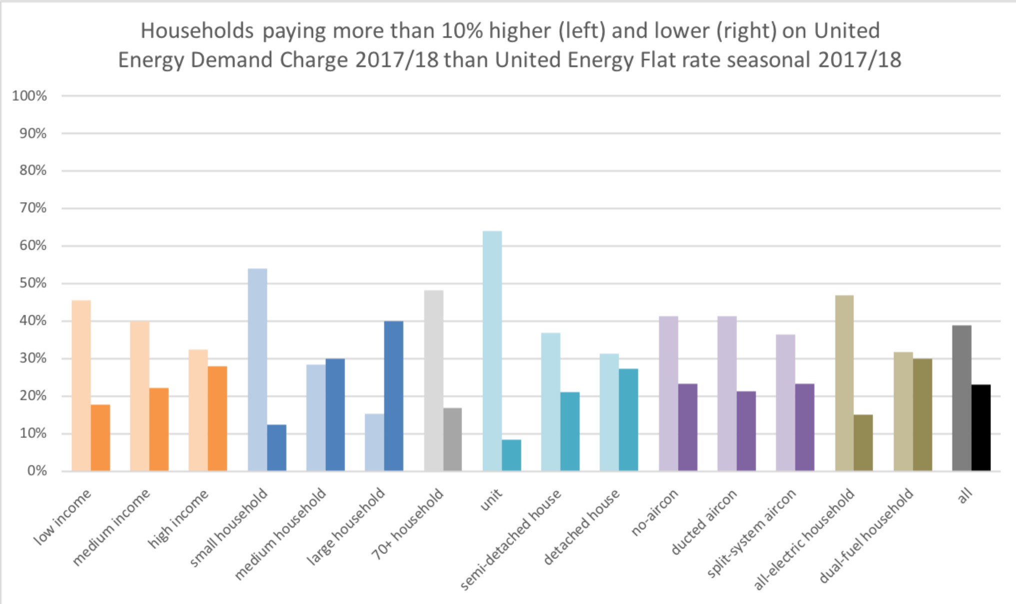
4.3.3 Impact of demand tariffs on different household types

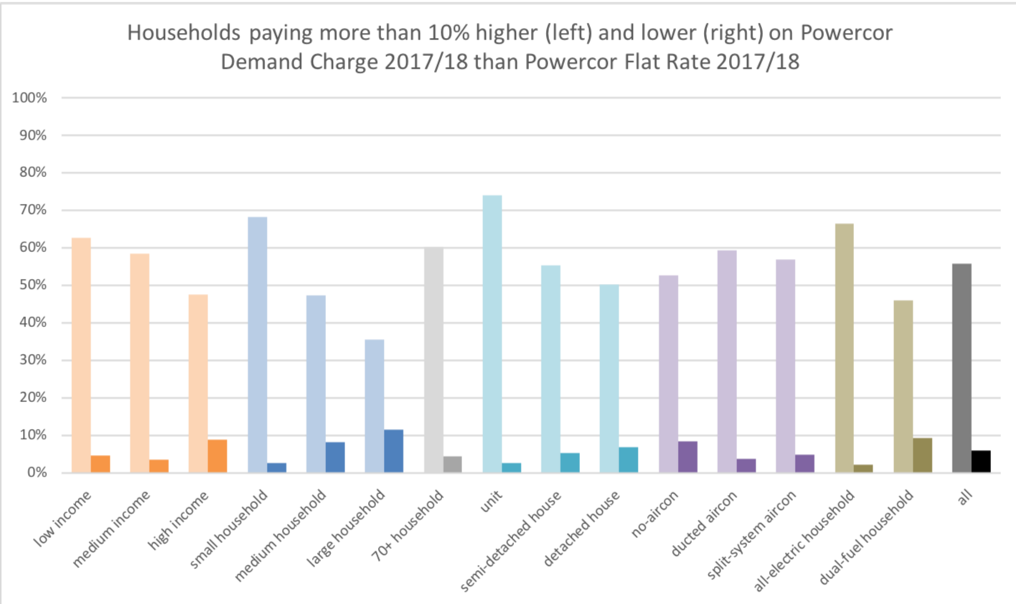
We also looked at the different price outcomes of demand vs. flat tariffs on the different social and demographic categories available in the dataset. Having demographic data attached to load profiles is of great benefit when examining tariff impacts. The lack of it is what limits analysis on other datasets.

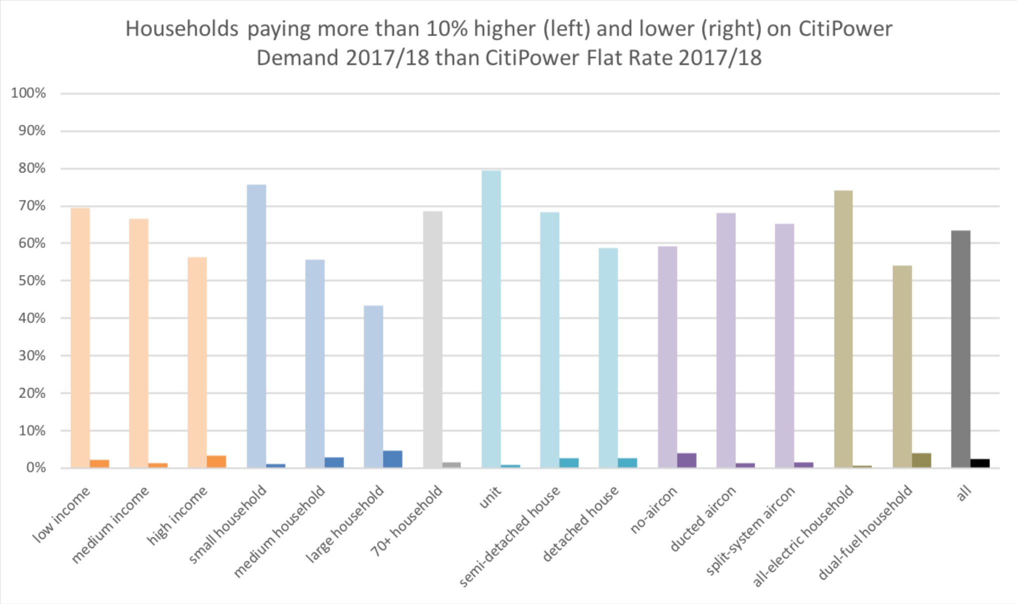


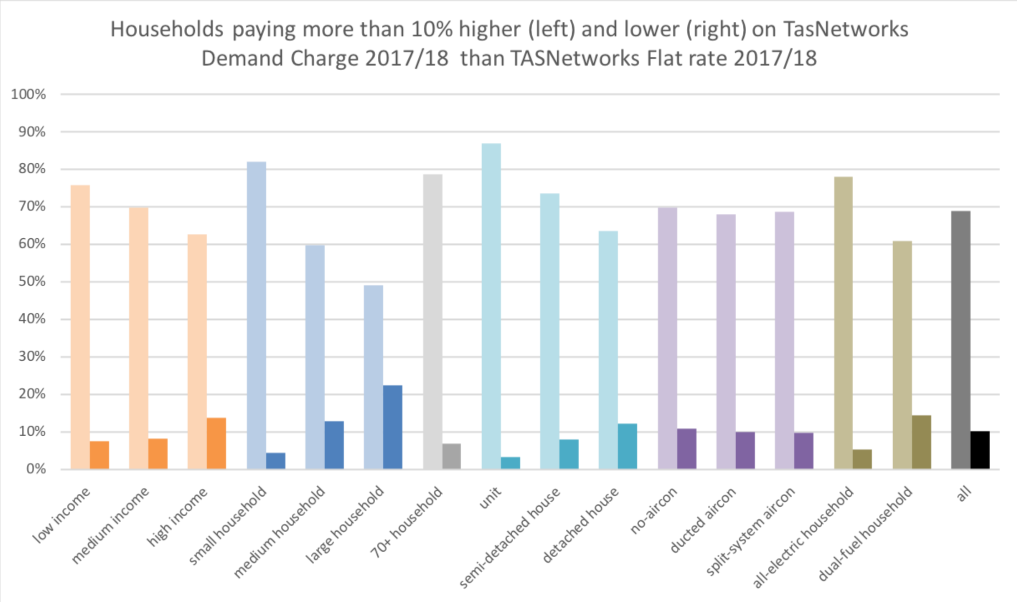


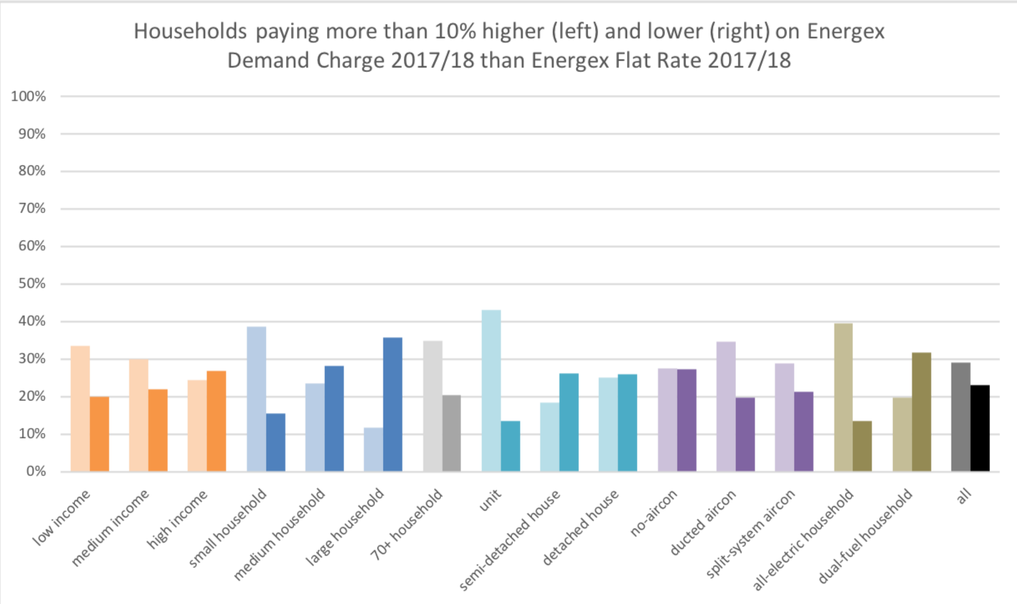

Households paying more than 10% higher (left) and lower (right) on Jemena Demand Tariff 2017/18 than Jemena Flat Tariff 2017/18
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
low income
medium income
high income
small household
medium household
large household
70+ household
unit
semi-detached house
detached house
no-aircon
ducted aircon
split-system aircon
all-electric household
dual-fuel household
all


Households paying more than 10% higher (left) and lower (right) on United Energy Demand Charge 2017/18 than United Energy Flat rate seasonal 2017/18
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
low income
medium income
high income
small household
medium household
large household
70+ household
unit
semi-detached house
detached house
no-aircon
ducted aircon
split-system aircon
all-electric household
dual-fuel household
all


Households paying more than 10% higher (left) and lower (right) on Powercor Demand Charge 2017/18 than Powercor Flat Rate 2017/18
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
low income
medium income
high income
small household
medium household
large household
70+ household
unit
semi-detached house
detached house
no-aircon
ducted aircon
split-system aircon
all-electric household
dual-fuel household
all


Households paying more than 10% higher (left) and lower (right) on CitiPower Demand 2017/18 than CitiPower Flat Rate 2017/18
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
low income
medium income
high income
small household
medium household
large household
70+ household
unit
semi-detached house
detached house
no-aircon
ducted aircon
split-system aircon
all-electric household
dual-fuel household
all


Households paying more than 10% higher (left) and lower (right) on TasNetworks Demand Charge 2017/18 than TASNetworks Flat rate 2017/18
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
low income
medium income
high income
small household
medium household
large household
70+ household
unit
semi-detached house
detached house
no-aircon
ducted aircon
split-system aircon
all-electric household
dual-fuel household
all


Households paying more than 10% higher (left) and lower (right) on Energex Demand Charge 2017/18 than Energex Flat Rate 2017/18
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
low income
medium income
high income
small household
medium household
large household
70+ household
unit
semi-detached house
detached house
no-aircon
ducted aircon
split-system aircon
all-electric household
dual-fuel household
all

Of most interest in these charts is the relationship between different groups, especially when compared to the ‘All households’ column. While the proportion of all households who pay more or less than 10 per cent higher on demand tariffs is a useful metric of their customer impact, results here need to be qualified, as noted earlier, by the recognition that each DNSP’s actual spread of user profiles may be systematically different from the Ausgrid dataset. However, the relativity of the different household types’ outcomes to each other gives an indication of the types of households that are more vulnerable to negative price impacts from cost reflective tariffs.

These results echo earlier discussion in this regard. In most cases:

- low income households are more likely to face higher costs and less likely to face lower costs than average, and the reverse is true for high-income;
- small households are more likely to face higher costs and less likely to face lower costs than average, and the reverse is true for large and medium households;
- households with occupants aged 70+ are more likely to face higher costs and less likely to face lower costs than average;
- households in units or apartments are more likely to face higher costs and less likely to face lower costs than average, and the reverse is true for other dwelling types; and
- all-electric households are more likely to face higher costs and less likely to face lower costs than average, and the reverse is true for dual fuel ones.

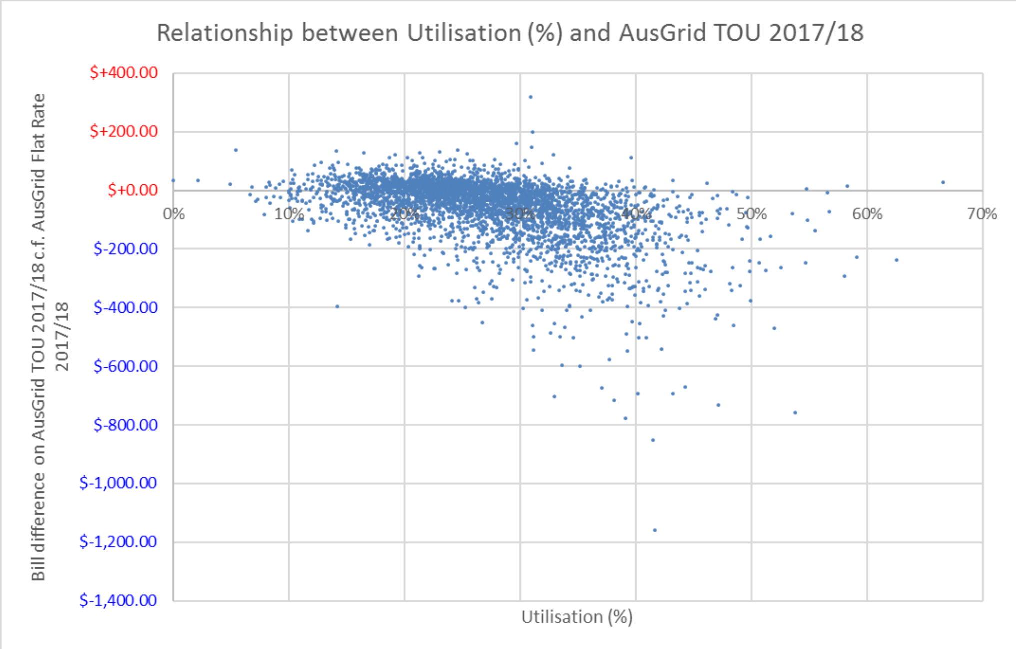
Except for the last point, the households likely to pay more are all associated with lower consumption. This underlines the general point that low consumption households are more likely to be the losers from tariff reform based on demand. (Higher prices for all-electric households are to be expected because the appliances typically powered by gas – heating, hot water, and (to a lesser extent) cooking – generally tend to lead to either (or both) higher consumption or/and higher demand.)

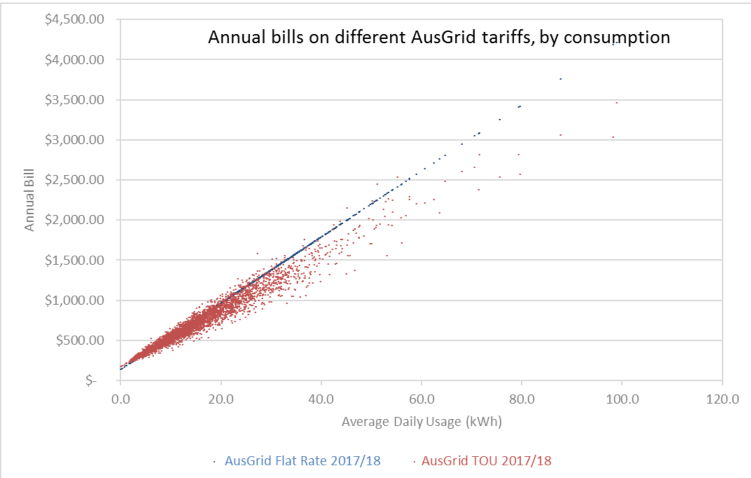
It's also important to note that in most cases, a significant proportion of low-income and low-consumption will still face lower prices under demand tariffs. This indicates an important fact: regardless of the finding that many vulnerable households will be worse off on demand tariffs, many others are worse off under current tariffs, and will benefit from tariff reform. It highlights the point made earlier: that tariffs cannot solve financial hardship or energy poverty. The true test for cost-reflective tariffs is not whether they benefit vulnerable or small households, but whether they more fairly allocate costs, providing the optimal foundation for targeted assistance to those who need it.

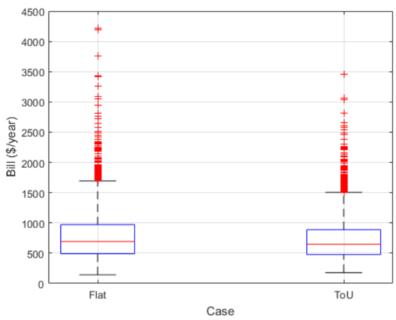
The mixed results for households categorised by type or presence of air conditioners, and semi-detached vs. separate housing, suggest that the load characteristics driven by these differences – primarily, the interplay between volume and demand – respond very differently to variations in the detail of tariff structures.

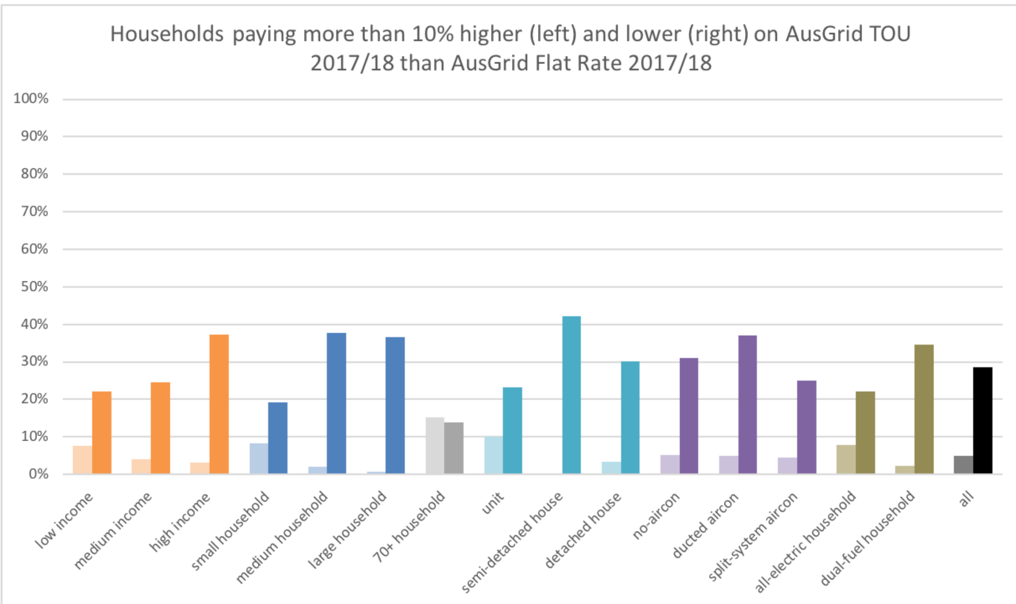
4.3.4 Time of use tariffs as cost-reflective tariffs

Some DNSPs have not chosen to implement demand tariffs. The NSW networks’ rationale for this has been that their networks are not appreciably demand-constrained; while Ausnet in Victoria has simply delayed introducing a demand tariff (though it plans to for 2018/19). Some commentators maintain that ToU tariffs may actually be more cost-reflective than demand tariffs (preferring that demand constraints are addressed locationally on peak demand days with critical peak tariffs). Thus, we also examined how ToU tariffs compare to flat tariffs in some networks that are not offering demand tariffs. (The above analysis also includes ToU tariffs compared to flat and demand tariffs for networks with demand tariffs.)

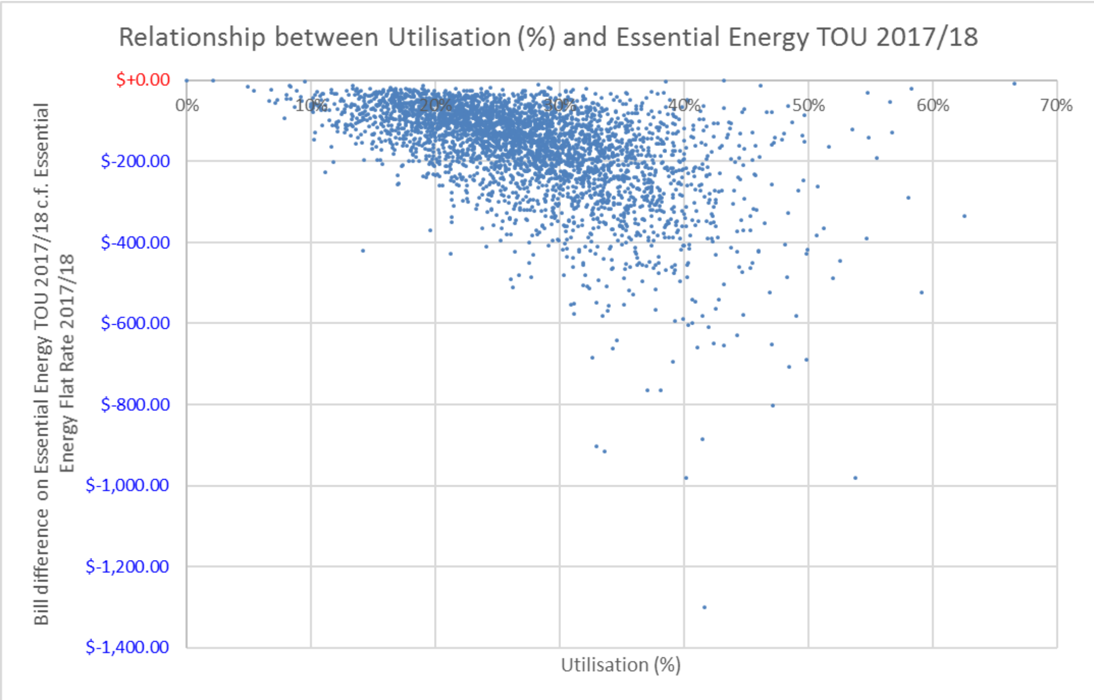


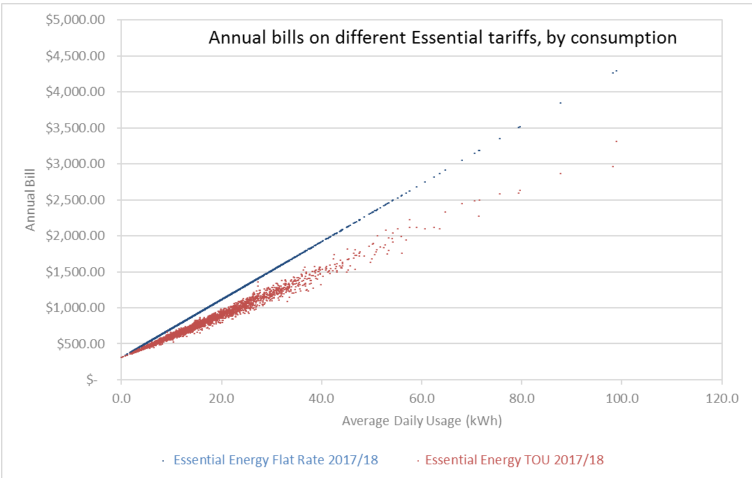


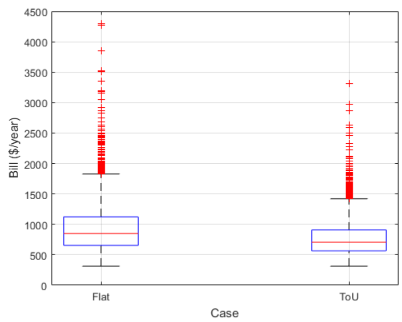




The Ausgrid analysis shows that the ToU tariff has a weaker relationship to utilisation than demand tariffs. Dispersion is very broad for household with flatter loads, showing that price outcomes are much more closely related to factors other than peakiness (obviously, time of usage). This may be appropriate for unconstrained networks, though it could be argued that demand is an appropriate metric for sharing sunk costs, not just augmentation. Like demand tariffs in other networks, it delivers a smaller spread of prices. It's also notable that most households face lower prices under the ToU tariff than the flat tariff – though like demand tariffs, lower-income, smaller, and unit-dwelling households are still more likely to face higher prices and less likely to face lower prices than higher-income, larger, and non-unit-dwelling households.

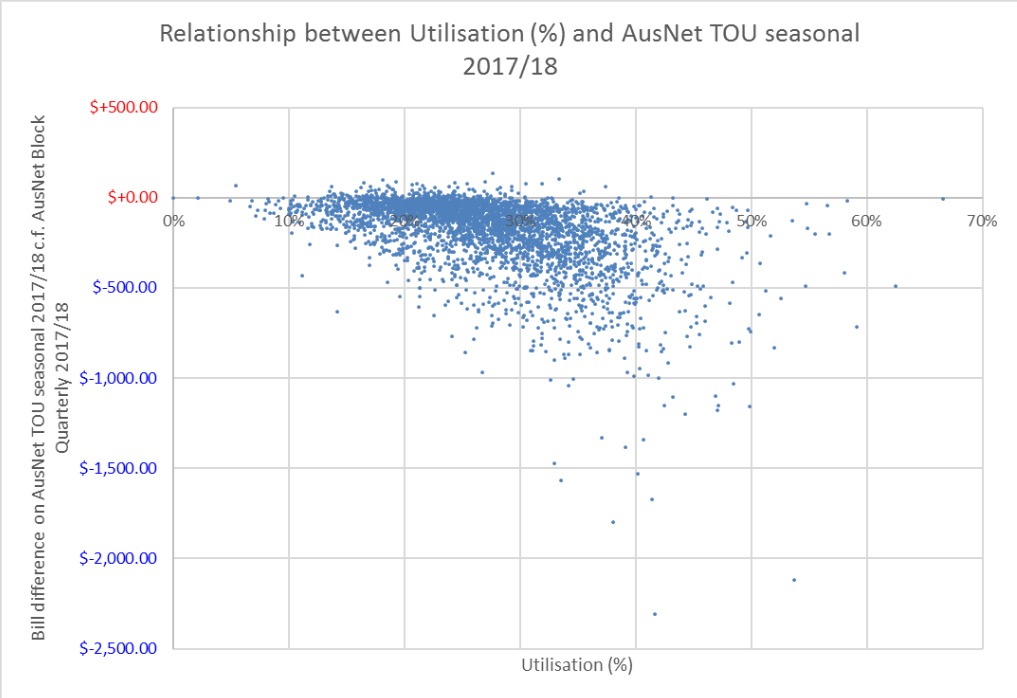


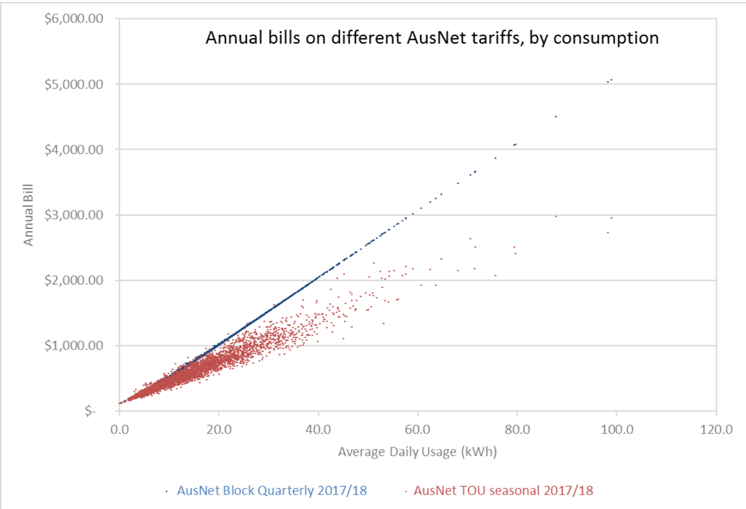


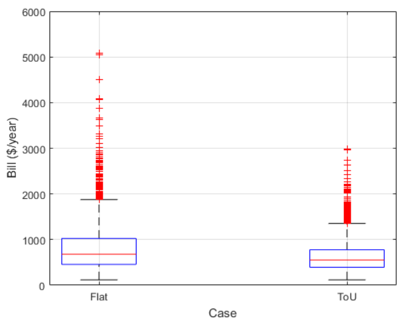


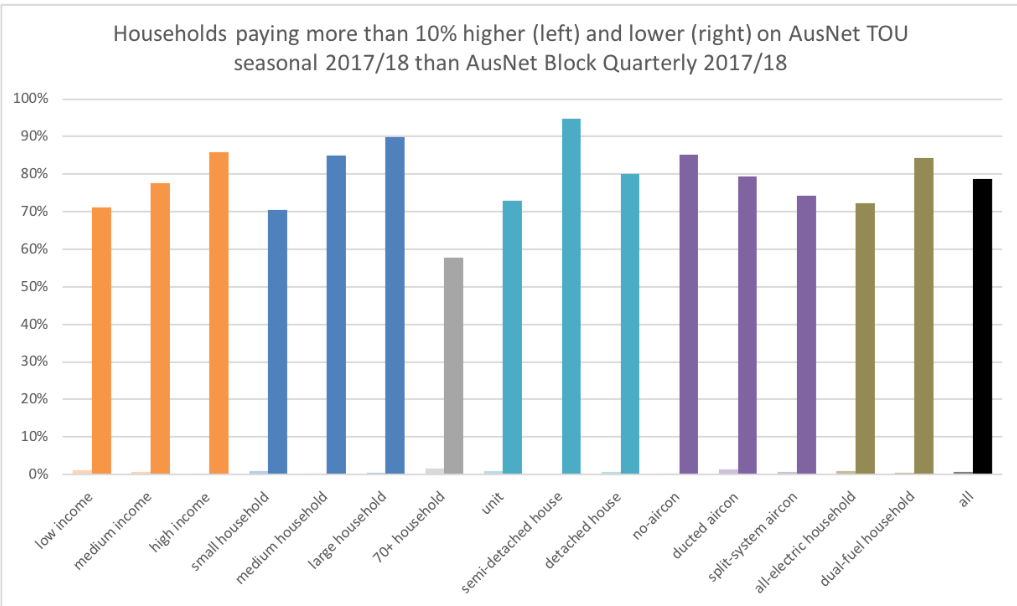
Essential's ToU tariff has similar characteristics to Ausgrid's, with the notable exception that no household pays more on a ToU than on the flat tariff. This reflects Essential's decision to incentivise customers to shift to the ToU tariff by loading a greater proportion of residuals into the flat tariff.[6]

[6] This was discussed at length during consultation sessions on tariff design.


Relationship between Utilisation (%) and AusNet TOU seasonal 2017/18
Bill difference on AusNet TOU seasonal 2017/18 c.f. AusNet Block Quarterly 2017/18
$+500.00
$+0.00
$-500.00
$-1,000.00
$-1,500.00
$-2,000.00
$-2,500.00
0%
10%
20%
30%
40%
50%
60%
70%
Utilisation (%)


Annual bills on different AusNet tariffs, by consumption
Annual Bill
$6,000.00
$5,000.00
$4,000.00
$3,000.00
$2,000.00
$1,000.00
$-
0.0
20.0
40.0
60.0
80.0
100.0
120.0
Average Daily Usage (kWh)
AusNet Block Quarterly 2017/18
AusNet TOU seasonal 2017/18


6000
5000
4000
3000
2000
1000
0
Bill ($/year)
Flat
ToU
Case


Households paying more than 10% higher (left) and lower (right) on AusNet TOU seasonal 2017/18 than AusNet Block Quarterly 2017/18
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
low income
medium income
high income
small household
medium household
large household
70+ household
unit
semi-detached house
detached house
no-aircon
ducted aircon
split-system aircon
all-electric household
dual-fuel household
all

AusNet Services' ToU tariff differs from Ausgrid's and Essential's by having much higher peak and shoulder rates that apply for shorter time periods, and a much lower daily charge. This probably accounts for the much lower spread of prices (indicated in the boxplot) as well as the greater advantage for high volume households. The low fixed charge also benefits low volume users. There is minimal impact on low-income, small, older, and unit-dwelling households; though they are still less likely to face lower prices on the ToU than other households.

4.4 Demand tariffs and rooftop PV cross-subsidisation

As part of this project we also explored the potential of demand tariffs to address the inequity that arises due to households with solar PV being undercharged for network access due to the volumetric basis of network tariffs. We compared solar and non-solar households' bill outcomes on Ausgrid flat, ToU, and proposed demand tariffs, as well as a demand-only tariff we designed to be cost-neutral for this customer cohort.

Type	Flat tariff	ToU tariff	Demand tariff	Demand only tariff	Annual usage	Monthly peak demand
Low income	$595.25	$461.15	$620.28	$578.22	4,630 kWh	3.3 kW
Med income	$665.54	$510.36	$681.52	$613.21	5,240 kWh	3.6 kW
High income	$852.43	$605.74	$821.79	$671.79	6,790 kWh	4.2 kW
Solar	$567.60	$405.92	$622.86	$610.10	4,443 kWh	3.6 kW

This modelling shows that:

1. Solar households on average have similar peak demand to average non-solar households
2. Demand tariffs see solar households paying a fair share of network costs
3. Demand tariffs without volumetric rates can benefit low-income households on average, (as can time-of-use tariffs). More analysis should be done here.

5 Conclusions

The main finding from this research and analysis was that it needs much greater resources and access to rich data to provide conclusive results. Nevertheless, it seems clear that:

- Drivers of network costs are complex when considered comprehensively, and cost-reflective tariffs need to be designed with this in mind. Sunk and ongoing maintenance costs have different drivers than augmentation. DNSPs should provide clear and transparently information about the main drivers of ongoing and new costs, and show how tariffs reflect all of them. We are not convinced that households' outlier peaks drive costs more than their typical peak demand (outside of critical peak events).
- Detailed tariff analysis on actual customer loads with demographic data attached can give an accurate picture of the potential customer impact of a new tariff. We urge DNSPs to collect customer load profiles with demographic descriptors of a representative sample of customers in order to undertake such analysis and thus give detailed information about the customer impact of proposed tariffs.
- Because high-consumption households tend to cross-subsidise low-consumption households on volumetric network tariffs, and consumption tends to scale with income while demand doesn't, cost-reflective tariffs are more likely to benefit higher income households and penalise lower income ones. This raises a social equity issue that needs to be addressed during tariff reform.
- Nevertheless, many lower income households are still likely to benefit from cost-reflective network pricing. The true test for cost-reflective tariffs is not whether they benefit

vulnerable or small households, but whether they more fairly allocate costs, providing the optimal foundation for targeted assistance to those who need it.

- Demand management would be a useful tool to help vulnerable households who are disadvantaged by demand-based tariffs.
- Demand tariffs have the potential to unwind cross-subsidies to households with solar PV – though this also raises a possible social impact issue on lower income solar households. At the same time, DNSPs should ensure that these households are fairly rewarded for their contribution to reducing network costs.