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Economists

Linkages between Ausgrid's tariff strategy and expenditure proposals

Key points

- The Australian Energy Regulator (AER) has asked Ausgrid to explain how its tariff strategy for the next regulatory control period minimises future network expenditure requirements. This stems from concerns that expenditure proposals are being developed independent of tariff strategy, which can lead to higher network expenditure than might otherwise be required.
- In response to this request, HoustonKemp has been asked to describe the relationship between tariff strategy and its expenditure proposals, to support Ausgrid's forthcoming regulatory proposal. This memorandum describes this relationship in detail, while providing quantitative evidence to support a conclusion that Ausgrid's tariff strategy is placing downward pressure on its expenditure proposals and will continue to do so into the future.
- Ausgrid's commitment to tariff reform reflects its understanding of the importance of using tariffs to promote efficient use of the network, which in turn will ensure that network expenditure is efficient.
- Ausgrid's tariff strategy continues to evolve as the network provides export and import distribution services, and customers increasingly embrace distributed energy resources.
- The next regulatory control period will provide the opportunity to better understand how customers respond to innovative tariff structures (through tariff trials) and will need to adapt in the future as Ausgrid's understanding of how the network is used, improves.
- Increasing discretionary load as consumers adopt electric vehicles, combined with increasing exports are expected to be critical drivers for network expenditure in the future. Ausgrid's tariff strategy has been designed to target both these drivers.
- To demonstrate the impact that Ausgrid's tariff strategy is having on network expenditure during the next regulatory control period, we have investigated how changes in the timing of electric vehicle loads impact on network expenditure. The network expenditure impact has been modelled using Ausgrid's DER expenditure models given expectations about future network loads and is undertaken at a high-level of disaggregation across the network.
- Our approach involved comparing network expenditure under a scenario of convenience electric vehicle charging, compared to a scenario whereby the consumer with an electric vehicle responds to Ausgrid's time-of-use tariff structure.
- We find that the time-of-use tariff has a significant impact on the timing of electricity use by electric vehicle load, which is reduced outside of the network load peak period.
- Importantly this has the effect of lowering network expenditure. By 2029 the tariff strategy reduces network expenditure by approximately $4.5 million, which increases to over $27 million each year by 2039. The relatively small impact in the early years reflects Ausgrid's expectation that electric vehicle loads will not be significant over the next regulatory control period.
- Given that the case study has been based on time-of-use tariffs only, we expect that in practice Ausgrid's 2024-29 pricing reforms will have a larger impact in reducing network expenditure. This arises from the focus of the strategy on improving pricing signals (through changes to the charging windows, and the export pricing transition amongst other pricing reforms).

- This analysis highlights the important contribution that Ausgrid's tariff strategy is having on network expenditure needs. We expect that this contribution will improve as Ausgrid improves its tariff strategy in the future as it improves its understanding of customer responsiveness to innovative tariffs.
- The next regulatory control period provides an opportunity for Ausgrid to undertake the research necessary and build the information base, to deliver further expenditure savings for consumers. This will require some focus on internal systems and processes particularly around information sharing and dissemination, to maximise the adoption of insights from the research work undertaken.

The discussion below has been drafted to be inserted in Ausgrid's regulatory proposal or tariff structures statement (as appropriate).

• Ausgrid's tariff strategy seeks to minimise future network expenditure needs

Since its first tariff structure statement in 2017, Ausgrid has been committed to improving its tariff structures to provide customers with price signals that promote efficient use of and investment in the network, consistent with the National Electricity Objective. As the number of smart meters installed in Ausgrid's network has increased, customers have been transitioned towards time-of-use and demand tariffs, and other tariff structures that better reflect the costs that usage of the network cause.

In doing so, customers that choose to use electricity during peak times, contribute to the investments needed, to provide the capacity required, to meet system reliability requirements. Those customers that choose to shift the time of electricity consumption in response to peak tariffs, improve the utilisation of the network and so lower costs for all consumers.

Ausgrid's focus on tariff reform and improving price signals to customers reflects the strong connection between changes in the expected future network load profile and the need for network expenditure to ensure that the network can reliably supply those loads.

With recent changes to the National Electricity Rules that formally recognise export distribution services, ensuring that customers are provided with appropriate price signals for efficient use of the network for both electricity use and export, has become even more important.

It follows that Ausgrid's tariff strategy for the 2024-29 regulatory control period has been designed to further improve price signals and so promote efficient use of the network by its consumers. In so doing, this will minimise future network expenditure needs, while also supporting the energy transition by promoting efficient investment by customers in technologies that will help to achieve Australia's net-zero emission goals.

In the remainder of this section, we describe how Ausgrid is practically linking its tariff strategy to its expenditure proposals, and how it intends to further evolve its tariff strategy in the future to continue to minimise its network expenditure needs in the coming years. We also set out the results of a case study that demonstrates how Ausgrid's network tariff strategy is minimising future network expenditure needs.

o Ausgrid's tariff strategy will support a transition to an efficient two-way flow network and support consumer choices to embrace distributed energy resources

In developing its proposed tariff strategy, Ausgrid has several key objectives, namely:

- to continue to improve price signals and promote efficiency by progressing the shift of network customers to more cost reflective tariff structures;
- to reward customers that are flexible in when and how they use energy;

- to promote fairness in how prices allow for the recovery of costs; and
- to design tariff trials that will allow Ausgrid to refine its tariff strategy into the future, as customer adoption of new energy technologies becomes clearer, and to improve Ausgrid's understanding about how price signals influence customers' network use.

The tariff trials are particularly focused on understanding how customers respond to price signals now that Ausgrid is responsible for providing two-way network flow services, and to better understand new types of network loads (eg, electric vehicle and greater electrification) anticipated as part of the energy transition.

Ausgrid's tariff strategy for the 2023-29 regulatory control period can be summarised as follows:

- continuing to promote transferral of customers to more cost reflective demand and time-of-use tariffs;
- refinement to demand and time-of-use charging windows to reflect changes in the network load profile as customer use of the network continues to change as part of the energy transition;
- transition to export pricing through the introduction of a two-way tariff pricing structure, that both rewards customers when importing or exporting to the network during periods of peak exports or peak imports, respectively, and charges customers when usage of the network imposes network costs;
- streamlining tariffs through the removal of 12 network tariffs that are very similar to other tariffs, or have few or no customers assigned to them;
- introducing three tariffs for embedded networks with medium or large annual energy usage to better reflect the costs to serve those networks;
- improving controlled load tariffs to allow customers to use controlled load devices during the daytime when solar customers are exporting to the grid;
- refining charging windows to better align pricing signals to peak network usage periods; and
- continuing to undertake a set of tariff trials to support increasing penetration of distributed energy resources and promote efficient use of the network, which includes examining the practical use of flexible load and dynamic cost-reflective tariffs.

Ausgrid's tariff strategy is expected to influence customer use of the network, by promoting greater use of the network during both import and export off peak periods. Over time, as we improve our tariff strategy and better understand customer responsiveness to innovative tariff structures, Ausgrid expects to spread network use further across the day, and so make better use of the existing network, minimising future expenditure needs while continuing to support customers' use of electricity.

It is for this reason that the proposed changes to charging windows in the 2024-29 regulatory control period are an important improvement to Ausgrid's tariff strategy. Specifically:

- aligning the timing of the peak charging windows between summer and winter as the timing of peaks in those two periods have become more aligned;
- providing the option to adjust the charging window periods from 1 July 2027, as the impact of new network use and tariff responses becomes clearer;
- extending the peak charging window to weekends for residential customers as weekend peaks become a more important driver of network costs, in part due to the greater adoption of distributed energy resources; and

- combining the shoulder and off-peak charging windows to improve the peak price signal and simplify the tariff structure to maximise consumer responsiveness to tariffs.

Finally, the tariff trials are an integral part of the strategy. They provide the opportunity to test alternative tariff designs and improve our understanding about how customers respond to the pricing signals. Our tariff trials, combined with the trials being undertaken by other distributors, will provide an important information base for the future.

Importantly, Ausgrid's tariff strategy supports its DER integration strategy by improving price signals for exports and so improving network utilisation. This will facilitate greater scope to host DER capacity across the network, compared to a circumstance where Ausgrid's tariff strategy was not implemented. Overall, this means that Ausgrid will need less expenditure than it might otherwise to support DER integration, with associated benefits through lower network charges to consumers.

o Ausgrid internally co-designs its tariffs strategy based on the best information on consumer response, activities to promote efficient investment in distributed energy resources by consumers, and in response to technological developments

As for all network businesses, Ausgrid builds its regulatory expenditure proposals on the basis of expectations about the growth in future network use, and a detailed understanding of the need for replacement of assets that are reaching the end of their life.

It follows that our consumption and maximum demand forecasts are a critically important input for the regulatory proposal. Historically, we have factored tariffs into our demand forecasts in two ways, namely:

- based on a price elasticity assumption given expected changes in the level of flat and peak consumption tariffs; and
- given expectations about the expected uptake of smart meters and therefore the extent to which more customers are expected to face time-of-use or other cost reflective price signals into the future.

This approach has ensured that incremental changes in price signals across Ausgrid's customer base have been appropriately considered in our expenditure needs over time.

However, the rapidly accelerating pace of the energy transition is placing renewed focus on tariff design and strategy, and the implications for expenditure needs. Without appropriate price signals, there are risks that consumers may not optimally take up distributed energy resource technologies, make best use of local networks or manage expected increases in discretionary loads.

Ausgrid is responding through its distributed energy resource integration strategy, which involves:

- building a customer education program (which works hand-in-hand with tariff trials) to improve customer understanding of how DER interacts with the network;
- addressing connection processes for DER to improve the speed and process for connections;
- improving billing systems to facilitate tariff trials and so create the capability to support the use of more innovative tariffs;
- investing in systems and tools to better understand power flows on the distribution network, and so support dynamic pricing and dynamic operating envelopes for exports; and
- developing systems to better monitor DER connection performance and compliance.

These activities provide the capabilities that are necessary to support greater use of innovative tariffs that can achieve our goals of maximising efficient use of the network by all customers, including those actively investing in DER.

Ausgrid recognises the importance of bringing together our internal experts in tariff design, demand forecasting, DER and network planning to ensure that we have a coordinated approach to the delivery of two-way network services as our knowledge grows during the next regulatory control period. Practically, this has involved putting in place an internal taskforce that meets regularly and so brings together all relevant areas of Ausgrid to sharing information, assumptions and new knowledge.

This will be particularly important as the results of our tariff trials become known, to ensure that the lessons can be used to support future demand forecasts given expectations around uptake of new tariff structures. Ultimately, this will translate into ongoing improvements in the efficiency of network services.

We believe this taskforce will be critical to ensuring that our tariff strategy continues to support efficient network expenditure during the energy transition.

For the 2024-29 regulatory control period, Ausgrid's forecast expenditure has been developed in three ways:

- projecting future zone substation maximum demand, based on:
  - actual historic load traces by zone substation, corrected for temperature;
  - projections of customer growth and expectations for new connection load; and
  - adjustments for DER integration (solar PV, EV growth etc) and energy efficiency improvements;
- analysing responsiveness to tariffs, for those parts of future consumption that are expected to be most influenced by tariff strategy (eg, emerging discretionary expenditure); and
- considering scenarios of future DER uptake, and tariff responsiveness, drawing upon assumptions set out in the Australian Energy Market Operator's Integrated System Plan, and other research undertaken internally.

This approach means that Ausgrid is confident that its projections of consumption and load profile changes, and associated expenditure proposals, is optimal given the best available information about tariff responsiveness and future maximum demand, at this time. That said, there is a need to continue to research and gather information to continually refine and hone the tariff strategy and expenditure pathways to ensure customer value into the future.

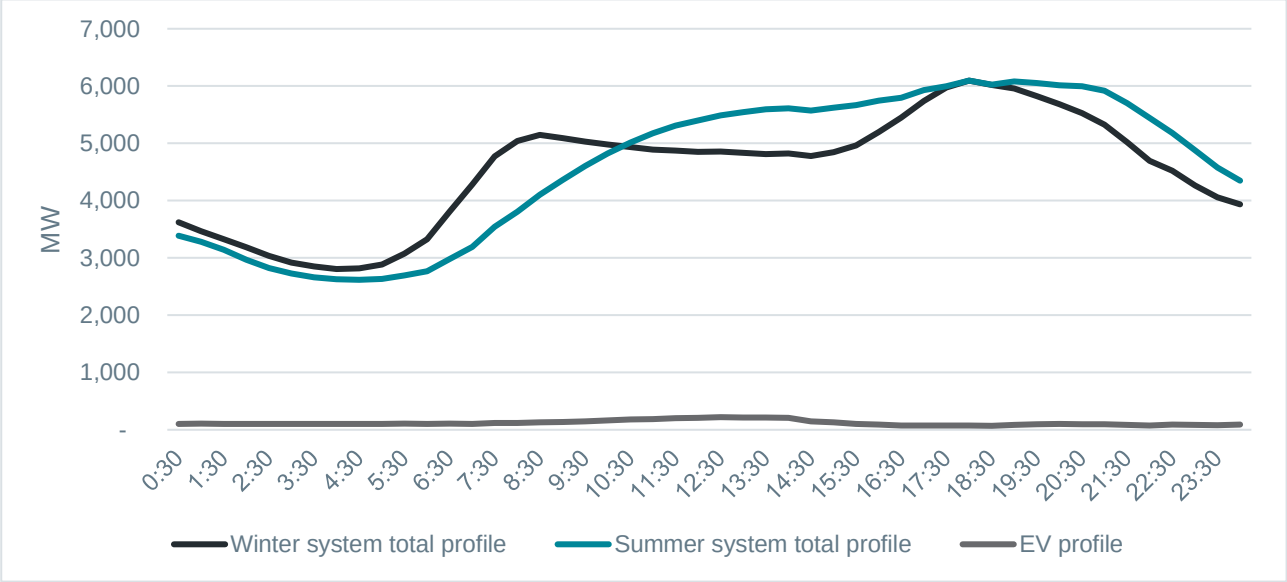
By targeting discretionary loads, Ausgrid is lowering its future network expenditure needs

A key consideration for Ausgrid looking ahead, is how best to manage anticipated increases in energy consumption as part of the energy transition. This increase is expected to result from multiple sources including the increasing uptake of electric vehicles (EV), as well as a shift to electrification of heating and other energy uses.

The expected growth in EV load is of particular interest from a pricing strategy perspective because for these loads, consumers are likely to be highly responsive to price signals, given the likely discretionary nature of the timing for recharging EV's.

Figure 1 decomposes EV charging demand as a proportion of Ausgrid's 2024 representative maximum demand projection.

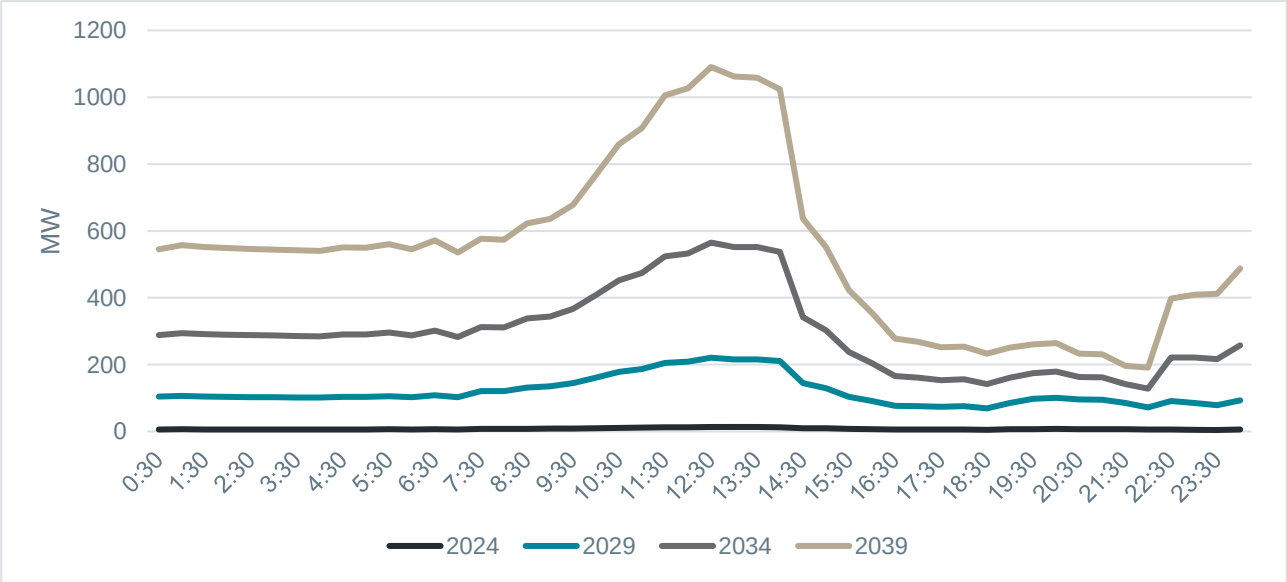
Figure 1. Electric vehicle load is a small proportion of the system total profile under the 2024 step change scenario



Source: HoustonKemp analysis of representative profiles provided by Ausgrid.

While current expectations about EV load means it is unlikely to be an important driver of network load over the next regulatory control period, it is expected to be important over the medium term. Figure 2 displays how EV load is expected to increase substantially over the years 2024, 2029, 2034 and 2039, assuming tariff structures that encourage solar soaking during the solar export peak periods during the middle of the day.

Figure 2. EV load increases and becomes peakier over time – step change scenario



Source: HoustonKemp analysis of representative profiles provided by Ausgrid.

In 2039, the maximum demand from EV charging load is currently expected to be 1,090 MW at 12:30pm. For context, this represents 18.9 per cent of Ausgrid's representative system total peak load in summer 2024 and is 1.7 times the size of NSWs forecast 2024 rooftop PV capacity, which is 6,448 MW[1]. Not only is this a large increase in demand, but this increase in EV load will also occur disproportionately in the middle of the day, such that there will be an 82-fold increase in demand around noon.

This highlights the extent to which tariffs are expected to affect future load and so expenditure over the coming years.

- Applying time of use tariffs to EV load provides a case study of how expenditure can be reduced through efficient tariff price signals on large flexible load

To illustrate the impact of Ausgrid's tariff strategy on expenditure, we have investigated how the timing of EV load throughout the day is affected by cost reflective tariffs and have estimated the implications for network expenditure.

Specifically, we compared the demand profiles for when customers charge their EVs when it is convenient to them, ie, the alternate case, to the demand profiles under Ausgrid's current tariff strategy, which focuses on ensuring that customers with EV's face time of use (ToU) price signals to encourage charging of EVs outside of peak load times, ie, the base case. [2]

Data and assumptions applied

We based this case study off the demand profile for a medium sized residential vehicle on a half-hourly basis throughout an average summer weekday.

To create this data, we converted AEMO's average weekday consumption data for a medium sized residential vehicle into demand. We then distributed this throughout a day on a half-hourly basis using average charging pattern data from AEMO's 2021 EV Workbook.[3] AEMO's workbook has three types of average charging patterns, for when the customer predominantly:

- convenience charges;
- charges during the day; and/or
- charges at night.

For the alternate case, we assumed that customers charge when it is convenient for them, and so attributed 100 per cent of the demand profile towards the convenience charging load profile. However, for the base case we incorporated all three customer charging patterns by weighting them according to our assumptions and findings from the 2019 Charge Together EV owner survey.

To assess how customers adjust their EV load in response to a change of price, we assumed that they faced Ausgrid's current residential tariffs. For the base case, we used the EA025 tariff, which varies by the time of day. For the alternate case, we used the EA010 tariff, which is a constant consumption price. These tariffs and the applicable time-of-use definitions are set out in table 1 below.

[1] AEMO, *2022 Forecasting Assumptions Workbook*, 31 August 2022.
[2] We have modelled time-of-use tariffs for this case study, rather than demand tariffs, for computation ease given earlier work estimating price elasticities of demand for Ausgrid's tariffs. That said, we would expect similar outcomes on expenditure from demand tariffs as observed here using time-of-use tariffs.
[3] AEMO, *2021 Inputs and Assumptions Workbook*, 10 December 2021.

Table 1. Ausgrid tariffs and time-of-use definitions

	Peak[4]	Shoulder	Off-peak
ToU time periods	2pm-8pm (summer) 5pm-9pm (winter) na (other months)	7am-10pm (excl. peak period)	All other times
EA025 tariff (¢/kWh)	25.37	5.62	3.62
EA010 tariff(¢/kWh)	8.65	8.65	8.65

Source: Ausgrid.

When comparing the alternate and base case scenarios, we assume that the total amount of demand does not change, ie, demand is redistributed across the day as opposed to being increased or reduced. We make this assumption for two reasons. First, because customers are relatively inflexible with the amount that they drive and so need to charge, and second, because the price that customers face has not necessarily increased or decreased, it has just been reapplied across the day.

We illustrate this example with the 2024 step change scenario, as this is the scenario used in our 2024-2029 proposal. However, to be comprehensive we have modelled the results for multiple scenarios and years, of which we display some of the results later in this case study.

To then find the effect on expenditure of moving from the alternate case to the base case, we used Ausgrid's DER integration modelling that excluded the Sydney CBD and private zone substations, and extrapolated this to include any other zones that could not be included due to inconsistencies.

Methodology used

We started by using the demand profiles for the base and alternate cases to determine the average demand in each of the Ausgrid time-of-use periods under the two respective tariffs. This can be seen below in table 2.

Table 2. Average half-hourly demand varies with the tariff applied to that period

Base case	Peak	Shoulder	Off-peak
Alternate case			
EA010 tariff	8.65 ¢/kwh	8.65 ¢/kwh	8.65 ¢/kwh
Demand (kW per vehicle)	0.398	0.342	0.071
Base case			
EA025 tariff	25.37 ¢/kwh	5.62 ¢/kwh	3.62 ¢/kwh

[4] Peak tariffs only apply on working weekdays in the relevant months.

• Demand (kw per vehicle)	• 0.210	• 0.301	• 0.237

Source: HoustonKemp analysis of data provided by Ausgrid, including data from AEMO's 2021 Inputs and Assumptions Workbook.

Under the alternate scenario, customers predominantly charge in the peak and shoulder periods, and very little in the off-peak period. Under the base case, when Ausgrid imposes a time-of-use tariff, customers charge more consistently across periods.

We note an anomaly in that customers reduced their demand in the shoulder period even though this tariff fell. This is unsurprising given:

- the off-peak tariff fell to a lower price than the shoulder tariff, and thus customers may have been incentivised to shift their demand from the shoulder period to the off-peak period; and
- the windows for the three periods do not accurately reflect consumer behaviour, and so will distort the result.[5]

By comparing how demand changes when the tariff changes, we can calculate the implied elasticity, ie sensitivity of customers to a change in price. These are set out in table 3 below.

Table 3. Implied price elasticity[6]

	Peak	Shoulder	Off-peak
• Ausgrid implied elasticities	• -0.25	• 0.27	• -3.93
• HoustonKemp 2017 benchmark elasticities[7]	• -0.07	• -0.30	• -0.07

Source: HoustonKemp analysis of data provided by Ausgrid, including data from AEMO's 2021 Inputs and Assumptions Workbook, and data from HoustonKemp's 2017 price elasticity of demand report.

These elasticities show that:

- customers are not very sensitive to a change in the peak period tariff, meaning that a large increase is required in order to incentivise them to shift their charging away from this period;
- customer demand in a given period is dependent on both the tariff for that period and the tariff for the adjacent periods, as demonstrated by the reduction in demand in the shoulder period despite a fall in the shoulder period tariff;[8] and
- customers react strongly to a decrease in the off-peak tariff, with a reaction that is proportionally greater than the reduction in the tariff.

The elasticities set out in table 3 are consistent with our expectations. They are greater than HoustonKemp's 2017 benchmark elasticities, reflecting the fact that EV charging is a large and flexible load, so there will be a

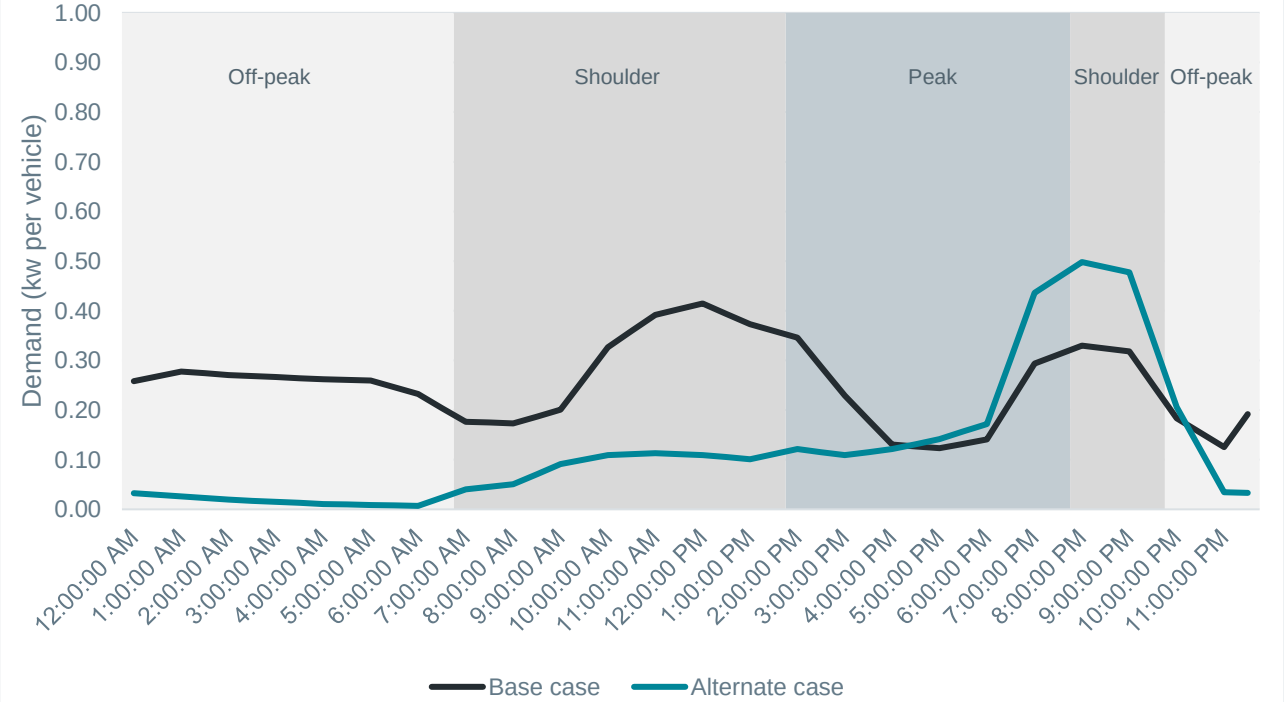
[5] Figure 3 highlights the issue that the windows for each of the periods do not align with customer charging behaviour. Ausgrid is aware of this problem and looking to adjust the windows.
[6] A price elasticity measures the percentage change in consumption resulting from a one per cent increase in price.
[7] HoustonKemp, *How do customers respond to price signals?,* 7 December 2017.
[8] Although part of this effect may be explained by the times for each period being inadequately defined.

significant reaction a change in tariffs. While the shoulder period elasticity is positive and the HoustonKemp one is negative, this is simply because ours includes the effect of a drop in the off-peak period price, while the HoustonKemp elasticity does not include cross-price elasticity effects.

A time of use tariff notably affects customer demand

The customer reaction to Ausgrid incentivising preferable customer charging behaviour can be seen below in Figure 3 and figure 4.

Figure 3. Customers smooth their demand in response to price signals – 2024 step change scenario



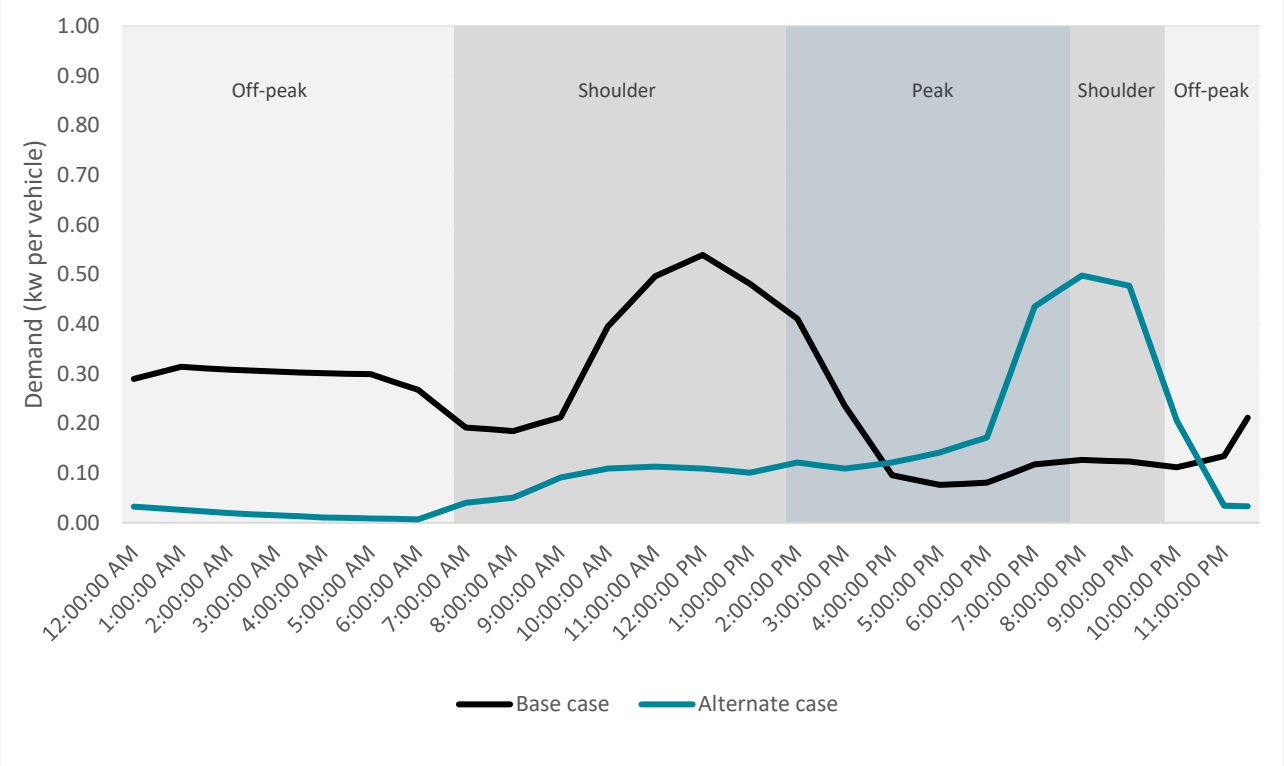
Source: HoustonKemp analysis of data provided by Ausgrid, including data from AEMO's 2021 Inputs and Assumptions Workbook.

A shift from a flat tariff to a time-of-use tariff incentivises customers to reduce their peak demand and increase their off-peak demand.

This has a smoothing effect, reducing the peak amount of demand for a medium residential vehicle from 0.50 kW to 0.21 kW, which is a reduction of more than half. We note that the time-of-use tariff also has the effect of creating a peak in the shoulder period. However, given this period is not a typically constrained time of day for the grid from an import perspective, we do not anticipate that this increase will have a material effect on expenditure when taken into consideration with other forms of connecting load. Indeed, it could assist with lowering the impact of increasing solar PV exports during this period.

We note that the results for the 2039 step change scenario are similar. These are presented in figure 4 below, and show that the customer reaction to the TOU tariff has become stronger. This change reflects the fact that over time an increasing number of customers with EVs will face a cost reflective tariff.

Figure 4. Customers smooth their demand in response to price signals – 2039 step change scenario



Source: HoustonKemp analysis of data provided by Ausgrid, including data from AEMO's 2021 Inputs and Assumptions Workbook.

A targeted tariff can be used to significantly reduce expenditure

The impact on Ausgrid's expected future expenditure from this shift in EV charging behaviour is substantial, even when excluding the Sydney CBD and private zone substations.

We have modelled the implications for power flows and constraints across the two tariff strategy options considered. We find that the cost reflective tariffs have the effect of reducing expenditure compared to the base case by approximately $4.5 million. The disaggregated results are set out in table 4 below.

Table 4. The potential savings on expenditure increases over time

	2024	2029	2034	2039
Base case	$77,061,676	$90,014,902	$140,116,217	$196,397,025
Alternate case	$78,968,145	$94,037,044	$147,716,002	$220,415,931

Change ($)	$2,169,037	$4,576,090	$8,646,462	$27,326,899
Change (%)	2.5%	4.5%	5.4%	12.2%

Source: Ausgrid.

While the expenditure savings in 2024 may seem like a relatively small percentage, at 2.5 per cent, this is still a very significant saving of $2.17 million. Over time this expenditure saving is expected to increase to $27.33 million or 12.2 per cent.

This case study on EV charging load demonstrates how Ausgrid can and is using time-of-use tariffs to significantly reduce its expenditure. The savings when EV charging load reacts to time-of-use tariffs is already large, and we anticipate that this effect would increase as Ausgrid's customer base electrifies over the coming decades.

Relevantly, these results are based only on the implications of time-of-use tariffs on EV charging load. We would expect there to also be network expenditure reductions arising from cost reflective tariffs improving the utilisation of the network by other DER activities (eg, virtual power plants, etc). Importantly, all the elements of the 2024-29 proposed pricing reforms work together to improve price signals to network users. It follows that the tariff strategy will in practice deliver expenditure savings that are likely to be higher than those quantified through our case study above.

Looking forward, and in addition to the above, we would expect that future tariff strategies will be able to deliver greater cost savings for consumers as an improved understanding of customer responsiveness is developed through the next regulatory control period.

The next regulatory period will provide the research and information base to deliver further expenditure savings for consumers

Looking forward, Ausgrid is focused on further improving its understanding about customer responsiveness to innovative tariff structures and putting in place the capabilities to better manage both imports and exports across the network and understand how changing network use affects the need for future expenditure. This will build the information base to support ongoing refinements to our tariff strategy, and so facilitate continued provision of efficient network services for customers.

We are conscious of ensuring that our internal systems and processes, information sharing and dissemination will maximise the lessons from the research work that we will be undertaking. This is to ensure that the best possible information is used to support our tariff strategy, and to maximise the opportunity to continue to reduce future expenditure for the benefit of our network users, as network demands change during the energy transition.