AUSTRALIAN ENERGY REGULATOR

EV workshop on Victorian tariff structure statement proposals

Chaired by Board Member Groom

11 November 2020

aer.gov.au

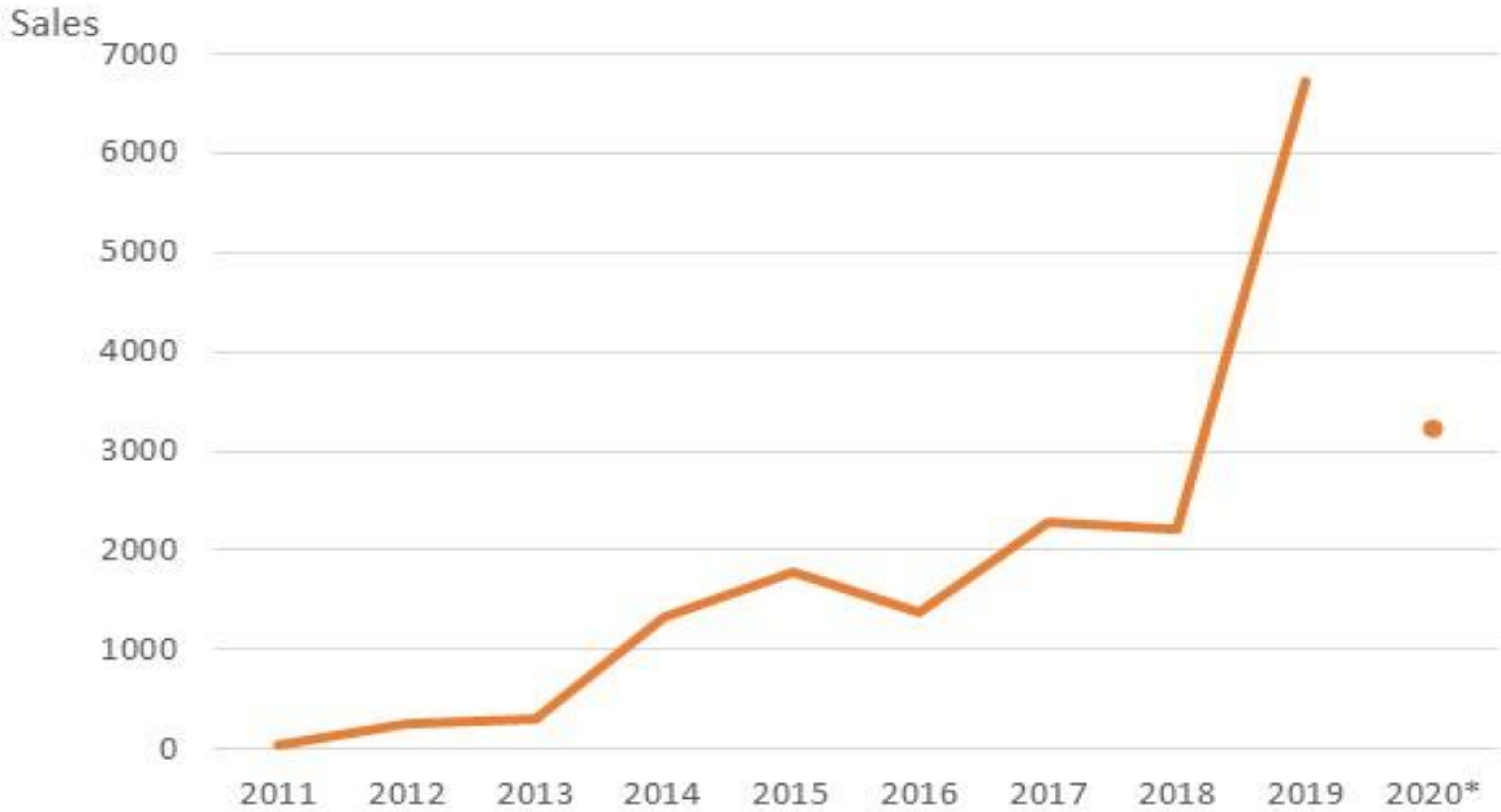
Agenda

- 09:30 Welcome and introduction
- 09:40 Victorian Government policy
- 09:50 Efficient distribution tariffs
- 10:10 AER draft decision
- 10:20 Discussion

<Break>

- 10:50 EVC submission on tariffs for EV charging stations
- 11:00 Remembrance Day
- 11:01 Discussion
- 11:40 ECA submission on small user tariffs
- 11:50 Discussion
- 12:25 Close

Electric vehicles are a small but rapidly growing source of demand



Source: Electric Vehicle Council, 2020, *State of Electric Vehicles*

Charging can support or strain electricity distribution networks

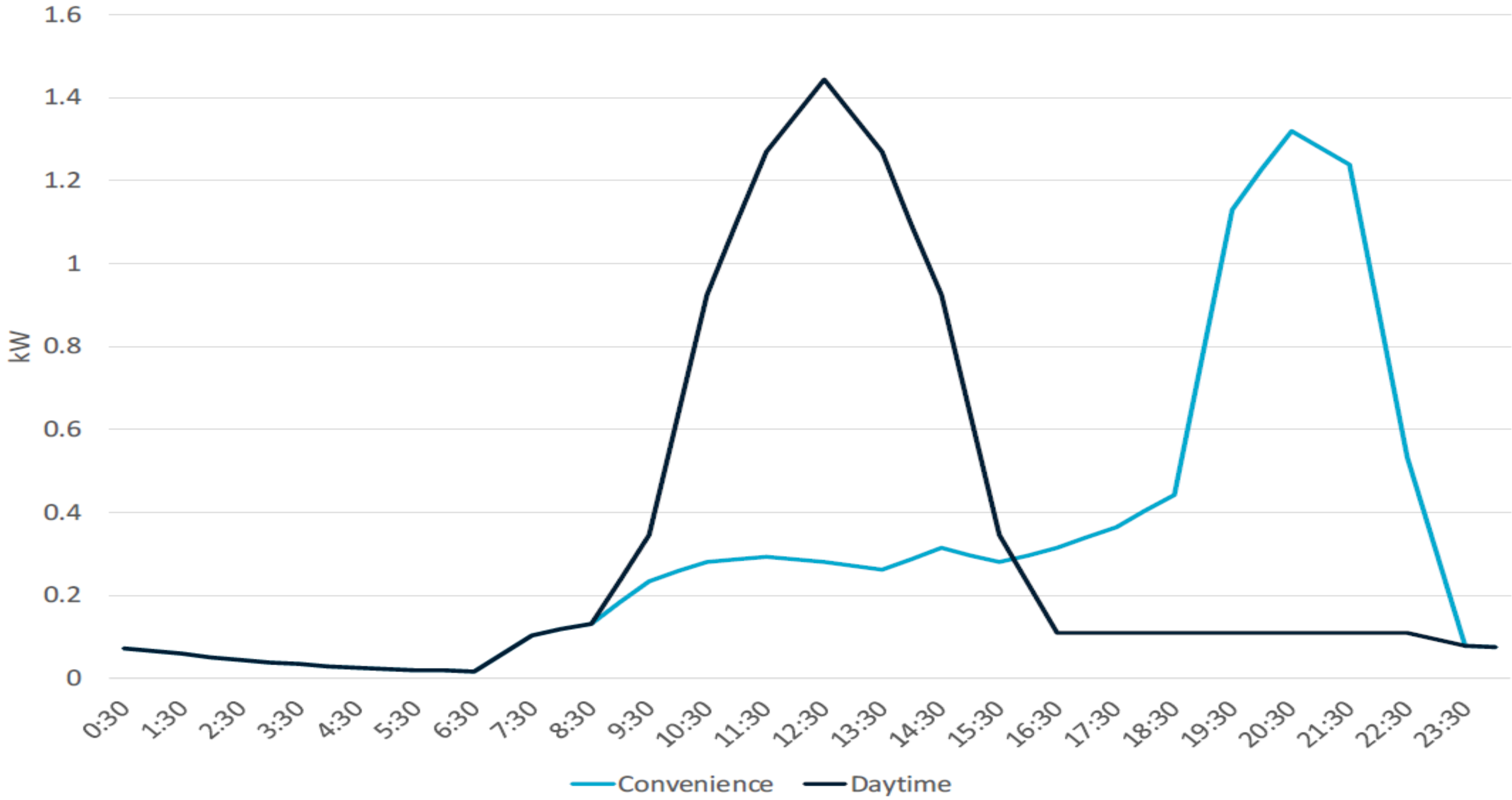


Figure 29 - Convenience (flat tariff) and incentivised daytime electric vehicle charging profile for NSW medium passenger vehicle

Source: CSIRO and CutlerMerz, 2020, *Value of Distributed Energy Resources: Methodology Study*

DELWP's policy - network tariffs for electric vehicles

VICTORIA State Government | Environment, Land, Water and Planning

As the energy system transitions to a future with a greater proportion of decentralised renewable energy generation and widespread electric vehicle uptake, we consider that flat tariffs are no longer the most effective or fairest means of recovering the cost of supplying electricity.

1. **Affordability and equity** – helping reduce peak demand growth will defer avoidable network investment, while also moving to a fairer and more equitable system for charges based on the costs that consumers impose on the network.
2. **Sustainability and the energy transition** – providing signals to incentivise rooftop solar self-consumption, uptake of battery storage, and preparing for the integration of EVs can maximise renewable energy consumption.
3. **Reliability and security** – incentivising consumers to shift their energy consumption away from peak times can moderate peak demand on the network and reduce risk of outages.

There is a role for the Victorian Government to work closely with the energy sector to support consumers on the network tariff transition.

We consider the upcoming 2021-26 regulatory control period is an important opportunity to ensure that effective price signals are in place to incentivise EV owners to optimise charging during off-peak periods, which means the existing infrastructure is utilised more efficiently and importantly, minimise the need for additional future investment.

If managed well, the integration of EVs into the energy system could be relatively seamless, with EV owners on non-flat tariffs achieving significant savings on their electricity bills by avoiding charging at times of high demand.

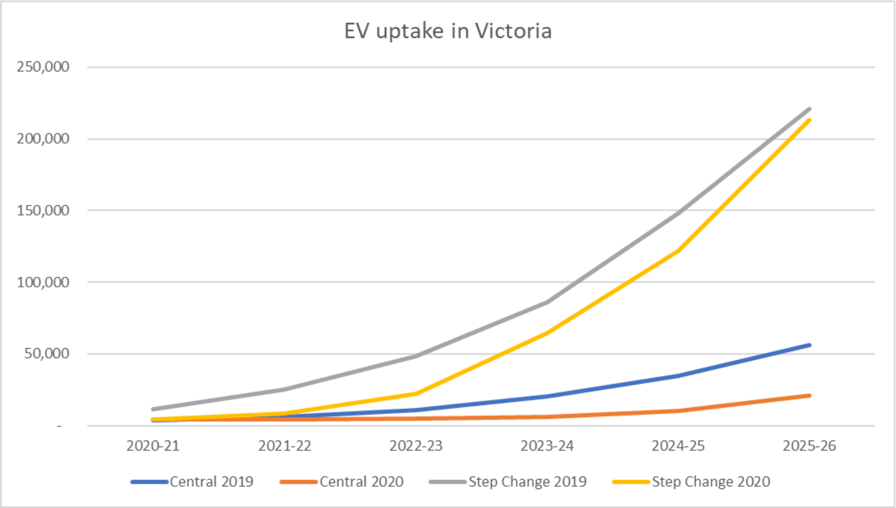
If managed poorly, the integration of EVs into the energy system could drive a rapid increase in network and generation to meet demand, particularly if convenience charging becomes the norm.

Forecast EV uptake in Victoria over 2021-26

In its consideration of the policy on network tariff reform, the Victorian Government referred to AEMO's forecasts for EV uptake over the regulatory control period.

Based on AEMO's 2019 forecasts, there is the potential for the number of EVs in Victoria to increase to approximately 56,000 by 2025-26 under a Central Case scenario which represents the status quo.

Although the figure under this scenario has been revised down in the most recent update, it is worth noting that the 2019 and 2020 Step Change scenarios which represent the most optimistic scenario for EV uptake both sit at approximately 220,000 by 2025-26.



Victorian Government position on tariff structure statements

The Victorian Government provided a submission on tariff structure statements to the AER in May 2020, which recognised the extensive customer engagement undertaken by the Victorian distribution businesses in developing their draft tariff structure statements.

Although the proposed approach on tariffs was broadly supported, the Victorian Government's position is that customers who install an EV charger at their premises be assigned to the new ToU tariff without the option to opt-out to a flat tariff to incentivise off-peak charging which can benefit both EV owners and the grid.

We are generally supportive of key elements of the AER's draft decision and have commenced the process of briefing the Minister.

Next steps – network tariff reform package

<u>For residential and small business customers</u>

- We note that the AER’s draft decision has sought further stakeholder input and discussion on Energy Consumers Australia’s proposed voluntary tariff targeting EV owners, and the prospect for broader tariff trials to explore what arrangements are possible at the distributor, retailer and consumer level.
  - ➢ ***We are particularly interested to understand whether stakeholders are supportive of the option of more cost-reflective tariffs available on a voluntary basis.***

<u>For medium and large business customers</u>

- We note that the AER’s draft decision requested that distributors provide greater tariff choice for medium and large business customers.
- We consider that tariff optionality can provide medium and large business customers some benefit in having choice between tariffs that best suit their business model and we share the AER’s view that tariffs need to be designed in a way that supports the rollout of public EV charging stations, and also balances potential costs to all consumers.
  - ➢ ***We are particularly interested to understand whether there is scope for more tailored tariffs for public EV charging and how best to progress this area.***

Next steps – Victorian Government related work programs

The Victorian Government will work with the EV and electricity industry to promote and optimise a transition to zero emissions vehicle technologies.

Given where we are in the Victorian EDPR process, we acknowledge that there is limited time to undertake detailed tariff development.

Nonetheless, we encourage further collaboration between the EV industry and distributors in particular to explore the potential of tariff trials during the upcoming regulatory control period through the Distributed Energy Integration Program (DEIP) EV Grid Integration Working Group and other similar forums.

We look forward to continue engaging in discussions such as this to better understand how the Victorian Government can assist.

AUSTRALIAN COMPETITION
& CONSUMER COMMISSION

Efficient distribution tariffs and applications to EV charging

Darryl Biggar

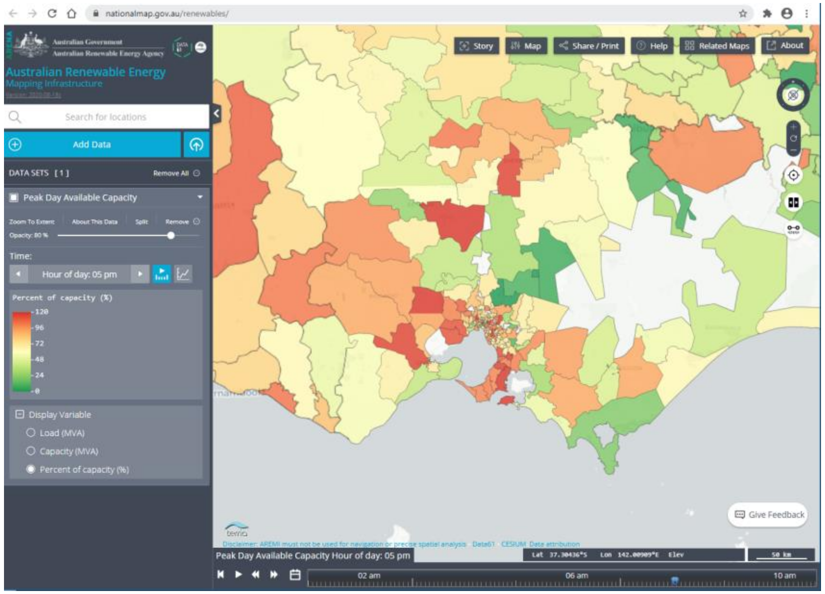
November 2020

Overview

- What objectives do we want to achieve?
- What does a theoretically ideal distribution network tariff look like?
- Do existing proposed tariffs meet this ideal?
- What are the special features of EV fast charging?
- What does an ideal tariff for EV fast charging look like?
- What are the problems with existing tariffs applied to EV charging?
- What are the possible directions for the next stage of reform?

Achieving efficient usage of and investment in electricity networks

- Taking a step back, what is it that we are doing?
- Electricity networks are a substantial component of the total cost of delivered electricity (up to half).
- We would like to create a framework within which electricity users and consumers make investments which are *co-optimised* with network investment so as to achieve the overall best outcome for the welfare of Australians.
- We want to achieve usage and investment decisions by users which are *coordinated* with network operation and investment decisions.



What objectives should we seek to achieve with distribution tariffs?

- A key tool for achieving that coordination is **network prices**.
- There are a number of objectives that we would like to achieve, such as the following:
- The tariffs should yield **sufficient revenue** to cover the allowed costs of the DNSP.
- The tariffs should provide the **correct signals** for users regarding usage of electricity, and investment in local electricity consuming, producing, and storage devices.
- Tariffs should be:
  - Technology neutral
  - Independent of structure of customer (e.g., whether customer is also generator, integrated or not)
  - Non-discriminatory across customer classes
- Fixed component of tariffs:
  - Should not affect usage or investment decisions
  - Should be fair in their allocation of fixed costs.
- Tariffs should, on average, be stable and reflect long-run network costs

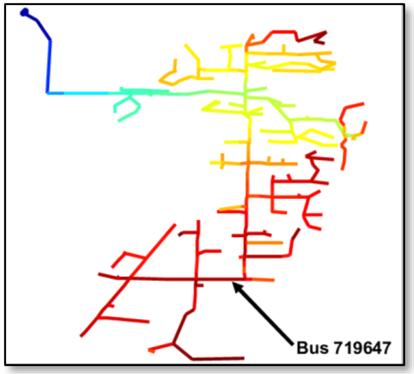
What does a theoretically ideal tariff look like?

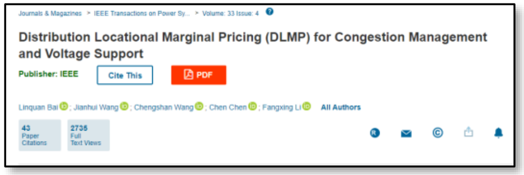
- A theoretically-ideal tariff has the following properties:
- The **usage charge** varies dynamically across locations and across time …
  - At off-peak times (i.e., when there is no congestion) the tariff should only reflect the cost of losses.
  - At peak times (i.e., when there is congestion) the tariff should be sufficient to ration scarce network capacity (i.e., should reflect the cost of congestion and losses)
    - When the network is congested in the importing direction, the local electricity price may need to be much higher than the broader regional price.
    - When the network is congested in the exporting direction, the local electricity price may need to be much lower (or negative) compared to the broader regional price.
- These dynamic tariffs lead to a revenue stream for the network, but that revenue stream probably will not cover the full costs. Additional **fixed charges** will be necessary.
  - We expect that the residual costs to be recovered through fixed charges will be 10-40% of total costs.
- In addition: The network must be augmented when congestion is occurring with sufficient frequency and/or severity.
  - This step is necessary to ensure efficient coordination of network investments with end-user usage and investment decisions

What does a theoretically ideal tariff look like?

- Researchers are developing approaches for **locational marginal pricing** of distribution networks.
- In principle, such charges provide the correct incentives for both the operation of and investment in all distribution-connected production and consumption assets including:
  - Local storage
  - Electric vehicles
  - Embedded generators
  - Smart appliances (including pool pumps, AC, and so on).
- Locational marginal prices are often visualised using "heat maps" like this one:

- Efficient tariff structures are particularly important when network congestion is threatening and production or consumption is controllable. (This is when coordination and co-optimisation is most important)





Journals & Magazines > IEEE Transactions on Power Sy... > Volume: 33 Issue: 4

Distribution Locational Marginal Pricing (DLMP) for Congestion Management and Voltage Support

Publisher: IEEE | Cite This | PDF

Linquan Bai ; Jianhui Wang ; Chengshan Wang ; Chen Chen ; Fangxing Li   All Authors

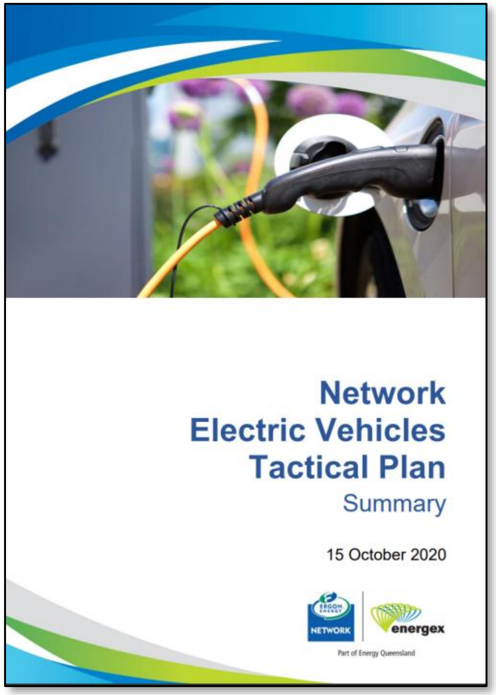
43 Paper Citations | 2736 Full Text Views

Existing tariff structures fall short of this ideal…

Network pricing approach	Achieves the objectives?	On the other hand…
Time-of-use pricing	No. Doesn't reflect dynamic conditions on the network. Doesn't vary with location. Charges are too high at off-peak times, too low at peak times.	May cause some load shifting (but not efficient). Gets customers used to idea of some (limited) time-variation in charges.
Demand charges	No. Demand charges are based on customer peak not network peak. Sends inefficient incentives to over-invest in devices to lower customer peak (e.g., storage). Doesn't vary with location?	Charges are, in effect, highly volatile, but just not in the right way.
Critical Peak pricing	Maybe? Critical peak could be linked to network congestion in some areas, but conditions must be anticipated and notice given. Limit on number of such notices per year. Doesn't vary with location?	Charges are volatile, and partially dynamic, and could be partially(?) reflective of network congestion.
Locational marginal pricing	In principle yes. Charges vary dynamically with time and location and reflect cost of using the network.	Requires establishing a DSO/DMO.

Application to EV charging

- It is particularly important to get distribution tariffs right for EV charging:
  - Peak demand is very high and could easily exceed the limits of local distribution network.
    - It would not take many simultaneous EVs charging on the same street to exceed the local feeder capacity. The same could be true at large charging stations on major highways.
  - By its nature, EV charging load can be shifted in time and in space (EVs are literally batteries on wheels) – but this requires action by drivers.
    - The situation is a bit different for highway charging where opportunities for inter-temporal substitution by drivers are a bit more limited, but still possible if there is storage on site.
  - EV charging, done well, could also serve to *alleviate* local congestion (when that congestion is in the export direction).



A Tesla Model S "with a low battery charge could consume in several hours as much electricity (kWh) as an average household consumes in a week. The point-in-time demand (kW) could be up to four times that of a typical home during the evening peak. Some of the coming EVs will have even larger capacities and faster charging rates"

Application to EV charging

- EV chargers (without on-site storage) are like a giant electric kettle – they have very high peak demand, very low capacity factor.
- But in principle the same optimal tariff ideas still apply.
  - In principle, if I only use my electric kettle at off-peak times, I should only pay the cost of losses on the network (plus the on-going fixed costs)
  - If I use my electric kettle at peak times, I should be allowed to do so provided I am prepared to pay a price which reflects the rationing required at such times.
- In principle, this pricing scheme provides exactly the right signals to achieve an efficient mix of customer investment / usage and network investment.

Which is the socially-efficient way to deliver a supply of boiling water?

The **kettle** has much lower set up costs, but if customer demand coincides with network peak times, might result in need for costly network upgrades if customers are not prepared to shift consumption in time.

The **urn** has higher set up costs, but has the ability to shift demand across time, avoiding the network peaks, allowing for less network build, higher average utilisation.

Network charges should induce end-users to make the efficient decision!

Application to EV charging

- The same principles apply directly to EV charging.
- Providing the right signals to EV owners or EV charging stations will induce them to make the right decisions:
  - Using the storage and/or mobility in EVs to direct customers to other charging sites or other times of day (where that is the overall better solution).
  - Or, installing local storage to allow local time-shifting of consumption…
  - Whichever is the socially-preferred choice.
- The same principles apply to residential EV charging – applying an efficient tariff structure will induce customers (or retailers on their behalf) to:
  - Charge at off-peak times or charge at other (uncongested) locations
  - Allow the retailer (or EV charging provider) to interrupt the charging process at peak times.
  - Install local storage.

Kreisel manufactures an integrated storage and fast charging system.

More sophisticated network pricing schemes may be *essential* if we are to accommodate large volumes of EV charging without significant, costly upgrades to the distribution network.

Problems with current tariff structures for EV charging

- Many of the existing tariffs are not consistent with this ideal structure.

Time-of-use tariffs	Demand-based tariffs	Critical peak tariffs	Locational marginal prices
Overly discourage consumption at off-peak times and do not effectively ration consumption at peak times. Do not vary with location.	Overly discourage consumption at times of local peak (not network peak). Overly incentivise installing local storage. Do not vary with location.	In principle, could reflect local network congestion, but do they vary with location? Network must have advance notice (no good for unexpected congestion).	In principle provide the correct price signals, both where congestion is anticipated and where it is not.
Do not provide the correct signals for EV fast charging. May result in need for costly upgrades to the distribution network.	May inefficiently increase the cost of providing EV fast-charging.	Some incentive to avoid peaks through time shifting, but harder to avoid peaks through location shifting.	

Problems with the recovery of fixed costs

- The past few slides have focused on how to structure the usage components of charges…
- Dynamic locational charges will result in a payment stream to distribution networks…
- But in practice there will almost certainly remain a residual to be recovered through fixed charges. (Perhaps 10-40% of total revenue)
- The recovery of these fixed charges may affect actions of EV owners or EV charging stations.
- How should we fairly recover the fixed or residual charges?
  - Based on the size of the customer?
  - Based on the usage?
- Ideally the way we structure these charges should not affect incentives – such as the size of the EV charging station, or how it is used…
  - But is there any more we can say?


Caught in a Fix

The Problem with Fixed Charges for Electricity

Prepared for Consumers Union
February 9, 2016

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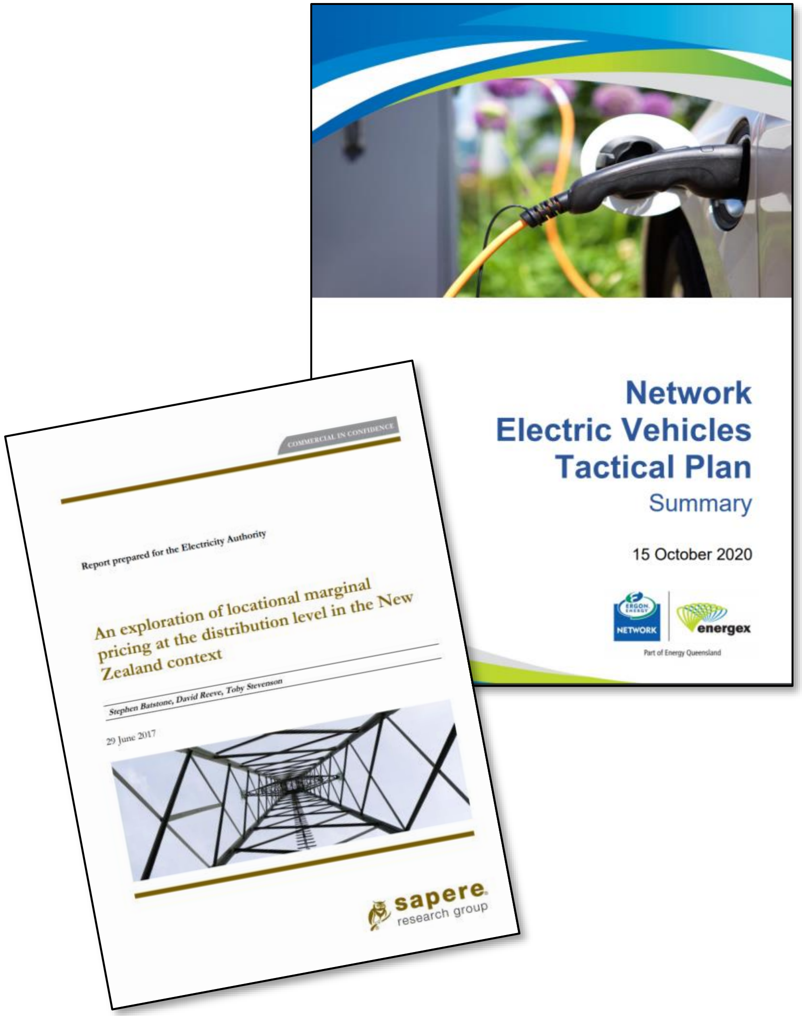
Possible directions for reform

- DNSPs are already taking important steps.
- The tariff structures raised here go well beyond what is currently being discussed. But, in my view, they represent where we should be heading (the “light on the hill” concept).
  - DNSPs should be trialling mechanisms for setting dynamic, locational prices, *especially* where network constraints threaten to be binding.
- There are many questions to be resolved including:
  - What is the best market mechanism for establishing local prices?
  - Is it possible to allow customers to “opt in” to receiving dynamic charges.
  - What proportion of charges will be recovered through the usage charges (and therefore how large the residual will be)?
  - How should fixed charges be structured in a way that is fair and reasonable?
- How do we transition from where we are to the dynamic, locational charges of the future?



Conclusions

- Ideally, distribution pricing should lead to efficient coordination and co-optimisation between users and networks.
- EV charging, with its very high peak demand, low capacity factor places particular pressure on distribution network.
- Getting distribution network tariffs right (which is always important) is particularly important when discussing EV charging.
- None of the tariff structures that are currently actively discussed (time of use, demand charges, critical peak charges) will fully achieve the objectives.
- DNSPs should be establishing mechanisms for market-based dynamic locational network charges, especially in locations where network constraints threaten to be binding.
  - Users should be anticipating facing dynamic network charges in future.

Figure 3: Evie Networks first ultrafast 350kW EV charging site on the Bruce Highway at Coochin Creek QLD, launched in November 2019

Dale Johansen, AER

AER draft decision

Draft decision

- Network tariffs need to increasingly reflect cost of providing customer’s service (varies by time and location)
- This is only the second round of TSS in a longer term transition to implement the reform
- Trade offs between complexity and customers’ ability to understand (customer impact principles)
- Pricing for load not technology is desirable but accessing potential services and support from load requires price signals
- Need to think more about linkages with DER and demand management strategies

Small user tariffs

- Support simplifying to flat, time of use or demand network tariff for retailers to package into offers
- Coordinated peak of 15:00 to 21:00 will help messaging to consumers
- Those on cost reflective network tariffs will receive a discount to reward uptake
- Electric vehicle households will face time of use or demand tariffs once they can be identified
- We want to hear stakeholder views on ECA’s submission

Large user tariffs

- Approved proposed default tariffs:
  - AusNet – critical peak demand
  - CitiPower and Powercor – time of use and rolling demand
  - Jemena – time of use and rolling anytime demand
  - United Energy – time of use, rolling demand and summer incentive demand

- Encourage networks to consider more targeted peak periods

- Networks should provide choice but for them to consider:
  - Choice for all or targeted to specific largest users
  - Individually calculated or just alternative structures
  - Use of locational components
  - Alignment with DER strategy

Discussion

Break

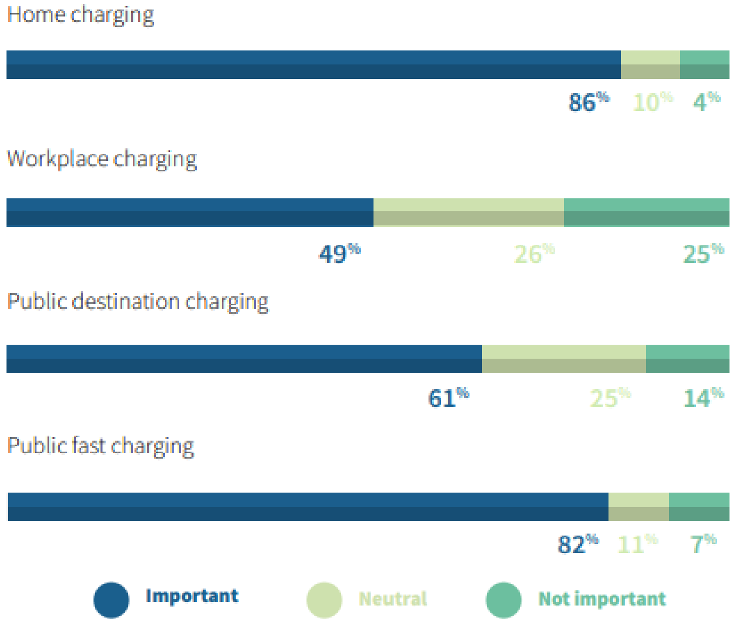
Behyad Jafari and Larissa Cassidy, Electric Vehicle Council

Submission on tariffs for EV charging stations

Problem Summary

- Network tariff structures are **not fit-for-purpose** for public EV charging load
- Tariff structures are an agreed industry problem and restrict public charging infrastructure investment
- Public charging infrastructure is vital to increase EV uptake and is what consumers want

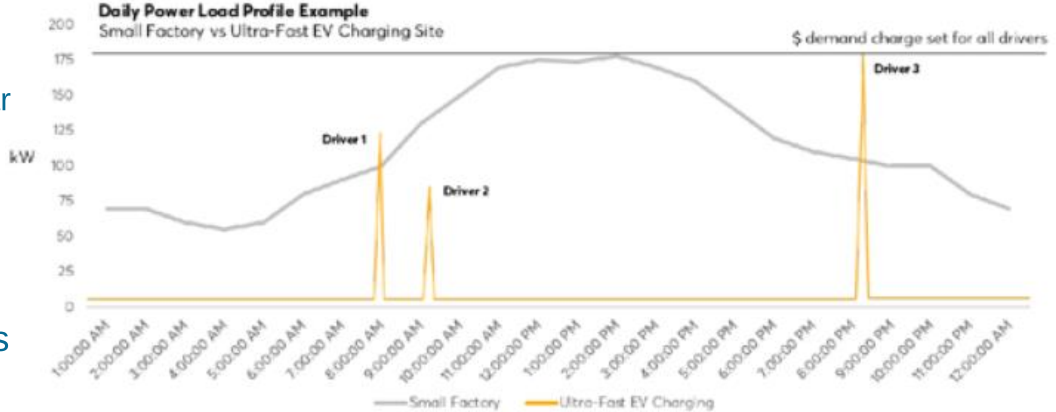
Importance of different charging types according to consumers



Source: State of Electric Vehicles 2020 (EVC)

Tariff structures are not fit-for-purpose for public EV charging because:

1. Public fast charging sites are often assigned to C&I tariffs due to site capacity alone (e.g. sites featuring multiple 50kW or 150kW or 350kW chargers)
   - BUT forecast site volumes of consumption are far below the volumes typical of large customers
   - PLUS individual EV drivers are not C&I customers either



2. Broad, recurring peak demand charge windows are difficult to avoid and don't reflect seasonality of network peaks
   - Public fast charging site traffic peaks typically don't coincide with actual, seasonal DNSP network peaks

3. Charging providers already pay separate, upfront capital contributions to increase grid capacity, but then are still charged to access this capacity on an ongoing basis.

ELECTRIC VEHICLE COUNCIL

What do we want in Victoria?

1. DNSPs and public charging industry work together to identify and trial appropriate tariff structures – one that allows DNSPs to appropriately recover costs
2. Until a tariff can be developed, assign EV charging sites onto small business tariffs

➢ This will align the Victorian DNSPs with DNSPs in other states and create a level playing field for rollout of public charging sites

➢ Now is the time to trial:
  - Relatively low uptake of EVs
  - A clear path forward will create certainty for EV industry
  - Will futureproof DNSP future cost recovery

ELECTRIC VEHICLE COUNCIL

11:00 Minute of silence for Remembrance Day

Discussion

‘Prices-to-Devices’ Tariffs: Developing a more cost reflective EV Tariff for Victoria

Energy Consumers Australia Presentation to the AER Victorian TSS Workshop

Wednesday 11 November 2020

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Electric Vehicles are an exciting part of our future (1/2)

EVs are a significant part of the energy transition	Charging could significantly impact household electricity bills	EV load management is a window into the future

EVs are a significant part of the energy transition

- Increasing customer engagement with their energy bills remains difficult, despite the impact of the energy transition
  - An exception to this is consumer engagement with the growth of Electric Vehicles (EVs).
- ECA is interested in capturing this latent interest in EVs from electricity consumers across the NEM, to leverage this interest to help **harness consumer attention and engagement** on electricity sector issues.

Charging could significantly impact household electricity bills

- The addition of EV charging load would mean that the average household's consumption could double – with significant **potential electricity bill impacts**.
- Developers of EV charging service equipment have given thought and attention to the development of **load management solutions** that respond to network price signals.

EV load management is a window into the future

- The acceleration of consumer adoption of EVs is therefore likely to lead to significant automatable load across Australia, giving consumers and their agents a **high-tech, low involvement tool** to respond to network price signals.
  - Looking into the future, the energy transition is expected to result in the adoption of more generalised load management solutions
- EVs will be the largest and most easily controllable load for household consumers in the near future

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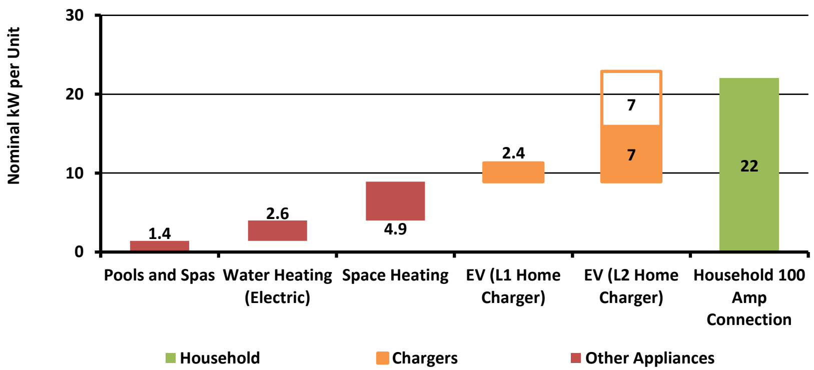
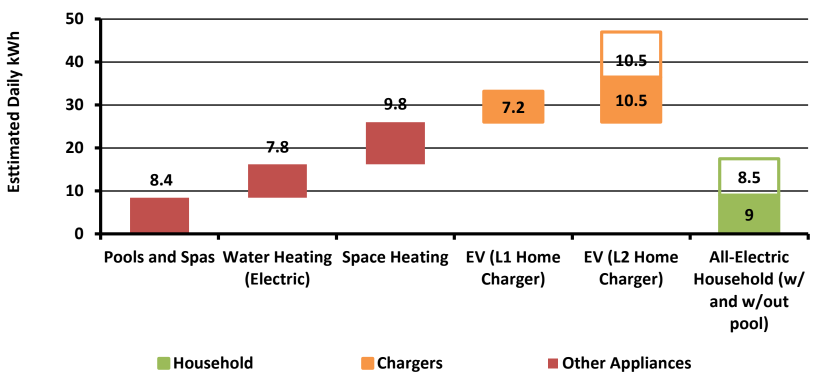
Electric Vehicles are an exciting part of our future (2/2)

Estimates of Household Loads per Appliance



Source: Energeia

Daily Household Consumption by Appliance



Source: Energeia; Note: No assumption for diversity, assumes 6hrs pool pump, 3hrs water heating, 2hrs space heating, per day combined with either 1.5hrs or 3hrs of L1 or L2 EV charging

- Networks should **design tariffs for load managing appliances**, like EV chargers:
  - Household consumers are increasingly installing large load appliances, that are capable of managing and shifting significant amounts of load
- Networks can use their **pricing strategy to manage peak demand growth**:
  - Controllable loads, like a smart EV charger, can shift load to avoid a sharp peak price signal, and this can be significant given that EV loads are roughly equivalent to average household loads
- The development of specific EV tariffs to allow consumers to respond to price signals is a **first step towards more cost reflective structures**.
  - Networks need to be able to signal peak periods, so that consumers are incentivized to diversify the use large loads e.g. pool pump + EV charger

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Developing an Electric Vehicle Tariff for Victoria (1/2)

Objective

- ECA's objective for this work was for Energeia to review existing EV/tech neutral tariffs offered by other networks/retailers and develop **best practice, incentive-driven, NER compliant and voluntary network tariffs**, which would drive the right technology-enabled responses for consumers.
- This project was both:
  - an exercise in designing tariffs according to best practices, and at the same time;
  - a demonstration of the benefits to customers of strongly cost reflective prices.

Approach

- Energeia's approach was split into two stages:
  - *Tariff Optimisation* – Energeia developed a tariff design for EVs in Victoria, using a sample set of consumer **smart meter and demographic data** developed by ACIL Allen on behalf of the Victorian DNSPs and shared with ECA and Energeia.
  - *Consumer Bill Impacts* – Energeia assessed the impact of the cost-reflective network tariffs on both EV customer and non-EV customer bills a number of ways, including the primary (**immediate consumer bill savings**), secondary (**DER incentives and cross-subsidies**) and tertiary (**long term**) order impacts by customer segment.

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Developing an Electric Vehicle Tariff for Victoria (2/2)

Energeia found that the more cost-reflective network tariff design – which was not technically compromised for consumer understanding or behavioural response reasons, as allowed under the Rules, but was targeted at the ability of their devices to respond to price signals – would look very different to current tariffs. Our technically optimised tariff for EV drivers, targeted at the ability of EV charger to respond to sharp price signals, has the following key characteristics:

Efficient Avoidable Peak Costs	Long Run Marginal Costs (LRMCs) signal the industry costs that can be avoided in the long-term if not needed. Energeia's first principles estimates of Victorian DNSPs' LRMCs suggested that these costs, which are used to determine the price signal during the peak period, should be 2-5 times higher than currently in use.[1]
Efficient Congestion Period Timing	An efficient peak period is dramatically shortened to just 2% of the existing peak window, based on our in-depth analysis of network and generation peak demand, including spatial peak demand, adjusting for 1 in 10-year weather, and underlying trends in demand
Efficient Off-Peak Costs	Moving residual costs out of off-peak prices, consistent with economic theory, results in an every day low (10c/kWh) off-peak retail rate which would likely be highly attractive to customers.[2]

Energeia's assessment of the above tariff's impact on customer bills, customer behavior, and long-term system outcomes found that consumers without solar PV or EVs would be no worse off on average, and that consumers with EVs could save $86 more per year on average per EV, compared to the proposed Victorian DNSP tariff designs.

Notes: 1. This also reduced the size of unavoidable sunk or 'residual costs', which are recovered as scaled fixed charges. 2. These prices are purely based on estimated off-peak wholesale market costs, covering 99% of hours.

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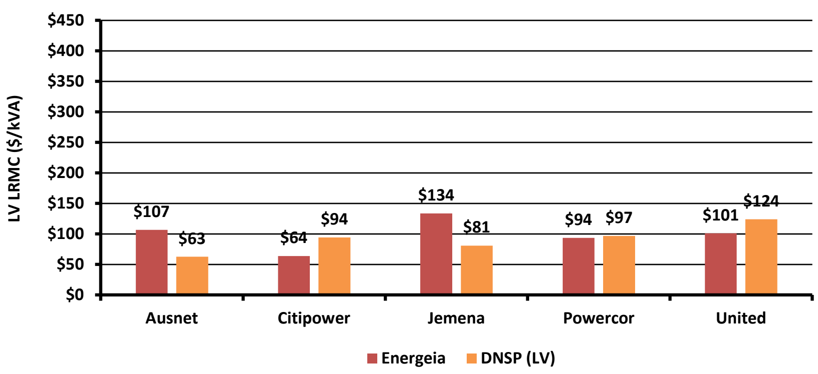
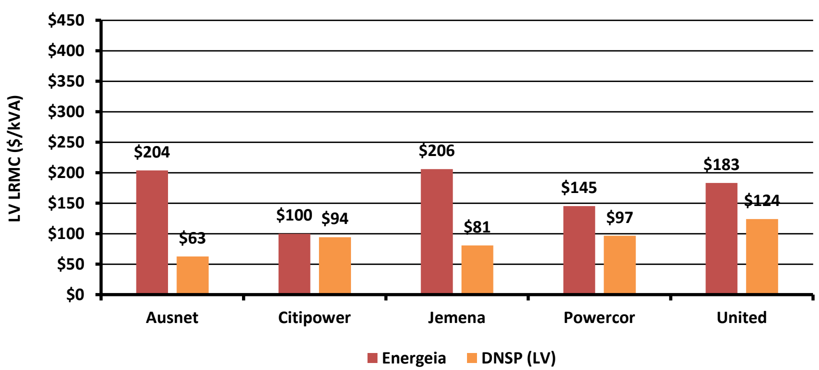
Optimising for Efficient Avoidable Peak Costs

Energeia's Estimated LRMC with 12% Repex vs. Published



Source: Energeia, DNSP Tariff Structure Statements, Note: Connex excluded, avoidable Repex assumed to be 12%

Energeia's Estimated LRMC with 50% Repex



Source: Energeia, DNSP Tariff Structure Statements, Note: Connex excluded, avoidable Repex assumed to be 50%

Energeia's Estimated LRMCs vs. Published

- Energeia developed a tool for calculating LRMC, which is similar in operation and input to DNSP tools
  - It also draws from RIN data
  - It can be parameterised to generate the same results with the same settings as the DNSPs
- The top left graphic shows our bottom-up estimates compared to the DNSP reported LRMCs
  - Assuming 12% of repex is avoidable delivers the best match between observed and modelled
- The graphic on the bottom left assumes 50% repex is avoidable
  - This assumes that the absence of load could enable the removal of assets

ENERGEIA

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Optimising for Efficient Congestion Period Timing

• Source: Energeia

United CAGR P10 Weekday

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
0:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
0:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
3:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
3:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
4:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
4:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
5:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
5:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
6:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
6:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
7:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
7:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
8:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
8:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
9:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
9:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
10:00	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%
10:30	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%
11:00	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%
11:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
12:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
12:30	0%	0%	0%	0%	2%	0%	2%	2%	0%	0%	0%	0%
13:00	0%	0%	0%	0%	2%	2%	7%	7%	0%	0%	0%	0%
13:30	0%	0%	0%	0%	10%	5%	10%	7%	0%	0%	0%	0%
14:00	0%	0%	0%	0%	10%	2%	2%	2%	0%	0%	0%	0%
14:30	0%	0%	0%	0%	12%	5%	0%	5%	0%	0%	0%	0%
15:00	0%	0%	0%	0%	12%	26%	0%	10%	0%	0%	0%	0%
15:30	0%	0%	0%	0%	10%	31%	0%	17%	0%	0%	0%	0%
16:00	0%	0%	0%	0%	10%	52%	0%	19%	0%	0%	0%	0%
16:30	0%	0%	0%	0%	12%	57%	0%	17%	0%	0%	0%	0%
17:00	0%	0%	0%	0%	5%	57%	0%	24%	0%	0%	0%	0%
17:30	0%	0%	0%	0%	0%	36%	0%	19%	0%	0%	0%	0%
18:00	0%	0%	0%	0%	0%	31%	5%	10%	0%	0%	0%	0%
18:30	0%	0%	0%	0%	0%	10%	10%	14%	0%	0%	0%	0%
19:00	0%	0%	0%	0%	0%	5%	12%	5%	0%	0%	0%	0%
19:30	0%	0%	0%	0%	0%	2%	10%	2%	0%	0%	0%	0%
20:00	0%	0%	0%	0%	0%	0%	10%	0%	0%	0%	0%	0%
20:30	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%
21:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
21:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
22:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
22:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
23:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
23:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Generation CAGR P10 Weekday

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
0:00	48%	41%	45%	47%	31%	45%	54%	38%	59%	39%	46%	49%
0:30	41%	41%	43%	46%	31%	40%	50%	36%	55%	40%	44%	47%
1:00	40%	40%	41%	44%	36%	38%	49%	35%	53%	39%	41%	46%
1:30	39%	41%	40%	43%	30%	36%	50%	34%	48%	37%	41%	45%
2:00	37%	40%	39%	41%	30%	36%	47%	33%	46%	36%	40%	46%
2:30	39%	38%	40%	39%	30%	38%	46%	32%	46%	35%	38%	45%
3:00	35%	38%	39%	37%	29%	38%	46%	31%	46%	34%	38%	46%
3:30	35%	39%	38%	37%	30%	37%	49%	32%	47%	37%	36%	44%
4:00	35%	40%	39%	37%	30%	35%	54%	33%	48%	37%	36%	43%
4:30	37%	41%	39%	39%	38%	36%	56%	34%	48%	40%	38%	43%
5:00	38%	42%	40%	41%	39%	36%	60%	34%	48%	46%	44%	44%
5:30	39%	43%	41%	45%	39%	35%	65%	36%	49%	55%	39%	47%
6:00	42%	46%	44%	47%	37%	35%	71%	40%	49%	64%	44%	50%
6:30	47%	51%	48%	51%	39%	36%	79%	41%	52%	70%	47%	57%
7:00	53%	54%	52%	52%	41%	35%	83%	41%	53%	69%	47%	61%
7:30	55%	56%	56%	51%	38%	32%	88%	40%	52%	59%	52%	64%
8:00	57%	54%	55%	46%	38%	31%	92%	39%	53%	53%	54%	67%
8:30	55%	50%	51%	44%	39%	31%	91%	37%	59%	50%	56%	71%
9:00	54%	48%	46%	44%	38%	34%	92%	37%	61%	46%	54%	70%
9:30	52%	47%	45%	43%	39%	38%	90%	36%	67%	45%	53%	67%
10:00	48%	46%	42%	42%	42%	42%	88%	36%	72%	44%	52%	65%
10:30	46%	44%	39%	42%	45%	46%	86%	35%	45%	38%	53%	60%
11:00	46%	42%	37%	43%	38%	48%	83%	35%	47%	44%	54%	57%
11:30	44%	40%	36%	42%	39%	49%	81%	36%	49%	43%	52%	55%
12:00	43%	39%	36%	36%	40%	50%	85%	37%	51%	42%	54%	54%
12:30	41%	39%	34%	38%	42%	51%	86%	39%	54%	42%	53%	54%
13:00	41%	37%	31%	39%	42%	53%	85%	41%	59%	45%	54%	53%
13:30	40%	38%	31%	40%	42%	55%	82%	44%	62%	47%	50%	54%
14:00	40%	40%	30%	40%	43%	57%	81%	50%	65%	48%	50%	52%
14:30	39%	41%	31%	42%	44%	59%	82%	54%	67%	49%	50%	53%
15:00	40%	42%	32%	44%	44%	63%	84%	78%	72%	48%	48%	53%
15:30	41%	42%	33%	48%	46%	63%	84%	86%	74%	49%	47%	53%
16:00	48%	43%	33%	49%	45%	65%	86%	85%	79%	50%	50%	53%
16:30	52%	42%	35%	51%	47%	67%	87%	84%	78%	53%	55%	56%
17:00	55%	42%	37%	56%	49%	72%	89%	82%	78%	53%	53%	58%
17:30	54%	42%	40%	56%	49%	74%	95%	81%	77%	53%	50%	61%
18:00	58%	53%	42%	60%	49%	73%	98%	80%	77%	56%	52%	63%
18:30	60%	56%	44%	60%	47%	71%	98%	78%	77%	57%	60%	64%
19:00	60%	55%	46%	58%	44%	66%	94%	77%	74%	57%	61%	66%
19:30	58%	55%	46%	59%	44%	67%	94%	78%	71%	55%	61%	65%
20:00	58%	53%	47%	59%	43%	66%	98%	73%	71%	54%	60%	67%
20:30	55%	52%	52%	56%	41%	64%	100%	67%	67%	53%	60%	63%
21:00	54%	51%	51%	52%	38%	64%	95%	64%	66%	50%	58%	63%
21:30	53%	52%	49%	51%	39%	64%	90%	62%	64%	49%	56%	61%
22:00	50%	52%	49%	50%	37%	60%	86%	59%	60%	49%	54%	59%
22:30	48%	51%	46%	48%	36%	58%	76%	55%	55%	46%	50%	53%
23:00	45%	50%	44%	44%	33%	54%	72%	52%	52%	44%	47%	49%
23:30	45%	50%	43%	43%	33%	50%	69%	53%	49%	44%	44%	47%

Retail CAGR P10 Weekday

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
0:00	0	0	0	0	0	0	0	0	0	0	0	0
0:30	0	0	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0	0	0
1:30	0	0	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0	0	0
2:30	0	0	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0	0	0
3:30	0	0	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0	0	0
4:30	0	0	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0	0	0
5:30	0	0	0	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0	0	0	0
6:30	0	0	0	0	0	0	0	0	0	0	0	0
7:00	0	0	0	0	0	0	0	0	0	0	0	0
7:30	0	0	0	0	0	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	1	0	0	0	0	0
8:30	0	0	0	0	0	0	1	0	0	0	0	0
9:00	0	0	0	0	0	0	1	0	0	0	0	0
9:30	0	0	0	0	0	0	0	0	0	0	0	0
10:00	0	0	0	0	0	0	0	0	0	0	0	0
10:30	0	0	0	0	0	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0	0	0	0	0
11:30	0	0	0	0	0	0	0	0	0	0	0	0
12:00	0	0	0	0	0	0	0	0	0	0	0	0
12:30	0	0	0	0	0	0	0	0	0	0	0	0
13:00	0	0	0	0	0	0	0	0	0	0	0	0
13:30	0	0	0	0	0	0	0	0	0	0	0	0
14:00	0	0	0	0	0	0	0	0	0	0	0	0
14:30	0	0	0	0	0	0	0	0	0	0	0	0
15:00	0	0	0	0	0	0	0	0	0	0	0	0
15:30	0	0	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	1	0	0	0	0	0	0
16:30	0	0	0	0	0	1	0	0	0	0	0	0
17:00	0	0	0	0	0	1	0	0	0	0	0	0
17:30	0	0	0	0	0	0	1	0	0	0	0	0
18:00	0	0	0	0	0	0	1	0	0	0	0	0
18:30	0	0	0	0	0	0	1	0	0	0	0	0
19:00	0	0	0	0	0	0	1	0	0	0	0	0
19:30	0	0	0	0	0	0	1	0	0	0	0	0
20:00	0	0	0	0	0	0	1	0	0	0	0	0
20:30	0	0	0	0	0	0	1	0	0	0	0	0
21:00	0	0	0	0	0	0	1	0	0	0	0	0
21:30	0	0	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0	0	0
22:30	0	0	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0	0	0
23:30	0	0	0	0	0	0	0	0	0	0	0	0

United CAGR P10 Weekend

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
0:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
0:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
3:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
3:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
4:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
4:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
5:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
5:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
6:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
6:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
7:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
7:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
8:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
8:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
9:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
9:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
10:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
10:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
11:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
11:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
12:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
12:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
13:00	0%	0%	0%	0%	0%	2%	0%	2%	0%	0%	0%	0%
13:30	0%	0%	0%	0%	0%	0%	2%	2%	0%	0%	0%	0%
14:00	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%
14:30	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%
15:00	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%
15:30	0%	0%	0%	0%	0%	0%	2%	2%	0%	0%	0%	0%
16:00	0%	0%	0%	0%	0%	0%	2%	5%	0%	0%	0%	0%
16:30	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%
17:00	0%	0%	0%	0%	0%	0%	0%	7%	2%	0%	0%	0%
17:30	0%	0%	0%	0%	0%	0%	0%	0%	10%	0%	0%	0%
18:00	0%	0%	0%	0%	0%	0%	0%	0%	7%	0%	0%	0%
18:30	0%	0%	0%	0%	0%	2%	0%	7%	7%	0%	0%	0%
19:00	0%	0%	0%	0%	0%	2%	0%	2%	5%	0%	0%	0%
19:30	0%	0%	0%	0%	0%	2%	0%	5%	5%	0%	0%	0%
20:00	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%
20:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
21:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
21:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
22:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
22:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
23:00	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
23:30	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Generation CAGR P10 Weekend

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
0:00	41%	52%	36%	51%	38%	68%	36%	36%	63%	36%	49%	50%
0:30	38%	45%	34%	50%	35%	62%	33%	35%	58%	34%	47%	50%
1:00	37%	43%	33%	46%	34%	59%	32%	35%	57%	36%	46%	49%
1:30	36%	36%	33%	46%	34%	55%	34%	42%	56%	36%	45%	50%
2:00	35%	33%	32%	44%	33%	51%	35%	40%	53%	36%	44%	50%
2:30	34%	32%	31%	42%	32%	49%	32%	38%	49%	38%	41%	48%
3:00	33%	32%	32%	40%	33%	45%	33%	37%	49%	37%	41%	45%
3:30	32%	30%	32%	39%	33%	42%	33%	37%	45%	38%	40%	45%
4:00	33%	32%	30%	40%	33%	41%	34%	35%	45%	37%	40%	45%
4:30	33%	32%	30%	37%	32%	41%	35%	34%	45%	37%	40%	45%
5:00	34%	31%	30%	38%	34%	40%	34%	33%	45%	38%	41%	44%
5:30	34%	32%	31%	39%	35%	38%	35%	32%	45%	32%	42%	44%
6:00	35%	32%	32%	40%	36%	37%	35%	32%	47%	34%	42%	44%
6:30	37%	36%	32%	42%	39%	36%	36%	34%	46%	34%	49%	45%
7:00	36%	38%	34%	42%	39%	35%	35%	35%	49%	34%	46%	46%
7:30	36%	38%	35%	40%	39%	34%	35%	34%	51%	37%	49%	48%
8:00	36%	40%	34%	37%	36%	35%	35%	38%	54%	37%	52%	49%
8:30	37%	39%	37%	37%	32%	38%	35%	38%	56%	37%	52%	53%
9:00	40%	42%	38%	36%	31%	39%	32%	38%	59%	36%	51%	54%
9:30	40%	42%	32%	36%	31%	41%	30%	41%	63%	37%	47%	57%
10:00	42%	53%	29%	35%	28%	40%	31%	44%	68%	41%	43%	57%
10:30	43%	52%	28%	31%	29%	41%	31%	45%	73%	40%	45%	56%
11:00	41%	49%	27%	33%	29%	40%	30%	47%	54%	39%	45%	55%
11:30	42%	46%	27%	34%	28%	40%	30%	50%	55%	39%	44%	56%
12:00	44%	49%	29%	34%	28%	42%	31%	53%	56%	36%	44%	55%
12:30	44%	49%	28%	37%	28%	39%	31%	55%	58%	34%	45%	55%
13:00	43%	48%	28%	45%	27%	42%	32%	59%	61%	33%	43%	54%
13:30	43%	48%	33%	48%	26%	45%	32%	65%	64%	33%	43%	55%
14:00	43%	47%	38%	47%	62%	50%	33%	66%	68%	34%	42%	56%
14:30	43%	44%	41%	45%	62%	52%	34%	83%	73%	34%	38%	54%
15:00	45%	47%	44%	44%	63%	55%	34%	62%	76%	34%	38%	55%
15:30	47%	48%	48%	43%	63%	58%	35%	63%	79%	33%	41%	55%
16:00	49%	48%	46%	45%	63%	59%	36%	67%	83%	34%	43%	55%
16:30	53%	54%	49%	47%	65%	59%	37%	69%	86%	39%	45%	56%
17:00	56%	54%	47%	49%	66%	59%	40%	71%	88%	40%	46%	57%
17:30	55%	57%	50%	48%	66%	60%	41%	74%	90%	42%	42%	60%
18:00	55%	42%	45%	48%	65%	62%	44%	76%	93%	44%	43%	66%
18:30	54%	44%	44%	48%	63%	62%	45%	79%	96%	46%	42%	70%
19:00	54%	43%	43%	47%	62%	61%	46%	81%	95%	46%	42%	72%
19:30	52%	41%	52%	47%	58%	59%	44%	79%	92%	45%	42%	74%
20:00	50%	39%	51%	44%	56%	56%	44%	74%	90%	44%	40%	73%
20:30	50%	39%	51%	44%	53%	55%	42%	78%	87%	43%	40%	70%
21:00	48%	38%	49%	43%	50%	52%	40%	76%	80%	42%	38%	69%
21:30	48%	37%	47%	42%	34%	47%	39%	72%	77%	44%	38%	64%
22:00	47%	37%	44%	42%	32%	43%	37%	68%	73%	43%	40%	62%
22:30	45%	34%	41%	42%	32%	40%	33%	64%	66%	40%	40%	58%
23:00	43%	33%	37%	41%	32%	39%	32%	56%	61%	37%	42%	57%
23:30	43%	39%	38%	40%	34%	41%	32%	54%	60%	36%	41%	54%

Retail CAGR P10 Weekend

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
0:00	0	0	0	0	0	0	0	0	0	0	0	0
0:30	0	0	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0	0	0
1:30	0	0	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0	0	0
2:30	0	0	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0	0	0
3:30	0	0	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0	0	0
4:30	0	0	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0	0	0
5:30	0	0	0	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0	0	0	0
6:30	0	0	0	0	0	0	0	0	0	0	0	0
7:00	0	0	0	0	0	0	0	0	0	0	0	0
7:30	0	0	0	0	0	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0	0	0	0	0	0
8:30	0	0	0	0	0	0	0	0	0	0	0	0
9:00	0	0	0	0	0	0	0	0	0	0	0	0
9:30	0	0	0	0	0	0	0	0	0	0	0	0
10:00	0	0	0	0	0	0	0	0	0	0	0	0
10:30	0	0	0	0	0	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0	0	0	0	0
11:30	0	0	0	0	0	0	0	0	0	0	0	0
12:00	0	0	0	0	0	0	0	0	0	0	0	0
12:30	0	0	0	0	0	0	0	0	0	0	0	0
13:00	0	0	0	0	0	0	0	0	0	0	0	0
13:30	0	0	0	0	0	0	0	0	0	0	0	0
14:00	0	0	0	0	0	0	0	0	0	0	0	0
14:30	0	0	0	0	0	0	0	0	0	0	0	0
15:00	0	0	0	0	0	0	0	0	0	0	0	0
15:30	0	0	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0	0	0
16:30	0	0	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0	0	0
17:30	0	0	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	1	0	0	0
18:30	0	0	0	0	0	0	0	0	1	0	0	0
19:00	0	0	0	0	0	0	0	0	1	0	0	0
19:30	0	0	0	0	0	0	0	0	1	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0	0	0
20:30	0	0	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0	0	0
21:30	0	0	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0	0	0
22:30	0	0	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0	0	0
23:30	0	0	0	0	0	0	0	0	0	0	0	0

Generation, Network (United) and Retail Peak Periods

- Charts show the network, generation and combination (retail) period definitions
- The generation peak was based on VIC NEM demand data from AEMO
- The retail peak periods combine the network and generation peak periods
- *Energeia recommends the retail peak periods as the most cost reflective*

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Optimising for Efficient Off-Peak Costs

Comparison of Retail Bills

		Peak Timing	Fixed Charges ($/day)	Peak Cost ($/kWh)	Off-Peak Costs ($/kWh)
Victorian DNSP Proposal	Ausnet	3pm to 9pm, weekends and weekdays	1.025	0.348	0.242
	CitiPower		0.933	0.263	0.196
	Jemena		0.600	0.355	0.258
	Powercor		0.979	0.258	0.189
	United Energy		0.805	0.314	0.236
Energeia EV ToU	Ausnet	5pm to 6pm, December weekdays; 5.30 to 7pm, January weekdays	2.437	7.306	**0.100**
	CitiPower	10am to 5.30pm, January weekdays	1.581	1.617	**0.100**
	Jemena	4.30 to 5pm, December weekdays; 3.30 to 5.30pm February weekdays	2.059	5.876	**0.100**
	Powercor	7pm to 9.30pm, January weekdays	1.716	5.586	**0.100**
	United Energy	4pm to 5.30pm, December weekdays	1.823	11.460	**0.100**

Source: Energeia; Notes: Ausnet and Powercor based on current Energy Australia retailer tariffs and CitiPower, Jemena and United Energy are based on current AGL retailer tariffs

- Optimising for off-peak costs (in this case, resulting in a consistent off-peak energy charge of 10c per kWh), under a revenue cap has a predictable impact on other costs:
  - Increasing the peak charge by between 5 and 35 times
  - Roughly doubling or tripling the daily fixed charge
- However, the peak period is reduced significantly from over 2,000 hours in the year, to under 50 hours
  - The total peak period hours range from just 35 hours in United Energy to over 170 hours in CitiPower per year
  - The peak window in Ausnet, Jemena and Powercor ranges between 50 and 60 annual hours

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Stakeholders support cost reflective pricing

Stakeholder Feedback by Issue and Stakeholder Type

Response Themes		EV Sector	Consumer Advocates	Market Bodies	Govt.	Networks
Consumer Protection	Customer Equity		High	High	High	
	Consumer Behaviour	Low		Medium		
EV Business Models	Tariff Access	High	Low		High	
	Market Impacts	Medium		Medium		High
Network Pricing Strategies	Fixed Peak Period		High	Medium		High
	Pricing Methodology	Low			Low	
Network Management Practices	DER Integration		Low	Low		
	Network Utilisation			Low		

- Not surprisingly, consumer protection was one of the key issues raised by impacted stakeholders, given that over the next 10 years EVs are likely to remain a middle- or upper-income household purchase
- The EV sector welcomed the idea of a tariff tailored for or targeted at their current and future customers, and the ability of charging devices to respond to sharp cost reflective price signals.
- The largest issue for networks was whether it was appropriate to apply such a narrow peak period given the unfamiliar risks associated with implementing the accurate determination of a peak period.

Source: Energy Consumers Australia, Energeia Analysis

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Prices-for-Devises can unlock optimal solutions

The positive response of impacted stakeholders, be they networks, governments, market bodies, consumer advocates or the EV sector, suggests that a targeted EV tariff could deliver improved outcomes for both EV drivers and non-EV drivers, and induce greater consumer acceptance of more cost reflective tariffs.

The tools exist to design more cost reflective network tariffs

- Energeia's review of international best practice has identified that time-of-use based tariffs are the most attractive to customers, and that the network pricing tools that DNSP pricing managers have available in their toolkits (primary time-of-use or secondary controlled load tariffs) are best practice throughout all of the jurisdictions with high levels of EV uptake.
- Given the tools are in place, and consumer demand for EVs and associated solutions continues to grow, Energeia believes that distribution networks, electricity retailers, the EV sector and third party service providers can work together to develop solutions that deliver best-for-system / best-for-customer outcomes.

Success in the EV sector would pave the way for other household loads

- The development of such solutions would be ground-breaking in Australia and industry leading globally, and would have implications for other technologies, such as hot water systems and pool pumps. Grid load has traditionally been considered relatively inelastic in electricity markets, due to the lack of cost-effective substitutes and storage.
- Rooftop solar PV, vehicle electrification, behind the meter storage and smart appliances are rapidly increasing the potential for load flexibility. However, the pace of development depends on the existence of efficient price signals. Without them, consumers will under invest in lower cost technology over higher cost grid services.

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Thank You

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Discussion

Thank you all for your participation