The future operation of New Zealand's power system

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ELECTRICITY AUTHORITY
TE MANA HIKO

What we will cover today and the purpose of the webinar

- Introductions
- Purpose of the webinar
- Context for the consultation paper
- Overview of the paper
- Next steps
- Questions
  Pop them into the Q&A function

Our power system is changing

- New Zealand has committed to net zero greenhouse gas emissions by 2050
- **To achieve this, we need to:**
  - Electrify sectors of the economy, eg transport and industrial processes
  - Meet the resulting increase in demand with renewable electricity.
- This will create fundamental changes to our power system.
- The transition has already started, as supported by our future security and resilience (FSR) indicators.

Changes to the power system are already happening…

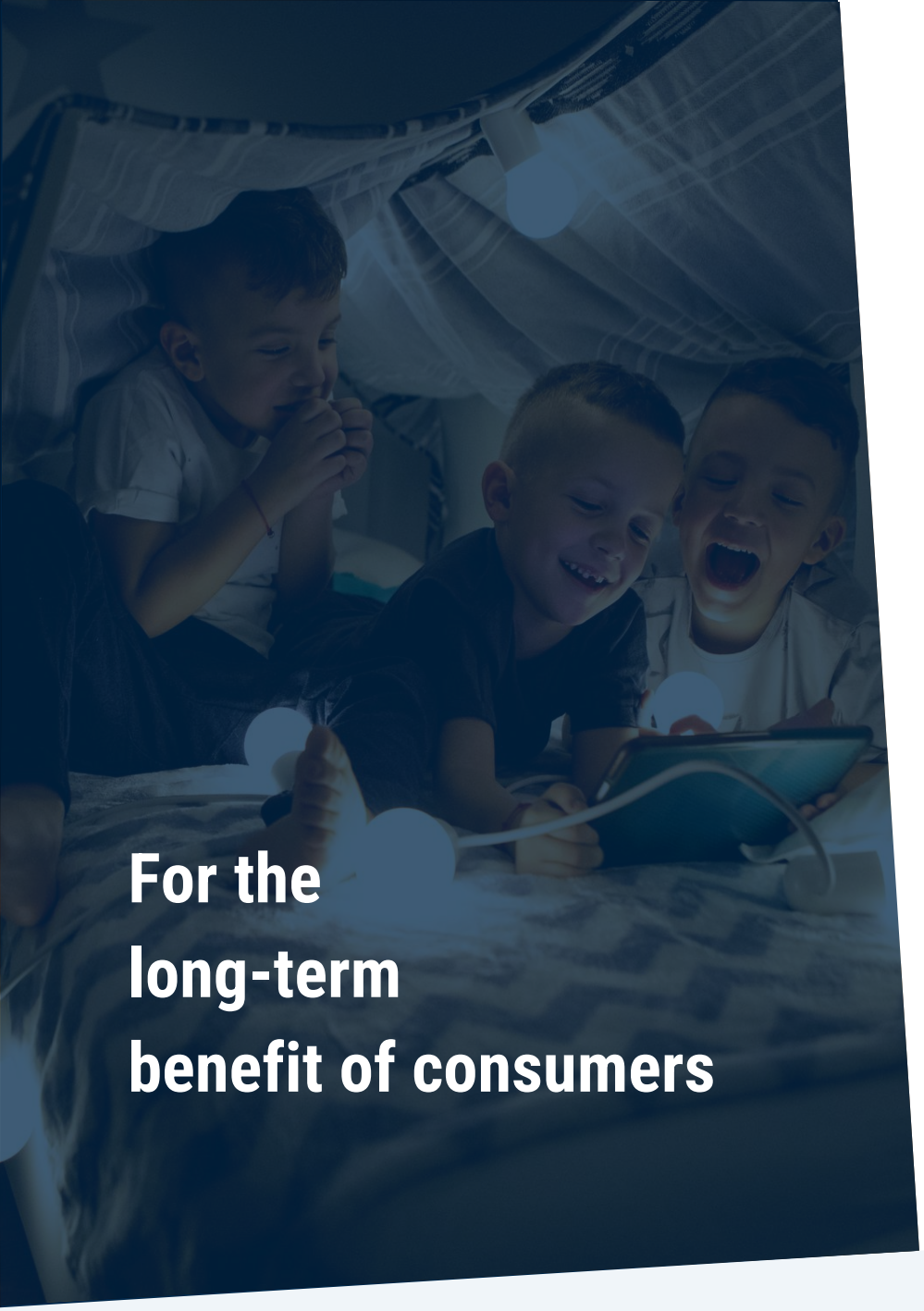
- Proportion of inverter-based resources (IBR) is growing, and will continue to do so
- More participants in the electricity industry
- New ways for consumers to participate
- Greater reliance on intermittent and variable wind and solar generation
- These changes impact the security and resilience of our power system.

Traditional assumptions will not hold effect

We cannot predict exactly how the power system will evolve – but we can prepare for this change by understanding the challenges and opportunities.

Assumptions being challenged include:

- Large, centralised synchronous based generation
- One way power flow through the transmission grid to the distribution networks
- Relatively stable and predictable demand growth
- Fossil fuel energy storage to balance supply and demand
- Infrastructure built for peak demand.



For the long-term benefit of consumers

- An efficient power system is essential to the long-term benefit of consumers.
- Consumers will become prosumers.
- Consumers should be able to exploit the full potential value of their distributed energy resources (DER) and demand response.
- DER gives consumers the ability to be independent of the network and more resilient to disruptions.
- Better coordination between participants is needed to unlock these benefits.

How are we preparing for these changes?

- Key projects under way
  - Updating distribution regulatory settings
  - Potential solutions for peak electricity capacity issues.

The paper we are discussing today is part of the **Future Security and Resilience (FSR)** work programme.

- The FSR programme commenced in 2021 in response to one of the recommendations from the Government's 2019 Electricity Price Review.

Future system operation

a workstream under Future Security and Resilience

Purpose

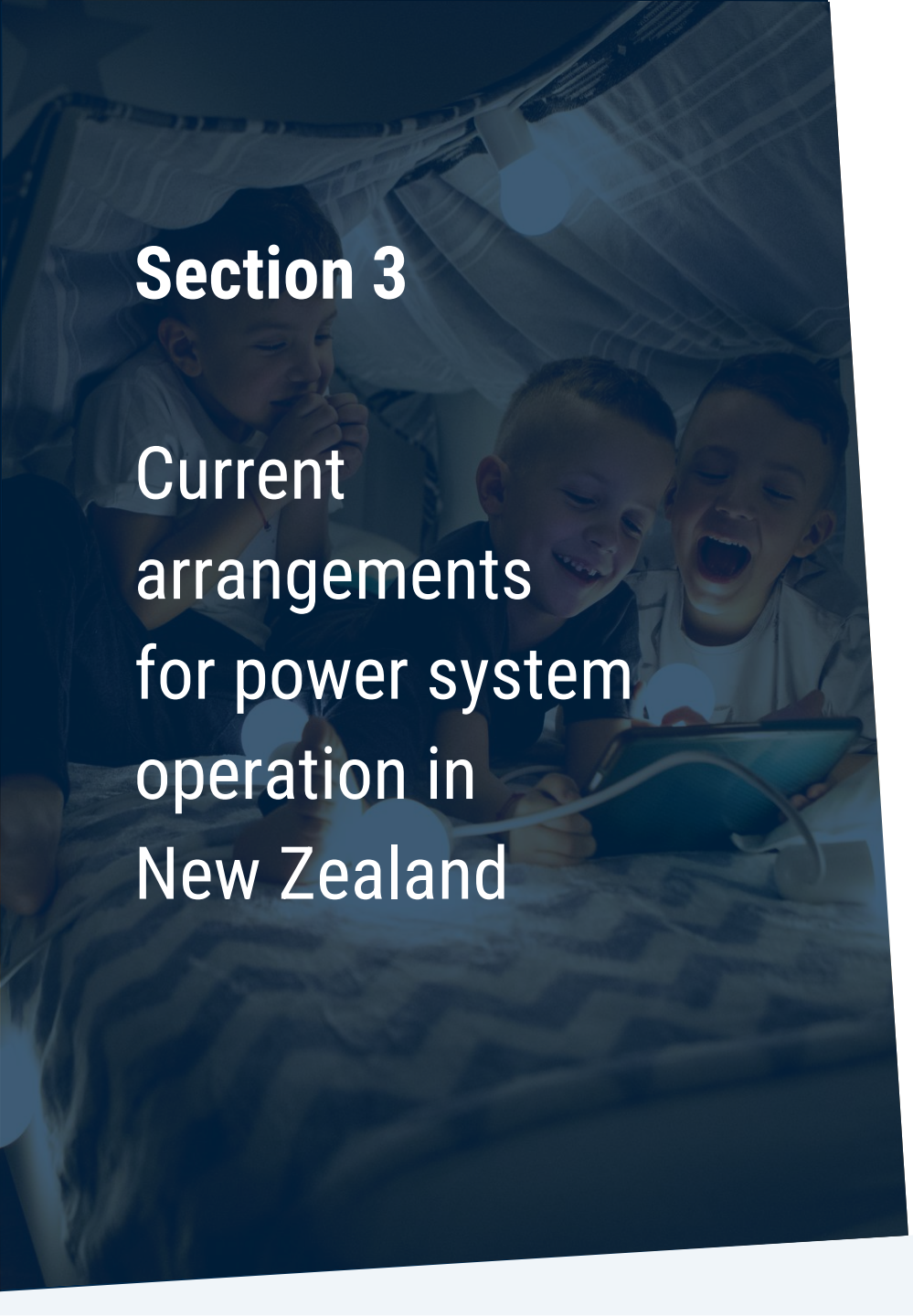
- Identify challenges and opportunities with current power system arrangements given expected changes
- Identify if any regulatory changes are needed to address these challenges.

This workstream (FSO) was initiated in response to:

- Stakeholder feedback to have a coordinated approach to an evolving power system
- The Authority's desire to take into account relevant international developments.

Structure of the FSO paper

Section 3	Current arrangements for power system operation in New Zealand
Section 4	Key drivers of change to power system operation in New Zealand over the coming decades as New Zealand transitions to net zero emissions
Section 5	Possible key challenges and opportunities in relation to power system operation during New Zealand's transition to net zero emissions
Appendix A	Regulatory arrangements for power system operation
Appendix C	Future system operation – international literature review



Section 3

Current arrangements for power system operation in New Zealand

This section summarises the current arrangements for power system operation in New Zealand.

It also includes the key regulatory obligations related to power system operation.

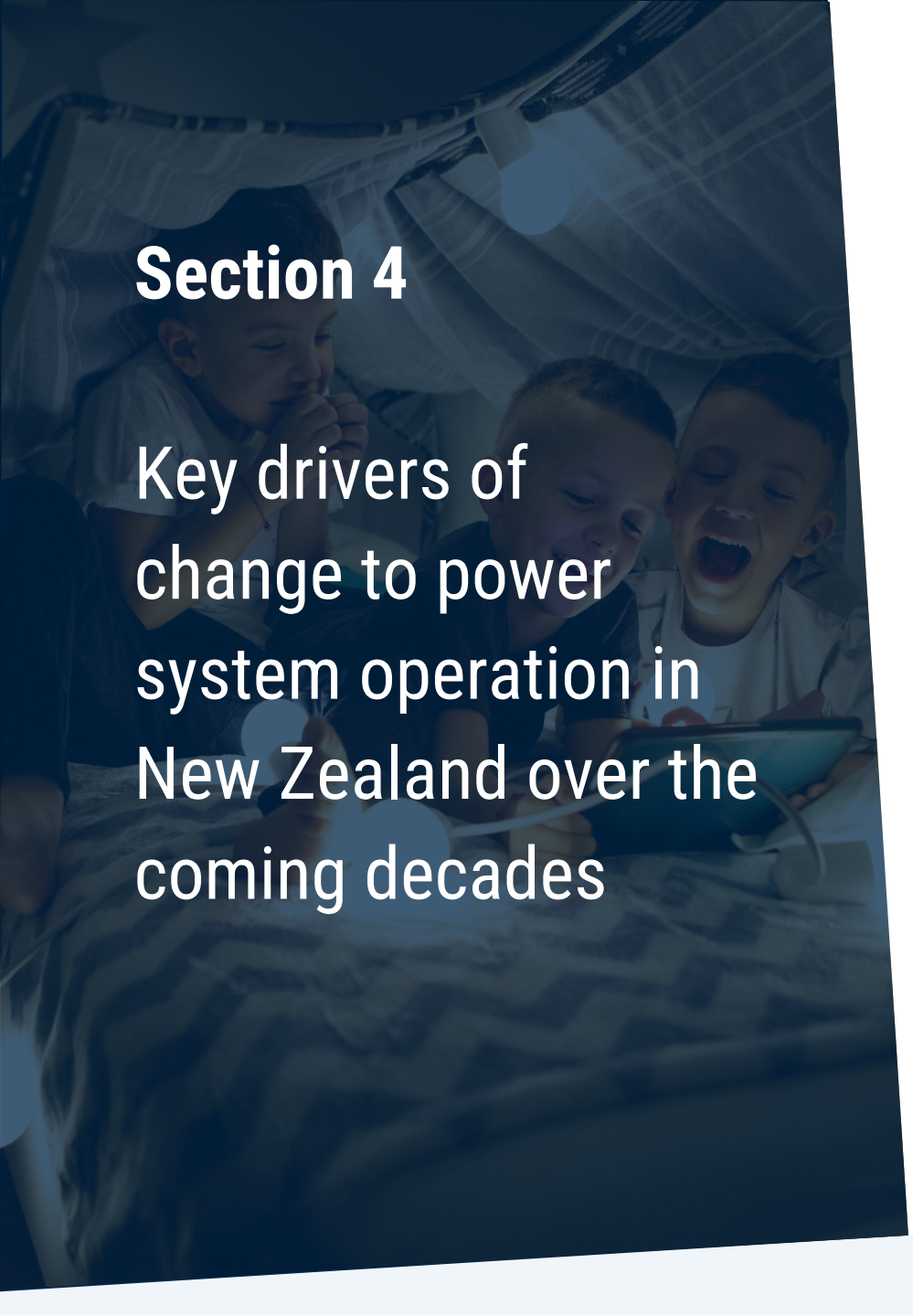
Power system operation in New Zealand

Roles and responsibilities of:

- Transpower as the system operator
- Transpower as the grid owner
- Distributors
- Ancillary service providers

Roles and responsibilities of:

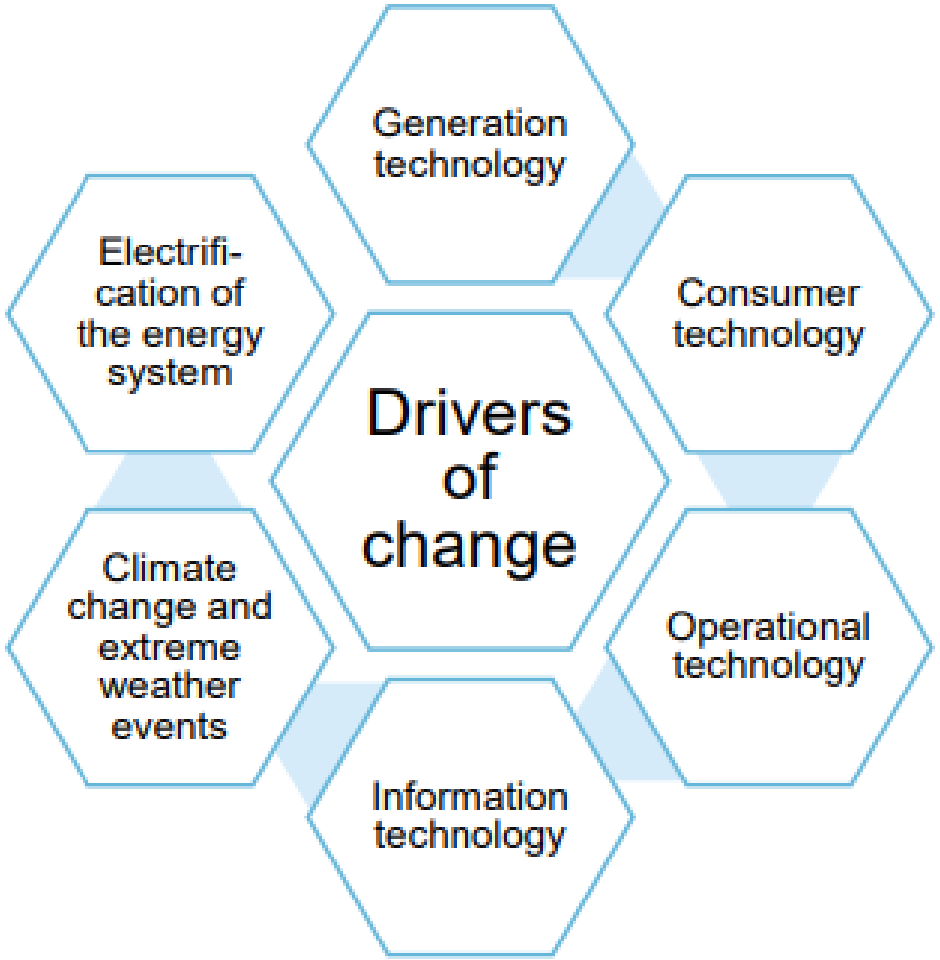
- The Electricity Authority
- The Commerce Commission
- WorkSafe New Zealand (WorkSafe)



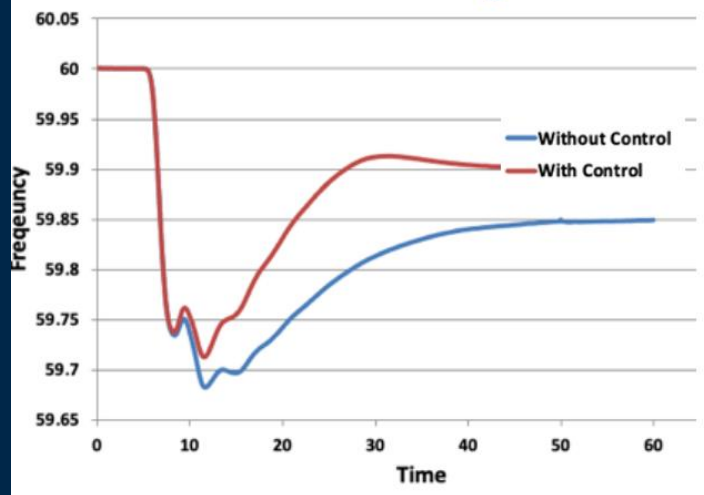
Section 4

Key drivers of change to power system operation in New Zealand over the coming decades

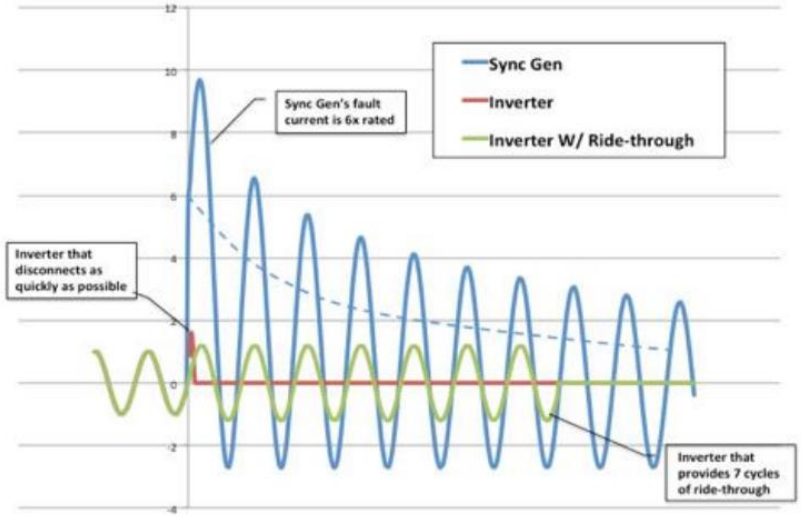
6 key drivers of change to power system operation



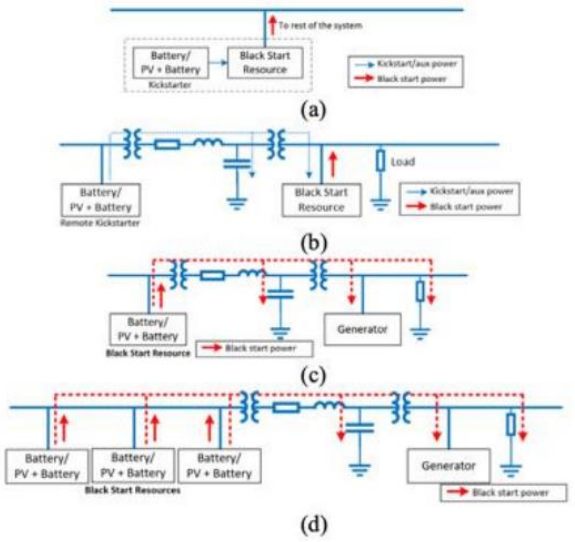
Stability



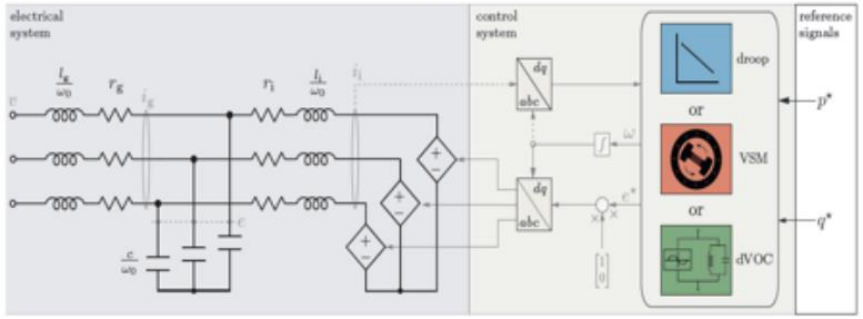
Protection



Grid-forming/Blackstart



Control system interactions and resonances



Power System Oscillations

Key driver 1 -Changes in generation technology

Traditionally in New Zealand electricity is generated by large power plants which are predominantly synchronous machine based.

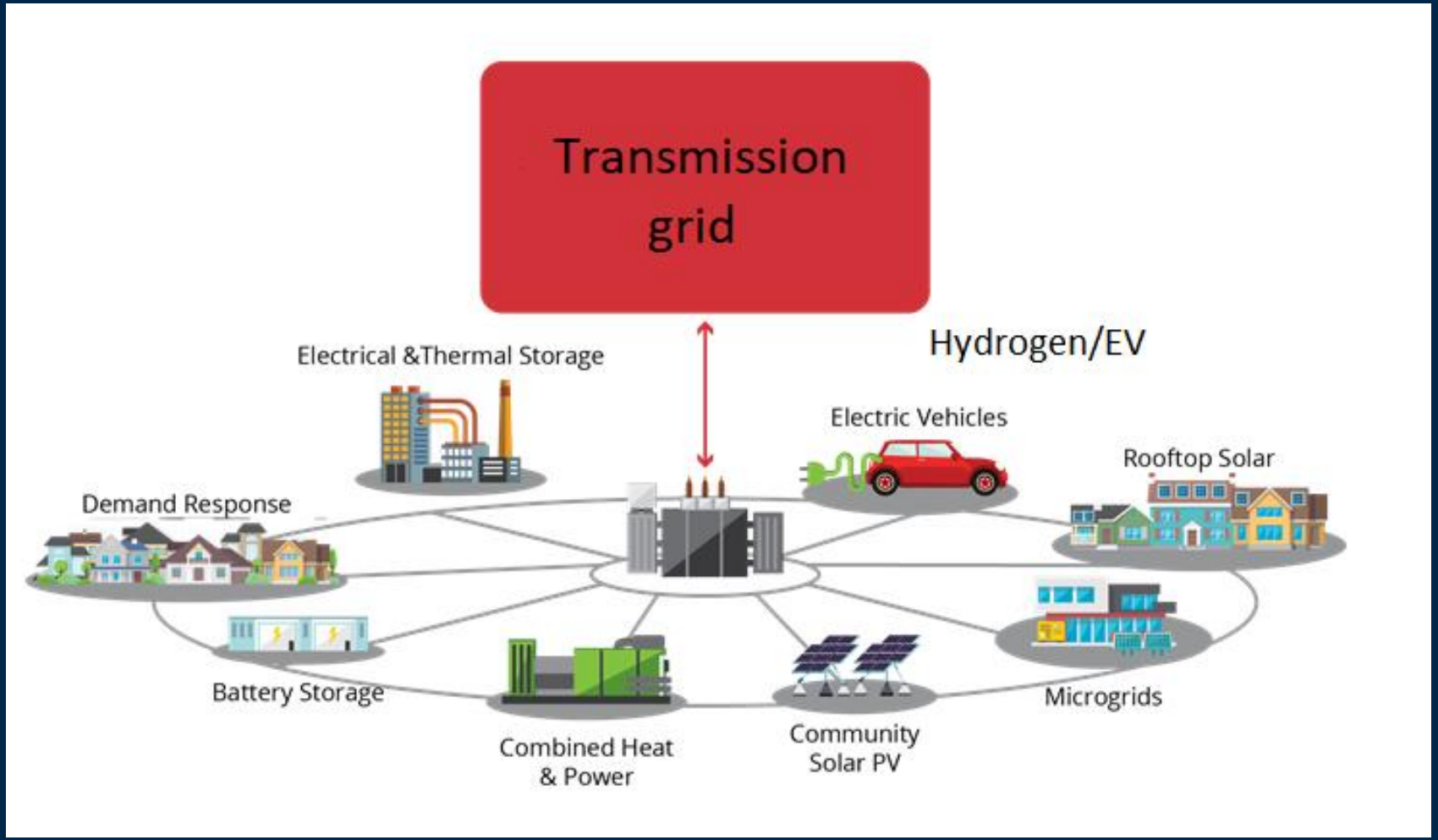
There is a large increase in the share of inverter-based resources (IBR) in the generation mix which includes solar PV farms, wind farms, BESS, and hydrolyser-based generation.

Greater use of IBR poses a number of technical challenges for power system operation:

- Non-synchronous nature and inertial characteristics
- Variability and intermittency
- Dynamic response during transient events.

Key driver 2 - Changes in consumer technology

- An increasing number of individuals / organisations no longer passively consume energy
- Prosumers - individuals and businesses can now actively manage their consumption and produce their own energy, which can be exported back into the grid
- Consumers can increasingly participate in demand-side flexibility/management.

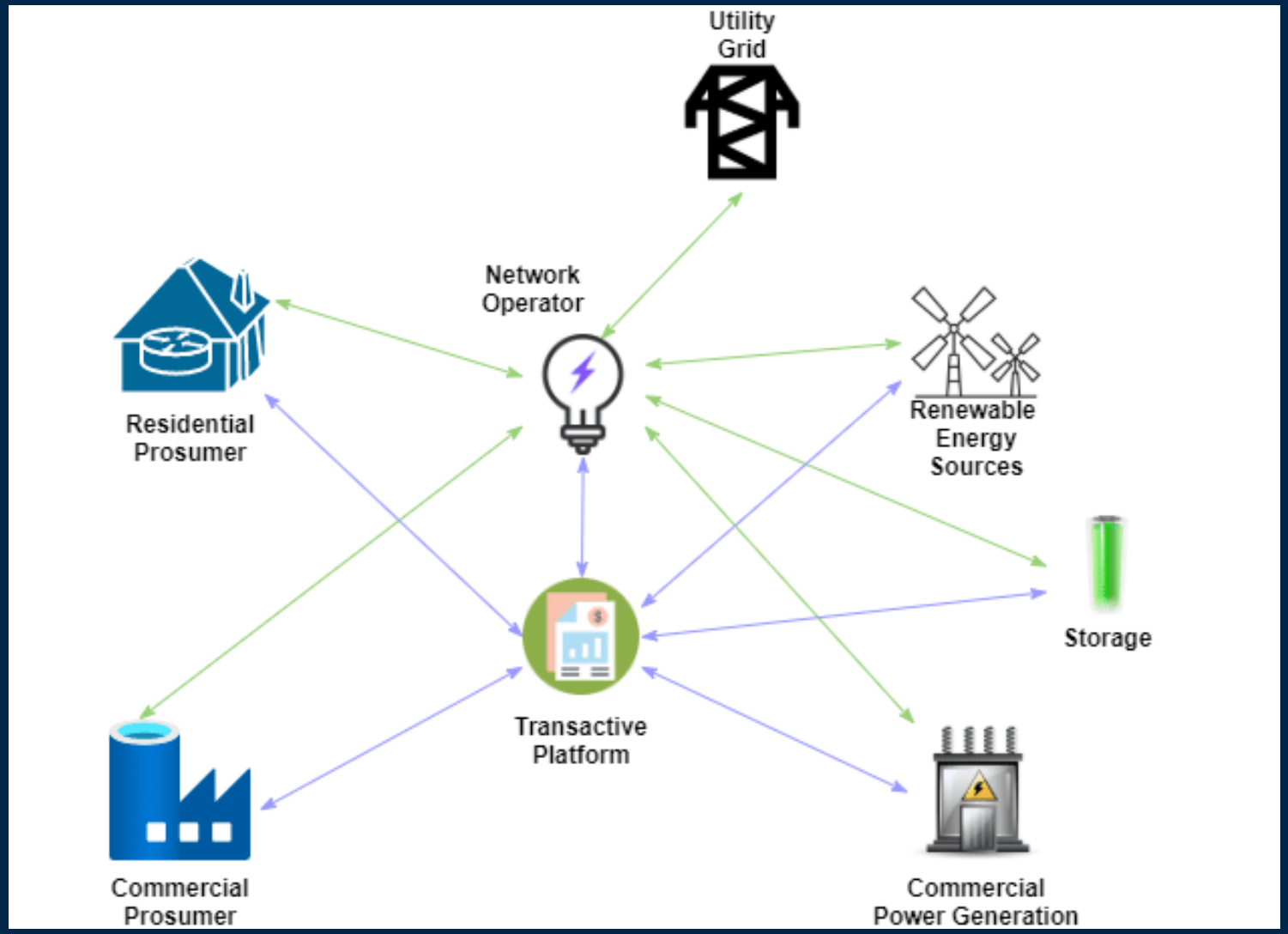


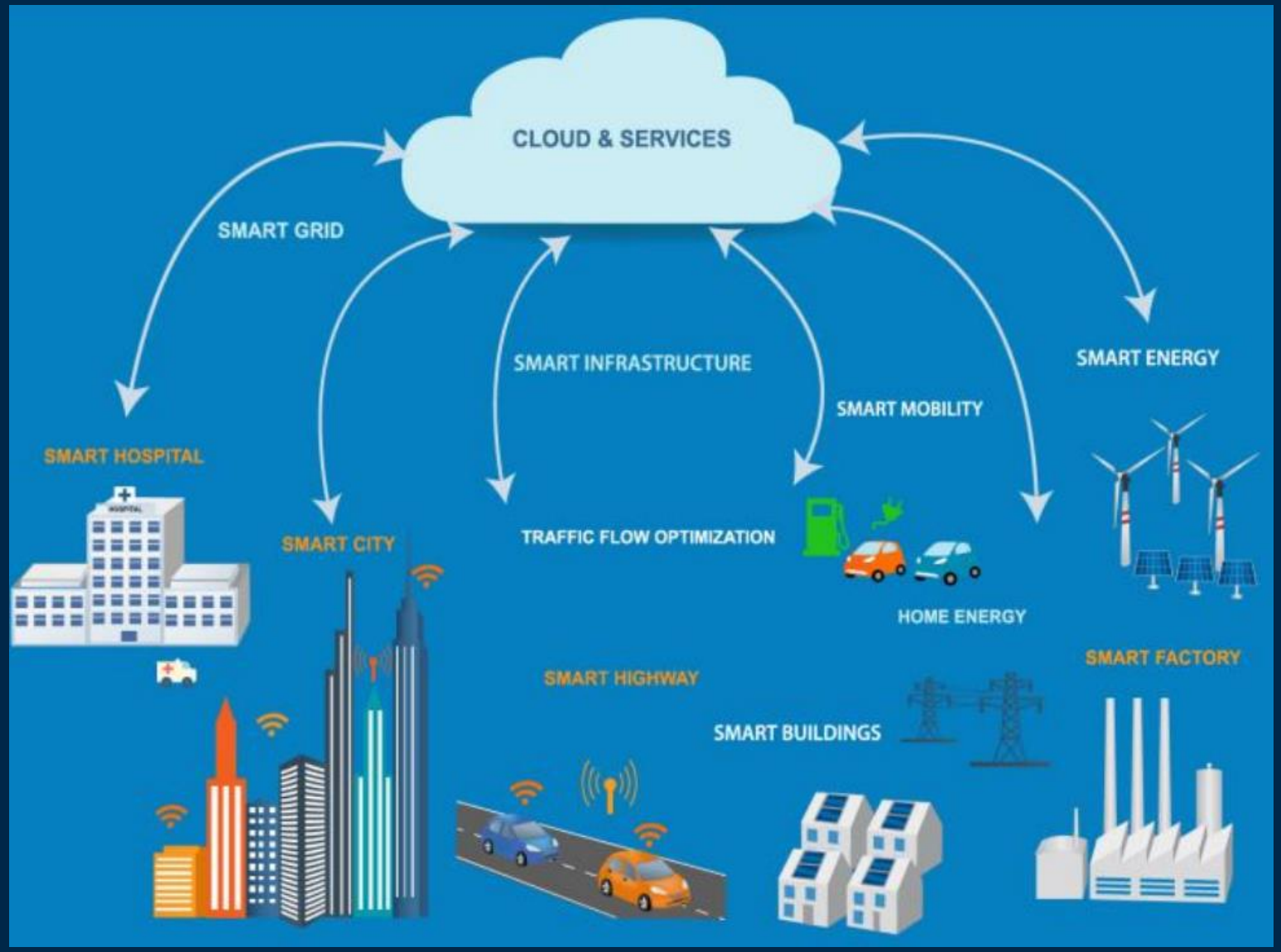
Key driver 3-changes in operational technology

The power system is evolving into a ‘system of systems’ using new technologies:

- Peer-to-peer trading
- Vehicle-to-electric grid technology
- Microgrid community grids
- Aggregators and virtual power plants
- Increased uptake of non-network solutions.

These new technologies will need to be integrated into system operations at the transmission and distribution network level.





Key driver 4 - changes in information technology

digitisation and digitalisation

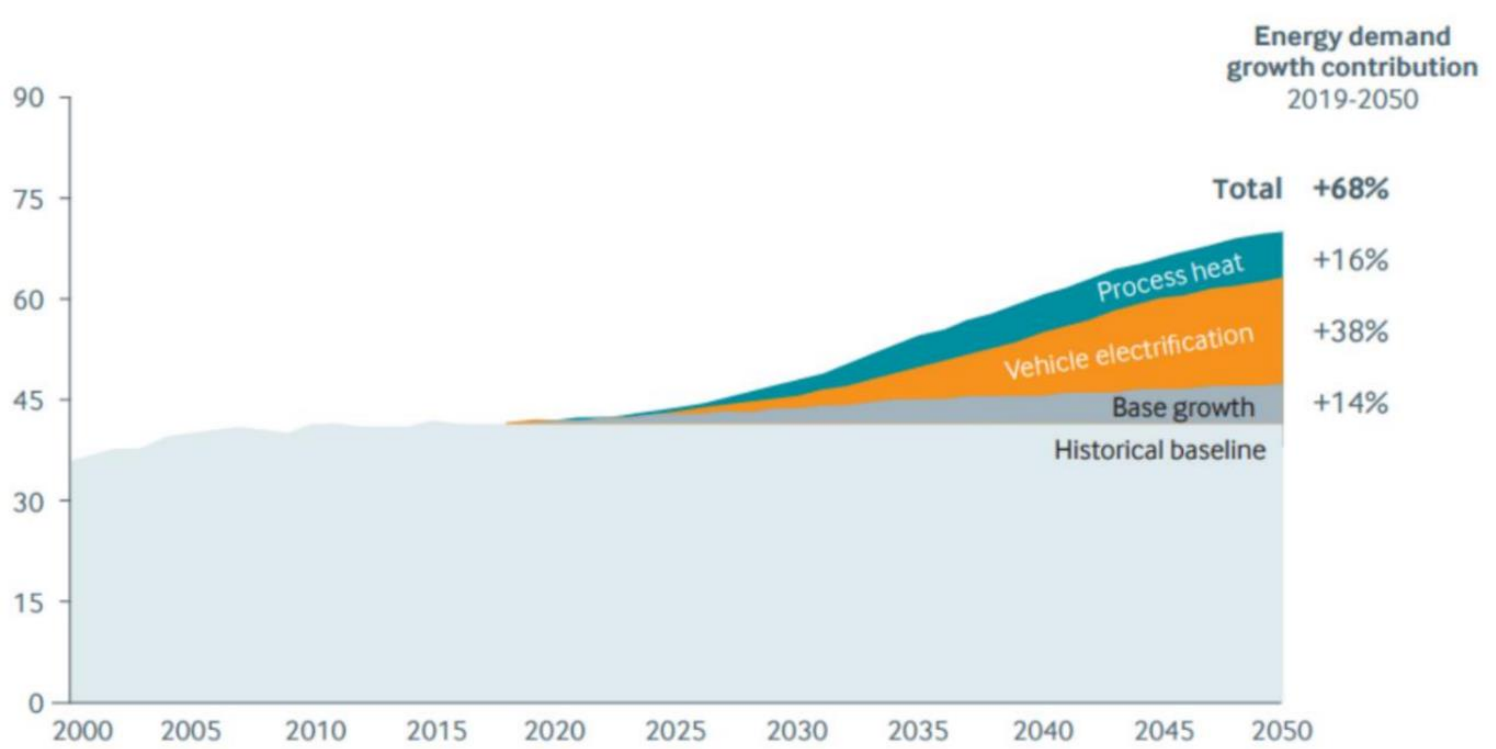
- With the high uptake of large-scale IBR and DER connected at the residential level, the number of IoT devices exchanging data across the power system will be enormous.

- Information, data sharing and coordination between flexibility service providers, distribution networks, and the system operator will be critical in ensuring overall system security and increasing efficiency for consumers.

Key driver 5 - climate change and extreme weather events

- Climate change is affecting weather patterns in New Zealand – more extreme weather and more often.
- These are leading to localised blackouts and secondary tripping of IBR plants

Key driver 6 - electrification of the energy system



Source: Whakamana i Te Mauri Hiko - Empowering our Energy Future[82]

- More electricity will be needed to electrify New Zealand's economy with current estimation at ~ 68% more required by 2050
- Large transmission and distribution network investments will be needed to meet this extra demand
- Non-network solutions could be used to reduce the level of network investment required
- Most agree that the investment will be in the billions of dollars.

Section 5

Possible challenges and opportunities during the transition to net zero emissions

This section explores 4 broad questions as a result of the drivers discussed in the previous section:

- Is there sufficient coordination of system operation?
- Are existing system operation requirements compatible with distributed energy resources?
- Is there sufficient coordination of network planning?
- Are there significant conflicts of interest associated with network ownership, network operation and network planning?

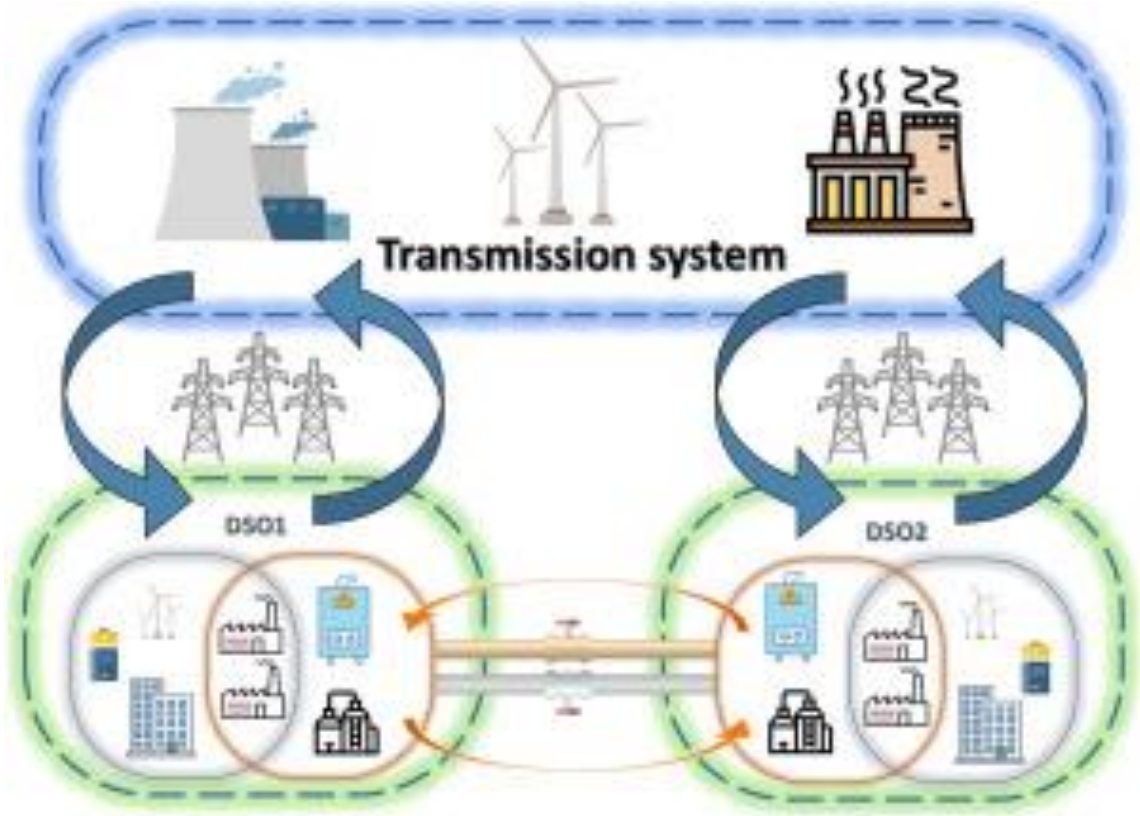
The Authority does not yet have a view on these questions and is seeking further information and evidence.

Is there sufficient coordination of system operation?

In the future we expect:

- more **complex** operation of transmission and distribution networks
- more **participants** – mostly consumers and aggregators
- more **DER** connecting - if left uncoordinated, could cause problems
- more **automation** likely in day-to-day management of the power system operation.

We are seeking views of new players in flexibility and ancillary services markets about barriers to participating.



Are existing system operation requirements compatible with distributed energy resources (DER)?

- More **DER** = increasing bi-directional power flows across GXPs.

- More **IBRs** = challenges for aspects of power quality (eg, frequency, voltage, flicker and harmonics).

  *A key issue for future system operation is the lack of visibility and control of DER – impacts power system operation at both distribution and transmission levels and requires **coordination** to maximise efficient network utilisation.*

- What is the Authority's role in relation to future system operation?
  - Facilitate change primarily through Code amendments
  - Facilitate change through other measures or policies
  - Or both.

Is there sufficient coordination of network planning?

To minimize costs to consumers, we need to ensure the most efficient level of network investment in New Zealand.

- Significant network investment required to support transition to net zero emissions.
- Efficient level of network investment benefits consumers.
- Network planning includes:
  - coordination between transmission and distribution networks, and across regions/distribution networks
  - being informed by relevant wider energy planning activities across sectors (eg, gas, heat, hydrogen, transport).
- Overseas examples:
  - Ireland – Joint System Operator Programme
  - Australia – Integrated System Plans
  - UK – Regional System Planners

Are there significant conflicts of interest associated with network ownership, network operation and network planning?

There can be potential or perceived conflicts of interest for parties with more than one role.

Examples:

- **Transpower** - transmission network owner and planner, and system operator
- **Distributors -** distribution network owners, planners, and operators or for some through their ownership and or control of DER.

Conflicts of interest could lead to sub-optimal outcomes for consumers.

Conflicts of interest continued

Conflicts of interest can arise due to:

- Misalignment of incentives
- Bias towards the status quo – relying on a bigger network rather than alternatives

NZ already has safeguards in place…

Electricity Industry Participation Code 2010

Commerce Act 1986

Public Act 1986 No 5
Date of assent 28 April 1986
Commencement see section 1(2)

Other countries, e.g. the UK, have already made changes to deal with this issue…

In summary

- New Zealand is in a unique position, we already have a very high level of renewable electricity generation.
- However, a fully renewable power system is not without challenges and opportunities.
- To address the challenges and opportunities, it is important to work collaboratively to achieve the best outcome for New Zealand and our consumers.
- We encourage you to provide submissions and feedback on this consultation paper.

Next steps

Appendix B of the consultation paper provides the format for submissions.

Submissions close **5pm, Thursday 11 April**.

If you have any queries or would like to meet individually, email us at **FSR@ea.govt.nz**


Questions?

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THANK YOU