EA networks
connecting our community

0800 430 460

22 JB Cullen Drive
Ashburton Business Estate
Ashburton

Private Bag 802
Ashburton 7740
New Zealand

eanetworks.co.nz

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Submissions
Electricity Authority
PO Box 10041
Wellington 6143

by email: policyconsult@ea.govt.nz
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Submission on CRP6-002 Sharing control of load between distributors and others

Thank you for the opportunity to provide feedback on the Electricity Authority's (the Authority) Code review proposal 2 in Code review programme #6. Our submission focuses on CRP6-002 - Sharing control of load between distributors and others.

There are significant opportunities to improve the way we manage existing load that is subject to control arrangements, and also opportunities to derive benefits from new loads that provide a degree of flexibility without impacting on customer utility. We are supportive of initiatives to realise these benefits but concerned that if we are not careful, we may undermine the benefits that we are already providing to our customers if sufficient care is not taken to preserve the existing capabilities.

Current arrangements mainly revolve around ripple control of water heating. Over many decades:

- customers have invested in larger cylinders and bigger elements to take advantage of controlled tariff options,
- electricity distribution businesses (EDBs) have invested in ripple signalling equipment, control arrangements, and
- electricity retailers have maintained pricing plans and procured metering and switching equipment to participate in the control arrangements.

Prior to the default distributor agreement (DDA) being put in place, in 2006 the (then) Electricity Commission recognised the benefits of this investment and set up the "Existing Capabilities Working Panel" (ECWP) to explore the issue and provide a pathway forward where the current benefits would not be lost in the scramble for value stacking. The working group provided advice to the Electricity Commission on amendments to the Model Use of System Agreement to preserve the existing benefits, and this largely shaped the approach that we have in the DDA today. It is important that we don't forget this work and fall in to the trap that we sought to carefully avoid.

The ECWP also received legal advice on the property rights associated with managing load. That advice acknowledged that the customer owns the load, but must separately contract for the supply of electricity, and that service can come with options or conditions. Almost 20 years on and we still hear the phrase "the customer owns the load" as if it gives some inalienable right to an uninterrupted power supply that the customer can then choose to switch in exchange for some form of reward.

The Electricity Commission's work in this area was prompted by the actions of a start-up advanced metering provider. This provider sought to establish a lower cost solution to ripple receivers and displaced approximately 6000 ripple receivers, replacing them with time-based controllers. While this time-based control was aligned with typical peak periods, all were set to operate at the same time and dynamic control in response to other events was lost. This is a real world example of where an entrant has understandably acted to optimise its own costs, but done so without regard for the wider implications of its actions.

Managing hot water load is a lot more complicated than most people imagine. It's not just about turning load off, it's a lot more about managing when the load is on. While each controllable load will have its own characteristics, water heating has some unique characteristics that make it particularly challenging to manage well.

Summary of points

In this submission we ask that the Electricity Authority:

- Pause and consider the wider issue more comprehensively. We are concerned that the proposed tweaks to the DDA may undermine or extinguish existing benefits.
- Consider all controllable load and generation. Many of the issues raised in relation to water heating will apply equally to other controllable load.
- Think beyond EDBs and retailers. Any party can persuade customers to cede control of load and will usually not be exposed to the full gamut of impacts they cause. They will understandably act in response to their own financial interests and may drive costs into the industry that will ultimately fall to customers.

The remainder of this submission elaborates on the issues that support these points.

We have a lot more to lose than we have to gain

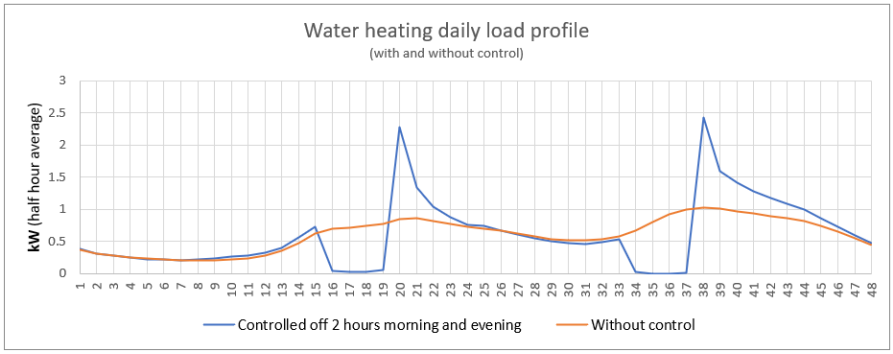
We ask that the Authority exercise caution in opening up controllable load to participants that have alternative motivations. Electricity distributors provide their delivery service to customers with very diverse usage patterns, and this diversity provides significant efficiencies, efficiencies which can easily be lost when load is managed.

For example, a residential house typically has a peak electrical loading of about 12kW, yet when it is in a group of houses, we only need to size the distribution transformer to provide 5kW for each house, at the subtransmission level it's 3kW, and on the national grid it's just 2½kW that's needed. It's the human diversity between usage patterns that provides this efficiency – we all do things at different times.

The very definition of managing load is centralised control that overrides this diversity. In the case of water heating load, the normal pattern for a group of customers is that at times of peak hot water usage, around a third of the thermostats will be turned on. If a load manager was to turn supply off, over time, more and more of the cylinder thermostats will click on, ready to reheat. Over a period of a several hours a point is reached where all thermostats will be in the on position (we call this the cool-curve).

Returning supply to that group of customers at that point will create a load that is three times higher than would ever occur naturally. So, while we might turn off an average of 1kW for every household in the group (a third of elements turned on), when service is returned we see 3kW.

To illustrate, the following graph is taken from actual meter readings for a large group of residential customers. It shows the impact of a relatively short 2-hour period where water heating load has been turned off (note that this is the electrical load of the water heater only, excluding the rest of the household).



It is very clear to see that managing load and eliminating the diversity can create spikes (the blue line) that are much greater than the load would be if we left it alone (the orange line). Good management of water heating load has the potential to remove 1kW of load per household. Poor load management runs the risk of instead adding 2kW.

Hot water load is just one part of customers' load where, if poorly managed, system stability can be placed at risk. The balance of customer load is of a greater magnitude, and if poorly managed, has even greater potential to cause system stability issues.

Undermining existing control systems

The graph above shows that exercising management of load has a subsequent effect on the amount of load that can be controlled. Our control systems model the load curve during the day (the orange line above) to estimate the response of each load group, the cool curve is modelled to know how much load will be restored, and the reheat curve is modelled to know how much load would be shed if a subsequent call was made.

It's important to know the amount of load that will be switched on or off to maintain a stable system. We don't have access to the state of each thermostat, and we can't see how much heating is required to bring each cylinder back up to temperature but, knowing how the load group has been controlled, we can reasonably accurately model the cool and reheat curves for the load group as a whole.

With multiple controllers, each additional controller would be affecting a subset of the wider load group, and the ability to model the combined characteristics (even if information is shared) becomes impossible. To share management of load, a lot more is needed than the "parallel control" mechanism that the Authority mentions.

In future, systems and communications might allow the state of each water heating system to be monitored, and the management of load could be optimised for each individual system, including in response to multiple load managers. However, that technology is not yet available.

Rather than a tweak to the default distributor agreement to open this up, we think that a more in-depth project is warranted to look at the wider issues and integration between those seeking to manage load.

Provide certainty

Many EDBs rely on access to controllable load (either pre or post contingent event) to meet their security of supply standards. With significant lead times to build the network alternative, and with the high cost and impact that would be caused if they fail to meet the security standard (for example, a widespread or prolonged outage), engineers become wary when access to tangible controllable load is challenged.

We observe that the current uncertainty and threat to management of water heating load that has persisted over the last 20 years is affecting investment decisions. We think twice about investing in new ripple injectors where they might become redundant before they reach end of life. We have adjusted our design standards to accommodate higher loadings that might occur on our low voltage networks.

Without access to current controllable load, we will need to invest more. Once we have made that investment, the opportunity to avoid it is lost. We can't unbuild our network to regain the efficiencies that might be lost.

It's wider than water heating, and beyond the EDB/retailer relationship

The benefits of diverse customer behaviour extend to all types of load, even to contributions from generation or batteries. New entrants seeking to control load will unavoidably affect this natural diversity. While they may derive a benefit in the market they are operating, they may also drive additional costs into distribution businesses. In many situations, these additional costs will not be borne by the new entrant, but will ultimately fall to our customers, one way or another.

This issue can be addressed with cost reflective pricing, but the level of complexity needed to capture and communicate cost impacts to customers is well beyond our current approach, and would come with significant challenges and costs that may outweigh any benefits.

A useful alternative might be to regulate to require retailers to impose restrictions on coordinated switching in their retail contracts with customers. This restriction might aim to ensure that any centralised management is via an approved scheme that conforms to a set of minimum standards or the relevant EDB's load management protocol (LMP).

We acknowledge that this is the reverse of the direction that the Authority is taking, where it seeks to open up the market for managing load. However, we think it is important to address the risk of adverse impacts on customers.

What we provide now

Acknowledging that options vary across regions, it's useful to understand what is currently offered to customers in the water heating realm. It's important to consider how the changes to the DDA will impact our ability to maintain these options.

Option	Service description	Suitable for
Night only	The EDB switches the water heater on for 8 hours each night. The EDB can adjust the times to manage the turn-on load, and can also interrupt the load in emergencies.	The largest water heaters which can meet household hot water needs for an entire day. This option pushes all water heating load into the night period, and the element needs to be sized to fully reheat the cylinder in an 8 hour period.
Night boost	The EDB switches the water heater on for 8 hours each night, and then provides a 3 hour heating boost during the afternoon. The EDB can adjust the times to manage the turn-on load, and can also interrupt the load in emergencies.	Larger water heaters which can meet household hot water needs throughout the morning, but need to reheat to meet demand in the evening. This option pushes approximately half the water heating load into the night period.
Controlled supply	EDB chooses when to provide heating under a service level target. Typically, this specifies that heating will be provided for (say) 16 hours per day. More sophisticated service levels specify that power will be on for 4 hours in any 8 hour period.	Water heaters which are sized to provide sufficient hot water for a 4 hour period, and where the element is big enough to reheat the cylinder in 4 hours.
Day / Night	This provides a pricing incentive to shift water heating load into the night period. Customers can elect to use the switching options above to shift load, or can control their own load (for example with a smart switch and phone app).	Situations where a customer needs more flexibility to tailor a solution to meet their own needs, including where the hot water demand may fluctuate (and can be used as an uninterrupted water heating supply).
Anytime	Uncontrolled water heating	Situations where a customer has a high demand for water heating and does not wish to have an interrupted supply.

The price-service offerings for customers are established and mature. This is not a new frontier, and we are not starting from a zero-base. The industry has been active in this space for more than half a century.

As technology advances, regulatory settings are needed to preserve the options and benefits that we already provide at the same time as providing opportunities to enhance the options available to customers.

Responding to customer complaints

Currently, where one party is managing a water heating load, that party must respond when the control adversely affects a customer's service. It is often difficult to diagnose if the issue is caused by signalling, a receiver fault, an electrical fault within the customer's premise or a plumbing fault. The issue could also simply be a symptom of changing hot water demands, where the customer needs to transition to an alternative option that provides more heating.

If we allow multiple parties to control load, then the adverse impact may be caused by a combination of the control exercised by each party, rather than by any one party. Without a centralised coordinator, diagnosing and resolving issues where services to customers are impacted becomes a lot more difficult.

As a real-world example, several years ago a customer raised a no-hot-water complaint. The retailer replaced their ripple receiver twice, the EDB's power quality team took measurements at the property for signal strength and interference. The problem continued, and a subsequent inspection found that a controller for a solar water heating system was the culprit – we spotted that a device in the hot water cupboard was reading 5am during a visit in the afternoon. The power to the property had been turned off for renovations, and when it was reinstated the timer on the solar controller was not reset. The solar controller was intended to turn the water heater off all day to allow for solar heating, but was instead turning it off all night when the ripple control was turned on. In this situation, the retailer and the EDB incurred considerable expense rectifying the situation, and the customer experienced several weeks of very limited hot water. The solar installer was not impacted.

Water heating is a simple load to control, yet problems are already complex to resolve. The complexity that is added when multiple controllers are in the mix should not be underestimated, both in terms of the added stability risks, and the additional costs that it brings.

Customised service offerings

Through its pricing work, the Authority promotes the provision of customised service options to meet customers needs. One of the ways that EDBs do this is through non-standard new connection agreements where a customer might elect to have a cheaper new connection option in exchange for a lower service level. This can sometimes be provided in conjunction with an interruptible arrangement, where the customer agrees that the EDB can turn off part or all of the customer's load in a contingent event.

To provide these arrangements we need to be sure that regulation will not cut across contractual access to interruptible load. We acknowledge that the customer might find alternative value in responding to an alternative load aggregator, but this needs to be an additional response, rather than an alternative response.

Concluding remarks

The Authority's decisions in this area will have system wide impacts, will create winners and losers, and may drive unintended costs that customers will ultimately bear. Thank you again for the opportunity to provide feedback. If you have any queries regarding these comments, please feel free to contact me on 027 248 8614 or at anisbet@eanetworks.co.nz.

Alex Nisbet
Pricing Manager