Meeting Date: 22 February 2024

INCENTIVE GAPS IN THE ELECTRICITY SECTOR

SECURITY AND RELIABILITY COUNCIL

This paper introduces a presentation from SRC Member, Barbara Elliston on where attention is needed to promote positive decision-making and behaviours that support power system security and reliability.

Incentive gaps in the electricity sector

1.1.1 Long-standing SRC member Barbara Elliston has kindly agreed to present a paper aligned with the theme of future power system operation.

1.1.2 The paper, entitled ‘incentive gaps in the electricity supply environment’ offers a member-perspective, which challenges the reader to consider the rapidly evolving power system with aggregated and disaggregated two-way power flows and considerable demand-side (consumer) input and choice.

1.1.3 The paper questions whether the right incentives are in place to engage consumers, regulators and policy writers to understand and address the needs of such a system.

1.1.4 The paper notes the importance of a roadmap to demonstrate both the path ahead and the roles to be played to achieve it. Notably for the latter, the need to look beyond the traditional participants toward incentives for both consumers and prosumers. In the paper’s view, such investigations need to expand beyond incentives around time-of-use and must enable future technologies aligned with future consumer choice and patterns of use.

1.1.5 The paper cautions the considerable safety aspects arising from consumer electricity participation independent of the grid, and the need for a regulatory framework that supports alternative supply resilience.

1.1.6 Members are encouraged to consider the issues raised in the paper and bring their perspectives to the meeting for sharing and discussion. Member suggestions about how the secretariat can include these issues in the forward work programme are also welcome.

1.1.7 Barbara Elliston will present her paper and be available for questions. At members’ request we have included additional time for discussion for this item at the meeting.

Questions for the SRC to consider

The SRC is asked to consider the following general questions.

Q1. What are members views on the issues raised in the paper?

Q2. Does the SRC wish to hear from other presenters on these issues, as a follow-up paper or presentation at a future meeting?

Q3. What further information, if any, does the SRC wish to have provided to it?

Q4. What advice, if any, does the SRC wish to provide to the Authority in the light of issues raised in the paper?

Appendix A: Incentive gaps in the electricity supply environment

Incentive gaps in the electricity sector

Electricity supply is a service which requires a seamless physical interface between generation (prime movers), transmission (national grid), distribution (network assets) and retail (metering). These physical assets have been in place prior to the establishment of the financial and contractual arrangements present today, albeit the newer physical assets have advanced control, better information, high tech communications, and more standardised protocols etc.

The whole system works together to give a very reliable power supply to power consumers throughout the entire power system.

The oversight by both the Commerce Commission and the Electricity Authority seek to address competition issues and system operations to ensure that consumers receive their electricity service at least cost – within the constraints of the current infrastructure and system architecture as we know it.

If the sector was not changing (physical generation/transmission/distribution/settlement as they have been historically), and if technology was not changing (away from dumb appliances and electro-mechanical components and control), then the current system infrastructure and architecture would be fit for purpose.

Instead, we have firstly a situation where large and small consumers can now generate power at the point of use and export any surplus into the distribution as well as transmission networks. This directly affects system architecture design principles, driving "reverse" power flows for legacy equipment that was never designed for bi-directional power flows. As an example, the broader distribution system consists largely of transfomers with fixed "tap changers" having set points which assume that voltage falls from the supply system towards consumer premises, and a physical site visit is often required to change these set points. There are thousands upon thousands of these in the networks.

In addition, consumer appliances - from residential equipment such as reverse cycle air conditioners and heat pumps, lighting, refrigeration, electronics within numerable household items, information technology and communication, right through to industrial plant with PLCs (programmable logic controllers), solid state switching equipment, switch mode power supplies, industrial automation, and demand side response able to interact with the electricity market - all impinge on the clear incentives and accountabilities previously able to be applied to the supply side of the sector alone.

All of this equipment (generation at point of use as well as equipment which are "smarter") can, and in some cases already have, become part of the infrastructure of the power system, and fundamentally should also be taken into account in a new paradigm towards system architecture.

There is now substantial demand management that commercial and industrial customers can provide. The incentives in place in the current market design lean towards provision of more capacity, with provision of demand management being accommodated by modifications to existing rules. If we had demand management services right from the start of the market, a more balanced

approach between demand and supply side would likely have been the case. The market is not really set up to encourage this participation.

This also means the incentives (and accountabilities) should no longer be applicable only to the traditional electricity market participants, but on the demand side as well, to ensure a power system that is not only lowest cost but fit for purpose.

This requires is completely different way of thinking – not just a tinker of what is there now. A roadmap to the destination is required, as it may take at least a decade if not longer due to the long lives of assets in the power system.

The incorporation of the demand side into the electricity "supply chain" has not had the attention it deserves while the regulatory regime is primarily geared towards uni-directional power flows. There are no incentives at the consumer level other than time of use pricing to improve the overall economics of the electricity service as a whole, when we know that technological change will enable consumers to be fully integrated into the supply chain and driving costs down.

<u>Some examples</u>

1. EV charging/discharging and the electrical wiring standard AS/NZS 3000

EV battery charging has been a key concern of EDBs for some time. The issues of utilisation and overload management have been the key concerns.

However, as EV battery technology evolves, from a demand side perspective, consumers will want to use their batteries as an integral part of managing their own electricity demand, and rightly so when EVs batteries are already larger than those required for household distributed energy systems.

One of the first things to resolve is the allowance of greater swings in supply voltages from consumers with distributed energy resources – the regulated quality of supply needs to allow for the larger variation of +/-10% of 230V at the consumer premises. A large number of consumer appliances can accommodate this wider range now, but this relaxation needs to be formally signalled so that manufacturers and suppliers of long-lived assets that are built to the current narrower range of +10%/-5% can begin to change their products and have them electrically compliant to the wider voltage range over a known time frame. At the moment this particular issue has been taken inside MBIE, where changes to tree regulations also reside.

As the demand side becomes integral with the supply side, this is no longer "consumer issue" *per se*. They are no longer consumers only, but the new name "prosumers". The nature of the consumer has changed, and this has significant implications of how we should be treating them in the regulatory framework.

The change of mere power-taking "consumers" to active "prosumers" (capable of power-exporting and provision of voltage regulation) is happening already, with the likely outcome of lowering the cost of service to consumer premises, especially as better battery technologies with lower and lower costs gain market momentum. To really capture the economic benefits, consumers now need to be treated as part of the of the power sector. MBIE has no incentive to address this issue promptly, as achieving the lowest cost of electricity supply to consumers is not a key performance measure for MBIE.

Where should this issue reside, where the incentives to enable consumer participation and innovation can be best achieved? Should the Electricity Authority's terms of reference be expanded, with a specific requirement to incorporate the economic benefits arising from "prosumers" into market design initiatives?

A second aspect of the large EV batteries is that consumers now have the prospect of being able to provide electricity for themselves, even in a power cut. And rightly so: from an economic efficiency perspective, it would be non-sensical and economically inefficient to disallow consumers with significant EV battery capacities to be prevented from using them at any time, and especially when there is a power cut.

The electrical safety aspect of this consumer participation is daunting.

For this "innovation", a much more difficult asset issue needs to be resolved. Quoting Peter Morfee of Energy Safety, a member of New Zealand's electrical safety team within MBIE:

"*..if houses and light commercial and industrial buildings are going to be able to operate independently of the grid, then a whole new approach to electrical regulation and standards has to be put in place to include alternative supply resilience. As it stands today, the regulatory scope is confined to simply protecting the public from shock and fires. ….. Calculated into this will be the linking of IT and TT systems of supply as safer alternatives to MEN in connection with resilient installations.*[1]"

Explainer: the New Zealand wiring regulations use a fundamental earthing architecture called MEN – the "multiple earth neutral" system. Peter Morfee is alluding to a possible requirement to move to IT and TT earthing systems. This is hardware, not software. Any changes require a site visit, not an update from the cloud. To enable consumers to achieve security and reliability in an electrically safe manner, as technological advances provide the equipment to do so, a lot of time and resources would be required if even small modifications are required to the premises of the almost 2 million power consumers. Furthermore, this transition needs to have a planned sequence due electrical safety considerations.

This is a key security and reliability consideration – a way of achieving consumer security and reliability that is not through the regulatory framework applied to system operations, or SAIDI and SAIFI[2] measures scrutinised by the Commerce Commission, or any security and reliability overview from the Electricity Authority. It encourages competition to provide the quality, security and reliability desired by consumers.

Where in the regulatory framework should oversight of incentivising, or at the very least ensuring no dis-incentives to, consumer participation reside? More broadly, if bi-directional power flows are the likely outcome of technological advances, should consumers/prosumers be embedded into the regulations applying to the power sector, so that there are one set of coherent regulations from prosumers right through to the wholesale market?

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[1] *New Scope for AS/NZS 3000*, ElectroLink, Issue 159, January-February 2024, pp 4

[2] The measurement of SAIDI and SAIFI, a key regulatory compliance measure, may need to be reviewed also, if consumer premises are actively participating in the provision of power supply security.

2. V2G vehicle charging:

The EV manufacturers have recently begun to produce EVs capable of V2G. Currently there are no international protocols for allowing an EV to push power back into a power network. As New Zealand is not a manufacturer of EVs, we largely have to wait and respond to what the vehicle manufacturers end up doing. The questions of synchronisation and anti-islanding are relatively precise, and a technical solution will be forthcoming from either the manufacturers or third party equipment suppliers, just like the grid-connected inverters we currently have connected to the NZ power system.

What we shouldn't be doing however, is waiting to see what the impact is when the equipment becomes available.

We should be investigating what communication protocols we as a nation are likely to need, identifying a statement of needs through consultation now. The technical solution to getting a vehicle feeding back to the grid is a doddle compared with getting the electricity market ready to accept multiple consumer backfeeds, and the information flows required to manage these.

An example of this currently is the SolarZero aggregation of stationery batteries to bid into the grid. Can the market system we have accommodate not one or a few SolarZeros, but potentially tens or hundreds of them, in order to harness the capability of hundreds of thousands of EVs and multiple aggregator service providers?

This issue is likely to impact on metering service providers due to the information requirements of the V2G function and associated settlements.

The consultation would need to include consumers, metering providers, network operators and network owners, regulatory bodies and likely others. A statement of needs should at least identify any complexity or roadblocks to V2G.

This isn't a wholesale market issue nor a retail issue. However, it does have significant economic efficiency implications if there is a delay to implementing V2G systems when the vehicle fleet have capability to do this.

Who should be accountable to undertake this work in a timely manner? Does it fit within the Electricity Authority's mandate?

3. Power system design aspects

Although our regulatory framework has clear demarcation between the aspects of generation, transmission, distribution and retail, the physical power system does not have any demarcation.

Physical power is generated, transmitted, distributed and supplied into consumer premises through a power system that has been designed to hold it all together, to provide electricity at a nominal 50 Hz sine wave, at prescribed voltages at supply points throughout the system. Most of the physical supply aspects are historic and were established prior to the electricity market we have today.

When the design parameters were put in place, the previous high voltage electricity department in its different re-incarnations undertook a number of power sector research and development projects resulting in the stable system we enjoy today. With the electricity market regulatory framework, we now have, such types of work programmes have been taken into MBIE.

The question arises as to whether adequate focus has been given to these issues by MBIE.

One example is an issue recently emerged to do with the rejection of a wind farm application. Transpower rejected the South Island application because the wind turbines were of a design that cannot accommodate fault ride through when the frequency dropped to 45 Hz. The same turbine would not have faced this requirement in the North Island, where 47 Hz was the requirement. The rationale for the 45 Hz South Island requirement was to ensure that Transpower's own HVDC link is protected when the frequency dropped to this level. This topic arose because at a recent CQTG meeting (Common Quality Technical Group, Electricity Authority), widening of the frequency band for New Zealand as a whole was discussed, but the consensus of the CQTG group was that international turbine manufacturers were unable to make a compliant turbine if the fault ride-through frequency was 45 Hz. This is at odds with Transpower's requirement for the South Island.

The question arises as to what Transpower's incentives are to ensure that the power system develops in an optimal way, where manufacturers can actually make a piece of equipment that is able to comply with Transpower's connection requirements, on a level playing field? Does Transpower have the right incentives not skewed to its own assets?

Another question arises as to which statutory body has oversight of such decisions, so that an entity such as Transpower is being scrutinised adequately in these situations?

The above are some examples of aspects of the power system which require consideration as we move from the current uni-directional power system to a fully bi-directional one. The issues identified show that for different aspects of power system design or operation, there may be gaps where no one is incentivised to investigate, engage with, or remedy problems that are not directly under the regulatory oversight of the Commerce Commission or the Electricity Authority.

Undoubtedly there would be other similar areas where incentives to improve the power supply chain are missing.

When such a situation is identified, there needs to be a mechanism established that allows it to be raised and thoroughly investigated, and incentives and accountabilities established, so that the objective of providing consumers with the lowest cost of electricity at the quality they desire can be achieved.