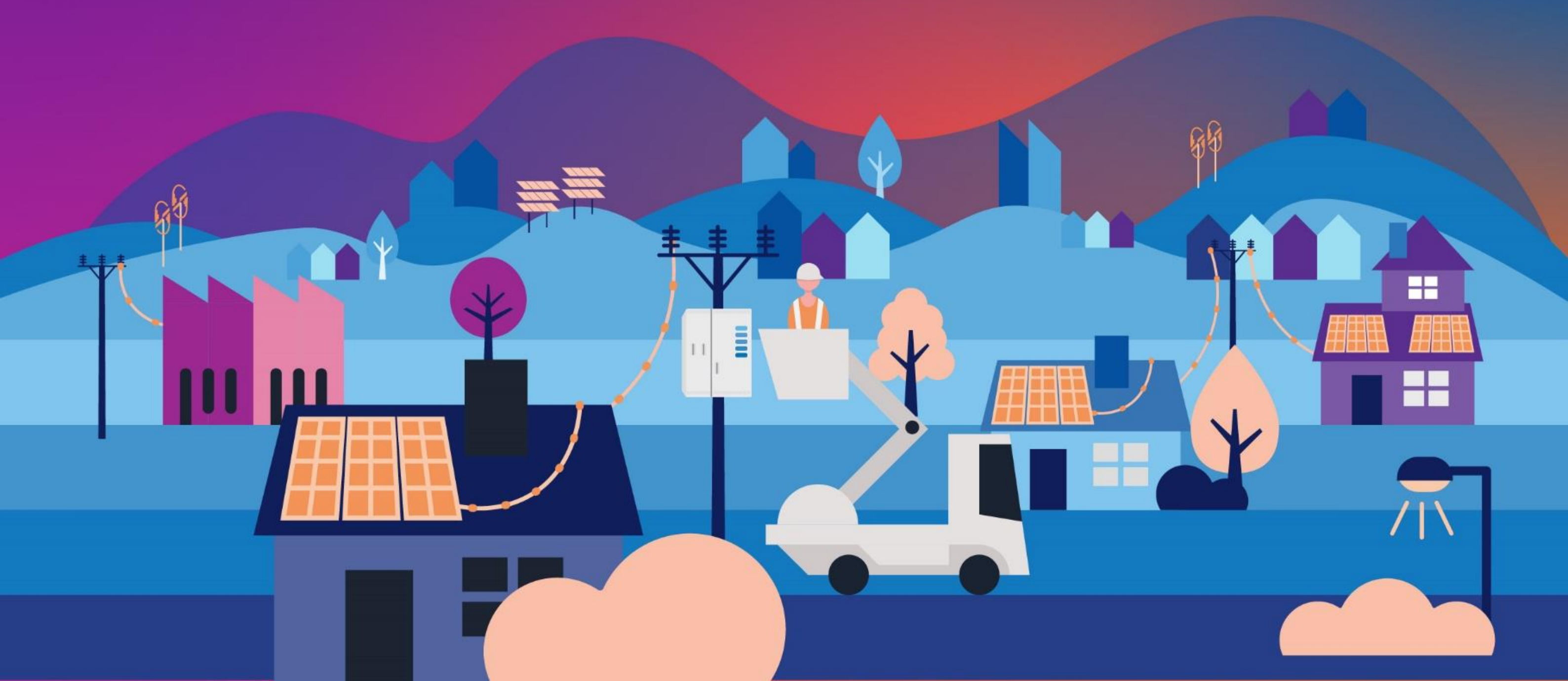
Consultation paper on integrating storage into our networks

FEBRUARY 2024



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1. Overview

AEMO's draft 2024 Integrated System Plan highlights that storage is a critical technology for Australia's affordable transition to a net zero economy.

> *Renewable energy connected by transmission, firmed with storage and backed up by gas is the lowest cost way to supply electricity to homes and businesses throughout Australia's transition to a net zero economy*[1]

AEMO forecasts that storage capacity in the National Electricity Market will need to increase from 3 GW today to 19 GW in 2030 - a sixfold increase. Likewise, the Victorian Government has identified the importance of storage to achieving its legislated renewable and net zero targets by setting a Victorian energy storage target of 2.6 GW by 2030. These targets occur within our next 2026-31 regulatory period.

Storage also has the potential to provide network services to manage maximum or minimum demand if located in the right network area.

CitiPower, Powercor and United Energy (the networks) can support the integration of the expected influx of storage on distribution networks by providing more certainty about how storage will be integrated into our networks for the net benefit of our electricity customers.

This paper covers stand-alone distribution connected storage and does not cover home batteries and other storage co-located behind-the-meter with other loads.

Storage is unique in that it is flexible and solely provides electricity services. Storage owners and operators should be capable of understanding and dealing with more complex network arrangements than a typical distribution network customer. The two-way flexibility of storage provides new opportunities to integrate this technology to maximise benefits to all customers.

This consultation paper now seeks submissions on our proposed approach to integrate storage connecting to our networks.

Submissions to this consultation paper are due by 22 March 2024.

Submissions should be emailed to community@powercor.com.au

2. Introduction

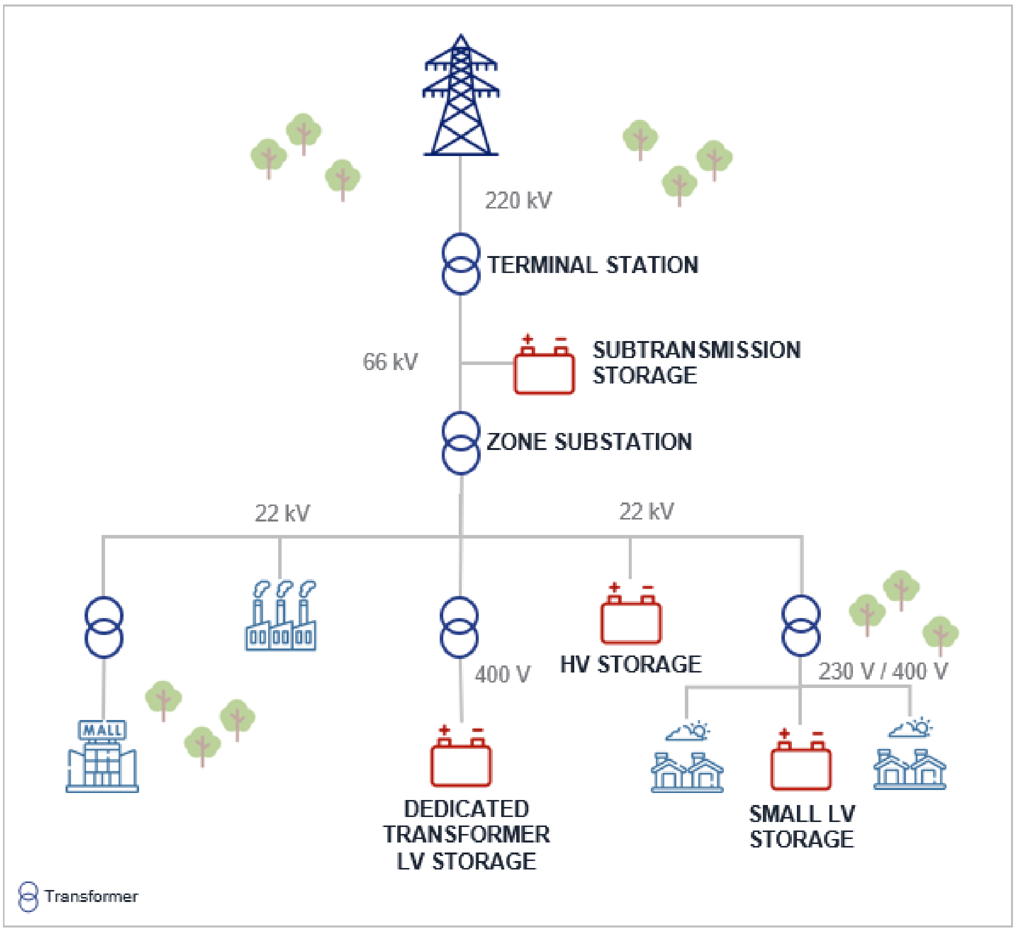
2.1 Storage definition

For the purposes of this paper, storage is defined as distribution connected stand-alone batteries and similar devices which can consume, store, and release electricity on demand at the point of connection to the network. These are sometimes referred to as a battery energy storage system (BESS) which refers to the total system including battery cells, inverter, controls, metering, and protection.

Storage includes:

- batteries connected on the low voltage network downstream of an existing transformer which also supplies other customers and could range in size from 30 kW to 240 kW
- batteries connected on the low voltage network with a dedicated transformer and could range in size from 200 kW to 2,000 kW
- batteries connected on the high voltage network and could range in size from 1 MW to 10 MW
- batteries connected on the 66kV sub-transmission network and could range in size from 5 MW to 120 MW.

DIFFERENT LEVELS OF STAND-ALONE STORAGE



The above characteristics of storage may also occur where storage is located behind-the meter with generation or load where there is sufficient storage capacity to consume, store, and release electricity on demand at the point of connection to the network.

Home and car batteries (including vehicle-to-grid) connected behind the meter do not meet the above definition of storage. The Victorian distributors are separately consulting on an opt-in two-way residential tariff which could be fit-for-purpose for residential customers with behind-the-meter batteries.

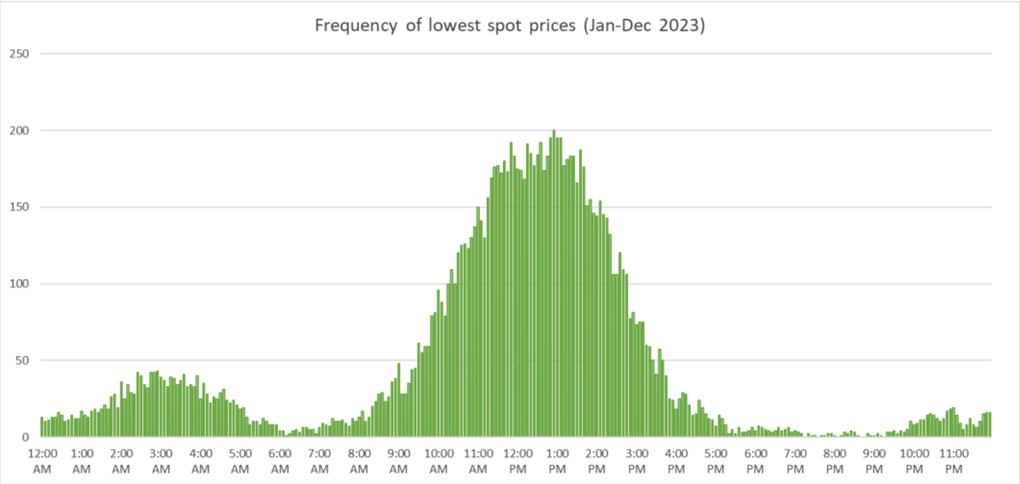
The terms ‘community battery’ and ‘neighbourhood battery’ are not used in this paper since these terms are interpreted in different ways and can have very specific definitions under various state and federal funding programs.

In this paper, electricity consumed from the grid is referred to as 'imports' and electricity released onto the grid is referred to as 'exports'.

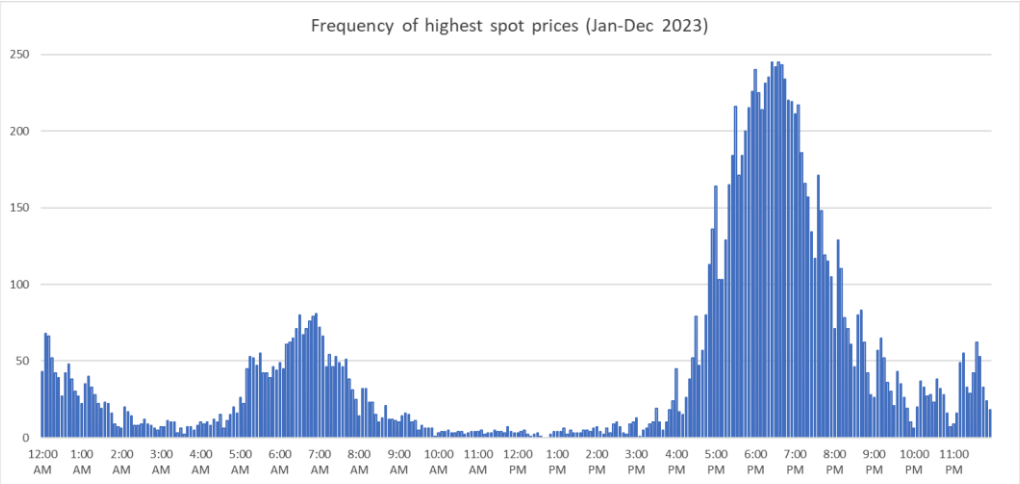
2.2 Drivers of storage operation

Storage is expected to derive most of its revenue from wholesale market price arbitrage. The following diagrams show the frequency of the highest 5-minute Victorian spot prices for three hours each day in 2023 and similarly the lowest. They illustrate that the optimal operation of a battery to arbitrage wholesale market prices is generally predictable, although there are infrequent times when the optimal operation would be different.

FREQUENCY OF LOWEST SPOT PRICES IN 2023

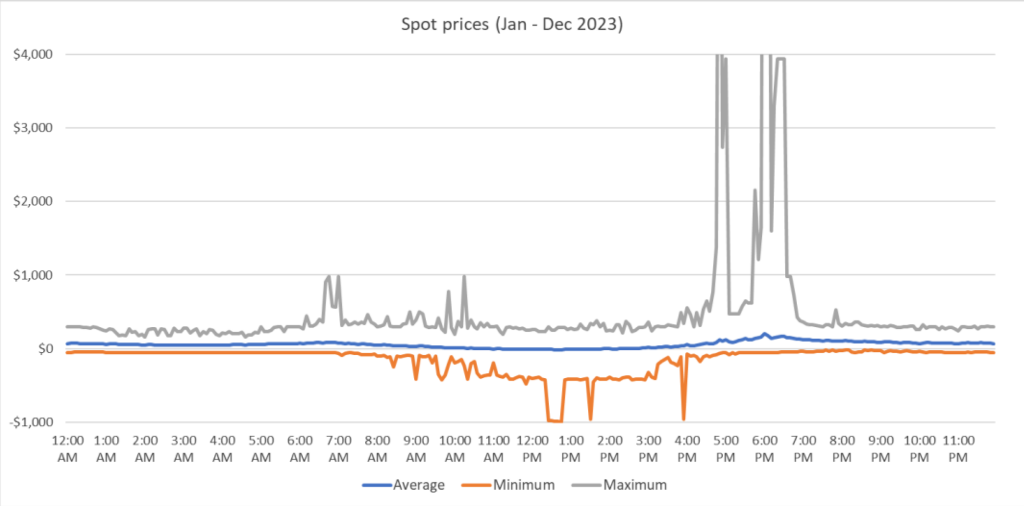


FREQUENCY OF HIGHEST SPOT PRICES IN 2023



Wholesale spot prices can range from -$1,000 per MWh to $16,600 per MWh which are likely to be higher than any acceptable network price signal. The following chart shows average, minimum and maximum 5-minute wholesale spot prices (the chart is truncated at $4,000 per MWh but the highest prices was $14,522 per MWh).

AVERAGE, MAXIMUM AND MINIMUM SPOT PRICES IN 2023



Storage is also capable of providing raise and lower frequency control ancillary services (FCAS) by quickly charging or discharging in response to the system frequency conditions. Frequency response services range from one second to five minutes.

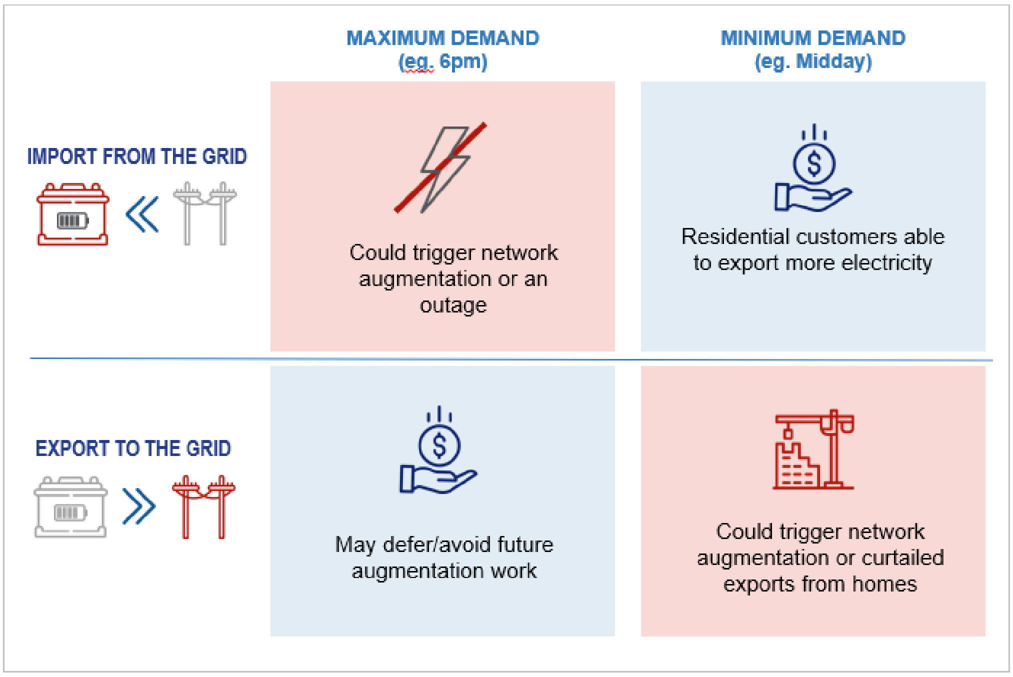
In addition to responding to wholesale energy and FCAS market price signals, storage could operate at unintended times through human error or an unanticipated automated storage behaviour or in response to unusual wholesale market conditions

3. Impact of storage on networks

Storage is unique in that its sole purpose is to provide electricity services. Storage is flexible, can respond quickly, imports and exports energy for a limited number of hours each day and at any point in time its operating state could range from maximum imports to maximum exports.

These characteristics mean that storage can potentially require network augmentation needs or defer the need for network augmentation as illustrated below.

POTENTIAL IMPACTS OF STORAGE ON THE NETWORK



Unmanaged storage would only need to operate at the wrong time once or several times to trigger the need for augmentation. However, storage would need to operate at the right time almost every time to defer augmentation.

Demand profiles on distribution network assets vary depending on the types of customers supplied and their location. For instance:

- network assets supplying residential customers in cooler areas or areas where gas is not available can be winter peaking but otherwise, they will usually be summer peaking
- network assets which largely support residential load will generally peak around 5pm-9pm whereas network assets which largely support commercial and industrial load will generally peak around 11am-3pm
- network assets which supply a mix of residential and commercial customers can peak around 4-6pm
- some network assets experience different timing of peak periods each year depending on temperatures and customer behaviour.

The variability of demand profiles on the network means network controls and incentives for a battery are location dependent.

3.1 Network integration

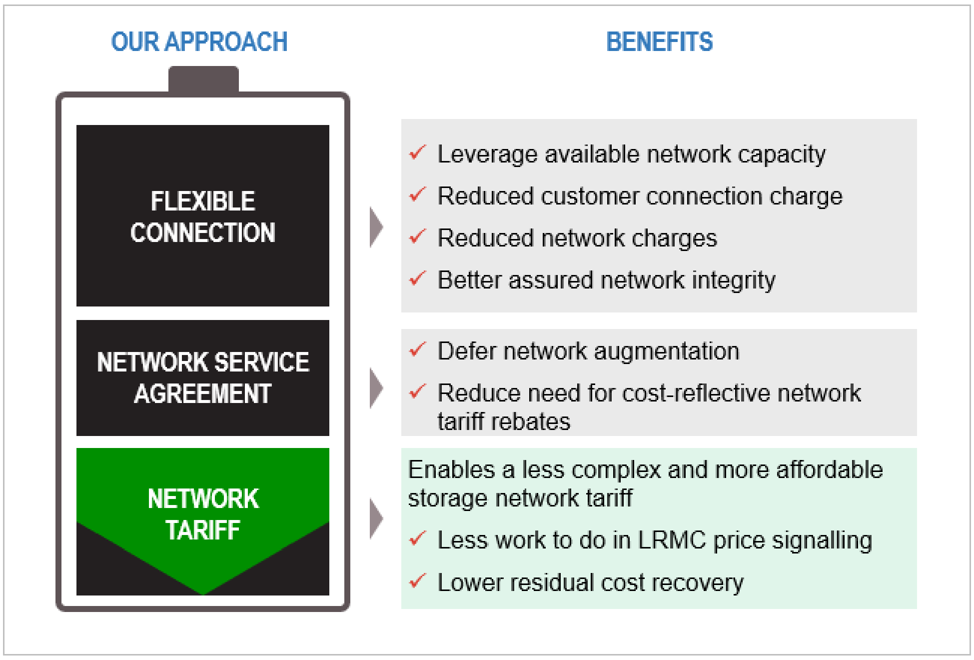
Our experience to date is that storage proponents generally have already selected a site and approach us seeking to connect their storage at that site.

Their main interest is in:

- cost of connection to the network
- any operating constraints that would be imposed
- whether they can be paid for providing network support services
- the network tariff.

Our response to the above issues can materially impact the financial returns of a proposed storage project.

The following diagram illustrates how we envisage flexible connections, network support arrangements and network tariffs would be used to integrate storage onto our network.



The remainder of this paper elaborates on the diagram.

4. Flexible connections

CitiPower and Powercor have a high voltage distributed energy resource management system (HV DERMS), which interfaces with a generation and/or storage customer's systems that is connected to the high voltage network.

HV DERMS, which applies to HV and sub-transmission storage / generator connections, provides a dynamic operating window by discontinuing, interrupting or limiting the quantity of electricity imported from or exported to the distribution system at any time for the following reasons:

- planned maintenance, repair or augmentation of the distribution system
- unplanned maintenance or repair of the distribution system in circumstances where the storage connection poses an immediate threat of injury or material damage to a person, property or the distribution system
- where otherwise permitted or required under the Electricity Law or in accordance with any valid direction given by an authority in accordance with Electricity Law
- in the case of an emergency
- where directed by AEMO (or its agent) or a transmission system operator
- where the customer is in breach of its obligations
- where the customer has failed to act as required under Electricity Law
- where the distributor is entitled or required to disconnect the point of supply under its deemed distribution contract
- where the distributor forms a reasonable opinion that it is necessary to maintain the reliability, safety, security and stability of the distribution system or a transmission system.

The connection of LV batteries is still very much in development. Our networks don't have an equivalent LV DERMS system, although it is likely that such a system will be implemented soon. Currently, LV batteries on our networks are usually subject to certain contractual operating constraints specific to their location.

These flexible connections have the advantage that requirements are tailored to the specific location of the storage connection resulting in connection costs for the storage owner being lower than they would have otherwise been.

Connection costs are further discussed in section 6.

Do you think that flexible connections are an effective method to reducing the cost of integrating storage?

5. Network support arrangements

The potential positive impacts of storage on the network are best addressed through network support arrangements since the conditions and payments can be location specific and time bound, which broad based tariff approaches can't provide. As an example, if the network forecasts the need for a zone substation augmentation in three years' time due to forecast load growth in the area, then the following can be calculated:

- load growth, energy at risk and economic timing of augmentation
- detailed design and costing of the augmentation project
- amount of required demand reduction each year to avoid or defer the augmentation
- seasonal timing of when the demand reduction would be required
- maximum number of demand reduction events needed each year
- duration of demand reduction required for each demand reduction event
- the costs which can be avoided by demand reduction.

The network can then tender out demand reduction with the appropriate responsibilities, obligations and network support payments for that network location. No published network tariff could be as effective.

The following is a recent network support arrangement entered into by one of our networks with a Battery Energy Storage System (BESS). Due to the confidentiality of the agreement, the description is non-specific.

BESS network support arrangement

BESS will provide the agreed available capacity for a certain duration per event.

BESS will provide up to a defined number of network support events per year during a defined network support period.

Network will notify the BESS of a network support event by no later than a defined time prior to the network support event.

BESS must provide real-time monitoring information to the distributor's control room.

BESS must be configured to allow the distributor to remotely control it during a network support event.

BESS will be paid an agreed fee for network support service.

Conditions for when the fee can be reduced due to failure to provide the network support service.

In our 2026-2031 regulatory proposal we intend to propose expenditure to improve network data visibility and enhance our ability to procure network services. We intend to propose to:

- improve our operational forecasting ability at the low voltage network level. Improving our forecasting ability will provide the market, including storage, more granular and future-focused forecasts of network capacity, to better target the location of storage and provide more opportunity for proponents to capture network support services
- invest in an enhanced distribution energy resource management platform which will improve our process for partnering with large customers, including storage, to provide network support services
- invest in a flexibility procurement platform which integrates our network constraint data with a procurement platform to enable a more streamlined approach for suppliers to select and bid on specific constraints in a 'one stop shop'. We will be trialling a flexibility procurement platform in 2024.

Our storage tariffs need to be designed considering that location-specific contractual arrangements are our preferred approach to procuring network support services.

Do you think that network support arrangements are better managed through tailored network support contracts outside of network tariffs?

6. Connection charges

6.1 Connections under NER Chapter 5A

Non-registered participants connect under National Electricity Rules (NER) Chapter 5A unless they elect to connection under NER Chapter 5.3. Non-registered participants are usually less than 5 MW.

Under the AER connection guideline for NER Chapter 5A connections, a customer's contribution to connection costs must be calculated as follows:

ICCS + ICSN – IR + O&M

where:

ICCS is Incremental Cost Customer Specific. It is the cost of connection services used solely by the connection applicant and can include augmentation and extension costs.

ICSN is Incremental Cost Shared Network. It is the average unit cost of upstream augmentation multiplied by the estimated peak coincident demand of the connection applicant.

IR is Incremental Revenue. It is the present value of incremental distribution (DUOS) revenue (excludes transmission revenue) expected to be received from the connection applicant. It is normally calculated over 15 years for non-residential connections.

O&M is operating and maintenance costs which can be accounted for in two ways:

- an estimate of O&M costs arising from the connection assets; or
- remove from DUOS charges that component which recovers O&M costs

6.2 Upstream augmentation costs

We propose that because storage is subject to flexible connections, ICSN should be assumed to be zero, which will significantly lower connection costs for a storage connection applicant. However, the storage site will face the risk that they will become increasingly constrained in the future. To avoid being cross-subsidised by other customers, a storage connection wanting to:

- use the network unconstrained from the start will need to pay higher connection charges to support network augmentation
- remove constraints in the future will need to pay a new connection upgrade charge to support network augmentation.

Do you support waiving ICSN for storage connections, but that they will need to pay for augmentation if they wish to remove network constraints in the future?

6.3 Connections under Chapter 5.3

A Registered Participant or person intending to be a Registered Participant connects under NER Chapter 5.3 for load connections and NER Chapter 5.3A for embedded generators.

Under Chapter 5 there is no framework for calculating customer contribution. We propose to apply the NER Chapter 5A framework which has a regulator approved economic underpinning and should result in lower connection charges for storage.

Do you support applying the NER Chapter 5A framework for calculating connection charges for storage?

7. Network tariff principles for storage

The AER's 2021-26 determination for the Victorian networks requires that storage should incur network tariffs and make a contribution to network costs[1]

> *Our final decision is that stand-alone energy storage assets, such as batteries but potentially also other energy storage technologies, that provide services other than solely network support, must be assigned to tariffs according to the usual tariff class assignment criteria. It is appropriate that such assets contribute to network cost recovery and see network price signals to guide their operation.*

The AEMC's final rule for Integrating Storage in the NEM, which was finalised after the AER determination, clarifies that storage will continue to be charged network tariffs when connecting to the distribution system[2].

7.1 Should there be specific storage tariffs?

For the purposes of this paper, storage is defined as stand-alone batteries and similar devices which can consume, store, and release electricity on demand at the point of connection to the network.

Arguably, network tariffs which are designed for flexible imports and exports should be opt-in tariffs for any customer. However, storage is subject to operating constraints which are not imposed on load connections because load connections don't have the same flexibility as storage. An exception is hot water heating under our control which receives a hot water heating dedicated tariff. We likewise propose to have dedicated network tariffs for storage. Should other situations arise where loads are subject to operating constraints, for instance electric vehicles, we would also consider dedicated network tariffs.

Should there be storage specific network tariffs?

7.2 Treatment of generators

All storage is capable of generation onto the network. Storage can also be co-located with onsite generation, which raises the question of how much storage is required before a generator connection become eligible for a storage tariff.

While generators with no storage export energy, they still need to import a small amount of auxiliary energy when they are not exporting. Generators need to be assigned to a network tariff for these imports.

The objective of generators with or without storage is to participate in the electricity system whereas load customers have wider objectives. For this reason, generators with or without storage are subject to more operating restrictions than load customers.

We therefore propose that all generators are eligible for storage tariffs and that the tariffs be labelled as 'generator storage' tariffs.

Should storage tariffs be eligible for generators with no storage?

[1] AER, Final Decision, AusNet Services, CitiPower, Jemena, Powercor, and United Energy Distribution Determination, 2021 to 2026, Attachment 19, Tariff structure statement

[2] AEMC, Integrating energy storage systems into the NEM, Rule determination, 2 December 2021

7.3 Treatment of existing storage / generators

All our existing trial tariffs end on 30 June 2026. We propose that all storage / generators on an existing trial tariff are transferred onto the new storage generator tariffs from 1 July 2026, and the trial tariffs closed.

Should all existing storage / generators on a trial tariff be transferred onto the new storage tariffs?

7.4 Treatment of loads co-located with storage

We recognise that innovative models might emerge in the future where generation, storage and loads could be co-located – for instance an electric vehicle (EV) charging station with solar generation and a battery. In this situation, storage tariff eligibility comes down to the extent of customer flexibility and the level of control we would have over this connection. For instance, if flexible connection arrangements are adopted then it may make sense to allow this connection onto a storage tariff. However, the technology and regime around flexible connections is not sufficiently mature to define it at this stage and we therefore propose to restrict a storage tariff to stand-alone storage and/or generation with no other co-located load.

We would use trial tariffs to test any innovative models which may arise during the next regulatory period.

7.5 Treatment of distributor-owned storage

We propose that all storage is subject to the same network tariffs irrespective of ownership. Therefore, distributor owned storage would be assigned the same network tariff as any other storage.

7.6 Long run marginal cost - imports

The National Electricity Rules (NER) require that each tariff must be based on the long run marginal cost (LRMC) of providing the service to which it relates. LRMC is the long-term cost that is caused by the production of an additional unit of service.

Average LRMC across a distribution network is often driven by a relatively small number of planned augmentations in a small number of specific locations. We propose to address these identified distribution network constraints, and new network risks created by the storage connection, through non-tariff controls and rewards. The remaining LRMC to be signalled to storage is relatively small and we propose to signal times when long term non-locational maximum demand growth is expected to be highest, that is, 4pm to 9pm every day.

Does it make sense for locational signals to be achieved through non-tariff initiatives and non-locational signals through tariff price signals?

On this basis, a critical peak demand charge / rebate, which is a very sharp price signal that is ideally locational, is not warranted.

Demand charges can provide a strong incentive not to import energy in peak times, but once a certain level of demand has been triggered, there is no incentive for demand to be reduced below the initially triggered level for the remainder of the demand period which could be to the end of the month or for 12 months. Peak period energy charges overcome this problem, but the peak period energy charges would need to be high to provide an equivalent signal strength. The optics of a high energy charge could be adversely received and perhaps not justified since most of LRMC management is being achieved through flexible connections.

We propose high peak period import energy charges from 4pm to 9pm every day for the summer and winter months, with no other import energy charges. With no import charges from 9pm to 4pm, network charges will not be a barrier to storage cycling more than once a day.

We proposed to apply import rebates from 11am to 3pm to small LV storage. These rebates would not apply from May to August when LV exports is not expected to be a problem. We propose to only have import rebates for small LV batteries because most export driven network investment is expected to be in residential areas on the low voltage network due to the continued growth in rooftop solar. Section 7.8 discusses eligibility for these rebates.

Does the structure of our proposes import LRMC charges and rebates make sense?

7.7 Long run marginal cost - exports

The recent Access and Pricing rule change removed the prohibition of export charges, which will enable networks to charge or reward their customers for exporting to the grid. The NER requires that export tariffs should also be based on LRMC and therefore the same principles as for imports apply.

For the same reasons mentioned for imports, we propose for small LV batteries to apply export charges from 11am to 3pm and exports rebates from 4pm to 9pm.

We propose that no export charges should apply to LV storage connected to a dedicated LV transformer, HV and sub-transmission connected storage and/or generation:

- to preserve competitive neutrality with connection to the transmission network
- this generation is most likely to be exposed to dynamic export controls
- most export issues occur on the LV network where a large amount of rooftop solar is installed.

We incur transmission charges for energy supplied from the transmission network. Generators, including storage generation, connected under NER Chapter 5 (as an Embedded Generator or a Market Network Service Provider) are eligible for avoided charges for the locational component of prescribed TUOS services (avoided TUOS). This means that LRMC for TUOS is rewarded for eligible storage - usually with generation capacity above 5 MW.

We propose that export rebates should only apply where there are also export charges, except for storage /generators, that are eligible for avoided TUOS.

Does the structure of our proposes export LRMC charges and rebates make sense?

7.8 Eligibility for the small LV network tariff

The proposed tariff structure for small LV storage is different to other storage in that it has import and export charges and rebates. Below are three options for how we could define tariff eligibility for the 2026-31 period.

Option 1

The above small LV storage tariff is intended for storage and/or generation connected on the low voltage network downstream of an existing transformer which also supplies other customers where maximum demand occurs in the early evening and rooftop solar exports occur around midday. This would be the more cost-reflective way of defining tariff eligibility and would involve the distributor publishing a list or map of eligible transformers.

Option 2

The above tariff is for LV storage with a capacity less than 240 kW[3]. Under this criterion some storage will not receive the appropriate price signals for where it is located. For instance, a battery located downstream of a transformer supplying commercial load with maximum demand in the middle of the day and no exports. Price signals under this option would be weaker than under option 1.

Option 3

To have a single LV storage tariff for any LV storage. Price signals under this option should be weaker than under option 1 and option 2 because the tariff could apply to storage or storage locations which are not suited to the tariff. For instance a battery located on the LV network where there is no rooftop solar.

We propose to define eligibility to be for storage less than 240 kW because the definition is clearer than option 1 and allows for stronger price signals than option 3.

How should eligibility of the LV storage tariff be defined and why?

7.9 Residual costs

The NER states that the total revenue from network tariffs must permit a distributor to recover the expected revenue in accordance with the AER revenue determination. LRMC will only recover a proportion of this revenue and the remainder is referred to as residual costs.

We propose that storage should make a fair contribution to residual costs just like any other customer, consistent with the AER and AEMC decisions referred to at the start of this section. To be fair, the contribution of storage to residual costs should be discounted because storage operates under flexible connections. The residual cost discount for storage is a judgement which is further discussed in section 8.1.

Consistent with other network tariffs, we propose that recovery of residual costs per kW of capacity should decrease as the connection voltage increases because less of the distribution network is used to supply higher voltage levels.

The NER does not allow residual costs to be recovered through export charges, and therefore residual costs will only be recovered through import charges.

A Brattle Group[4] report for the AEMC on the recovery of residual costs suggested that the most efficient way to recover residual costs is through fixed charges.

Accordingly, we propose to recover residual costs through fixed charges, but we need a way to scale fixed charges to the size of a customer. We propose that residual costs are recovered through an import capacity charge which would ensure that a customer contributes to residual costs proportionately to capacity required from the network. This is consistent with the advice provided by Argyle Consulting and Endgame Economics to AER[5].

Residual cost recovery should not occur through export charges and therefore the capacity charge would be based on the amount of import capacity required by the customer. We propose that the capacity charge be based on the 12-month rolling kW import demand. We think that measured demand is better than contract demand since supply capacity may be sized for exports rather than imports and removes the risk of administrative error. Since it is not always

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[3] This is the maximum LV capacity we would connect to a LV circuit.

[4] The Brattle Group, Structure of Electricity Distribution Network Tariffs: Recovery of Residual Costs, prepared for the Australian Energy Market Commission, August 2014.

[5] Argyle Consulting and Endgame Economics, Network tariffs for the distributed energy future, Final paper to the Australian Energy Regulator, June 2022.

optimal for generation to occur at a power factor of unity, we propose that the capacity charge is based on real power (kW) rather than total power (kVA).

Should the contribution of storage to residual costs be discounted because storage is subject to flexible connections?

Should we recover residual costs through a 12-month rolling kW import demand charge?

7.10 Local use of system pricing

Local use of system (LUOS) pricing recognises that the network costs should be reflective of the depth of network use.

Any electricity imported in the middle of the day on the LV network downstream of a transformer which supplies residential customers with rooftop solar, will likely be partially sourced from local rooftop solar.

Consuming local solar export can increase the local solar hosting capacity of the network. We propose a midday import rebate balanced by a high early evening import charge.

Less exports reach the HV network, and those that do are used by other customers supplied from the HV network. Therefore, we don't propose a midday import LUOS rebate on the HV network.

Some have argued for networks to support a community battery subscription scheme. At its simplest networks would:

- be notified of customers who have signed up to participate in a community battery scheme
- identify the exports of these customers while the community battery is importing during an agreed period
- identify how much these customers consume while the community battery is exporting during an agreed period
- charge participating customers a lower network charge for this local electricity compared with electricity which has not been supplied locally.

We don't support such an arrangement because:

- it is the actions of the community battery rather than of participating customers which allows energy to be used locally. Therefore, the community battery should be rewarded through a rebate and it is up to the community battery as to whether they want to share the rebate with local customers
- only customers who would be fortunate enough to have a community battery installed in their neighbourhood would have access to this LUOS discount and they would receive it for not changing their behaviour, that is, it would be a windfall gain funded by all other customers
- we have proposed that all residential customers should receive a highly discounted rate in the middle of the day when electricity is more likely to be sourced locally
- the complexity and cost of implementing such an arrangement.

Do you agree with our reasoning for not supporting a community battery subscription scheme?

7.11 Basic export level

Basic export level (BEL) is a level below which a distributor must not charge a customer for export services on the basis that intrinsic export hosting capacity has already been paid for by customers. The Victorian Government has imposed a further consumer protection measure by expecting that small customers can only opt into an export charge.

Under our proposed storage tariffs, BEL is only applicable to the small LV storage tariff since this is the only tariff which is proposed to have an export charge.

We believe that the intrinsic hosting capacity of the network should be assigned to residential and small business customers and not to stand-alone storage because:

- existing residential and small business customers will have already been contributing to the cost of intrinsic hosting capacity through their network tariffs, and it would be unfair for storage to connect and use it
- we are proposing that storage makes a materially lower contribution to residual costs
- storage is flexible, unlike rooftop solar, and therefore does not need a consumer protection.

Additionally, BEL distorts price signals and unnecessarily over-complicates a storage tariff, particularly if the BEL is set at a trivial level for a storage tariff.

For these reasons, our preference is to set the BEL at zero for stand-alone storage.

Do you agree with our proposal to set BEL at zero for storage tariffs?

7.12 Tariff assignment

Storage tariffs could be dedicated with no other option, or they could be optional tariffs.

We propose to make storage tariffs mandatory in the next regulatory period because:

- we cannot see a scenario where our traditional tariffs would be more favourable for storage
- there is more chance that the forecast revenue that is used to calculate the customer's connection charge will be incorrect
- optional tariffs add more complexity and time into the connection process since connection staff will need to explain and work through the network tariff options and connection charge implications with storage proponents
- provides more certainty and avoids potential confusion for storage proponents.

One exception would be for new connections above 10 MW import capacity where there would be an option of going onto an individually calculated network tariff.

Should all storage tariffs be mandatory for eligible storage connections?

7.13 Local time or market time

The time periods for all our network tariffs are expressed in local time - the time on your watch or phone. The wholesale spot market operates in Australian Eastern Standard Time (AEST).

We propose to express time periods for storage network tariffs in local time for consistency with all our other network tariffs, and because if storage operators can engage with the complexity of the wholesale markets, then they should be able to accommodate network tariffs in local time.

Do you have any objections to using local time for storage tariffs?

8. Indicative network tariffs

8.1 Pricing non-locational LRMC

As discussed earlier, locational LRMC does not need to be signalled through the network tariff, leaving only longer term non-locational LRMC to be in network tariff. The distribution LRMC decreases with higher voltage level since less of the distribution network is used. The transmission LRMC would be the same across all voltage levels if it is assumed that peak transmission demand occurs outside of embedded generation times. These different components of LRMC are conceptual and cannot be quantified with any certainty. Therefore, LRMC price signals are based on judgement, taking into consideration network tariffs for other customers and the total expected network charge for storage.

8.2 Pricing rebates for LV batteries

We propose no export charges for large LV, HV and sub-transmission storage and likewise propose no rebates.

We propose low rebates for small LV batteries because:

- small LV storage may be rewarded through a network support agreement
- small LV storage may be located on a part of the network where no import or export constraint is forecast
- small LV storage as defined (less than 240 kW) could be located on a part of the network which is midday peaking and the rebate incentives could work against the network
- the potential long term network value of storage exporting or importing at desirable times is only realised if a battery consistently operates at the right times and for the right duration of time. If storage misses out on this desirable behaviour even for a few days in the year, little, if any, long term network value is realised.

8.3 Recovery of residual costs

Residual costs are conceptually the difference between total network revenue allowance and network revenue recovered from LRMC. LRMC is highly uncertain and therefore residual cost is highly uncertain.

Argyle Consulting and Endgame Economics state that preliminary indications are that applying the pure LRMC charge to the corresponding charging parameter (e.g. peak energy, demand or capacity) would recover between 10-30% of total efficient distribution costs, depending on the network. The remaining 70-90% of total network costs are residual costs that need to be recovered[6]. We have assumed residual costs are a lower proportion of total revenue.

We have estimated total network revenue allowance per kW of customer capacity, and then calculated the residual cost assuming a certain proportion of total revenue.

[6] Argyle Consulting and Endgame Economics, Network tariffs for the distributed energy future, Final paper to the Australian Energy Regulator, June 2022, p25.

RESIDUAL COST BASED ON PROPORTION OF TOTAL REVENUE ($/KW/YEAR)

	Residual cost as a proportion of total revenue		
	30%	50%	70%
Powercor	$ 47	$ 78	$ 109
CitiPower	$ 46	$ 77	$ 107
United Energy	$ 42	$ 70	$ 98

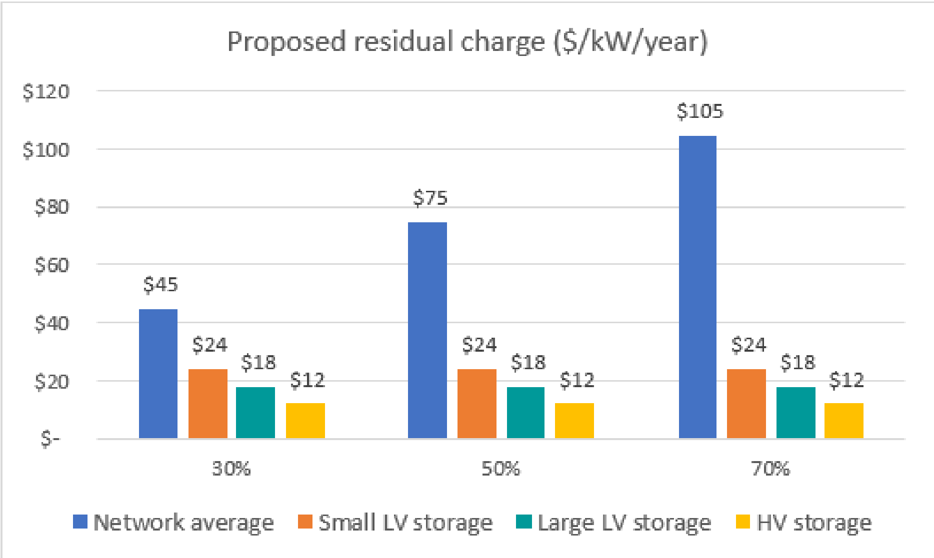
Since the residual costs are so close for our three networks, we propose the same residual cost charge across our three networks.

The following table shows residual cost recovery from different storage capacities and compares it to typical annual network charges under our current trial tariffs, noting that a 100kW battery is expected to receive a network rebate rather than pay a network charge.

RESIDUAL ANNUAL CHARGE BASED ON PROPORTION OF TOTAL REVENUE ($/YEAR)

	Residual cost as a proportion of total revenue			Current
Storage capacity	30%	50%	70%	trial tariffs
100 kW	$ 4,659	$ 7,765	$ 10,871	-$ 1,500
1,000 kW	$ 46,592	$ 77,653	$ 108,715	$ 18,250
5,000 kW	$ 232,960	$ 388,267	$ 543,574	$ 91,250

The following diagram compares our proposed residual charges for storage with the average network residual cost, assuming that residual costs are 30%, 50% or 70% of total costs.

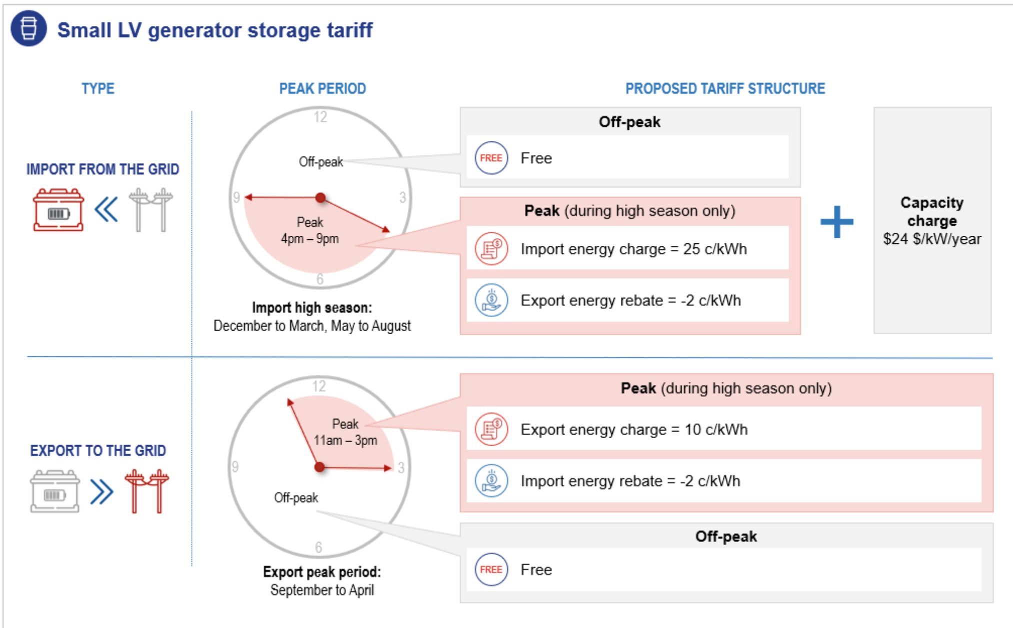


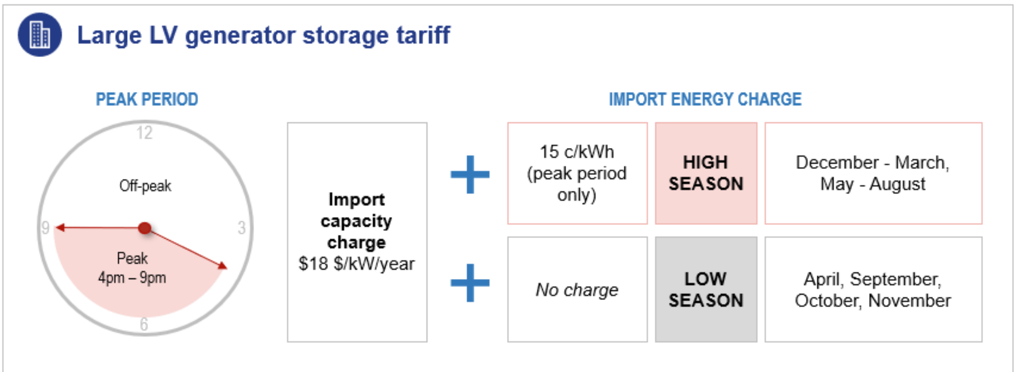
Our proposed storage capacity charges consider:

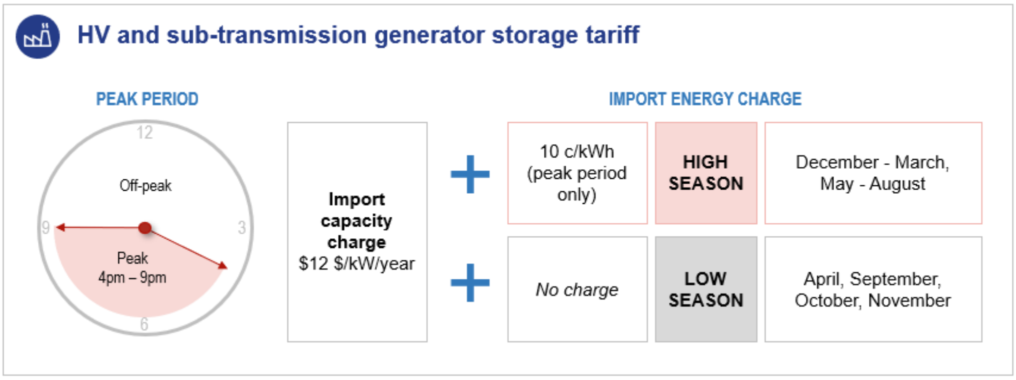
- network average residual costs which non-storage customers are paying
- that storage operates under flexible connections
- current charges recovered by storage trial tariffs
- the total network charge for small LV storage (including LRMC rates and assuming a certain operating profile)

8.4 Proposed structure and indicative rates

The following are our proposed structure and indicative rates for generator storage tariffs.







0 presents scenarios of annual network charges based on the proposed storage tariffs.

8.5 Individually calculated tariff

We intend to propose in our regulatory proposal that new connections with an import capacity above 10 MW have the option of going onto an individually calculated tariff. This would also apply to generators and storage new connections of this size.

Principles for individually calculated tariffs are proposed to be:

- the customer pays for incremental transmission costs incurred by the distributor
- the customer contributes to distribution residual costs quantified based on specific circumstances.

What are your thoughts on our individually calculated tariff proposal?

9. Storage annual charge scenarios

The following are various scenarios of the annual network charge that storage would incur under the proposed tariffs.

Storage hours	2.0	LV storage import / export in rebate periods	100%
Storage efficiency	85%		
Cycles per day	1	Storage import in peak period	0%

INDICATIVE RATES	Imports			Exports	
	Charge Capacity $/kW/year	Charge 4-9pm Dec-Mar, May-Aug c/kWh	Rebate 11am-3pm Sept-Apr c/kWh	Charge 11am-3pm Sept-Apr c/kWh	Rebate 4-9pm Dec-Mar, May-Aug c/kWh
Small LV storage	24	25	- 2	10	- 2
Large LV storage	18	15			
HV storage	12	10			

VOLUMES	Imports			Exports		Imports
	Charge Capacity kW	Charge 4-9pm Dec-Mar, May-Aug kWh/year	Rebate 11am-3pm Sept-Apr kWh/year	Charge 11am-3pm Sept-Apr kWh/year	Rebate 4-9pm Dec-Mar, May-Aug kWh/year	Total MWh/year
Small LV storage	120	-	58,400	-	49,640	88
Large LV storage	1,000	-				730
HV storage	5,000	-				3,650

CHARGES	Imports			Exports		Total	Average
	Charge Capacity $/year	Charge 4-9pm Dec-Mar, May-Aug $/year	Rebate 11am-3pm Sept-Apr $/year	Charge 11am-3pm Sept-Apr $/year	Rebate 4-9pm Dec-Mar, May-Aug $/year	Charge $/year	Network Cost S/MWh
Small LV storage	2,880	-	- 1,168	-	- 993	719	8
Large LV storage	18,000	-				18,000	25
HV storage	60,000	-				60,000	16

Storage hours	3.0	LV storage import / export in rebate periods	100%
Storage efficiency	85%		
Cycles per day	1	Storage import in peak period	0%

INDICATIVE RATES	Imports			Exports	
	Charge Capacity	Charge 4-9pm Dec-Mar, May-Aug	Rebate 11am-3pm Sept-Apr	Charge 11am-3pm Sept-Apr	Rebate 4-9pm Dec-Mar, May-Aug
	$/kW/year	c/kWh	c/kWh	c/kWh	c/kWh
Small LV storage	24	25	- 2	10	- 2
Large LV storage	18	15			
HV storage	12	10			

VOLUMES	Imports			Exports		Imports
	Charge Capacity	Charge 4-9pm Dec-Mar, May-Aug	Rebate 11am-3pm Sept-Apr	Charge 11am-3pm Sept-Apr	Rebate 4-9pm Dec-Mar, May-Aug	Total
	kW	kWh/year	kWh/year	kWh/year	kWh/year	MWh/year
Small LV storage	120	-	87,600	-	74,460	131
Large LV storage	1,000	-				1,095
HV storage	5,000	-				5,475

CHARGES	Imports			Exports		Total	Average
	Charge Capacity	Charge 4-9pm Dec-Mar, May-Aug	Rebate 11am-3pm Sept-Apr	Charge 11am-3pm Sept-Apr	Rebate 4-9pm Dec-Mar, May-Aug	Charge	Network Cost
	$/year	$/year	$/year	$/year	$/year	$/year	S/MWh
Small LV storage	2,880	-	- 1,752	-	- 1,489	- 361	- 3
Large LV storage	18,000	-				18,000	16
HV storage	60,000	-				60,000	11

Storage hours	4.0	LV storage import / export in rebate periods	100%
Storage efficiency	85%		
Cycles per day	1	Storage import in peak period	0%

INDICATIVE RATES	Imports			Exports	
	Charge Capacity	Charge 4-9pm Dec-Mar, May-Aug	Rebate 11am-3pm Sept-Apr	Charge 11am-3pm Sept-Apr	Rebate 4-9pm Dec-Mar, May-Aug
	$/kW/year	c/kWh	c/kWh	c/kWh	c/kWh
Small LV storage	24	25	- 2	10	- 2
Large LV storage	18	15			
HV storage	12	10			

VOLUMES	Imports			Exports		Imports
	Charge Capacity	Charge 4-9pm Dec-Mar, May-Aug	Rebate 11am-3pm Sept-Apr	Charge 11am-3pm Sept-Apr	Rebate 4-9pm Dec-Mar, May-Aug	Total
	kW	kWh/year	kWh/year	kWh/year	kWh/year	MWh/year
Small LV storage	120	-	116,800	-	99,280	175
Large LV storage	1,000	-				1,460
HV storage	5,000	-				7,300

CHARGES	Imports			Exports		Total	Average
	Charge Capacity	Charge 4-9pm Dec-Mar, May-Aug	Rebate 11am-3pm Sept-Apr	Charge 11am-3pm Sept-Apr	Rebate 4-9pm Dec-Mar, May-Aug	Charge	Network Cost
	$/year	$/year	$/year	$/year	$/year	$/year	S/MWh
Small LV storage	2,880	-	- 2,336	-	- 1,986	- 1,442	- 8
Large LV storage	18,000	-				18,000	12
HV storage	60,000	-				60,000	8

Storage hours	3.0	LV storage import / export in rebate periods	100%
Storage efficiency	85%		
Cycles per day	2	Storage import in peak period	0%

INDICATIVE RATES	Imports			Exports	
	Charge Capacity	Charge 4-9pm Dec-Mar, May-Aug	Rebate 11am-3pm Sept-Apr	Charge 11am-3pm Sept-Apr	Rebate 4-9pm Dec-Mar, May-Aug
	$/kW/year	c/kWh	c/kWh	c/kWh	c/kWh
Small LV storage	24	25	- 2	10	- 2
Large LV storage	18	15			
HV storage	12	10			

VOLUMES	Imports			Exports		Imports
	Charge Capacity	Charge 4-9pm Dec-Mar, May-Aug	Rebate 11am-3pm Sept-Apr	Charge 11am-3pm Sept-Apr	Rebate 4-9pm Dec-Mar, May-Aug	Total
	kW	kWh/year	kWh/year	kWh/year	kWh/year	MWh/year
Small LV storage	120	-	87,600	-	74,460	263
Large LV storage	1,000	-				2,190
HV storage	5,000	-				10,950

CHARGES	Imports			Exports		Total	Average
	Charge Capacity	Charge 4-9pm Dec-Mar, May-Aug	Rebate 11am-3pm Sept-Apr	Charge 11am-3pm Sept-Apr	Rebate 4-9pm Dec-Mar, May-Aug	Charge	Network Cost
	$/year	$/year	$/year	$/year	$/year	$/year	S/MWh
Small LV storage	2,880	-	- 1,752	-	- 1,489	- 361	- 1
Large LV storage	18,000	-				18,000	8
HV storage	60,000	-				60,000	5

Storage hours	3.0	LV storage import / export in rebate periods	90%
Storage efficiency	85%		
Cycles per day	1	Storage import in peak period	0%

INDICATIVE RATES	Imports			Exports	
	Charge Capacity	Charge 4-9pm Dec-Mar, May-Aug	Rebate 11am-3pm Sept-Apr	Charge 11am-3pm Sept-Apr	Rebate 4-9pm Dec-Mar, May-Aug
	$/kW/year	c/kWh	c/kWh	c/kWh	c/kWh
Small LV storage	24	25	- 2	10	- 2
Large LV storage	18	15			
HV storage	12	10			

VOLUMES	Imports			Exports		Imports
	Charge Capacity	Charge 4-9pm Dec-Mar, May-Aug	Rebate 11am-3pm Sept-Apr	Charge 11am-3pm Sept-Apr	Rebate 4-9pm Dec-Mar, May-Aug	Total
	kW	kWh/year	kWh/year	kWh/year	kWh/year	MWh/year
Small LV storage	120	-	78,840	-	67,014	131
Large LV storage	1,000	-				1,095
HV storage	5,000	-				5,475

CHARGES	Imports			Exports		Total	Average
	Charge Capacity	Charge 4-9pm Dec-Mar, May-Aug	Rebate 11am-3pm Sept-Apr	Charge 11am-3pm Sept-Apr	Rebate 4-9pm Dec-Mar, May-Aug	Charge	Network Cost
	$/year	$/year	$/year	$/year	$/year	$/year	S/MWh
Small LV storage	2,880	-	- 1,577	-	- 1,340	- 37	- 0
Large LV storage	18,000	-				18,000	16
HV storage	60,000	-				60,000	11

Storage hours	3.0	LV storage import / export	90%
Storage efficiency	85%	in rebate periods	
Cycles per day	1	Storage import in peak period	5%

INDICATIVE RATES	Imports			Exports	
	Charge Capacity	Charge 4-9pm Dec-Mar, May-Aug	Rebate 11am-3pm Sept-Apr	Charge 11am-3pm Sept-Apr	Rebate 4-9pm Dec-Mar, May-Aug
	$/kW/year	c/kWh	c/kWh	c/kWh	c/kWh
Small LV storage	24	25	- 2	10	- 2
Large LV storage	18	15			
HV storage	12	10			

VOLUMES	Imports			Exports		Imports
	Charge Capacity	Charge 4-9pm Dec-Mar, May-Aug	Rebate 11am-3pm Sept-Apr	Charge 11am-3pm Sept-Apr	Rebate 4-9pm Dec-Mar, May-Aug	Total
	kW	kWh/year	kWh/year	kWh/year	kWh/year	MWh/year
Small LV storage	120	4,380	78,840	-	67,014	131
Large LV storage	1,000	36,500				1,095
HV storage	5,000	182,500				5,475

CHARGES	Imports			Exports		Total	Average
	Charge Capacity	Charge 4-9pm Dec-Mar, May-Aug	Rebate 11am-3pm Sept-Apr	Charge 11am-3pm Sept-Apr	Rebate 4-9pm Dec-Mar, May-Aug	Charge	Network Cost
	$/year	$/year	$/year	$/year	$/year	$/year	S/MWh
Small LV storage	2,880	1,095	- 1,577	-	- 1,340	1,058	8
Large LV storage	18,000	5,475				23,475	21
HV storage	60,000	18,250				78,250	14