

STRATEGY AND PRIORITIES

SECURITY AND RELIABILITY COUNCIL

This paper is to aid the Security and Reliability Council's (SRC) discussion of its strategic environment at the SRC's annual risk and strategy session. It provides a framework for considering the SRC's strategic objectives, sets out some discussion material, and includes an environmental scan of current strategic issues.

Note: This paper has been prepared for the SRC. Content should not be interpreted as representing the views or policy of the Electricity Authority.

Strategy and priorities

- 1.1 The Security and Reliability Council's (SRC) statutory function is to provide independent advice on the performance of the electricity system and the system operator, and reliability of supply issues.
- 1.2 A previous survey of SRC members found that "establishing an agreed SRC strategy would help drive a work programme and agenda relevant to the SRC brief, ensure the SRC is fulfilling its role, and provide the Authority with more meaningful, actionable advice."
- 1.3 The SRC concluded there should be an annual opportunity to discuss the current SRC work programme, explore emerging strategic issues, consider these in the context of the SRC role and develop an agreed SRC strategy.
- 1.4 John Hancock of Signature Consulting will act as facilitator in a workshop style session, with a brief to draw out from members what they see as areas of focus, what is the greatest risk to the sector, and what themes and other items the SRC wants to see on its forward work programme and its risk radar.
- 1.5 An agenda for this session has been provided in the attached slides (appendix A) and members have been given 'prework' in preparation for the session.
- 1.6 The overall goal of the session is to support the SRC's understanding of risks and priorities across a range of issues and timelines.
- 1.7 Key outcomes from the session are to identify key issues and topics the SRC should include in its forward work programme and what changes need to be made to the SRC's risk radar.

Questions for the SRC to consider

- 1.8 The SRC may wish to consider the following questions:

- Q1. What changes would members like to see for their next risk and strategy session in 2024?**
- Q2. Does the SRC have further guidance for the secretariat about how it would like to receive information about the themes for upcoming meetings?**

Appendix A: 2023 Strategic environment review (and session agenda)

2023 Strategic Environment review

Security & Reliability Council

V5 – 1/8/23

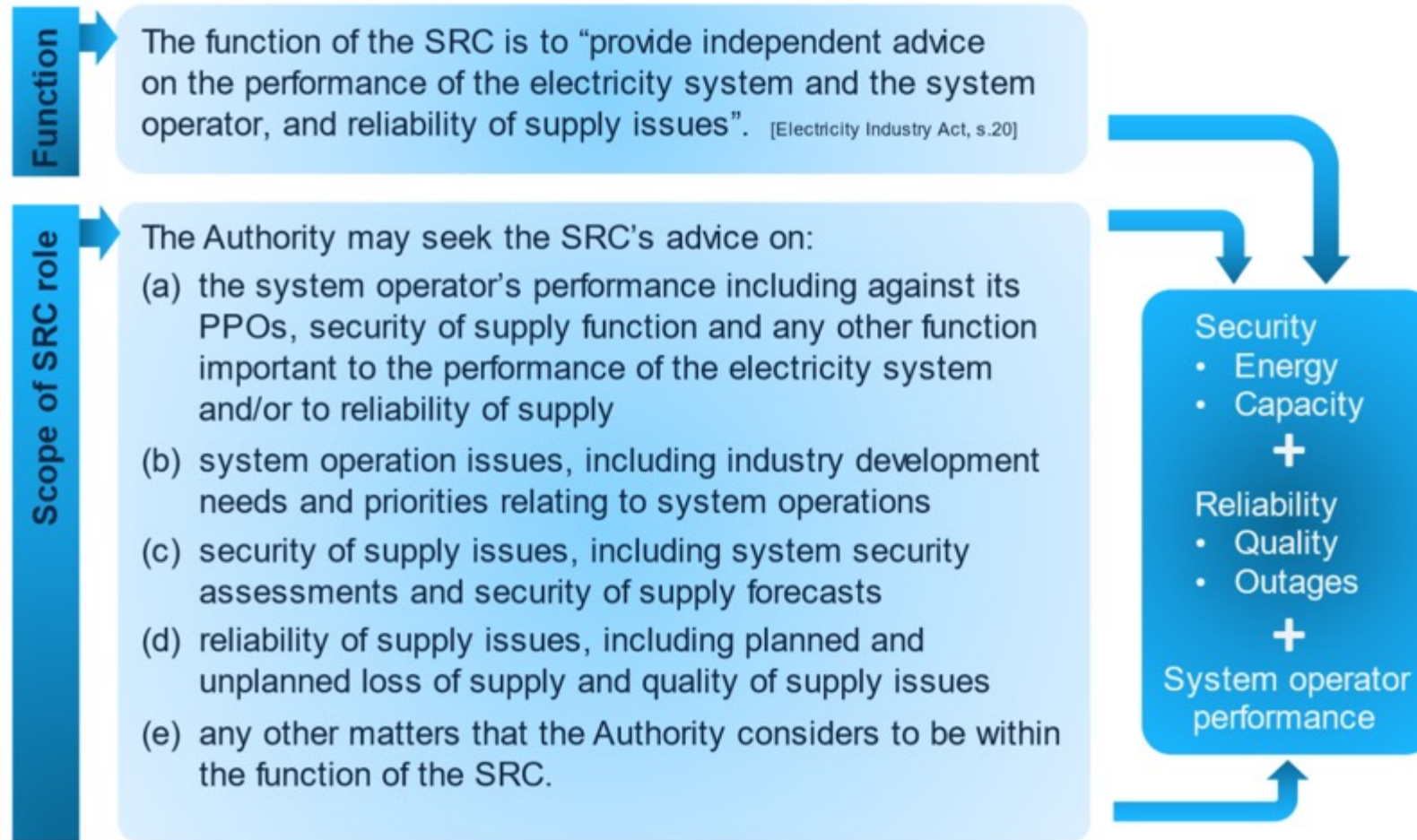
Approach for 2023 SRC risk & strategy session

- Remind ourselves what the SRC's job is and the outcomes we want
- Check what we came up with last year
- Look overseas
- Have a look at the external environment
- Have a think about how that might affect security and reliability
- And confirm what's new or changed and what we need to do about it

Agenda for 16 August

9.00	Context, outputs and expectations	Heather
9.10	Icebreakers and homework	All (John)
9.30	What's PESTLE got to do with Security and Reliability	All (John)
10.15	Mapping current risks in the Risk Radar	
10.45	Coffee	
11.00	New and dynamic risks for the Risk Radar	All (John)
11.30	Themes for future SRC sessions	All (John)
11.50	Closing thoughts and next steps	Heather

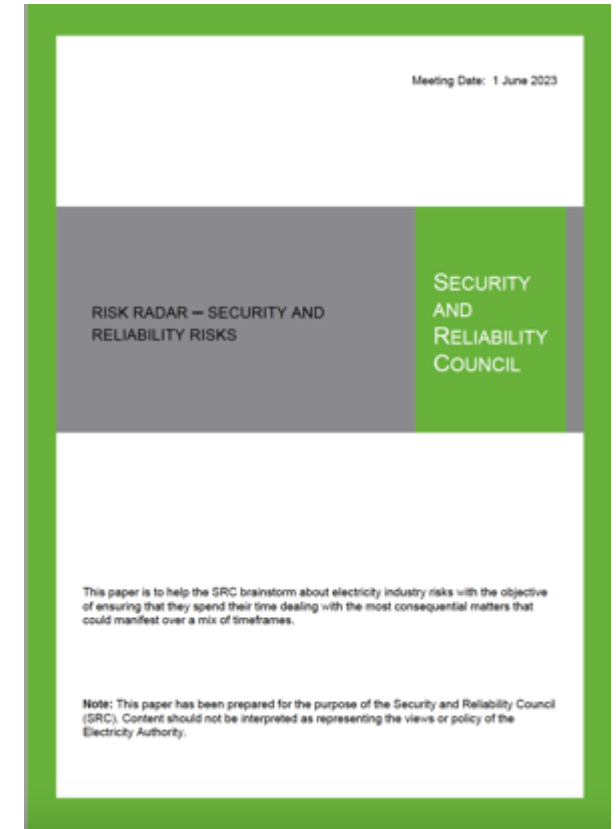
You know your job



So we’re interested in how the external environment is changing in a way that might affect the performance of the electricity system and any new things that might make it easier to manage?

Last year, SRC was focused on legacy technologies and revealed patterns

Short term Within 1 year	Medium term Within 5 years	Long term More than 5 years	Persistent Could arise at any time
S1: the risk of a growing disconnect between energy and capacity issues due to more intermittent renewables (without adequate firming) causing more regular industry disruption and could result in unplanned outages (e.g., 9 August 2021).	M1: Inefficient market response to significant industrial demand reductions (eg Tiwai exit).		P1: Cyber-attack damages power system assets and/or cuts supply, for example Waikato DHB and Colonial Pipeline (both 2021), or breaches data security - Pinnacle Midlands Health Network (2022)
S2: The prospect of Dry winter / official conservation campaign increasing prices and carbon emissions through increased thermal generation and as the risk becomes realised there is likely to be supply reductions both voluntary and mandatory.	M2: Continued delay to the Review of 'Tree Regs' increases risk of damage and blackouts due to tree interference with lines.	L1: Ageing and/or under-invested generation, distribution, and transmission assets lead to increased failures.	P2: Gas supply running down (in part due to exploration uncertainty) reduces generation adequacy and availability.
S3: Market confidence reduced by the pain from high prices and security of supply (dry year) causing regulatory intervention impacting on investor's willingness to invest long-term in assets for de-carbonisation.	M3: Aspirational Government carbon goals leading to early thermal exit potentially causing reduced reliability and security of supply, if capability and ambition are misaligned.	L2: The increasing dependence on artificial intelligence (AI) and automation reduces the industry's ability to deal with unusual and unexpected critical issues (in real time or to quickly recover)	P3: Physical attack (war, terrorism, sabotage, and political unrest/protest) damages power system assets and/or cuts supply.



System Operator in England and Wales is really worried about system strength

Operability Strategy Report 2023

Reliable Network

102GVA_s

The level that system inertia must remain above for secure zero carbon operation in 2025

2200MVA_r

The volume of new reactive capability needed to economically maintain a compliant network in 2025

2030

When we expect GB to be a net annual exporter of electricity by

100%

Of national demand restored, within 5 days, under the new restoration standard in the event of a power outage

Stability

Operationally, this level of inertia can be maintained via existing system behaviour and our stability pathfinders. Future procurement of stability services will be to ensure economic system operation.

We are working to ensure our policy on managing low fault infeed levels is fit for purpose for the future system.

Voltage

Our need to absorb reactive power continues to increase, driven by decarbonisation of the electricity system and continual decline in reactive power demand.

We are exploring options to access new sources of reactive power, reduce voltage costs in the short term and define long term future reactive needs.

Thermal

Significant growth in renewable generation and interconnection continues to drive a need for more network capacity.

We are enabling the transition to Net Zero by mitigating rising constraint costs, contributing to network planning reviews and enabling the connection of renewable generation and new technologies.

Restoration

The new Electricity System Restoration Standard also requires 60% of regional demand to be restored within 24 hours (in all regions).

We are beginning to use learnings from Distributed Restart to enable DER such as solar, wind and hydro to provide restoration services and reduce our reliance on fossil fuel generators.

Balancing the System

2500MW

The maximum requirement for Balancing Reserve by 2025

46GW

Volume of expected Within-day flexibility from storage and demand by 2030 in Leading the Way

>50%

By 2035 in leading the way, there will be surplus generation in more than half of the year.

Frequency

More variable sources of generation, increasing volumes of demand flexibility and price driven coordinated behaviour of assets, such as EV's and interconnectors, create more challenging balancing conditions for the ESO.

New services such as Balancing Reserve and Static Recovery will help us manage these new challenges.

Within-day Flexibility

Changing the timing of demand, mainly with smart appliances and storage, will become the main source of within-day flexibility in the 2030s.

Understanding the contribution of this to system needs, starting with peak demand, will be critical for efficient zero carbon operation.

Adequacy

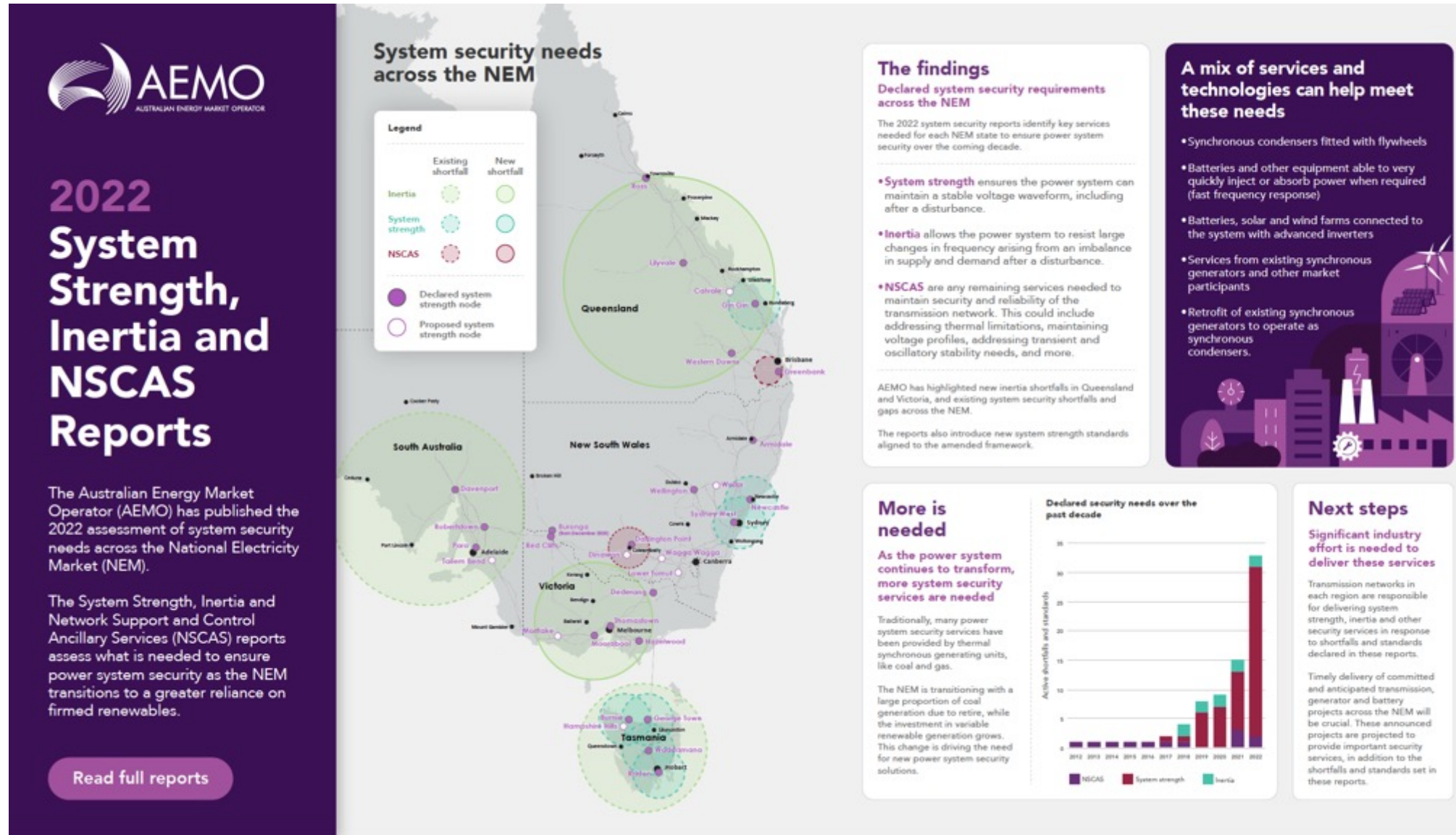
There is no trade-off between adequacy and net zero. We can deliver adequacy in a fully decarbonised power system.

Investment in at least one new reliable low carbon technology such as nuclear, carbon capture storage (CCS), hydrogen or long-duration storage will be needed.

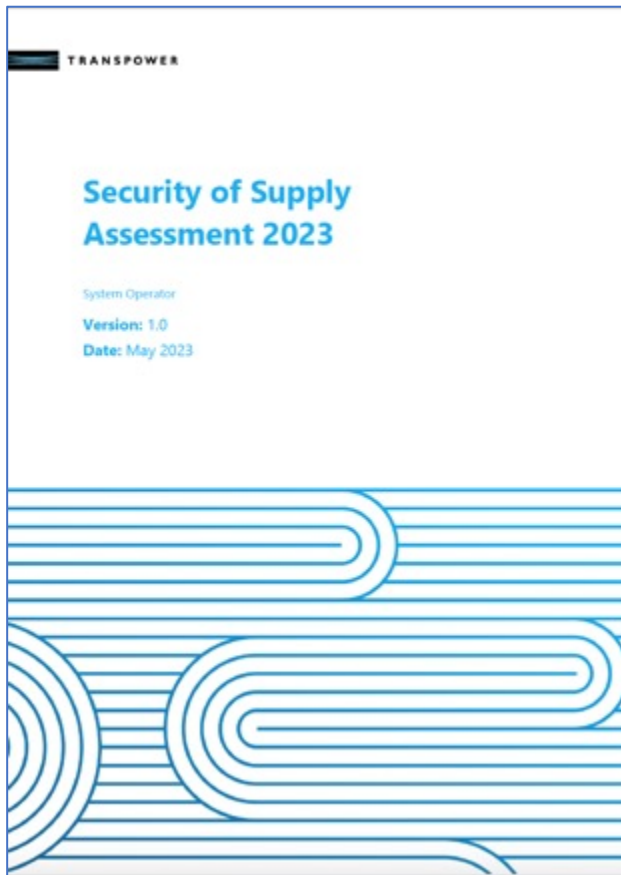
System strength is “the size of the change in voltage following a fault or disturbance on the power system”

So is the System Operator in the NEM

“Timely delivery of committed and anticipated transmission, generator and battery projects across the NEM will be crucial.”



NZ System Operator is more bothered about energy and capacity margins



Key Insights across the time horizon

Inputs – Demand and supply are growing

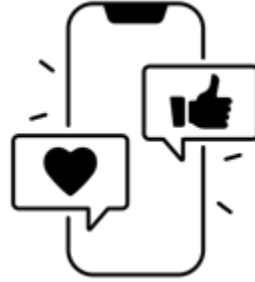
1. Expectations of demand growth are increasing
2. The supply pipeline is being developed and is largely renewable and intermittent

Energy – Development of the pipeline needed

1. The supply pipeline, if developed in time, is sufficient to maintain margins
2. Development of the pipeline is needed under nearly all demand sensitivities
3. Thermal generation and its fuel is needed to maintain margins for some years

Capacity – Development of flexible resources needed with more urgency than energy

1. Margins drop below the standards by 2026; projects need to be developed beyond those with consent
2. Thermal generation is required to maintain margins through to the end of the forecast horizon
3. High levels of intermittent generation on the system will drive more periods with low margins
4. Non-generation resources can contribute to the supply pipeline (e.g. batteries or demand response) and can come online quickly



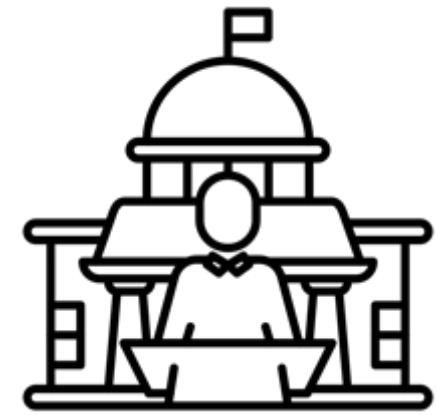
Before we think about Security and Reliability, we need to look at the strategic environment through the 6 dimensions of the PESTEL

Some new themes to ponder ...



- Global supply chains have been remarkably adaptable but are changing
- Generative AI really does seem like a breakthrough technology but it's not magic
- NZ's relationship with Climate Change is getting more complex by the day
- NZers' relationship with the State, Māori and communities is getting equally complex by the day

Politics



- Election is on Saturday, 14 October 2023
- Major parties are too close to call but ACT is pulling away from the Greens making a National/ACT coalition the most likely
- If anything National is pulling to the right

In my view, the debate over densification is now at risk of 'going nuclear' and into full 'culture war' mode during the election campaign ...

Brown has already nudged into culture war territory with his comments on cycling and a 'war on cars' by urban activists ... It depends just how much Luxon wants National to appeal to younger voters nearer the centre, or how many votes he thinks can be switched with an appeal to suburban conservatives railing against 'daylight robbery', 'living in hutches' and 'too many cars for too few roadside carparks'.

My view so far is Luxon appears not able to pivot back to the centre and do the sort of surprise bipartisan deal that then-National-leader (and Luxon mentor) John Key did before the 2008 election with then Labour PM Helen Clark over anti-smacking legislation. Key was able to stare down the social conservatives in his caucus and win the attention of 'netball mum' median voters in the big cities with his surprise stance.

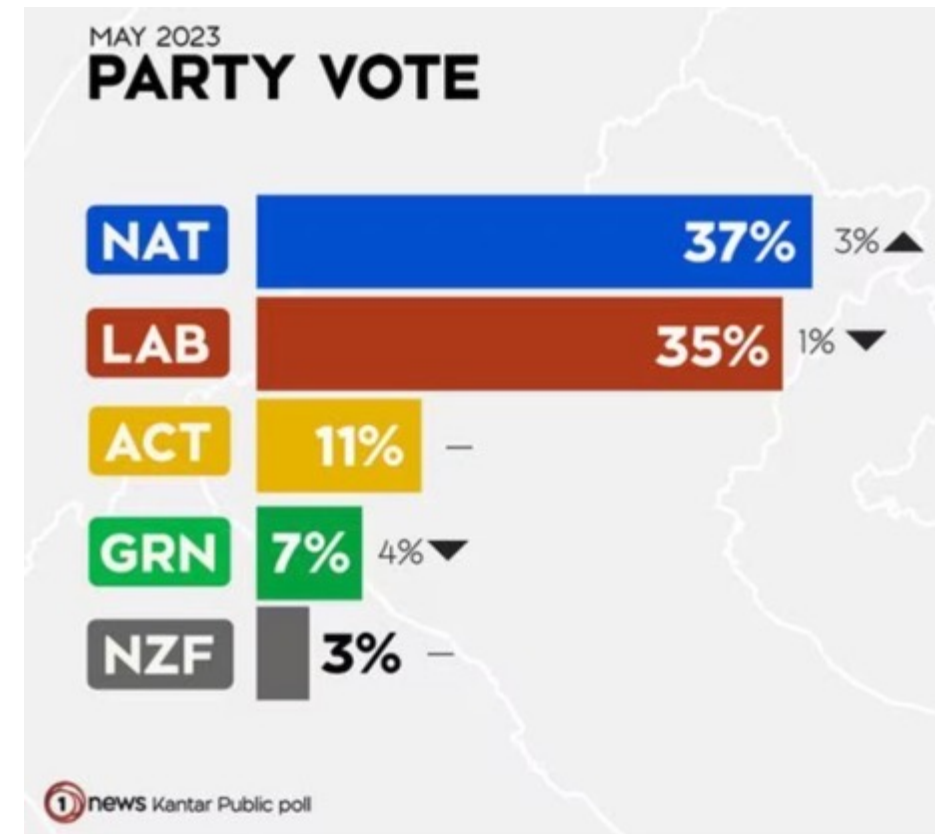
So far, Luxon has done little to rebuke or shut down the more extreme views on social, transport and environmental issues from the likes of Simeon Brown, Chris Penk, Simon O'Connor, Judith Collins, Harete Hipango and Maureen Pugh.

Bernard Hickey, The Kākā, 29/5/23

- National's Electrify NZ Energy policy is "plausible", pro-market and hands-off – emissions reduction may be much less of a priority?

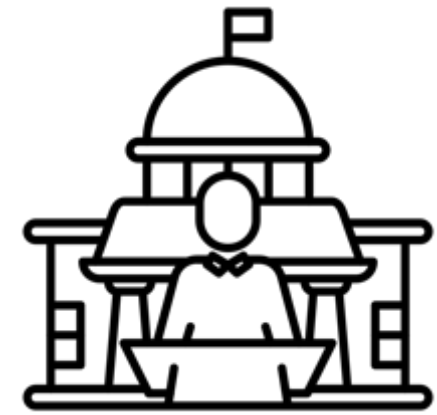
- *National would drop Labour's aspirational policy of 100% renewable electricity generation, citing research by the government's Interim Climate Change Committee (CCC) that said this could increase electricity prices by 39% for industrial users, make blackouts more likely, and effectively raise emissions by delaying the transition off fossil fuels to electricity in transport and industry.*
- *National would also drop the idea of a \$16 billion pumped hydro scheme at Lake Onslow.*

Luxon says easier consenting rules will electrify NZ, Business Desk, 31/3/23



Source: 1news

Bread and butter replaces idealism



- PM Hipkins has already cut back on emissions reduction

The new Cabinet will be focused on core bread and butter issues like the cost of living, education, health, housing and keeping communities and businesses safe

Chris Hipkins, Beehive.co.nz, 31/1/23

- Ditching “cash for clunkers”, social leasing and biofuels mandates are all examples of pragmatic retreat

Hipkins told RNZ’s morning report he believed there were “better ways of achieving those emissions reduction targets than those [policies]”.

Government insists it’s still committed to climate goals, pointing out axed policies weren’t that great to begin with, NZ Herald, 14/3/23

- Rejecting Climate Change Commission’s advice on emissions budgets has seen a 40% (!) reduction in the carbon price and undermined investor confidence in its independence from political whim

NZ Market: NZU price drops to 18-mth low as confidence in market “wafer thin”

New Zealand’s carbon allowance price on Thursday fell by 10% to an 18-month low, as the usual end of financial year doldrums have been compounded by cratering confidence in the market

Carbon Pulse, 30/3/23

Price History



NZers' relationship with the State, Māori and communities is getting more complex



The simplicity of life under an absolute majority Labour government with closed borders has been replaced by an increasingly noisy and polarised exchange of values

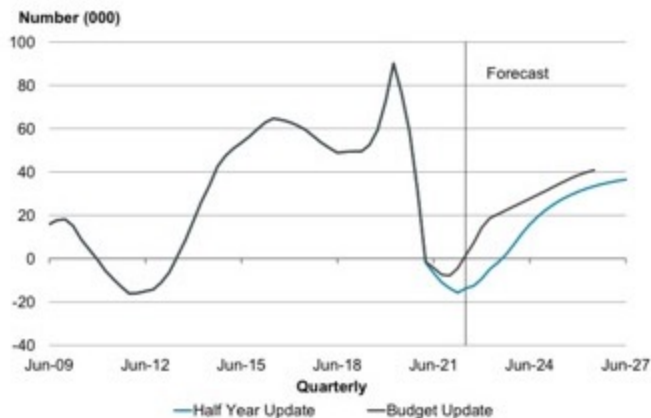
- Bernard Hickey suggests NZ's divisions are not left vs. right but generational: homeowners against renters
- Central government is stepping back: replacing centralised 3 Waters reforms with regionally owned and led "Affordable Waters"
- "Cogovernance" has been politicised
- National withdrawing from cross-party housing accord (now opposing urban densification)

Economy

- Labour shortages and inflation seem to have peaked but are at multi year highs
- Net migration is back to 2012 levels and forecast to increase as we struggle to compete
- Government expenses forecast to remain constant at ~40% GDP to 2027

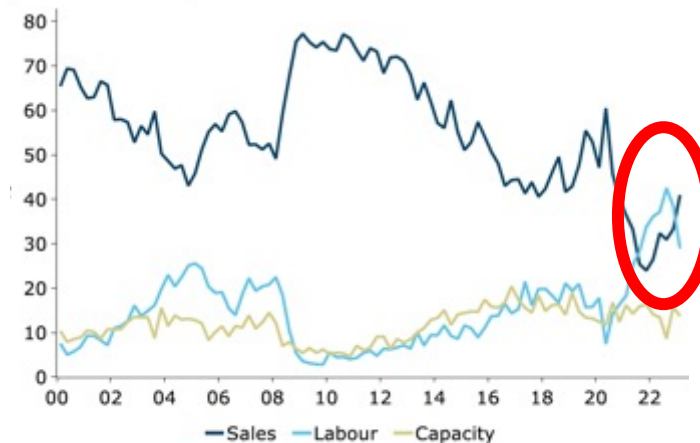


Annual net migration



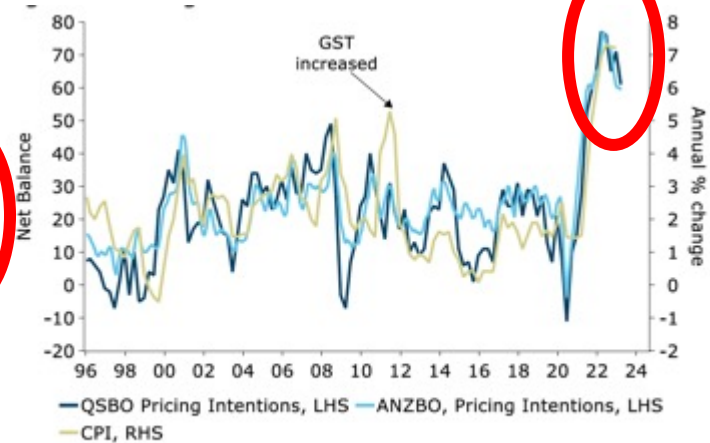
Sources: Stats NZ, the Treasury

Limiting factors in the economy



Source: NZIER, Macrobond, ANZ Research

Pricing intentions and CPI inflation



Source: NZIER, Stats NZ, Macrobond, ANZ Research

Migration trend has corrected despite competition for talent



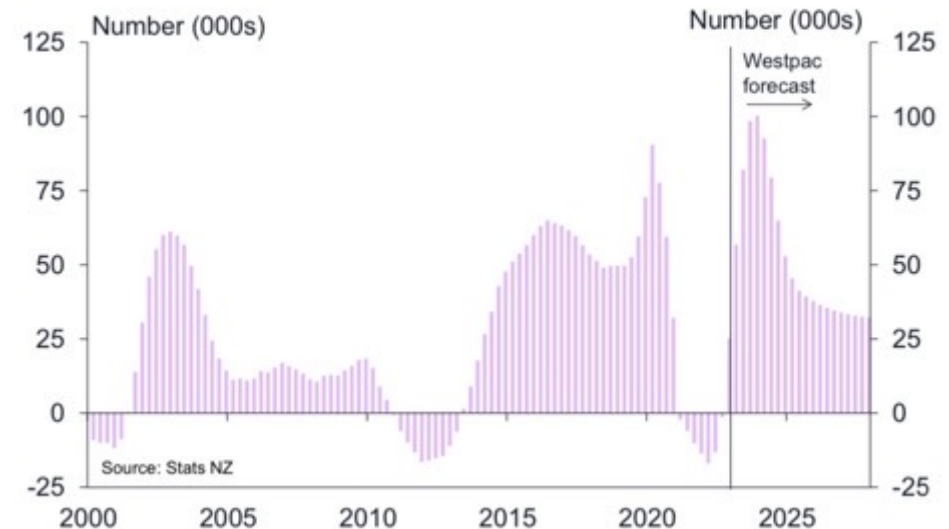
Salaries are consistently 20-40% higher in Australia

Nurse	\$72,000	\$96,000
Primary teacher	\$66,000	\$98,000
Secondary teacher	\$69,000	\$100,000
Builder	\$64,000	\$103,000
Labourer	\$54,000	\$74,000
Hairdresser	\$57,000	\$64,000
Chef	\$55,000	\$71,000
Retail assistant	\$50,000	\$71,000
Courier driver	\$59,000	\$62,000
Accountant	\$83,000	\$104,000
Architect	\$91,000	\$146,000
Doctor/specialist	\$137,000	\$202,000

Australian salary figures calculated using an exchange rate of 1AUD = 1.091 NZD

Net inflow will peak but forecast to continue indefinitely

Figure 4: Net migration



Building is still flat but house prices seem to be stabilising



In the year ended April 2023, the actual number of new dwellings consented was down 9.3 percent from the year ended April 2022.

Momentum improving

House price changes – monthly change (May 2021 – October 2022)

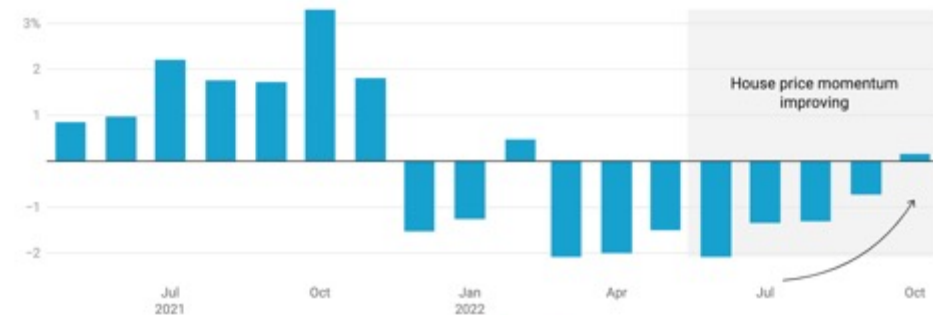


Chart: Ed McKnight – Opes Partners • Source: REINZ House Price Index • Created with Datawrapper

Most house price falls have already happened

Reserve Bank house price forecast

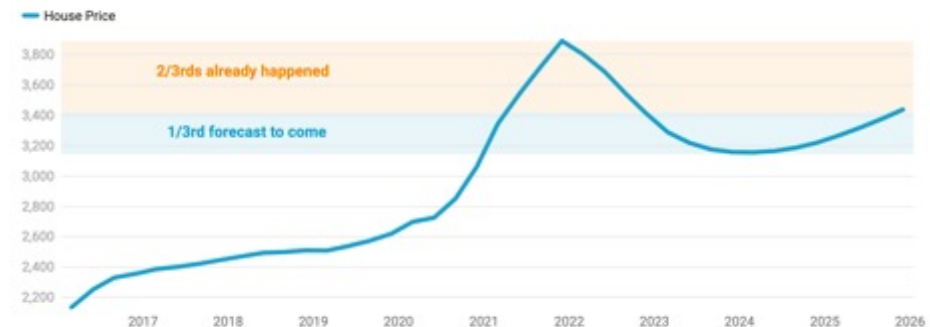
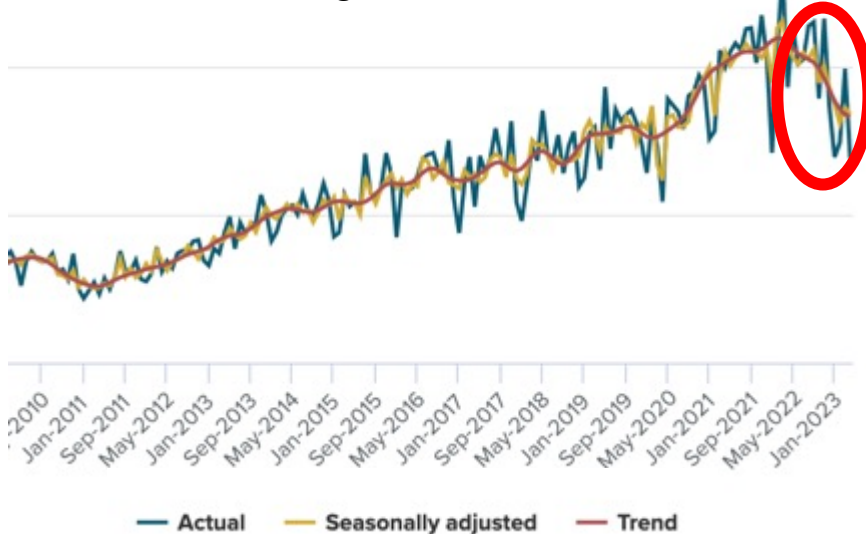


Chart: Ed McKnight – Opes Partners • Source: Reserve Bank of New Zealand forecasts • Created with Datawrapper

New dwellings consented



Sources: Stats NZ, May 2023, Opes Partners

Global supply chains have been remarkably adaptable ...



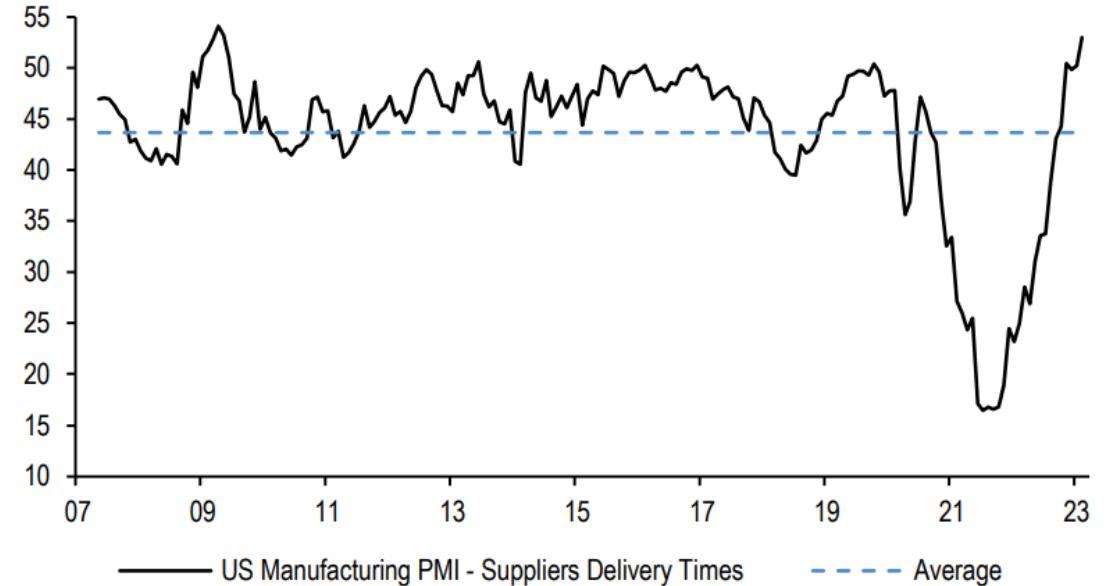
Europe: Dutch TTF gas futures, front month



Source: Oxford Economics/Haver Analytics

Europe has effectively decoupled itself from Russian gas supply ...

US Manufacturing PMI - Suppliers Delivery Times



Source: J.P. Morgan

... and US manufacturing supply chains are as timely as before lockdowns

... but global supply chains are changing

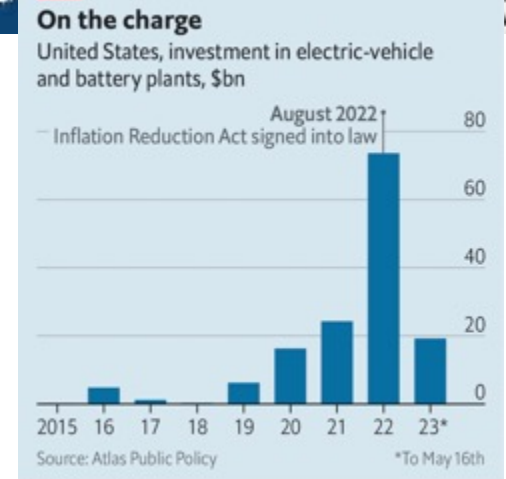


Combination of lockdown disruption, war in Ukraine and increasing tension between US and China is seeing reshoring of supply and manufacture

Has \$369bn of subsidies for US manufacturing in Inflation Reduction Act triggered a global 'clean-energy arms race'?

- Europe responding, fragmentedly
- Non-Chinese Asia claiming WTO breaches but matching subsidies
- Non-US America (esp Canada and Mexico) trying to fall under IRA

Implications for NZ? More supply diversity? Higher costs? More complexity? Less standardisation?



Social

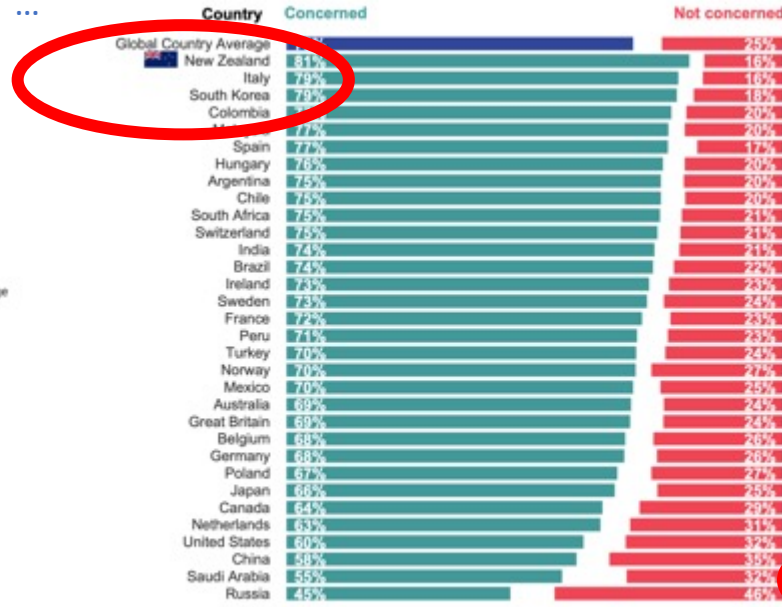
On Climate Change New Zealanders are concerned

But unlikely to take action that makes a difference

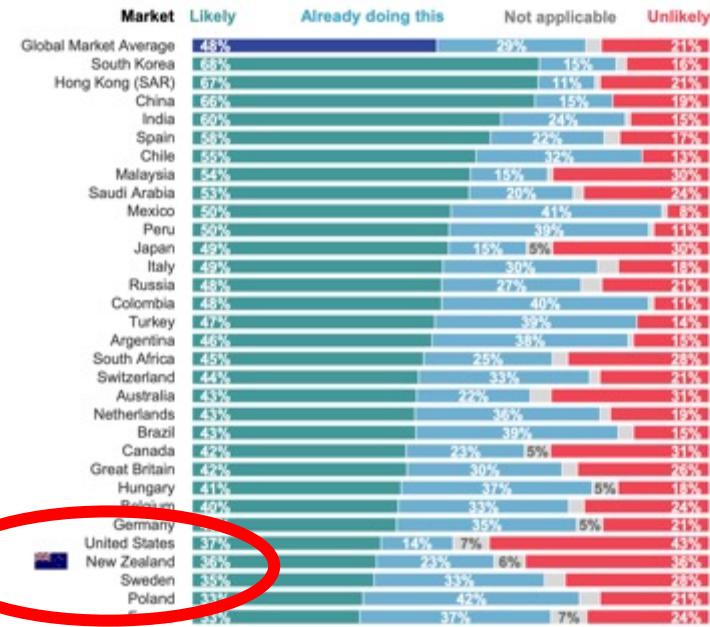
Annual food price inflation in Aotearoa



Chart: Bernard Hickey • Source: Stats NZ • Created with Datawrapper



QED: How concerned are you, if at all, about the impacts of climate change that are already being seen...
Base: New Zealand (n=1,003); Global (n=23,577 online adults across 31 countries, 18 Feb-4 Mar 2022). NB: Surveyed adults aged 16-74 in 30 countries, adults aged 16-99 in Norway.



Base: Global market average (excl. New Zealand: n= 21,011; New Zealand: n=1,010. Note: Only percentages 5% and over are shown.

- "Bread and butter" politics is a direct response to cost of living crisis
- Both Consumer Advocacy Council and Energy Hardship Expert Panel now exist and are beginning to engage in energy sector policy and regulatory decision making
- ACT & National are challenging the interpretation of te Tiriti o Waitangi, the role of cogovernance and the Māori roll
- On Climate Change ... New Zealanders were:

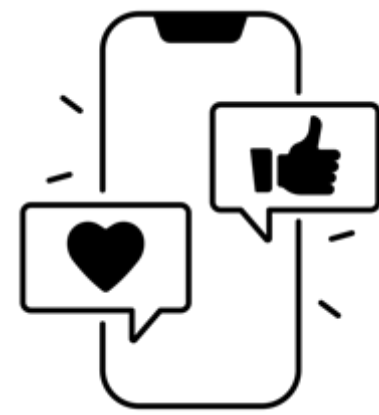
the most concerned about climate change in the world; more optimistic about making significant improvements than most countries; and, more confident than those in most other countries that their Government had a clear plan.

But among the least likely to take action that made a difference; among the most likely to think recycling and using less packaging is the most effective thing to combat climate change, even though it is one of the least effective means; and, among the least likely to change our travel habits to low emission methods, even though it is the most effective means of reducing emissions.

Sources: Bernard Hickey, Ipsos survey July 2022



NZ is following a global trend to social polarisation



Four forces that lead to polarisation

ECONOMIC ANXIETIES



Economic optimism is collapsing around the world, with the majority of countries seeing all-time lows in the number of people who think their families will be better off in five years.

INSTITUTIONAL IMBALANCE



Business is the only institution seen as competent and ethical; government is viewed as unethical and incompetent. Business is under pressure to step into the void left by government.

TRUST-CLASS DIVIDE

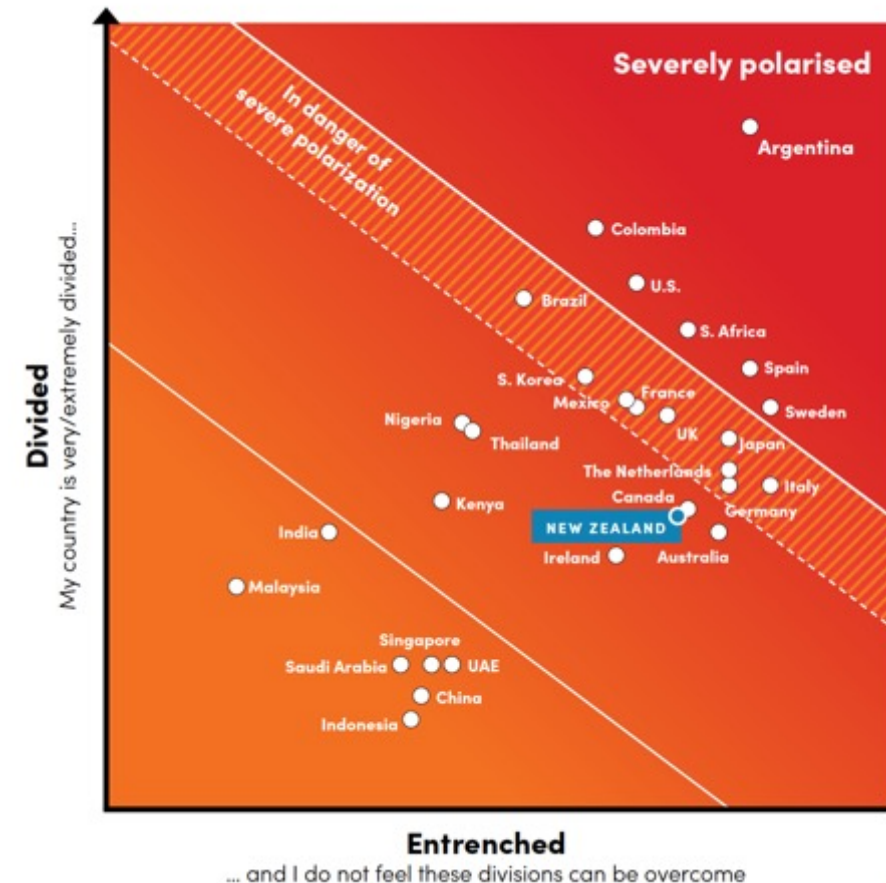


People in the top quartile of income live in a different trust reality than those in the bottom quartile.

THE BATTLE FOR TRUTH



A shared media environment has given way to echo chambers, making it harder to collaboratively solve problems. Media are not trusted, with particularly low trust in social media.



NZ's relationship with Climate Change is getting more complex by the day



Far from “my generation's nuclear free moment” that Jacinda Ardern campaigned for in 2017, climate change response is being relitigated. In incoming Genesis CEO Malcolm Johns’ first speeches in the sector he says countries across the Asia-Pacific region prioritise three issues above climate change – food security, energy security and housing security (although arguably climate change and related extreme weather events are a major cause of food, energy and housing insecurity)

“They don’t differ,” he says. “It doesn’t matter whether they’re an autocracy, a communist country, a democracy or any other form of governance.” For Johns, the biggest risk to the energy sector as he sees it is failing on energy security and facing a public backlash followed by intervention by government regulator.

Human beings are feeling machines that think – and when they feel more than they think, governments change policies,” he says. “I don’t believe climate change is the greatest threat this sector has to address. I think energy security and keeping the lights on is.”

And that

climate change will be a fertile area for trade protectionism in coming decades. The carbon border adjustment mechanisms proposed in Europe are the most obvious example of that and will attempt to police flows of goods based on their net carbon intensity.

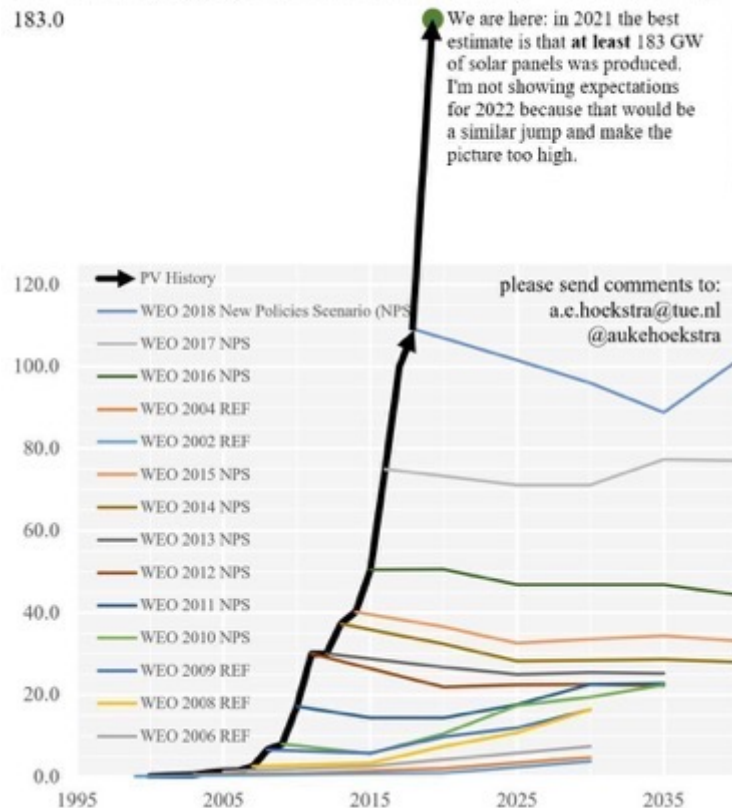
Technology – Forecasters continue to get the exponential trend for batteries (and EVs) and solar wrong



Annual PV additions: historic data vs IEA WEO predictions

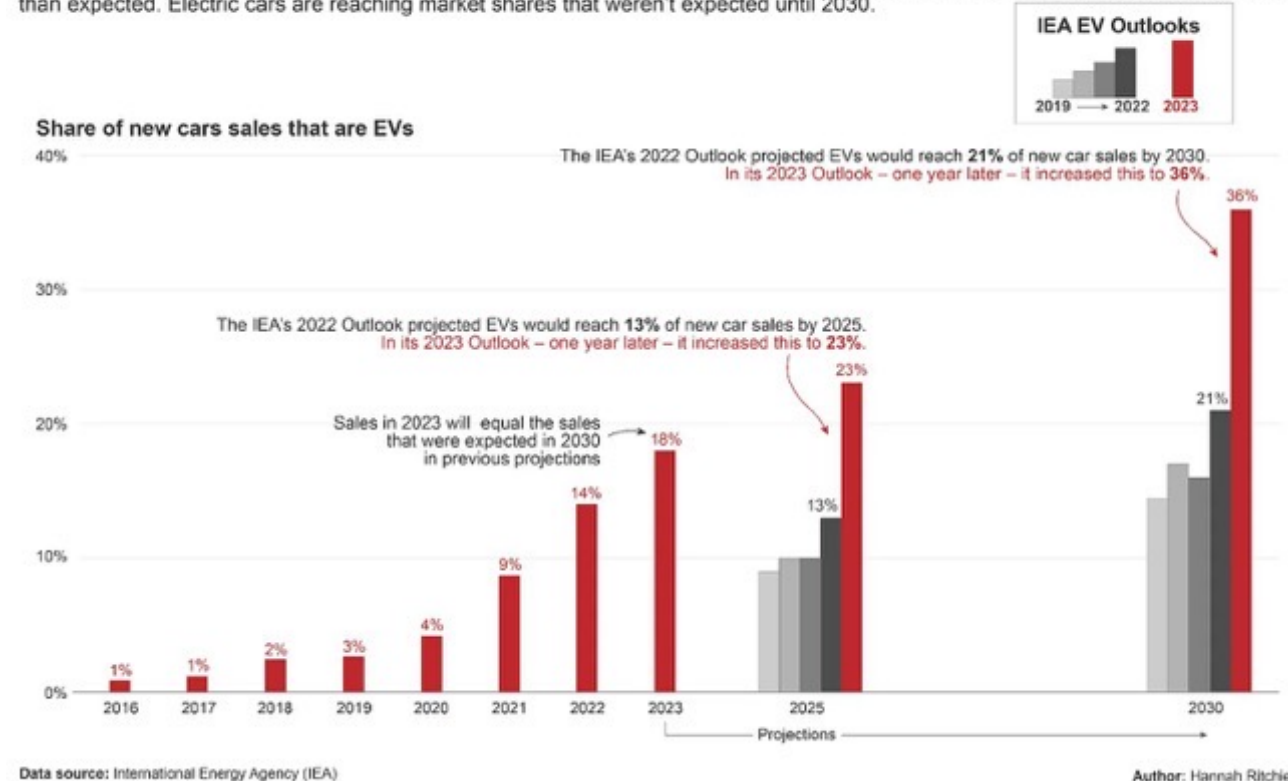
In GW of added capacity per year - source International Energy Agency - World Energy Outlook

183.0

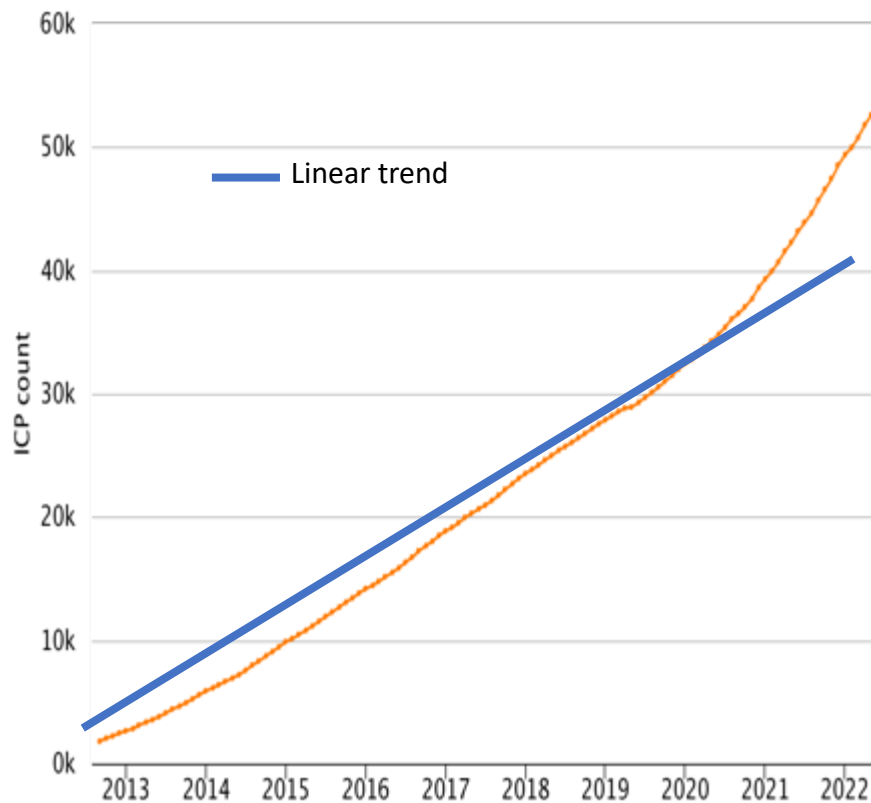


Electric cars: explosive growth in sales are beating all previous projections

Each year, the International Energy Agency (IEA) publishes an 'electric vehicle' (EV) outlook, giving the latest global data, and projections of sales to 2030. Over the last few years, these projections have increased because EV sales are growing much quicker than expected. Electric cars are reaching market shares that weren't expected until 2030.



Solar penetration In NZ might be starting to look like a curve?



Source: *Installed distributed generation trends*, Electricity Authority “Electricity Market Information” website, accessed 19/6/23

Release of 2023 Asset Management Plans has a material uplift in projected capex by several EDBs primarily to accommodate decarbonisation through electrification - EV hosting and heating (residential and commercial)

Exhibit 88: Historical and forecast peak demand and distribution expenditure



Source: *The Future is Electric*, Boston Consulting Group, 2022

Generative AI really does seem like a breakthrough technology but it's not magic



- Chat GPT3 is amazing and a potential boon to productivity and consumer experience but winners will be the organisations who use it to optimise their pre-existing strategic posture - not just those who fill blank space

*The insights of Clayton Christensen, a management guru who pioneered a theory of innovation just as the internet giants were bursting onto the scene, can provide a useful guide. Christensen noted that smaller companies often gain traction in low-end markets and entirely new ones, which the largest incumbents eschew. The **incumbents focus on deploying new technology for their existing customers and lines of business. They are not incompetent or ignorant of technological progress. Instead, they follow the seemingly correct path from a profit-maximising perspective**—until it is too late and they are fatally undermined.*

- It doesn't remove the need for professionalism at work:

This week, a corporate lawyer asked ChatGPT for legal precedents, and got, well, things that looked like precedents and cases numbers, and duly used them in his filings. Of course, they don't actually exist, and now he has to beg for mercy from a very unamused federal judge. In my opinion, this is partly the lawyer's fault - he really should have checked those cases directly - but a lot of blame also goes to OpenAI's product design. It looks like magic, but it really does not communicate what it's doing and how it works, and it's far too easy for people who don't read AI papers to think that this is doing some kind of database lookup

- Generative AI has increased demands on Cybersecurity capabilities across the economy, including electricity lines – participants in Commerce Commission's March 2023 Targeted Information Disclosure Review workshop noting that cybersecurity was a “growing issue” not properly considered when AMP requirements were first made

Environmental



- Trend in NZ carbon prices (due to political involvement) now inconsistent with global trends
- Increased frequency and severity of storms, flooding and cyclones directly linked with climate change

Kiwi scientists have contributed to a study that's found evidence climate change fuelled the impacts of Cyclone Gabrielle in Hawke's Bay and Tairāwhiti last month.

Emissions of greenhouse gases from human activity caused a 20 to 30% increase in rainfall in the area, and extreme rainfall events like this have become three to four times more likely, while still rare, the study reports.

- IPCC analysis suggests that the world is going to miss limiting global warming to 1.5°C

According to the IPCC the budget for a 50% chance of avoiding more than 1.5°C of warming is 2,890bn tonnes of carbon dioxide. Some 2,390bn of this had already been emitted by 2019. That left a pre-pandemic carbon budget of 500bn tonnes. Since then, a further 40bn tonnes has been emitted each year, roughly, leaving less than 400bn tonnes in the budget.

Source: chart - ft.com, text - *Study finds Cyclone Gabrielle rainfall affected by climate change*, 1News, 15/3/23 and *The world is going to miss the totemic 1.5°C climate target*, The Economist, 5/11/22



Legal (and Regulatory)



- Commerce Commission's *input methodologies review* draft decision published in June – proposals for reopeners and less scrutiny on customer-initiated capex
- MBIE has signalled a major consultation in July covering Electricity Market Measures, Offshore Energy, Hydrogen, the New Zealand Energy Strategy and possibly the Gas Transition Plan
- Market Measures will consider *issues relating to increasing the supply and share of renewable generation; the future of fossil fuel generation; competition in the wholesale market; investment adequacy in transmission and distribution and the role of flexibility services.*

And what's happening overseas?

BSUoS Forecast for Apr-23

ESO



System balancing in the UK is forecast to get MUCH more expensive next year

iea

Contents

Australia 2023

Executive summary

Energy transition towards net zero

The June 2022 electricity crisis reinforces the urgency and the need for an orderly transition in the NEM. Based on the AEMO's and the Australian Energy Regulator's (AER) analysis of the crisis and its upcoming recommendations, the government should expedite a review of the reliability approach taken by the AEMC.

Problem was primarily caused by a shortage of energy: a combination of the global gas crisis and problems with coal supply due to widespread flooding in Australia. Unlike NZ, the NEM has never really had to worry about energy shortages; their problems are always caused by capacity shortages. The NEM rules are predicated on that assumption.

As Australia decarbonises, energy shortages will become the primary source of reliability risks. NEM design will need to address these risks.

So what's that got to do with Security and Reliability?

Does a fish know that it's wet?



Are we taking 'the givens' for granted?



Throwback to Smart Grid Forum in Feb 2015

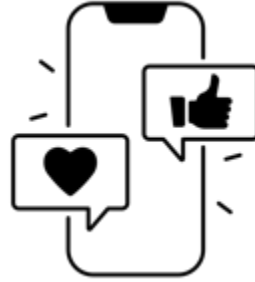


Some *Givens* of power networks

DEMAND can be predicted
DIVERSITY will reduce peak demand
CONSUMERS are passive
CONSUMERS have locations
PLANT RATINGS are seasonal numbers
SECURITY is achieved by redundancy
REDUNDANCY is unavoidable
SHORT CIRCUITS cause fault current
FREQUENCY must be tightly controlled
WAVEFORM doesn't worry anyone
CONTROL ENGINEERS are in the loop
20 MINUTES is a good time horizon
FORECASTING looks forwards
LOW FREQ DEFENCE = trip feeders

DISTORTION is created by harmonics
TAPS alter sending end volts
RE-ENERGISATION restores prior load
BLACK START calls known load blocks
T & D can be operated independently
SYSTEM MODELS are comprehensive
EQUIVALENT networks are useful
LOOP FLOWS are unintended
MARKETS only impact Transmission
COMMS FAILURES are inconvenient
CYBER attack is a risk for *other* sectors
SYSTEM control happens at the centre
PPS/NPS/ZPS can represent asymmetry





So what are our emerging trends
and how does that affect security
and reliability?

Everyone seems to be worried what replaces thermals when they exit



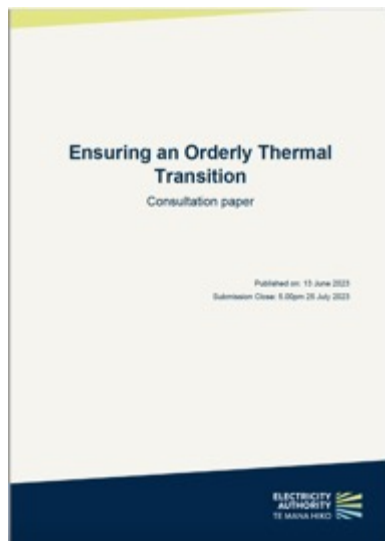
Cost to provide thermal back-up

Retention /investment decisions for thermal back-up

Availability of non-thermal flexibility services

Demand flex

Batteries & other storage



- Are there services that are currently provided freely as by-products that will become scarce under 100%RE?
- (b) Will new ancillary services such as inertia, standby reserves on a longer time scale than current instantaneous reserves, ramping duties and reactive power be required?
 - (c) How can these new products be priced in a way that sends the correct operational and investment signals? Can or should they be integrated with the dispatch objective to allow automated dispatch and co-optimisation?
 - (d) How can decentralised distributed resources and new technology be sourced and used to provide current and new ancillary services?

But what else is going to change?

Political	Environmental	Social	Technological	Economic	Legal
Less direct involvement in energy market outcomes?	Continuing trend of extreme weather?	Consumer-empowerment – buy and install DER, ask for forgiveness later?	Exponential uptake in DER changes location and dynamism of both supply and demand.	Recession. Industrial exit Shift to services	Sustained focus on existing rules and regulation – wholesale market, transmission and distribution?
Knee jerk interventions after Winter 2023?	Shifting patterns of demand in response to climate change?	Expectation that service quality will be maintained in a more complex world but prices will fall?	New tools for managing power systems	Agricultural economy changes ... but how?	Anarchy at the edges?
Suspension of market after major outage?			New threats and opportunities from AI		

And what are the implications for security and reliability ... and what should we do about them?

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