28 October 2015

Australian Energy Market Commission
PO Box A2449
Sydney South NSW 1235

By email: aemc@aemc.gov.

Re: Preparing Markets for Technological Change –
The Integration of Energy Storage
Submission from *The Customer Advocate*

Thank you for the opportunity to provide a submission regarding the AEMC's "Integration of Energy Storage' discussion paper of 9 October 2015.

I wish to present a view of the issues raised in the discussion paper from the point of view of residential and small-to-medium enterprise consumers in the somewhat unique Australian energy market. This response does not consider in detail the role of energy storage at a utility level for frequency control or ramp-rate response, which can be studied in many applications overseas.

Many of the AEMC's preliminary findings raised in the discussion paper are supported.

I base this submission on my thirty years' experience as a professional engineer in the electricity distribution industry, practicing in three states in the fields of network planning and investment, network operations and most recently in customer advocacy and energy strategy.

Of course, I will be happy to meet with the AEMC to discuss this submission should I be desired.

Thank you once again for the opportunity to respond.

Kind Regards,

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Overview

There are many factors that have contributed to the current interest in small-scale battery energy storage, including falling technology prices and well-timed marketing announcements in an environment of increasing grid costs and a deep mistrust of the energy supply industry generally.

The introduction of cheaper, accessible, integrated and technologically-elegant energy storage will bring benefits to energy customers, from not only lower network charges through reduced investment in assets to meet peak demand, but also through bill empowerment and improved supply reliability to those who value energy continuity.

As the impact of energy storage is considered, however, it is important not to overlook some simple yet important customer and market perceptions regarding energy storage.

This response addresses the practical adoption of energy storage.

It is hoped that Australia will not see a requirement to distort the energy market through further cost imposts such as the 'sun tax' in Italy or Spain, or require limitations of energy export and subsidised energy storage such as in Germany. Whilst a regulatory response by the AEMC that looks well into the future is useful, experience shows that unintended external factors and political influence tend to drive energy storage policy. Unfortunately, a number of the case studies presented in the AEMC discussion document do not acknowledge the externalities that have influenced these examples.

Energy storage is 'not new', and the regulatory framework to adopt energy storage is largely in place. It is how the regulations are interpreted and applied by the segments of the energy market that will have the biggest bearing on how energy storage is adopted.

The technical process for the connection and management of energy feed-in from embedded generators is already in place, testament to the 4.4GW of installed solar PV capacity in Australia. Similarly, customer and network demand management practices are well-embedded.

Existing regulation largely already supports the emerging energy storage and its potential application to energy customers. It's how distributors & retailers approach the application of energy storage through tariffs and connection rules that really matters.

This response discusses a number of issues regarding the emergence of battery storage, in summary:

1) The ***framework for peak-demand shifting and energy storage already exists*** through stored hot water and other responses by customers to off-peak tariffs. The trend in network tariffs, however, are actively discouraging more efficient use of the power network.
2) *The* **mechanism for the connection of embedded micro-generators is already in place**, albeit poorly executed. These connection rules are independent of the energy source, whether it be solar PV or stored energy from batteries.
3) To a customer, ***networks already provide energy storage services*** with 'the biggest battery on the world' – the grid. The complexity is how that service is charged to customers. New and innovative Use of System charges are required to adapt not only to energy storage, but also short-haul DUoS (virtual net metering) and energy communities.

4) The application of ***network storage at grid level is no more than an alternative to other more traditional solutions to network augmentation*** for peak demand; power quality and voltage control; or frequency control / ramp rate services. Existing 'most efficient solution' decisions can corporate storage as an option where appropriate within existing regulation.

5) The ownership and control of demand-management and demand-shifting capability behind-the-meter apply to many technologies, of which energy storage is only one. Provided it is done at arms-length to networks in a ***fair and commercial environment***, any regulatory environment should empower customers to make reasonable investment and control decisions as to their energy choices and bill management.

There are three fundamental concepts that should underpin the adoption of energy storage:

1. Energy storage is adopted by choice by the customer in response to fair, cost reflective tariffs;
2. Those tariffs reflect the true benefit to the network and retailer of the demand management or energy feed-in actions of the customer; and
3. Network owners require an incentive to allow customers to fairly adopt energy storage.

Each of these requirements are addressed in turn below.

Addressing the Needs of the Energy Customer through Fair Tariffs

The cost and benefit of energy storage will, ultimately, bear on the energy customer. Therefore, it is useful to consider the application of energy storage through the direct impact on the energy consumer.

The uptake of energy storage will be almost entirely dependent on the financial considerations by the energy consumer, who is exposed to the quantum and tariff structure of the power bill.

Granted, there is a strong undercurrent driving uptake of energy storage just to 'get off the grid' in a response to rising energy prices and a fundamental dissatisfaction with those in the energy market. Similarly, there is a market for energy storage from customers who place a value on high network reliability, where the Uninterruptible Power Supply (UPS) function will be attractive.

Must consumers, however, will make an informed decision based on the commercial information before them. The falling battery prices, whilst significant, is only part of the story, with energy tariffs being the major influence on battery uptake.

A customer's decision to embrace energy storage will be fundamentally around the value of time shifting their consumption; that is, the price differential between 'the cheapest power of the day' and the 'most expensive power of the day'.

Examining the current Tariff Structure Statement (TSS) information available from networks to date, the approach of offering demand-based tariffs for small customers may encourage the adoption of energy storage. However, the ability for the energy price to vary year-on-year will discourage customers from making investment decision that require some visibility of the price over life of the storage asset. Price stability is necessary.

In addition, the pricing practice of rising fixed connection charges reduces the incentive to invest in energy storage.

The energy bill – the shape of the tariff and the cost components - will be the predominant factor in a customer's consideration of energy storage. The gap between the 'cheapest power of the day' and the 'most expensive power of the day' will drive the customer decision.

Another significant barrier to a customer's uptake of energy storage will be how the customer will be able to answer the question "will I be better off ?" The remarkably poor uptake of flexible tariffs to date is largely due to both the inability for a customer to reasonably identify the benefit of new technology and tariffs, despite the plethora of regulation and websites to assist, and the industry's reluctance to offer meaningful time-based cost differentials in their pricing. Lack of trust in the industry and poor awareness of the cost risks associated with customer load patterns and 'one off' demand events is poorly understood by customers.

The decision for solar was easy– use less energy from the grid, your bill will be smaller. (This was of course before rising fixed connection charges.)

Regulation already allows trusted third-party access to a customer's energy use patterns (on request, of course) and consider a range of demand management options against a range of tariff options. However, some element of technical risk should be absorbed by the network and retailer. After all, risk is already inherent in decisions such as After Diversity Maximum Demand design and the customer's own energy use decisions, so networks and retailers should be encouraged to take a less-risk-adverse position in regard to the customer's use of energy storage, whether through tariff stability, reduced fixed connection charges or fair and reasonable technical connection rules. At a high level, this will be achieved by ensuring the distributor has some benefit in encouraging storage.

In practice, the following will need to occur:

1. Network tariffs fairly reflect the value of a demand–shifting capability by customers from times of peak to times of low network utilization or low energy cost
2. Tariffs do not unfairly penalize customers for unintentional or rare digressions from the statistical norms for energy demand

Networks have little incentive to fairly price 'off-peak' energy and spare capacity, and retailers are reluctant to do so as off-peak energy is not a headline rate. As an example, consider the changes in retail energy tariffs in one state since 2010. In Queensland, the connection charge, or fixed charge, has increased from 7.47 cents per day to over $1.06 per day in just five years, - an increase of 1323% ! (and this is in a state that does not have to fund a mass-rollout of smart meter infrastructure.)[1]

Granted, the increase in fixed charge has taken some pressure off the rise in standard supply volumetric charges, however not so with the cost of 'off-peak' energy. See the table below, where it can be seen that since 2010, the relative retail cost of off-peak energy (intended to provide the customer with signals of low-cost generation and unused network capacity) has increased over 62 %, compared to a change of 15% in 'peak' or 'anytime' energy.

[1] Queensland Government Extraordinary Gazettes, May 2010 to June 2015

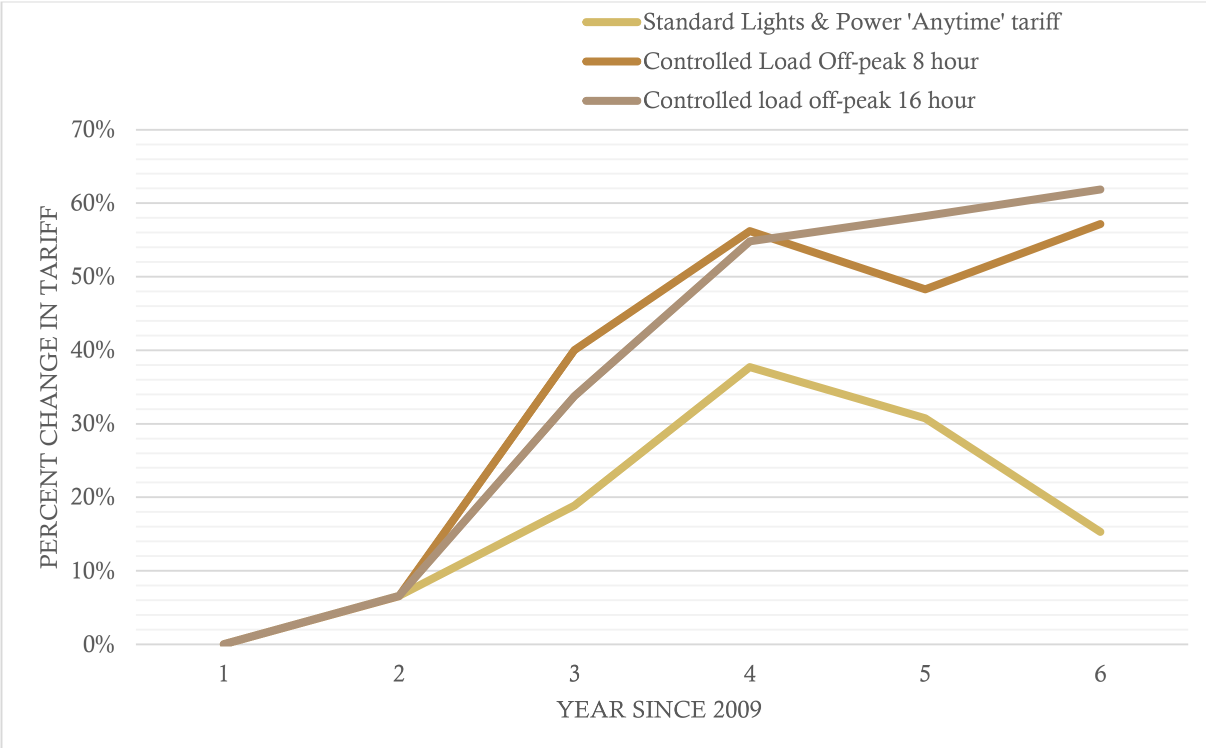


FIGURE 1- PERCENT CHANGE IN RESIDENTIAL TARIFFS SINCE 2009 – QUEENSLAND

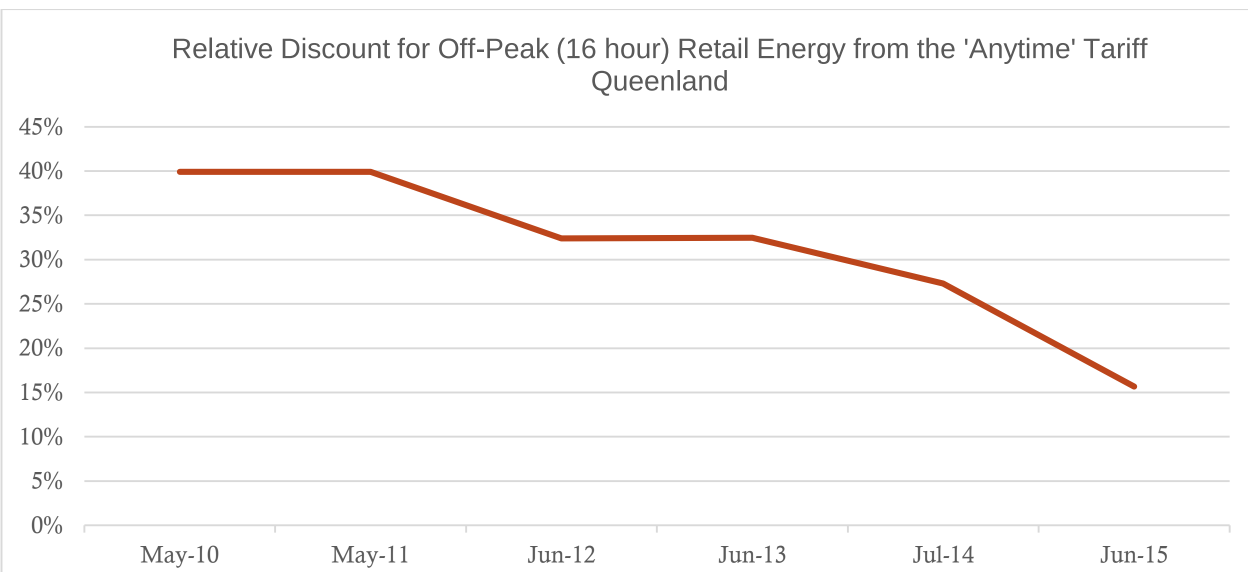


FIGURE 2- RELATIVE RETAIL PRICE INCENTIVE FOR OFF-PEAK ENERGY _ QUEENSLAND

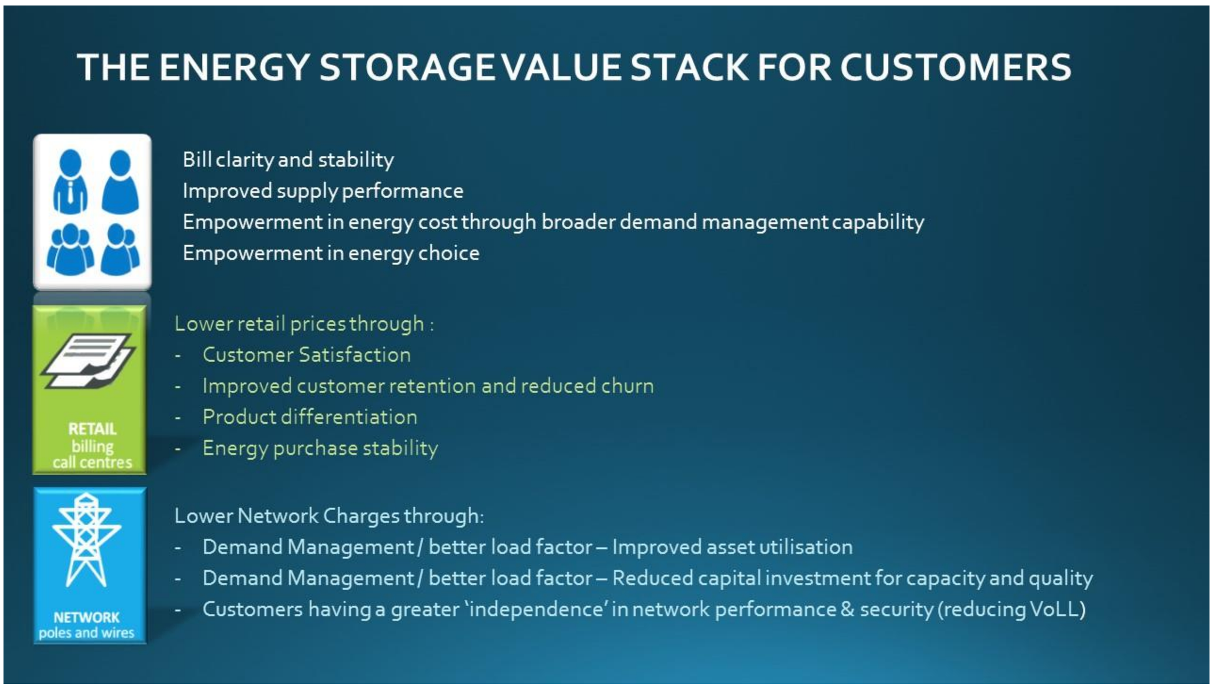
Without fair pricing of off-peak energy and network capacity, energy storage will not be a viable investment for customers. There is little incentive for networks to price off-peak capacity fairly, as to do so will shift cost-recovery to the more visible and sensitive standard energy rate.

Sharing the Value of Energy Storage with the Customer

The strongest case for energy storage will be when the customer (or investor) benefits from the largest 'value stack' – that is; an aggregation of the benefits that energy storage offers the customer through:

- the ability to make best use of the 'cheapest' energy where a price differential through the day exists;
- a component of the retail benefits through their contract with the energy retailer; and
- a component of the network benefits from better utilization of the local power network.

Any regulatory framework needs to support the ability for the amalgamation of the 'value stack' and pass much of that value back to the energy customer.



The current structure of energy tariffs and capital contributions are not conducive for the application of energy storage.

In particular, the rapid increase in the fixed connection charge is not helpful. There are three concerns for customers in this approach:

1. In areas where the fixed charge is a predominant proportion of the energy bill, the customer will have an incentive to 'leave the grid', in most cases leaving stranded network assets in place that contribute no return to the network and must be funded by other customers;

2. A larger fixed component of the bill disempowers customers, by reducing the incentive for customers to be aware of how much energy they use, and when they use it. Demand management incentives are reduced, and the potential for another 'peak demand capital blowout' in another few years exists; and

3. It becomes very difficult for customers to understand the purpose of the fixed charge. Historically, it was representative of the cost of the assets required to directly service the customer (service wire, meters, fuse), but as the widely varying fixed charge across distributors attests, it is 'just the way the distributor chooses to cut the pie'. The intent of the fixed component signal is now lost with customers.

Consideration for the AEMC to influence energy storage for the benefit of customers include:

1. A reasonable mechanism to set ***the fixed connection charge for customers that fairly reflects the actual connection assets employed***, with use of the shared network charged through a variable tariff structure that reflects the actual use the customer makes on the network;

2. A ***variable network charge that empowers customers to have control of the cost of supply*** through choice in the level of energy use, appliance type, daily routine and degree of participation in demand management;

3. The ***ability for aggregators*** to identify and draw out the maximum value from the use of energy storage across the energy value chain on behalf of customers; and

4. An ***incentive for network operators to negotiate effective connection contracts*** with customers that reflect the benefit of a customer's investment in demand management, energy storage and embedded generation where such a connection provides benefit to the network itself.

An energy 'reverse' auction was carried out to identify new sources of energy in an emerging constrained network. Amongst the successful bidders was a battery provider, who not only installed the energy storage, they negotiated on behalf of the customer for a reduced retailer charge, through a contract that included energy curtailment and a greater component of off-peak energy. The bidder then negotiated a lower-cost network connection agreement that reflected a much improved load factor and a greater level of demand management available to the network operator.

Considering a Network's Incentive Towards Storage

Network operators need further incentives to permit customers to use storage. The relative indifference by networks to falling load factors and falling energy throughput in an environment of low demand growth is of significant concern. This approach comes largely as a result of the way networks are regulated and compensated, with the lion's share of regulated funding having little to do with the amount of ‘product’ the network operator delivers. Declining asset utilization and reduced energy throughput is simply addressed though the ‘overs-and-unders’ mechanisms and the ability to rebalance tariffs year-on-year. DMIS and other incentive strategies are not generally seen as sources of core, sustainable income.

This means that for networks, energy storage is little more than a ‘hobby’. At present. there is little commercial incentive for networks to be involved in energy storage or to provide reasonable incentives to customers to participate in demand management or time shifting of demand - other than as an expansion of the Regulated Asset Base.

Perhaps the biggest commercial challenge (that should be) facing networks today is the falling load factor. Much attention is drawn to the management of ‘peak demand’, however an equally pressing matter is how to address the ‘hole in the daily load curve’ for many parts of a network. Networks need to be provided an incentive to improve the returns from what is a more-and-more underutilised asset; where the impact of this underutilisation is unfortunately being passed onto customers with relative ease.

Such an incentive could technically take the form of storage at a grid level, however the cost, cost-sharing and overheads of such a solution suggest this approach is unlikely to be efficient. A better solution is to address the ‘source’, with the encouragement of customer load management through attractive tariffs to use energy at times when parts of the network is relatively ‘idle’.

An opportunity exists to consider a network’s desire to ‘sell’ that spare network capacity to energy communities or through ‘short-haul’ customer-to-customer DUoS charges. This consideration is largely outside the scope of this response paper.

The fragmentation of the market stands in the way of this approach, however. In the middle of the day, when many residential network sectors are underutilised due to the high penetration of solar PV, a network operator may consider a lower network tariff. However, the risks and variability of this approach mean networks are unlikely to consider such a position favorably, unless the ‘spare network capacity’ can draw a new revenue stream – perhaps as an unregulated service.

The matter of spare network capacity will become a significant conversation as the application of ‘local energy communities’ grows in the future.

The Value of the Network Storage Service to Customers

The electricity grid is already ‘the biggest, cheapest battery available’ today

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In the eyes of energy customers who have invested in micro-generation, the electricity grid is an excellent energy storage device. Customers can send their spare energy out to the grid, then take it back in pristine condition later for re-use. At the moment, for customers not on premium feed-in tariffs, the cost of that storage is the difference between the value of that energy at the time (say, in many states, around 6c /kWh) and the cost of buying that energy back again when needed (again assume a standard anytime tariff of $25c / kWh). The ‘storage’ charge is therefore essentially all the costs in the bill other than the energy – NUoS, retail overheads, green schemes and the like – in this example 19c / KWh.

As explained later in this response, the establishment of grid-level energy storage as a specific 'customer service' is meaningless – it's about the 'buy' price and the 'energy foregone' network price.

The issue centres on the dichotomy between the grid-centric view that the power is not actually stored, but used nearby; versus the customer thinking that 'their power' is stored and returned later today, or tomorrow, or next summer.

Much of this approach will be considered in the current work in a number of states on the value of energy supplied to the network; such as the QPC's 'Fair Price for Solar' study. This work already is considering the value of the energy exported, whether it be at a fixed or dynamic price for the energy exported; and the value to the network in so far as the power is delivered utilizing only a small subset of the assets that are considered in the DUoS charge.

The fundamentals of the current 'fair price for solar' discussions are common to the 'fair price for a customer's stored energy'; just that a premium will be placed on the ability to 'dispatch' the energy

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Storage as an Alternative to Network Augmentation

The installation of explicit local energy storage is really no more than an alternative to more traditional forms of network augmentation to meet capacity or quality constraints.

The RIT-D process is intended for networks to consider the most efficient way of addressing a network limitation. The use of energy storage at 'grid fringe' will no doubt prove more effective as battery prices fall, as reflected in the Ergon Energy GUSS initiative.

However, for the vast majority of networks, the limitations that arise at sub-transmission level, distribution networks or low-voltage distribution will almost always be most efficiently addressed through traditional network augmentation. For example, battery installations won't help distributors supply new loads. Network operators are somewhat ambivalent to the nature of the new loads, because the cost to supply is passed onto the customer anyway.

The application of a network-connection battery as to address network limitations due to high penetrations of solar PV is a long way from being feasible. It's not the idea of storage; it's the complexities of its implementation. For instance:

- Other than at single-premise rural transformers, most problems with voltage rise occur in the longer low-voltage networks in rural residential areas where a number of customers connect along the low voltage line.
- It is the power flow from the customer onto low voltage network itself that is the prime cause of voltage rise, so there is really no 'ideal place' on the circuit to install storage to alleviate voltage rise other than at the source – that is, at the customer's premises.
- A battery installation in a street will be socially and financially expensive. Batteries are generally too heavy to be pole-mounted; land on the footpath or private property will be needed. Community concerns regarding land use and safety will often be significant. These

costs are comparable to the batteries themselves. Additional maintenance, inspection and depreciation costs would apply. If it was a good idea, then it would be done now !

- Installation of storage at a customer's installation means the customer provides the space, the physical connection, and often the inverter. Grid-connected storage will duplicate all these assets.
- Commercially, no framework exists for a network to charge the customers who benefit, other than a capital contribution. Who caused the problem, so who should pay ? The last connection, or all of them ?

A peculiarity of high levels of embedded generation is that the power flow can, at times, reverse. This creates interest from networks regarding the quality and reliability of the network protection at the generator, resulting in cost imposts for additional network-grade protection being prescribed as part of the connection requirements. Similarly, traditional network design considerations such as protection coordination and voltage profiling are challenged.

Storage at network level could 'absorb' this reverse power flow. However, with tens of thousands of low voltage segments and distribution feeders across Australia likely to display some form of reverse power flow, the cost to consider storage as a common tool to manage reverse power flow is prohibitive. A more appropriate response will be for networks to embrace the fact that reverse power flow is now 'a fact of life' and explore more appropriate technical solutions (such as innovative voltage management) and demand-side incentives through attractive tariffs to customers.

For networks, the AEMC should consider the following:

1. For a distribution network, energy storage at grid level is no more than an alternative to be considered to meet peak demand or power supply quality requirements. There is little justification for distributors to offer grid-level storage to customers as a service.

2. Instead of storage, the AEMC needs to consider incentives for customers

History as a Predictor of the Future

Energy storage for many small customers in particular is not new. Cheap energy storage in the form of stored water heating has been a significant energy storage and demand-time-shift device for millions of energy customers, particularly in Queensland and New South Wales, for many years. Experience in the changing uptake and application of storage water heating in the light of emerging tariffs and energy costs will provide insights into the customer approach to battery storage.

Energy Storage is not new. Changing customer attitudes to stored hot water, a product that has been around for many years, will provide an insight into the likely customer response to battery energy storage.

There is evidence that customers are moving away from hot water storage, particularly in recent years. The convenience of instantaneous gas heating is one reason, however the rising fixed cost and reduced tariff differential for off-peak energy acts as a detractor. Hot water storage offers energy consumption time shifting just as will battery storage. Understanding why controlled load or off-peak water heating is not offered as a powerful DM product to customers will provide a significant insight into the likely uptake of batteries as energy storage.

Retailers have been reluctant or unsuccessful in marketing stored water heating to small customers. Similarly, energy network operators tend to be somewhat indifferent to encouraging a move to off-peak energy, other that direct incentives such as the successful ‘peaksmart’ campaign for pool pumps run by Energex in Queensland [2], where cash rebates are offered. This is curious, given the increase in off-peak energy charges from that company which tends to reverse the customer incentive.

Considering the Customer Investment in Storage

The AEMC discussion paper covers the wide range of considerations of the introduction of energy storage. However, it is useful to ‘come from the other direction’ and test the matters in the discussion paper from the viewpoint of the likely application of battery storage by a customer.

Battery storage by customers is really just an extension of existing demand management thinking. Similarly, there is little difference between batteries being used for demand reduction or for returns from energy feed-in.

A. Customers Purchasing Batteries to Better Utilise Solar Power

Battery storage is first and foremost a demand management tool for customers and networks alike. Demand management thinking has been a major consideration for customers and networks for many years in the form of off-peak energy tariffs, controlled–load capability, peak-related pricing signals, subsidies and mass-advertising. In the regulatory world, demand management is well understood and is funded by the Australian Energy Regulator through the Demand Management Incentive Scheme.

A customer’s response to demand management signals is largely through the ease of access, low entry cost and clear benefits to the energy bill.

Battery storage is a powerful addition to the arsenal of tools for Customer Demand Management, as well as a repository for ‘spare’ solar energy. The role of energy storage should feature as a component of a wider Integrated Demand Management strategy for customers with consistent network price signals and reasonable connection processes.

As discussed above, demand management and peak-shifting initiatives have been around for ages, and are not getting much traction with customers nowadays. Customers with solar PV who are not still on a generous feed-in tariff will of course look to store energy that would otherwise been export at a small tariff to offset energy consumed later in the day. With current flat tariffs, that proposition is

[2] https://www.energex.com.au/residential-and-business/positive-payback/positive-payback-for-households/households

around 18c / kWh, still well below the cost of battery storage. This may change, of course, should the variable cost of energy present a greater margin over the cost of storage.

Interestingly, many customers are rewiring their homes to take appliances ***off*** the controlled load tariffs (around 18c / kWh) to use solar power that would otherwise only earn them around 6c / kWh. This is in fact a way of cheaply adopting energy storage.

In this case, the customer:

- Already has a grid-connected inverter in service, so connection is not an issue
- Bi-directional metering in place (other than NSW, which will change to net metering)
- Owns the system or has an ownership contract with a third-party.

In this case, no change to the current regulatory framework is required.

B. Customers purchasing storage in response to peak-demand & peak-shifting signals

At the moment, volumetric pricing signals are much too weak to support a commercial decision. Should tariffs move over time to, say, demand pricing, then the customer will require an installation much like (A) above, without the solar PV. In this case, considerations are:

- The network provided may consider tariff rules that restrict the impost of high charging loads in off-peak times
- The customer will most likely explore a suite of demand management options in conjunction with batteries, including 'smart' appliance control

In many cases with solar PV now, customers accept a 'zero export' limitation from the distributor, where the value of the embedded generator is adequate for the customer's economic purposes without consideration of the retail or network value of energy exported to the grid. In fact, 'zero export' is a favored position in many connection agreements for embedded generators. The same will apply for storage – customers are likely see the majority of benefit in investing in storage in peak-shifting, without the complexity, cost and limited commercial benefit of energy feed-in.

Again, none of these initiatives require regulatory change.

C. Networks being involved in 'behind the meter' storage

in the current regulatory environment, networks are conflicted in their approach to energy storage, as they are with grid-connected solar power. There are three factors in this thinking. One, in a regime where the predominant source of funding is the return of the investment in assets, a network owner is encouraged primarily to be involved in energy storage only as an opportunity to grow the asset base.

Secondly, networks are naturally very conservative, and tend to raise barriers to entry of new technology on the basis of load characteristics present 'a risk to the network'. This submission is not critical of this approach by distributors, however of seeking a return from 'both sides of the meter' raises questions of ability to manage risk, market power and customer focus should network owners be able to participate in behind-the-meter installations.

‘Behind the Meter’ is not a natural place for a network operator. Cross subsidies and complex, integrated customer connections contracts are likely, to the detriment of the customer and the storage industry. Customers will detect an obvious conflict of interest, given the inherent distrust of the energy industry.

Third, the ingredients of an energy storage capability already exist in the realms of embedded generation and demand management. A distributor and retailer essentially have two fundamental and legislated interfaces to manage the nature of devices the customer can connect to the network –

a) The technical conditions of connection, such as the Service and Installation Rules or the requirements for safe operation of an embedded generator, and
b) The price and inherent connection requirements that exist in a connection tariff and, if necessary, contribution to network augmentation.

It’s not the framework of the offerings that is the challenge, it’s how the connection requirements and the application of the tariff as applied by the market participants that are of concern.

Distributors, retailers and regulators should respect those relationships, and avoid implementing more regulation, requirements, rules and complexity into those requirements. Chapter 5A already provides a connection framework that (some may say poorly) addressed the connection of customer capability beyond that of straight consumption, and distributors have a tariff-setting capability, approved by the AER, to signal customer responses and manage the implementation of the tariff.

Frameworks already exist for the connection and tariff-setting of embedded generation (regardless of the source) and customer demand response. Any action by the AEMC and other regulators (other than for customer safety) should focus on improving these existing mechanisms. No ‘new regulation for energy storage’ is required.

End Users and Aggregators

Chapter 5a already presents a number of challenges for the connection of new customer technologies, in particular embedded generation. A prime example is the fact that almost all solar PV connection applications are considered ‘negotiated’, with the commensurate fees, variable outcome and extended time for a response proving a disincentive for customers take up new technologies.

When batteries become reasonable for customers, this type of connection framework will only heighten the level of frustration and distrust (through a perceived conflict of interest) between the customer, the installer and the distributor.

Consideration of how small energy storage behind the meter can be a ‘basic’ connection will greatly assist customers with surety and transparency, and remove (low priority) workload from distributors.

It is important to note that almost every energy storage system is likely to be considered an embedded generator, regardless of its intent or rating to export energy to the grid. From a technical standpoint, a storage system will incorporate an inverter that will either:

- Operate in parallel with the mains supply, as does a grid-connected solar PV system; or
- Operate as a changeover facility, providing a load-transfer or uninterruptible power supply capability.

In the latter case, the distributor (or the market, of that matter) has no jurisdiction over the installation other than the tariff conditions for the supply to the battery charger.

In the former, the existing situation regarding solar PV inverter connection will apply, as the storage is purely a ‘different source of energy’ to the grid connected inverter.

Hence the connection approval will need to consider the both technical impact of the generator on the network, as well as considering the impact of the battery charging load. The first issue is within the connection agreement, the second in the tariff rules.

A capital contribution regime is largely unnecessary for that vast majority of storage situations, as a demand tariff and connection adequate for charging will determine the nature of the connection. The fact that storage and feed-in from storage is involved is not material.

Response to Consultation Questions

1. (p13, connection processes) The connection processes for small embedded generators – which will be necessity be similar for storage - remains complex and difficult for customers. The intent should be that small energy storage systems should not differ too much to a customer engaging in most other forms of behind-the—meter demand management, where a customer is empowered to respond to network connection pricing requirements though a range of technologies and applications, of which storage is just one. However, as any inverter energy system has the capability of providing energy to the network, networks will exercise the similar concerns regarding barrier to entry for batteries as those that exist in solar PV systems.

   These barriers include technical requirements such as ‘zero export’ and a very risk-adverse approach by distributors as to the technical and commercial impact of embedded generation.

   The ‘soft costs’ of entry remain high, including:

   - Application, approval and administrative costs inherent in the ‘negotiated’ connection;
   - Varying technical requirements across jurisdictions;
   - Unknown approval outcomes based on low network data transparency for customers;
   - Limiting customer and installer innovation due to the complexities of working with a distributor on what could be a moderate - volume activity;
   - Considering the impact of hanging tariff structures as network conditions and regulatory requirements change, for instance increasing fixed connection charges;
   - Extended approval times, up to 60 days, as most applications are currently regards as ‘negotiated’ under the NECF framework; and
   - Poor levels of technical engagement by distributors.

Much if this has to do with the fact that distributors have little to gain from the changing customer consumption landscape, hence new connection entry other than new load is seen as a 'grudge purchase'. It is important to continue to consider the following as priorities in regard to the efficient connection processes for energy storage:

- Encourage a wider application of the 'basic' connection process to present more surety, confidence and timeliness of sales, design and implementation of energy storage;
- A common or harmonized approach across the NEM to the technical requirements of small grid-connected embedded generation, whether from solar PV of stored energy or stored energy;
- Recognition that many energy storage installations are no more than an extended demand management solution implemented by the customer; and as such regulatory involvement and distributor approvals should be kept to a minimum, focusing on grid safety and performance; and
- Require a review of network voltage standards by distributors to consider the impact of the changes in demand and customer load profile on network voltage planning, thereby permitting a more informed view to the impact of battery charging and generation.

(p13) DNSPs have a framework for pricing and peak-demand management in place already; whether it be purely commercial (time of use pricing, demand pricing, etc.) or connection-rules based (e.g. off-peak tariffs for hot water). The form of these mechanisms is adequate to maintain a storage response that is appropriate to the distributor. No more specific connection offering for storage is required.

Of course, how those mechanisms are applied will require review as part of the growth of energy storage.

2. (p15, industry standard)

An energy industry standard for the connection of small storage is definitely not necessary. Technically, it's the same as connecting a small embedded generator, which is already addressed.

As solar PV developed for small customers, the distribution industry attempted to cover emerging issues of power feed-in in different ways across the NEM. For instance, the issue of household voltage rise is addressed in the Service and Installation Rules in NSW, the customer connection contract in Qld and SA, and Victoria is relatively silent on the issue.

There is no doubt that a national or harmonized safety standard for grid-connected energy storage is urgently necessary, as existing battery standards such as IS61425:1999 or AS3000 do not adequately contemplate the application of energy storage in a residential or small commercial situation. Matters as simple as protection for the batteries from vehicular contact when installed in a garage are needed. Safety issues, clearly, remain the responsibility of state safety instrumentalities, however the preparation of appropriate standards for the safe installation of these devices needs to be started soon.

3. (p17, Aggregator)

The consideration of an aggregator can take two forms – that of a demand management aggregator, where control of storage can be seen as reducing the network loads of many customers; or as a source of energy into the grid.

If the first form was to work, then we would have seen aggregators successfully implementing DM solutions through load curtailment of machinery or water heating. This remains under the auspices of the distributor, as highlighted by the exception of load management capability to distributors in the recent metering rule change. To put it more bluntly, action to encourage storage as part of an aggregated demand response is the same action needed to make demand response work with other technologies.

Secondly, aggregation of feed-in control well exceeds the most likely customer value proposition for storage; that is, to shift cheap energy to a different (higher priced) time. The issues of high fixed connection charges, and the absence of non-market-peak based power purchase agreements will have to be addressed before aggregation of feed-in energy becomes practical.

The overhead of registration and administration of aggregation with AEMO remains as much an issue for solar PV as it will for storage. It is inevitable that the AEMC will have to soon consider the aggregation of community-based small generation ('microgrids'), where an aggregation of energy infeed from solar PV is 'retailed' to the local shareholders. The same issue will apply with embedded storage at multiple sites as a network management or energy adequacy tool.

4. (p20, AS4777)

   Australian Standard 4777:2015 is the appropriate requirement for a grid-connected inverter within a customer installation that incorporates a battery storage system. The ability to signal inverters to enter a 'control mode' for power output, power factor or frequency. What remains undefined, and with no clear mechanism, is the 'who', 'why' and 'when' and 'who gets paid ?' questions that are prevalent in customer's minds. Storage and PV though inverters represent a significant investment by customers, and come with an expectation of the commercial returns of the system. The implications of the control modes must exist in terms or tariffs, subsidies or other compensation to the customer.

   Similarly, there will be tension as to who invokes the control mode, as there is now with direct load control. A retailer may require storage to feed-in based on their purchasing situation, yet a distributor has primary concern about network voltage. The commercial and regulatory issues of control modes must be thought through as part of the consideration for customers, especially with storage.

5. (p21, FCAS)

   Of the over 4.0 GW of solar PV capacity already installed in the NEM, most has been installed with requirements that focus on the network connection. Voltage trip settings have focused on the protection of the low-voltage network, and frequency trip have been determined by local jurisdictions with little NEM-wide coordination. Fault ride-through has not been a major consideration.

   For instance, the fault ride-through performance varies from state to state, with low-voltage trip settings for the existing inverters as high as -12.5% in some stages. Under frequency trip settings vary across the NEM states, being highest at 48.5 in Powercor, and 48.0 Hz / 2 seconds in NSW.

The introduction of storage could be seen as a method of placing greater robustness into the fault ride-through capability of networks, rather than a specific FCAS market capability.

6. (p21, preliminary findings, connection)

I. Supported – the existing connection process for micro-embedded generation is adequate for circumstances where energy storage is connection. For feed in, the prime issue is the lack of commercial incentives to feed-in energy, as heighted in the number of investigations into a 'fair price for solar' currently under way. For demand management purposes, no additional offering is necessary. Most utilities seem to lean towards a 'zero export' connection option anyway.

II. Agreed. Harmonisation of connection standards for embedded generation, as for energy storage, is very useful. Most modern inverters will comply with AS4777:2015. The requirements for customers to actually activate the features such as power factor control, export limiting and dynamic controls will generate customer concern for storage, as it does today for embedded micro-generation. No commercial incentives for customers apply.

Connection agreements for anything but the smallest generators are generally classed as 'negotiated', with the commensurate complex connection process and risk-adverse position taken by networks. Generally, generators connected to the low-voltage network will strike technical limitations as to export capability well before commercial agreements for energy export become viable.

III. A wider demand-response market that includes all forms of customer load control, including energy storage and energy-feed-in, may be possible. However, the current relatively limited success of the new customers embracing the demand response market suggests further investigation is needed to in order to consider extension of the concept to a specific type of market participant.

Generally, generators connected to the low-voltage network will strike technical limitations as to export capability well before commercial agreements for energy export become viable. Such an agreement would most likely only be beneficial at the local low-voltage network level before the same limitations that networks see for high levels of solar feed-in become a concern.

IV. The issue of FCAS for distributed generation and storage is more a question of having proper 'ride-through' capability for network or generation contingencies (refer the HEPCO Hawaii experiences), as the ability for distributed generation and storage to have adequate co-ordination and control capability for FCAS response is unlikely to be economic.

FCAS and generator ramp-rate capability of larger battery storage systems directly connected to networks can be useful, such as in the US East Coast energy markets where a high penetration of utility-scale exists.

7. (p34, service classifications)

As stated earlier, networks already provide energy storage services to customers, through 'the biggest battery in the world'. Existing regulatory services are already provided by the network within existing frameworks. Battery storage at a distribution network level is essentially no more than an alternative to more traditional approaches to network augmentation to meet peak demand.

There are cases where storage will be more attractive than more poles and wires, such as the Ergon Energy GUSS initiative at grid fringe, where traditional network augmentation is very expensive.

Whilst trials by distributors are attractive (refer UE example, p45), appropriate pricing signals to customers to incentivise appropriate behind-the-meter energy efficiency and peak load shifting are more effective, as the beneficiary directly carries the cost.

8. (p59) Preliminary Findings – Networks Integrating Storage

I. Supported – It is agreed that existing service classifications will incorporate energy storage. Behind the meter installations that benefit the entire 'value stack' for customers should be contestable and ring-fenced from network businesses.

II. It is agreed that networks should be able to consider energy storage and other 'non-traditional' ways of addressing network limitations as part of the existing RIT-D and similar processes.

9. (p65, control as a barrier)

The customer is empowered to take all reasonable actions to manage their energy costs, and the installation of energy storage is part of the overall action. Some businesses, particularly retailers, will seek to use energy storage as a device for the customer to enter into a longer term contact that is more attractive to the retailer and, hopefully, the customer.

Under NECF, it will be necessary to contemplate the customer's rights where a decision to switch retailers, or in the case of a complaint about a retailer, that the complaint could involve issue beyond the actual sale of energy, billing or connection. NECF will need to be reviewed to ensure that these attractive 'value added services' are seamlessly integrated into the upholding of customers rights in their relationship with the retailer.

In addition, the matter of demand control remains complex. Networks will rightfully uphold their right for control of a customer's load under a network tariff agreement. This concept can be extended to extended to new network tariffs that customers can voluntarily take up, where those tariffs include an element of load control by the network operator. The energy retailer, however, will be required to reasonably reflect those control tariffs through to the customer through the retail bill.

Attachment 1 – About The Customer Advocate

Mike Swanston is the Managing Consultant for **The Customer Advocate,** an advisory body for energy consumers, grid operators, governments and regulators, with a passion to encourage and support the changing needs of energy consumers.

Our mission is the development of simple and engaging strategy and policies to effectively adopt new technology, provide intelligent and empowering tariffs and energy prices, with a focus on just plain old sensible, simple and efficient customer service.

Skills & Experience:

Mike is a professional engineer with over thirty years of experience in the electricity industry, crossing the boundaries of technical design, field operations and, for the past ten years, into the realm of renewable energy and Advocacy for energy customers.

The most recent experience in the electricity industry was as Customer Advocate within the Customer Services Team at Energex in South-east Queensland. Taking engineering skills - which include the role as Network Operations Manager and Network Development Engineer - into the world of government policy and customer advocacy, Mike led the strategic integration of renewable energy policies into Energex.

Earlier this year Mike recently returned from Germany and California following discussions with manufacturers, utilities and regulators regarding the connection of behind-the-meter renewable energy generators and energy storage. This was followed by some time working with the International Energy Agency in Bangkok regarding the issues associated with the high penetration of generation and storage in advanced electricity grids.

Mike is conversant with the current and proposed versions of Australian Standard AS4777, as well as related standards and industry practices on the installation of PV systems and inverters, stand-alone systems and battery installations. Mike presents at workshops and professional development days on the impact and requirements for inverters to consider PV impacts at both a grid level (frequency load rejection) and local distribution (voltage, quality of supply, safety).

Until his recent departure from Energex, Mike was a member of the Queensland Energy Ombudsman Advisory Council since the inception of the scheme, and has presented a number of discussion papers on consumer-oriented subjects such as the empowerment of the energy consumer and the effective commercial, technical and social integration of renewable energy.