TRANSPOWER

Opportunities and challenges to the future security and resilience of the New Zealand power system

Phase 1 Report & Phase 2 Roadmap

February 2022

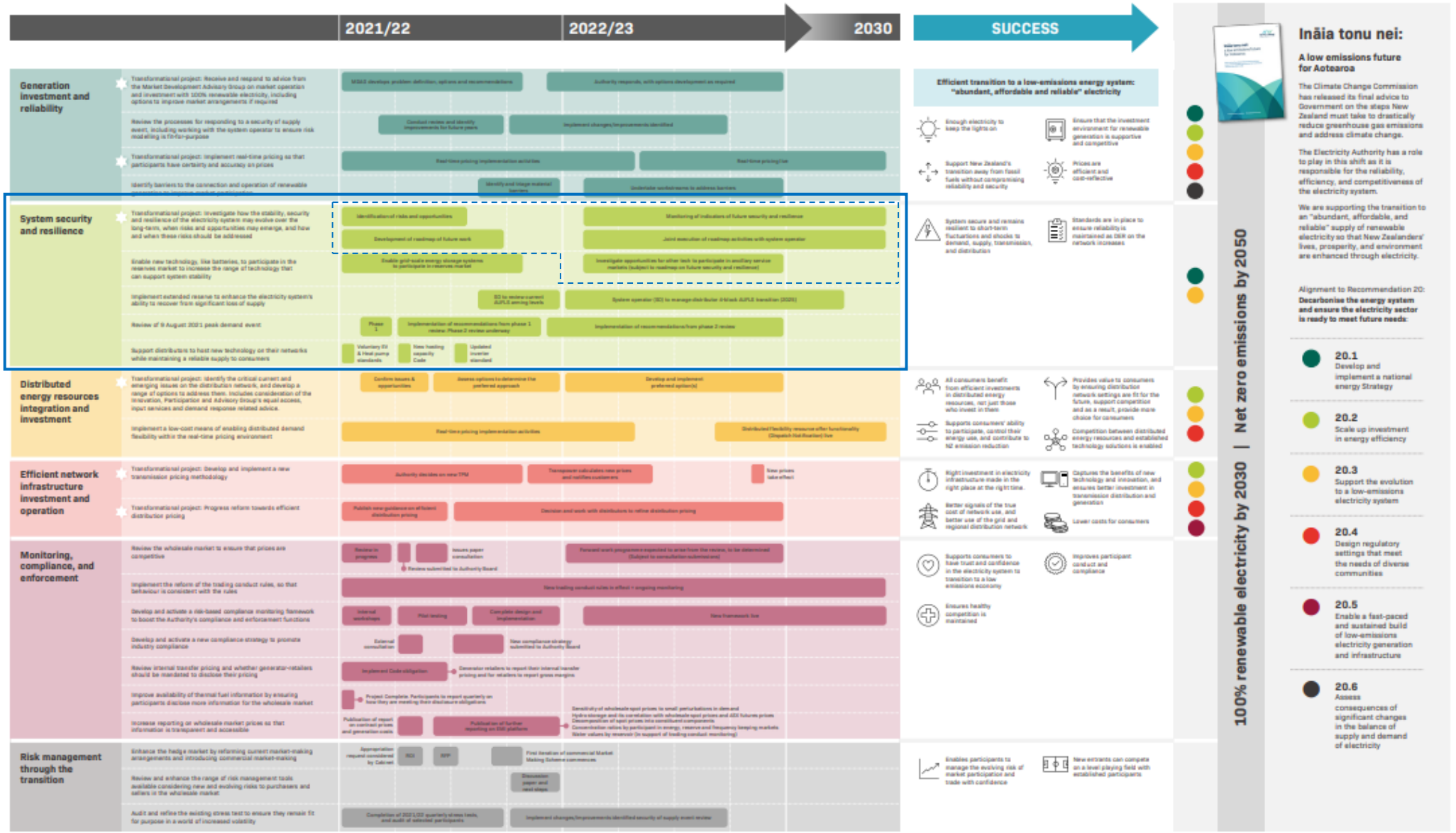
ENERGY TRANSITION ROADMAP

Supporting an efficient transition to a low-emissions energy system

New Zealand has committed to achieving net zero emissions by 2050, with the Government aspiring to achieve 100% renewable electricity by 2030. Heating and transportation in New Zealand will need to be electrified. The significant increase in demand for electricity will require large quantities of new renewable electricity generation, increased use of distributed energy resources, new ways to participate and more participants – changing the dynamics of the electricity system and markets.

As the regulator of New Zealand's electricity system, our work provides an important platform for the country's aspirations. Low-emissions energy is one of our five key strategic ambitions, and we are working to ensure the transition is as efficient as possible while maintaining energy security, system adaptability, and affordable electricity for consumers.

ELECTRICITY AUTHORITY
TE MANA HIKO



Ināia tonu nei:

A low emissions future for Aotearoa

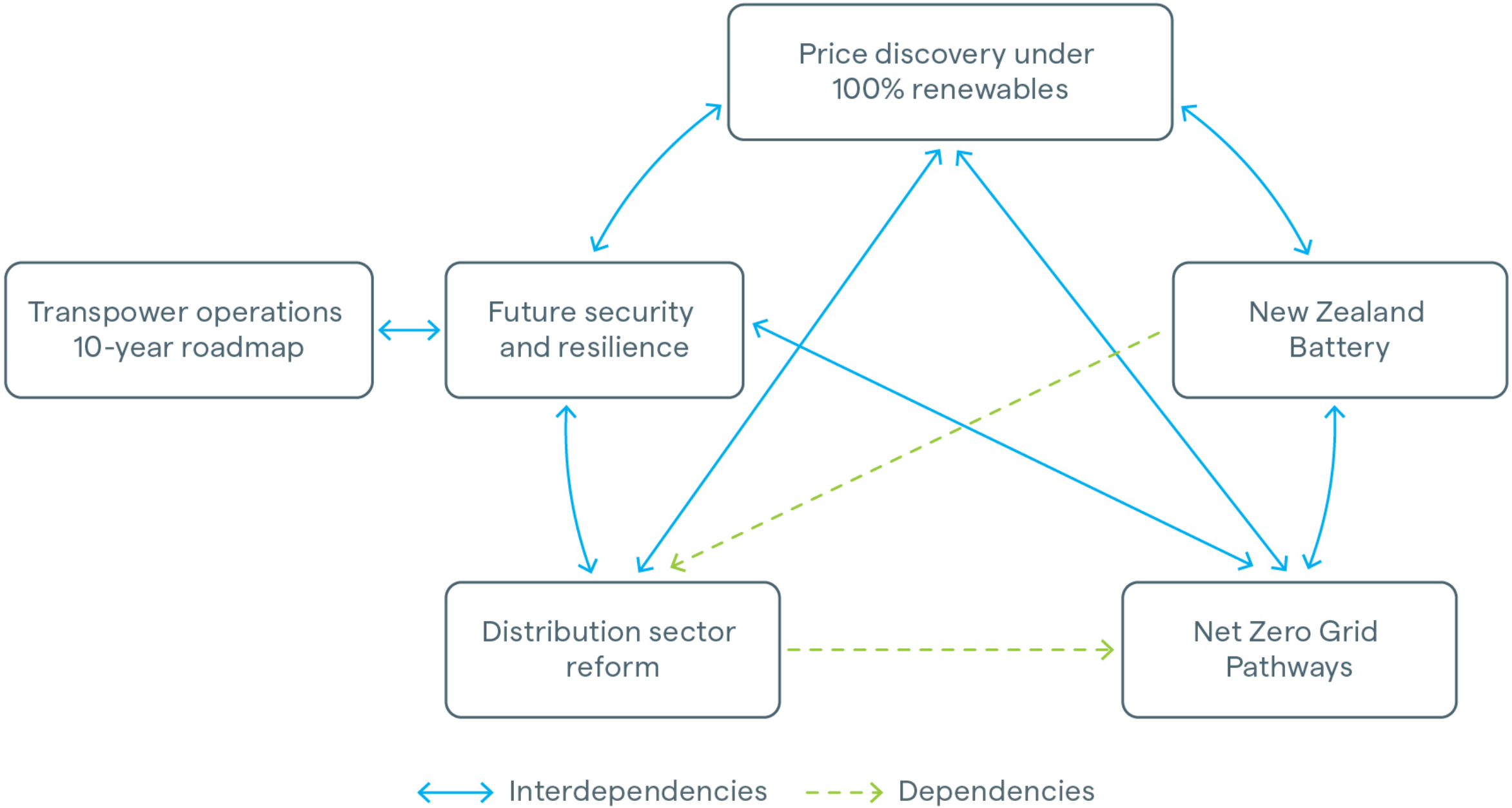
The Climate Change Commission has released its final advice to Government on the steps New Zealand must take to drastically reduce greenhouse gas emissions and address climate change.

The Electricity Authority has a role to play in this shift as it is responsible for the reliability, efficiency, and competitiveness of the electricity system.

We are supporting the transition to an "abundant, affordable, and reliable" supply of renewable electricity so that New Zealanders' lives, prosperity, and environment are enhanced through electricity.

Alignment to Recommendation 20: **Decarbonise the energy system and ensure the electricity sector is ready to meet future needs:**

- **20.1** Develop and implement a national energy Strategy
- **20.2** Scale up investment in energy efficiency
- **20.3** Support the evolution to a low-emissions electricity system
- **20.4** Design regulatory settings that meet the needs of diverse communities
- **20.5** Enable a fast-paced and sustained build of low-emissions electricity generation and infrastructure
- **20.6** Assess consequences of significant changes in the balance of supply and demand of electricity


Price discovery under 100% renewables
Transpower operations 10-year roadmap
Future security and resilience
New Zealand Battery
Distribution sector reform
Net Zero Grid Pathways
Interdependencies
Dependencies

FSR background and approach

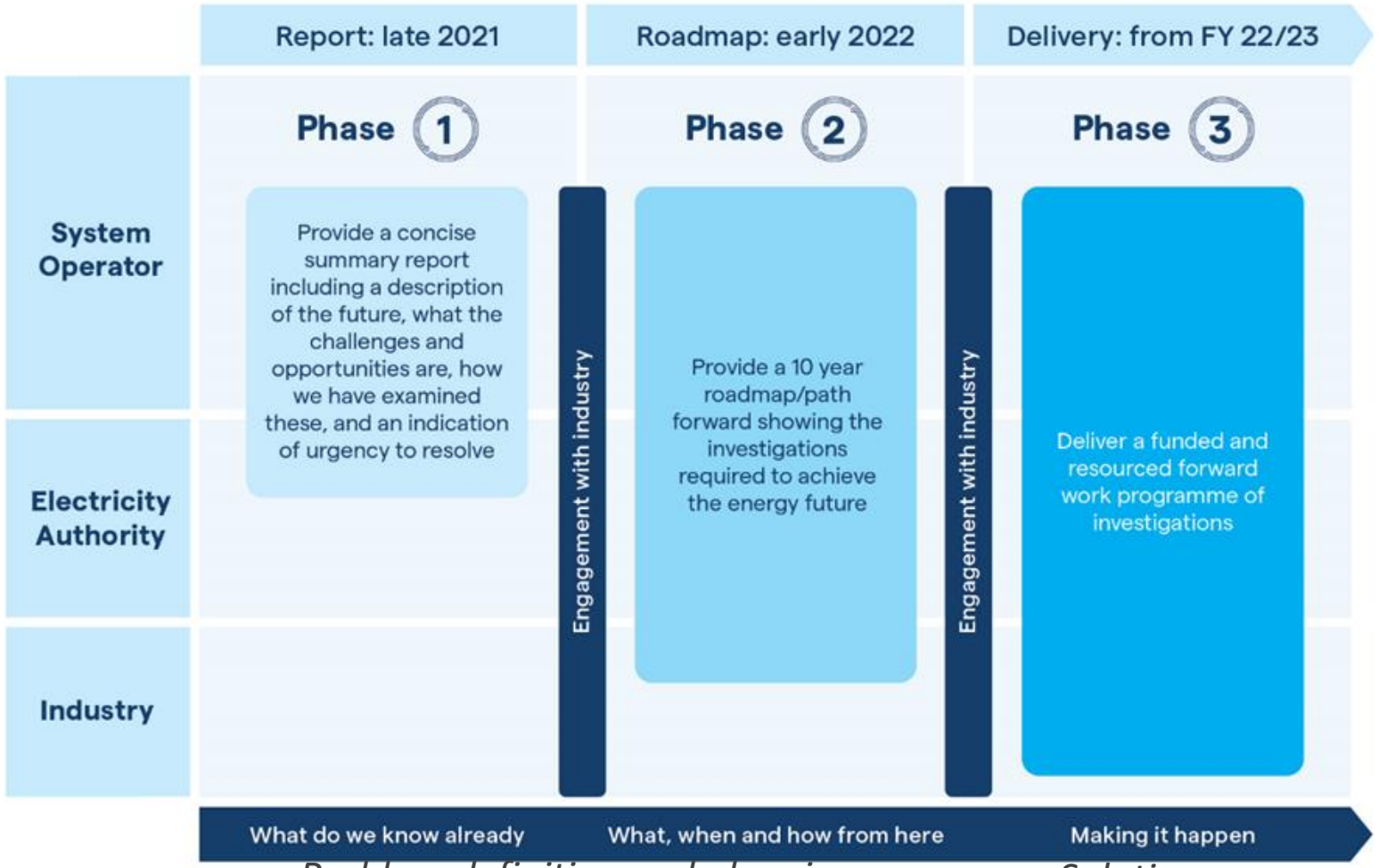
What is the Future Security and Resilience programme?

Key trends	Current	2030
Decarbonised: Transition to 100% renewables	• 85% renewable electricity • Mostly synchronous generation • Security of supply managed by market • Thermals to meet peaks and dry years • Small amount of DER	• 100% renewable electricity • More asynchronous and inverter-based generation • Will energy-only market manage security of supply? • New solutions needed for peaks and dry year • Increased reliance on DER
Decarbonised: More electrified economy	• High reliance on electricity in the economy • Electricity not relied on heavily for transport • Few, traditional demand growth sources – new industry, new housing	• Very high reliance on electricity in the economy • Electricity relied on heavily for transport and in industry • Many different demand growth sources – hydrogen, data centres, EVs, process heat
Distributed: More distributed electricity system	• Small amount of DER • Limited performance requirements in the Code but small penetration means this is not yet an issue • Limited use of demand-side and battery technology to manage peaks	• Millions of DER able to manage peaks in real-time (EVs, batteries, smart appliances) • Multi-directional power flows • More consumer participation and more market players • Potential issues caused by inverter-based DER
Digitised: Increasing digitisation and use of digital tech	• Increasing data and data management requirements • Gradual use of automation for control and switching • Increased use of data-driven decision making	• Increased complexity and volume of data • Expectation from operators and customers that controls, and communications will be automated and data-driven • Opportunities to improve consistency and efficiency

Over the next 10 years, the NZ power system is expected to undergo a significant transformation

The EA have asked Transpower to develop a work programme to protect the future security and resilience of NZ's power system

Future Security and Resilience programme activities



The draft Phase 1 report has been published

Phase 1 report industry engagement is underway

Draft roadmap is about to be shared with the Electricity Authority

Opportunities & challenges to FSR (Phase 1)

How did we identify opportunities and challenges in the report?

Agreed scope and assumptions

- System Operator-centric
- Security of supply excluded

Confirmed our definitions of security & resilience

Considered what the future power system will look like

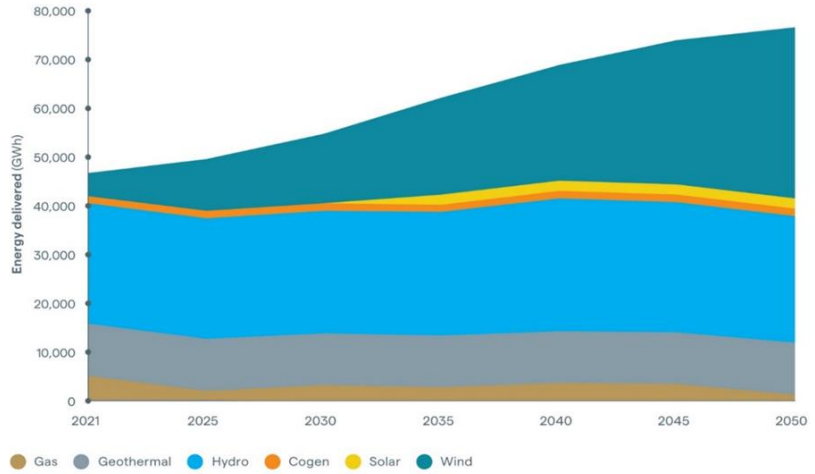
- Whakamana i Te Mauri Hiko Mobilise to Decarbonise scenario

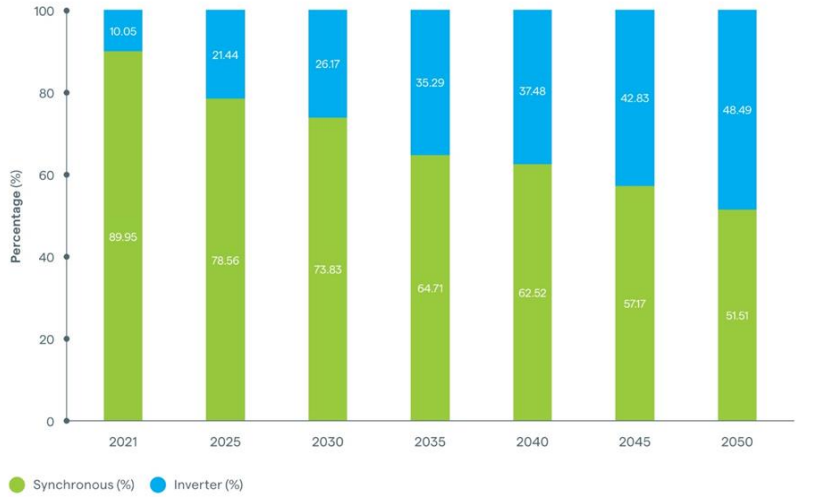
Reviewed existing studies

- Wind, Solar PV, BESS, EVs, Inertia & System Strength

Lessons learned from other jurisdictions

- Australia, Great Britain, Ireland, Hawaii, Singapore





Future Security and Resilience report findings

Opportunities and challenges	Timeframe	Priority
Leveraging DER to build and operate the future grid	3-7 years	Medium
Visibility and observability of DER	3-7 years	Medium
Coordination of increased connections	0-3 years	High
Balancing renewable generation	3-7 years	Low
Managing reducing system inertia	7-10 years +	Low
Operating with low system strength	3-7 years	Medium
Accommodating future changes within technical requirements	0-3 years	High
Leveraging new technology to enhance ancillary services	Enduring	Medium
Maintaining cyber security	Enduring	High
Growing skills and capabilities of the workforce	Enduring	High

Rise of Distributed Energy Resources Changing generation portfolio Foundational opportunities and challenges

The rise of DER

The challenges of a changing generation portfolio

Foundational

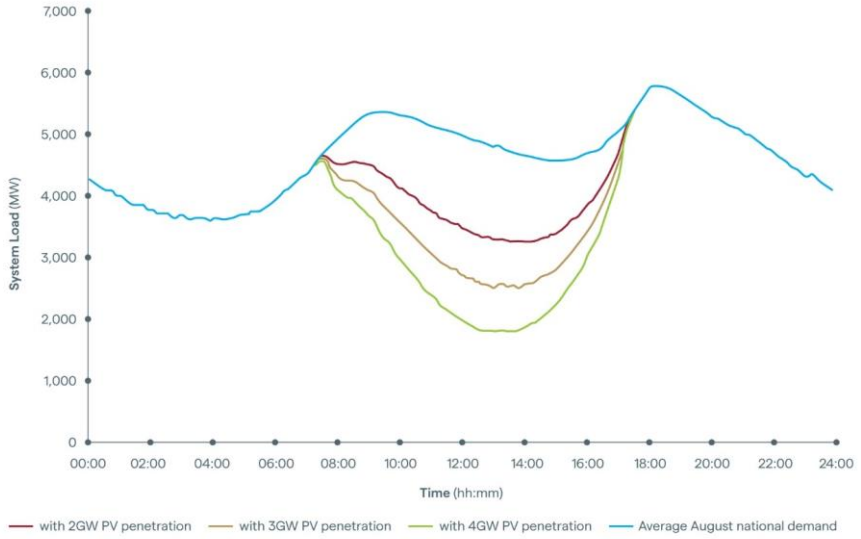
High Priority = already negatively impacting on FSR and/or given level of understanding or effort to address means it needs immediate attention

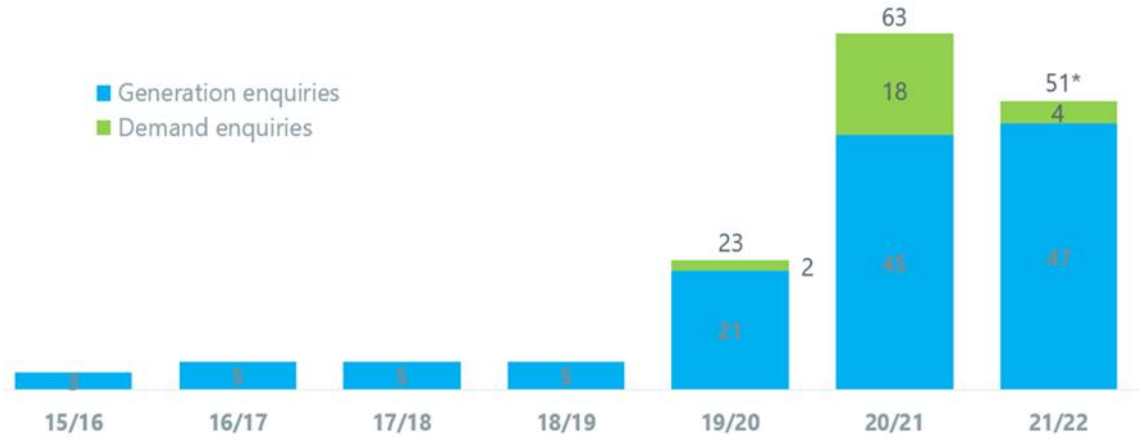
Medium Priority = no immediate negative impact on FSR but investigation required

Low Priority = not likely to impact on FSR however will be monitored for changes in priority/urgency over time

The rise of DER

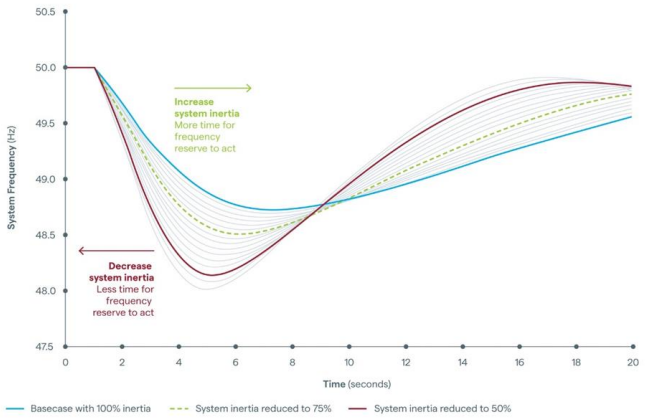
Opportunities and challenges	Timeframe	Priority
Leveraging DER to build and operate the future grid	3-7 years	Medium
Visibility and observability of DER	3-7 years	Medium
Coordination of increased connections	0-3 years	High

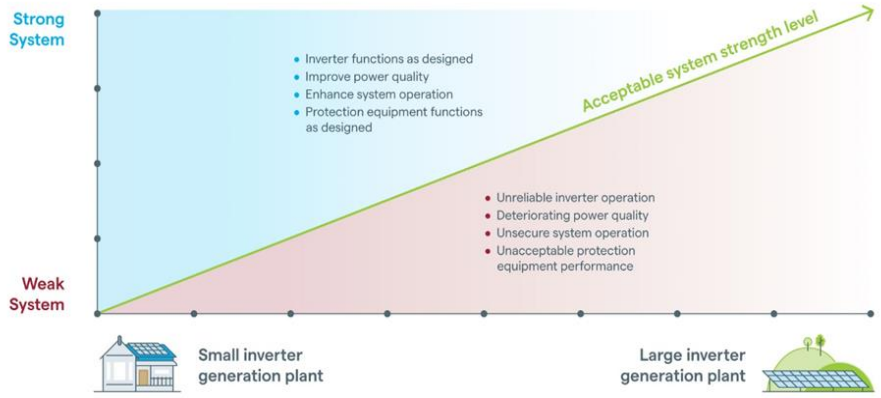




Changing generation portfolio

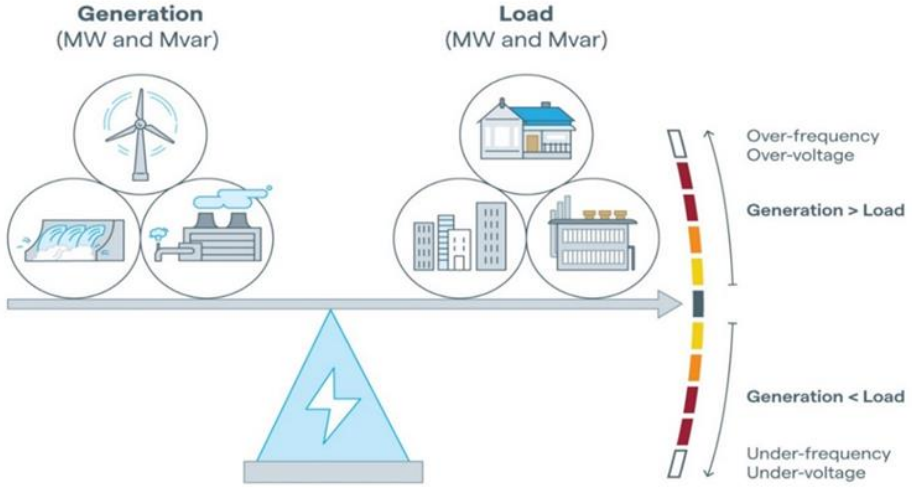
Opportunities and challenges	Timeframe	Priority
Balancing renewable generation	3-7 years	Low
Managing reducing system inertia	7-10 years +	Low
Operating with low system strength	3-7 years	Medium
Accommodating future changes within technical requirements	0-3 years	High

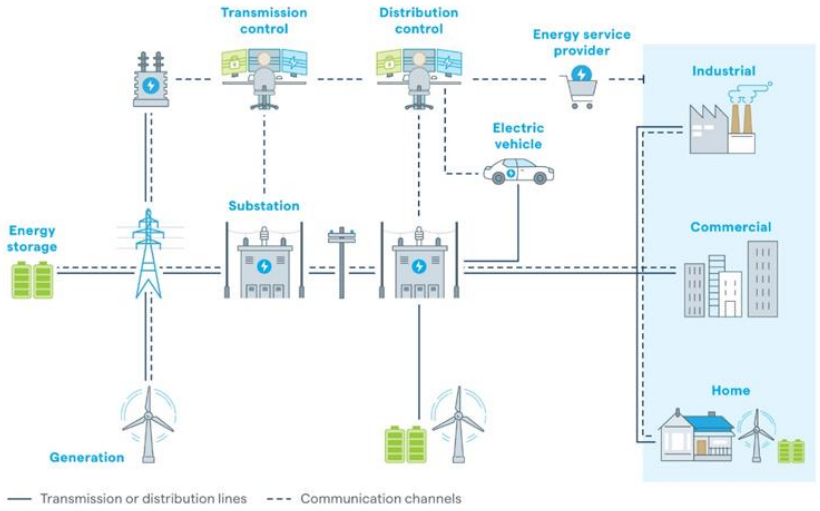




Foundational opportunities and challenges

Opportunities and challenges	Timeframe	Priority
Leveraging new technology to enhance ancillary services	Enduring	Medium
Maintaining cyber security	Enduring	High
Growing skills and capabilities of the workforce	Enduring	High





Draft FSR roadmap (Phase 2)

Opportunity or challenge		Activity		Primary enabler	Year 1 2023	Year 2 2024	Year 3 2025	Year 4 2026	Year 5 2027	Year 6 2028	Year 7 2029	Year 8 2030	Year 9 2031	Year 10 2032	Outcome
Accommodating future changes within technical requirements		7.1	Review and update Part 8 of the Code	System Operator, EA											Parts 8, 6, 7, 13, 14 of the Code will be updated to incorporate the capability and performance of new technologies and changes in the power system. Harmonics standards and other engineering standards, modelling and testing standards will take into account the introduction of new technologies. The Policy Statement and any other policies, procedures, guidelines and tools will also be updated accordingly.
		7.2	Review and update Parts 6, 7, 13 and 14 of the Code to ensure they align to Part 8												
		7.3	Identify standards to support technical requirements in the Code	Industry											
		7.4	Update the Policy Statement to manage emerging risks	System Operator, EA											
		7.5	Update the System Operator's policies, procedures, guidelines and tools	System Operator											
Coordination of increased connections		3.1	Update Grid Owner and System Operator commissioning processes and benchmark agreement	System Operator, Grid Owner											All System Operator and distributor processes will be updated to accommodate increased connections. The Grid Owner, EDBs and the System Operator will have the resources and capability to commission DER. Updated market tools, real-time operational tools and study tools will reflect the behaviour and capability of DER.
		3.2	Review the approach to planning connection studies												
		3.3	Review and update market and real-time operational tools	System Operator											
Operating with low system strength		6.1	Investigate system strength challenges and opportunities	System Operator											System strength performance criteria will be defined and established. The regulatory framework will be updated to include technical requirements for system strength. Relevant market products, operational procedures and tools will be in place.
		6.2	Amend the Code to require DER to support performance criteria	System Operator, EA											
		6.3	Develop suitable market products and tools	System Operator											
Leveraging DER to build and operate the future grid		1.1	Enhance the Code and market system dispatch capability to accommodate DER offers	System Operator											The Code will define the technology agnostic role of DER. The market system will accept offers from DER owners, and operational tools and procedures will assess and dispatch DER. Electricity markets, the Grid Owner, EDBs and the System Operator will send efficient signals to DER. Grid exit point aggregation and participation of third-party flexibility traders will be enabled.
		1.2	Improve real-time security modelling and dispatch tools												
		1.3	Investigate DER functions to support the grid												
Visibility and observability of DER		2.1	Establish the impact of DER	System Operator											The impact of high levels of DER will be understood and managed. The regulatory framework will accommodate a high degree of DER uptake. Operational requirements will be established between the System Operator and distributors/DSOs.
		2.2	Determine the risk DER poses to the system												
		2.3	Update the Code to clarify DER obligations and operational requirements	System Operator, EA											
		2.4	Update procedures and tools to include DER asset information	System Operator											
Balancing renewable generation		4.1	Improve market system and generation/demand forecast	System Operator											The market system, operational procedures and tools will allow the scheduling and dispatching of renewable generation. Intermittent generation offers and the System Operator's demand forecast will be efficient and accurate. New or revised ancillary services will effectively manage active power imbalances.
		4.2	Consider new or revised ancillary services to maintain balancing												
Managing reducing system inertia		5.1	Create a frequency reserve strategy	System Operator											A frequency reserve strategy will be created. The updated Procurement Plan and testing methodologies will support assessment and procurement of new reserve types. Operational procedures and tools will be ready to dispatch new reserve types.
		5.2	Ensure that the Code and the market system can accommodate new reserve types												
		5.3	Incorporate new reserve types in the Procurement Plan and testing methodology												
		5.4	Update operational procedures and tools												
Leveraging new technology to enhance ancillary services		8.1	Investigate ancillary services	System Operator											The regulatory framework, engineering standards and procedures will be updated to reflect the capability and performance of new technologies and other changes within the power system. The Code will enable new technologies to offer ancillary services, and the System Operator's processes and tools will allow new technologies to accept offers and dispatch ancillary services. Studies will identify whether and when new ancillary services products are needed.
		8.2	Ensure tools monitor the performance of the power system												
		8.3	Update market system to enable DER to provide existing ancillary services												
Maintaining cyber security		9.0	Continually review and update cyber security measures	New Zealand energy sector											The energy sector's approach to the management of cyber security will be robust and well coordinated.
Growing skills and capabilities of the workforce		10.0	Encourage and train the workforce's next generation	Industry, educational institutions, professional associations											New Zealand will be able to produce its own workforce, with minimum reliance on overseas talent.

Future Security and Resilience
Outcomes

OPPORTUNITIES AND CHALLENGES

CHANGING GENERATION PORTFOLIO

2022

Accommodating future changes within technical requirements

- Parts 8, 6, 7, 13, 14 of the Code will be updated to incorporate the capability and performance of new technologies and changes in the power system.
- Harmonics standards and other engineering standards, modelling and testing standards will take into account the introduction of new technologies.
- The Policy Statement and any other policies, procedures, guidelines and tools will be updated accordingly.

2025

Operating with low system strength

- System strength performance criteria will be defined and established.
- The regulatory framework will be updated to include technical requirements for system strength.
- Develop suitable market products and tools.

Balancing renewable generation

- The market system, operational procedures and tools will allow the scheduling and dispatching of renewable generation.
- Intermittent generation offers and the System Operator's demand forecast will be efficient and accurate.
- New or revised ancillary services will effectively manage active power imbalances.

2027

Managing reducing system inertia

- A frequency reserve strategy will be created.
- The updated Procurement Plan and testing methodologies will support assessment and procurement of new reserve types.
- Operational procedures and tools will be ready to dispatch new reserve types.

RISE OF DISTRIBUTED ENERGY RESOURCES

Coordination of increased connections

- All System Operator and distributor processes will be updated to accommodate increased connections.
- The Grid Owner, EDBs and the System Operator will have the resources and capability to commission DER.
- Updated market tools, real-time operational tools and study tools will reflect the behaviour and capability of DER.

Leveraging DER to build and operate the future grid

- The Code will define the technology agnostic role of DER. The market system will accept offers from DER owners, and operational tools and procedures will assess and dispatch DER.
- Electricity markets, the Grid Owner, EDBs and the System Operator will send efficient signals to DER.
- Grid exit point aggregation and participation of third-party flexibility traders will be enabled.

Visibility and observability of DER

- The impact of high levels of DER will be understood and managed.
- The regulatory framework will accommodate a high degree of DER uptake.
- Operational requirements will be established between the System Operator and distributors/DSOs.

SECURE AND RESILIENT POWER SYSTEM OPERATION

FOUNDATIONS

- Leveraging new technology to enhance ancillary services
- Maintaining cyber security
- Growing skills and capabilities of the workforce

	Rise of Distributed Energy Resources			Changing generation portfolio				Foundational opportunities and challenges		
	Leveraging DER to build and operate the future grid	Visibility and observability of DER	Coordination of increased connections	Balancing renewable generation	Managing reducing system inertia	Operating with low system strength	Accommodating future changes within technical requirements	Leveraging new technology to enhance ancillary services	Maintaining cyber security	Growing skills and capabilities of the workforce
Why	Monitoring the amount and type of DER available will assist in identifying opportunities to leverage it for system operations	Establishing a measure for DER impact on system performance will enable the risk to be monitored	Monitoring connection requests will identify emerging risks	Monitoring existing system performance as intermittent generation increases will enable the risk to be monitored	Monitoring existing system performance as the proportion of synchronous generation reduces will enable the risk to be monitored	Establishing a measure for impact of system strength on system performance will enable the risk to be monitored	Ongoing monitoring of system performance and types of connection requests will enable gaps in technical requirements to be identified	Monitoring the number and type of connections, and amount and type of DER will assist in identifying technologies which could be used to enhance ancillary services	Monitoring cyber security events will assist in identifying if this risk is increasing or evolving over time	Monitoring the number and type of skilled resource vacancies to assess if this challenge is increasing or evolving over time
What (Measures)	Number and type of DER installations	TBC pending investigation	Number, location and type of connection requests	Number of frequency and voltage excursions outside acceptable limits	Number of instances where Rate of change of frequency exceeds 0.8 Hz per second for a CE contingency	TBC pending investigation	System performance Number and type of connections requests	Number and type of connection requests Number and type of DER installations	Number and type of cyber security incidents	Number of vacancies for given technical roles
Key	Grid level					Industry wide				

Next Steps

- Final Phase 1 report to be published in March
- Draft Phase 2 roadmap to be published in March
- Industry engagement on the roadmap will be in early April
- A final roadmap will be published mid-year in anticipation of commencing Phase 3 in July
- All updates on the programme are published in the Electricity Authority Market Brief

To be successful, the programme will be heavily dependent on input and cooperation from across the industry and to work closely with other key initiatives.

Questions?

Thank you

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