Submission to: Targeted Reform of Distribution Pricing Issues Paper

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Introduction to solarZero, its technology and how the technology is being deployed

solarZero has around 11,000 solar and battery systems installed on households across Aotearoa New Zealand. We are installing over 400 per month and aim to get to 100,000 systems by 2030. Panasonic is solarZero's technology partner.

The systems collect data on a range of parameters every 5 minutes giving an unparalleled view of household demand and conditions on the electricity network, such as voltage. We can control the battery systems, within seconds and can (and do) respond to dispatch instructions sent by Transpower or a lines company.

Each system has a micro-computer (ICON) that is designed in New Zealand and the software is also developed in New Zealand. The ICON provides the communication gateway to the inverter and provides data back to the servers. It sets the charge/discharge cycles for the battery. These cycles are developed in the cloud via machine learning and the cycles sent to each individual battery system. All software updates are over the air (wifi with cellular backup).

Since October 2022 solarZero has been in the reserves market in New Zealand providing fast and slow response to a frequency event. The ICON monitors frequency every 30-40. This is the first time globally that distributed batteries have provided reserves.

solarZero is the sole provider for two non-network solutions: Upper Clutha and Coromandel. These are the only non-network solutions in New Zealand and both are world leading. The solarZero systems are visible in the lines company control rooms and can be dispatched by them. The Upper Clutha project aims to defer a network upgrade. The Coromandel project provides contingent response.

This winter solarZero is piloting with Ara Ake an innovative "winter peak product". At peak demand times when there is a shortage of electricity and prices reach a particular threshold (designated scarcity price in the Code), the solarZero fleet will be dispatched by the system operator as dispatch notified load (DNL). To our knowledge this is the first time globally that distributed batteries have provided this service as a price-dispatched resource.

An aim of solarZero is to ensure the energy transition is just. An innovative financial model is at the heart of the solarZero system. Uptake of solarZero systems is flat across the deprivation index. What this means is that the uptake of solarZero systems is the same in lower socio-economic areas as it is in higher socio-economic areas.

Focus of submission – residential, peak and off-peak

This submission focuses on residential pricing. Unless otherwise stated the term "pricing regime" (or similar terms) refers to residential pricing. This submission only covers peak and off-peak pricing.

Example of problematic lines pricing regime

A community-owned lines company covering one of the poorest areas of New Zealand has a very high fixed price and a low kWh price. The area has a mixed socio-economic profile with wealthy people building large houses with swimming pools, spa pools and have EV. The lines company is investing to meet increasing peak. In this true example, the poorer people are subsidising the rich as a consequence of the lines pricing regime. Further, the investment is inefficient with almost no incentive for the wealthier households to run their pool more at night/charge their EV at night etc. The pricing regime makes everyone poorer because capital is not efficiently used with the impact being most felt by the existing less-well off people who in effect are subsidising the new wealthier people moving in.

This kind of lines charging regime needs to change if the energy transition is to be just and cost effective.

Residential batteries, hot water and load control

On average hot water control is around 350W per house. We base this number of the observed hot water usage across houses with solarZero systems. Hot water load is one of the parameters solarZero system measures.

A solarZero residential battery system can provide around 4.6kW to the power system, i.e. a battery is greater than **10 times** more effective at helping manage peak (via injection of power) than hot water control. If, for example, 80% of households have hot water load control then the same electricity-system impact will be achieved by 8% of households have a controllable battery system. In addition, we can also control hot water load.

In effect, the battery is just another household appliance to be managed. The computer that controls the battery can also control other loads in the house that have wifi functionality. Appliance manufactures are now starting to add wifi functionality which will further increase the amount of load that can be controlled in a household. EV charging is another obvious load in the house that can be controlled, which the solarZero system has the capability to do.

The solarZero system provides visibility of household load in real time and the amount that can be managed at any time. The system moves away from the “large numbers principle” that lines companies use to estimate and manage hot water load. What is possible now is precise management of household batteries and (in the future) other loads in near real time, with high precision in terms of location and load reduction/amount of injection at the household level.

Taking the concept of ripple and hot water control into the 20th century

As is suggested in the issues paper, there are opportunities to improve the efficiency of the distribution networks. Technology such as batteries and smart control of loads can substantially improve the efficiency of the power system by reducing peaks and using power during troughs. Lines companies have in many cases used existing technology, mainly hot water ripple control, to great effect. New technology can massively improve on ripple control, i.e. take the ripple hot water control concept into the 21st century.

Figure 2 in the issues paper identifies that there are differences in the implied LRMC for hot water control and time of use pricing. This difference we assume is a consequence of lines companies having more control and visibility (even though the visibility is via large-numbers estimation) and therefore certainty of hot water load control. As expected, lines companies acknowledge and reward certainty.

Distributed energy resources can provide excellent control and reporting – substantially better than hot water ripple control. The game changer is moving from a model of large numbers of hot water systems with no real visibility (only visibility based on a big number estimate) that on aggregate provide a known response to a potentially smaller number of systems that have excellent visibility and a known, highly predictable response. For example, Aurora Energy has visibility of the solarZero battery systems in the Upper Clutha area and can control them.

DER, such as batteries, EV chargers and heat pumps can be very accurately controlled in space and time, and the availability and impacts of control reported back to lines companies in near real time. This level of certainty and reporting must be worth more than the certainty/reporting associated with hot water control.

Three types of residential rate

Currently lines companies essentially provide two types of pricing for residential rates:

- Uncontrolled which increasingly has a time of use component. Lines companies potentially believe that a ToU rate does not provide the certainty associated with a controlled rate and therefore value it less (Figure 2 in the issues paper) than a controlled rate.
- Controlled. Lines companies have greater certainty about the outcomes of hot water control and therefore value this more highly than ToU rates (As per Figure 2 in the issues paper),

We propose a third: "VPP" or "Flex" rate. This rate would be used to signal the need for flexibility services in a geographical area. A VPP/Flex rate could have a set of requirements that provides greater certainty, better spatial and temporal control, and better reporting than hot water control. The value of VPP technology must be even higher than the value of hot water control technology because of the greater certainty, controllability and reportability. The VPP rate would more strongly signal the need to change usage patterns and would more strongly encourage the uptake of controllable DER that can verify its performance.

Elements of the VPP/Flex rate would include:

- A higher differential between peak and off peak, reduction in fixed rate. The VPP/Flex rate incentivises the household to adopt flex technology.
- Payment to an aggregator. The aggregator would in turn have to agree to the devices being able to be controlled and provide visibility in near real time. We assume that lines companies will want to work with aggregators rather than working with each individual households. This payment incentives the aggregator(s)[1].

[1] A household may have a relationship with more than one aggregator, with each aggregator controlling different devices.

This VPP/Flex rate can be imagined as a “super” controlled rate. The rate should be put in place at least 2 years (ideally 5) years before the flex capacity is required by the lines company so that flexibility providers can secure resources in the area.

This third type would not supplant lines companies going to contract for specific flexibility services. However, it may reduce the need for specific contracts or push out the timeline for them.

Questions

Q1. Are there other options that you think the Authority should consider?

Q2. Do you have any comments on the options outlined?

The ideal is that the Authority has a clear, long term view on pricing that is largely agreed across the sector. Unfortunately, that clarity has not yet emerged and what we have seen in the past is changes in views on lines charging regimes. The electricity sector has now accepted that an energy transition is underway and has never occurred before. To ensure the transition is efficient the industry needs to ensure that the correct price signals are sent together with the appropriate options as discussed in the Issues Paper. We suggest a set of workshops for the industry to discuss and debate further with the aim of getting to a stronger shared view across the entire sector.

Q3A. Do you agree that a combination of TOU tariffs and load control (appliance) tariffs would be useful for the smart management of peak demand?

We suggest that there should be three categories of tariffs (see above section):

- TOU.
- Controlled, which will have a ToU component.
- VPP/Flex, involving a stronger ToU element (or similar incentive to the householder) and a payment to an aggregator on the basis of certainty of control and visibility.

As discussed, a house with a controllable and visible battery reduces peak by the equivalent of ten houses with controllable hot water cylinders. Further, the change in demand profile can be managed with much greater visibility and accuracy than hot water control. The certainty of the new technology should have advantages to lines companies and that certainty should be recognised and incentivised.

Q3B: Do you consider TOU pricing could have unintended consequences for congestions on the LV network?

We assume this question refers to the end of a peak price spell, for example, EV chargers all starting in a very short space of time creating a significant ramp. solarZero can manage battery charge, discharge, EV charging and similar. For example, we can randomly stagger EV or battery charging over a half hour time frame or longer, thus reducing ramp rates as seen by a network. Again, something to be discussed at a workshop.

Q3C. Do you consider that use of shoulder pricing as part of the TOU price structure could be an effective way to mitigate this risk? What other ways could be effective?

As above.

Q4. Do you agree with the assessment of the current situation and context for peak period pricing signals? What if any other significant factors should the Authority be considering?

As per paragraph 4.26 we consider it inconceivable that residential networks will not be challenged by EV charging and the general electrification of the economy. Therefore, TOU pricing should be the norm.

The only other significant factor that the Authority should consider is the VPP/Flex rate as discussed above.

Q5. Do you agree with the problem statement for peak period pricing signals?

Yes. Succinctly and accurately stated in two paragraphs. Well done.

Q6. Do you have any comments on the Authority's preferred pricing for peak periods?

Again, paragraphs 4.29 and 4.30 are very clearly articulated and accurate. Point 4.29(d) is critical. We would like to see that topic explored with the industry as discussed above with the idea of a VPP/Flex rate being a key part of the discussion.

Q7. Are there other options you think the Authority should consider for improving peak period pricing?

Q8. Which if any of the above options do you consider would best support distribution pricing reform around peak pricing signals and why?

An additional suggestion to the options listed: It should be possible to develop an assessment of how efficiently the network is being operated, for example, the difference between peak and average demand at a GXP or feeder level. These measures could then be published by the Authority and the relative operating efficiency of each network (or area of a network) could be assessed, in terms of the way the network is being utilised. This ranking, based on data and an agreed methodology, may be a way of highlighting differences in efficiency across networks or parts of networks.

Q9. Do you agree with the assessment of the current situation and context for off-peak pricing signals? What if any other significant factors should the Authority be considering?

Q10. Do you agree with the problem statement for off-peak price signals?

Yes to both questions. Nothing more to add.

Q11. Do you have any comments on the Authority's preferred pricing for off-peak usage?

No – the issues are clearly canvassed.

Q12. Are there other options you think the Authority should consider for improving off-peak pricing?

Q13. Which if any of the above options do you consider would best support distribution pricing reform around off-peak pricing signals and why?

We have no comment on the options.