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Consultation paper – The future operation of New Zealand's power system

Nova Energy ('**Nova**') welcomes the opportunity to provide feedback on the Electricity Authority's ('**Authority**') consultation on the future operation of New Zealand's power system. It is appropriate to conduct a high-level review of the power system operations at this time in anticipation of the level of growth and new technologies expected to impact on the industry.

Overall the consultation paper presupposes that there will be a need, and increased capability, to improve the centralised control of the power system. Nova proposes an alternative framework, one in which distributed energy resources ('**DER**') and home energy systems respond to market signals, voltage and frequency to reduce the reliance on central control systems. A brief description of the concept is provided in Appendix B to this submission.

Under this scenario, the regulatory and planning focus on maintaining system security at the distribution level should be on ensuring the appropriate commercial incentives are in place to encourage retailers and aggregators to develop and market suitable systems to consumers.

The System Operators role will remain pivotal to maintaining grid security and efficient dispatch of generation and reserves, but this will be much more straightforward if the distribution networks have smart systems embedded within them.

Nova's specific responses to the Authority's questions are covered in Appendix A.

Yours sincerely

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Appendix A

Nova submission: The future operation of New Zealand's power system

Q No.	Questions	Response
Q1.	Do you consider section 3 to be an accurate summary of the existing arrangements for power system operation in New Zealand? Please give reasons if you do not agree.	Section 3 provides a reasonable outline of the functional arrangements of the New Zealand power system. Nova agrees the "Power system operation in New Zealand will continue to evolve". Para 3.71 describes some futures for power systems operation where increased complexity leads to a need for increased control. Para 3.71(f) acknowledges that system operation may "evolve organically (through market innovation) and not require any of the above", but this idea is not developed further in the paper. Nova believes the power system can cope with increased penetration of DER without substantial changes to distributed systems operations (**DSOs**). A market economy is an example of a highly complex system that is not subject to central control. Nature also provides examples of complex decentralised systems that work very effectively[1]. It is Nova's premise that with increasing DER, smart systems and data handling capability, distribution networks can become more self-managing and resilient. The key to achieving this is to have appropriate incentives to install DER and home energy systems that respond to the network to which they are connected. Such system could reduce the necessity for instantaneous management of power-flows at the distribution level. Under this scenario, DSOs should be able to focus on outage management and points of network failure rather than needing to actively dispatch generation and demand response across their networks on a continuous basis.
Q2.	Do you agree that we have captured the key drivers of change in New Zealand's power system operation? Please give reasons if you do not agree.	Another driver of change impacting the market is the relative speed of building new generation and demand versus building new or upgrading transmission and distribution lines. This is putting pressure on Transpower and distributors (**EDB**s) to build capacity ahead of expected upgrade requirements, but without the certainty that projects will proceed.

[1] Refer to Appendix B

Q No.	Questions	Response
		If distribution networks can be made more robust by increased responsiveness of DER and home energy systems at a time when networks are under pressure from increased loads, then everybody gains.
Q3.	Do you have any feedback on our description of each key driver?	Nova concurs with the description of each key driver. Some of the elements within the drivers have a lower probability of having a significant impact on the market than others, but that assessment does not need to occur until specific actions are considered in support of them. "Key driver 5: Climate change and extreme weather events" provides a clue to the missing element in the Discussion Paper; i.e. the need, and opportunity, for increased resilience of distribution networks[2]. It does not take much technology for DER and demand response to respond to the 5-minute price at the GXP and voltage on the distribution network at the point of connection. So long as the right parameters are programmed into DER and home energy systems at the ICP level, demand at the ICP can be self-managed without requiring any form of control from a DSO. Safety considerations will also be an important consideration in the setting of regulations, given that with DER parts of a network may remain live even when isolated through switches or line outages.
Q4.	What do you consider will be most helpful to increase coordination in system operation? Please provide reasons for your answer	The primary requirement is that the different elements required are priced correctly and therefore provide the right incentives for development. This includes elements such as system inertia, reactive power, voltage support and provisions for load control where these are important for maintaining system security and operations. Many micro-systems can potentially contribute to grid stability if the right incentives are used to encourage their development. At the ICP level, such incentives should be managed through either the retailers' supply agreements or an aggregator of services. If the DSO is to directly control the customers DER or demand, then that should be a commercial arrangement with the retailer and settled between the retailer and EDB. Consolidation of EDBs (by way of either asset mergers or via operating contracts) would help create greater economies of scale at the DSOs. Unfortunately, we are unlikely to see greater consolidation and rationalisation of EDB activities under the current regulatory arrangements. Forcing consolidation or merging of EDB network operations would also not necessarily result

[2] The resilience of the Transpower grid is a separate issue.

Q No.	Questions	Response
		in improved efficiencies. There are many elements that need to be considered when making such decisions and the EDBs are best placed to make those decisions themselves.
Q5.	Looking at overseas jurisdictions, what developments in future system operation are relevant and useful for New Zealand? Please provide reasons for your answer.	Developments in overseas jurisdictions provide useful insights into circumstances that may arise in New Zealand in future, for example the impact of subsidised rooftop solar PV in Australia. While the Australian approach appears to be focussed on gaining greater control over DER through initiatives such as 'Project Symphony,' it is also useful to note that 'In the longer term the intention is to develop markets where DER, including rooftop solar, actively participates to provide services required by the grid'. Nova is proposing that New Zealand skip the attempts to control DER centrally and move directly to the longer term model of using DER to actively support the networks. It is notable that PJM is trialling paying V2G the market rate for grid support services and that this was valued at approximately US$1,200 per year per vehicle in revenue. Even if the value was much less in New Zealand, it would provide as strong incentive to adopt a smart EV charging system. With the growth in electric bus fleets in New Zealand there is an ideal opportunity to trial smart energy systems. The need for planning and scenario analysis is common to all markets given the pace of change to renewable generation and new sources of electricity demand. For instance, the growth in demand from data centres supporting cloud based software and AI systems is a comparatively new source of base-load demand that was barely recognised just a few years ago. Electricity markets in different countries also tend to have fundamental differences in their structure however, and solutions being adopted there will often have either little relevance to NZ, or reflect a level of political or regulatory involvement that New Zealand has deliberately chosen to keep to a minimum. New Zealand's extensive rural network, unstable landforms, and a dairy industry heavily dependent on reliable supply, calls for a significant emphasis in building resilience into electricity networks that a decentralised system could help support.
Q6.	Do you consider existing power system obligations are compatible with the uptake of DER and IBR-	There are aspects of the power system obligations that could be improved to better reflect the systems costs of different generation technologies, e.g.

Q No.	Questions	Response
	based generation? Please provide reasons for your answer.	• system inertia. While there is adequate system inertia in the system currently, the marginal value of this should be reflected in market prices well before it becomes an issue. • BESS dispatch and demand. BESS are capital intensive, and even with falling costs it is important that BESS can realise value from as many revenue streams as is practical. Nova notes the statement 'that enhanced observability and controllability of DER, efficient data exchange and the right level of transparency of data, and the existence of connected data hubs with non-discriminatory access for network operators, will be important in the future.'[3] This presupposes that DER operation must be integrated directly or at least controlled by the network operator. While it may be physically possible to extend centralised system operations and controls into the distribution networks, this risks adding excessive complexity for little gain. Notably in terms of: • Costs associated with the level of engagement required with consumers and DER owners, and • Increasing the reliance on communications networks and control systems, versus the alternative of self-correcting systems. Rather than trying to coordinate the whole system centrally, the system should be able to operate based on commercial incentives (price) and key power system parameters (voltage and frequency). Retailers engage with EDBs and their connected parties. Given that retailers are responsible for the costs and revenues associated with energy consumption and generation then they also should be the primary agent for communicating with the retail customer on the operation of their home energy management systems. (Parties should still be able to aggregate DER or flexibility capability and thereby overcome the cost overheads and make such responsiveness worthwhile.)
Q7.	Do you consider we need an increased level of coordination of network planning, investment, and	There is likely to be benefit in increased coordination of network planning and investment as embedded generation and demand grows, but it would also be beneficial if the system could operate at the distribution level with minimal centralised control.

[3] Para 5.29

Q No.	Questions	Response
	operations across the New Zealand power system? Please provide reasons for your answer.	The characteristic of power flows at many GXPs is be expected to change, with greater volatility, shifts between import and export, and changing power factors depending on types of generation and demand. Nova believes the EDBs have the best understanding of their local network and that they should retain control of their assets, rather than attempting to centralise services with the System Operator. That said, there also needs to be greater pressure on the EDBs to seek economies of scale where possible and to merge their operations rooms into regional DSOs where and when this makes sense.
Q8.	Do you think there are significant conflicts of interests for industry participants with concurrent roles in network ownership, network operation and network planning? Please provide reasons for your answer.	There are natural tensions at play in the different roles. While these may be resolved or balanced out internally, there will always be the question if decisions are made in the best interests for the consumer, or for the participant if their interests do not align. Given the parties involved are natural monopolies, and subject to pricing regulation, the most cost effective remedy is likely to be transparency. Separation of roles at the EDB level may bring about some useful consolidation of roles such as DSO, but it may also result in creating smaller and therefore costlier operations. The most effective tool for promoting cost effective EDB operations would be to allow the Commerce Commission to use benchmarking to ensure that EDB are operating efficiently on a comparative basis. This would place financial pressure on EDBs that could not achieve results comparable to their peers. A case could be made to require EDBs to map out their expected long term development plans and provide these to Transpower as grid owner. These would need to be updated on a regular basis and project out 15 years or so, i.e. beyond the current timeframes required by the Commerce Commission for regulatory purposes. Some EDBs no doubt already do so, but this should apply to all EDBs. EDBs would not need to develop those plans in isolation but could be expected to coordinate with each other or other parties to develop their projections. Transpower's 'Te Mauri Hiko' work itself provides a long term perspective that EDBs could use as a basis for their projections.

Q No.	Questions	Response
Q9.	Do you have any further views on whether this is a good time for the Authority to assess future system operation in New Zealand, and whether there are other challenges or opportunities that we have not covered adequately in this paper? Please provide reasons for your answer.	Given the extensive list of recommendations made by MDAG that the Authority is choosing to work further on, it is appropriate the Authority also maps out its priorities under the FSR work. Much of this work will also be important in ensuring the operation of the market is advanced in parallel. It is also critical that the appropriate technologies required to achieve a robust distribution system are defined now and regulated before the mass roll-out of DER, and in particular EV charging systems. Issues to be addressed can include access to instantaneous voltage and frequency data from AMI meters, minimum standards for EV chargers and BESS (which may include communications capability), and identifying and incentivising favoured home energy control systems. The Nordic countries provide an example where the need for smart EV charging systems and bidirectional V2G is regarded to be key to managing electricity demand. In the New Zealand market we are already seeing innovative solutions being offered at the retail level, for instance Octopus Energy[4] with its differentiated time-of-day energy buy-back rates, and the features of the smart EV chargers being installed by We.EV[5]. Such initiatives are totally consistent with incorporating DER and home energy systems that are responsive to network conditions.

[4] https://www.energynews.co.nz/news/electricity/156683/octopus-buyback-plan-pays-double-during-peaks
[5] A smarter way to charge (we-ev.co.nz)

Appendix B - Operating a decentralised electricity distribution system

Creating a nationwide electricity distribution system that operates in real-time, with small generation units and loads coordinating like schools of fish or flocks of birds, is concept worth further investigation. The intent is to create a system that is highly decentralized and dynamic, with each unit responding autonomously to local conditions such as voltage, frequency, and price signals. In concept this is much like individual birds or fish respond to their immediate environment, while units in the network still align with the overall objective of providing a high level of energy security to all connected parties.

Here is a conceptual overview of how such a system might work:

a) Decentralized Generation and Load Management: Each small generation unit, like a rooftop solar panel or a small wind turbine, would operate independently. They would generate power based on available resources (like sunlight or wind) and feed it into the local grid. Similarly, each load, such as a household or a factory, would adjust its power consumption based on real-time needs and electricity prices.

b) Responsive to Local Conditions: The operation of these units would be sensitive to local grid conditions. For example, if the frequency of the grid goes down, indicating a lack of power, nearby generation units could ramp up production, or loads could reduce consumption to balance the grid.

c) Price as a Signal: Electricity prices fluctuate based on supply and demand. Higher prices incentivize more generation and less consumption, while lower prices encourage the opposite. Price signals therefore help balance the grid in real-time without centralized control.

d) Advanced Metering and Communication: Smart meters and IoT devices can provide real-time data on electricity usage, generation, and grid conditions. This data can be communicated to the generation units and loads, enabling them to respond appropriately to current grid needs.

e) Machine Learning and Predictive Analytics: Advanced algorithms could predict generation and consumption patterns, further optimizing the balance between supply and demand. Machine learning could enable the system to improve its efficiency over time, learning from past patterns to better predict future needs.

f) Grid Stability and Reliability: To ensure stability, the system would need robust fail-safes and redundancies. This might include energy storage systems that can quickly release or absorb power to keep the frequency and voltage within safe limits.

This approach to grid management is akin to the concept of “swarm intelligence” found in nature, where simple agents following simple rules lead to the emergence of complex, intelligent behaviour. It represents a shift from traditional, centralized power systems to a more resilient, adaptive, and sustainable model.

Equipment and connection standards will be important in this context to ensure that consumers/prosumers don’t import and install types of equipment that disrupt rather than facilitate decentralised coordination. Care must be taken, however, that such standards do not go too far and become a barrier to innovation.