TRANSPOWER

System Operator Strategy

Phase 2 Consultation Paper: Draft Strategic Priorities

JUNE 2026

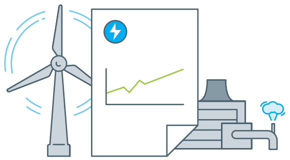
Contents

Our strategy on a page

PRIORITIES

Operating a secure, highly variable power system

Proactively manage system risk and limits to keep the power system secure and operable under increasingly complex conditions.

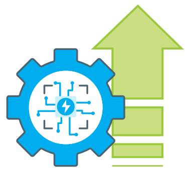


Efficient market operations and information provision

Efficient delivery of Authority market design. Inform development of future market design and security of supply framework to support the Authority's delivery of a competitive, reliable system.

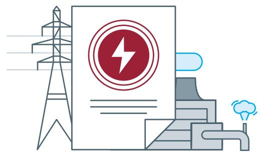
Evolving operational capability

Develop a resilient, integrated System Operator capability leveraging AI and digital solutions, that scales with system complexity and leads operational practice across the sector.



Leveraging data and distributed resource integration

Enable secure whole of system operation through shared visibility, common standards and data, TSO-DSO coordination, so that DER/CER can integrate anywhere without undue operational risk.



Strengthening industry resilience

Strengthen industry preparedness, coordination and restoration response for unplanned outages, as event frequency and severity increases.

HOW WE DELIVER

- Value for money operations
- Open, accessible communication and engagement
- Impartial and transparent decision making
- Collaboration with regulators and policy makers
- Agile change management capabilities

KEY PERFORMANCE INDICATORS

These will be developed with the Electricity Authority

Overview and approach

Transpower, as System Operator, is seeking feedback on its draft System Operator Strategy (SO Strategy). The System Operator plays a pivotal role in New Zealand's power system. We are responsible for maintaining power system security[1] and operating the wholesale electricity market in real-time, providing security of supply[2] information, managing supply emergencies, and ensuring the system remains stable today and in an increasingly complex and dynamic future. Our role also extends to supporting the government and Electricity Authority (the Authority) in designing market and policy requirementsthat ensure we transition towards a renewable, affordable, and secure energy future.[3]

This work is becoming increasingly complex as the power system evolves. System Operators worldwide are having to rapidly expand their understanding of new system dynamics as the supply mix changes to inverter based, variable renewable sources, and invest in data, systems and other capabilities to respond effectively. Electrification of new loads, in some cases very large loads like datacentres, brings a more sophisticated demand side that has different needs from, and can offer new opportunities to, the power system. The impact of this evolution must be effectively understood and addressed to allow Aotearoa to have the vibrant, stable electricity system it needs to support electrification of our economy and ultimately meet our emissions reduction targets.

The development of a forward-looking strategy for the System Operator is therefore very important. In times of increasing complexity and change it is vital to have clear priorities that will deliver robust outcomes now and provide optionality and agility to support future system needs. The SO Strategy therefore takes a ten-year forward view to set a clear direction for how the System Operator service will need to evolve into the future, and guide investment planning for the next three-year System Operator service funding period that will commence in July 2028.

All of this must be done with affordability being front of mind. While we do not have any ability to control electricity prices, the services we provide are fundamental to the delivery of an efficient, competitive electricity market. It is therefore important that we continue to invest in the systems, capabilities and processes that allow for efficient dispatch and vibrant competition from the demand and supply sides. However, we must also run an efficient operation so that we can provide an effective service while keeping our costs as low as possible. Finally, we must consider the impact we have on overall system costs through the obligations and requirements we may place on market participants to manage system stability. A careful balancing of the cost and risk trade-offs must always be part of our decision making.

Our proposed strategic priorities have been informed not only by our own experience managing Aotearoa's power system, but also extensive industry consultation and learnings from other markets. This industry engagement has been a critical part of the process as we have heard directly from those interacting in the power system about what it needs to be able to deliver now and into the future.

We now invite your feedback on this draft SO Strategy, including any comments you may have the strategic priorities, outcomes, strategic initiatives and other content presented in this paper.

1. System security refers to the ability of the power system to remain stable, secure, and operable in real time—maintaining frequency, voltage, and system integrity under normal conditions and credible contingencies. This can also be referred to as system stability.
2. Security of supply refers to the ability of the electricity system to ensure sufficient generation and energy is available to meet demand over time, including during peak demand and prolonged periods of supply stress such as a dry winter. This is also more broadly referred to as resource adequacy.
3. Refer to Appendix A for more information on the System Operator role.

1.1 Our approach to developing the SO Strategy

The development of our SO Strategy is being informed by two rounds of industry engagement. As noted, industry consultation is a new and important element of our strategic planning approach, ensuring that diverse perspectives from across the sector contribute to shaping our priorities. The approach we have taken is summarised in Figure 1.

In the first phase consultation, we invited feedback on a broad review of trends and influences in our sector. These were informed by our own experience and operational knowledge, international engagement with other System Operators, system events domestically and internationally as well as our risk management approach. In addition to the Phase 1 consultation submissions, we engaged with different industry stakeholder groups and participants in a series of workshops ahead of and during the consultation period. We have continued to evolve our thinking,and the development of this second phase consultation through a second round of stakeholder workshops over the last few months. The feedback we have received by engaging this way has been insightful, revealing significant cross-industry alignment while testing our thinking in several areas.

In this second phase of industry engagement, we now seek feedback on the draft strategic priorities. The feedback on this document will inform the final SO Strategy published later in 2026. The Strategy will then provide a foundation for our forward work and investment planning, including our proposal to the Authority for funding to cover Transpower's costs of providing the System Operator service from July 2028 to June 2031.

4. Te Kanapu I Transpower

Figure 1: System Operator Strategy development approach

Working together with other industry processes

This draft SO Strategy combines technical, market, and policy information to complement a range of existing and planned work programs. It considers both the scope of the System Operator's role and functions today, as well as contemplating the future needs of the power system, market and industry. As the analysis for our Strategy has contemplated the broader needs of the power system and stakeholders' own plans and strategies, we anticipate that our Strategy will feed into the Authority's work plan development and prioritisation process. Where we have identified issues that are not for the System Operator to progress, or require us to work with other parties, we have noted this for raising with those parties (refer to Section 4).

It is also important that the SO Strategy both considers and helps shape the industry's plans, as well as Transpower's Te Kanapu future grid blueprint.[4] These reflect a common strategic context – a rapidly evolving electricity sector in New Zealand. Te Kanapu focuses on how the transmission grid needs to evolve to support an electrified future, looking ahead to 2050. In contrast, the SO Strategy is focused on keeping the power system functioning over the next 10 years and in real time. Transmission is an important part of that operational perspective, but only one of many factors the Strategy must consider. Likewise, Te Kanapu will look to the SO Strategy to assess how transmission planning and operations may need to evolve to support a more complex, dynamic system. While distinct, the two workstreams are highly complementary.

1.2 We want to hear from you

We want to hear your views on the draft strategic priorities, outcomes and initiatives outlined in this consultation document, including whether they appropriately reflect the key issues and opportunities for system operations over the next decade based on the trends shaping our industry. We invite you to scrutinise our thinking and consider questions such as:

Strategic priorities:

1. To what extent do you agree with each strategic priority? Please explain your reasoning.
2. Are there any proposed strategic priorities that you consider more important than the others, and why?
3. Do you agree with how the five strategic priorities have been defined? Are any priorities missing, are there any overlaps, tensions or trade-offs that need to be better addressed?

Outcomes and initiatives:

4. For each strategic priority, do you agree with the proposed outcomes? Are the outcomes sufficiently clear and measurable?
5. We have provided a program of proposed initiatives under each of the priorities. Are there any additional or different actions lthat are needed to achieve the intended outcomes?
6. Are there priorities or initiatives in this Strategy where the System Operator role needs to be expanded, reduced or clarified to deliver on the strategic priorities?

Implications and implementation:

7. What do you see as the key barriers or enablers to delivering this strategy (e.g. effective communication and engagement, enduring collaboration with regulators and industry, data access, capacity and capability, investment and funding)?

These are only a guide however and we welcome your feedback on any aspect of the draft Strategy.

How to provide feedback

Please send submissions to system.operator@transpower.co.nz. We will acknowledge receipt of all submissions. Submissions will be published on our website on our System Operator consultations page.[5] You can also contact us at system.operator@transpower.co.nz to arrange a group discussion or phone call to provide verbal feedback and we will ask your permission to record this as a formal submission response.

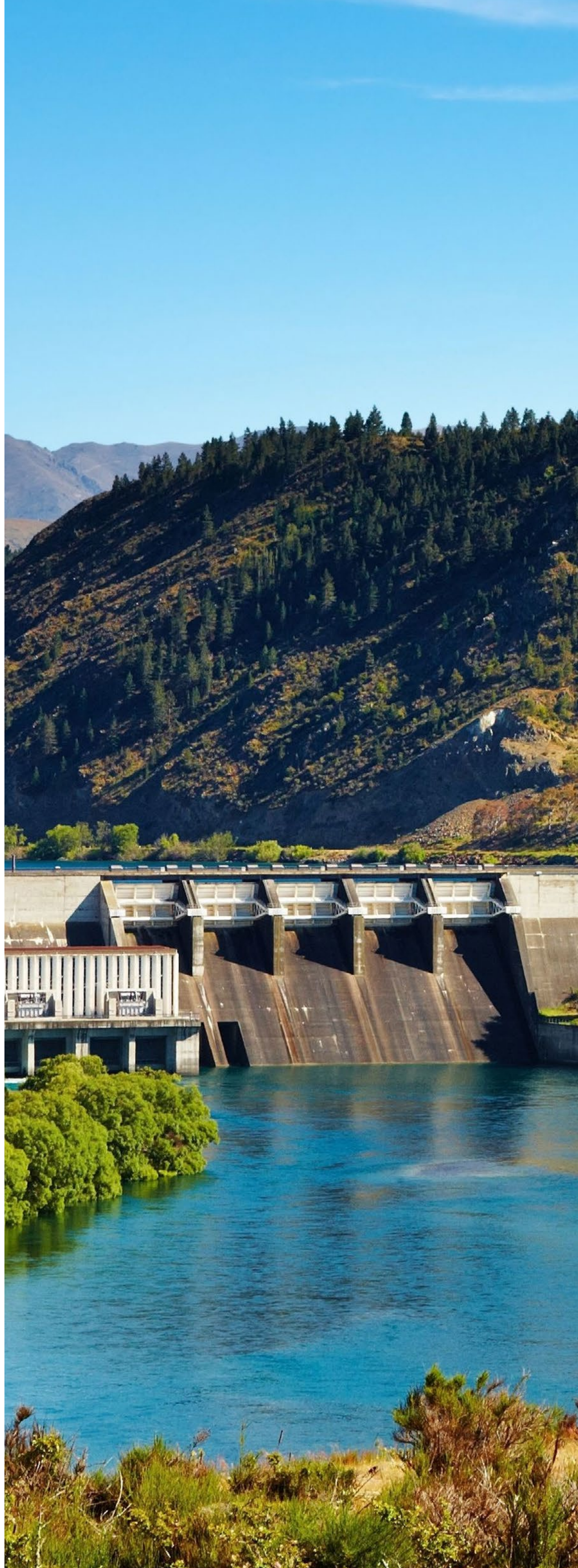
If your submission contains confidential material, please ensure this is clearly identified and provide a version of your submission that can be published.

Please note that all information provided to Transpower is subject to potential disclosure under the Official Information Act 1982. Clause 7.20(4) of the Code also requires that the System Operator provide a copy of each submission received to the Electricity Authority.

If you have any questions about this consultation, please also send them to system.operator@transpower.co.nz. Your questions and our responses to them will be published on our website for reference by other submitters and stakeholders unless noted as confidential.

Consultation closes at 5pm, 24 July 2026.

After considering consultation feedback a draft Strategy will be provided to the Authority before being finalised before end of December 2026.



5. System Operator Consultations | Transpower

A strategy to support a dynamic system

2.1 The context in which we operate has shifted

New Zealand's energy sector is undergoing transformational change that is unprecedented in pace, scale and complexity. Accelerating electrification across transport, industry, and households is expected to drive new investment and increases in electricity demand, while the generation mix is shifting rapidly towards renewable, weather dependent, and inverter-based resources. At the same time, distributed energy resources, such as rooftop solar, batteries, electric vehicles, and demand response, are expected to be material contributors to the electricity system. These changes are fundamentally altering how the electricity system behaves and how it needs to be operated.

In developing our Strategy, we evaluated the theme of change in our Phase 1 *'Trends and Drivers'* consultation,[6] which captured our own knowledge and operational experience, the key risks[7] in our risk register, recent work by others completed on Aotearoa's energy sector, and learnings from international jurisdictions. This was further informed through our deep engagement with stakeholders. This evidence supports our view of the key shifts and changes in system attributes that will impact on the electricity system, and informs the development of our strategic priorities.

Although the System Operator's core objectives and functions are enduring, we must adapt to our changing environment and be proactive in taking a more forward looking and adaptive approach. As change occurs, we must evolve our services to plan for and proactively respond to a range of complex issues, identify opportunities to improve, and prudently mitigate risks where we can influence.

During our Phase 1 engagement, we identified and consulted with industry on a set of trends and drivers that are likely to impact the operation of the electricity system over the next 10 years. The key trends and drivers from Phase 1 are outlined below. We have included feedback from industry on each area highlighting the key drivers that resonated most strongly during our Phase 1 consultation.

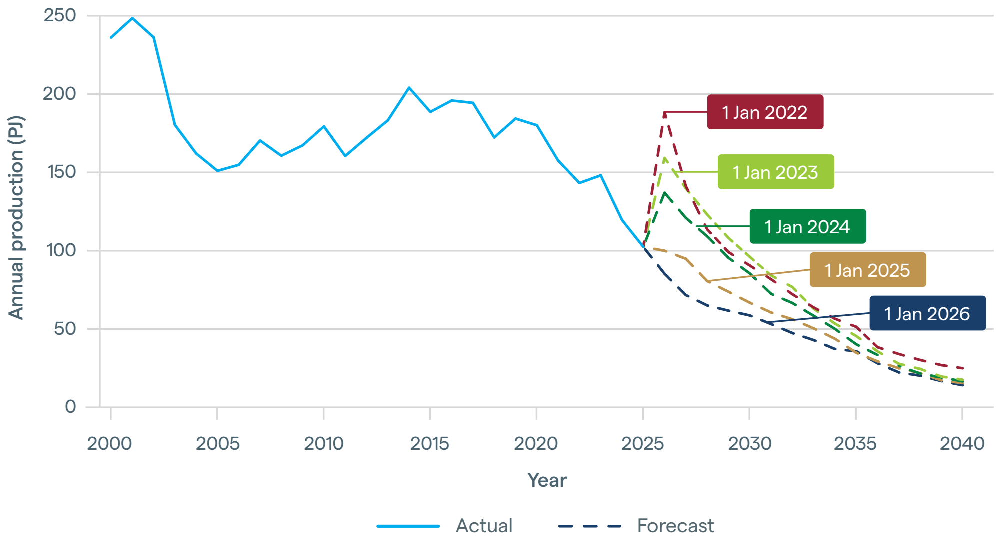
6. System Operator Strategy 'Trends and Drivers' – Consultation 1
7. Refer to Appendix C for a mapping of key risks to the strategic priorities

Political and regulatory environment

The global environment in which New Zealand operates is becoming more unstable. Global geoeconomic instability, supply-chain constraints, and competition for capital and equipment continue to challenge the energy sector. Here in New Zealand, there is increased political and regulatory emphasis on security of supply and market performance, while the pace of regulatory change continues to accelerate. Natural gas reserves declined by 43% between 2024 and 2026, materially increasing security of supply risk. The Government has announced that it is committed to establishing an LNG import facility to support energy security.

Consultation feedback
Focus on security of supply: This emerged as a central strategic issue for the sector, reflecting tightening fuel availability, dry-year risk, growing peak demand pressures and increasing public sensitivity to reliability and price outcomes. The conversation is no longer solely about delivering the transition at least cost; it is about ensuring the system remains dependable through that transition, including under stressed conditions. Stakeholders highlighted increasing real time and weather driven risks, and a need for clearer accountability and stronger system capability to maintain reliable supply. While the System Operator has a clear role for the provision of information, explicit accountability for delivering security of supply is not clear across stakeholders. For example, security of supply assessments signal a need, but do not carry triggering actions or outcomes that are required to address the need (e.g. obligations on participants, new ancillary services, system capability).[8]
Regulation pace mismatch with technology and system change: The system is changing faster than traditional regulatory cycles were designed for, and that gap is becoming a strategic risk in its own right. If settings lag too far behind technology and system need, investment slows, risks accumulate and the cost of later catch-up increases. However, some stakeholders believed regulatory change is too fast, fragmented, and uneven across the sector, with capability not keeping pace. There was no single consensus but all agreed that the value of regulatory change needs to be clearly articulated and the ability of different businesses to ingest this change needs to be considered.

Figure 2: Natural gas production forecasts



Source: Transpower analysis

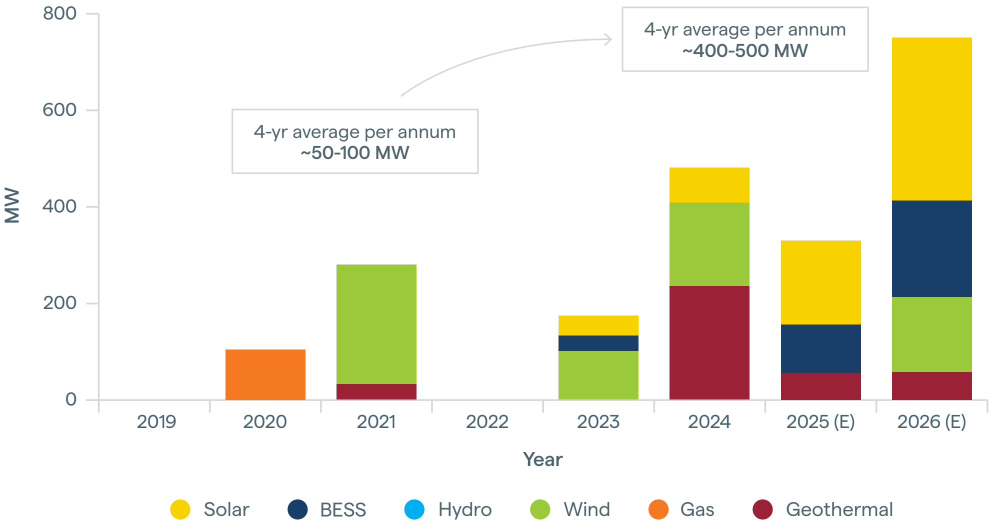
8. Note on 9 June 2026 MBIE launched a consultation on a new winter energy reliability obligation that would place new obligations on market participants to meet winter energy margins.

Economic and market changes

The electricity sector is undergoing rapid economic and market change as electrification accelerates and the generation mix shifts toward renewable and distributed resources. Investment in new renewable generation is increasing, while declining domestic gas supply and reduced availability of thermal generation are increasing reliance on renewable energy. Electricity demand is expected to grow over time, driven by electrification and emerging large loads, but growth remains uncertain in scale, timing, and location. At the same time, higher renewable penetration is increasing price volatility and the value of firm and flexible resources such as batteries and demand response.

Consultation feedback
Electrification investment: Investment is accelerating. Stakeholders emphasised the need for faster connections, improved incentives for new technology to participate in the market, more flexible risk management, and modernised tools and frameworks to support demand growth. A clear example is the lumpiness of investment, which tends to be in step changes (i.e. data centres). This reflects the tension between enabling large growth, while maintaining system stability and efficient investment. Conversely, sudden exit of large load can have the same impact.
Firming and flexibility: There is a growing need for firming and flexibility (e.g. BESS, demand response, hydro) to manage variability from intermittent generation and demand, but many stakeholders believe the market is not fully enabling this. Discussions surfaced questions such as who is best placed to deliver firm and flexible supply in the market – with clear trade-offs across the need for firm and flexible supply, broader security and price volatility. Stakeholders also highlighted concerns around whether current market settings and price signals are sufficient to support investment in firm and flexible supply, with questions around revenue adequacy and the ability of scarcity pricing to emerge consistently.
Electricity market innovation/DSO: Stakeholders highlighted that market design, price signals and operational models are not keeping pace with decentralisation, with unclear roles, weak coordination, and a need for improved Transmission System Operator to Distribution System Operator (TSO–DSO) integration. For example, a clear tension with stakeholders was the need for clear roles and responsibilities across the TSO-DSO model.

Figure 3: Generation supply additions, MW



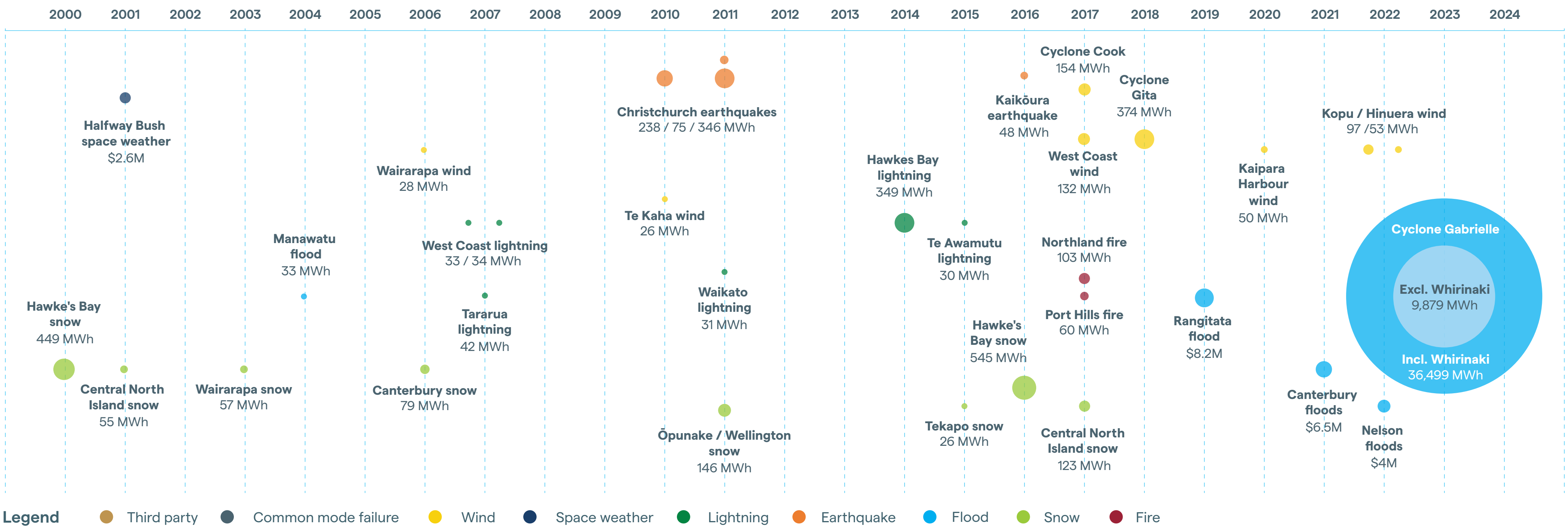
Environmental

Climate change and severe weather events are amplifying both operational and planning challenges. The electricity system is becoming more exposed to more frequent and severe weather events, increasing the risk of asset damage, supply disruption, and forecasting error. In addition, as our supply mix becomes more weather dependant, changes in rain, wind or sun can cause significant swings on the power system.

Consultation feedback

Climate change (weather and resilience risks): Stakeholders agreed that a highly weather dependent system will be inherently more volatile and harder to forecast. They also noted that the system response will need to be faster to maintain system stability as weather patterns such as cloud cover and wind gusts impact generation output. There was an additional challenge raised, particularly by distribution businesses, around the need for increased event management co-ordination and training. The System Operator was seen as a potential source of knowledge and expertise for the sector looking to improve capability in event management.

Figure 4: Resilience History



The bubbles indicate the amount of energy unserved, which is a measure of the energy demand that could not be met due to the event. Where there was no loss of service the cost of the impact is shown. The bubble size is made relative using a standard value of lost load of $25,000 per MWh.

Societal and consumer evolution

Societal and consumer expectations are also shifting. Electricity is becoming the dominant energy source for daily life and economic activity, increasing public sensitivity to outages, price volatility, and perceived system risk. Consumers and communities are placing greater emphasis on resilience, affordability, and participation, investing in their own generation and electric vehicles. A study by the Energy Efficiency and Conservation Authority (EECA) found that 83% of New Zealanders worry about increasing household energy prices.

Other trends, related to digitalisation, such as cyber security (refer to Appendix F) and system integrity are emerging as critical trust issues for the system to navigate as we electrify our economies. In parallel, workforce demographics and skills availability are changing, increasing competition for specialised capability and heightening the importance of knowledge retention and capability development.

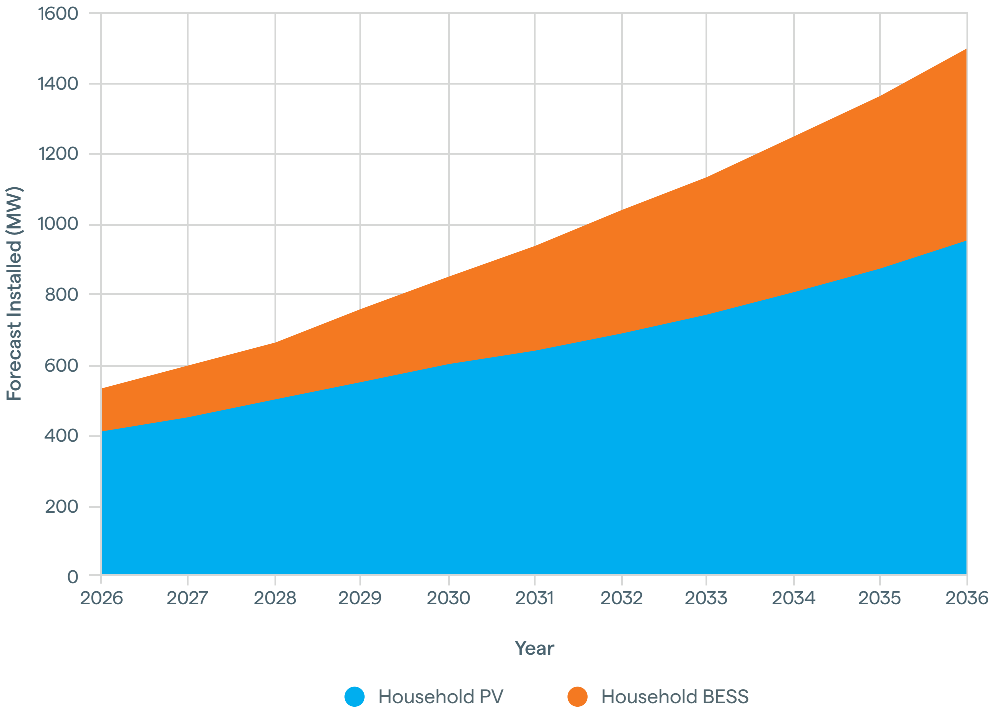
Affordability ranks highest as an important issue facing the electricity sector and is the one New Zealanders are most concerned about

- **80% of residents** and **86% of small businesses** view affordability as an important issue facing the sector.
- **69% of residents** and **57% of small businesses** are concerned electricity will become unaffordable for some over the next 10 years.

Source: Consumer Advocacy Council, Consumer survey 2023

Consultation feedback
Talent pipeline: Many stakeholders shared a similar concern about an aging specialist talent base and growing competition for the next generation of critical capability. Stakeholders also highlighted broader, industry wide constraints in building and retaining this capability, including competition for specialised skills and limited training pipelines. Some stakeholders see the need for coordinated approaches to capability development in control rooms and the need for clear leadership to progress this.
Energy affordability: Affordability remains a defining issue for consumers and is central to maintaining public support for electrification. If the transition is seen as driving higher bills without clear benefit, the sector's social licence and the pace of change may both come under pressure. Stakeholders emphasised the need for a more efficient, well coordinated energy system to deliver value, manage cost where appropriate and support economic outcomes (such as efficient dispatch of the lowest cost resources in the market). While stakeholders recognise that the System Operator has a limited direct role in influencing affordability, it remains an important contextual consideration for us. We discuss this further in the *how we deliver* section of the document.

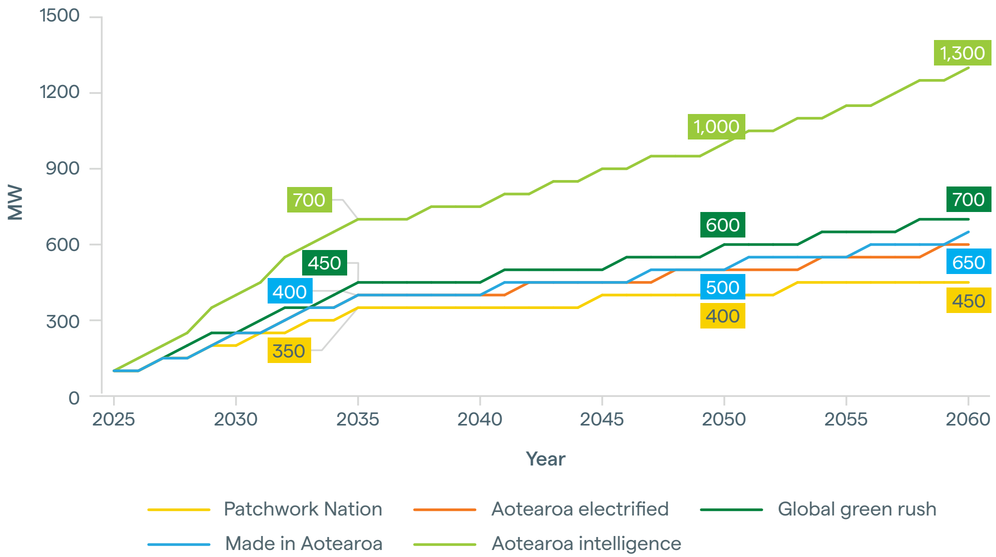
Figure 5: **Projected NZ household DER and BESS installed capacity**



Technological change

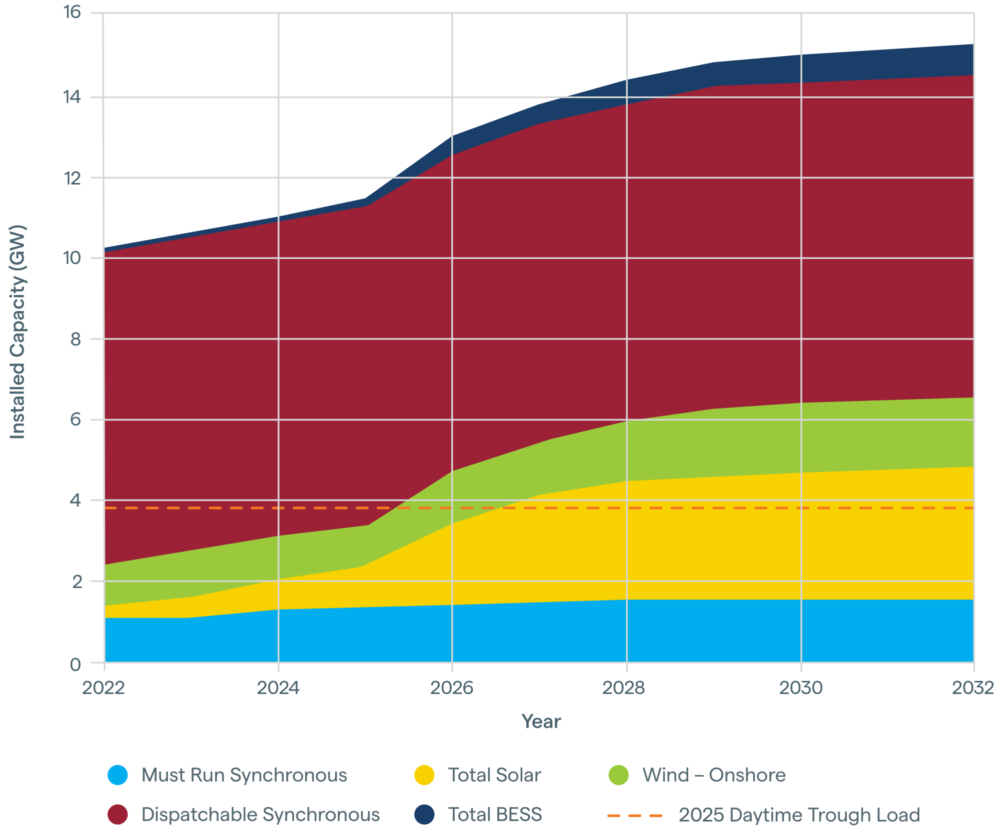
Shifts in technology are both a driver of complexity and a critical enabler of future system performance. Rapid advances in digitalisation, data availability, automation, and artificial intelligence are transforming how power systems can be monitored, analysed, and controlled. At the same time, declining system inertia, reduced system strength, and the proliferation of inverterbased resources are introducing new operational risks that require new tools, skills, and market arrangements to manage.

Figure 6: New Zealand data centre electricity demand scenarios



Estimates of the shares of AI in total data centre electricity consumption vary widely and are based at best on imperfect proxies

Figure 7: Forecast generation mix



(based on existing generation and upcoming commissioning projects as at December 2025)

Consultation feedback
Decentralisation and distributed energy resources: Stakeholders consistently described the future becoming more distributed, dynamic, and less directly observable. Stakeholders emphasised the need for clear roles, stronger coordination, and better visibility across both transmission and distribution. In the System Operator context this is an increased understanding and visibility of resources on networks to improve whole of system operations, rather than direct control at the distribution level.
Data and digitisation: Data is seen as a foundational enabler of future system operations. As the number of connected devices, sensors and controllable resources expands, the ability to collect, share, trust and act on data will increasingly determine how effectively the sector can forecast, optimise and manage risk. Increased data access and sharing, data standards, interoperability, and increased system visibility are seen as essential foundations for operating a more complex, decentralised system. Stakeholders viewed data as a foundational prerequisite for other key areas, such as managing distributed energy resources, establishing flexibility, and coordinating event responses.
Inverters and BESS: Stakeholders agreed that the rapid growth of inverter-based generation and battery storage is one of the most significant structural changes facing the power system. While these technologies offer major benefits, they also change system physics by reducing inertia, affecting system strength and introducing new stability risks that legacy frameworks were not designed to manage. Most stakeholders saw these issues as core competencies for the System Operator to develop and ensure there was sufficient data to assess the risks as well as fit-for-purpose solutions developed that did not introduce excessive cost.
Artificial intelligence: Stakeholders noted opportunities from the use of AI to increase operational capability and capacity in forecasting, planning, connection studies, and real time decision support, but adoption must be underpinned by strong data foundations and AI governance. Stakeholders agreed that we need to take an iterative "test and learn" approach given the criticality of infrastructure involved. Stakeholders also noted that the System Operator would need to build capability to respond to increasing use of AI by market participants, including automated decision making and agent-based interactions.

Collectively, these changes noted in the above sections are shaping the future System Operator role. The trends and drivers create risks and opportunities for the delivery of the System Operator service. The task is no longer limited to managing a centralised, linear and predictable system, but instead requires embracing a more decentralised, data rich, and dynamic system involving a wider range of participants and technologies. This context necessitates a strategic shift in how the System Operator approaches capacity, capability and investment in the next 3-10 years.

Lessons from the Chilean blackout, February 25, 2025

On 25 February 2025, Chile experienced a near nationwide blackout. Power was lost mid afternoon and full restoration took up to 24 hours in some areas. The initial trigger was a failure on a high voltage transmission line following a failure of protection communications on the circuits. This event led to cascading disconnections across the national system.

The Central-Southern region collapsed after about 4 seconds due to underfrequency, and the Northern region collapsed after about 4 minutes due to overvoltage. Restoration of all demand took 24 hours, with several black start facilities failing to synchronize to the grid, and some areas losing SCADA. Whilst human error, combined with single point vulnerabilities in communications and protection triggered the event, there are lessons from this event which should be applied in NZ:

- *Weak grid support from both synchronous and IBR generation and non-compliant generation accelerated the collapse* – In NZ we undertake routine and commissioning testing for compliance, but we need to strengthen compliance in these areas including monitoring and reviewing events for generator, BESS and large load performance.
- *Low inertia and voltage instability contributed to island failure* – We need to expand expertise and tools to help monitor and assess system strength and mitigate these risks.
- *Limited transparency made event reconstruction and response assessment harder* – Visibility of system parameters and DER will become increasingly important as we move to higher IBR penetrations, both for our Automatic Under Frequency Load Shedding (AUFLS) and for real-time visibility and risk assessment.
- *Restoration was delayed and uncertain due to insufficiently detailed planning* – We regularly test our black start capabilities but we need to review these in light of international events and a changing power system. New technologies may be able to offer additional services in this area.

Figure 8: High voltage network, Coordinador Eléctrico Nacional (CEN) – Chile

Source: Chilean Grid Blackout of February 2025: Causes and Lessons

2.2 What does the power system look like in 2036?

We understand how our current context has changed but what could the power system look like in 2036?

By 2036, we aim to operate a power system that is co-ordinated, data-driven, and highly adaptive—moving beyond today's centralised, transmission-led model. A practical hybrid TSO–DSO model underpins system operation. Distribution networks actively manage local conditions, while the System Operator orchestrates system-wide balancing and security management across demand and supply-side resources—enabled by shared visibility of operational data, clear roles, and aligned market signals.

The system is more complex—with high penetrations of variable renewable, and inverter-based generation, distributed energy resources, EVs, and active demand—but this complexity is contemplated in the Electricity Authority's market design and the System Operator has invested in the tools and capability needed to actively manage it. Security is maintained through a deep understanding of system behaviour and limits, dynamic operating envelopes, and decisions are informed by probabilistic, forward-looking analysis, rather than static rules. Intervention is a last resort as market-based products and fit-for-purpose tools and systems in our control rooms enable more proactive event management.

A step-change in data visibility is foundational to this shift. Real-time insight across transmission, distribution, and distributed resources enables better coordination, and more efficient outcomes. Data is treated as core system infrastructure.

Markets have evolved to unlock flexibility across all levels of the system. Participation has broadened—from large generators to aggregated consumer resources—with more granular, time-sensitive signals aligned to real system conditions. The System Operator plays a defined role: implementing market design, maintaining real-time security and efficiency, and providing trusted information on system conditions and security of supply.

Operational capability has scaled through investment in targeted automation and advanced AI decision support. Routine actions are increasingly automated, allowing operators to focus on risk, judgement, and high-impact events in a more complex environment. Resilience is built into the system—through grid-forming technologies, storage, and multiple restoration pathways. Cross-sector dependencies are actively managed as part of system security.

Our strategic priorities highlight what we plan to do over the next three years to move from where we are today to this future power system. We articulate the choices we will make to deliver the highest value outcomes for Aotearoa's power system, identifying capability and capacity building initiatives across our people, process, tools and systems.

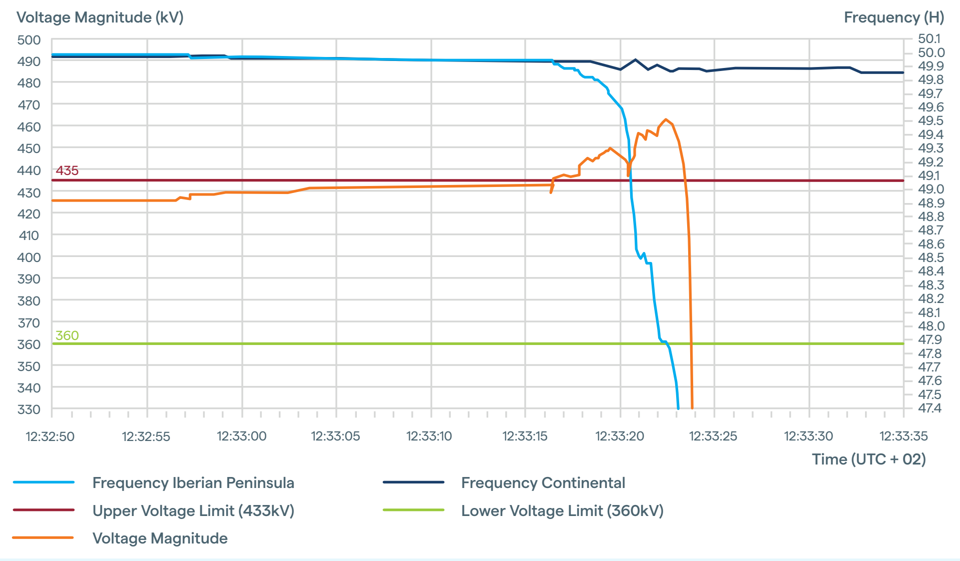
Lessons from the Iberian blackout, April 28, 2025

On 28th April 2025 at 12:33 pm Spain and Portugal experienced a full blackout. Some areas of the peninsula were without power for over 16 hours. This was the most severe blackout in Europe in 20 years. Ultimately the system collapsed after voltage rose toward operational limits and triggered generator disconnections. However, the event involved a build-up of factors in the 30 minutes or so before failure.

The system began experiencing undamped oscillations – one of which was new and triggered by IBR control system interactions. Control rooms tried actions to damp these, but those actions worked to push voltage up. As the voltage climbed, a 350 MW generator tripped, pushing voltages higher, and in the next two minutes, almost 2,000 MW of generation tripped. The back-stop system defence – equivalent to our AUFLS – was insufficient to prevent full system collapse. Whilst the NZ system is different in many ways to the Spanish system, several of the learnings from ENTSO-E investigation can be applied to our context.

- *The Iberian system ran out of reactive margin (spare reactive power capacity) to control the voltage and overvoltage protection settings for many generators and networks were not aligned with system needs.* There are several recommendations to combat these issues for Spain, and in some cases NZ is in a better position. However, as for Chile, it is important to strengthen testing, compliance and performance of generators and BESS in supporting voltage control. We also need to consider how ramp rates of intermittent generation affect system frequency and voltage.
- *The Iberian system experienced potentially damaging undamped oscillations ahead of collapse.* Understanding, monitoring and analysing these undamped oscillations is an increasingly important area internationally and NZ is no exception. We need to grow our engineering capability in this field, develop process and tools to assist us.
- *System defence in Spain failed, and they had poor visibility of DER.* In NZ we have updated our AUFLS scheme, but we will need to review the effectiveness of this in the light of more DER. Similarly we need greater visibility of DER volumes within the distribution networks to both plan and operate the system security.
- *The Iberian event has underscored the value of industry restoration training and practices.* In NZ we run 6-monthly black start exercises and annual whole-of-industry practices. These will need to continue and evolve as the industry transitions.

Figure 9: Evolution of frequency and voltage in Carmone (Spain) against frequency in Continental Europe



Source: ENTSO-E Final Report

Proposed strategic priorities for the System Operator

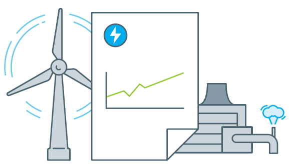
To develop the strategic priorities for the System Operator service we have taken into consideration a wide range of analysis, international learnings and stakeholder feedback. There are clear themes that have risen to the top of the agenda across those various inputs as well as other areas where there may be less alignment but where there is a clear power system impact that must be addressed. The strategy synthesises those different perspectives into the following five priority areas of focus for the next three years to fit the specific conditions of Aotearoa's power system.

In addition to clarity on *what* we must do, there are some elements that have come out of our Phase 1 work which are important to *how we deliver* our work. We have captured these as key enablers of the strategy to reflect their importance and need for ongoing focus. We discuss these below, followed by a section for each of the five strategic priorities, the outcomes we want to deliver and the planned initiatives we are seeking funding to execute. Some of the initiatives are already underway and we have used this Strategy development process to prioritise our existing work programme. Most of the initiatives focus on the three years at the heart of this Strategy 2028-2031. Where we are clear that some initiatives will extend beyond that timeline we have highlighted this to signal now to the Authority and market participants the likely change and investment requirements.

PRIORITIES

Operating a secure, highly variable power system

Proactively manage system risk and limits to keep the power system secure and operable under increasingly complex conditions.

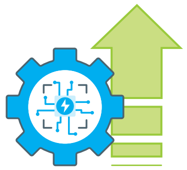


Efficient market operations and information provision

Efficient delivery of Authority market design. Inform development of future market design and security of supply framework to support the Authority's delivery of a competitive, reliable system.

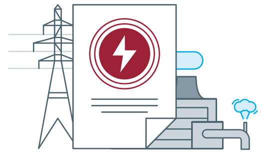
Evolving operational capability

Develop a resilient, integrated System Operator capability leveraging AI and digital solutions, that scales with system complexity and leads operational practice across the sector.



Leveraging data and distributed resource integration

Enable secure whole of system operation through shared visibility, common standards and data, TSO-DSO coordination, so that DER/CER can integrate anywhere without undue operational risk.



Strengthening industry resilience

Strengthen industry preparedness, coordination and restoration response for unplanned outages, as event frequency and severity increases.

How we deliver

As we considered the range of opportunities and challenges facing Aotearoa's power system over the next 10 years it became clear that there were important choices for the System Operator function to make in terms of what initiatives were prioritised. This has formed the basis of the five priorities. There are however a range of key enablers that we need to maintain or develop over the next ten years that go more to *how we deliver* our work. These are important to the delivery of the Strategy for us but also for our stakeholders. Some of them also require additional investment as we mature our ability to deliver in these important areas.

Affordability must be top of mind – value for money operations:

The System Operator function, by design, does not interact directly with consumers. We are however acutely aware of the impact that electricity prices have on the homes and businesses of New Zealand. We are also mindful of the impactful role we have in supporting the wider industry to supply reliable electricity supply to consumers across the country at affordable, competitive prices. This is a delicate balance – underinvestment in key capabilities will potentially hold back the electrification of Aotearoa's economy but overinvestment will not be affordable. We must therefore ensure we operate efficiently, prioritising investments to the highest value outcomes and effectively managing cost-risk trade-offs associated with any market change or obligations on participants.

Open, accessible communication and engagement:

The System Operator team undertakes a significant range of consultations and engagements throughout the year. From regular System Operator forums to annual Industry Exercises, to regular publications of Energy Supply Outlooks, the System Operator is constantly communicating and engaging with market participants and stakeholders. This becomes even more important during periods of transition and change. While we believe we have good communication tools we recognise there are significant improvement opportunities in this space that will improve the effectiveness of our communications, the clarity of the information we provide and the transparency and accessibility of publications. We also hear from stakeholders that they want to hear more from us about how we make decisions on the power system and ensure we share the analysis and insights that we generate internally. As part of delivering on this Strategy we commit to continuing to improve in this area and investing in communication channels and additional resources as required.

Impartial and transparent decision making:

The System Operator function is a legislated function of Transpower under the Electricity Industry Act 2010. The Act also requires the Electricity Authority to contract Transpower for its System Operator services. This allows Transpower to recover the costs associated with the provision of that service above and beyond its requirements as the transmission owner and operator for New Zealand. This integrated approach makes sense for a small market like New Zealand where the cost and skillset required to run a separate System Operator would be onerous. However, it is important that the System Operator acts in an impartial way given its central role in the system. Impartiality ensures that the System Operator does not favour Transpower's transmission business in its operation of the system in real time or in commissioning or in any other way across the power system. We take these impartiality obligations very seriously. Since 2019 there have been regular external audits of the System Operator function and its impartiality practises with no material findings in any of these reviews. These audits highlight that the training and processes we have in place are robust and operating effectively. There are however always areas of opportunity to improve and we will continue to focus on evolving our practises and the transparency of our reporting in this area.

Collaboration with regulators and policy makers:

The electricity sector has a number of policy and regulatory bodies that are important to the delivery of the System Operator service. We have sought direct engagement with these institutions in the development of this Strategy to help support increased collaboration and alignment on system wide goals and priorities. We believe this is increasingly important given the rapid pace of change. Similarly, industry engagement in the development of our strategic priorities, our work program and in the numerous consultation processes we run throughout the year is vital to the creation of effective, workable outcomes. We have been very grateful to all of the government, regulatory and business stakeholders that have given their time to shape this Strategy and look forward to continuing this level of engagement in our work going forward. In section 4 we outline where we believe other stakeholders have a role in progressing important outcomes. We have attempted to be clear in the initiatives associated with the five priorities what role the System Operator should play in achieving the priority. We welcome your feedback on whether we have articulated this clearly and/or whether the allocation of roles is appropriate.

Agile change management capabilities:

Delivering change into a System Operator can be a very difficult process. As a critical service, operating 24/7 we do not have the luxury of taking an outage while we upgrade the dispatch system or hoping that staff eventually start to use a new tool when they get time for training. Every change must be carefully planned, delivered into our tools and systems effectively and supported with rigorous but co-ordinated training. Planning however must be sufficiently agile that the changing needs of the power system can still be met by the time the project is delivered. In this sense we need a fast, replicable way to deliver change that can pivot quickly if needed given changing system dynamics. This is a skillset that must be built up over time – across the System Operator team but also critical support teams like ICT and Finance. Previous large change projects like Real Time Pricing were managed implementation events. These sorts of significant market-wide changes are likely to be necessary more frequently with potentially more significant impacts. The System Operator needs to build in that ability to quickly adapt and embed change in order to keep pace with the needs of the power system.

Priority 1: Operating a secure, highly variable power system

What does this priority mean?

Proactively manage system risk and limits to keep the power system secure and operable under increasingly complex and variable conditions. We will deliver our fundamental responsibility to keep the lights on by matching energy and demand in real time, maximising system usage, while balancing the risk of system failure and cost.

This priority addresses:

- **Risks:** Loss of real-time system operability, unplanned outages, cascade failure, and erosion of trust.
- **Challenges:** Changing generation mix, increasing variability, declining inertia and system strength, forecasting uncertainty, and increasingly complex outage coordination.
- **Opportunities:** Improved realtime monitoring, optimised and new ancillary services, more sophisticated risk management, new operational tools and frameworks support maximising system usage.

How does it align to stakeholder feedback?

Stakeholders consistently identified a secure and operable system in real time as a nonnegotiable expectation of the System Operator. System Operator workshops highlighted that the most credible failure mode is a failure to anticipate, manage and explain emerging system risks to industry. Without this, stakeholders may assume risks are being managed and when they eventuate, this can erode System Operator trust and social licence. Distribution businesses and generators reinforced the need for clearer system limits, better outage coordination, and improved anticipation of instability under high renewable conditions and higher levels of inverter-based resources in the system. There is strong support for the System Operator to lead on defining operational guardrails including emergency management for load, procuring new ancillary services where needed, and clearly communicating system risks and trade-offs.

What does success look like?

- The power system remains secure and operable across a wide range of credible future conditions.
- Emerging operability risks are proactively identified and mitigated ahead of need.
- System limits, margins, and stability constraints are clearly understood, monitored, and actively managed.
- The System Operator safely operates closer to system security limits balancing the risk of failure and cost to consumers.

How to interpret the timing of our initiatives

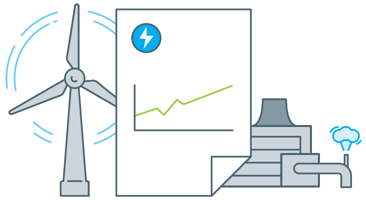
For each of the initiatives under our priorities we have identified the changes we need to progress over different time horizons. These time horizons line up with our funding periods from the Electricity Authority:

- From now until 2028 we are prioritising our work program within our existing funding envelope.
- For Future Investment Priorities (2028-2031) we are signalling what our funding request will include to the Electricity Authority for that funding period.
- For investment beyond 2031 we are signalling where capability or capacity build may take longer to deliver or where we can already see new requirements of the System Operator function based on what we know today.

How we will achieve the outcomes of this priority

ID	Initiative	Description	Planned for delivery
P1.1	**Evolving real-time security and supporting Future Security & Resilience work program**	As the power system transitions, we are adapting to changing system stability challenges. We will evolve our system monitoring, regulatory requirements, assessment and modelling tools, and new ways to mitigate emerging risks.	**Prioritisation of current work (Now-2028)** • Continue to undertake technical analysis to support the delivery of the Authority's Future Security and Resilience work programme. • Continue to evolve our scheduling and dispatch tools, existing ancillary services capability and operational policies including the Policy Statement, consistent with the Authority's market design, to integrate a growing portion of intermittent generation securely. • Enhance our monitoring of power system health (both offline and real-time) and continue to assess effectiveness of existing security management. • Investigate and develop options for managing System Strength and Frequency Stability, and to mitigate risks associated with inverter-driven instability. **Future investment priorities (2028-2031)** • Develop additional real-time monitoring including real-time high-resolution monitoring for oscillatory stability. • Grow modelling and analysis capability to better understand risks and develop appropriate tools and mitigation options. • Work with the Authority to develop and implement new mitigations (such as evolved reserve products and scheduling and dispatch market design changes) for emerging stability challenges. **Beyond 2031:** • Review and maintain system effectiveness of security management strategies and tools.
P1.2	**Shift to probabilistic forecasting and risk assessments**	Growing our understanding and capability to assess the growing range of plausible system security outcomes given the level of uncertainty in supply and demand, and the range in power system risks (including thermal, voltage, frequency, stability, and residual generation) that could occur in both real-time and planning timeframes.	**Prioritisation of current work (Now-2028)** • Utilise regional P10, P50 and P90 solar, wind and demand forecasts and develop probabilistic scenario analysis capability within our current tooling to assess system security outcomes. In the planning timeframe this will enable increased efficiency allowing studies to take place further out in the planning timeframe. This will support the industry to co-ordinate outages with longer lead times and greater certainty. **Future investment priorities (2028-2031** • Explore trends and emerging capability for real-time dispatch tooling where system security is dependent on near real-time probabilistic forecasts. • Expand our capability to utilise digital tools such as AI, enabling us to stress test a wider range of load and generation scenarios and make recommendations on best grid configuration and operator actions given the range of outcomes that could be expected. **Beyond 2031:** • Work with the Authority on the scheduling and dispatch system of the future across market design changes and the tooling capability that can implement it.

ID	Initiative	Description	Planned for delivery
P1.3	**Improving Special Protection Scheme (SPS) Management**	SPSs (otherwise known as remedial action schemes) allow the system to be run harder by enabling automatic responses to mitigate security violations resulting from system events rather than relying on manual operator responses. SPSs are increasing in number rapidly and pose operational risk if not well integrated into our control rooms, as they currently rely on manual operator arming/disarming based on system conditions, which can change rapidly. This initiative will focus on transitioning from manual to system driven management of SPS in the control room.	**Prioritisation of current work (Now-2028)** • Improve SPS modelling capability within our current tooling, using rule-based assessment and alarms to signal when an SPS needs armed or disarmed. **Future investment priorities (2028-2031)** • Expand our capability to utilise AI to consider current system conditions, as well as future trading periods, along with contingency analysis results, and the aggregated response of SPS and make recommendations on any changes needed to SPS settings. **Beyond 2031:** • Consider automation opportunities and further streamlining of SPS management.
P1.4	**System Security Forecast (SSF) & Credible Event Review evolution**	We continue to evolve the System Security Forecast and Credible Event Review framework to highlight to stakeholders existing and emerging power system risks, system limits, along with the mitigations System Operator will employ to manage these risks. It will be important to continuously revalidate options for managing risks with the introduction of new IBR standards, controls, and demand behaviour and response.	**Prioritisation of current work (Now-2028)** • Staged evolution of System Security Forecast and Security Policy/Credible Event Review to lay foundations for future needs. **Future investment priorities (2028-2031)** • As new NZ power system operating models and technologies (Distribution System Operations, new generation, storage and demand technologies, changing consumer and industry risk appetites) evolve, we will need to make step changes in our Credible Event Review and Security Policy to align with these. This will involve potential redesign of our policy and a series of consultation with NZ industry and consumers.



Priority 2: Efficient market operations and information provision

What does this priority mean?

Operate and implement the Authority's market design, while providing transparent security of supply information to support efficient participant response and inform ongoing market development. This will enable the market to signal and respond to system risk, coordinate participant behaviour, and deliver secure outcomes at least cost for the long-term benefit of consumers, with reduced reliance on System Operator intervention.

This priority addresses:

- **Risks:** Ineffective implementation of market design, poor visibility of system conditions, unmanaged capacity and energy risk.
- **Challenges:** Operating scheduling, dispatch, and ancillary services under increasing uncertainty and evolving technologies, while ensuring market arrangements function as intended in real-time and limit need for control room intervention.
- **Opportunities:** Better use of operational information and existing market mechanisms to reveal system conditions, support participant response, and reduce reliance on intervention; strengthening the feedback loop between market operation and market design.

How does it align to stakeholder feedback?

Generators, retailers, and large electricity users strongly support a marketled approach but noted the gaps and challenges for the power system. Submissions highlighted the need for improved leadership to take action to address security of supply, ancillary services, clearer market signals and pricing to incentivise firm and flexible resources and manage system risk, and provide better transparency around system needs.

Stakeholders were acutely aware of the need for the right pace of regulatory change and expect the System Operator to work with the Authority to evolve market arrangements that allow participants to respond efficiently within the energy-only market. There is broad support for modernising scheduling, dispatch, ancillary services, innovation and information provision to better address system realities.

What does success look like?

- System Operator can operate the market across a wide range of credible future conditions.
- Energy and capacity risks are effectively signalled.
- Evolving ancillary services, market products, and emerging technologies are incorporated within market operations.
- Market evolution results in less need for System Operator dispatch intervention.

How we will achieve the outcomes of this priority

ID	Initiative	Description	Planned for delivery
P2.1	**Updates to Scheduling, Pricing and Dispatch (SPD) market system**	With the changing, more intermittent generation mix, larger contribution from BESS, DER and CER, and maturing DSO capabilities, there is a need to reconsider the future SPD capability needed to dispatch the power system securely and efficiently in real-time.	**Prioritisation of current work (Now-2028)** • Development of clear set of prioritised limitations with SPD given changing market conditions. **Future investment priorities (2028-2031)** • Work with the Authority to scope market design initiatives including to address (for example) periods of oversupply of cheap renewables, inflexible base load generation, new hybrid and BESS plant, and increasing forecast uncertainty. • Determine investment required in SPD or another market system that is consistent with emerging trends for system operations in other jurisdictions. Finalise implementation requirements and market participant impact. **Beyond 2031:** • Finalise implementation of upgraded or new market system.
P2.2	**Evolving ancillary services**	As the power system becomes more complex there is a need to evolve ancillary services to manage new or increasing risks to ensure the system remains stable and secure. This includes not only new products but also ensuring existing products remain fit for purpose and accessible to a wide range of participants, including BESS.	**Prioritisation of current work (Now-2028)** • Changes to ancillary services rules to enable participation from BESS and demand, work with the Authority to identify and address any Code issues. • Changes to current ancillary services tools and workflow management to better support increasing numbers of ancillary service participants/sites and new products. This will support improved monitoring and reporting on performance of ancillary services. **Future investment priorities (2028-2031)** • Work with the Authority to investigate and implement (if needed) new frequency stability ancillary services. • Investigate options for products and services to mitigate risks associated with low system strength. **Beyond 2031:** • Continue to invest in associated ancillary services tools and processes to support ongoing evolution of ancillary service products, participation, performance monitoring, contractual compliance and transparency.
P2.3	**Evolving Security of Supply (SOS) framework**	Ensuring the market and stakeholders have accurate, timely and accessible information is key to them understanding changing risks and taking appropriate action. The SOS framework needs to evolve to ensure it can operate to this high level in a rapidly changing environment with many more market players and changing supply and demand mix with changing expectations from the power system and the impacts of its risks.	**Prioritisation of current work (Now-2028)** • Continue to enhance the existing data collection processes for the SOSA and Electricity Security Outlook (ESO) building on recent changes. Improve alignment between ESO and New Zealand Generation Balance (NZGB). • Assist the Authority with Security Standards Assumption Document (SSAD) updates and implement the SSAD changes as part of the Security of Supply Assessment (SOSA). **Future investment priorities (2028-2031)** • Further develop and implement ESO/SOSA modelling and forecasting tools and processes. • Build SOS risk visualisation for external users on website. • Implement any additional SSAD updates as part of SOSA and refine reporting and risk indicators for industry.

ID	Initiative	Description	Planned for delivery
P2.4	**Implement MBIE dry year risk mitigations**	MBIE is consulting on a new winter energy reliability obligation as part of the Government's plans for mitigating dry year risk. This two-layer winter energy reliability obligation would: • be triggered when the SOSA shows a future winter energy shortfall • require market participants to secure sufficient short-term fuel and long-term winter energy cover • support earlier contracting and investment • provide greater confidence for households and business that electricity will remain affordable and reliable during dry years. It also requires the System Operator to develop an Electricity Security Opportunities Statement to assist industry understand how investment in different types or combinations of assets could address any identified gap.	**Prioritisation of current work (Now-2028)** • Subject to the finalisation of the consultation, work with MBIE and the Authority on details associated with implementing the two reliability obligations. • Develop the first Electricity Security Opportunities Statement to support industry and investors in the NZ power system. **Future investment priorities (2028-2031)** • Implement any additional changes associated with this policy direction.
P2.5	**Integrating new asset types into both the power and market systems**	As we evolve our system security management and market design for future needs, we need to ensure we are ready to integrate new sizes and technologies for both demand and generation. This will involve reviewing and implementing performance standards to keep pace with industry developments. We also need to evolve System Operator tools supporting commissioning and onboarding of new assets into the market.	**Prioritisation of current work (Now-2028)** • Support Code changes to establish standards for large load and review CACTIS to take account of technology developments. • Proactively work with the industry to incorporate into the market new assets being invested in at all levels of the system. • Adapt our use of existing tools where possible to support commissioning and participation of BESS, intermittent generation and new large loads. **Future investment priorities (2028-2031)** • Enable integration of new operating models (e.g. DSO, aggregators, Vehicle-to-grid) into the market. Modify our tools to more robustly and efficiently enable integration of new technologies including BESS, intermittent generation and large loads.
P2.6	**Market sandpit**	Enable small scale technology to test and pilot grid edge implications of non-grid scale assets (CER/DER) including as EDBs increasingly establish foundational DSO capability including LV network visibility, and associated data sharing and standards supporting interoperability with the TSO.	**Future investment priorities (2028-2031)** • Investigate and enable a market sandpit.

Priority 3: Evolving operational capability

What does this priority mean?

Build a resilient, adaptive System Operator capability by evolving people, tools, and operating models together—strengthening integrated decisionmaking, safely augmenting human judgement with digital tools such as AI, and demonstrating operational leadership across the sector.

This priority addresses:

- **Risks:** single points of failure, workforce fatigue, loss of institutional knowledge, inability to keep pace with industry needs.
- **Challenges:** skills shortages, ageing workforce, tool fragmentation, increasing workload.
- **Opportunities:** modern operating models, new technology, automation and AI-enabled decision support.

How does it align to stakeholder feedback?

Stakeholder workshops strongly emphasised workforce capability and constraints, business resilience, and decision making as critical risks, and opportunities for the System Operator. External stakeholders reinforced the opportunities for evolving workforce capability and capacity and coordinated approaches to capability development across the power system. Workforce skills would be augmented by modern tools, AI enabled decision support, and operators focused on oversight rather than manual intervention. Stakeholders agreed with our view that AI is no longer a future enhancement but is increasingly seen as core capability for today's system operations. There is broad acceptance that investment in people, tools, and our business models is a productivity enhancement and risk control and that the System Operator should take a leadership role in developing the "control room of the future."

What does success look like?

- A resilient, adaptive workforce with sufficient capability and capacity.
- Operational decisionmaking is integrated, consistent and robust across a wide range of credible future conditions.
- Tools, training, and operating models evolve in step with system needs.
- Human decisionmaking is augmented by digital, AI tools, and automation.

How we will achieve the outcomes of this priority

ID	Initiative	Description	Planned for delivery
P3.1	**Control Room of the Future (CRoF)[9]**	CRoF aims to build control room capability through trusted data, sensible automation, embedded operational knowledge, advanced decision support, modern tools, simulationbased training, efficient communications, and resilient facilities — enabling operators to safely manage an increasingly complex power system. Refer to Appendix E for more information on this initiative that we expect to invest in over the next decade.	**Prioritisation of current work (Now-2028)** • Finalise CRoF roadmap and sizing of investment for engagement with stakeholders. Commence building foundational capability to unlock advanced decision support, along with strengthening data governance. **Future investment priorities (2028-2031)** • Incorporate funding requirement for delivery of CRoF Roadmap. Continue to deliver CRoF capability into the control rooms and engaging with industry on implementation requirements. **Beyond 2031:** • Incorporate final funding requirement for later stage capability uplift and maintenance of delivered capabilities against CRoF roadmap.
P3.2	**Streamlining commissioning and market onboarding**	We continue to work with the industry to develop and streamline our Code commissioning and market onboarding tools and processes.	**Prioritisation of current work (Now-2028)** • Develop right-sized commissioning processes as asset owner Code obligation thresholds decrease to 10MW and we see more, smaller generators being developed. Further extend commissioning process and tools optimisation through to successful onboarding and participation of new assets into markets for energy and ancillary services. **Future investment priorities (2028-2031)** • Leverage automated workflows and digital tools such as AI where feasible to manage risk but reduce System Operator and participant workloads for commissioning and onboarding into the market.
P3.3	**Operations Customer Portal & Data Exchange**	Undertake a significant digital programme to modernise how industry participants interact with, and exchange non-real-time data with the System Operator and with industry (when applicable). This would include information such as ACS, AUFLS, POCP, SOS and ancillary services information. This would include a standard flexible API, that transfers data between industry and the System Operator.	**Prioritisation of current work (Now-2028)** • Consolidate existing separate databases into one, enabling interactive reporting and data visualisation products. **Future investment priorities (2028-2031)** • Develop a single API for participants to transfer non-real-time data and information with Transpower. • Develop interactive reporting and data products with industry. **Beyond 2031:** • Investigate and develop a digital twin of the market system and its applications for participants to utilise.
P3.4	**Forecasting and modelling uplift**	Forecasting supply and demand is a key foundation of system operations. As variability in supply and demand continues to increase, the level of forecast uncertainty also increases. We need to ensure that our capability to forecast supply and demand evolves to address this growing uncertainty, to support secure system and market operations.	**Prioritisation of current work (Now-2028)** • Review forecast arrangements of medium-term load forecast while exploring additional data needs including exploring greater regional granularity such as GXP forecasts and uncertainty metrics to support initial probabilistic security risk assessments. • Investigate enhanced modelling capabilities for forecasting energy and capacity security of supply margins. **Future investment priorities (2028-2031)** • Review of forecasting arrangements considering advancements in forecasting capabilities and the effects of growing distributed resource and intermittency. Investigating tools to enhance System Operator decision-making that incorporate increasing forecast uncertainty and insights that forecasting can provide. • Developing enhanced modelling capabilities for forecasting energy and capacity security of supply margins to aid market information and System Operator decision-making. This should consider effects such as climate change effects on weather patterns, demand response, thermal fuel constraints, aging generation fleet, electrification, reliability standards.

9. Refer to Appendix E for more details on Control Room of the Future.

ID	Initiative	Description	Planned for delivery
P3.5	**Talent Pipeline ongoing maintenance / growth**	We are seeing an uplift in the volume of engineering, specialist market expertise and control centre work, and at the same time have an aging workforce. We have invested in out graduate programmes and in supporting universities in applied power systems engineering research.	**Prioritisation of current work (Now-2028)** • Further developing our graduate programmes to broaden the range of skillsets that can be utilised effectively. • Leverage our engagement with the University of Canterbury's Power Engineering Excellence Trust and Electric Power Engineering Centre, and other university partners to both improve the quality and diversity of graduates. • Identify research priorities for the System Operator to leverage PhD funding to progress key theoretical and applied research topics. **Future investment priorities (2028-2031)** • Extend this work in focused areas including more specialised training in areas to support skillset development and speed to competency in the New Zealand power system.
P3.7	**Evolve compliance monitoring**	Whilst the industry is transitioning, it becomes more important that new generators, large load and storage meet Code obligations and requirements.	**Prioritisation of current work (Now-2028)** • Work with the Authority and participants to strengthen compliance monitoring and provide a focus on Code requirements that are important for system security and market outcomes. **Future investment priorities (2028-2031)** • Streamline our Code compliance monitoring and reporting processes, to ensure consistency and routine reporting where possible. • Build our capacity to understand more monitoring work given the growing importance of compliance with generator and load performance obligations. **Beyond 2031:** • Investigate opportunities to leverage system and asset capability data with digital tools to perform increased compliance monitoring.
P3.8	**Cyber & Physical Security**	Cyber risk is an increasingly important system-level consideration as the electricity sector becomes more digital, distributed and interconnected (Refer to Appendix F for more details). The System Operator will benefit from Transpower's broader investment to strengthen the resilience of the operational, market and supporting systems through secure design and delivery, proactive risk management, strong identity and access controls, vulnerability management, enhanced monitoring and response, and regular exercising of coordination and response arrangements. Transpower will also continue to work with industry and relevant agencies to support information sharing, preparedness and a common understanding of emerging cyber and physical security risks, helping maintain a power system that is secure, operable and trusted, with material risks to security of supply communicated through appropriate channels.	**Prioritisation of current work (Now-2028)** • Continued delivery of Transpower cyber security plan. • Finalise future needs of Hamilton control room given seismic and team requirements. **Future investment priorities (2028-2031)** • Investment in Hamilton Control Room environment to support greater physical security and earthquake resilience. • Review and update of Transpower cyber security investment plan to support changing System Operator system and tool vulnerabilities with a focus on threats from greater distributed interactions and AI. • Contribute to Department of the Prime Minister and Cabinet (DPMC) work to develop cybersecurity obligations for critical infrastructure. **Beyond 2031:** • Ongoing funding and threat identification as technology matures.

Priority 4: Leveraging data and distributed resource integration

What does this priority mean?

Enable secure future system operation and minimise whole of system costs by building appropriate whole of system visibility, common data standards and protocols, to better enable coordination across Transmission System Operator (TSO), Distribution System Operators (DSOs), and participants. By converting data into trusted, realtime operational insight we will support safe integration of distributed energy resources (DER) and consumer energy resources (CER) at scale, supporting higher levels of participation in the market and flexibility products for the long-term benefit of consumers.

This priority addresses:

- **Risks:** Inadequate coordination at grid interface, EDBs not managing CER/DER compliance with inverter standards, unknown DER/CER performance during events, cascade failure, unplanned outages.
- **Challenges:** Fragmented data, inconsistent standards and protocols, limited whole-of-system visibility, growing number of participants to coordinate with.
- **Opportunities:** Shared situational awareness, AIenabled insight, scalable coordination that drives greater optimisation of all system resources and lowers costs for consumers.

How does it align to stakeholder feedback?

Stakeholders consistently called for improved data access and sharing, data standards, interoperability, coordination and increased visibility across transmission and distribution layers. Stakeholders agreed these areas as essential foundational elements to operate the power system. While stakeholders viewed increased whole of system visibility as a requisite from a more distributed and dynamic future power system, they cautioned against the System Operator directly controlling distributionconnected assets.

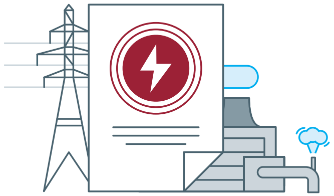
Electricity distribution businesses emphasised the need for clearer TSO–DSO coordination frameworks and shared situational awareness, particularly during events. Generators and retailers highlighted data, flexibility and digitalisation as prerequisites for faster connections, better forecasting, and more efficient operation.

What does success look like?

- The System Operator has wholeofsystem visibility at the level required to operate securely.
- Common standards and protocols enable effective TSO–DSO–participant coordination.
- Data is shared and used effectively to enable timely, actionable operational and planning insight.
- Emerging technologies can be integrated across the system without compromising system operability or security including small scale CER/DER connected to distribution networks.

How we will achieve the outcomes of this priority

ID	Initiative	Description	Planned for delivery
P4.1	**Development of a standard operational data set for industry use**	Establish a common data standard and dataset to enable interoperability between System Operator and other industry participants.	**Prioritisation of current work (Now-2028)** • Work proactively with industry to investigate must-have static and dynamic data needs and sharing across the industry but particularly at the interface between DSO and TSO. Specifically consider the data that would be useful for System Operator visibility beyond the GXP. **Future investment priorities (2028-2031)** • Trial and refine implementation of static and dynamic data sharing for operational and security needs in line with agreed standards. **Beyond 2031:** • Full implementation of static and dynamic data sharing for operational and security needs in line with agreed standards.
P4.2	**AI Governance**	The utilisation of AI in the operation of the power system will increase rapidly. It will be important that industry guidelines are established around the appropriate use of AI agents, when human decision making is required and the implications of AI-enabled trading outcomes. Transpower and other organisations are already developing their own AI governance frameworks, but without industry guidelines we risk inconsistency in approach and a lack of transparency on AI usage. System Operators in other jurisdictions are moving quickly to work with regulators and policy makers to establish fit-for-purpose governance arrangements.	**Prioritisation of current work (Now-2028)** • Undertake review of European, Australian and other relevant jurisdictions to develop a thought piece on a proposed approach to AI governance for the New Zealand electricity system given our operating context. • Discuss with MBIE and the Authority who is the most appropriate agency to implement AI governance for the sector and confirm what the System Operators role would be.
P4.3	**Data access and use**	Work with emerging Distributed System Operators to agree and establish data access and use arrangements enabling all parties to have the right level of data and visibility to perform their functions under the Code today and into the future.	**Prioritisation of current work (Now-2028)** • Establish initial access and data sharing with EDBs in relation to controllable load, providing visibility for event management. **Future investment priorities (2028-2031)** • Expand access and data sharing to include a wider range of participants and better enable whole of system security. • Consider broader access requirements as market dynamics change. Assess what other data collection obligations may be required.
P4.4	**Future System Operator interoperability**	Actively contribute to the Authority's development of an effective hybrid TSO-DSO functional model for New Zealand given our central position as the System Operator. This includes the ability to effectively monitor the performance of non-transmission and other flex solutions that are being implemented across the grid.	**Prioritisation of current work (Now-2028)** • Support the Authority to clearly define a standard TSO-DSO model as part of their Future System Operations work programme. This would include defining interfaces, roles, operating protocols, and accountability. • Work with the Authority and EDBs on compliance of CER/DER installations with inverter and other technology standards to manage issues such as voltage ride-through. **Future investment priorities (2028-2031)** • As part of the Control Room of the Future initiative, identify key operational and market system updates that are required to incorporate distribution level data. Including how to incorporate distribution constraints (operating envelopes) and DER states into overall constraint/security management, dispatch, scheduling, and outage management as appropriate. • Undertake no-regret modifications to our existing EMS/SCADA and market system to enable sharing of data and instructions from different Advanced Distribution Management Systems (ADMS) and Distributed Energy Resource Management Systems (DERMs). **Beyond 2031:** • Undertake any remaining system modifications to enable the transition to a fully functional hybrid TSO-DSO operating model.



Priority 5: Strengthening industry resilience

What does this priority mean?

Improve industry resilience to prepare, respond and recover from high impact events by clarifying roles and responsibilities, evolving response plans and practises to cater for system and industry changes. Strengthen shared situational awareness, to support faster, safer restoration while maintaining public trust in the power system.

This priority addresses:

- **Risks:** Poor coordination during events leading to slower than necessary restoration and the economic and social impact.
- **Challenges:** Unclear roles and responsibilities, inconsistent or missing information, increasing system complexity, rising public expectations on supply availability.
- **Opportunities:** Wholeofsystem coordination, shared situational awareness, improved restoration outcomes.

How does it align to stakeholder feedback?

Stakeholders emphasised the need to strengthen industry resilience across power system event coordination, communication, restoration, response and resilience. Stakeholders recognised the interdependence and need for strong alignment and coordination. During workshops key challenges during major weather events were highlighted. Stakeholders perceived risks to trust and social licence due to increasing number of events or inefficient event management as a critical failure pathway for the System Operator. There is strong support for the System Operator to play a clearer lead coordinator role without displacing industry and asset owners' responsibilities.

What does success look like?

- The System Operator effectively coordinates industry response to high impact system events.
- Industry understands its roles and responsibilities during high impact system events.
- Response plans and practises evolve to cater for changing system conditions and consumer expectations.
- Shared situational awareness enables faster and safer restoration.

How we will achieve the outcomes of this priority

ID	Initiative	Description	Planned for delivery
P5.1	**Industry situational awareness**	Improve communication of our System Operator response to an event or unplanned outage, including near real-time power system status to provide greater situational awareness for industry to enable their coordinated and timely response.	**Prioritisation of current work (Now-2028)** • Implement one to one and one to many messaging capabilities with participant control rooms, including satellite fallback to increase resiliency when primary communication channels fail. **Future investment priorities (2028-2031)** • Investigate options to share near real-time power system status with participants involved in restorations and implement any quick wins. **Beyond 2031:** • Continue to review industry situational awareness needs and sharing options as required.
P5.2	**Evolve black start and restoration processes**	As the system continues to change it is important to evolve black start and restoration processes to leverage new technology and maintain or improve regional resilience during events and unplanned outages.	**Prioritisation of current work (Now-2028)** • Review current black start and restoration processes against approaches used in other jurisdictions to identify any potential opportunities to explore i.e. grid forming technology, BESS, automated switching. **Future investment priorities (2028-2031)** • Evolve black start and/or restoration processes as required including training, resource uplift, process changes and identifying any potential tool changes.
P5.3	**Maintaining AUFLS capability**	Our AUFLS system has evolved to meet the immediate challenges – particularly in the North Island. However, with increasing Distributed Energy Sources, and with reduced inertia on the system we will need to review it to check it remains fit for purpose.	**Prioritisation of current work (Now-2028)** • Initial review of impact of DER and potential for dynamically armed systems to determine future needs in both North and South Islands. **Future investment priorities (2028-2031)** • Work with the Authority on planning and start implementation of any advances to the AUFLS system that may be required. **Beyond 2031** • Work with the Authority to finish implementation of any advances to the AUFLS system that may be required.
P5.4	**Coordinating emergency demand management**	With increasing DER/CER in the power system, and more participants such as Retailers and Aggregators taking control of demand (including traditional EDB controllable hot water load) it is important that we agree, operationalise, and test an emergency load and consumer resource management protocol suitable for both national and regional events.	**Prioritisation of current work (Now-2028)** • Support the Authority and ENA to refine a national 'Common Load Management Protocol and build visibility of what controllable load is available to support emergency management. **Future investment priorities (2028-2031)** • Operationalise and test the LMP to provide assurance of overall system performance.
P5.5	**Monitoring and responding to Natural Hazards (Including Space Weather) and other threats**	As the frequency and severity of weather events continues to get worse, and geopolitical tensions rise, it's important that we continue to identify, understand and develop responses to both natural hazards and other threats including cyber and physical sabotage/attack. In addition to cyclic review of existing response plans we need to consider the following:	**Prioritisation of current work (Now-2028)** • Continue to grow our understanding of the space weather hazard and refine our industry response plan and interactions with NEMA etc. This may include accessing new or different datasets from overseas jurisdictions. **Future investment priorities (2028-2031)** • Work with industry and NEMA to identify the most critical high impact low probability hazards, review and refine any existing response plans based on latest understanding of the hazards and develop new response plans for any hazards not covered.

ID	Initiative	Description	Planned for delivery
P5.6	**Increase industry response capability**	With increasing system complexity, new participants, and a rising risk of events occurring on the power system resulting in disruptions to consumers supply it is becoming increasingly important for us to work together to test and refine our response capability. To do this we undertake regional restoration workshops, simulations exercises, and pan-industry exercises, which draw heavily on people to plan and execute, and have limitations due to our current training simulator functionality.	**Prioritisation of current work (Now-2028)** • Develop a plan to build sufficient people and technical capability such that we can more easily and more regularly test industry responses to hazards. For example, currently we only manage to facilitate one regional restoration workshop a year. We have 11 different regions to cover, meaning each region is only discussing their plan once every 11 years. **Future investment priorities (2028-2031)** • Invest in Transpower capability uplift required both in terms of people and technology to enable us to test industry response to a wider range of hazards more often.

Issues for others to consider

Through our Phase 1 consultation and subsequent engagement, stakeholders raised a number of issues that are highly relevant to the future operation of the power system but cannot be fully addressed by the System Operator acting alone. In several cases, the issue is not one of System Operator capability or performance in itself, but of broader market design, infrastructure, regulatory settings, or the need for coordination across multiple parties.

Recognising these issues in the Strategy is important and something we committed to doing through the Phase 1 engagement process. The intent is to help clarify where future system-operability risks are emerging, where dependencies exist for successful System Operator delivery, and where coordinated action will be required across the electricity sector. It also helps distinguish between matters the System Operator can address directly through its own investment, tools, operating model and processes, and matters where the System Operator's role is better framed as one of insight, implementation support, or informed coordination.

We have summarised the main areas where we believe other parties may play a critical role in progressing the right work. This is for the consideration of these different organisations as they plan their future work programs and decision making.

- **Focus for regulatory setting changes:** A recurring theme in submissions was that market and regulatory settings must keep pace with technological and system change, particularly in relation to BESS, DER, CER, demand-side flexibility and new ancillary or flexibility products.
- **Connection of new generation and load:** Stakeholders also pointed to the pace of connection and commissioning processes, and the need to unlock more from existing infrastructure, as critical to enabling electrification and new generation investment.
- **TSO and DSO roles:** Several submitters emphasised that future system operation will require far clearer articulation of TSO–DSO roles, especially as more flexibility and distributed resources sit within distribution networks rather than at the transmission interface.
- **Foundational data requirements:** There was strong emphasis on the need for common data standards, interoperability frameworks, secure information exchange, and better observability across the system — but with repeated caution that visibility should not be conflated with direct control.
- **Cross-sector information:** Stakeholders also highlighted cross-sector dependencies, including fuel and gas-market information, which sit outside the direct responsibilities of the System Operator but still materially affect security-of-supply monitoring and future system risks.

Many of these issues show up in the System Operator's priorities. Within each of the strategic priorities we have considered our role and highlighted where we are dependent on others to support the overall delivery of the outcome. We have made this distinction to ensure we are explicit about where our current role would suggest we operate so that we have can have an informed discussion with other involved stakeholders about appropriate roles and responsibilities. Consultation and engagement indicate broad support for a proactive and engaged System Operator, but it also indicates clear stakeholder expectations that responsibilities remain appropriately allocated across the sector.

The following diagram depicts at a high level where the primary responsibility likely sits in relation to the issues raised.

Appendix A: The current roles of the System Operator

The System Operator is a critical enabling service central to Aotearoa New Zealand's electricity system. Transpower performs this role, scheduling and dispatching the power system and electricity market every second of every day. Our commitment to this role enables a cost-effective, reliable electricity supply upon which homes and businesses across the motu depend.

The System Operator service currently consists of six core functions:

- **Manage security** – we manage the flow of electricity from generation sources to points of demand all around the national grid, keeping frequency and voltage within operating limits, maintaining system stability and avoiding cascade failure. These are our Principal Performance Obligations (PPOs).
- **Forecast, schedule and dispatch the power system** – we coordinate electricity supply resources and balance them with forecast demand for electricity from 7 days out through to real-time. In doing so, we facilitate operation of the wholesale electricity market.
- **Forecast, monitor and coordinate security of supply** – we regularly assess the adequacy of resources on the power system to meet expected forecast demand and provide information to the industry that allows them to respond to potential supply risks, in both the operational and investment time frames.
- **Manage system security risks** – we undertake long-term planning and engineering studies to ensure any threats to real-time operation of the system are understood and mitigated. We procure and schedule ancillary services to keep the system in a secure operating state.
- **Monitor and assess compliance** – we ensure equipment connected to the power system is operating in a way that makes the system accessible for all participants. We advise asset owners when they are commissioning and refurbishing their plant and monitor its operation against performance requirements.
- **Assess and coordinate outages** – we work closely with industry, including Transpower in its grid owner role, to ensure they can undertake maintenance on the system and keep assets in sound operating condition, without compromising supply to consumers.

As the power system of the future develops, the System Operator role could expand to perform new duties that require centralised coordination and planning of resources.

How Transpower delivers the System Operator service

Transpower's Operations Division provides the 'core' System Operator service: real-time operations, operational planning, power system engineering, market scheduling and security of supply. Other divisions within Transpower provide the supporting functions required to deliver the service: ICT, data and communications infrastructure, physical assets, corporate functions, and business and strategic development. Transpower provides the System Operator service in an impartial and independent manner across its dealings with all participants, including its business as owner and operator of the National Grid.

This integrated model (Grid Owner and System Operator functions in a dual-role entity) provides efficiencies that deliver value for New Zealand electricity consumers. In particular:

- Transpower employs a high level of expertise and foresight in the evolution of the system. Leveraging this understanding of where and how much renewable generation is coming into the electricity system, as well as the needs of electricity distribution businesses and other large customers from the transmission grid, helps the System Operator better understand and prepare for future challenges.
- close cooperation (where that does not compromise independence) between the grid operator and System Operator teams within a single organisation increases the efficiency of our day-to-day service provision. Our teams benefit from coordinated training, common management structures and knowledge sharing that reduces operating costs.
- as an integrated business, Transpower can attract top talent to continue the development of New Zealand electricity system as well as provide opportunities for staff to upskill and gain experience in a wide range of roles. This ultimately increases the expertise and knowledge base of the people providing the System Operator role.
- we are able to reduce costs of providing the System Operator service by leveraging Transpower's corporate capabilities and physical assets.

Managing impartiality within Transpower

We remain committed to providing the System Operator service with impartiality and independence from Transpower's grid owner role, as required by the Code. We ensure this by putting in place measures and controls to address any perceived or actual conflicts of interest, such as:

- training all Transpower staff on the need for impartiality between Transpower's dual roles;
- maintaining a conflicts of interest register;
- escalation pathways at operational and governance levels; fostering a workplace culture of awareness of the separation of roles and ensuring we conduct ourselves with professionalism;
- having a committee of the Transpower Board to focus on the System Operator service including providing strategic direction, reviewing our approach to risk management, and assessing performance; and
- having a senior leadership role, to oversee System Operator impartiality and regulatory independence.

Supporting the Authority's objectives

In delivering the System Operator service, we are a provider to the Authority. As New Zealand's electricity regulator, the Authority has several roles to which we contribute:

- **Operating the electricity system and markets:** we provide the System Operator service, coordinating the day-to-day functioning of the power system and facilitating the operation of the electricity market along with other market operation service providers.
- **Enforce compliance:** under Part 8 of the Code we are responsible for monitoring participants' compliance with their common quality obligations. We also monitor market operation and provide analysis and advice to the Authority on system events. This includes supporting participants to connect to the power system and engage in the market effectively.
- **Promote market development:** we support the Authority in its development of the market rules, through provision of operational expertise and implementing regulatory changes in our systems and processes. We work closely with the Authority to provide input to its process for amending the Code to enable new technologies and new modes of operation

Appendix B: Phase 1 engagement on trends and drivers

We received consistent feedback through submissions and stakeholder engagement that our articulation of the key trends, drivers, and their impacts accurately reflects industry perspectives.

In addition to formal submissions, we undertook targeted engagement with a broad cross-section of the industry, including electricity distributor businesses (EDBs), generators, retailers, energy service providers, large energy users, regulators, and industry bodies. In total across industry, regulators and Transpower we held between 20-25 separate workshops and meetings on Phase 1. These workshops focused on identifying key system issues, challenges, and risks for the System Operator, building on trends and drivers from the SO Strategy Phase 1 consultation. Participants used a structured, bottomup approach, capturing opportunities, risks and challenges from the trends and drivers and clustering into themes for deeper discussion.

Collectively, across submissions and workshops, several trends and drivers had strong convergence on their importance and impact on the future operation of the power system. These are summarised below.

Political and regulatory environment	Economic and market changes	Environmental	Societal and consumer evolution	Technological change
Geopolitical instability	Electrification investment	Climate change	Changing demographics	Inverters and BESS
NZ electricity reform	Increased electricity demand	Weather dependence	Talent pipeline	Decentralisation
Focus on security of supply	Price volatility		Increasing reliance on electricity	Data and digitisation
Pace of regulatory change	Firm and flexible supply		Local resilience	Artifical intelligence
	Electricity market innovation/DSO		Energy affordability	

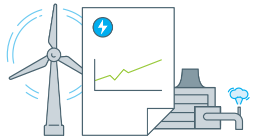
Appendix C: Risk Mapping

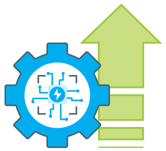
High level threat	Ref	Sub level threat	Applicable Strategic Priority
Failure to evolve with the operating environment	**1.1**	Risk that System Operator does not have the tools or processes to securely manage a changing operating environment	All priorities
	1.2	Risk that regulations and standards do not keep pace with changing environment	1. Operating a secure, highly variable power system 2. Efficient market operations and information provision 4. Leveraging data and distributed resource integration
	1.3	Risk of external processes and funding not evolving with our operating system	Covered elsewhere within System Operator policy and contractual arrangements
Failure to maintain service levels	**2.1**	Reputational risk (Loss of social license)	All priorities
	2.2	Risk of failing to meet expected customer requirements	All priorities
	2.3	Risk of grid-scale cyber security event	3. Evolving operational capability 5. Strengthening industry resilience
Failure of tools, facilities or people to manage the power system	**3.1**	Risk of not having skilled people in roles	3. Evolving operational capability
	3.2	Risk of tools being unable to manage power system	All priorities
	3.3	Risk affecting availability or safety of facilities	5. Strengthening industry resilience
Insufficient power system assets to manage the power system	**4.1**	Risk of insufficient information to reliably operate the power system	1. Operating a secure, highly variable power system 4. Leveraging data and distributed resource integration
	4.2	Risk of insufficient supply to meet demand or ancillary services	1. Operating a secure, highly variable power system 2. Efficient market operations and information provision
	4.3	Risk of significant power supply interruptions	1. Operating a secure, highly variable power system 2. Efficient market operations and information provision 4. Leveraging data and distributed resource integration 5. Strengthening industry resilience

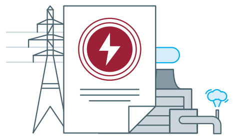
Appendix D: Issues identified through stakeholder feedback

The table below sets out the issues identified through stakeholder feedback, and maps how they connect to the key trends and drivers shaping the system, and how these in turn inform the strategic priorities.

Strategic Priority	Stakeholder Group	Issue	Group trend/driver
 **SP1: Operating a secure, highly variable power system**	Grid Owner (Transpower)	**Proliferation of special protection schemes (SPS):** The growing use of SPS and risk of multiple SPS interactions is not yet consistently understood end to end, which increases operational complexity and can undermine secure, predictable system operation.	Economic and market changes
		Real-time security challenges: Maintaining a secure and stable system in real time is becoming harder as variability increases across generation types and weather dependent system conditions.	
		Increasing voltage and stability risks: Voltage management and broader system stability are becoming more challenging as performance depends more heavily on distributed and inverter-based resources across the system.	Technological change
		More complex outage planning: Outage planning is becoming more difficult as greater uncertainty, accelerating system change, and the pace of renewable build out occurs (e.g. renewable generation build out).	Environmental
	Generator	**Security risks are becoming more dynamic and real time:** New realtime risks (inverters, voltage, fuel, weather) are emerging faster than legacy tools can detect, price, or mitigate them.	Economic and market changes
		Inverter based resources are impacting on system operations: These are not being integrated in a way that preserves essential system capabilities (e.g. to replace inertia, voltage support, and system strength as synchronous assets exit).	Technological change
		Operational practices are too conservative for today's system "sacred cows": Conservative operational conventions and capability constraints limit efficient use of existing assets (e.g. Longstanding operational "rules of thumb" such as N1, outage practices, offload times, protection standards).	Political and regulatory environment
	EDB	**Large new loads as a system risk:** Datacentres and other large new loads (size, connection voltage, uncertain profiles) create major stability and emergency management risks and opportunities, which are not explicitly address in generation focused regulatory frameworks.	Economic and market changes
		Inverter based resources, flexibility and BESS: Rapid growth and changes in behaviour from inverter based and flexible resources (e.g. EV, BESS) is increasing operational complexity, challenging system visibility, forecasting outage planning, and regulatory alignment, creating emerging operability and security risks.	Technological change
	Cross industry and energy user	**The system is becoming weather-dependent and harder to maintain reliably:** Greater reliance on intermittent renewables, weather variability, hydro and declining utilisation of firm thermal assets in normal conditions, while still depending on them in stress events.	Environmental

Strategic Priority	Stakeholder Group	Issue	Group trend/driver
 **SP2: Efficient market operations and information provision**	**Generator**	**Firm and flexible resources and scarcity are not valued adequately:** The system lacks fit for purpose mechanisms to value and procure firm and flexible supply in a high intermittency environment, distorting investment and operational behaviour.	**Economic and market changes**
		Pace mismatch of market frameworks and regulations lag technology: Slow, fragmented, and poorly signalled regulatory change is creating uncertainty, limiting innovation, and constraining efficient system operation.	**Political and regulatory environment**
	EDB	**Regulation pace mismatch with technology and system change:** The pace and volume of regulatory change are outstripping the sector's capacity to respond, with inconsistent capability and readiness across participants.	**Political and regulatory environment**
	Retail and Energy Services	**Inconsistent incentives for flexibility:** Flexibility is not yet consistently valued across transmission, distribution and market settings, weakening investment signals and participation (e.g. implementation of distribution and transmission pricing models).	**Economic and market changes**
		Increased variable renewable energy requires greater demand side participation: Outcomes increasingly rely on coordinated supply and demand response in a variable renewable energy weather dependant system.	
		Fragmented systems create complexity: Fragmented systems create complexity and barriers to participation, particularly for aggregators (e.g. 29 EDBs, differing protocols)	**Political and regulatory environment**
		Market signals do not consistently support flexibility investment: Current price and market signals alone may be too incomplete, or poorly translated into investable demand side and flexibility responses and needs better predictability and enabling frameworks than relying on the spot electricity market.	
	Cross industry and energy user	**Growing importance of investment and operational signals for flexibility and firming:** The system needs more flexibility and firming, but investment and operational signals may be insufficient. The need to address intermittency (e.g. wind, solar, climate) is driving focus on firm capacity, storage, and new market/products, alongside better signals for investment and dispatch.	**Economic and market changes**
		Electrification investment in large loads as a major demand shock: Large, lumpy load growth (e.g. data centres) and connection demand are creating timing, capacity, and system stability challenges.	
		The system needs firm and flexible supply: Firm and flexible supply is the main lever to deliver security of supply at lowest cost and there is a role for the System Operator playing a stronger leadership role including ability to support (e.g. capacity, capability).	
		Misalignment between market/regulatory frameworks and system needs: Rapid technology change and political cycles are outpacing regulatory settings, creating investment uncertainty and operational friction.	**Political and regulatory environment**
		Security of supply is key: The system may not deliver enough supply to maintain security of supply at lowest cost. An emerging gap in security of supply needs to be addressed and requires greater accountability to ensure it is delivered.	
		Affordable energy is critical for industry: Energy affordability is highlighted as critical for business confidence, investment, and economic growth.	**Societal and consumer evolution**

Strategic Priority	Stakeholder Group	Issue	Group trend/driver
 **SP3: Evolving operational capability**	**Grid Owner (Transpower)**	**System Operator agility constraints:** The System Operator is increasingly constrained in its ability to adapt to fast changing and more complex system behaviour (e.g. technology) and respond through evolution of tools.	**Economic and market changes**
		Erosion of operational knowledge and experience: The loss of critical operational expertise, alongside growing capability demands, risks reducing control room effectiveness (e.g. talent/digital skills).	**Societal and consumer evolution**
		Workforce capacity and capability constraints: Workforce capacity and capability may become a limiting factor as the system becomes more complex and the demands on operational expertise continue to increase.	
		Information overload outpacing decision-making: Limits the ability to convert data into effective operational decisions (human and non-human centred decision making).	**Technological change**
	Generator	**Electrification is outpacing system readiness:** Demand growth, especially from large new loads, is moving faster than transmission, market reform, and operational capability, risking System Operator ability to enable electrification.	**Economic and market changes**
	EDB	**Human capability, talent pipeline and future capability:** Scarcity of operational talent and training burdens in System Operator and EDB control rooms were identified as risks, with support for collaboration, and need for new future system digital skills alongside a human in the loop governance for AI and automation.	**Societal and consumer evolution**
	Cross industry and energy user	**Data, forecasting, and digital capability becoming foundational:** Current data, visibility, forecasting, and digital capability (including AI) may be insufficient for a more complex, dynamic system. Role of data and digitalisation is essential to avoid rising costs and system risk as electricity demand grows.	**Technological change**
 **SP4: Integrating data and distributed energy resources**	**Grid Owner (Transpower)**	**Limited visibility of behind the meter distributed energy resources:** Limits whole of system awareness and makes it harder for operational coordination between participants.	**Technological change**
		Poor data reliability and interoperability: The System Operator is increasingly reliant on data that is not always sufficiently reliable, interoperable, or high quality enough to support confident and timely operational decisions.	
		Unmanaged AI adoption risks: Increasing use of AI without sufficiently mature governance, assurance, and shared understanding of its limits could lead to greater operational reliance before appropriate safeguards are in place.	
	Generator	**System visibility and data is insufficient:** Fragmented and incomplete operational, demand, and fuel data reduce realtime confidence, coordination, and trust in system decision limiting operational confidence and coordinated decision making.	**Technological change**
	EDB	**Power system quality issues:** Unclear accountability and operational ownership for security of supply, voltage, inertia, and power quality across the transmission and distribution boundary.	**Economic and market changes**
		DSO-TSO role, interoperability and coordination: Roles, standards, and coordination mechanisms between the System Operator, DSOs, retailers, and aggregators are unclear and have weak visibility of flexibility, and poor coordination during contingencies.	
		Whole of system visibility and interoperability: Limited distribution level visibility of load/DER/flex and inadequate data sharing and real time accurate information. Visibility and interoperability needed for effective coordination and resilience.	**Technological change**
		Data, digitalization and AI: The electricity system lacks a shared and common data operating model, with fragmented standards, unclear ownership, weak forecasting, and no agreed governance for AI use. This is critical as data and AI are seen as critical enablers for system operations.	
	Retail and Energy Services	**Lack of data foundations:** Immature industry data foundations limit competition, visibility, access and participation (e.g. standards, interoperable, communication protocols etc).	**Technological change**
		Visibility of flexibility: The system has limited visibility of the capability, availability and response characteristics of flexible demand and distributed resources (e.g. real time, day ahead).	
	Cross industry and energy user	**Distributed resource integration increases system complexity and reduced visibility:** More distributed, behind the meter, and dynamic resources are making system behaviour harder to predict and operate in real time.	**Technological change**

Strategic Priority	Stakeholder Group	Issue	Group trend/driver
 **SP5: Strengthening industry resilience**	**Grid Owner (Transpower)**	**Unclear operating model for emerging risks:** Cyber security, regulatory change, and resilience are becoming more material operational risks without a clear model to manage these risks	**Technological change**
	EDB	**Restoration event management & emergency response blind spot:** Increased events means system restoration is increasingly complex and unpredictable at LV, power quality oscillations /system swings and worsening voltage/FR, with DER/flex hard to restore safely and need for coordination mechanisms.	**Environmental**
		Event coordination, communication readiness: The system is underprepared for major events due to limited shared planning, poor real time visibility, unclear restoration processes, and reliance on manual communication channels.	
	Retail and Energy Services	**Clarity of roles and obligations needed:** The growth of decentralised and aggregated resources is outpacing the clarity of market roles, operational obligations, and visibility requirements (for example, roles in dispatch / load management approaches with retailers, aggregators and EDBs.	**Economic and market changes**
	Cross industry and energy user	**Weather and climate risks are materially increasing system uncertainty:** More frequent extreme events and hydrological variability are directly impacting both physical assets and energy resilience and availability.	**Environmental**

Appendix E: Control Room of the Future

New Zealand's electricity system is becoming more complex to operate in real time. Increasing electrification, renewable variability, decentralisation, and more frequent weather-related disruption are driving higher levels of operational uncertainty and risk.

These pressures are concentrated in the control room, where timely, consistent decisions are critical to maintaining system security and quality market outcomes. However, current operational capability—reliant on fragmented data, manual processes, and tacit knowledge—will not scale effectively to this future state. Without intervention there is a growing risk of:

- Reduced consistency and predictability in system operation
- Slower response under stressed system conditions
- Increased reliance on individual expertise rather than systemised capability

As system complexity increases, so too does the consequence of these risks.

The Control Room of the Future (CRoF) is a targeted programme to ensure real-time operational capability remains fit-for-purpose as the system evolves. It delivers a coordinated uplift across eight key areas:

- Standardised and unified operational data – enabling a single, trusted operational view
- Knowledge management capability – improving access to critical operational knowledge
- Streamlined and sensibly automated operational processes – reducing manual effort and variability
- Operational intelligence and decision support – embedding analytics and advanced tools into decision making
- Unified operator experience and advanced tools – reducing cognitive load and improving usability
- Operational communications and event response – strengthening coordination across the system
- Operator learning evolution – building future-ready workforce capability
- Adaptable facilities and hardware – supporting flexible and resilient operations

This represents a step change in how real-time operations are supported, aligning people, process, and technology to manage increasing system complexity.

CRoF directly addresses the emerging risk by delivering:

- More consistent and reliable decision making – Faster, repeatable, and better-informed operational responses
- Reduced operational risk – Lower reliance on manual processes and improved ability to manage dynamic system conditions
- Improved efficiency – Automation of routine activities and better use of operator capability
- Scalable capability for future growth – Ability to operate a larger, more dynamic and data-rich system

These outcomes ensure the System Operator can continue to maintain system security and reliability as complexity increases.

CRoF is a foundational enabler of the electricity system:

- Supports system security and reliability, underpinning all market outcomes
- Maintains efficient market operation through consistent and predictable system actions
- Reduces the likelihood and impact of high-cost system events
- Enables effective integration of renewable and distributed resources

It also delivers system-wide benefits, including greater certainty for participants, improved coordination during events, and stronger overall system resilience. As the electricity system evolves, the capability to operate it in real time must evolve faster. CRoF is a targeted investment in the operational backbone of the system—ensuring increasing complexity does not compromise security, reliability, or market performance. Over the next 12 months we will be looking to engage and share more with industry on CRoF.

Control Room of the Future

Our Vision

A future-ready control room that combines people, technology and intelligence to operate New Zealand's power system safely, securely and efficiently for a better energy future.

People Empowered

Skilled operators with better tools, insights and support to make confident decisions.

Intelligent Operations

AI and advanced analytics turning data into real-time insights and decision support.

Connected Ecosystem

Seamless data and communication across the power system and industry.

Resilient by Design

Built for resilience, adaptability and security in a rapidly changing world.

Sustainable Outcomes

Enabling a reliable, affordable and sustainable energy future for Aotearoa New Zealand.

Appendix F: Increasing vulnerability to cyber risks

The electricity sector in New Zealand consists of multiple businesses with different roles and levels of capability. There are twenty-nine distribution companies, with operations ranging from large urban networks to smaller rural systems. Their size and technical sophistication vary; some have extensive networks with automation, while others operate on a smaller scale with basic setups. Electricity generation is dominated by five main firms, but smaller generators also contribute. Distributed and embedded generation, such as rooftop solar and industrial cogeneration, adds further complexity.

This diversity helps decentralise supply, but it potentially increases risk. Some smaller operators may not have robust cybersecurity measures, while larger organisations face complex threats due to their scale and connectivity. The interconnected nature of the sector means that a failure in one area may affect the wider system.

Transpower uses the Inter-Control Centre Communications Protocol (ICCP) for secure, real-time data exchange with industry partners. Telemetry links with external parties, such as generator and distributor control centres, are being migrated to this standard. The ICCP system transmits critical functions, including dispatch instructions, over secure channels. Transpower also operates the TransGO telecommunications network, which connects substations and control centres for protection and SCADA communications. This private, fibre-optic network allows Transpower to monitor and control the grid, as well as operate the wholesale electricity market systems, without relying on public internet networks.

While New Zealand hasn't experienced major cyber-induced outages, international incidents are increasing and cybersecurity risk in the electricity sector is no longer confined to firewalls and passwords. Our analysis shows there are three critical emerging areas of threat.

- **Supply Chain:** Sophisticated cyber adversaries increasingly bypass direct attacks by targeting third-party vendors, suppliers, and service providers with privileged access. Considering this sector, this can include manufacturers of operational equipment, software vendors supporting SCADA and corporate systems, and contractors with remote access for maintenance. A compromise at any point in this chain—whether through malicious code in a software update or stolen credentials—can serve as a gateway into critical infrastructure.
- **Geopolitics and State Actors:** Geopolitical tensions are reshaping the threat landscape for critical infrastructure, with state-sponsored cyber actors increasingly targeting electricity networks as part of broader strategic campaigns. Groups such as Volt Typhoon and Salt Typhoon, linked to the People's Republic of China, exemplify this shift—operating stealthily within energy and telecommunications systems to establish footholds for potential future disruption. Their tactics, which blend into normal network activity, make detection particularly challenging.
- **Personnel and Human Engineering Risk:** Personnel risk remains one of the most persistent and complex challenges in cybersecurity. Inadvertent errors and insider threats can undermine even the most robust technical controls. The rise of AI-assisted impersonation— through hyper-personalised phishing, voice deepfakes, and synthetic personas—has elevated the threat landscape. These techniques blur the line between legitimate and malicious communication, making user awareness and rapid reporting essential.

As well as new opportunities, the rapid expansion in digital technology creates risks that utilities and asset owners must manage to ensure security of supply. This impacts both new assets connecting to the power system, and also the tools that operators use to manage networks. New DER devices, being largely commercial-off-the-shelf and internet-connected, may not come with robust cybersecurity protections by default, which in aggregate creates a significant risk of exploitation. In some cases, these technologies are also vulnerable to malign influence from state actors. Similarly, a more complex network requires sophisticated software solutions and network integration, many of which are vendor-supplied; as vendors meet their requirements to maintain operable and secure software, this is driving increased maintenance costs. Increasing digitalisation and mitigation of inherent risks will require greater interconnectedness among industry participants to collectively manage and enforce good data hygiene and cyber security.

Going forward there is a clear need for a coordinated, sector-wide approach to cybersecurity and reliability within New Zealand's electricity sector. As the threat environment continues to escalate government and industry must work in partnership.

Our approach to cybersecurity

We will continue to invest in cybersecurity controls to maintain existing capabilities and develop new capabilities in response to the changing threat, technology and business environments with a view to maintaining the cybersecurity risk profile in alignment with Transpower's risk appetite.

While we are not mandated to comply with any specific industry regulations for cybersecurity, our approach is to selectively align with the following standards where requirements are relevant to Transpower, to drive the effectiveness of our cybersecurity controls and validate our alignment to cybersecurity best practices:

- **ISO27001:2013 – Information Security Management:** Secure our information assets by informing requirements for establishing, implementing, maintaining and continually improving our information security management.
- **Voluntary Cyber Security Standards for Control Systems Operators (VCSS – CSO):** Leverage guidance on New Zealand best practices for mitigating risk to industrial control systems and infrastructure. We assess ourselves on a regular basis against the VCSS-CSO standards and continuously work with New Zealand government agencies and other industry participants to adapt and refine our approach as required.
- **Center for Internet Security (CIS):** The Critical Infrastructure Protection (CIP) security standards are issued by the North American Electric Reliability Corporation (NERC). Compliance is mandatory for all North American entities that own or manage facilities that are part of the US and Canadian electric power grid. Many other countries have adopted standards and frameworks that align with the NERC-CIP precepts. Transpower has adopted the Center for Internet Security (CIS) Control model, which defines 20 controls that encompass the same breadth of topics as NERC-CIP but is less prescriptive, not being designed for mandatory application. These standards are used to define and measure the effectiveness of our controls. Control performance is monitored and reported on monthly basis and drive the prioritisation of our cybersecurity investments.
- **National Institute of Standards and Technology (NIST):** Leverage selected requirements from NIST standards to inform domain specific security policies and standards.

Glossary

Term / Abbreviation	Description
ACS	Asset Capability Statement
AI	Artificial Intelligence
API	Application Programming Interface
AUFLS	Automatic Under Frequency Load Shedding
BESS	Battery Energy Storage System
CACTIS	Connected Asset Commissioning, Testing and Information Standard
CER	Consumer Energy Resource
CRoF	Control Room of the Future
DER	Distributed Energy Resource
DSO	Distribution System Operator
EA / Authority	Electricity Authority
EDB	Electricity Distribution Business
EECA	Energy Efficiency and Conservation Authority
ENA	Electricity Networks Aotearoa
ERC	Electricity Risk Curve
ESI	Electricity Supply Industry
ESO	Electricity Security Outlook
EV	Electric Vehicle(s)
GO	Grid Owner
IBR	Inverter-based resource(s)

Term / Abbreviation	Description
LMP	Load Management Protocol
LNG	Liquefied Natural Gas
LV	Low Voltage
MBIE	Ministry of Business, Innovation and Employment
MW	Megawatt
NEMA	National Emergency Management Agency
NIWA	National Institute of Water and Atmospheric Research
NTS	Non-transmission solution
NZGB	New Zealand Generation Balance
POCP	Planned outage coordination process
PPO	Principal Performance Obligation(s)
SO	System Operator
SOSA	Security of Supply Assessment
SOSPA	System Operator Service Provider Agreement
SPD	Scheduling, Pricing and Dispatch
SPS	Special Protection Scheme, also referred to as a remedial action scheme (RAS)
SSAD	Security Standards Assumptions Document
SSF	System Security Forecast
SST	Simulated Storage Trajectory
TSO	Transmission System Operator

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