Price discovery in a renewables-based electricity system

OPTIONS PAPER

MARKET DEVELOPMENT ADVISORY GROUP

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Acknowledgements

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MDAG's role

The Market Development Advisory Group (MDAG)[1] was established by the Electricity Authority (Authority) in October 2017. The MDAG provides independent advice to the Authority on the development of the Electricity Industry Participation Code 2010 (the Code) and market facilitation measures. The MDAG focuses its advice on matters relating to the evolution of the 'machinery' of the electricity market. Specifically, under its terms of reference the MDAG can advise on:

- Initiatives to promote efficient pricing in markets and for monopoly services
- Initiatives to promote efficient management of capacity and energy risks, and
- Any other policy matters that the Authority considers appropriate.

This project

In June 2021, the MDAG proposed to the Authority that it undertake a project to understand how price discovery would work in the New Zealand wholesale electricity market (including spot and hedge markets[2]) under a 100% renewable electricity system.[3]

The objective of the project would be to develop sound recommendations on what changes should be made to the wholesale electricity market assuming 100% renewable supply to ensure economically efficient price signals (from short to long term) to meet the statutory objective of promoting competition in, reliable supply by, and the efficient operation of the electricity industry for the long-term benefit of consumers.

The proposed project would consider short-, medium-, and long-term price discovery and would consider:

(a) how the spot market will promote efficient operation on a daily and inter-seasonal basis when a high proportion of generation has low or zero marginal cost of operation (i.e. short-run marginal cost (SRMC))[4]

(b) how water will be priced, without thermal plant in the market

(c) how the wholesale market will enable efficient investment when supply is dominated by low-SRMC generation

(d) how to ensure efficient pricing in extended periods of scarcity such as dry years.

1 www.ea.govt.nz. 2017. Charter, Terms of Reference and Operating Procedures. Available at: https://www.ea.govt.nz/development/advisory-technical-groups/mdag/charter-and-terms-of-reference/.

2 Hedge markets include over-the-counter hedges, exchange-traded futures, power purchase agreements and financial transmission rights.

3 The MDAG's project proposal and proposed scope are available here: www.ea.govt.nz/development/advisory-technical-groups/mdag/mdag-price-discovery-project/

4 Note that running costs can differ from the short run marginal costs at times. In particular when supply is scarce the SRMC will include any scarcity rents. See p72 of the MDAG's review of the high standard of trading conduct provisions (https://www.ea.govt.nz/assets/dms-assets/26/26404High-Standard-of-Trading-conduct-MDAG-discussion-paper-on-pivotal.pdf) for more information.

The proposed project would have three stages:

(a) **Issues discovery**: understanding the way in which the electricity system is likely to behave with 100% renewable supply and identifying the key issues that may need to be addressed from a market design perspective.

(b) **Option identification and analysis:** identifying and analysing options to address the problems established in (a).

(c) **Option identification and analysis**: reporting with recommendations to the Authority's Board.

The MDAG's proposal noted that the project was complementary to the New Zealand Battery Project and the Future Security and Resilience (FSR) project being undertaken by the Authority and the system operator.

Authority approval of proposal

The Authority approved the MDAG's project proposal in July 2021.[5] The Authority agreed with the MDAG's view on the importance of determining early whether the current wholesale market model is robust under a 100% renewable generation future.

Disclaimer

This paper has been prepared by the Market Development Advisory Group for the purpose of advising the Electricity Authority. Content should not be interpreted as representing the views or policy of the Electricity Authority.

5 See footnote 3 above

Contents

1 Foreword

Goal of 100% renewable electricity

The terms of reference for this project were established in mid-2021 and reflect the Government's stated policy target at the time of 100% renewable electricity (100%RE) by 2030.

This has since been recalibrated by the Government's Emission Reduction Plan, released in May 2022, which aims to achieve 50 per cent of total final energy consumption coming from renewable sources by 2035. The Plan refers to 100%RE by 2030 as an aspirational target. The Climate Change Commission projects renewables will reach a 96.5% share by 2030.

To be clear, our analysis and proposals do not depend on reaching 100%RE, or even 96%. This is because the conditions that give rise to the need for our preferred options are likely to come into play in advance of reaching such a high level of renewables.

As outlined below, we are seeing evidence that the conditions of the transition have already started to emerge, some years in advance of expectations when this project started.

To avoid any confusion, in the balance of this paper we refer to steps needed to prepare for a 'renewables-based' system, noting this encompasses the aspirational target of 100% renewables.

What this is about

1.2 In brief, our task is to advise on how our wholesale electricity arrangements should be changed to enable our electricity system to play its role, fully and efficiently, in decarbonising New Zealand's economy.

How it relates to current industry issues

1.3 Understandably, the industry is focused on various issues that feel quite 'pointy' in the near-term, in particular:

(a) How to ensure that capacity will be available next year to meet peak demand on cold winter evenings;

(b) What to do about forward wholesale prices that seem stuck at high levels well above the cost of new generation;

(c) Related to (b) above, how to unclog the things that seem to be holding back the construction of new renewable power stations; and

(d) How to ensure market participants have continued access to exchange-traded futures platforms following recent disruption.

1.4 They are important issues that need to be addressed properly. Various workstreams are in progress to this end[6].

6 On 1.3(a), an informal group of industry parties has been working on possible mechanisms for consideration by the Electricity Authority, and the Authority has published a consultation paper at www.ea.govt.nz/assets/dms-assets/31/Driving-efficient-solutions-to-promote-consumer-interests-through-winter-2023.pdf. On 1.3(b) and 1.3(c), the Authority recently published this paper at www.ea.govt.nz/monitoring/enquiries-reviews-and-investigations/2022/wholesale-market-competition-review-oct2022/. On 1.3(d), see open letters from the Authority available at www.ea.govt.nz/assets/dms-assets/30/Open-Letter-for-RFPs-October-2022.pdf and www.ea.govt.nz/assets/dms-assets/30/Open-Letter-Stage-1-October-20221378506-v3.2.pdf.

1.5 To a large degree, these issues are outside the MDAG's brief; however, where a transition issue has the potential to impact on the market in the period we are looking at, then our brief leaves it open for us to offer a view[7]. In short, we see the four issues above as manifestations of an accelerated transition to a renewables-based system, which is happening sooner than expected even a year ago. The solutions need to be consistent with the long-term framework outlined in this paper, recognising the importance of avoiding *ad hoc* or temporary *add-on* solutions. We comment in particular on the winter peak issue in Chapters 7 and 12.

Approach to possible NZ Battery solutions

1.6 Consideration of a possible Lake Onslow 'battery' or other potential energy storage project sponsored by the Government is outside our scope. Our brief calls for us to assume a "renewables electricity system with dry year supply provided by the market, whether in the form of generation 'over-build', storage or demand response, or some combination of these".[8] All of the options canvassed in this paper have been developed consistent with this brief.

1.7 For completeness, we note that as outlined in our Issues Paper, it appears to be challenging but technically feasible at a system level to achieve 100% renewable supply without a NZ Battery solution, if the right market settings are in place.[9]

Where this paper fits

1.8 This paper is the second instalment in a suite of three papers by the MDAG on its review of how the wholesale electricity market should work assuming 100% renewable supply.[10]

1.9 Our first (issues) paper of 2 February 2022[11] set out our analysis of the problem. In the process of preparing our issues paper, we gained the benefit of extensive bilateral consultations with stakeholders. In the formal submissions process, we received 29 submissions, all of which were helpful.

1.10 This second paper sets out our analysis of the options to address the issues set out in our first paper. Recognising that there are several other papers and projects under review by the industry, and that the Christmas holidays will happen shortly, the consultation period for this paper has been extended out to 6 March 2023.

1.11 Our third and final paper will set out our recommendations to the Authority. It will take into account bilateral consultations and submissions on this second paper, and further work undertaken by the MDAG. We expect our third and final paper to be produced and released by June next year.

7 Our terms of reference for this MDAG project provide: "While the transition path from the current arrangements to 100% renewables is not directly within the scope of the project, it is likely to come into view as a question during the process of the project and may be taken into account in developing the MDAG's recommendations".

8 See www.ea.govt.nz/assets/dms-assets/28/MDAG-proposed-scope-price-discovery-under-100-renewables.pdf.

9 For completeness, we note that there are some differences in assumptions in the modelling work undertaken by the MDAG and for the NZ Battery project. This is because the NZ Battery accessed more refined data on some physical variables (e.g. solar and wind flows) and used different cost assumptions in some areas (e.g. solar relative to wind costs). However, these differences are not expected to materially affect the nature and direction of the modelling conclusions in the MDAG's work.

10 See www.ea.govt.nz/assets/dms-assets/21/21667Terms-of-reference-for-the-SRC-and-other-advisory-groups.pdf.

11 See www.ea.govt.nz/assets/dms-assets/29/01-100-Renewable-Electricity-Supply-MDAG-Issues-Discussion-Paper-1341719-v2.4.pdf (referred to in this paper as 'our February paper' or 'the February paper' or the 'Issues paper').

Rigorous and interactive approach

1.12 We have continued to approach this task with an open mind, seeking to build a more empirical and evidenced-based framework and sharing what we learn with the industry, policy makers and wider stakeholders, without seeking to favour or disfavour any particular outcomes.

1.13 This is genuinely a journey of discovery in which we need to remain open to revisiting our intuitions if robust analysis points us in a direction different to that which we may have assumed.

1.14 We have greatly benefited from speaking at some length with regulators in a range of overseas markets and other international experts. Along the way, we have also conferred with various other related policy and industry projects in progress. And we have encouraged interested parties to contact us directly to further discuss issues and share insights and analysis.

1.15 We will share our key findings with stakeholders on a bilateral basis and expect to follow up with further engagement when stakeholders have had an opportunity to review our work in more detail.

1.16 This open and interactive approach is extremely valuable for our process and, we perceive, for the market as a whole.

International experience and expertise

1.17 In addition to reviewing literature, we have benefitted greatly from in-depth discussions with regulators and experts involved in the development and operation of capacity mechanisms in a range of jurisdictions, including

(a) European Union – Agency for the Cooperation of Energy Regulators

(b) Alberta – Market Surveillance Administrator

(c) Australia – Energy Security Board

(d) Singapore – Electricity Market Authority

(e) Columbia – Prof. Peter Cramton

(f) PJM, Texas, other markets - Prof. Peter Cramton

1.18 Their advice and insights, which strongly influenced our thinking, are reflected in this paper. We have shared what we learned directly with various stakeholders and would be happy to convey it directly to any other parties with an interest.

Accompanying documents

1.19 More detailed analysis undertaken in this stage of our project and other related information is set out in the following accompanying documents[12]:

(a) **'Library' of Options** – a paper by the MDAG describing the options reviewed by the MDAG for the purposes of this paper;

(b) **Summary of submissions** – a paper prepared by the MDAG secretariat which provides an overview of issues on the Issues Paper raised in submissions;

12 These documents are available at www.ea.govt.nz/development/work-programme/pricing-cost-allocation/100/consultations/#c19134.

(c) **Competition analysis** – a slide pack by Concept Consulting and JC[2] setting out their further analysis of how a renewables-based system could impact on competition in the wholesale electricity market;

(d) **Demand-side flexibility (DSF)** – a paper by Stephen Batstone setting out the framework applied by the MDAG in considering options to enable more efficient use of DSF;

(e) **DSF case studies** – a slide pack by Stephen Batstone illustrating the potential integration of forward wholesale price information and DSF options into the evaluation of real-world demand-side investment decisions; and

(f) **'Nega-watt scheme'** – a slide pack by Stephen Batstone examining in more detail the option of a 'nega-watt' scheme.

Interaction with other related projects

1.20 How our electricity system should change to meet our national decarbonisation goals is being considered by a range of government and private sector processes, including:

(a) **NZ Battery Project** – a government initiative run out of MBIE that is evaluating the technical, environmental and commercial feasibility of large-scale pumped hydro (Lake Onslow) and other potential energy storage projects as a replacement for existing thermal generation covering prolonged periods of low hydro inflows (or 'dry years')[13];

(b) **NZ Energy Strategy** – another government initiative run by MBIE to develop a New Zealand Energy Strategy to support the transition to a low emissions economy, address strategic challenges in the energy sector, and signal pathways away from fossil fuels[14];

(c) **Gas Transition Plan** – another government initiative run by MBIE to develop a plan to decarbonise and reduce reliance on fossil gas, while still providing for some fossil gas use in 2035[15];

(d) **Future Security and Resilience Project** – an initiative by the Electricity Authority, in conjunction with Transpower as the 'System Operator', focused on how to ensure that the electricity system remains secure and resilient in the coming decades as we transition to a high level of renewable supply;[16]

(e) **Wholesale Market Review** – another initiative by the Electricity Authority, which is reviewing competition in the wholesale electricity market in the period from January 2019 to June 2021[17];

13 www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/low-emissions-economy/nz-battery/. Note also that the MDAG has a representative from the NZ Battery Project participating in the MDAG process as an 'observer'.

14 www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-strategies-for-new-zealand/new-zealand-energy-strategy/.

15 www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-strategies-for-new-zealand/gas-transition-plan/.

16 www.ea.govt.nz/development/work-programme/risk-management/future-security-and-resilience-project/development/future-security-and-resilience-project/.

17 www.ea.govt.nz/monitoring/enquiries-reviews-and-investigations/2021/wholesale-market-competition-review-2/ - The period of the review covers the sustained elevated electricity prices since an unplanned outage at the Pohokura gas facility in Spring 2018 and the announcement in January 2021 of the arrangements to extend operation of the New Zealand Aluminium Smelter (NZAS) at Tiwai by four more years.

(f) **Boston Consulting Group (BCG) Report**[18] – commissioned by several participants across the electricity sector[19] to advise on how the electricity sector could evolve to best contribute to the country's decarbonisation objectives;

(g) **Winter 'peak' issue** – this initiative is focused on ensuring that mechanisms are in place to ensure that sufficient capacity is available in the system to cover short periods of extremely high demand, typically in cold winter evenings. An informal group of industry participants has been seeking to develop a proposal for consideration by the regulator; and

(h) **Flex Forum** – a cross industry group formed to identify a set of actions to integrate distributed energy resources (DER) into the New Zealand electricity system and markets. Flex Forum has recently released a Flexibility Plan[20] which describes these actions.

1.21 In addition, the New Zealand Council of Trade Unions, with the Workers First Union and '350 Aotearoa', recently published a report arguing (among other things) that New Zealand's four largest generator-retailers[21] have under-invested in renewable generation capacity, which has resulted in higher prices for consumers, higher carbon emissions and excessive dividends[22].

1.22 In our view, the process of improving our system's regulatory settings benefits from an open exchange of information and a robust competition of ideas among interested parties. To this end, we have taken a very open and cooperative approach to sharing our work with other initiatives, and will continue to do so as our project works its way to final recommendations next year.

1.23 To show linkages and key points of difference to date, we have provided a summary comparison of our project's proposals relative to the Authority's Wholesale Market Review and BCG's "pathway" report in each key chapter of this paper.

18 www.bcg.com/publications/2022/climate-change-in-new-zealand.

19 Sector participants that commissioned this independent report include Contact Energy, Genesis Energy, Mercury, Meridian Energy, Vector, Unison Networks, Powerco, Wellington Electricity, and Orion. Manawa Energy, Lodestone Energy, Eastland, Nova Energy, Transpower, and Copenhagen Infrastructure Partners provided data but otherwise were not involved in the commissioning of this report.

20 www.araake.co.nz/projects/flexforum/.

21 Genesis Energy, Contact Energy, Meridian Energy and Mercury Energy.

22 See https://union.org.nz/wp-content/uploads/2022/11/GeneratingScarcity_Report.pdf.

2. What you need to know to make a submission

What this discussion paper is about

2.1 In mid-2021 the Electricity Authority asked the MDAG to identify the changes needed to the wholesale electricity market to facilitate the shift to a renewables-based electricity system. In February 2022 we published an Issues Paper describing areas where we thought challenges would likely arise and that could require changes to the wholesale market design. We had extremely positive engagement with stakeholders on the Issues Paper, and we want to thank stakeholders for their feedback.

2.2 This paper sets out the results of the second phase of our work and describes options for addressing the challenges identified in the Issues Paper and submissions.

How to make a submission

2.3 Our preference is to receive submissions in electronic format (Microsoft Word) in the format shown in Appendix B. Submissions in electronic form should be emailed to MDAG@ea.govt.nz with "Price discovery in a renewables-based electricity system – Options Paper" in the subject line.

2.4 Please note the MDAG wants to publish all submissions it receives. If you consider that we should not publish any part of your submission, then:

(a) indicate which part should not be published

(b) explain why you consider we should not publish that part

(c) provide a version of your submission that we can publish (if we agree not to publish your full submission).

2.5 If you indicate there is part of your submission that should not be published, we will discuss with you before deciding whether to not publish that part of your submission.

2.6 However, please note that all submissions we receive, including any parts that we do not publish, can be requested under the Official Information Act 1982. This means we would be required to release material that we did not publish unless good reason existed under the Official Information Act to withhold it. We would normally consult with you before releasing any material that you said should not be published.

When to make a submission

2.7 Please email your submissions to the address above by **5pm on Monday 6 March 2023**.

2.8 We will acknowledge receipt of all submissions electronically. Please contact us at MDAG@ea.govt.nz or 04 471 8628 if you don't receive electronic acknowledgement of your submission within two business days.

3. Executive summary[23]

Preparing for a renewables-based electricity system

3.1 In mid-2021 the Electricity Authority asked the MDAG to identify the changes needed to the wholesale electricity market to facilitate the shift to a renewables-based electricity system. In February 2022 we published an Issues Paper describing areas where we thought challenges would likely arise that require changes to the wholesale market design. We had extremely positive engagement with stakeholders on the Issues Paper, and we want to thank stakeholders for their feedback.

3.2 This paper sets out the results of the second phase of our work. It describes options for addressing the challenges identified in the Issues Paper and subsequent submissions.

3.3 As readers will see, we are proposing quite a few (over 40!) changes to the wholesale market design and associated arrangements. At first sight the list of proposed changes might appear a bit daunting. However, some are fairly straightforward and should be relatively easy to implement. Others are more significant and would need to be progressed over some years. We have included information on how the proposed changes should be sequenced.

3.4 We are keen to obtain feedback from stakeholders on the proposed options and their sequencing by 6 March 2023.

3.5 This feedback will be a key input to our work on a final recommendations paper, which will be completed later in 2023.

The future is arriving faster than expected

3.6 When our work began in mid-2021 a renewables-based system seemed to be many years into the future. However, it has since become increasingly clear that the transition to a renewables-based system is well underway. For example, New Zealand's renewable generation share is projected to reach around 94% by 2025 – compared to an average of 82% in the five years to 2021. Furthermore, we are starting to see *dynamics* more like those expected in a renewables-based system – such as increased short-term spot price volatility.

3.7 This means the options canvassed in this paper should not be seen as distant and academic. The future is arriving faster than expected - and so it is imperative that we prepare now for the transformative role that electricity will play in our economy and our day to day lives.

Overarching goals

3.8 Addressing the existential threat of climate change is the imperative of our generation. This is reflected in the Government's inaugural Emission Reduction Plan. This set a target of 50% of total energy consumption coming from renewable sources by 2035 and includes an aspirational target of 100% renewable electricity by 2030.

3.9 The electricity sector can support the nation's climate objectives in two important ways: reducing its own emissions and enabling our industry and transport sectors to convert to renewable electricity instead of coal, oil, diesel and gas.

3.10 As well as meeting New Zealand's sustainability objectives, the electricity system must produce power that is reliable and affordable. This is the trilemma – energy sustainability, energy reliability and energy affordability. These goals inform and frame our assessment of the options.

23 For brevity, sources for quotations and documents cited in this summary are not shown. See main body of paper for information on sources.

Do we still need a wholesale electricity market?

3.11 Before considering possible changes to the wholesale electricity market we have asked whether it is still needed at all. After all, our wholesale market was designed 30 years ago for a system that was strongly influenced by fossil fuel generation.

3.12 To answer this question, it is useful to more precisely define what we (the MDAG) mean by a “market”. It is not some abstract or philosophical notion. Nor is a template set of rules.

3.13 At its core, the primary functions of a wholesale electricity market are to enable a diversity of suppliers to offer competing solutions to meet consumers' demand, and for consumers to be able to choose the solutions that best meet their needs. The end result is that better solutions should displace less efficient solutions - in both the near-term (via selecting the cheapest supply sources each half-hour) and over time (via investment decisions) - to deliver reliable electricity at least cost.

3.14 So when we consider whether there is still a need for a market, we are asking, in effect, whether the above functions will remain relevant in a renewables-based system - namely, enabling many parties to compete to deliver least cost ways of meeting consumer demand, with consumers choosing which solution works best for them. In the MDAG's view, the answer is a clear 'yes'. Indeed, a wholesale market is likely to be even more critical to allow a wider range of parties to offer innovative solutions and to enable consumer choice.

3.15 As Transpower’s Chairman, Dr Keith Turner, recently put it:

> “The market is a way of discovering the lowest cost price. When I was power planning engineer, there was one decision-maker about the future of our power system. Now we’ve got thousands of decision-makers and if someone finds an innovation, they’re in there like a robber’s dog – and that’s fantastic”.

Five broad areas for future action

3.16 We now turn to the *particular areas* where we propose changes to beef up the wholesale electricity market design. These issues tie together in five interlocking themes, which are represented in the diagram below. The proposed options are grouped under these themes and are discussed in the next sections.

Figure 1: Five key areas for future action

Ensure reliable and efficient operational coordination

3.17 Our electricity system is undergoing a revolution. For over 100 years it had few suppliers and consumers were largely passive. Operational coordination was relatively simple – just match the generation to consumer demand. Our system is becoming far more decentralised and diverse with a lot more participants. For example, Transpower estimates there will be 3.9 million distributed energy resources across the system by 2035.

Spot price signals will need to provide the system's heartbeat

3.18 A spot market that accurately signals the value of energy at each location and time is the only viable option we have identified to efficiently coordinate *operational decisions* under a renewables-based system across a myriad of participants and devices. Many of these operational 'decisions' are likely be executed via smart devices rather than by fingers hitting switches. However, they still need coordination – and spot prices are expected to provide the heartbeat for that coordination.

3.19 Accurate spot prices may pose challenges for some parties. For example, accuracy will sometimes mean spot prices are volatile. This could pose financial risks for customers or suppliers with exposure to spot prices. However, we think this issue is better addressed via contracting and demand side flexibility (see later sections) rather than by muffling spot market signals at their source.

3.20 That is because the signaling benefits of spot prices will be lost or degraded if they are muffled. For example, it could mean electric vehicles are not charged during off-peak times, increasing the amount of new generation that needs to be developed. That in turn will raise costs to consumers and the environment.

3.21 New Zealand's electricity spot market has solid foundations (a point commented upon favourably by some of the international experts we spoke to) but needs to be upgraded in some areas as outlined below.

Options to ensure reliable and efficient operational coordination

Winter peaking and coordination issues

3.22 To date, New Zealand's electricity system has been primarily 'energy constrained'. With the shift to more renewables, we expect it to become more 'capacity constrained', as is typical in overseas systems. Indeed, capacity challenges are already emerging with several peaking 'pinch points' in the last two years. Importantly, these were not due to insufficient installed capacity which has kept pace with demand. Instead, the events reflect increasing challenges with operational coordination – i.e. whether sufficient resources (such as slower start thermal units) were ready to run when needed.

3.23 These challenges have raised questions about the merits of some sort of capacity mechanism, such as 'warming contracts' to ensure sufficient slower response resources are available when required. However, rather than an *ad hoc* intervention, it is better to focus on mechanisms that find the least cost solutions, as we do in matching supply and demand in any other time interval.

3.24 In this context, better short-term forecasting and related information will be vital so market participants can better gauge what resources to make available and when (**Option A1**). Another key area is ensuring the value of reliability to consumers is properly reflected in spot price signals, so resource providers are rewarded appropriately for making supply available or reducing demand (**Option A3**). We also see merit in a new ancillary service to reflect the changing risk profile on the system. Such a new service should harness the full range of potential resource providers including batteries and demand-side flexibility, be co-optimised with the wider spot market and conform to causer-pays principles (**Option A4**). We propose that these three measures should be actioned without delay.

3.25 Looking further out, we think a formalised ahead market might be needed to help participants with short-term planning, particularly for use of batteries and demand response (**Option A6**). An ahead market could have major benefits but would be a significant change and take some years to implement. In the meantime, the development of short-term bilateral contracts should be facilitated (see below).

Future security and resilience of the power system

3.26 Moving to highly renewable supply will have major implications for future security and resilience of the power system in (or close to) real time. This is the focus of the Authority's Future Security and Resilience (FSR) project – a foundational initiative expected to run for several years and have very significant longer-term implications. To help identify and address economic and technical trade-offs, we suggest the FSR initiative should be strengthened by adding both guiding principles and a governance (or reference) group (**Option A2**).

3.27 We are also proposing other more detailed market design changes (**Options A5, A7**) to better ensure efficient and reliable operation of the system. We have considered some other measures (**Options A8, A9, A10**) which are not recommended for further work. The operational coordination measures are summarised in Table 1.

Table 1: Proposed measures to ensure reliable & efficient operational coordination

	OPTION NAME	RATIONALE	STATUS	START	IN PLACE BY
A1	Improve short-term forecasts of wind, solar, and demand	Provides better information for decision-makers leading into real-time	Preferred	2023	2024
A2	Strengthen governance for next phase of FSR Project	Better ensures future design of system will be consumer centric	Preferred	2023	Mid 2023
A3	Update shortage price values	Ensures price signals are better aligned to consumers' interests	Preferred	2023	2025
A4	New reserve product to cover sudden reduction from intermittent sources	Ensures ancillary services reflect changing needs of system	Preferred	2023	Mid 2024
A5	Offer price reductions after gate closure	Unlocks some flexibility that is otherwise held back	Preferred	Mid 2024	Mid 2025
A6	Investigate + develop ahead market	Clearer price signals in lead-up to real-time should help parties to coordinate their plans	Preferred	2025	Mid 2027
A7	Remove UTS over-ride of trading conduct provisions	Reduces likelihood of confusing price signals from overlapping code provisions	Preferred	Mid 2025	2027
A8	Negative offers/prices	Complex to implement and appears unlikely to be needed for some time	Not preferred	NA	
A9	Centralised commitment based on complex offers	Complex and could hinder competition	Not preferred	NA	
A10	Warming contracts	Likely to raise costs for consumers relative to other options	Not preferred	NA	

SUPPORTS OPTION DOES NOT SUPPORT OPTION PARTIALLY SUPPORTS OPTION

Ensure effective risk management and efficient new investment

3.28 Effective risk management and efficient investment are heavily dependent on the contract market. Contracts are a key tool that wholesale buyers and sellers can use to manage their exposure to spot price risks. Forward contract prices also provide vital signals about where and when to invest, and about the best type of resource to develop.

3.29 Looking ahead we expect the contract market will need to do more heavy lifting to help both risk management and investment. On the risk management front, we expect a significant increase in shorter-term spot price volatility as the share of intermittent supply increases and fossil-fuelled thermal generation declines. Market participants will need access to products to manage the associated spot price risks.

3.30 On the investment front, we expect a very large volume of new generation, storage and demand response capability to be needed. We estimate the investment requirement to be $27-37 billion by 2050. There appears to be plenty of generation, storage and demand-side flexibility projects in the pipeline that could potentially satisfy these projected needs. But making sure the right projects go forward at the right times and locations is crucial.

Participant-led approach to contract/investment decisions is preferred

3.31 From a market design perspective, there are two basic approaches for organising contracting and investment decisions. One approach relies on market participants to actively manage their spot price risk exposure via their own investments or contracting with others (who in turn are incentivised to invest).

3.32 The alternative approach is for a regulator (or other central body) to determine a target for capacity adequacy, and then enforce contracting (or levying) obligations on purchasers to ensure the required capacity is deployed. A wide range of regulatory instruments have been developed for this purpose, which are often referred to as “capacity adequacy mechanisms”.

3.33 For the reasons set out in the body of the paper we think the latter approach will increase costs and become increasingly ineffective and difficult to implement in a renewables-based system. This was a strong and consistent message from overseas regulators and experts (including a leading former proponent of capacity mechanisms).

3.34 It is much better to rely on buyers and sellers putting in place effective risk management measures that are least cost for their circumstances, including a wider mix of options (for example, demand-side flexibility), which the transition to more renewables is likely to foster. However, participants must have good access to contracting tools and information, and robust incentives to manage their exposure to spot prices.

3.35 The measures proposed below are intended to strengthen these areas – particularly in relation to ‘shaped products’. This is the generic term we use to refer to non-baseload contracts that are likely to become more important as spot price volatility is increasingly driven by intermittent generation levels.

Options to ensure effective risk management and efficient investment

Better information on contract prices and supply/demand outlook

3.36 Participants will need much better information on trends in contract prices to help with contracting decisions, especially information on the prices of shaped products. Enhancing the contract price disclosure platform (**Option B1**) will further this objective. This should include information on contract offers and bids, as well as executed contracts. A forward curve that extends further into the future would also be beneficial for contracting and investment decisions. Some international exchanges are moving progressively towards longer dated futures (**Option B2**).

3.37 Another critical area where better information is required is the supply/demand outlook and range of live options in the development pipeline. The system is becoming much more dynamic and sensitive to the timing of new investments. For this reason, we propose more comprehensive and regular updates on the development pipeline, and projected energy/capacity margins should be collated and published (**Option B3**).

3.38 Being able to hedge shape-related price risk will become increasingly important for market participants. Historically, the industry and the Authority has investigated exchange-traded cap products. These products (in their traditional form) may not be the best risk management option for the types of risks we will see in the future. We propose that the Authority work with market participants to co-design a standardised product (or products) which meets the needs of buyers and sellers (including providers of DSF) (**Option B5**)**.** If trading of such products develops in the over-the-counter market, **Option B1** would provide the necessary transparency of the forward price of flexibility. Alternatively, the outcome of this design process may be to list these products on a futures exchange.

Ensure active management of forward price risks

3.39 To more closely monitor contracting behaviour and help ensure participants are actively managing their risk exposures, we propose that the stress testing regime be enhanced (**Option B4**). This would include extending the time horizon for stress testing (a few years ahead rather than just the coming quarter) and providing participants with information on how their own exposure compares to others while still preserving confidentiality for disclosers.

Reduce scope for exercise of market power in provision of shaped contract products

3.40 As noted above, shaped products are expected to become much more important in future, especially those which can provide firming for intermittent generation. However, the supply of these products may become more concentrated. To address this concern, we propose that dominant suppliers of flexibility products would be subject to an access code which would cover non-price terms (**Option B6**). For example, this could cover matters such as prescribing how requests for access are to be treated, an obligation to record requests for access products, and a requirement to provide responses to such requests in writing with reasons if they are declined, and possibly common 'non price' contract provisions co-designed by the industry. In addition we propose that the trading conduct rules in the Code would be extended to the hedge contract market (**Option B7**).

3.41 As a back-up option if these measures proved insufficient to support workable forward price discovery and liquidity for shaped products, we propose that market-making would be introduced for a shaped contract product (**Option B8**). We have considered some other measures (**Options B8, B9, B10**) which are not recommended for further work.

3.42 The measures to improve risk management and investment are summarised in Table 2.

Table 2: Proposed measures to improve risk management and investment

	OPTION NAME	RATIONALE	STATUS	START	IN PLACE BY
B1	Greater transparency of hedge info (esp non-base load) covering offers, bids + agreed prices	Make it easier for participants to compare prices, especially for non baseload contracts. Also get better info for regulator	Preferred	2023	Mid 2024
B2	Market-making for longer dated futures (for price discovery)	Improve forward price discovery and supports OTC longer term contracting	Preferred	2024	Mid 2025
B3	Publish aggregated information on pipeline of new developments, energy and capacity adequacy	Provide more information to help participants with contracting and investment decisions	Preferred	2023	2024
B4	Enhance stress testing regime	Help ensure that participants are actively considering and managing their exposure to spot price risk	Preferred	2023	2024
B5	Develop standardised 'shape' product(s)	Develop some standardised non-baseload products	Preferred	2024	2025
B6	Develop flexibility access code (non-price elements)	Promote reasonable access to 'flexibility contracts'	Preferred	2025	Mid 2026
B7	Extend trading conduct rules to hedge market	Deters participants from exercise of significant market power	Preferred	2025	2026
B8	Market making in caps or other shaped products	Strengthen forward discovery and liquidity for a shaped contract	Potential augmentation for B1, B5, B6-B7	Mid 2025	2028
B9	Capacity mechanisms	Significant implementation issues and likely to raise costs for consumers	Not preferred	NA	
B10	Strategic reserve	Likely to raise costs and unlikely to improve security	Not preferred	NA	

SUPPORTS OPTION DOES NOT SUPPORT OPTION PARTIALLY SUPPORTS OPTION

Lift demand-side flexibility

3.43 The idea that consumers could play a more active role in managing how much and when they use electricity has been talked about a lot over the last 30 years, but not a lot has happened. Demand-side flexibility (DSF) still plays a relatively limited role in our system. This is due to several historical factors which have made the “size of the prize” for individual consumers less than the cost of capturing it for them.

DSF has larger benefits in a renewables-based system

3.44 However, the landscape for demand-side flexibility is changing markedly. New technology means that consumers will be able to react more easily to dynamic price signals via the use of sensors, automation and smart devices etc.

3.45 Unlocking the full potential of DSF also has larger benefits in terms of reduced system costs, improved competition, bolstered political sustainability, and a deeper consumer understanding of the benefits available from the wholesale market.

Demand-side issues to be addressed

3.46 Our proposed package of options to lift DSF reflects the underlying philosophy of providing consumers with the right information about the value of their flexibility, and a sufficient range of options to contract that flexibility, for them to choose from.

3.47 We see a number of "early wins" that can help unblock DSF:

(a) Understanding the availability of tariffs requires better monitoring of tariff availability (**Option C1**). This should be implemented as soon as possible, since it underpins a range of future regulatory decisions.

(b) Accelerating the development of DSF tariffs requires a rapid adoption, by retailers, of the high frequency metering data that will underpin these tariffs (**Options C2**).

(c) For larger consumers, financial contracts need to be developed to underpin their investment in enabling DSF (**Option C4**).

(d) To support the uptake of DSF tariffs, consumers need the best information available about their choices, and the potential rewards, as soon as possible (**Options C15, C16**).

(e) The way the market can optimize the efficient use of DSF requires a number of existing or planned initiatives to proceed with a focus on understanding and enabling DSF (**Options C8, C9, C20, C13**). The accompanying 'DSF Case Studies' illustrates some of the information to be provided under **Option C13.**

3.48 Depending on the pace observed during the initial 1-2 years of monitoring (**Option C1**), further requirements on retailers to develop DSF-rewarding tariffs may be required (**Option C3**).

3.49 Consumers across the spectrum – from households to large industrial participants – are making electrification investment decisions today that would benefit from having flexibility being designed in at the outset. However, the DSF "market" is still very much in its infancy. We believe a well-funded and extended trial of new DSF-rewarding tariffs, technology, relationships and market integration (**Option C5**) can accelerate the closing of information and knowledge gaps.

3.50 The trial should help to solve a number of critical "common" problems so that the industry has a cohesive framework of standards and protocols that will allow competition to thrive. A trial would also promote "learning by doing"[24], that should showcase innovation and lead to a sustained increase in DSF in the New Zealand market. The level of government funding here should reflect the sizeable economic benefit to New Zealand from unlocking greater DSF.

3.51 These measures to increase DSF are summarised in Table 3.

24 See Newbery (2018), "Evaluating the case for supporting renewable electricity".

Table 3: Proposed measures to increase DSF

1	OPTIONS TO ADDRESS STRATEGIC ISSUE 1	**Tariffs mute a signal for flexibility: Yet to see widespread emergence of DSF-rewarding tariffs that enable DSF owners to make risk-value and engagement trade-offs**

	Option name	Rationale	Status	Start	in place by
C1	Monitor provision + uptake of DSF-rewarding tariffs	Provide reliable quantitative and time-series basis on which to assess retail market development and uptake of DSF tariffs	Preferred	2023	2024
C2	Sunset profiling if smart meters in place	Continued use of profiles is impeding retailers' development of DSF tariffs	Preferred	2024	2025
C3	Require retailers to offer DSF tariffs	Retailers are potentially slow to develop DSF-rewarding tariffs	Backstop if C1 evidence shows need	Mid 2024	2026
C4	Develop standardised shape-related hedge products to reward DSF	Enable large consumers to smooth volatile revenues from DSF	Preferred	2024	Mid 2025
C5	Provide significant funding for pilots/trials to kick-start dynamic tariff use	Help cut through complexities and risks in enabling use of DSF tariffs	Preferred	2024	Mid 2026
C6	Use Customer Compensation Scheme to reward DSF		Not preferred	NA	
C7	Negawatt scheme for wholesale market		Not preferred	NA	

2	OPTIONS TO ADDRESS STRATEGIC ISSUE 2	**Market is not able to achieve the highest aggregate value for DSF, therefore compromising benefits**

	Option name	Rationale	Status	Start	in place by
C8	FSR - improve DSF visibility and remove Code barriers	Covered in FSR project	Preferred	2023	2025
C9	FSR - accelerate new ancillary services for DSF uptake		Not preferred		
C10	Procurement process for high-scarcity DSF (RERT)	"Last resort" DSF should be formally contracted and paid for.	Backup if little increase in bid DSF	2025	2027
C11	Ensure distribution pricing reflects network needs	Improve coordination and optimising the use of DSF across both network and wholesale market	Preferred	2023	2025
C12	Investigate extending LMP into distribution networks	Static cost reflective tariffs may not provide the most efficient signal of dynamic network needs for flexibility, undervaluing the role that DSF can provide	Backup if C11 doesn't provide signals	Mid 2026	Mid 2029

3	OPTIONS TO ADDRESS STRATEGIC ISSUE 3	**Consumers and intermediaries have low awareness of current or future DSF value**			
	Option name	**Rationale**	**Status**	**Start**	**in place by**
C13	Provide info to help large users with upcoming DSF investment decisions	Help large consumers to better quantify the value of DSF in electrification investment decisions - see examples in accompanying 'DSF Case Studies'	Preferred	2023	2024
C14	Provide info to help domestic customers with DSF decisions	Help smaller consumers to better understand benefits of DSF tariffs	Preferred	Mid 2024	2026

SUPPORTS OPTION DOES NOT SUPPORT OPTION PARTIALLY SUPPORTS OPTION

Strengthen competition

Why it matters?

3.52 Competition is a vital ingredient to successfully shift to a renewables-based system. Without effective competition, consumers and policy makers will not have confidence in prices. That is obviously a problem for consumers, but it can also be bad for suppliers. If policy makers lack confidence in competition, the policy/regulatory environment will be less stable, harming suppliers and making further investment more difficult.

Observations from competition analysis

3.53 Analysis for the Issues Paper indicated that the shift to a renewables-based system will likely strengthen competition in some areas, and potentially thin it in others. The key area of concern was the provision of flexibility for periods of a week or longer. A sizeable slice of this flexibility comes from fossil-fuelled plant that would progressively retire under a renewables-based system. New sources of longer-term flexibility are likely to emerge – potentially including flexible demand sources, a level of renewable over-build, pumped hydro storage, biofueled thermal operation. Nonetheless, a significant thinning of competition in the provision of longer-term flexibility services appeared likely with most flexibility being held by parties with the major hydro generation.

3.54 For this paper we used scenario-based analysis to further explore competition issues. We compared a projection of the system in 2035 with the recent past (i.e. while fossil-fuelled thermal plants were still available to provide substantial flexibility). The key findings were that larger generators with substantial flexible resources may well have greater means and incentive to exercise market power in the supply of shaped products (such as contracts to complement intermittent generation sources) in the future.

3.55 Although these findings are not determinative because they are based on projections of the future, they nonetheless indicate the critical importance of maintaining effective competition for the provision of shaped products. While some may advocate for a ‘wait and see’ approach, we think this would be unwise.

3.56 First, it will take time to design possible solutions and put them in place. Waiting for a problem to emerge before starting that work could mean that an extended harm occurs before a solution is in place, or that hasty and sub-optimal solutions are implemented. Second, confidence in competition is a foundational ‘must have’ element for any open wholesale electricity market. If that confidence is not present, policy is unlikely to be durable. That in turn will make it less likely that investment at the pace needed to provide reliable and affordable power will occur.

3.57 Given these factors, we strongly recommend that pro-competitive measures directed at the provision of shaped products be pursued without delay.

Options to strengthen competition

3.58 We have considered a range of options to strengthen competition for the provision of shaped products. The options fall into two broad categories:

(a) Conduct measures – these seek to deter or mitigate the exercise of market power. They can be modified over time to reflect changing circumstances and therefore have less risk than structural measures. However, they require active and ongoing monitoring and enforcement and to some extent treat symptoms rather than underlying causes. For these reasons they may not always be effective.

(b) Structural measures – these seek to address undue market power at its source. They require less monitoring once in place. However, they are generally more costly and difficult to implement and have greater risk of unintended consequences.

3.59 We believe attention should focus on conduct-based measures in the first instance. These are a mix of options to measure competition and increase contract transparency (**Options D1 and D2**) and options to constrain anti-competitive conduct (**Options D3 and D4**). These options are expected to have solid competition benefits and low likelihood of unintended adverse effects (such as chilling investment incentives or creating coordination inefficiencies).

3.60 We also see merit in introducing market-making for a shaped contract product, such as some form of cap (**Option D5**). This is a preferred back-up option.

3.61 It is possible that conduct-based measures may prove insufficient from a competition perspective. In that event, structural measures would be required.

3.62 Given the nature of the competition concern, we expect structural measures would need to focus on the generation sector rather than disaggregating generation and retail operations. In making this observation, we recognise that disaggregation of generation and retail could improve contract market liquidity. However, it would not directly address upstream concentration at the generation level. We are also proposing other options to improve contract market liquidity and price discovery (**Options B1, B2, B5, B6, B8**).

3.63 Physical disaggregation of generation was used successfully in the 1990s to break the former ECNZ into four competitors, and to enhance competition in 2009 with the transfer of Tekapo stations to Genesis. However, as matters stand, there are few opportunities for further physical disaggregation of the hydro generation base without splitting ownership of closely related stations on river chains. Such splits could lead to coordination difficulties. Furthermore, such a ‘physical’ split would not address the key issue, which is the concentration of rights to longer term storage in the main upstream reservoirs at the head of each river chain.

3.64 By contrast, virtual disaggregation of hydro storage and generation – by reallocating rights to that longer term storage – is likely to more effectively target the issue while avoiding the complexities of physical asset transfers. For this reason, if structural solutions are needed, the preferred option would be a ‘virtual’ disaggregation of the longer term hydro storage by potentially reallocating (via auction) a significant tranche of flexible contracts from the primary holders of flexible supply (such as Meridian and Mercury) to other wholesale market participants (**Option D7**).

3.65 If structural solutions are ultimately required, they should be put in place with the least possible delay. That means some initial scoping work would make sense as a precautionary step, even if it turns out structural options were not ultimately needed. Proposed measures to strengthen competition are set out in Table 4.

Table 4: Proposed measures to strengthen competition

	OPTION NAME	RATIONALE	STATUS	START	IN PLACE BY
D1	Develop dashboard of competition indicators for flexibility segment of wholesale market	Better assess how competition for flexibility products is changing	Preferred	2023	2024
D2	(=B1) - Greater transparency of hedge info (esp non-base load) covering offers, bids + agreed prices	Make it easier for participants to compare prices, especially for non baseload contracts. Also get better info for regulator	Preferred	2023	2024
D3	(=B6) - Develop flexibility access code (non-price elements)	Promotes reasonable access to 'flexibility contracts'	Preferred	2025	Mid 2026
D4	(=B7) - Extend trading conduct rules to hedge market	Deters participants from exercise of significant market power	Preferred	2025	2026
D5	(=B8) - Market-making for shaped contract products	Creates better forward price discovery and market liquidity for a shaped contract	Potential augmentation for D1-D4	Mid 2025	2028
D6	Physical disaggregation of flexible generation base	Risk of river chain coordination inefficiencies and hard to physically reallocate storage	Not preferred	NA	
D7	Virtual disaggregation of flexible generation base	Addresses market power at source via structural change	Back-up if conduct measures not sufficient	2027[25]	2029
D8	Price caps applied in the electricity spot market	Significant risk of chilling investment	Not preferred	NA	

SUPPORTS OPTION DOES NOT SUPPORT OPTION PARTIALLY SUPPORTS OPTION

Increase public confidence

Why it matters

3.66 Public and government confidence in our electricity system is foundational. As the Hon Dr Megan Woods put it in her capacity as Minister of Energy and Resources: “For people to have confidence in our system, New Zealanders need to know that our electricity market is efficient, delivers fair prices and is working for the good of all New Zealanders. We also need to know that it is capable of responding to the enormous wave of technological change we are facing in the coming years”.

3.67 As noted in our Issues Paper, achieving public confidence and political confidence is highly influenced by whether there is sufficient competition and whether tools for managing spot risk are properly available, which supports efficient new investment and, in turn, adequacy of supply. In this regard, the measures proposed on Chapters 7, 8, 9 and 10 are fundamental for delivering public and political confidence in the wholesale market.

3.68 However, electricity systems are also complicated and any government’s understanding of the fine detail of how they work is likely to be relatively thin. So what matters is trust in the surrounding institutional arrangements – a sense that there are processes and expertise in place that governments trust to provide the required assurance it all works the way it is supposed to, and strong guidance on how to fix problems when they emerge.

25 High level specification to be completed earlier (2024-2025).

3.69 Public information is also essential. It must be neutral, clear, timely and relevant for consumers, lifting public understanding of what to expect from our electricity system (in both quality and price) and opportunities for consumers to get better value.

3.70 As we move to a renewables-based system, it is important that we strengthen the means by which governments in the future and the public in general can gain the assurance they need. Our preferred options below have also been developed to this end.

Options to increase public confidence

3.71 With the coming wave of renewables, we know that spot prices will progressively show more volatility, with more frequent short periods of very high and low prices. As a signal of real changes in the cost of electricity supply, this is a good thing, not a 'bad'. Furthermore, volatile spot prices *do not* necessarily mean volatile power bills. That will depend on how customers choose to buy their electricity, and how much exposure to spot prices they want to have.

3.72 For customers with the flexibility to lower or shift their usage, some exposure to spot prices can lower their purchase costs and be very beneficial. Unless there is a solid understanding of these types of issues, there is a risk that the public and policy makers will conclude that growing spot price volatility is problem, rather than a natural and necessary signal to help guidance sensible decision-making.

3.73 To improve the level of understanding of these issues we recommend a structured information programme designed for wider stakeholders such as consumer organisations, Members of Parliament, media and the like (**Option E1**). We also think key Ministers and officials should receive regular briefings on the near-term (seasonal) outlook for the system and spot market conditions (similar to the quarterly briefings provided on the primary sector). These briefings should also be published. This should help to avoid surprises and explain the weather linkages in more concrete terms (**Option E2**).

3.74 It is also important that New Zealand can draw fully on experience in other electricity systems that are transitioning to very high renewables. Our work has identified many lessons that are useful for New Zealand – some to emulate, others to avoid. For this reason we propose an increased inter-change with international electricity experts (**Option E3**).

3.75 Finally, it is important for the public and policy makers to have confidence in their independent regulators. For this reason, we propose that the market monitoring function of the Authority be beefed up and given more autonomy (**Option E4**), and that independent regulators be subject to periodic 'warrant of fitness' checks (**Option E5**).

3.76 Table 5 summarises the proposed options to increase public confidence.

Table 5: Proposed measures to increase public confidence

	OPTION NAME	RATIONALE	STATUS	START	IN PLACE BY
E1	Structured information programme for wider stakeholders	Explaining how security of supply is managed, both physically and via contracting, should promote better informed discussion of system performance	Preferred	2023	2024
E2	Regular briefings for Ministers and officials on current and expected conditions	Regular updates should reduce scope for surprises and foster awareness that weather-induced spot price volatility is expected and should not be artificially suppressed	Preferred	2023	2024
E3	Increase inter-change with international experts	Helps New Zealand to benefit from insights and experience from other jurisdictions	Preferred	2024	Mid 2024
E4	Enhance monitoring with more autonomy	Closer and more independent scrutiny of market performance should identify help to identify and remedy problems - and foster confidence in regulatory system	Preferred	Mid 2024	2026
E5	Periodic warrant of fitness review for independent regulatory agencies	Periodic independent reviews external should ensure any weaknesses are identified and contribute to confidence in regulatory system	Preferred	2027	2028

SUPPORTS OPTION DOES NOT SUPPORT OPTION PARTIALLY SUPPORTS OPTION

Navigating the transition

3.77 The industry is understandably focused on issues that feel quite 'pointy' in the near-term, for example potential concerns about reliability for winter 2023 and what to do about forward wholesale prices that seem stuck at high levels well above the cost of new generation. To a large degree, these issues are outside our brief and are under review in other workstreams. However, where the approach to a transition issue has the potential to impact on the market in the period we are looking at, then our brief leaves it open for us to offer a view.

Keep a clear eye on longer term objectives

3.78 We think some of these pointy issues are manifestations of (or at least related to) an accelerated transition to a renewables-based system. As a broad observation, we think it important to ensure that responses to these current issues take account of the broader goal of moving to a renewables-based system. Likewise, we would urge policy makers and stakeholders to avoid *ad hoc* or temporary measures to address symptoms. Experience elsewhere shows that such measures can delay the transition by increasing investor uncertainty, and/or extending the dependence on fossil-fuelled plant.

Will the transition from fossil-fuelled generation be orderly?

3.79 A core concern in the transition is whether there will be a smooth displacement of fossil-fuelled generation with new renewable sources, or whether the shift will become disorderly. In our view, there are three distinct risks to consider.

Risks relating to operational coordination

3.80 There are already some signs that operational coordination is becoming more challenging – especially in relation to commitment of slower-start thermal plant. We believe some of the measures proposed to strengthen operational coordination (**Options A1, A3 and A4**) will be beneficial in this context, and we propose that they be accorded a high priority. We think alternatives such as warming contracts (**Option A10**) which address symptoms rather than underlying causes, should not be pursued.

3.81 Such a mechanism presupposes that directing slow start thermal generators to 'warm up' (paid for by the industry as a whole) is the lowest cost option for ensuring reliability to cover winter peaks. This precludes other solutions that may be less costly. A key lesson from history is that no single or small group of decision-makers can see or deploy the full range of optimal solutions - consumers end up paying more than they should.

3.82 Another key reason we do not favour warming contracts is the likely chilling effect on contracting and investment incentives, and consequent risk of undermining reliability. It is better to focus on mechanisms that find the least cost solutions, as we do in matching supply and demand in any other time interval.

Risk of premature closure of existing fossil-fuelled thermal plant

3.83 Fossil-fueled thermal plant owners face a declining revenue outlook as renewables account for a rising share of total supply. It is inevitable that some plant will close – but the question is whether *premature* closures might occur. Based on current information, we think the answer is likely to be 'no'. The fundamental reason is that New Zealand (unlike some other countries) does not subsidise new renewables. This means that thermal plant operators should be able to earn sufficient revenue from the wholesale market to cover a plant's costs, if it is economic to retain that plant.

3.84 Of course, thermal operators will likely want some degree of certainty about forward revenues via contracting. Historical experience suggests that the process of negotiating such contracts can be noisy as respective parties maneuver to strike the best possible deal from their perspective. Nonetheless such contracts have been concluded in the past, and it appears deals are continuing to be struck. For example, Meridian recently announced it had concluded deals with Contact and Nova. Similarly, Genesis launched its Market Security Option products and stated it was in discussions with a number of prospective customers. Having made these observations, we note that some of the proposed measures in this paper should help to reduce the likelihood of premature thermal retirement (**Options B1-B4**). We think these options should be treated as high priorities.

Risk of delayed investment in additional flexibility resources

3.85 There is a possibility that investment in additional fast-start thermal capacity (or equivalent sources of short-term flexibility) could be desirable to support the shift to a renewables-based system. For example, the reference case scenario in the Issues Paper included around 700MW of 'green peakers' by 2035 as a possible solution. Although this example is generic in nature, the underlying point is that there could well be a need for investment in additional flexible resources during the transition.

3.86 In principle, such investment ought to be forthcoming if it is genuinely required because of the contracting and investment incentives generated within the wholesale market. However, parties contemplating investments in flexibility resources (especially new flexible thermal generation) arguably face some unique risks associated with two areas of policy uncertainty:

(a) The scale, location, and timing of any capacity developed under the auspices of the New Zealand Battery Project (NZBP).

(b) Whether any additional policy instruments (beyond the emission trading scheme) will be enacted to further restrict fossil-fuel use for power generation. Such measures could hasten or deter flexibility investments, depending on their form.

3.87 Any flexibility solutions directly affected by the above factors may not proceed until the uncertainties are resolved. The Government is working on a New Zealand Energy Strategy due for completion in 2024 that may clarify some uncertainties. However, if clarification of any aspects can be accelerated, that could help to facilitate an orderly transition.

Getting the work done

Resources for market development work

3.88 This report is proposing a wide range of measures to prepare for a renewables-based system. Furthermore, we think fast progress is needed on many of these issues because the transition is well underway.

3.89 If the proposals are carried through into final recommendations from the MDAG and accepted by the Authority, there will be a need to make a step-change in the rate of development of electricity sector arrangements.

3.90 Much of that development work would fall to the Electricity Authority to undertake or lead. It is possible that the Authority may be able to free up some resources by reprioritising existing activities. However, reprioritisation alone is very unlikely to free up the level of resource needed to undertake the proposed work. It is therefore imperative that the resourcing for the Authority be reviewed to enable implementation of the workplan with urgency.

How to undertake the work

3.91 Many of the initiatives proposed in this paper are 'bread and butter' regulatory measures. They should fit well with the typical approaches used by the Authority when considering possible amendments to the Code. However, some options are more in the nature of market acceleration or facilitation measures – such as on development of standardized shaped products.

3.92 For these types of options, we suggest the Authority undertake a facilitation and sponsorship role. This means more of the onus would be placed on stakeholders to co-design solutions, working within a framework established (and monitored) by the Authority. We suggest that prior successful experiences from the electricity and telecommunications sectors be drawn upon to set up co-design and market facilitation approaches for the relevant initiatives.

3.93 We are also mindful that other recent reports have made recommendations on the future development of the wholesale electricity market. These reports are the Electricity Authority's Wholesale Market Review of competition issues (WMR) and the report from the Boston Consulting Group (BCG) on 'Climate Change in New Zealand: The Future is Electric'. We see a high degree of alignment between many of the measures proposed in this paper and those reports.

3.94 Table 6 summarises the measures proposed in this report, their degree of alignment with the WMR and BCG reports, and our proposals on how the measures should be implemented if they are carried forward (code, or co-design etc).

Table 6: Proposed measures and process for implementation

TOPIC	CODE	MEASURE	MDAG	WMR	BCG	CODE	CO-DESIGN	HYBRID
Reliable and efficient operational coordination	A1	Improve short-term forecasts of wind, solar and demand	●	○	●	✓		
	A2	Strengthen governance for next phase of FSR project	●	○	○	✓		
	A3	Update shortage price values	●	○	●	✓		
	A4	New reserve product to cover sudden reduction from intermittent sources	●	○	●			✓
	A5	Offer price reductions after gate closure	●	○	○	✓		
	A6	Investigate + develop ahead market	●	○	◐	✓		
	A7	Remove UTS over-ride of trading conduct provisions	●	○	○	✓		
	A8	Negative offers/prices	◐	○	○			
	A9	Centralised commitment based on complex offers	◐	○	○			
	A10	Warming contracts	◐	○	◐			
Effective risk management and efficient investment	B1	Greater transparency of hedge info (esp non-base load) covering offers, bids + agreed prices	●	●	◐			✓
	B2	Market-making for longer dated futures (for price discovery)	●	●	●	✓		
	B3	Publish aggregated information on pipeline of new developments, energy and capacity adequacy	●	●	●	✓		
	B4	Enhance stress testing regime	●	○	○	✓		
	B5	Develop standardised ‘shape’ product(s)	●	◐	○		✓	
	B6	Develop flexibility access code (non-price elements)	●	●	●			✓
	B7	Extend trading conduct rules to hedge market	●	●	○	✓		
	B8	Market making in caps or other shaped products	◐	◐	●			✓
	B9	Capacity mechanisms	◐	○	◐			
	B10	Strategic reserve	◐	○	◐			

● SUPPORTS OPTION ◐ DOES NOT SUPPORT OPTION ◐ PARTIALLY SUPPORTS OPTION ○ OPTION NOT DISCUSSED

Table 6: Proposed measures and process for implementation (cont'd)

TOPIC	CODE	MEASURE	MDAG	WMR	BCG	CODE	CO-DESIGN	HYBRID
Lift demand side participation	C1	Monitor provision + uptake of DSF-rewarding tariffs (incl automation)	●	◐	○		✓	
	C2	Sunset profiling if smart meters in place	●	○	◐	✓		
	C3	Require retailers to offer DSF tariffs	◐	○	●			
	C4	Develop standardised shape-related hedge products to reward DSF	●	○	○		✓	
	C5	Provide significant funding for pilots/trials to kick-start dynamic tariff use	●	○	○		✓	
	C6	Use Customer Compensation Scheme to reward DSF	●	○	◐			
	C7	Negawatt scheme for wholesale market	●	○	○			
	C8	FSR – improve DSF visibility and remove Code barriers	●	○	○	✓		
	C9	FSR – accelerate new ancillary services for DSF uptake	●	○	○			
	C10	Procurement process for high-scarcity DSF (RERT)	◐	○	●			
	C11	Ensure distribution pricing reflects network needs	●	○	●		✓	
	C12	Investigate extending LMP into distribution networks	◐	○	○			
	C13	Provide info to help large users with upcoming DSF investment decisions	●	○	○		✓	
	C14	Provide info to help domestic customers with DSF decisions	●	○	○		✓	

● SUPPORTS OPTION ● DOES NOT SUPPORT OPTION ◐ PARTIALLY SUPPORTS OPTION ○ OPTION NOT DISCUSSED

Table 6: Proposed measures and process for implementation (cont'd)

TOPIC	CODE	MEASURE	MDAG	WMR	BCG	CODE	CO-DESIGN	HYBRID
Strengthen competition	D1	Develop dashboard of competition indicators for flexibility segment of wholesale market	●	●	◐			✓
	D2 (=B1)	Greater transparency of hedge info (esp non-base load) covering offers, bids + agreed prices	●	●	◐			✓
	D3 (=B6)	Develop flexibility access code (non-price elements)	●	●	●			✓
	D4 (=B7)	Extend trading conduct rules for hedge market	●	●	○	✓		
	D5 (=B8)	Market making in caps or other shaped products	◐	◐	●			✓
	D6	Physical disaggregation of flexible generation base	◐	◐	○			
	D7	Virtual disaggregation of flexible generation base	◐	◐	○			
	D8	Price caps applied in the electricity spot market	◐	◐	○			
Increase public confidence	E1	Structured information programme for wider stakeholders	●	○	○	✓		
	E2	Regular briefings for Ministers and officials on current and expected conditions	●	○	○			✓
	E3	Increase inter-change with international experts	●	○	○		✓	
	E4	Enhance monitoring with more autonomy	●	○	○	✓		
	E5	Periodic warrant of fitness review for independent regulatory agencies	●	○	○	✓		

● SUPPORTS OPTION ◐ DOES NOT SUPPORT OPTION ◐ PARTIALLY SUPPORTS OPTION ○ OPTION NOT DISCUSSED

4. Recap on Issues Paper

Key findings

4.1 Our Issues Paper provides the platform for our approach to this options stage, so let's first briefly recap our key findings back in January 2022.

4.2 In a nutshell, we examined the likely effects of 100% renewable supply on the electricity system as a whole. We concluded that all renewable supply appears to be technically achievable at a *system level* if the right settings are in place. From that analysis, we distilled the following key implications for *market design*:

(a) Real time coordination will become more challenging and make an effective spot market even more important;

(b) The types and quantities of ancillary services will need to change to maintain secure supply;

(c) Accurate spot price signals will be crucial for demand-side, contracting and investment incentives;

(d) Demand side flexibility will become more important;

(e) Contracts market will have to do more 'heavy lifting'; and

(f) Sufficiency of competition will be vital, particularly in flexible supply.

4.3 We set out five pre-conditions that need to be satisfied for our 'energy-only' arrangements to work well, namely:

(a) Wholesale prices reflecting real supply and demand conditions, including very high prices in times of scarcity;

(b) Confidence among wholesale buyers and sellers that the high prices make sense (which means confidence in the structure and rules of the market, including the sufficiency of competition);

(c) Availability of 'tools' for wholesale buyers and sellers to manage their exposure to those spot price risks;

(d) General public and political acceptance that volatility and high prices (in times of scarcity) in the wholesale market are, in fact, in the best long-term interest of consumers, and that measures to 'soften the landing for unhedged participants' can trigger a vicious circle of undermined investment incentives and higher future prices; and

(e) Confidence among consumers/politicians that investment will be timely and competitive.

4.4 We observed that achieving (d) and (e) above is highly influenced by whether (a) to (c) are satisfied.

4.5 We also pointed out that higher prices with more frequency in an energy-only regime will likely require both a change of mind-set and measures to strengthen delivery of the criteria outlined above.

4.6 In conclusion, we emphasised that although there is much that New Zealand can learn from international experience, our physical characteristics and lack of any grid interconnection to other countries mean the challenges and opportunities we face are unique in many areas.[26] As New Zealand moves forward on its decarbonisation journey, it will be important to monitor international developments but also to think deeply about the particular features on our system and the opportunities and challenges they present

[26] Indirect linkages to other markets could occur via other means, such as the production and sale of green hydrogen.

Submissions to date

4.7 We have benefited greatly from the number and quality of submissions on our Issues Paper. We reviewed each submission thoroughly and thoughtfully, systematically noting each key point. A summary of submissions is available at www.ea.govt.nz/development/work-programme/pricing-cost-allocation/100/consultations/#c19134. Stakeholders will discern from our approach and analysis that the submissions have constructively influenced our thinking and preferences. By way of assurance, we made a point of methodically reviewing whether we have properly weighed each key point from submissions on our Issues Paper before concluding this paper.

4.8 Once again, we look forward to your continuing commitment in helping the MDAG to assess the issues, evaluate the options and distil well thought-out recommendations – better readying our wholesale market for the challenges and opportunities in decarbonising our economy.

5. Our goals – what are we striving for

Decarbonising our economy – the imperative of our generation

5.1 Responding to the existential threat of climate change is the imperative of our generation. For the country as a whole, the Government has committed to reaching net zero for long-lived gases by 2050, set a target that 50% of total energy consumption will come from renewable sources by 2035, and has an aspirational target of 100% renewable electricity by 2030[27].

5.2 While electricity generation in New Zealand represents some 5% of the problem[28], it has the potential to play a significant role in reducing our long-lived greenhouse gases. We have the opportunity to convert much of our industry and transport to run on renewable electricity instead of coal, oil, diesel and gas[29].

27 MBIE, Terms of reference for Energy Strategy, 22 October 2022 - https://www.mbie.govt.nz/dmsdocument/25373-terms-of-reference-new-zealand-energy-strategy.

28 Electricity generation (using coal, oil, diesel and geothermal) accounts for only circa 5% of gross greenhouse gas (GHG) emissions.

29 Energy for transport, manufacturing, and electricity production accounts for circa 40% of gross GHG emissions. Energy, industry and building together account for circa 77% of gross long-live GHG emissions.

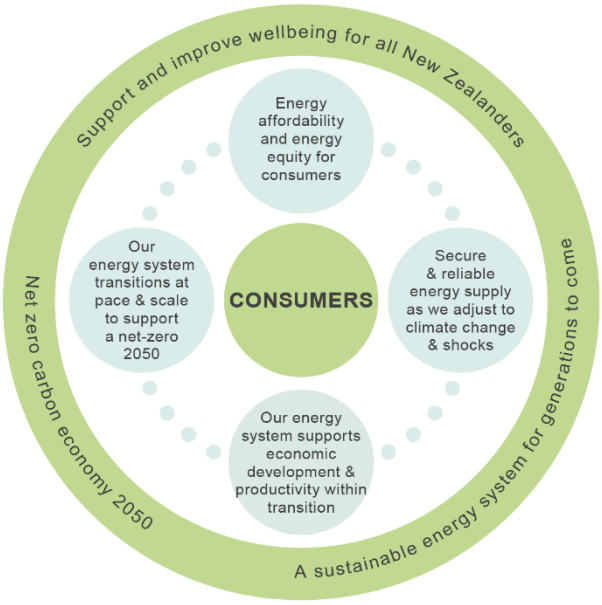
Renewable, reliable, and affordable power

5.3 As well as meeting our renewable objectives, we want our electricity system to produce power that is reliable and affordable. This is the trilemma – energy sustainability, energy reliability and energy affordability.

5.4 Put another way, we want renewable and reliable electricity at least cost to consumers[30].

5.5 The Government's vision for its energy strategy reflects this trilemma:

> "a net-zero carbon economy in 2050, where energy is accessible and affordable, secure and reliable, and supports New Zealanders' wellbeing"[31]



MBIE, October 2022

Need high reliability, but there is a cost trade-off

5.6 Clearly, it is vital that our electricity system meets our society's expectations in relation to both reliability and security[32].

> "Electricity resides at the top of any list of critical infrastructure"[33].

5.7 But how much security we want needs to be informed how much we are willing to pay to ensure that we don't have to go without power.

5.8 Of course, electricity outages can become very unpalatable from political viewpoint. For example, in 2016, Malcolm Turnbull as Prime Minister of Australia declared, in effect, that the political tolerance for blackouts is zero – "0.002% risk of outage is not good enough"[34].

Contrary to some perceptions, security has actually increased since we've had an electricity market. Between the 1940s and 1960s, supply shortages were frequent. The security standard was around 1-in-10 years. Between 1987 and 1992 (under ECNZ), it increased to 1-in-20. From 1992 to 1997, it lifted further to 1-in-60^. Since the start of the market in 1999, it increased to around 1-in-100.

^ After the Inquiry into the 1992 shortage.

Source:www.energylink.co.nz/news/blog/1992-shortage-revisited

5.9 But the infrastructure required to provide those last tiny fractions of percentages of absolute security can be *very* expensive indeed. Most consumers prefer to tolerate some very low risk of outage rather than pay much higher power bills. The ideal outcome is that consumers receive the level of reliability that reflects their willingness to pay.

30 Peter Cramton, Electricity market design, Oxford Review of Economic Policy, Volume 33, Number 4, 2017, pp. 589–612 – with the addition of "renewable".

31 MBIE, Terms of reference for Energy Strategy, 22 October 2022 - https://www.mbie.govt.nz/dmsdocument/25373-terms-of-reference-new-zealand-energy-strategy.

32 By "reliability", we mean having adequate generation and demand response to continuously meet consumers' demand for electricity. This covers all timeframes – within the half hour, hour, day, week, season, year and beyond. By contrast, "security" means tolerating a disturbance (such as loss of a major generator or transmission circuit) and still maintaining electricity supply to consumers. "Security" is a necessary, but not sufficient, condition for "reliability".

33 See LECG, Determining outcomes or facilitating effective market processes: a review of regulation and governance of the electricity sector. Prepared for Business New Zealand by: Kieran Murray, Graham Scott, Toby Stevenson 4 February 2008.

34 Aurora podcast.

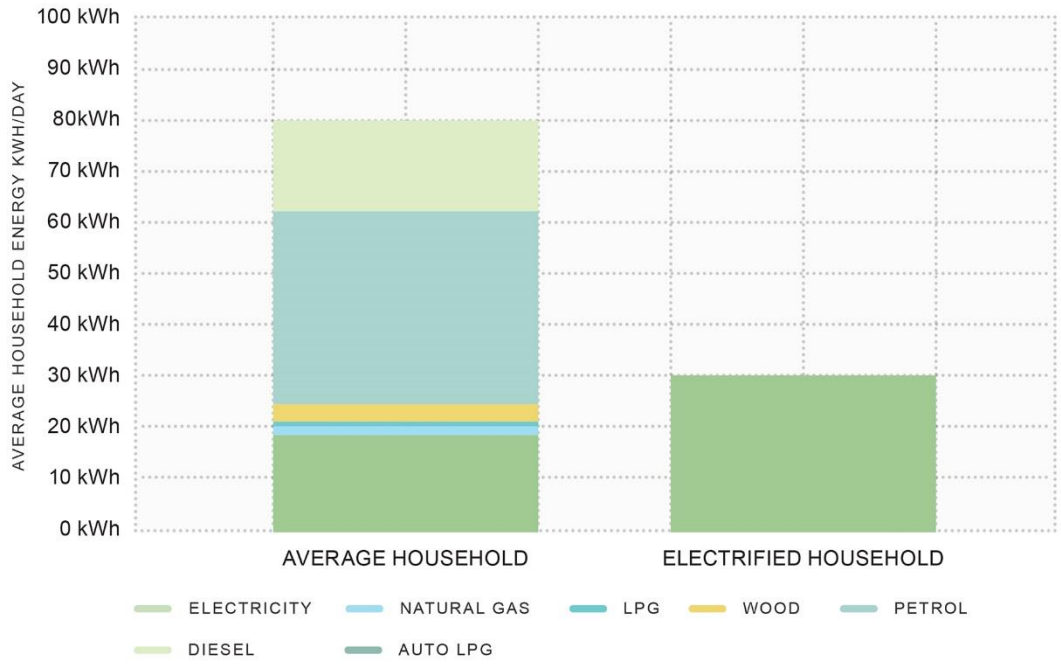
Affordable power

5.10 New Zealand has generally ranked well in past international comparisons of electricity prices. For example, data from the United Kingdom Department for Business, Energy & Industrial Strategy showed that in 2020 industrial electricity prices in New Zealand were in the lower half of International Energy Agency members.[35]

5.11 Looking ahead, it is important to ensure New Zealand electricity prices are as low as possible. This will be even more important in future for two reasons. First, many decarbonisation options such as electric vehicles use electricity and higher prices will slow down uptake of those options. Second, households and businesses will be more sensitive to electricity prices because it will account for the larger share of energy use.

5.12 That said, this will most likely occur due to the electrification of transport, which will in turn reduce household expenditure on petrol and diesel. Due to the efficiency of electric vehicles (relative to internal combustion engines), the net effect should be a reduction in the household's total expenditure on energy. As Figure 2 shows, a fully electrified household (including transport) will have a higher electricity bill, but potentially a much lower *energy* bill.

Figure 2: NZ average household energy use, current vs electrified[36]



5.13 We acknowledge that many households' transition to electrified transport, space and water heating will require a degree of expenditure on new appliances and vehicles that will be challenging for low income families. This is an important issue, but one that is beyond the scope of this work.

5.14 A positive factor in this context is that a renewable-based system may not lead to any significant change in average electricity prices if the system changes are managed well. As set out in the Issues Paper, simulation results under the reference case indicated that average price levels in 2035 and 2050 were quite similar to recent historical average levels in real terms.[37]

35 New Zealand had an average industrial electricity price of 7.74 pence/kWh compared to an IEA median of 8.66 pence/kWh in 2020. Prices included taxes and 25 countries were included in the dataset. See https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1107537/table_531.xlsx.

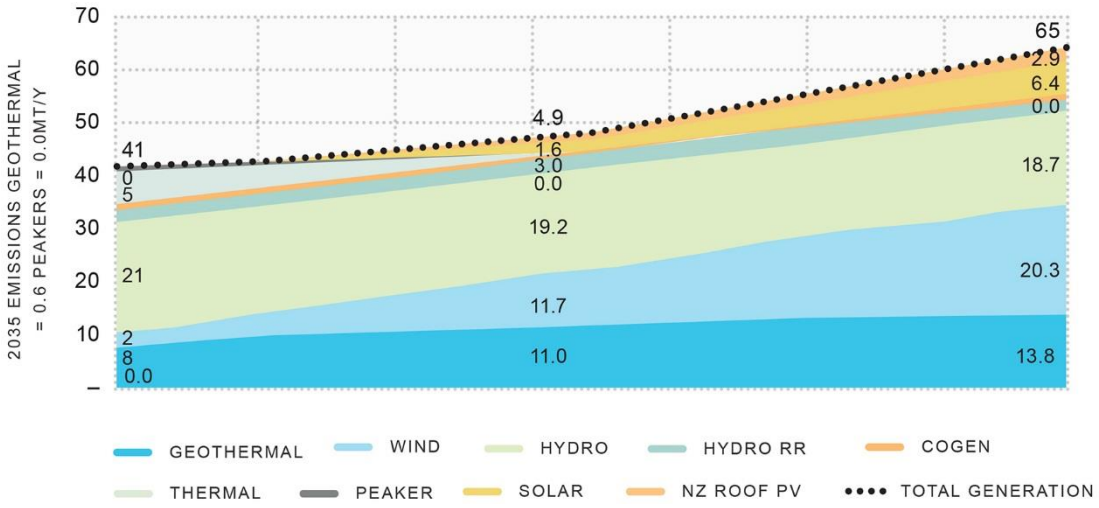
36 See Rewiring Aotearoa, Submission to Productivity Commission's "Fair chance for all" consultation, November 2022.

37 Issues Paper, Figure 9. Having made the above observations, it is important to note that this project is not seeking to predict the average level of future prices.

Huge ramp-up in new energy supply capacity will be needed

5.15 The future is never certain – but all forecasters agree that demand will rise as electricity increasingly powers New Zealand's transport sector and industry. For example, as shown in Figure 3, the Issues Paper projected energy demand to grow by around 33% between 2020 and 2035, and a further 33% in the next 15 years.

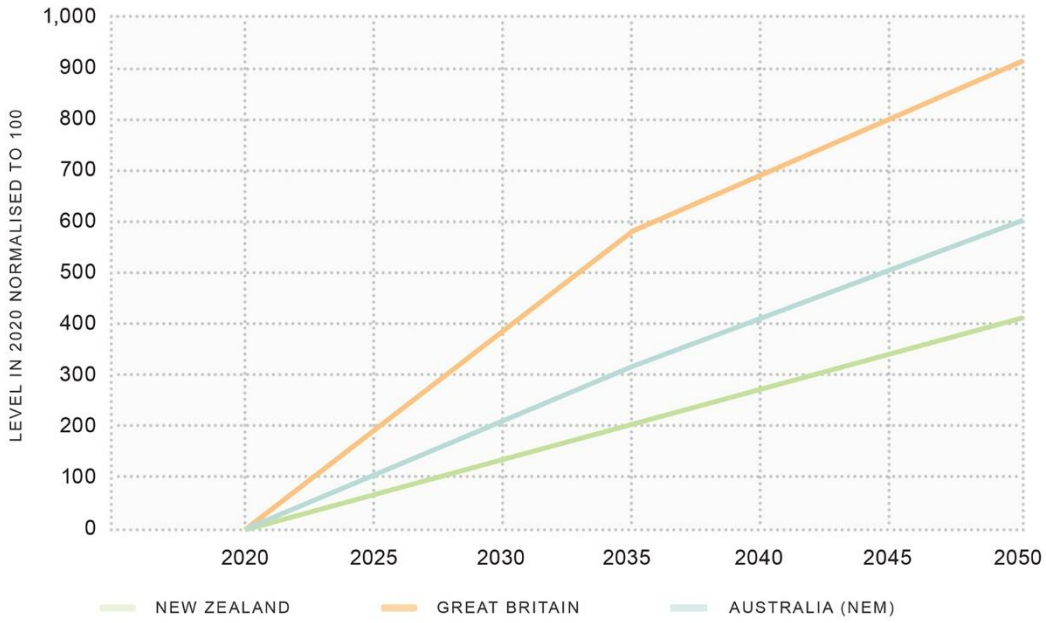
Figure 3: Projected energy demand (reference case)



5.16 A very large ramp up in investment will be required to satisfy growing demand and displace fossil-fuelled generation. For example, around 1,100 GWh of new renewable generation capability would be required each year until 2050 to meet the projected growth. This is almost 2.5 times the rate of renewable development achieved in the 30 years to 2020.

5.17 This is obviously a significant step-up, but by way of comparison New Zealand is better placed than many other countries, including for example Australia and Great Britain, as shown in Figure 4.

Figure 4: Projected growth in renewables and battery storage capacity



Ensuring timely and efficient investment

5.18 With the ramp of new supply needed to decarbonise our economy, it will be crucial to ensure timely and efficient investment in new generation and demand-side response.[38]

5.19 The technology used to deliver this dimension of "reliability" is changing quite significantly with new generation becoming smaller, more modular, quicker to build, and (in combination) having the potential to provide better "security".

5.20 As Sonia Aggarwal and Robbie Orvis point out[39]:

> "…newer resources tend to have smaller minimum unit sizes—on the order of tens of megawatts (MW) rather than hundreds or thousands. As a result, these resources can be deployed more quickly and in smaller unit sizes. Even if each individual wind power plant is less predictable than each traditional dispatchable coal plant, a fleet of wind power plants might actually be more reliable than the single dispatchable coal plant. This is because probabilistically, ten uncorrelated units that are 100 MW in size are more reliable than a single 1,000 MW unit that could trip off all at once."

5.21 As the Oxford Institute for Energy Studies observes[40]:

> "Solar and wind generation technologies offer emission free energy at close to zero marginal cost. Coupling these technologies with storage and demand response allows for firmer sources of power and improved balance between power demand and supply"

38 Timely and efficient development of additional network capacity will also be crucial. However, consideration of that issue is outside the scope of this project.

39 Sonia Aggarwal and Robbie Orvis "Wholesale Electricity Market Design for Rapid Decarbonization – Visions for the Future", JUNE 2019 - https://energyinnovation.org/wp-content/uploads/2019/07/Wholesale-Electricity-Market-Design-For-Rapid-Decarbonization.pdf.

40 Farhad Billimoria, Pierluigi Mancarella and Rahmatallah Poudineh, "Market design for system security in low-carbon electricity grids: From the physics to the economics", June 2020, Oxford Institute for Energy Studies, University of Oxford, OIES Paper: EL 41.

5.22 As Transpower's Chairman, Dr Keith Turner, highlights[41]:

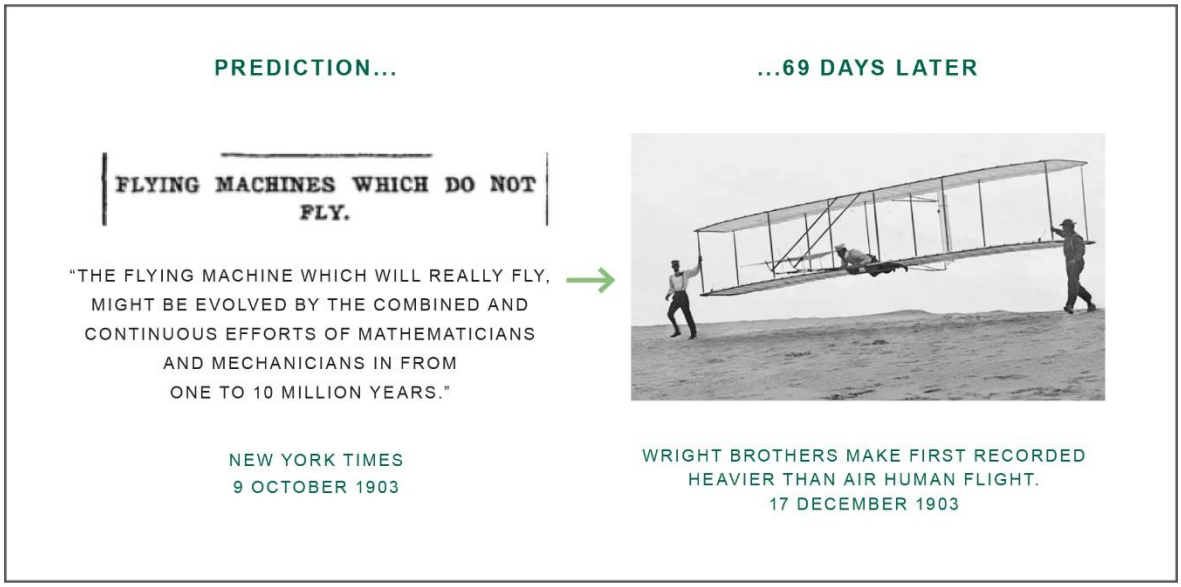
> "The difference between my days as a planning engineer and today is that these projects can be built in a year or two. You can build a solar farm – I've seen a solar built in Australia in nine months. And so you don't need to make a decision 10 years in advance of when you need the energy. And that is really important for generators – they can leave their decision to the last minute and then away they go"

5.23 And as explained in Chapter 9 below, demand-side response will become much more important.

Harnessing innovation will be critical

5.24 A technological revolution in renewable energy is underway around the world.[42] Myriads of organisations all around the world – private and public, for profit and philanthropic – are focused intensely on developing solutions to replace fossil fuels with renewable sources of electricity.

5.25 Predictions and solutions that look good today may well be overtaken by better options.



5.26 Indeed, most energy-economy models around the world have historically underestimated deployment rates for renewable energy technologies and overestimated their costs[43].

Examples of unpredicted innovation
Few people predicted that the cost of solar PV would decrease by more than **three orders of magnitude** since its first commercial, while prices for fossil fuels now (ex-carbon), after adjusting for inflation, are very similar to prices 140 years ago with no obvious long range trend

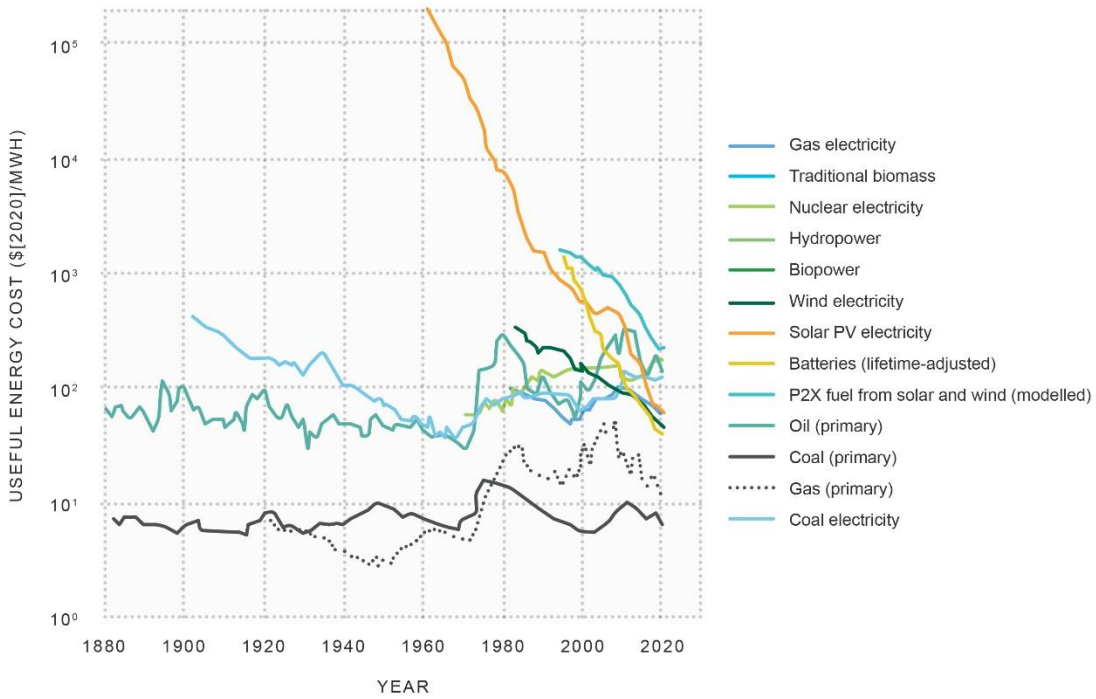
41 Dr Keith Turner, Chairman, Transpower New Zealand, Interview with Kathryn Ryan, "Nine To Noon" Radio New Zealand, 5 October 2022 at 12'46".

42 See footnote above.

43 Oxford Martin School – "Empirically grounded technology forecasts and the energy transition" – Sept 14th, 2021 INET Oxford Working Paper No. 2021-01.

5.27 Figure 5 shows the cost of useful energy from a wide variety of sources over a period of more than 100 years. Costs for fossil-fuel sourced energy has been fairly constant in real terms since 1880 (bar the Middle East 'oil shocks'). By contrast the cost of energy from most renewable sources has been steadily (or steeply) declining.[44]

Figure 5: Cost trends for different energy sources



5.28 Supply and demand-side solutions are likely to emerge that are currently not known or currently considered not viable. In short, innovation will continue to drive costs and technology in ways that we can't predict.

5.29 This means it will be important to carefully weigh the benefits of early decisions versus keeping options open across the energy landscape.

5.30 It is also important to recognise that moving to a renewable electricity system will require lots of decisions. For example, how much wind versus solar; what sort of storage and where and when; how much demand response versus supply side resources; and how much reliance on local solutions compared to grid-scale.

5.31 Backing up wind and solar when it suddenly slows is likely to come not just from bio-fuel thermals and hydro storage, but also from a variety of innovative solutions; for example, turning off big boilers; using cool-stores as batteries; industrial customers having massive stores of hot water; and virtual power plants (VPP), where cloud-based platforms using artificial intelligence and machine learning aggregate thousands of smart homes together and dispatches them as a virtual power plant.[45]

Competition and choice are critical

5.32 Another key lesson from history is that no single or small group of decision-makers can see or deploy the full range of optimal solutions. It requires a diversity of participants. The core functions of a wholesale market are to enable a diversity of parties to compete in offering solutions for meeting electricity demand, and for consumers to choose the solutions that best meet their needs. The end result is that better solutions should displace the less efficient solutions.

44 See footnote above.

45 For example, Solar Zero - solarzero.co.nz/upperclutha. See also www.scoop.co.nz/stories/SC2211/S00014/solarzero-enables-world-first-trade-in-nz-electricity-reserves-market.htm.

5.33 Harnessing innovation and diversity of views on risk will be critical if our electricity system is to play its full part in decarbonising our economy. A system that encourages competition and choice will provide the greatest scope for different ideas to be tested and for the best ideas to be adopted. The theme of encouraging choice permeates many of the options and proposals we make in later chapters of this paper.

5.34 In short, encouraging choice fosters innovation, and history shows that innovation is the best long-term way to achieve the trilemma objectives of driving down costs, improving environmental outcomes and lifting reliability for consumers.

5.35 This means the electricity systems and rules need to be neutral as far as possible as between supply- and demand-side solutions, and between different technologies. The system and its rules should also focus on outcomes/outputs where possible rather than inputs.

5.36 Lowering carbon emissions by wide-spread electrification using renewable resources is, without question, the overriding imperative for our country (and the world at large). It also important that we aim to achieve this imperative using the most efficient solutions over time. If we build more new generation than we need, we will impose more harm on the environment than we should have. If we use more expensive solutions than we could have, we will impose more costs on consumers than we should have. And, in both cases, we would waste scarce capital that should have been applied to higher value uses. In short, investment efficiency will count for a lot in how we deliver a renewable electricity system. The real prize is getting new generation built as cheaply as possible, in the right places, at the right times.

Empowering the consumer

5.37 The idea that consumers could play a more active role in managing how much and when they use electricity has been talked about a lot over the last 30 years, but not a lot has happened. Demand-side response still plays a relatively limited role in our system[46]. This is due to several historical factors which have made the "size of the prize" for individual consumers less than the cost of capturing it.

5.38 However, today's landscape for demand-side response is changing markedly. New technology means that consumers who receive a dynamic price signal should no longer have to dynamically (and often manually) determine their response. The recent evolution of sensors, automation, algorithms and smart devices has dramatically reduced this need for consumer engagement. Advanced communications are enabling an increasing range of consumption devices to be controlled remotely. And the widespread rollout of 'smart' meters in New Zealand has removed a key technology barrier (though many customers are still reconciled in the market using 'dumb' profiles) to tariffs that measure and reward customers whose demand responds to wholesale signals. They also provide for superior access and control of hot water.

5.39 This lays the platform for a range of commercial arrangements and tariffs through which market participants can procure and reward demand-side flexibility (DSF)[47] from resource owners (customers). We are starting to see these tariffs gradually emerge in the retail marketplace, but New Zealand is still at an early stage. The best way to discover consumer preferences is to see them revealed through their choices informed by the best information available regarding the costs and the benefits of doing so.

5.40 We expect the cost of reducing or shifting consumption will become increasingly competitive as an alternative to using supply-side resources, particularly as the value of flexibility heightens with the decline of flexible, dispatchable fossil-fuelled plant.

46 Demand-side response's most significant contribution has come from energy efficiency, rather than dynamic demand. Notwithstanding that, in the New Zealand context, hot water control has been extensively used to manage peak network loadings since the 1960s, public conservation campaigns were used to manage dry years in 2001 and 2003, and some large industrials (eg. Norske Skog Tasman) became quite sophisticated at dynamically managing demand in response to wholesale and transmission pricing signals.

47 Our technical meaning of DSF is set out in Chapter 9 below.

5.41 In short, we need to ensure that DSF competes efficiently with supply-side resources and networks in delivering reliability at least cost over the short, medium and longer terms. As Sonia Aggarwal and Robbie Orvis highlight[48]:

> "As it stands today, electricity demand can be increasingly flexible, but precious little has been done to access that flexibility. As new technologies come online at an ever-increasing pace, it's worth taking a closer look to see whether existing wholesale market structures are equipped to handle today's technology".

5.42 While our focus here is in DSF utilised in the wholesale market, the ability to optimise across all users of DSF (including networks) is critical to achieving this vision.

System and network operations become more complex – more 'neural'

5.43 The future electricity system will have many more participants and be more complex. At the transmission level, New Zealand's grid has been developed to handle changes in the direction of power flows due to fluctuations in renewable generation. This feature is different from many other national grids. But with the growth of batteries and generation located within homes and businesses, the network as a whole (grid and distribution lines) will become bi-directional. This will have very significant implications for how the system is managed.

5.44 As Transpower's Chairman, Keith Turner, recently explained that with many participants making decisions, not just one:[49]

> "you need a different way of responding to that. This is much more like a neural system than it is about a prescribed single investment..."
>
> "What we will need, though, is an entirely new visibility on what is happening and I think that leads to, how do we gather data on this stuff; how do we over-come the privacy protections – because I think we're going to need data on what's happen in a battery in a household – and it's got to be aggregated right up to the system operator, who's got to balance what's going in with what's coming out, perfectly every second of the day"

5.45 Vector's chief executive, Simon MacKenzie, has also spoken about the coming changes. Vector is working with Amazon and Google-X to develop digital platforms to interface with the multitude of technologies expected to proliferate at the consumer-level as transition to renewables unfolds in the coming years. Simon MacKenzie recently stated that:

> "It's a very different type of mind-set and technology [relative to] the traditional systems. It's because multiple flows are now occurring in the networks … 'Decentralised' is taking into account much more understanding what is going on at the customer level".[50]

48 Sonia Aggarwal and Robbie Orvis "Wholesale electricity market design for rapid decarbonisation – Visions for the Future", June 2019 - https://energyinnovation.org/wp-content/uploads/2019/07/Wholesale-Electricity-Market-Design-For-Rapid-Decarbonization.pdf.

49 Dr Keith Turner, Chairman, Transpower New Zealand, Interview with Kathryn Ryan, "Nine To Noon" Radio New Zealand, 5 October 2022 at 21'30" and 22'25".

50 Simon MacKenzie, chief executive, Vector Energy, interview with Kathryn Ryan, "Nine To Noon" Radio New Zealand, 6 October 2022 at circa 15'02".

5.46 In short, for the last 100 years the system has had relatively few suppliers and consumers have been mostly passive with little interest or ability to change their usage to reflect system conditions[51]. Real-time coordination has been relatively simple as it focused largely on matching generation to the level of consumer demand. Our system is becoming far more decentralised and diverse. A more decentralized and diverse system offers significant benefits to consumers. However, it will still need to be tightly coordinated if it is to be reliable. And that will require new approaches that recognise the much more 'neural' characteristics of the system.

Lifting public understanding and confidence will be important

5.47 Public and government confidence in our electricity system is foundational in enabling it to deliver reliable and renewable supply at least cost for consumers.

5.48 Electricity systems are quite complicated and any government's understanding of the fine detail of how they work is always likely to be relatively thin. So what matters is trust in the surrounding institutional arrangements – a sense that there are processes and expertise in place that governments trust to provide the required assurance it all works the way it is supposed to, and strong guidance on how to fix problems if they emerge.

5.49 Public information is also essential. It must be neutral, clear, timely and relevant for consumers, lifting public understanding of what to expect from our electricity system (in both quality and price) and opportunities for consumers to get better value.

5.50 As the Honourable Dr Megan Woods put it in her capacity as Minister of Energy and Resources: "For people to have confidence in our system, New Zealanders need to know that our electricity market is efficient, delivers fair prices and is working for the good of all New Zealanders. We also need to know that it is capable of responding to the enormous wave of technological change we are facing in the coming years"[52].

51 Notable exceptions to this are the two-way switch used in households in the 1940s (to choose between water heating and the oven), and the introduction of ripple control of hot water cylinders in the 1950s. Both were relatively world-leading at the time they were introduced.

52 Honourable Dr Megan Woods, Minister of Energy and Resources, Foreword to the Electricity Price Review- First Report for Discussion, 30 August 2018.

6. Do we need a market?

Built for a different era?

6.1 After all, our wholesale market was designed 30 years ago for a system dominated by a handful for large generators producing electricity to meet relatively inflexible demand, where prices and market revenues are tied to generators' opportunity costs, which have been strongly influenced by the cost of fossil fuels burned in thermal plant.

6.2 We are at the threshold of a step-change in how we need to produce and deliver electricity, not only in retiring fossil fuel thermals and building a huge amount of new renewables with low variable resource costs, but also in demand-side participation, which will be ever more important and in the way the lines networks will need to operate (less directional and more 'neural').

6.3 And to boot, we need this to happen with a reasonable degree of certainty to ensure that the imperatives of decarbonisation are achieved within a relatively definite timeline.

6.4 Among wider stakeholders, there is an understandable intuitive scepticism about whether the wholesale electricity market is capable of (or likely to be best at) delivering these outcomes – a sense that somehow the fundamentals of the basic electricity market will have to change so that there is more direct coordination, so that there is a 'plan' for make the step-change happen properly.[53]

6.5 We understand this intuition, and we have consciously considered alternatives.

What we mean by a "market"

6.6 Perhaps a key point in framing the issue to clarify what we (the MDAG) mean by a "market". It is not some abstract or philosophical notion. Nor is it a template set of rules put in place to entrench a defined structure.

6.7 At its core, the primary functions of a wholesale electricity market are to enable a diversity of parties to offer competing solutions to meet consumers' demand, and for consumers to be able to choose the solutions that best meet their needs. The end result is that better solutions should displace less efficient solutions – in both the near-term (via half hourly auctions) and over time (via investment decisions) – to deliver reliable electricity at least cost.[54]

6.8 The market's rules create a platform for processing information and coordinating actions among many electricity suppliers and consumers; and the structure and rules of the market have to be continuously updated and improved to better meet this primary purpose.

6.9 So when we consider whether we still need a market, we are asking, in effect, whether the above functions will remain relevant in a renewables-based system - namely, enabling many parties to compete to deliver least cost ways of meeting consumer demand, with consumers choosing which solution works best for them. In the MDAG's view, the answer is clear - yes it is. With the pressing trend toward more diversity and innovation, we need a well-functioning market approach more than ever, and the need for information sharing and coordination will only increase.

6.10 As Rob Gramlich and Michael Hogan concluded in 2019[55]:

53 For example, the IEGA submitted that "the role of the spot market in ensuring secure supply needs further analysis and thinking with a blank sheet of paper as opposed to assuming the current arrangements can be progressed / improved."

54 In essence, the market's purpose is to provide reliable electricity to consumers at least cost, see Prof. Peter Cramton, "Electricity market design", Oxford Review of Economic Policy, Volume 33, Number 4, 2017, pp. 589–612.

55 Rob Gramlich and Michael Hogan, Wholesale Electricity Market Design for Rapid Decarbonisation: A decentralized markets approach, June 2019 - https://energyinnovation.org/wp-content/uploads/2019/07/Wholesale-Electricity-Market-Design-For-Rapid-Decarbonization.pdf and www.raponline.org/staff/michael-hogan/.

> "A market structure with a central spot market and active de-centralised forward procurement between wholesale buyers and sellers (including exchange-based trading) will lead to sufficient investment to achieve resource adequacy, will facilitate a sufficiently rapid decarbonization, and will do so at the lowest reasonable cost to consumers".

6.11 As Transpower's Chairman, Dr Keith Turner, put it:[56]

> "We're going into a system now which is not as prescribed and as lumpy and as precisely defined as it used to be, and we are dealing with uncertainty every day. We are dealing with many people making decisions, not just one…
>
> The market is a way of discovering the lowest cost price. When I was power planning engineer, there was one decision-maker about the future of our power system. Now we've got thousands of decision-makers and if someone finds an innovation, they're in there like a robber's dog – and that's fantastic".

6.12 To be clear, however, the market we have needs significant strengthening, which is the main thrust of this paper.

Why marginal cost pricing

6.13 There are two other important intuitive reservations at large among some wider stakeholders that we should address.

6.14 First, the sense that pricing electricity in the wholesale market at the price of the most expensive generation to be dispatched in any half hour is unfair, giving 'windfall profits' to lower cost generators and consumers pay too much. Without doubt, this can be a real issue in extreme situations (as in Europe now with 'hostage' gas prices from Russia). But this is not the case in New Zealand. Some argue that buyers should pay the average price,[57] but this would result in consumers paying higher prices over time. A key study for the Officials Committee on Energy Policy in 1994[58] found that average pricing would result in near double the level of demand[59] – so a massive increase in the capital required for power stations, higher costs for consumers, and a lot more harm to the environment – all of which would have been avoided if wholesale buyers faced the full cost of producing an extra unit of electricity.

6.15 In any interval of time, we want to find the least cost way of meeting the next increment of demand; and rather than a single view on the best source, we want a diversity of providers innovating and competing to offer their best least cost solution. This process puts downward pressure on costs and prices. The lowest cost offering 'wins' and becomes the 'clearing price'.

56 Dr Keith Turner, Chairman, Transpower New Zealand, Interview with Kathryn Ryan, "Nine To Noon" Radio New Zealand, 5 October 2022 at 21'30" and 26'59".

57 For example, Engineers for Social Responsibility submitted that a 2013 proposal to set up a single electricity buyer "that would purchase the electricity from the power companies at a price that reflected their generating costs" should be reconsidered.

58 1997, "The State of the New Zealand Environment, 1997", Ministry for the Environment, section 3 at page 24. See also 1994. Wholesale Electricity Reforms (2): Economic Impacts of Electricity Pricing Options. Paper submitted to the Cabinet Strategy Committee on 28 October 1994 (CSC/94/148).

59 For the avoidance of doubt, average pricing is not a good way to spur consumers to convert from fossil fuel to renewable energy. Average pricing would invite users to over-consume electricity, effectively wasting it and causing costs to rise more than they otherwise would.

Market clearing price or pay-as-bid pricing

At present, generators place their offers into the ½ hourly spot price auctions.* The offers are ranked in price order the last one needed to satisfy demand sets the market clearing price. This means all generators receive the same price in each half-hour auction.[60]

If generators were paid their offer price, rather than the clearing price, they would increase their offer to their best guess of the clearing price, and some lower cost generators may not be dispatched. This would result in higher overall costs for consumers and society as a whole. The current system encourages competitive generators to offer at their actual marginal cost, no matter how low it is, and this benefits consumers.[61]

Paying generators their offer price would also significantly harm 'must run' renewable generation. Under the current system, they offer at low prices to ensure they are dispatched when they have energy (sun, wind, water) that can't be stored. If paid at their low offer price, rather than the clearing price, they would not recover their fixed costs (like cost of capital) over time, and this would seriously deter new investment in intermittent renewables. Their alternative of offering in at higher price (to recover their fixed costs over time) would put them up the 'merit order' and mean that they were not dispatched more often, and this would result in inefficient "spilling" of renewable fuels.

The core role of the wholesale market is to keep the lights on for the least cost, both in the current trading period but also in the coming week, month, year and decade. Marginal pricing will create the best outcome both now and across all other periods in the future.

* This is a highly simplified description.

6.16 In short, making wholesale prices reflect the cost of producing an extra unit of electricity in a given timeframe (rather than (say) averaging prices) is crucial for harnessing innovation and driving costs down over time for the benefit of all consumers.

Cooperation in competition

6.17 The second intuitive reservation at large among some wider stakeholders is the sense that we need a more co-operative approach, rather than framing our approach around competition among buyers and sellers. A key point to keep in mind is that competition is not antithetical to cooperation. Introducing new and better solutions to meet consumers' electricity needs relies fundamentally on individuals, groups, communities, and firms coalescing in a multiplicity of ways to share ideas, skills and interests. It is competitive in the sense that each new solution is competing to find its niche and, in effect, displace alternatives that may be less beneficial for the intended user.[62]

Essentials of a well-functioning market

6.18 Put succinctly, we want our electricity market to deliver *renewable* and *reliable* electricity *at least cost* to consumers[63]. These three elements are pivotal:

60 After adjusting for the effects of transmission losses and constraints.

61 For further explanation, see Electricity Authority, "The Economics of Electricity", 4 June 2013, paragraphs 7-15

62 As Fonterra noted in its submission, "it must be remembered it is key that central coordination is not central control but instead it is about maintaining trust in clearing the market through spot prices, futures and OTC's or PPA's".

63 Peter Cramton, Electricity market design, Oxford Review of Economic Policy, Volume 33, Number 4, 2017, pp. 589–612 – with the addition of "renewable". This objective is reflected in the Electricity Authority's statutory objective, which is "to promote competition in, reliable supply by, and the efficient operation of, the electricity industry for the long-term benefit of consumers" - section 15 of the Electricity Industry Act 2010. As held by Palmer J in Manawa Energy v Electricity Authority 2022, NZHC 1444 at 69 - 71, these three limbs do not have to be pursued equally (or even at all) as long as one of them is promoted consistently with the long-term

(a) "**Renewable**" electricity means generation from solar, wind, hydro, geothermal, biomass, tidal, wave, or ocean current sources[64];

(b) **"Reliable**" means having adequate generation and demand response to continuously meet consumers' demand for electricity across all timeframes – within the half hour, hour, day, week, season, year and beyond[65]; and

(c) "**Least cost**" means using the lowest cost resource[66] to meet the next unit of demand in the relevant period, whether a half hour, hour, day, week, season, year or beyond[67].

6.19 We can view this in two time-frames[68]: *short-run* – making the best use of existing resources; and *long-run* – promoting efficient investment in new resources. In other words:

(a) In the short-run, we want to deploy our *existing resources* in the lowest cost manner to meet demand. (This is 'productive efficiency').

(b) In the longer-run, if existing resources are not sufficient to meet expected future demand, we want *new resources* to come into the system at the right time, in the right size and type, in the right location, and at the lowest cost of the competing alternatives. (This is '**dynamic efficiency'**, which will be especially important in the coming decade and beyond as large amounts of capital are deployed in new 'supply' investments. Second to decarbonising our economy, it is the big prize we need to secure).

6.20 The heart of the process across all time-frames is a diversity of parties offering their best solutions to satisfy the next unit of electricity demand, with the lowest cost option prevailing. This approach will become particularly valuable as we see more diversity come into the system with decarbonisation.

6.21 Five mechanisms are essential to enable this process:

(a) **Accurate (efficient) prices**: A well-functioning market depends on a transparent process of discovering prices that accurately signal the value of an additional unit of electricity in the short, medium and longer term at different locations. In effect, these marginal prices become targets that market participants are competing to beat;

(b) **Tools to manage risk**: A diversity of parties will find an array of different ways to manage their risks beyond the choices likely to be deployed by a handful of near-monopoly decision-makers. However, the good regulatory framework needs to enable the risk to be allocated to parties best placed to manage risk;

(c) **Sufficient competition**: This is the third crux requirement – namely, a level of competition[69] among market participants to provide the best solution to meet demand such that no party has the means and

benefit of consumers…".The court stated: "the objective accorded to the Authority appears from the legislative text to be a paradigmatic case of 'a broadly expressed power that is designed to achieve economic objectives which are themselves expansively expressed'", citing the Supreme Court in Unison Networks Ltd.

64 National Policy Statement for Renewable Electricity Generation 2011.

65 By contrast, "security" means tolerating a disturbance (such as loss of a major generator or transmission circuit) and still maintaining electricity supply to consumers. "Security" is a necessary, but not sufficient, condition for "reliability".

66 Ideally with "lowest cost" viewed from a whole-of-system perspective (which includes externalities).

67 These elements in combination amount to "economic efficiency" in the provision of electricity.

68 Cramton (2017) referring to the twin goals of short-run and long-run efficiency.

69 Recognising that competition includes cooperative, as noted in paragraph 6.17 above.

incentive to exercise significant market power.[70] This can be a difficult thing to achieve in electricity markets, however, as Michael Hogan observes:

> "Ensuring competition is a non-negotiable prerequisite for the market in general, much less for proper energy price formation"[71]

(d) **Robust rules and governance:** These provide an efficient platform for processing information and coordinating actions among many electricity suppliers and consumers; and

(e) **Public and political confidence:** In particular –

(i) Confidence among wholesale buyers and sellers that the high prices make sense, (which means confidence in the structure and rules of the market, including the sufficiency of competition);

(ii) General public and political acceptance that volatility and high prices (in times of scarcity) in the wholesale market are, in fact, in the best long-term interest of consumers, and that measures to 'soften the landing for unhedged participants' can trigger a vicious circle of undermined investment incentives and higher future prices; and

(iii) Confidence among consumers/politicians that investment will be timely and competitive.

Need for significant strengthening

6.22 These mechanisms need to be strengthened significantly to meet the challenges described in Chapter 5 above, which is the main thrust of this paper. The next section provides an overview of the measures we prefer.

Need for prompt action and increased funding to implement core strengthening measures

6.23 As explained in Chapter 12 of this paper, the reality of the transition to a high level of renewables is already upon us. Several core strengthening measures for the wholesale market need to progress promptly. The Electricity Authority will need to be properly resourced to progress the substantial body of work in a timely manner.

Measures need to work for New Zealand and avoid complicating features

6.24 As noted earlier, New Zealand's physical characteristics and lack of any grid interconnection to other countries mean the challenges and opportunities we face are unique in many areas.[72] We also need to keep in mind that New Zealand's wholesale market design already has many features that overseas jurisdictions are looking to put in place[73]. So as we move forward on our decarbonisation journey, it will be important to monitor international developments but also to ensure that any changes work best for needs and features of our system.

70 Market power becomes significant when its exercise would have a net adverse impact on economic efficiency, which includes productive, allocative and dynamic efficiency. This concept is reflected in Electricity Code, 13.5A and 13.5B.

71 See "Hitting the Mark on Missing Money: How to Ensure Reliability at Least Cost to Consumers", Michael Hogan, 2016.

72 Indirect linkages to other markets could occur via other means, such as the production and sale of green hydrogen.

73 For example, overseas experts commented favourably on the fact that the New Zealand market has nodal pricing which encourages efficient locational choices for new investments, and that purchasers and suppliers see a uniform spot price, which facilitates demand side flexibility.

6.25 By way of general guidance, the considerable experience of Professor Peter Cramton across a range of countries is salient[74]:

> "Electricity market design is far from static. New challenges are emerging with the ongoing transformation of the electricity industry. The forces driving change are the expansion of renewables, demand response, distributed generation, smart homes, and battery storage…
>
> "Electricity markets are necessarily complex. This follows from the complexity of the engineering and economic problems that must be solved. Still designers should strive to keep the design as simple as possible. Complicating features should only be added if they are necessary and consistent with market principles".

Range of options, level of analysis, and next steps

6.26 In this paper, we describe our preferred options based on current information. We also describe other options that were considered but which are not preferred at this point. In both cases we set out reasoning for our views.

6.27 We did consider various other options not discussed in this paper. For completeness, other options considered but not developed are set out in Appendix A. This paper is already quite long and it would have become unwieldy if we had included our reasoning for excluding the options that appear on the long list but not in this paper. Keep in mind that our task is first to define 'problems' to be addressed to better achieve the goals described in Chapter 5 of this paper, and then to distil the measures that will best address those 'problems', rather than the other way around. In other words, our task is not to start with a list of possible measures and then decide whether we should use them or not. The analysis is properly driven by the 'problem', not the option.

6.28 We are keen to hear submitters' views on our assessment of options and their relative importance. This feedback will be a key input to our final recommendations paper in 2023.

6.29 To be clear, this paper outlines the options at a relatively high level. In the third and final stage in this project, we will go to the next level in specifying our preferred options and undertake a more thorough evaluation of costs and benefits, which will inform our final selection of options for our Recommendations Paper, which is due around May-June next year.

74 Peter Cramton, "Electricity Market Design", Oxford Review of Economic Policy, Volume 33, Number 4, 2017, pp. 589–612.

7. Keeping the lights on
How to ensure reliable and efficient operational coordination

7.1 The laws of physics require that the amount of electricity being injected onto the grid must continuously match the quantity being taken off. If operational coordination processes fail to maintain this balance, the electricity system will quickly become unstable and there will be widespread power cuts.

How the challenge of balancing the system is changing

7.2 Our electricity system is undergoing a revolution. For over 100 years it had few suppliers and consumers were largely passive[75]. Operational coordination was relatively simple – just match the generation to consumer demand.

7.3 Our system is becoming far more decentralized and diverse. Falling solar and wind costs mean that more consumers and communities can become suppliers. Technology is also making it easier for consumers to alter their demand to help balance the system. For example, a growing number of consumers have smart devices that can alter their power usage – lifting demand when supply is plentiful and cutting or deferring consumption when power supply is tight.

> Example: Tau Henare Marae project
>
> Tū Mai Rā Energy is completing a 150kWh solar network at the Te Henare Marae in Pipiwai, Northland. It will use over 300 panels to provide power to the marae, as well as to the local community through Māori retailer Nau Mai Rā.[76]

7.4 These trends are producing a system with a lot more participants. For example, Transpower estimates there will be 3.9 million distributed energy resources across the system by 2035.[77] A more decentralized and diverse system offers significant benefits to consumers. However, it still needs to be tightly coordinated if it is to be reliable.

Figure 6: Operational coordination – moving from a quartet to an orchestra

75 Notable exceptions to this are the two-way switch used in households in the 1940s (to choose between water heating and the oven), and the introduction of ripple control of hot water cylinders in the 1950s. Both were relatively world-leading at the time they were introduced.

76 See https://www.teaomaori.news/solar-powering-pipiwai.

77 See Transpower New Zealand (2020), Whakamana i Te Mauri Hiko – Empowering our Energy Future, page 61.

Spot price signals provide the system's heartbeat

7.5 A spot market[78] that accurately signals the value of energy at each location and time is the only viable option we have identified to efficiently coordinate *operational decisions* under a renewables-based system. This finding reflects an assessment of practicalities rather than any preference for a market-based approach[79].

7.6 This does not mean *investment decisions* would rely solely on spot market revenues. In fact, as we discuss in the next chapter, we expect investment decisions to be primarily based on contracts of various types, but contract prices reflect parties' expectations of future spot prices. In addition, contracts can preserve the incentives to respond to spot prices in real time.

7.7 Returning to operational decision-making, we have not identified any alternative to a spot market to efficiently coordinate decisions across many thousands of participants/devices such as:

(a) When to charge and discharge batteries (including those in electric vehicles);

(b) When to use/save other types of stored energy such as water in hydro reservoirs; and

(c) When consumers should best utilise any flexibility they have over their usage.

7.8 Many submissions expressed support for a wholesale market as the best tool to coordinate operational decisions. For example, Neil Walbran Consulting noted that "diverse and disaggregated resources are already emerging and a freely available spot price signal is the best way to coordinate these." Genesis agreed that "a wholesale market (with real-time pricing) remains key to ensuring diverse and disaggregated resources are coordinated and optimised."

7.9 This finding is echoed by many international experts. For example:

> "moving to a greater reliance on distributed resources (many and small) and demand participators (many and small) leads inexorably to a greater need to have real-time spot prices that send the right price signals. The central control of distributed resources would not be feasible, and prices must provide the needed incentives."[80]

7.10 Accurate spot prices will pose challenges for some parties at times. For example, accuracy will sometimes mean spot prices are volatile. This will pose financial risks for customers or suppliers with exposure to spot prices. However, we think this issue is better addressed via means to mitigate *exposure* to spot prices (see Chapters 8 and 9 on contracts and DSF respectively) rather than by muffling spot market signals at their source.

78 This refers to the whole set of arrangements to coordinate resources in the period leading into, and in real-time. It includes scheduling, short-term forecasting, ancillary service arrangements, as well as dispatch.

79 As Professor William Hogan of Harvard University observed in 2018, "…increased arrival of renewables and greater reliance on distributed resources both point to fundamentals that reinforce rather than invalidate the fundamental logic of electricity spot market operation and pricing" – see Prof William W. Hogan, "In My View, Best Electricity Market Design Practices", (forthcoming in IEEE Power & Energy), 3 October 2018.

80 Hogan, William W. "Market Design Practices: Which Ones Are Best? [In My View]." IEEE Power and Energy 17.1 (2019).

7.11 Artificial suppression or elevation of spot prices would mean suppliers and consumers do not face accurate signals about the true value of energy. That would encourage inefficient levels of consumption or investment. The potential consequences could be very significant. For example, a study in 1994[81] found that averaging of prices (one type of muffling) would over time result in near double the level of demand – so a massive increase in the capital required for power stations and a lot more harm to the environment. These effects would be avoided if the true cost of producing an extra unit of electricity was signalled to wholesale buyers.

7.12 Finally, a spot market needs supporting arrangements to be fully effective. For example it needs a system operation function to provide dispatch instructions to controllable resources,[82] and ancillary service products to address aspects of reliability that are impractical to achieve solely from the spot market for energy (such as frequency keeping).

International experts endorsed core elements of NZ spot market design

7.13 Discussions with international experts indicate that NZ's spot market has a good core design. In particular three key strengths were emphasised:

(a) The value of power at different locations is signalled via nodal prices. This ensures that the effect of transmission losses and constraints can be factored into decisions. This is especially important in a system with high levels of intermittent renewable resources because the volume/direction of power flows is more dynamic, altering the impacts of losses and constraints. Some other electricity systems don't have dynamic locational signals and are considering whether to introduce them.[83]

(b) A common price applies to both wholesale buyers and sellers at each grid location. This ensures the reward for demand reduction is the same as for increased supply (and vice versa). Spot markets in some other countries have different prices for supply and demand and this can hinder demand-side participation.

(c) Relatively uncapped spot prices to ensure that scarcity is properly signalled. Many countries have artificially capped spot prices to a degree that incentives to contract are substantially reduced, especially for 'insurance' plant such as peakers. This leads to under-investment in such plant, or alternative revenue streams being needed to ensure adequate investment occurs. By contrast, New Zealand's spot market provides clear signals about the value of such resources.[84]

Options to improve operational coordination

7.14 While New Zealand's spot market design has some key strengths, it is undercooked in some areas and needs to be strengthened to ensure reliable and efficient operational coordination. The proposed options are summarised below. Each option is described in more detail in the accompanying "Library of Options".

81 Referred to in "The State of the New Zealand Environment, 1997", Ministry for the Environment, section 3 at page 24. See also 1994, Wholesale Electricity Reforms (2): Economic Impacts of Electricity Pricing Options. Paper submitted to the Cabinet Strategy Committee on 28 October 1994 (CSC/94/148).

82 These could be a centralised or 'nested' model, with the latter having responsibilities shared between a grid-level operator and multiple distributor system operators.

83 See the discussion of locational pricing in Review of Electricity Market Arrangements (publishing.service.gov.uk). Officials at ACER also noted in our discussions that, to enable the transition to more renewable electricity systems, they are trying to encourage member states in the European Union to introduce features that New Zealand already has in place such as locational marginal pricing and financial transmission rights.

84 Two caveats apply. First, it is not ok for spot prices to elevated by the abuse of market power. As explained later in this paper, we think it is vital to address now the risk of increased market power in the coming years. Second, as set out in the following discussion, there are some areas where changes are proposed to improve operational coordination.

Winter peak risk

7.15 To date, New Zealand's electricity system has been primarily 'energy constrained'. With the shift to more renewables, we expect that our system to become more 'capacity constrained', as is typical in overseas systems.[85]

7.16 Capacity challenges are already emerging. In the last two years we have experienced several peaking 'pinch points' where insufficient resources were available to maintain normal reserve cover and meet demand.[86] Importantly, this was not due to insufficient installed capacity which has kept pace with demand growth[87]. Instead, the events reflect increasing challenges with operational coordination – i.e. whether sufficient resources (such as slower start thermal units) are ready to run when needed.

7.17 These challenges have raised questions about the merits of some sort of capacity mechanism, such as 'warming contracts' to ensure sufficient slower response resources are available when required. However, rather than an *ad hoc* intervention, it is better to focus on mechanisms that find the least cost solutions, as we do in matching supply and demand in any other interval.[88]

7.18 Better short-term forecasting and related information is vital so market participants can better gauge what resources to make available and when (**Option A1**). Another key area is ensuring the value of reliability to consumers is properly reflected in spot price signals, so resource providers are rewarded appropriately for making supply available or reducing demand (**Option A3**). We also prefer the idea of a new ancillary service to reflect the changing risk profile on the system. Such a new service should harness the full range of potential resource providers including batteries and demand-side flexibility, be co-optimised with the wider spot market and conform to causer-pays principles (**Option A4**). We propose that these three measures should be actioned without delay.

7.19 Looking further out, we think a formalised ahead market might be needed to help participants with their short-term planning, particularly for use of batteries and demand response (**Option A6**).[89] A formalised ahead market could have major benefits but would be a significant change and takes some years to implement. In the meantime, voluntary use of short-term products (such as day ahead contracts) should be encouraged and supported (see measures to strengthen contract market in Chapter 8).

85 This has because the main supply risk is from droughts that last weeks or months, rather than demand spikes that last a few hours. The flexibility needed to address droughts is currently provided by a combination of hydro storage lakes (which buffer shorter duration variations) and fossil-fuelled thermal generation that can be ramped up if needed. Looking ahead, the system is expected to remain energy-constrained, although low wind/solar periods will likely become important as well as droughts, and (b) fossil-fuelled plants are expected to progressively retire, reducing competition in the provision of longer-term flexibility services all other things being equal. New sources of longer-term flexibility are likely to emerge – potentially including flexible demand sources, a level of renewable over-build that leads to greater spill, pumped hydro storage, and biofueled thermal operation (note – chemical batteries are unlikely to be economic for longer-term flex) – Source: 100% renewable electricity supply – competition issues: Working note for secretariat discussions, 24 May 2022.

86 See https://tpow-corp-production.s3.ap-southeast-2.amazonaws.com/public/bulk-upload/documents/Market%20insight%20report%20-%20Winter%20Review%20-%2011%20Nov%202022.pdf?VersionId=QaQVHc8zmQ6_FpC_Ux7GOimodObF9Vt2.

87 Security assessments from the system operator since 2012 have shown installed capacity margins that consistently exceed 1,000 MW (compared to the winter capacity standard of 630-780 MW).

88 See the discussion of option A10 in the "Options Library" for more information on why we do not favour 'warming contracts'.

89 EPOC submitted that "such a two-settlement design be studied."

Future security and resilience of the power system

7.20 Moving to a highly renewable supply will obviously have major implications for the future security and resilience of power system in (or close to) real time. This is the focus of the Authority's Future Security and Resilience (FSR) project[90] – a foundational initiative that is expected to run for several years, involving a range of pivotal design choices[91] likely to have very significant longer-term implications.

7.21 To help identify and address those economic and technical trade-offs, and give shape to overall objectives, the FSR process should be strengthened by adding both guiding principles and a governance (or reference) group (**Option A2**).

7.22 We are also proposing other detailed changes (**Options A5, A7**) to better ensure efficient and reliable operation of the system.

7.23 These measures are summarised in Table 7. A full description of each option is set out in our "Library of Options".

Table 7: Proposed measures to strengthen operational coordination

	OPTION NAME	RATIONALE	STATUS	START	IN PLACE BY
A1	Improve short-term forecasts of wind, solar, and demand	Provides better information for decision-makers leading into real-time	Preferred	2023	2024
A2	Strengthen governance for next phase of FSR Project	Better ensures future design of system will be consumer centric	Preferred	2023	Mid 2023
A3	Update shortage price values	Ensures price signals are better aligned to consumers' interests	Preferred	2023	2025
A4	New reserve product to cover sudden reduction from intermittent sources	Ensures ancillary services reflect changing needs of system	Preferred	2023	Mid 2024
A5	Offer price reductions after gate closure	Unlocks some flexibility that is otherwise held back	Preferred	Mid 2024	Mid 2025
A6	Investigate + develop ahead market	Clearer price signals in lead-up to real-time should help parties to coordinate their plans	Preferred	2025	Mid 2027
A7	Remove UTS over-ride of trading conduct provisions	Reduces likelihood of confusing price signals from overlapping code provisions	Preferred	Mid 2025	2027
A8	Negative offers/prices	Complex to implement and appears unlikely to be needed for next 10-15 years	Not preferred	NA	
A9	Centralised commitment based on complex offers	Complex and could hinder competition	Not preferred	NA	
A10	Warming contracts	Likely to raise costs for consumers relative to other options	Not preferred	NA	

SUPPORTS OPTION DOES NOT SUPPORT OPTION PARTIALLY SUPPORTS OPTION

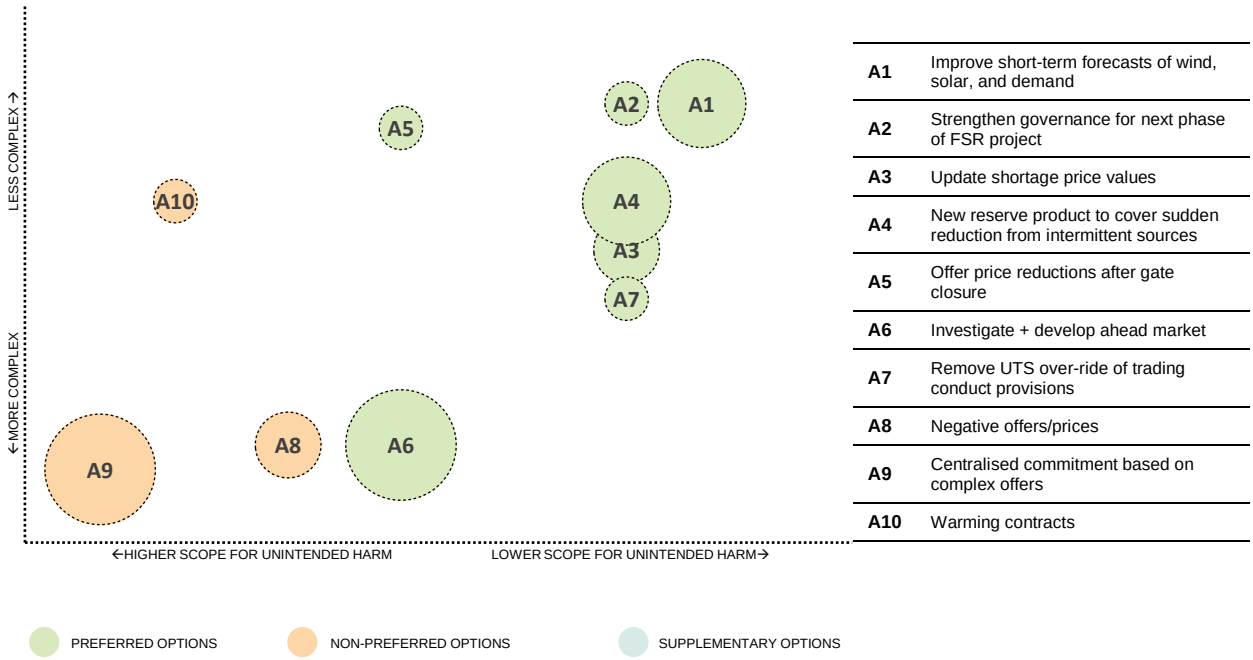
90 https://www.ea.govt.nz/assets/dms-assets/30/Covering-Paper-FSR-Final-Roadmap-and-Phase-Three.pdf 0.

91 For example, what is least cost; how much optimise on centralised vs decentralised basis; how to deal with implicit biases for some technologies over others; and so on.

Overall evaluation of options to strengthen operational coordination

7.24 Figure 7 summarises our high-level evaluation of these options in terms of net benefit (larger bubbles indicate greater benefit), relative ease of implementation and scope for unintended harm.

Figure 7: Assessment of options to strengthen operational coordination

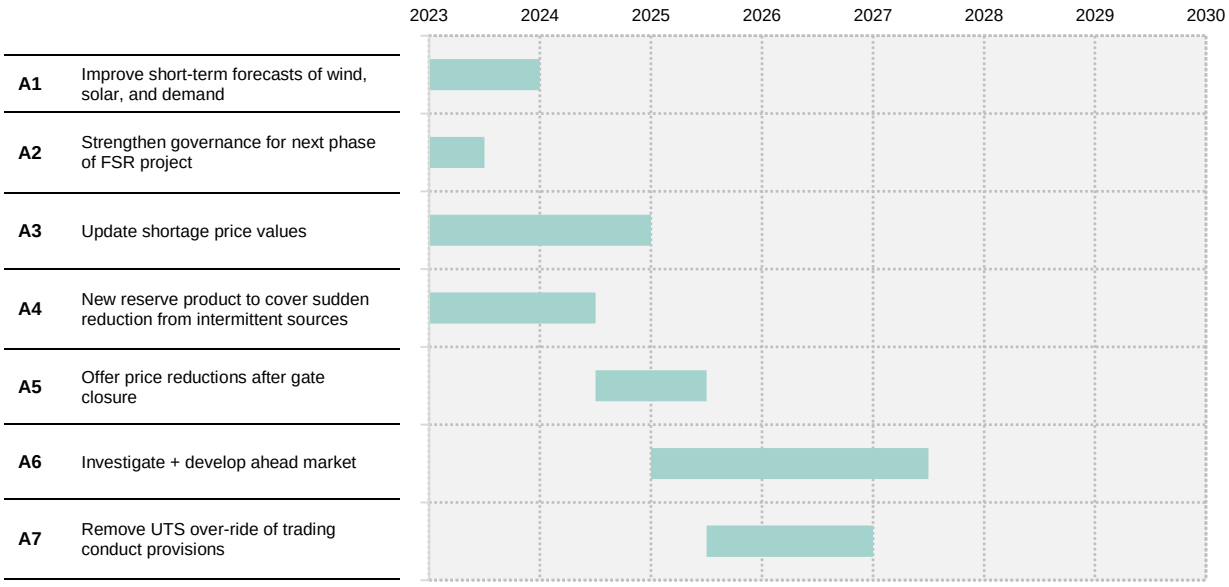


A1	Improve short-term forecasts of wind, solar, and demand
A2	Strengthen governance for next phase of FSR project
A3	Update shortage price values
A4	New reserve product to cover sudden reduction from intermittent sources
A5	Offer price reductions after gate closure
A6	Investigate + develop ahead market
A7	Remove UTS over-ride of trading conduct provisions
A8	Negative offers/prices
A9	Centralised commitment based on complex offers
A10	Warming contracts

Proposed timelines for progressing options to strengthen operational coordination

7.25 Figure 8 shows the proposed timelines for progressing each option. Options A1-A4 are proposed for prompt adoption because of the challenges that are already emerging in relation to operational coordination. The proposed timelines for other options reflect judgments about their priority relative to other areas that warrant action (see other chapters of this report).

Figure 8: Proposed timelines for options to strengthen operational coordination



Comparison of MDAG options with Wholesale Market Review and BCG reports

7.26 The following table compares the MDAG's options with those proposed by the Electricity Authority's Wholesale Market Review and Boston Consulting Group's recent study 'Climate Change in New Zealand: The Future is Electric'.[92]

Table 8: Comparison with WMR and BCG reports

	OPTION NAME	MDAG VIEW	WMR VIEW	BCG VIEW
A1	Improve short-term forecasts of wind, solar and demand	●	○	●
A2	Strengthen governance for next phase of FSR project	●	○	○
A3	Update shortage price values	●	○	●
A4	New reserve product to cover sudden reduction from intermittent sources	●	○	●
A5	Offer price reductions after gate closure	●	○	○
A6	Investigate + develop ahead market	●	○	◐
A7	Remove UTS over-ride of trading conduct provisions	●	○	○
A8	Negative offers/prices	◑	○	○
A9	Centralised commitment based on complex offers	◑	○	○
A10	Warming contracts	◑	○	◐

● SUPPORTS OPTION ◑ DOES NOT SUPPORT OPTION ◐ PARTIALLY SUPPORTS OPTION ○ OPTION NOT DISCUSSED

1. Do you agree that, weighing costs and benefits, our preferred options in

2. Table 7 above are likely to best address the operational coordination issues described in this chapter? If not, why not?

3. What is your view of the proposed sequencing and timing of measures to strengthen operational coordination?

4. What, if any, other options should be considered to strengthen operational coordination?

92 We note that in both this chart and other later charts the options described by the MDAG, the Wholesale Market Review and Boston Consulting Group are unlikely to overlap perfectly. Nevertheless, these charts provide a useful comparison of the general position taken in these reports.

8. Ensuring effective risk management and efficient investment

What is the contract market and what does it do?

8.1 The contract market plays two vital roles. First, it provides products that wholesale buyers and suppliers can use to manage their exposure to spot price risks. These products take many forms including 'over the counter' (OTC) contracts negotiated bilaterally and exchange-traded contracts which have standardised forms and published prices.

8.2 For example, retailers may enter into risk management contracts with generators to reduce the variability they would otherwise face in purchase costs for their wholesale energy. Likewise, generators can use contracts to reduce the variability of revenues they would otherwise face due to spot price volatility. Importantly, contracts reduce cost/revenue volatility for the contracted volumes, but buyers and sellers retain strong incentives to respond to spot price signals at the margin. This is important because wholesale participants retain strong operational coordination incentives as discussed in the previous chapter.

8.3 Effective risk management of spot price volatility also includes demand-side response ('DR'). More intermittent supply will make demand-side flexibility particularly valuable. Given its importance, this dimension has its own section in this paper (see Chapter 9 below).

8.4 The contract market's second critical function is to provide signals to guide longer term decisions – especially investment in generation, storage and demand-side capability. This signalling function arises because contract prices are affected by the level of expected future spot prices. If the system is expected to have abundant supply in a particular season or region next year, that will tend to reduce contract prices for power in that season or region relative to others. Contracts therefore provide vital signals about where and when to invest, and about the best type of resource to develop (such as battery storage, flexible generation or intermittent supply).

Large amounts of new investment will be required

8.5 As discussed in paragraphs 5.15 to 5.19 a very large ramp up in new investment will be required to meet power demand growth and displace fossil fuel generation. As discussed in the Issues Paper, there are huge benefits for New Zealand if the right investments are made at the right time and location. This is because the electricity sector is capital intensive and will require very large volumes of investment – estimated at $27-37 billion by 2050.[93]

8.6 There are plenty of projects in the pipeline that could potentially satisfy the projected growth in demand. Table 9 summarises the results of a recent survey of developers undertaken for the Electricity Authority.

93 See Issues Paper, page 65.

Table 9: Pipeline of potential generation projects (energy capability GWh/yr)[94]

	2023	2024	2025	2026+	TOTAL
Committed	1,822	762	6	19	**2,609**
Actively pursued	3,072	2,638	2,402	14,520	**22,633**
Other	526	451	165	30,351	**31,492**
Total	**5,420**	**3,851**	**2,573**	**44,890**	**56,734**

8.7 The survey identified projects with an energy generation potential of more than 50,000 GWh/year. This is roughly the same as the entire existing generation base.[95] Those projects offer a wide menu of ways to meet growing electricity demand, with projects in all regions of country and covering wind, solar, geothermal and other technologies. While many of these projects will never proceed for economic or other reasons, others will be added to the menu as developers identify further potential projects.

8.8 The same survey found that investment activity has accelerated in recent years, with supply additions since 2021 running at 250% of the rate observed in the decade to 2020.[96] Nonetheless, further acceleration will be needed in future to meet New Zealand's decarbonisation targets.

Contracting and investment decisions are likely to more efficient if they are determined by participants

8.9 From a market design perspective, there are two basic approaches for organising contracting and investment decisions. One approach relies on market participants to actively manage their forward exposure to spot price risks. Participants do this via their own investments in supply or demand response capability, or by contracting with other parties (who in turn are incentivised to make investments). This is often referred to as an 'energy-only' approach because the regulated spot market provides for suppliers to be paid only for energy production, and any other payments are based on private contracts.

8.10 The alternative approach is for a regulator (or another central body) to determine a target for capacity adequacy, and then enforce contracting (or levying) obligations on purchasers to ensure the required capacity is deployed. A wide range of regulatory instruments have been developed for this purpose, which are often referred to as "capacity adequacy mechanisms".[97]

8.11 For the reasons set out in the Options Library report we think it will be very hard for a regulator to efficiently identify the best mix and level of resources for the system, especially as the share of renewable supply increases and makes the system much more dynamic. This was a strong and consistent message from overseas regulators and experts (including a leading former proponent of capacity mechanisms).

94 See www.ea.govt.nz/assets/4-Monitoring/Information-paper-Generation-Investment-Survey-2022-Concept-Consulting-report-for-the-Electricity-Authority.pdf.

95 Transpower connection inquiry data also shows a substantial number of potential developments, with inquiries recorded for over 250 generation or energy storage projects as at late 2022. See https://experience.arcgis.com/experience/97d4604079b545448280423f9269b9ea/page/Dashboard/.

96 This is based on a comparison of the gross rate of increase in supply additions. See www.ea.govt.nz/assets/4-Monitoring/Information-paper-Generation-Investment-Survey-2022-Concept-Consulting-report-for-the-Electricity-Authority.pdf.

97 See for example the range of capacity adequacy mechanisms in Tables 2 and 3 Bublitz et al (2019) – Andreas Bublitz, Dogan Keles, Florian Zimmermann, Christoph Fraunholz, Wolf Fichtner, "A survey on electricity market design: Insights from theory and real-world implementations of capacity remuneration mechanisms", Energy Economics 80 (2019) 1059–1078 - https://doi.org/10.1016/j.eneco.2019.01.030.

8.12 We think the much better approach is to rely on buyers and sellers putting in place effective risk management measures that are least cost for their circumstances, including a wider mix of options (for example demand side flexibility) that the transition to renewables is likely to foster. However, this means participants must have good access to contracting tools and information, and robust incentives to manage their exposure to spot prices.

Contracting and risk management have come a long way in 10 years

8.13 As noted in our Issues Paper[98], a recent study[99] indicates that risk management (e.g. risk models, policies, and use of hedge products) across market participants has evolved and improved substantially since the commencement of the electricity market, and especially over the past ten years.

8.14 While this evolution may have taken longer than intended, the study found no evidence of systemic exposure to risk across the market; in fact, most of the observable data showed an increasing use of contract products.[100]

8.15 While that evolution is encouraging, a step-change improvement in the contract market will be required to underpin a renewables-based system, because of its much higher level of spot price volatility.

8.16 A key question raised in the Issues Paper was whether the availability and liquidity of hedge products – especially shaped products – will be sufficient to allow parties to workably manage risk in a renewables-based system.

8.17 Assessing the willingness of market participants to buy and sell contracts (i.e. generate liquidity) in a future world is difficult, given the behavioural factors involved. However, some insight can be gained by considering what physical resources[101] are likely to be operating under different system states and associated price levels. Put another way, we can examine what types of resources would be the natural "backing" for risk management products at those price levels. To this end, we extracted relevant data for the Issues Paper reference case scenario for 2035. The results are presented in Figure 9.

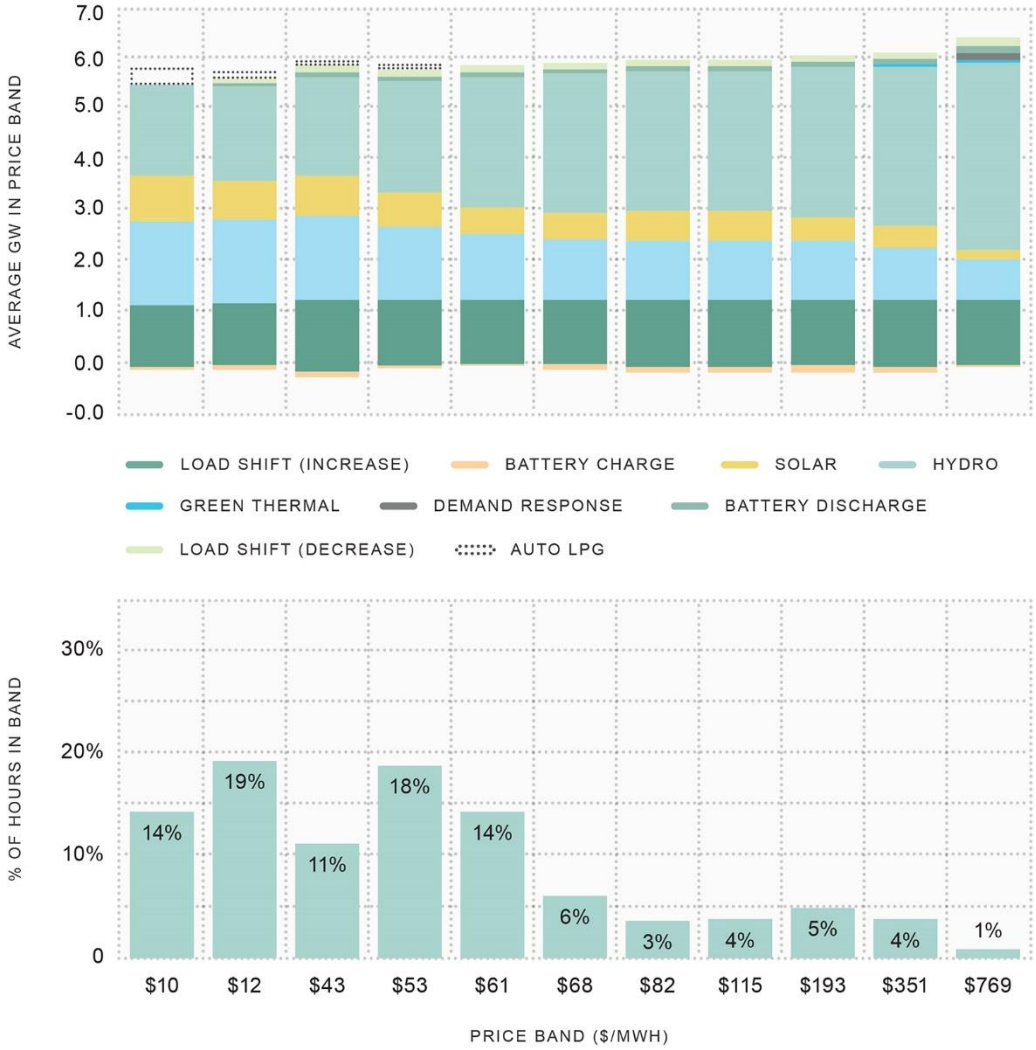
98 MDAG Issues paper, paras 7.104 – 7.124.

99 Batstone, S (2021) "Wholesale risk management practice trends in the New Zealand electricity market, and prospects for a high renewables future", Working paper for MDAG, October 2021.

100 Ibid, section 3.4.

101 This includes generation types, energy storage devices and demand-side flexibility.

Figure 9: Contribution from resource types by price band (2035 reference case)



8.18 Key observations from the simulation results include:

(a) Hydro generation makes a much greater contribution to supply in the periods when spot prices are higher. For example, it accounts for more than 50% of the resource supplied in the 1% of periods when prices are highest.

(b) By contrast, the reverse is true for intermittent generation sources such as solar and wind. Their contribution tends to be higher in the periods when prices are lower and vice versa.

(c) Demand side flexibility (demand response and load shifting), grid-scale batteries and green peakers play a much more significant (collective) role in higher price periods, compared to any other part of the distribution.

(d) While spot prices are affected by demand (higher prices occur when demand is higher and vice versa), this effect is likely to be less marked that in the past. This is shown by the relatively modest difference in average demand (around 1GW) between the lower price periods (left hand end of chart) and the higher price periods (right hand side). By contrast, the availability (or not) of intermittent generation sources has much more influence on prices.

8.19 The likely implications for the contract market from these simulation results include:

(a) Contractual products that offset price risk associated with intermittent generation are likely to become much more important. Parties seeking such shaped contracts could include developers seeking to sell a firmed product to end-users/retailers, or end-users/retailers seeking to buy a firming product to complement their purchase of intermittent generation output.

(b) The 'natural' providers of such products include hydro generators are flexible supply bases (noting some hydro generation is relatively inflexible), but green peakers, energy storage providers, and parties with demand-side flexibility would also be potential hedge providers.

8.20 Given that intermittent generation is expected to provide the bulk of new supply, we used simulation analysis to further examine the effect of different contract sale/purchase mixes on earnings volatility for wind/solar developers. Although this analysis was necessarily high level in nature, it showed that if developers could *purchase* a cap (among the simplest form of shaped firming products), this should significantly reduce the earnings volatility they would face from *selling* project output via baseload products.[102] In reality, caps may not the most suitable product for the New Zealand market. Nonetheless, this is an important result because it indicates that access to shaped products is likely to strongly influence new generation investment.

8.21 Vertical integration is one route that can allow intermittent generation projects to 'access' the flexibility of the hydro system (and other flexibility resources). This may be the most efficient option for some new generation developments.[103] However, it is important to ensure that vertical integration is a genuinely more efficient option, and not just a reflection of the exercise market power. As discussed in Chapter 10, a particular concern is this area is potential increase in market concentration for the provision of longer-term flexibility products.

8.22 The contract market has a vital role to play in addressing these competition concerns because it can allow different business models to be tested and for customers to choose the model that best meets their needs. For example, customers might purchase from vertically integrated parties, from independent developers, using a sleeved contract[104] of some form, or a mix of spot price exposure and standardised exchange-traded contracts.

What does this all mean for the contract market?

8.23 New Zealand is perceived by some international academics to have one of the most advanced electricity contract markets in the world, that has adapted over the last 20 years to increasingly meet the needs of participants. This work is by no means done[105]. Looking forward, we think the key areas to focus on are:

(a) Increasing the visibility on contract prices – especially prices for different product shapes, such as the price to firm wind or solar output.

(b) Improving the information available for investment and longer-term contracting decisions.

(c) Ensuring that vertically integrated players with significant flexibility cannot use that to hinder competition.

102 See slide pack on competition issues at https://www.ea.govt.nz/development/work-programme/pricing-cost-allocation/100/consultations/#c19134.

103 We note the 2009 Ministerial Review concluded that vertical integration was net beneficial to consumers but highlighted the criticality of a liquid contracts market in mitigating the downsides of vertical integration.

104 Sleeved contracts take a variety of forms. One type is for a customer to buy the output from a project, and the half-hourly volume differences between their demand profile and the project output are covered by the 'sleeve' contract provided by a third party such as a flexible generator or retailer.

105 See Batstone (2021) Risk Management at www.ea.govt.nz/assets/dms-assets/29/04-Risk-Management-Trends-and-Prospects-for-a-High-Renewables-Future-Dr-Stephen-Batstone1341583-v2.1.pdf.

Options to support effective risk management and efficient investment

Better information on contract prices and supply/demand outlook

8.24 Participants will need much better information on trends in contract prices to help with contracting decisions, especially information on the prices of 'shaped' products such as products to provide firming for wind or solar generation. Enhancing the contract price disclosure platform (**Option B1**) will further this objective. This should include information on contract offers and bids, as well as executed contracts. A forward curve that extends further in the future would also be beneficial for contracting and investment decisions. Some international exchanges are moving progressively towards longer dates futures[106] (**Option B2**).

8.25 Another critical area where better information is required is the supply/demand outlook and range of options in the development pipeline. The system is becoming much more dynamic and sensitive to the timing of new investments. For this reason, we propose more comprehensive and regular updates on the development pipeline, and projected energy/capacity margins should be collated and published (**Option B3**).

8.26 Being able to hedge shape-related price risk will become increasingly important for market participants. Historically, the industry and the Authority has investigated exchange-traded cap products. As indicated above, these products (in their traditional form) may not be the best risk management option for the types of risks we will see in the future. The Authority should work with market participants to develop a standardised product (or products) which meets the needs of buyers and sellers (including providers of DSF) (**Option B5**)**.** If trading took place in the OTC market, **Option B1** would provide the necessary transparency of the forward price of flexibility. Alternatively, the outcome of this design process may be to list these products on a futures exchange.

Ensure active management of forward price risks

8.27 To more closely monitor contracting behaviour and help ensure participants are actively managing their risk exposures, we propose that the stress testing regime be enhanced (**Option B4**). This would include extending the time horizon for stress testing (a few years ahead rather than just the coming quarter) and providing participants with information on how their own exposure compares to others while still preserving confidentiality for disclosers.

Reduce scope for exercise of market power in provision of shaped contract products

8.28 As noted above, shaped products will become much more important in future, especially those which can provide firming for intermittent generation. However, the supply of these products may become more concentrated.

8.29 To address this concern, we propose that dominant suppliers of flexibility products would be subject to an access code which would cover non-price terms (**Option B6**). For example, this could cover matters such as an obligation to record requests for access products, and a requirement to provide responses to such requests in writing with reasons if they are declined, and possibly common 'non-price' contract provisions co-designed by the industry. In addition we propose that the trading conduct rules in the Code would be extended to the hedge contract market (**Option B7**).

8.30 As a back-up option if these measures proved insufficient to support workable forward price discovery and liquidity for shaped products, we propose that market-making would be introduced for a shaped contract product (**Option B8**).

8.31 These measures are summarized in Table 10. A full description of each option is set out in our "Library of Options".

106 Further discussed in MDAG, "Library of Options" available at www.ea.govt.nz/development/work-programme/pricing-cost-allocation/100/consultations/#c19134.

Table 10: Proposed measures to improve risk management and investment

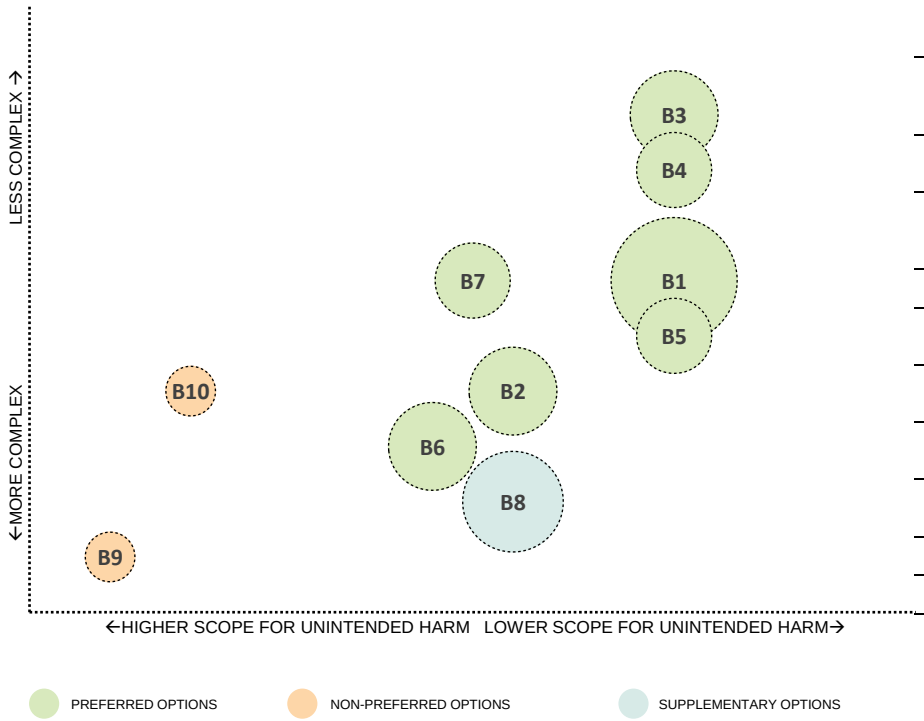
	OPTION NAME	RATIONALE	STATUS	START	IN PLACE BY
B1	Greater transparency of hedge info (esp non-base load) covering offers, bids + agreed prices	Make it easier for participants to compare prices, especially for non baseload contracts. Also get better info for regulator	Preferred	2023	Mid 2024
B2	Market-making for longer dated futures (for price discovery)	Improve forward price discovery and supports OTC longer term contracting	Preferred	2024	Mid 2025
B3	Publish aggregated information on pipeline of new developments, energy and capacity adequacy	Provide more information to help participants with contracting and investment decisions	Preferred	2023	2024
B4	Enhance stress testing regime	Help ensure that participants are actively considering and managing their exposure to spot price risk	Preferred	2023	2024
B5	Develop standardised 'shape' product(s)	Develop some standardised non-baseload products	Preferred	2024	2025
B6	Develop flexibility access code (non-price elements)	Promote reasonable access to 'flexibility contracts'	Preferred	2025	Mid 2026
B7	Extend trading conduct rules to hedge market	Deters participants from exercise of significant market power	Preferred	2025	2026
B8	Market making in caps or other shaped products	Strengthen forward discovery and liquidity for a shaped contract	Potential augmentation for B1, B5, B6-B7	Mid 2025	2028
B9	Capacity mechanisms	Significant implementation issues and likely to raise costs for consumers	Not preferred	NA	
B10	Strategic reserve	Likely to raise costs and unlikely to improve security	Not preferred	NA	

SUPPORTS OPTION DOES NOT SUPPORT OPTION PARTIALLY SUPPORTS OPTION

Overall evaluation of risk management and investment options

8.32 Figure 10 summarises our high-level evaluation of these options in terms of net benefit (larger bubbles indicate greater benefit), relative ease of implementation and scope for unintended harm.

Figure 10: Assessment of risk management and investment options

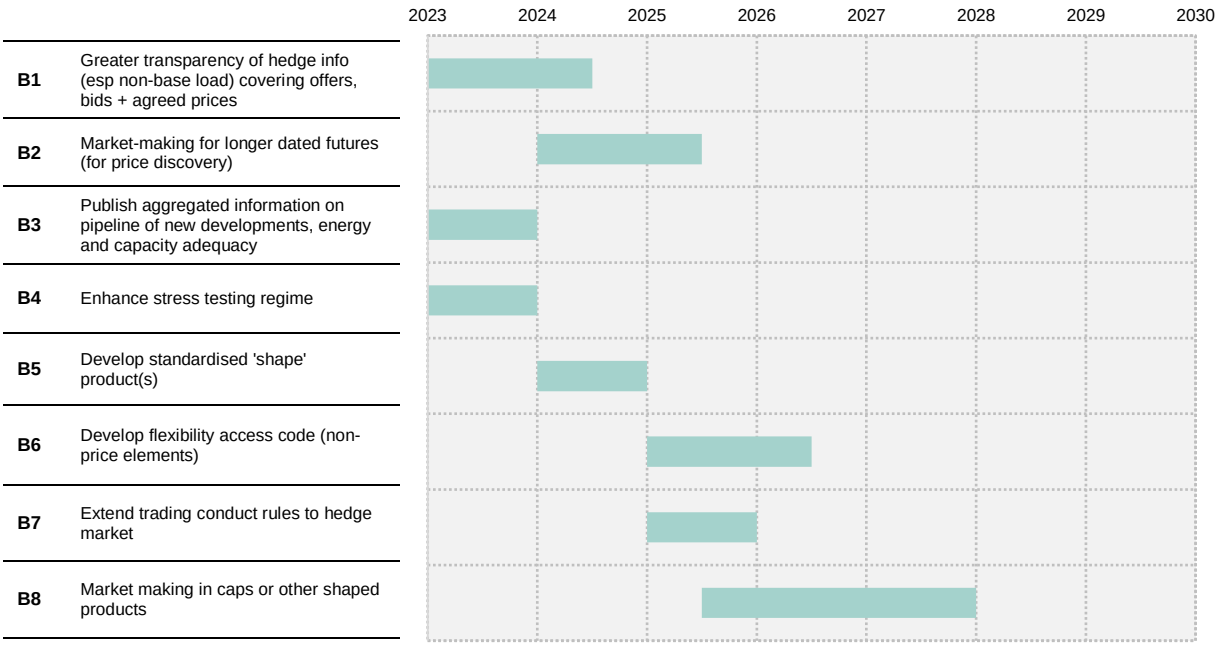


B1	Greater transparency of hedge info (esp non-base load) covering offers, bids + agreed prices
B2	Market-making for longer dated futures (for price discovery)
B3	Publish aggregated information on pipeline of new developments, energy and capacity adequacy
B4	Enhance stress testing regime
B5	Develop standardised 'shape' product(s)
B6	Develop flexibility access code (non-price elements)
B7	Extend trading conduct rules to hedge market
B8	Market making in caps or other shaped products
B9	Capacity mechanisms
B10	Strategic reserve

Priority and sequencing of risk management and investment options

8.33 Figure 11 shows the proposed timelines for progressing each option. Options B1, B3 and B4 are proposed for prompt adoption because they are foundational in nature and should be relatively straightforward to implement. Options B2 and B5 will require more time to implement but should be commenced relatively soon. Options B6 and B7 are likely to be the most complex and require the greatest time.

Figure 11: Proposed timelines for risk management and investment options



Comparison with WMR and BCG of risk management and investment options

8.34 The following table compares the MDAG's options with those proposed by the Electricity Authority's Wholesale Market Review and Boston Consulting Group's recent study 'Climate Change in New Zealand: The Future is Electric'.

Table 11: Comparison with WMR and BCG reports

	MEASURE	MDAG	WMR	BCG
B1	Greater transparency of hedge info (esp non-base load) covering offers, bids + agreed prices	●	●	◐
B2	Market-making for longer dated futures (for price discovery)	●	●	●
B3	Publish aggregated information on pipeline of new developments, energy and capacity adequacy	●	●	●
B4	Enhance stress testing regime	●	○	○
B5	Develop standardised 'shape' product(s)	●	◐	○
B6	Develop flexibility access code (non-price elements)	●	●	●
B7	Extend trading conduct rules to hedge market	●	●	○
B8	Market making in caps or other shaped products	◐	◐	●
B9	Capacity mechanisms	●	○	●
B10	Strategic reserve	●	○	●

● SUPPORTS OPTION ● DOES NOT SUPPORT OPTION ◐ PARTIALLY SUPPORTS OPTION ○ OPTION NOT DISCUSSED

4. Do you agree that, weighing costs and benefits, our preferred options in Table 10 above are likely to best address the risk management and investment issues described in this chapter? If not, why not?

5. What is your view of the proposed sequencing and timing of measures to improve risk management and investment?

6. What, if any, other options should be considered to improve risk management and investment?

9. Lift participation of demand-side flexibility (DSF)

DSF as a competitive alternative to generation

9.1 As highlighted earlier, our core aim is to ensure reliable, renewable electricity at least cost. It therefore follows that, if the marginal cost of reducing or shifting demand is less expensive than the cost of producing an additional unit of electricity from the next cheapest source of generation, then the demand-reduction or demand-shifting option should prevail – it is best for the economy, the environment and consumers.

9.2 To date, wholesale market-driven demand-side response has played a relatively limited role in our system. This is due to several historical factors which have made the "size of the prize" for individual consumers less than the cost of capturing it[107].

9.3 However, today's landscape for demand-side response is changing markedly. We expect the cost of reducing or shifting consumption will become increasingly competitive as an alternative to using supply-side resources, particularly as the value of flexibility heightens with the decline of flexible, dispatchable fossil-fuelled plant.

9.4 Put simply, we need to ensure that DSF competes efficiently with supply-side resources in delivering reliability at least over the short, medium and longer terms.

9.5 By DSF, we mean dynamic demand responses to the wholesale market price[108]. The sources of DSF that fit within our primary field of focus are:

(a) Smart controls on home and business energy consuming devices (from EV charging and hot water cylinders through to industrial process heat) that allow the dynamic management of consumption; and

(b) Battery storage systems installed on a customer's premises, including EVs with vehicle-to-grid technology.

9.6 These resources can be used to provide the following services to the wholesale market:

(a) Short-term shifting of consumption between time periods (utilising thermal inertia or chemical storage); and

(b) Increasing or decreasing electricity demand for a range of periods (minutes, days, weeks, months) when low or high wholesale prices persist.

Benefits of DSF

9.7 There is a broad set of benefits[109] provided by demand-side response in general. DSF offers particular benefits, which are heightened in wholesale market of 100% renewable energy (or close to it) – namely:

107 Key reasons are set out in the accompanying "Framework for DSF option development" paper by Stephen Batstone at https://www.ea.govt.nz/development/work-programme/pricing-cost-allocation/100/consultations/#c19134.

108 We refer to OFGEM's definition of flexibility as recommended by IPAG in "Draft IPAG review of the Transpower Demand Response Programme", 8 July 2021.

109 These benefits include reducing spot price volatility; improving system security and reducing the risk of black-outs (for example, by emergency load shedding, ancillary service markets, voltage support, and limiting the consequences of network faults once they occur); reducing network congestion; delaying construction of additional generation, and/or grid and network upgrading; reducing greenhouse gas emissions; improving market efficiency by enhancing consumers' ability to respond to changing price, and lowering consumers' total electricity costs, with demand side resources competing effectively, displacing more expensive supply side investment – see "Electricity Demand-side Management", Treasury, October 2005. See also Batstone (January 2021) and MDAG Issues Paper (January 2021) at 7.90. Increased wholesale market participation from consumers was seen as

(a) More competitive pressure on wholesale prices/costs, especially during times of higher prices when generation is scarce, mitigating market power concerns. As noted by Hogan (2016):

> "Markets cannot function without the check of effective competition, with the latitude to form effective energy prices being a principal casualty. Ensuring competition is a non-negotiable prerequisite for the market in general, much less for proper energy price formation. And although the system 0perator's role as buyer/seller of last resort sets an upper limit on shortage pricing, full confidence in unfettered energy market prices is unlikely until demand has developed a more dynamic capacity to clear the market based on the range of values consumers actually place on continuous service, rather than at an administratively set average."[110]

(b) Bolstering the political sustainability of scarcity prices. In particular, if customers are able to reveal their true willingness to pay for electricity via bids into the wholesale market, the marginal price of electricity will reflect customers' valuation rather than an administered price (such as VOLL[111]). Formal bidding of "willingness to pay" (WTP) demand bids into the wholesale market would therefore improve the social and political acceptability of prices, especially during periods of scarcity[112], and forestall the use of non-price demand rationing (and administrative pricing) in these situations;

(c) Broadening and deepening consumers' understanding of how electricity pricing works, and the arrangements that underpin it, which flows from them having greater engagement (directly or via intermediaries) in the wholesale pricing process;

(d) Reducing system costs as DSF can – at least partly – fulfil the role of a peaking plant or grid-scale storage schemes, potentially at lower cost to the system[113] and reducing greenhouse gas emissions from fossil fuelled plant;

> Joskow (2019) shows that dynamic retail pricing yields a 2.4% - 4.6% reduction in electricity expenditures (in a fossil-fuel environment), but an 8.5% - 24.3% improvement in a system heavily dependent on renewable generation

(e) Stabilising wholesale spot prices (energy and ancillary services), especially when intermittent supply resources create volatility in the supply curve; and

(f) Further, if formally bid into the market, improved granularity and accuracy of the demand and supply curves the system operator optimises in finding the least-cost dispatch solution[114]; formal bidding also helps the discovery of "shape" in the demand curve, potentially replacing the contribution that thermal offers currently make to the supply curve.

important during the market design period in New Zealand (see Culy (1995) and internationally (see e.g., Cramton, Ockenfels and Stoft (2013), Fraser (2001), Hunt (2002)).

110 Hogan, M., (2016), "*Hitting the mark on missing money*, downloaded from www.raponline.org.

111 Value of Lost Load.

112 It is far preferable to maintain security of supply through price-based reductions in demand, rather than to have administratively set prices (usually referenced to an approximated value of lost load, or VOLL) or non-price rationed involuntary curtailment.

113 For example, adding ~800MW of short-term load shifting (EV charging, BTM batteries and/or hot water control) and 600MW high priced curtailment reduces system costs at the wholesale level by $93M pa (~$117/kW pa). Adding a further 400MW of fully flexible demand reduced wholesale system costs further by $77M - $91M pa ($192/kW – $227/kW) - i.e., longer term flex worth ~1.5x - 2x short term flex. These figures don't include the cost of the investment that enables the DSF – but provides a target cost to beat.

114 Consultation paper, Electricity Authority, March 2019, 3.53.

9.8 These benefits in combination – lowering overall system costs for consumers, mitigating market power concerns, lowering the need for forced demand curtailment in periods of scarcity, adding consumer-driven valuations of consumption into the demand curve, and more consumer engagement with the pricing process – promote the crucial overarching benefit of achieving reliability at least cost, while strengthening political-economy and public confidence in the market arrangements. We see this as a foundational for a well-functioning wholesale electricity market.

9.9 As we transition to a very high renewables system, flexibility becomes a highly valuable service to the system. Our analysis also suggests that revealing more information on the "shape" of forward prices will be critical as we move into a renewables-based system. Hence many of the benefits noted above – while valuable in all scenarios – become increasingly valuable to a renewables-based system.

Demand-side issues to be addressed

9.10 In short, we see it as extremely important to have market arrangements that enable DSF to compete efficiently with supply-side resources in delivering reliability at least over the short, medium and longer terms. For this to happen:

(a) Consumers need to have choice about whether and how they provide demand flexibility, with arrangements available to suit different customer preferences about the level of automation, engagement, cost volatility, service level and control; and

(b) Simultaneously, we need to ensure consumers have access to the information that will help them make good decisions about providing DSF (benefits, costs, service impacts); and

(c) Tariff and technology innovation is needed to drive the development of these tariffs, and to lower the transaction costs of making demand-side flexibility available to the wholesale market; and

(d) DSF should have access to relevant value streams (sharing in the underlying benefits) where it has an economically efficient service to provide. This includes how large-scale DSF is integrated into existing markets.

9.11 Despite the significant changes in the technology that enables DSF, as well as a future which ascribes greater benefits to flexibility, we believe there remain factors that will slow the uptake of DSF. Our Issues Paper distilled the factors that are impairing the requirements outlined above. We grouped the various particular issues around common strategic issues, as set out in the table below.

Table 12: DSF issues and consequences

ISSUE	STRATEGIC ISSUE	CONSEQUENCE
Dominant tariff offering is FPVV	Tariffs mute a signal for flexibility (yet to see widespread emergence of DSF-rewarding tariffs that enable DSF owners to make risk-value and engagement tradeoffs)	Inefficiently low provision of wholesale DSF, since costs exceed (understated) benefits for a number of consumers with potential DSF
Existing tariffs mute DSF signal		
Where signalled, DSF requires high consumer engagement		
High compliance cost to formally bidding DSF	Market is not able to achieve the highest aggregate value for DSF, and therefore compromising benefits.	Inefficiently low provision of wholesale DSF since costs exceed realised benefits for a number of potential DSF investors (intermediaries and consumers)
Accessing DSF value limited by technical barriers or lack of market		
Potential co-ordination challenges between wholesale and network signals for DSF		
Consumer (and possibly intermediaries) have low awareness of or missing information about current or future DSF value		Inefficiently low provision of DSF, as investors (intermediaries and consumers) miss opportunities to enable DSF

Options to improve DSF

9.12 Our preferred package of options for lifting DSF in the wholesale market reflects the underlying philosophy of providing consumers with the right information about the value of their flexibility, and a sufficient range of options to contract that flexibility, for them to choose from. We want to see these options and the information set, available as soon as possible.

9.13 To achieve this, we see a number of "early wins" that can help unblock DSF:

(a) Understanding the pace at which development of commercial DSF arrangements is occurring requires better monitoring of the retail DSF market, especially tariff availability (**Option C1**). This should be implemented as soon as possible, since it underpins a range of future regulatory decisions.

(b) Accelerating the development of DSF tariffs requires a rapid adoption, by retailers, of the high frequency metering data that will underpin these tariffs (**Options C2**).

(c) For larger consumers, financial contracts need to be developed to underpin their investment in enabling DSF (**Option C4**).

(d) To support the uptake of DSF tariffs, consumers need the best information available about their choices, and the potential rewards, as soon as possible (**Options C15, C16**).

(e) The way the market can optimize the efficient use of DSF requires a number of existing or planned initiatives to proceed with a focus on understanding and enabling DSF (**Options C8, C9, C20, C13**).

9.14 Depending on the pace observed during the initial 1-2 years of monitoring (**Option C1**), further requirements on retailers to develop DSF-rewarding tariffs may be required (**Option C3**).

9.15 Consumers across the spectrum – from households to large industrial participants – are making electrification investment decisions today that would benefit from having flexibility being designed in at the outset.[115] Providing these consumers with information about the current and future benefits of DSF – today - is vitally important to achieving efficient levels of DSF uptake (**Options C13** and **C14**). We have prepared illustrative examples of the kinds of information likely to be useful under **Option C13** (see accompanying "DSF Case Studies")**.**

9.16 Further, the DSF "market" is still very much in its infancy. We understand that developing new retail products, relying on new technology, new relationships with customers and other intermediaries (e.g flexibility traders), in a changing market environment is risky. There are a range of information and knowledge gaps about how DSF will work at scale which, combined with the historical inertia around DSF development, could see the development and uptake of DSF occurring slower than needed to play its important role as intermittent renewables increase[116].

9.17 Rather than embed significant changes in the market design to de-risk this process, we believe a well-funded and extended trial of new DSF-rewarding tariffs, technology, relationships and market integration (**Option C5**) can accelerate the closing of these common information and knowledge gaps, as well as "learning by doing"[117], that will lead to an accelerated and sustained increase in DSF in the New Zealand market. Such a trial should include how wholesale and network uses of DSF can be value stacked and integrated.

9.18 The level of government funding here should reflect the sizeable economic benefit to New Zealand from unlocking greater DSF. While the quantum of funding will be informed by how the trial is conducted, we note ARENA's demand response co-funding programme which saw 200MW of demand response realised through AUD36M of public co-funding[118].

9.19 We are cognisant of not wanting this trial to interfere with the natural competitive processes that will drive innovation. Rather, we see the trial solving a number of critical "common" problems so that the industry has a common framework of standards and protocols that will allow competition to thrive[119]. These are common problems - and the solutions then provide a platform for competition.

9.20 These measures are summarised in Table 12. A full description of each option is set out in our "Library of Options".

115 For example, EA Networks' submission noted that their network is expecting a significant amount of industrial electrification, but "few are thinking about how the future shape of electricity prices" or intending to invest in DSF systems.

116 As noted by Flex Forum, "Developing the capability, practices and processes cannot occur overnight. Electricity distributors in the United Kingdom have made considerable progress since announcing a flexibility commitment8 in December 2018, going from 116MW of flexibility contracted in 2018 to 1.6GW contracted in the first half of 2021.9 However, the UK's journey to use flexibility began in 2011." Flex Forum Flexibility Plan 1.0, p8.

117 Newbery (2018), "Evaluating the case for supporting renewable electricity". We note that the Flex Forum's Flexibility Plan 1.0 is also strongly supportive of "learning by doing" trials for DSF, as was IPAG in its review of Transpower's Demand Response Trial.

118 See https://arena.gov.au/assets/2019/03/demand-response-rert-trial-year-1-report.pdf.

119 For example, how DSF will interact with the system operator's forecasts (Option C8), how DSF can value stack wholesale and network drivers (Option C11), and how better information can be provided to consumers who may wish to enable DSF (options C13 and C14). Flex Forum's Flexibility Plan 1.0 has a comprehensive list of the information gaps that exist today, many of which need to be solved for DSF to be efficiently deployed.

Table 12: Proposed measures to increase DSF

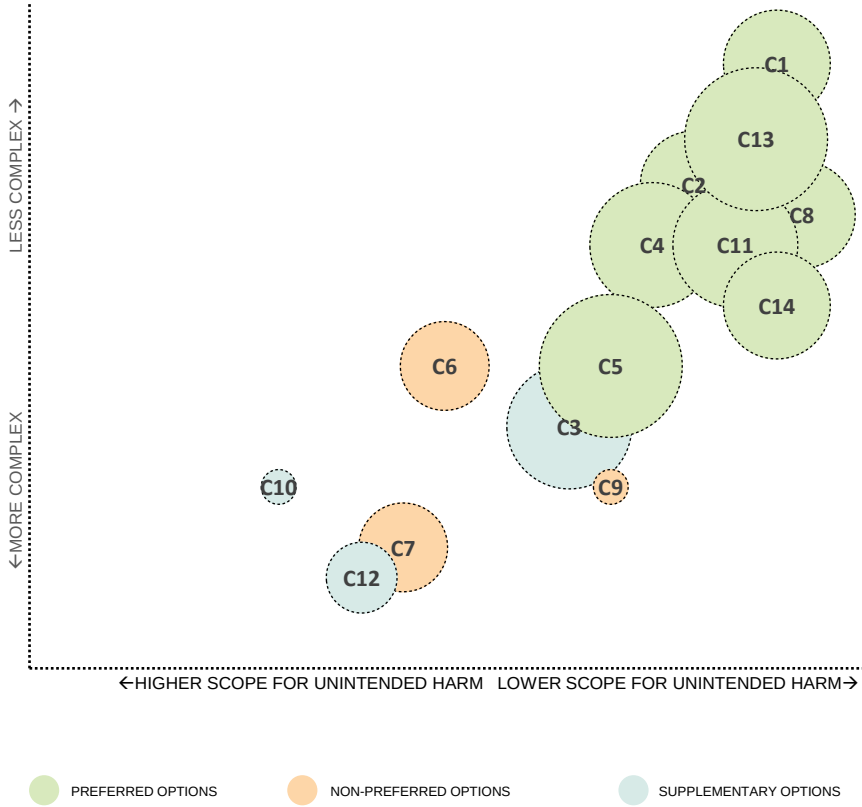
1	OPTIONS TO ADDRESS STRATEGIC ISSUE 1	**Tariffs mute a signal for flexibility: Yet to see widespread emergence of DSF-rewarding tariffs that enable DSF owners to make risk-value and engagement trade-offs**			
	Option name	**Rationale**	**Status**	**Start**	**in place by**
C1	Monitor provision + uptake of DSF-rewarding tariffs	Provide reliable quantitative and time-series basis on which to assess retail market development and uptake of DSF tariffs	Preferred	2023	2024
C2	Sunset profiling if smart meters in place	Continued use of profiles is impeding retailers' development of DSF tariffs	Preferred	2024	2025
C3	Require retailers to offer DSF tariffs	Retailers are potentially slow to develop DSF-rewarding tariffs	Backstop if C1 evidence shows need	Mid 2024	2026
C4	Develop standardised shape-related hedge products to reward DSF	Enable large consumers to smooth volatile revenues from DSF	Preferred	2024	Mid 2025
C5	Provide significant funding for pilots/trials to kick-start dynamic tariff use	Help cut through complexities and risks in enabling use of DSF tariffs	Preferred	2024	Mid 2026
C6	Use Customer Compensation Scheme to reward DSF		Not preferred	NA	
C7	Negawatt scheme for wholesale market		Not preferred	NA	
2	OPTIONS TO ADDRESS STRATEGIC ISSUE 2	**Market is not able to achieve the highest aggregate value for DSF, therefore compromising benefits**			
	Option name	**Rationale**	**Status**	**Start**	**in place by**
C8	FSR - improve DSF visibility and remove Code barriers	Covered in FSR project	Preferred	2023	2025
C9	FSR - accelerate new ancillary services for DSF uptake		Not preferred	NA	
C10	Procurement process for high-scarcity DSF (RERT)	"Last resort" DSF should be formally contracted and paid for.	Backup if little increase in bid DSF	2025	2027
C11	Ensure distribution pricing reflects network needs	Improve coordination and optimising the use of DSF across both network and wholesale market	Preferred	2023	2025
C12	Investigate extending LMP into distribution networks	Static cost reflective tariffs may not provide the most efficient signal of dynamic network needs for flexibility, undervaluing the role that DSF can provide	Backup if C11 doesn't provide signals	Mid 2026	Mid 2029
3	OPTIONS TO ADDRESS STRATEGIC ISSUE 3	**Consumers and intermediaries have low awareness of current or future DSF value**			
	Option name	**Rationale**	**Status**	**Start**	**in place by**
C13	Provide info to help large users with upcoming DSF investment decisions	Help large consumers to better quantify the value of DSF in electrification investment decisions - see examples in accompanying 'DSF Case Studies'	Preferred	2023	2024
C14	Provide info to help domestic customers with DSF decisions	Help smaller consumers to better understand benefits of DSF tariffs	Preferred	Mid 2024	2026

SUPPORTS OPTION DOES NOT SUPPORT OPTION PARTIALLY SUPPORTS OPTION

Overall evaluation of DSF options

9.21 Figure 12 summarises our high-level evaluation of these options in terms of net benefit (larger bubbles indicate greater benefit), relative ease of implementation and scope for unintended harm. It reflects our view that a large-scale trial of DSF (**Option C5**), along with significant information support to large consumers who are currently electrifying process heat (**Option C13**), are likely to have the most significant benefits.

Figure 12: Assessment of DSF options



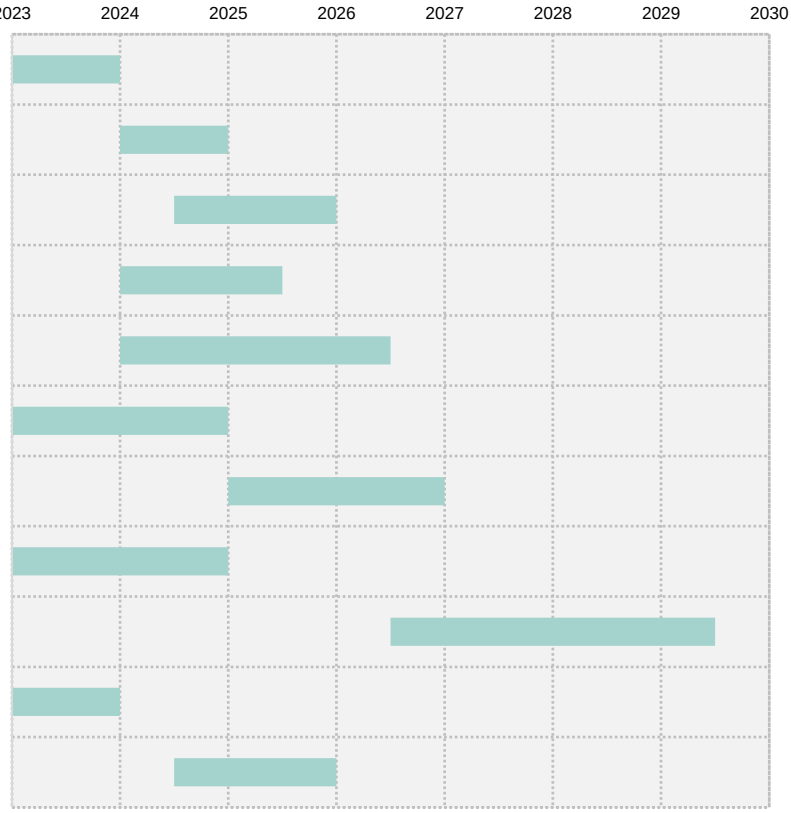
C1	Monitor provision + uptake of DSF-rewarding tariffs
C2	Sunset profiling if smart meters in place
C3	Require retailers to offer DSF tariffs
C4	Develop standardised shape-related hedge products to reward DSF
C5	Provide significant funding for pilots/trials to kick-start dynamic tariff use
C6	Use Customer Compensation Scheme to reward DSF
C7	Negawatt scheme for wholesale market
C8	FSR - improve DSF visibility and remove Code barriers
C9	FSR - accelerate new ancillary services for DSF uptake
C10	Procurement process for high-scarcity DSF (RERT)
C11	Ensure distribution pricing reflects network needs
C12	Investigate extending LMP into distribution networks
C13	Provide info to help large users with upcoming DSF investment decisions
C14	Provide info to help domestic customers with DSF decisions

Priority and sequencing of DSF options

9.22 Our current view of priority and sequencing is as follows. Other than the current programming of existing initiatives (**Options C8** and **C11**), our sequencing reflects the need to commence monitoring of the retail market through a DSF lens as soon as possible (**Option C1**). This information will support any future decisions about changes to the market design. We see a similar level of urgency in providing large consumers with information regarding the current and future benefits of enabling DSF as they make electrification decisions (**Option C13**).

Figure 13: Proposed timelines for DSF options

C1	Monitor provision + uptake of DSF-rewarding tariffs
C2	Sunset profiling if smart meters in place
C3	Require retailers to offer DSF tariffs
C4	Develop standardised shape-related hedge products to reward DSF
C5	Provide significant funding for pilots/trials to kick-start dynamic tariff use
C8	FSR - improve DSF visibility and remove Code barriers
C10	Procurement process for high-scarcity DSF (RERT)
C11	Ensure distribution pricing reflects network needs
C12	Investigate extending LMP into distribution networks
C13	Provide info to help large users with upcoming DSF investment decisions
C14	Provide info to help domestic customers with DSF decisions



Comparison with WMR and BCG of DSF options

9.23 The following table compares the MDAG's options with those proposed by the Electricity Authority's Wholesale Market Review and Boston Consulting Group's recent study.

Table 13: Comparison with WMR and BCG reports

	MEASURE	MDAG	WMR	BCG
C1	Monitor provision + uptake of DSF-rewarding tariffs (incl automation)	●	●	○
C2	Sunset profiling if smart meters in place	●	○	●
C3	Require retailers to offer DSF tariffs	●	○	●
C4	Develop standardised shape-related hedge products to reward DSF	●	○	○
C5	Provide significant funding for pilots/trials to kick-start dynamic tariff use	●	○	○
C6	Use Customer Compensation Scheme to reward DSF	●	○	●
C7	Negawatt scheme for wholesale market	●	○	○
C8	FSR – improve DSF visibility and remove Code barriers	●	○	○
C9	FSR – accelerate new ancillary services for DSF uptake	●	○	○
C10	Procurement process for high-scarcity DSF (RERT)	●	○	●
C11	Ensure distribution pricing reflects network needs	●	○	●
C12	Investigate extending LMP into distribution networks	●	○	○
C13	Provide info to help large users with upcoming DSF investment decisions	●	○	○
C14	Provide info to help domestic customers with DSF decisions	●	○	○

● SUPPORTS OPTION ● DOES NOT SUPPORT OPTION ● PARTIALLY SUPPORTS OPTION ○ OPTION NOT DISCUSSED

7. Do you agree that, weighing costs and benefits, our preferred options in

8. Table 12 above are likely to best address the demand side flexibility issues described in this chapter? If not, why not?

9. What is your view of the proposed sequencing and timing of measures to improve demand side flexibility?

10. What, if any, other options should be considered to improve demand side flexibility?

10. Strengthen competition

Why it matters

10.1 As discussed in the Issues Paper competition is a vital ingredient to successfully shift to a renewables-based system.[120] Without effective competition, consumers and policy makers will not have confidence in electricity spot or contract prices. Competition is often reduced when the system is tight, and yet those are the times when it can be most important to have confidence in prices and the market rules that govern their formation.

10.2 A lack of confidence in competition is obviously a problem for consumers, but it can also be bad for suppliers. If policy makers lack confidence in competition, the policy/regulatory environment will be less stable. That in turn can have a chilling effect on the longer-term investments needed to underpin the shift to renewables.

10.3 Competition also has a critical role to play in spurring innovation and driving its uptake. Experience shows that innovation is the biggest source of gains in terms of cost reductions, better service levels, and environmental improvements.

10.4 International experts also emphasise the critical importance of competition. The view is summed by Michael Hogan who stated:

> "Ensuring competition is a non-negotiable prerequisite for the market in general, much less for proper energy price formation"[121]

Key findings in Issues Paper

10.5 The Issues Paper found the shift to a renewables-base system may strengthen competition in some areas. For example, batteries may increase competition in the provision of short-term flexibility services and some ancillary services (< few days).

10.6 Conversely, competition may thin in other areas. We identified the provision of flexibility services for periods of a week or longer as the area of greatest concern.

10.7 This is because much of this flexibility comes from fossil-fuelled plant which will progressively retire under a renewables-based system. Batteries are unlikely to be economic for cycling over a week or longer[122]. This means the provision of longer-term flexibility services would become more concentrated among parties with flexible hydro generation capacity, all other things being equal.[123]

10.8 New sources of longer-term flexibility are likely to emerge – potentially including flexible demand sources, a level of renewable over-build that leads to greater spill, pumped hydro storage, biofueled thermal operation. Nonetheless, a significant thinning of competition in the provision of longer-term flexibility services appears likely with most flexibility being held by parties with the major hydro generation.[124]

120 See https://www.ea.govt.nz/assets/dms-assets/29/01-100-Renewable-Electricity-Supply-MDAG-Issues-Discussion-Paper-1341719-v2.4.pdf.

121 See "Hitting the Mark on Missing Money: How to Ensure Reliability at Least Cost to Consumers", Michael Hogan, 2016.

122 Chemical batteries are unlikely to be economic for longer-term flex.

123 Most submissions on the Issues Paper supported these observations. For example the submission from Electric Kiwi Haast stated "Getting the foundations of a competitive wholesale market right should be the highest priority of the Authority in preparing for a 100% renewables market."

124 In passing, we note that New Zealand's electricity system is 'energy constrained' rather than 'capacity constrained' – this is because the main supply risk is from droughts that last weeks or months, rather than demand spikes that last a few hours. Looking ahead, the system is expected to remain **energy-constrained**, although low wind/solar periods will likely become important as well as droughts. Fossil-fuelled plants are expected to progressively retire, reducing competition in the provision of

Submissions

10.9 There was widespread support for these views in submissions. Fonterra noted that "as the baseload thermal generation exits the market and the role of hydro changes there could be a loss of competition for generation that could support firmed contracts and other base energy services". Electric Kiwi/Haast submitted extensively on this issue, noting that "getting the foundations of a competitive wholesale market right should be the highest priority of the Authority in preparing for a 100% renewables market". Generator-retailers also supported the MDAG undertaking this analysis, although Meridian considered that "MDAG may struggle to analyse competition in a hypothetical future market". Meridian also noted that competition in "aggregation of consumer load, particularly vehicle to grid flexibility is one area to watch out for".

Advice from international literature and experts

10.10 As Prof. Paul Joskow observed: "Market power is a significant potential problem in electricity markets, but the cure can be worse than the disease. Try to deal with potential market power structurally ex ante rather than ex post."[125] Likewise, Prof. Stephen Littlechild opined that, given the difficulties of satisfactorily defining and proving anti-competitive conduct, it is better to focus on structure and incentives in designing remedies (new entry, enforced divestment, contracts markets and the like), rather than on conduct.[126]

10.11 Following release of the Issues Paper, we spoke with overseas experts to discuss frameworks to further examine competition for flexibility services under a renewables-based system.[127] Key points that emerged from the discussions were:

(a) If flexibility services became a 'bottleneck' in competition terms, that could have very significant implications for functioning of the wider electricity market. For example, if there is inadequate competition for the provision of firming services for intermittent generation, that could in turn reduce competition in the upstream generation investment market and/or in the downstream market for electricity retailing. Limited competition for flexibility services was a concern in the United Kingdom in early 1990s when two players were regarded as controlling most of the flexible generation on the system.

(b) When assessing how competition for flexibility services could affect the wider market, it is important to consider the structure of spot prices. If some parties have sufficient market power to sustainably alter the structure of spot prices, those parties would likely have scope to influence competitive dynamics in other parts of the wholesale market. A particular concern would if parties could increase the 'volatility of volatility' – i.e. appreciably increase uncertainty about the future structure of prices as that might deter some types of new entry and therefore increase *average* prices.

(c) There is no universal approach to apply when analysing competition in the future. However, one useful approach is to consider the likely degree of *change* in parties' ability or incentives to exercise market power. This information, combined with knowledge about current levels of competition, provides a basis for assessing whether competition concerns are likely to grow or recede.

longer-term flexibility services all other things being equal. Over time, we expect the 'energy constrained' feature of the NZ system to reduce, transitioning to become more '**capacity constrained'** as is typical in overseas systems.

125 Joskow, 2007, Lessons Learned from Electricity Market Liberalization, page 12 - http://econwww.mit.edu/files/2093 cited in Investigation Report: Commerce Act – Electricity Investigation", Commerce Commission 21 May 2009 at 665.

126 Littlechild, 2001.

127 This included virtual meetings with Professor George Yarrow and Dr Chris Decker (both of whom are United Kingdom-based competition experts) and personnel at the Australian Energy Market Commission.

(d) Market power can be regarded as significant if the economic cost of the harm exceeds economic cost of the remedy.[128] In this context, it is important to note that electricity markets are unusual – appreciable harm can occur in a relatively short period.

10.12 The costs of sustained significant market power have the potential to be extremely high. Without broad confidence in the sufficiency of competition, the foundations of the wholesale market are weak and all participants are exposed to the serious risk of *ad hoc* regulatory changes that effectively give up on a market process.

Observations from further competition analysis

10.13 With the above factors in mind, scenario-based analysis was used to compare the system in 2035 with the recent past (i.e. while fossil-fuelled thermal plants are still available to provide substantial flexibility).[129] The results are set out more fully in the competition issues slide pack[130]. The key findings are that:

(a) Larger generators with flexible resources may well have greater means to significantly and rapidly raise volatility of volatility under a renewables-based system than in the past.

(b) Large generators with significant flexibility would not appear to face much direct cost or disruption from raising the volatility of volatility.

(c) It seems likely that significant volatility of volatility would deter potential new entrant intermittent generators.

(d) Generators with significant flexible resources face would appear to derive material gain if new entry is deterred.

(e) If increased volatility of volatility hinders new generation entry, that could lead to higher *average* prices.

10.14 Although these findings are not determinative because they are based on projections of the future, they nonetheless indicate the critical importance of maintaining effective competition for longer term flexibility products. While some may advocate for a 'wait and see' approach,[131] we think this would be unwise.

10.15 First it will take time to design options and put them in place. Waiting for a problem to emerge before starting that work could mean that an extended harm occurs before a solution is in place, or that hasty and sub-optimal solutions are implemented. Second, confidence in competition is a foundational 'must have' element for an electricity market. If that confidence is not present, parties will be unlikely to invest at the pace needed to provide reliable and affordable power and there is a continual risk of government intervention.

10.16 Given these factors, we *strongly* recommend that pro-competitive measures directed at the provision of flexibility services be pursued with dispatch.

128 This is the definition proposed by Professor Yarrow and reflected in trading conduct provisions of the Code. Of course, there may be instances where the economic cost of the is very sizeable, but nonetheless smaller than the economic cost of the remedy. Further, the exercise of market power is not made acceptable by high costs to remedy or prevent it.

129 As discussed in the competition issues slide pack, historical data is used for the past when assessing market concentration measures. For other measures, the recent past was represented by a simulation of the existing system, but with more new entry to bring it to an equilibrium state. This was because measures such as a comparison of wholesale contract prices and new supply costs indicate the system is not currently in long run equilibrium.

130 See www.ea.govt.nz/development/work-programme/pricing-cost-allocation/100/consultations/#c19134.

131 For example Meridian's submission on the Issues Paper suggested that "we do not know how the market will evolve over the coming years. If seasonal flexibility services are highly concentrated, then the issue could be considered as and when it arises."

Options to strengthen competition

10.17 We have considered a range of options to strengthen competition for the provision of flexibility services. The options fall into two broad categories:

(a) Conduct measures – these seek to deter or mitigate the exercise of market power. They can be modified over time to reflect changing circumstances and therefore have less risk than structural measures. However, they require active and ongoing monitoring and enforcement and to some extent treat symptoms rather than underlying causes. For these reasons they may not always be effective.

(b) Structural measures – these seek to address undue market power at its source. They require less monitoring once in place. However, they are generally more costly and difficult to implement, have greater risk of unintended consequences and can create significant disruption at a time when the sector is needing stability to support investment decisions in long life assets.

10.18 We believe attention should focus on conduct-based measures in the first instance. These are a mix of options to measure competition and increase contract transparency (**Options D1 and D2**) and options to constrain anti-competitive conduct (**Options D3 and D4**). These options are expected to have solid competition benefits and low likelihood of unintended adverse effects (such as chilling investment incentives or creating coordination inefficiencies).

10.19 We also see merit in introducing market-making for a shaped contract product, such as some form of cap (**Option D5**). This is a preferred back-up option.

10.20 It is possible that conduct-based measures may prove insufficient from a competition perspective. In that event, structural measures would be required.

10.21 The problem we have identified is the potentially greater concentration of flexible supply (medium term hydro storage). , Disaggregating generation and retail operations (or vertical separation) would not remedy this issue. In making this observation, we recognise that disaggregation of generation and retail could improve contract market liquidity; however, it would not directly address upstream concentration at the generation level. We are also proposing other options to improve contract market liquidity and price discovery (**Options B1, B2, B5, B6, B8**).

10.22 Physical disaggregation of generation was used successfully in the 1990s to break the former ECNZ into four competitors, and to enhance competition in 2009 with the transfer of Tekapo stations to Genesis.

10.23 As matters stand, there are few opportunities for further physical disaggregation of the hydro generation base without splitting ownership of closely related stations on river chains.[132] Such splits could lead to coordination difficulties.[133] Furthermore, such a 'physical' split would not address the key issue, which is the concentration of rights to longer term storage in the main upstream reservoirs at the head of each river chain.

10.24 By contrast, virtual disaggregation of hydro storage – by reallocating rights to that longer term storage is likely to more effectively target the issue while avoiding the complexities of asset transfers. For this reason, the preferred structural option would be a 'virtual' disaggregation of longer term storage by potentially allocating (via auction) a significant tranche of flexible contracts from the primary holders of flexible supply (such as Meridian and Mercury) to other wholesale market participants (**Option D7**).

132 An exception would be to separate the common ownership of Manapouri hydro and Waitaki hydro schemes. However, the Manapouri hydro scheme has very little seasonal flexibility, so the competition benefits (at least as far are medium term flexibility are concerned) appear to be modest from this particular physical option.

133 The same type of challenge is the reason that some stations are combined into groups for dispatch purposes under the 'block dispatch' provisions of the Code.

10.25 If structural solutions are required, they should be put in place with the least possible delay. That means some initial scoping work would make sense as a precautionary step, even if it turns out that structural options were not ultimately needed.

10.26 Table 14 summarises the options, and they are described in more detail in the accompanying "Library of Options".

Table 14: Proposed measures to strengthen competition

	OPTION NAME	RATIONALE	STATUS	START	IN PLACE BY
D1	Develop dashboard of competition indicators for flexibility segment of wholesale market	Better assess how competition for flexibility products is changing	Preferred	2023	2024
D2	(=B1) - Greater transparency of hedge info (esp non-base load) covering offers, bids + agreed prices	Make it easier for participants to compare prices, especially for non baseload contracts. Also get better info for regulator	Preferred	2023	2024
D3	(=B6) - Develop flexibility access code (non-price elements)	Promotes reasonable access to 'flexibility contracts'	Preferred	2025	Mid 2026
D4	(=B7) - Extend trading conduct rules to hedge market	Deters participants from exercise of significant market power	Preferred	2025	2026
D5	(=B8) - Market-making for shaped contract products	Creates better forward price discovery and market liquidity for a shaped contract	Potential augmentation for D1-D4	Mid 2025	2028
D6	Physical disaggregation of flexible generation base	NA	Not preferred	NA	
D7	Virtual disaggregation of flexible generation base	Addresses market power at source via structural change	Back-up if conduct measures not sufficient	2027[134]	2029
D8	Price caps applied in the electricity spot market	NA	Not preferred	NA	

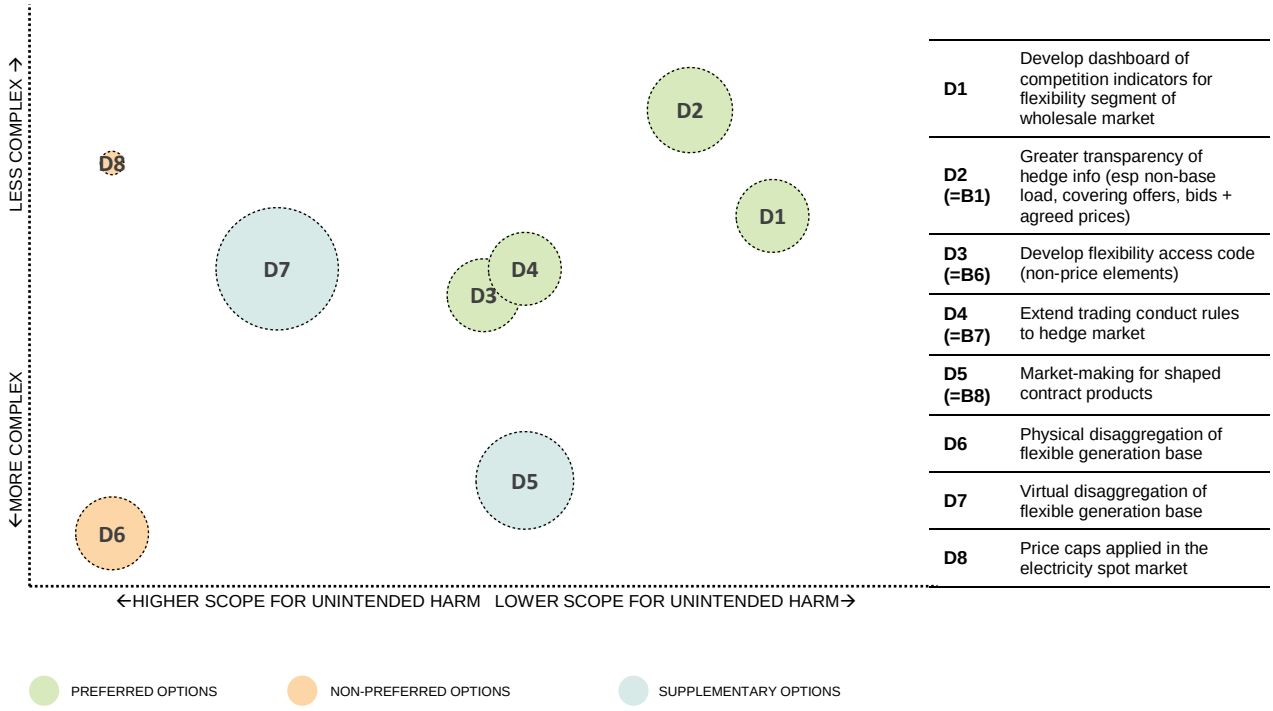
SUPPORTS OPTION DOES NOT SUPPORT OPTION PARTIALLY SUPPORTS OPTION

Overall evaluation of competition options

10.27 Figure 16 summarises our high-level evaluation of options in terms of net benefit (larger bubbles indicate greater benefit), relative ease of implementation and scope for unintended harm.

134 High level specification to be completed earlier (2024-2025).

Figure 14: Assessment of options to strengthen competition



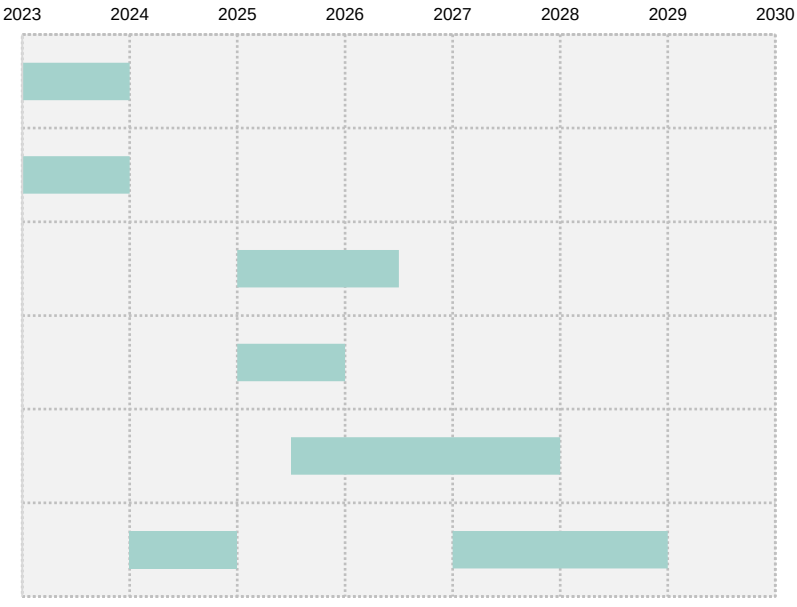
D1	Develop dashboard of competition indicators for flexibility segment of wholesale market
D2 (=B1)	Greater transparency of hedge info (esp non-base load, covering offers, bids + agreed prices)
D3 (=B6)	Develop flexibility access code (non-price elements)
D4 (=B7)	Extend trading conduct rules to hedge market
D5 (=B8)	Market-making for shaped contract products
D6	Physical disaggregation of flexible generation base
D7	Virtual disaggregation of flexible generation base
D8	Price caps applied in the electricity spot market

Priority and sequencing of competition options

10.28 Figure 15 shows the proposed timelines for progressing each option. **Options D1** and **D2** are proposed for prompt adoption because they are foundational in nature and should be relatively straightforward to implement. **Options D3 and D4** will require more time to implement but should be commenced relatively soon. **Option D5** is a potential supplementary measure to augment **Options D1-4** and improve forward price discovery and liquidity for shaped contracts. If it is progressed, it should follow **Options D1-4**.

10.29 While Option **D7** is a back-up measure, an outline of how it would work should be developed early on so that it can be put in place without delay if the conduct-based measures turn out to be inadequate.

Figure 15: Proposed timelines for options to strengthen competition



D1	Develop dashboard of competition indicators for flexibility segment of wholesale market
D2 (=B1)	Greater transparency of hedge info (esp non-base load, covering offers, bids + agreed prices)
D3 (=B6)	Develop flexibility access code (non-price elements)
D4 (=B7)	Extend trading conduct rules to hedge market
D5 (=B8)	Market-making for shaped contract products
D7	Virtual disaggregation of flexible generation base

Comparison of MDAG options with Wholesale Market Review and BCG reports

10.30 The following table compares the MDAG's options with those proposed by the Electricity Authority's Wholesale Market Review and Boston Consulting Group's recent study 'Climate Change in New Zealand: The Future is Electric'.

Table 15: Comparison with WMR and BCG reports

	MEASURE	MDAG	WMR	BCG
D1	Develop dashboard of competition indicators for flexibility segment of wholesale market	●	●	◐
D2 (=B1)	Greater transparency of hedge info (esp non-base load) covering offers, bids + agreed prices	●	●	◐
D3 (=B6)	Develop flexibility access code (non-price elements)	●	●	●
D4 (=B7)	Extend trading conduct rules for hedge market	●	●	○
D5 (=B8)	Market making in caps or other shaped products	◐	◐	●
D6	Physical disaggregation of flexible generation base	●	●	○
D7	Virtual disaggregation of flexible generation base	◐	◐	○
D8	Price caps applied in the electricity spot market	●	●	○

● SUPPORTS OPTION ● DOES NOT SUPPORT OPTION ◐ PARTIALLY SUPPORTS OPTION ○ OPTION NOT DISCUSSED

10. Do you agree that, weighing costs and benefits, our preferred options in Table 14 above are likely to best address the competition issues described in this chapter? If not, why not?

11. What is your view of the proposed sequencing and timing of measures to strengthen competition?

12. What, if any, other options should be considered to strengthen competition?

11. Increase public confidence

Why it matters

11.1 As outlined earlier, harnessing innovation and diversity of views[135] will be critical if our electricity system is to play its full part in decarbonising our economy. We consider this is best achieved by an 'energy only' market approach[136] in which market participants seek out the risk-management options that best meet their particular needs. This decentralised approach allows greater choice over the type, timing and location of contract cover and new resource investment, which means greater investment efficiency and lower costs for consumers and the environment.

11.2 However, for an energy-only approach to work, five conditions need to be satisfied, two of which centre on public confidence, namely:

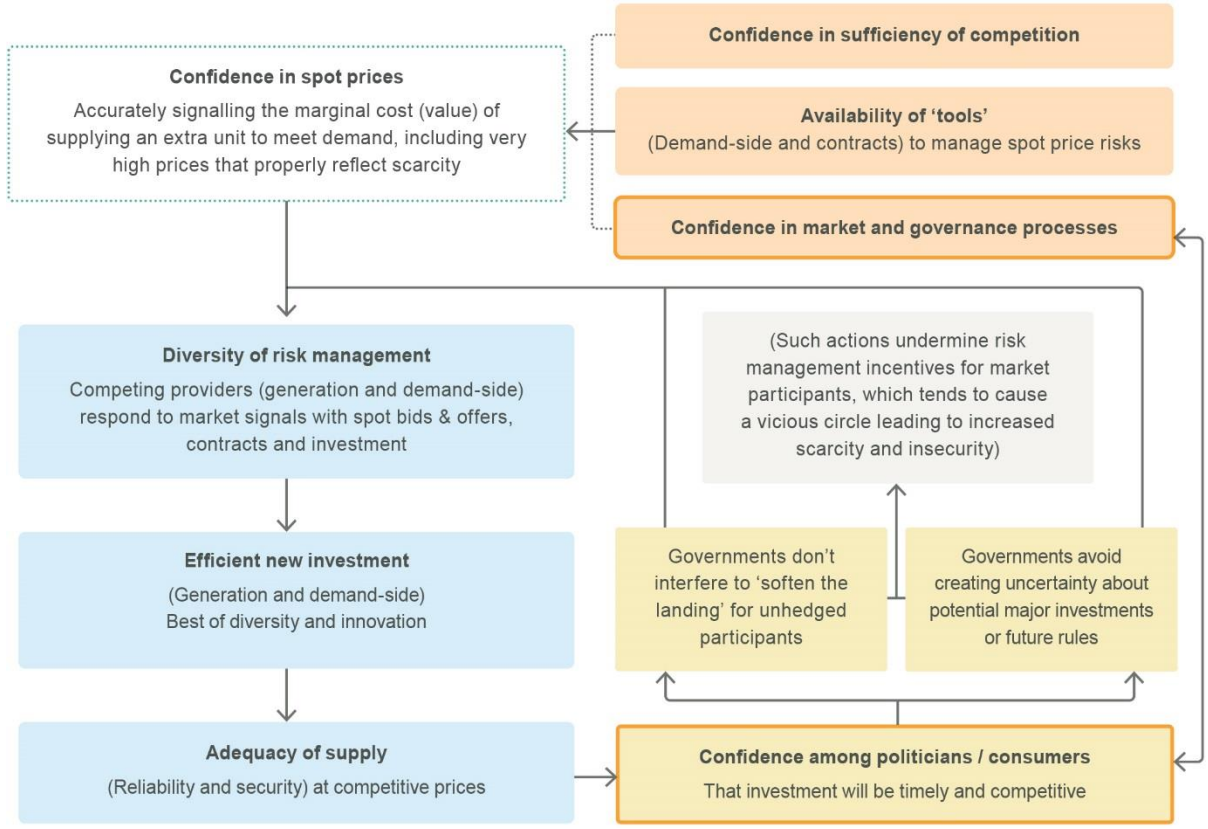
(a) General public and political acceptance that volatility and high prices (in times of scarcity) in the wholesale market are, in fact, in the best long-term interest of consumers, and that measures to 'soften the landing for unhedged participants' can trigger a vicious circle of undermined investment incentives and higher future prices; and

(b) Confidence among consumers/politicians that investment will be timely and competitive.

11.3 Governments need to reinforce (and avoid unintentionally undermining) incentives on market participants to manage risk properly, recognising that government intervention can cause a vicious circle where measures can chill investment leading to increased scarcity, more high prices and greater insecurity. We have tried to represent this in the flow-diagram below, which seeks to show the ingredient dynamics in a successful energy-only market.

135 On how best to provide additional 'supply' to meet demand. As noted earlier, diversity is a process – people and firms continuously adapting resources with an ever-evolving array of ideas and strategies to meet changing risks and opportunities. Put another way, "adapting to a complex changeable world is best achieved by a multiplicity of experiments from many different players" (Tim Harford, Economist).

136 In an energy-only market, suppliers are paid for all energy produced at spot prices (and likewise purchasers pay for usage at spot prices), and generators and wholesale purchasers choose their level of contracting to mitigate spot price volatility. By contrast, "capacity mechanisms" typically regulate that purchasers must buy some minimum level of contracts and this creates a regulated revenue stream for suppliers that is distinct from spot market payments.



11.4 Put simply, public and government confidence underpin at a fundamental level how incentives work among market participants. By way of a metaphor, if we think of our electricity market as a fuel cell in which the flow of electrons is akin to market participants' incentives (to properly manage risk and invest), then public and government confidence is akin to voltage in the fuel cell. Low voltage (low confidence) means weak electron flow (which means weak incentives to manage risk and invest).[137]

11.5 As we observed in our Issues Paper, achieving public confidence and political confidence is highly influenced by whether there is sufficient competition and whether tools for managing spot risk are properly available, which (as shown in the diagram above) supports efficient new investment and, in turn, adequacy of supply. In this regard, the measures proposed on Chapters 7, 8, 9 and 10 are fundamental for delivering public and political confidence in the wholesale market. The measures outlined below are focused on improving public information and understanding, working in conjunction with those other measures.

Public and political expectations

11.6 To understand more objectively the factors that influence political confidence in the electricity system, we interviewed a range of people[138] who were involved at the centre of various previous governments over the last 20 years in dealing with electricity price and industry regulation issues. Their insights have informed our analysis and proposals below.

11.7 Public and political expectations of the electricity system are relatively straightforward: first, "keep the power on"; and second, "don't charge too much". It is really only if these "rules" are perceived to be broken that electricity become an issue of public interest.

137 Of course, the opposite applies where public and government confidence is reinforced by market participants making timely decisions to cover risk and invest in response to efficient price signals.

138 The interviews were conducted on a confidential basis and we not at liberty to disclose who we met with, suffice to say that none could be seen as political. All are widely viewed as knowledgeable, balanced, highly experienced and measured.

11.8 Spot prices are not capped in New Zealand. They change every half hour to reflect physical conditions[139]. As explained in our Issues Paper, volatility is likely to increase, with lower and higher prices more frequently, as electricity supply becomes more and more renewable.

11.9 It is important that this volatility is not misconstrued as a bad thing; on the contrary, it needs to be seen an inherent feature of a highly renewable electricity system where spot prices properly signal real changes in the cost (value) of producing (or storing) another unit of electricity as physical conditions change.

11.10 Artificially suppressing or smoothing those spot prices signals could cause serious problems in how participants manage their risks and, in turn, whether we get enough investment coming online at the right time.

11.11 However, the idea that more volatile spot prices is a good thing may well seem like an oxymoron to some stakeholders and the politicians they influence. Given the importance of governments not intervening to suppress efficient spot prices, it is very important to strengthen public and political understanding of how pricing works and what to expect as we transition to more renewables.

How to build trust that the system is sound

11.12 As several of the senior people we interviewed pointed out, while electricity is so vital to the nation's well-being, any government's understanding of the fine detail of how the electricity market works is always likely to be relatively thin. So what matters is a government's trust in the surrounding institutional arrangements – their sense that there are processes and expertise in place that they trust to provide the required assurance it all works the way it is supposed to, and advice on how to fix problems if they emerge.

11.13 As we move to a renewables-based system, it is important that we strengthen the means by which governments in the future and the public in general can gain the assurance they need. Our preferred options below have also been developed to this end.

Options to increase public confidence

11.14 With the coming wave of renewables, we know that spot prices will become progressively more volatile, with more frequent periods of very high and low prices. As a signal of real changes in the cost of electricity supply, this is a good thing, not a 'bad'. Furthermore, volatile spot prices do not necessarily mean volatile power bills. That will depend on how customers choose to buy their electricity, and how much exposure to spot prices they want to have.

11.15 For customers with the flexibility to lower or shift their usage, some exposure to spot prices can lower their purchase costs and be very beneficial. Unless there is a solid understanding of these types of issues, there is a risk that the public and policy makers will conclude that growing spot price volatility is problem, rather than a natural and necessary signal to help.

11.16 To improve the level of understanding of these issues we recommend a structured information programme designed for wider stakeholders such as consumer organisations, Members of Parliament, media and the like (**Option E1**). We also think key Ministers and officials should receive regular briefings on the near-term (seasonal) outlook for the system and spot market conditions (similar to the quarterly briefings provided on the primary sector). These briefings should also be published. This should help to avoid surprises and explain the weather linkages in more concrete terms (**Option E2**).

139 Volatility is caused by several factors – relatively inelastic demand; our long, stringy transmission network; highly changeable weather; large variations in hydro inflows; step-changes in the cost of supply (across hydro, wind, geothermal, gas, coal and diesel); and (hopefully seldomly) by the exercise of market power.

11.17 It is also important that New Zealand can draw fully on experience in other electricity systems that are transitioning to very high renewables. Our work has identified many lessons that are useful for New Zealand – some to emulate, others to avoid. For this reason we propose an increased inter-change with international electricity experts (**Option E3**).

11.18 Finally, it is important for the public and policy makers to have confidence in their independent regulators. For this reason, we propose that the market monitoring function of the Authority be beefed up and given more autonomy (**Option E4**)[140], and that independent regulators be subject to periodic 'warrant of fitness' checks (**Option E5**).

11.19 Table 16 summarises the proposed options to increase public confidence. Each option is described in more detail in the accompanying "Library of Options".

Table 16: Proposed measures to increase public confidence

	OPTION NAME	RATIONALE	STATUS	START	IN PLACE BY
E1	Structured information programme for wider stakeholders	Explaining how security of supply is managed, both physically and via contracting, should promote better informed discussion of system performance	Preferred	2023	2024
E2	Regular briefings for Ministers and officials on current and expected conditions	Regular updates should reduce scope for surprises and foster awareness that weather-induced spot price volatility is expected and should not be artificially suppressed	Preferred	2023	2024
E3	Increase inter-change with international experts	Helps New Zealand to benefit from insights and experience from other jurisdictions	Preferred	2024	Mid 2024
E4	Enhance monitoring with more autonomy	Closer and more independent scrutiny of market performance should identify help to identify and remedy problems - and foster confidence in regulatory system	Preferred	Mid 2024	2026
E5	Periodic warrant of fitness review for independent regulatory agencies	Periodic independent reviews external should ensure any weaknesses are identified and contribute to confidence in regulatory system	Preferred	2027	2028

SUPPORTS OPTION DOES NOT SUPPORT OPTION PARTIALLY SUPPORTS OPTION

Summary evaluation of options to increase public confidence

11.20 Figure 16 summarises our high-level evaluation of options in terms of net benefit (larger bubbles indicate greater benefit), relative ease of implementation and scope for unintended harm.

140 The "Library of Options" briefly describes the continuum of options we considered in relation to E4 to strengthen autonomy and resourcing. On balance, we prefer the model where monitoring and enforcement functions are established within the Authority as an identified operating 'unit' with its own public budget (within the Authority's budget), its own web site presence, public performance reporting, and published 'operating protocols' (prescribed by the Authority), which would include principles of neutrality, objectivity, following an evidence-based approach, with the goal of ensuring compliance with the Code to achieve the statutory objectives.

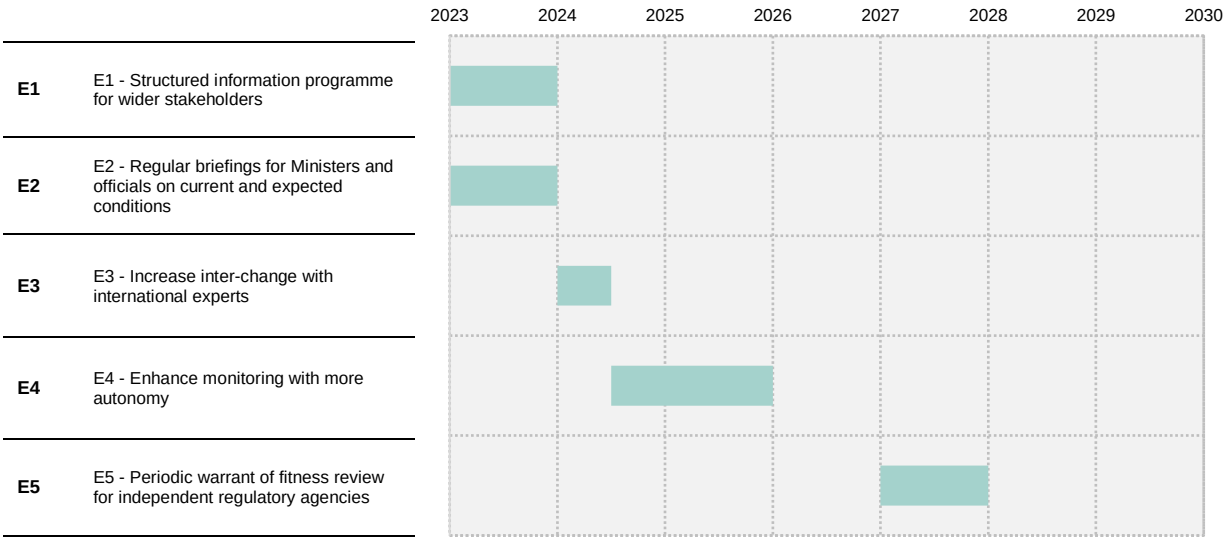
Figure 16: Assessment of options to increase public confidence

Proposed timelines for progressing options to increase public confidence

11.21 Figure 7 shows the proposed timelines for progressing each option. **Options E1 and E2** are proposed for prompt adoption because the system is already experiencing higher spot price volatility as the renewable share of supply increases. **Option E3** should be relatively easy to implement but is not urgent compared to other priorities.

11.22 **Option E4** is less urgent than the other measures in this category but should be advanced. The first regulatory 'warrant of fitness' (**Option E5**) would be due in five years so preparations need not commence until 2027.

Figure 17: Proposed timelines for options to strengthen public confidence



Comparison of MDAG options with Wholesale Market Review and BCG reports

11.23 The following table compares the MDAG's options with those proposed by the Electricity Authority's Wholesale Market Review and Boston Consulting Group's recent study 'Climate Change in New Zealand: The Future is Electric'.

Table 17: Comparison with WMR and BCG reports

	MEASURE	MDAG	WMR	BCG
E1	Structured information programme for wider stakeholders	●	○	○
E2	Regular briefings for Ministers and officials on current and expected conditions	●	○	○
E3	Increase inter-change with international experts	●	○	○
E4	Enhance monitoring with more autonomy	●	○	○
E5	Periodic warrant of fitness review for independent regulatory agencies	●	○	○

● SUPPORTS OPTION ● DOES NOT SUPPORT OPTION ● PARTIALLY SUPPORTS OPTION ○ OPTION NOT DISCUSSED

13. Do you agree that, weighing costs and benefits, our preferred options in Table 16 above are likely to best address the public confidence issues described in this chapter? If not, why not?

14. What is your view of the proposed sequencing and timing of measures to increase public confidence?

15. What, if any, other options should be considered to increase public confidence?

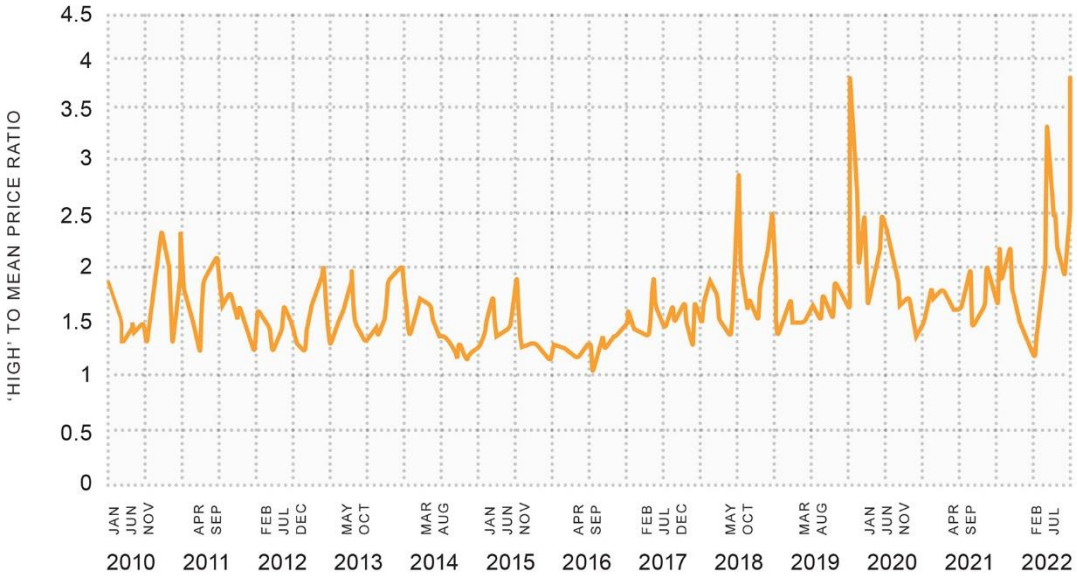
12. Navigating the transition

The future is arriving faster than expected

12.1 Our core task is to identify the changes needed to ensure the electricity market will facilitate and support a shift to a renewables-based system. When we started this project in mid-2021, the destination looked to be sufficiently far into the future that we need not consider the journey of how to get there. With those factors in mind, we focused largely on the renewables 'destination'.

12.2 However, it has become increasingly clear that the transition is already underway. The renewable generation share is now rising and is projected to reach around 94%[141] by 2025 – compared to an average of 82% in the five years to 2021. The Climate Change Commission projects the renewable share will reach 96.5% by 2030[142] and some other more recent forecasts have even higher estimates. As anticipated in the Issues Paper, we also are seeing an accompanying rise in spot price volatility as shown in Figure 18.

Figure 18: Spot price variability (high to mean price ratio per month)



12.3 Given that transition issues have come into view we have given some high-level consideration to the journey as well as the destination[143].

Keep a clear eye on longer term objectives

12.4 As noted in Chapter 1, the industry is focused on various issues that feel quite 'pointy' in the near-term. For example these include potential concerns about reliability for winter 2023 and what to do about forward wholesale prices that seem stuck at high levels well above the cost of new generation. To a large degree, these issues are outside our brief and are under review in other workstreams. However, where the approach to a transition issue has the potential to impact on the market in the period we are looking at, then our brief leaves it open for us to offer a view.

141 For example see 'Genesis Energy Insights on Biofuels', May 2022. Renewables ratios range between 92% and 96% for 2025 depending on scenario, with a simple average of 94.5%.

142 See Modelling and data » Climate Change Commission (climatecommission.govt.nz).

143 Our terms of reference for this MDAG project provide: "While the transition path from the current arrangements to 100% renewables is not directly within the scope of the project, it is likely to come into view as a question during the process of the project and may be taken into account in developing the MDAG's recommendations".

12.5 We think some of these pointy issues are manifestations of (or at least related to) an accelerated transition to a renewables-based system. As a broad observation, we think it will be important to ensure that responses to these issues take account of the goal of moving to a renewables-based system. Likewise it will be important to address underlying issues rather adopt *ad hoc* or temporary measures to address symptoms. Experience elsewhere shows that ad hoc measures can delay the transition by increasing investor uncertainty, and/or extending the dependence on fossil-fuelled plant.

Will the transition from fossil-fueled generation be orderly?

12.6 A core concern in the transition is whether there will be a smooth displacement of fossil-fuelled generation with new renewable sources, or whether the shift will become disorderly. Experience from Australia and some other jurisdictions indicates that a smooth transition is not necessarily a given.

12.7 In our view, there are three distinct risks to consider in relation to thermal transition:

(a) Operational coordination issues, especially poor commitment of slow-start thermal units.

(b) Premature closure of existing thermal plant.

(c) Inadequate investment in new thermal plant.

12.8 We discuss each of these risks below. In proposing remedies, we also are mindful of the need to avoid *ad hoc* or temporary *add on* solutions. This approach is reflected the sage advice from Prof. Peter Cramton cited earlier:

> "Electricity markets are necessarily complex. This follows from the complexity of the engineering and economic problems that must be solved. Still designers should strive to keep the design as simple as possible. **Complicating features should only be added if they are necessary and consistent with market principles.**"[144]

Risk of operational coordination problems

12.9 Thermal generation is undergoing a transition. Baseload operation is declining and thermal plant is increasingly being used as a source of flexibility – especially fast-start operation. Some existing thermal units are less well-suited to this role because they take 8-12 hours to start if they are cold. These units need to be 'committed' ahead of time if they are to be available for use. This means that operators need to form a view of whether to start their units based on spot price forecasts some hours into the future. They will be mindful that if the forecasts are wrong, start-costs will be incurred without offsetting revenue.

12.10 The need to make unit commitment decisions is not new.[145] Furthermore, market arrangements are intended to encourage operators to commit units if the benefits to consumers will exceed the start-up costs. For example, if a unit will be required to help satisfy demand for (say) this evening's peak, an operator is likely to commit the unit because of the spot revenues it will earn. This decision is arguably even more likely if the operator has sold forward contracts that mean it would be a net purchaser during the evening if the unit is not running. In short, a combination of clear spot price incentives and contracting activity should produce reasonable unit commitment decisions.

144 Prof. Peter Cramton, "Electricity Market Design", Oxford Review of Economic Policy, Volume 33, Number 4, 2017, pp. 589–612.

145 Nor are they unique to thermal units. Other resource owners can face similar needs to make decisions ahead of time – such as demand response providers or hydro operators.

12.11 However, the environment for making unit commitment decisions does appear to be getting more challenging. Start costs have increased substantially due to much higher fuel and carbon charges. There is also increased uncertainty in spot forecasts as intermittent generation rises. Finally, the declining *average* use of thermal also means there is a greater frequency of unit commitment decisions being required (i.e. slower start units are less likely to already be warm or hot).

12.12 There are already some signs that operational coordination is becoming more challenging. A key indicator in this area is the growing frequency of 'near miss' events where insufficient generation was offered to maintain normal reserves cover and satisfy demand. Such events were very rare after scarcity pricing was introduced in 2013. However, since mid-2021 they have occurred six times and there was an actual shortage of generation in August 2021. Unit commitment issues appear to have been a contributing factor in all of these events. Importantly, the increased frequency of the events does not reflect an investment adequacy issues, because there was no material change in the installed capacity margin for the North Island over the last five years.

12.13 In summary, unit commitment issues for slower-start thermal are likely to become more challenging in the transition. We believe these will be best addressed through some the measures proposed in Chapter 7 to assist more generally with operational coordination. The measures of particular benefit in the transition are summarised in Table 18 below.

12.14 The transition challenges have raised questions about the merits of some sort of capacity mechanism, such as 'warming contracts'. This would be an ad hoc or add on measure responding to symptoms, not causes. Further, such a mechanism presupposes that directing slow start thermal generators to 'warm up' (paid for by the industry as a whole) is the lowest cost option for ensuring reliability to cover winter peaks. This precludes other solutions that may be less costly. A key lesson from history is that no single or small group of decision-makers can see or deploy the full range of optimal solutions - consumers end paying more than they should.

12.15 Another key reason we do not favour warming contracts is the likely chilling effect on contracting and investment incentives, and the consequent risk of undermining reliability. We think it is better to focus on mechanisms that find the least cost solutions, as we do in matching supply and demand in any other time interval.[146]

Risk of premature closure of existing thermal plant

12.16 Thermal plant owners face a declining revenue outlook as renewables account for a rising share of total supply. However, this should not necessarily cause *premature* thermal plant closures. This is because units that are providing a service whose value to consumers exceeds the go-forward retention costs should in principle produce net revenues for their owners. Hence, the real question is whether there are factors that will depress revenues below the value of plant retention to consumers.

12.17 Based on current information, we think the answer is likely to be 'no' in New Zealand, unlike some other countries. First, we are not aware of any evidence to show that market rules or processes are causing spot prices to be artificially suppressed when thermal plant is required. On the contrary New Zealand introduced a robust scarcity pricing arrangement in 2013.[147]

146 This is addressed more fully in www.ea.govt.nz/assets/dms-assets/31/Driving-efficient-solutions-to-promote-consumer-interests-through-winter-2023.pdf.

147 Having said that, we are proposing a review of the values used in the scarcity pricing mechanism to ensure they are accurate for the contemporary and future system.

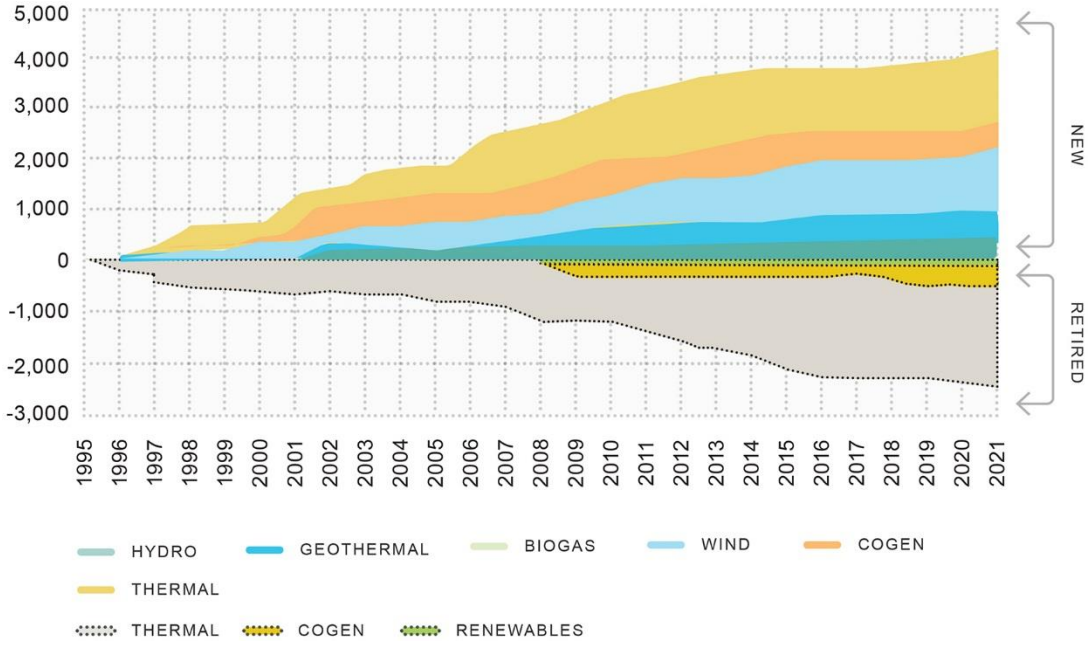
12.18 Of course, thermal operators will likely want some degree of certainty about forward revenues, rather than relying solely on expectations of future spot prices to inform their retention/retirement decisions. Historical experience suggests the process of negotiating such contracts can be noisy as parties maneuver to strike the best possible deal from their perspective. Nonetheless such contracts have been concluded in the past, and it appears deals are continuing to be struck. For example, Meridian recently announced it had concluded deals with Contact and Nova. Similarly, Genesis launched its Market Security Option products and stated it was in discussions with a number of prospective customers[148].

NZ wholesale market inherently coordinates renewable entry and thermal exit

In some other jurisdictions renewables are heavily subsidised by instruments outside of the wholesale market. This can make it harder for thermal units to earn sufficient spot or contract revenue in the wholesale electricity market to justify retention. This has been referred to as the 'merit order' effect.[149]

This factor does not currently apply in New Zealand because renewables are competitive without subsidies. Both renewable and thermal generation types obtain their revenue exclusively from the wholesale electricity market. This provides a natural coordination mechanism, because new entry (of any type) tends to reduce the wholesale revenue pool available for other generation, which in turn induces retirement of higher-cost (especially thermal) plant[150]. This is illustrated by Figure 19.

Figure 19: Entry and exit of renewable and thermal generation since 1995



148 It will be interesting to see the degree to which those options are purchased by market participants. Clearly the level of uptake will depend on a range of factors, including the price level sought by Genesis.

149 As noted by Prof Paul Simshauser, this merit order effect is only unwound when thermal plant is forced to exit as a result of "financial distress arising from policy-induced [Variable Renewable Energy] plant entry". See Simshauser (2019), "On the Stability of Energy-Only Markets with Government-Initiated Contracts-for-Differences" Energies 2019, vol 12, page 11.

150 By contrast, in overseas jurisdictions where there are explicit policy instruments which incentivise the entry of renewables, Prof Paul Joskow notes that the "policy of incentivising large scale entry of intermittent solar and wind has been made relatively easy so far by free riding on the declining existing stock of dispatchable generating capacity." He notes that in a situation where entry continues to be driven by centralised policy, while exit of thermal is determined by market-driven energy and ancillary service prices, it is not at all clear whether the system will find the lowest-cost solution to consumers. See Joskow, P (2019), "Challenges for Wholesale Electricity Markets for Intermittent Renewable Generation at Scale", Working Paper CEEPR WP 2019-001, MIT Center for Energy and Environmental Policy Research.

12.19 In summary, there should not be a high risk of premature thermal plant retirement in New Zealand. However, some of the measures to improve risk management and investment discussed in Chapter 8 should further reduce the risk. The measures of particular benefit in the transition are summarised in Table 18 below.

Risk of insufficient investment in additional flexibility resources such as additional fast-start thermal plant

12.20 There is a possibility that investment in additional fast-start thermal capacity (or equivalent resource) could be desirable to support the shift to a renewables-based system. For example, the reference case scenario in the Issues Paper included around 700MW of 'green peakers' by 2035. These were assumed to be open cycle gas turbines (OCGT) running on a biofuel with a variable fuel cost of around $45/GJ. Despite their high running costs, the simulation modelling indicated these were the cheapest option to provide firm capacity that is seldom required. If green peakers were to eventuate, they might be a repowering of existing OCGTs, or new plant or some mix of the two.

12.21 While green peakers should be treated as one possible solution, the underlying point is that there could well be a need for investment in additional flexible resources (such as OCGTs) at some point in the transition. In principle, such investment ought to be forthcoming if it is genuinely required because of the drivers and incentives on investors discussed in Chapter 8. However, parties contemplating investments in flexibility resources arguably face some risks that investors in renewables do not face. These risks stem from two areas where there is currently significant policy uncertainty:

(a) The scale, location, and timing of any capacity developed under the auspices of the New Zealand Battery Project (NZBP).[151] If a large-scale NZBP option were to proceed, it seems likely that it would be ready from early/mid-2030s at the earliest. However, some additional flexibility might be needed before then – especially if the renewable share is close to 100% by the end of this decade.

(b) Whether any additional policy instruments (beyond the emission trading scheme) will be enacted to further restrict fossil-fuel use for power generation. Additional restrictions could accelerate or deter new flexibility investments, depending on the form of any instruments and how they affect different fossil fuels.

12.22 Any flexibility solutions that are directly affected by the above factors may not proceed until the uncertainties are resolved, because investors may be concerned about the potential for adverse impacts or even economic stranding. The significant impact that uncertainty can have on the timing of irreversible investments has been examined extensively in the economic literature[152]. The Government is working on a New Zealand Energy Strategy that may help to clarify some of the uncertainties.[153] This work is due to be completed in 2024. However, if any aspects can be accelerated, that could help to facilitate an orderly transition.

Proposed measures to facilitate an orderly transition

12.23 Many of the measures proposed earlier in this paper will help ensure an orderly transition. However, the measures in Table 18 are especially important and we propose they be prioritised for early action. In addition, as noted in the previous section, we think transition risks would be reduced if the Government can make timely decisions in relation to the NZ Battery project and use of fossil fuel for power generation.

151 See www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/low-emissions-economy/nz-battery/.

152 For example see 'Irreversibility, Uncertainty, and Cyclical Investment', Ben S. Bernanke, The Quarterly Journal of Economics, Vol. 98, No. 1 (Feb., 1983).

153 See Terms of reference: New Zealand Energy Strategy (mbie.govt.nz).

Table 18: Proposed measures to facilitate orderly transition

	OPTION NAME	WHY IT FACILITATES ORDERLY TRANSITION	START	IN PLACE BY
A1	Improve short-term forecasts of wind, solar, and demand	Better information will assist operational coordination (unit commitment) decisions	2023	2024
A3	Update shortage price values	Ensuring accurate price signals will assist operational coordination (unit commitment) decisions	2023	2025
A4	New reserve product to cover sudden reduction from intermittent sources	New ancillary service should reduce exposure to sudden large fluctuations in wind/solar output	2023	Mid 2024
B1	Greater transparency of hedge info (esp non-base load) covering offers, bids + agreed prices	Improves investment signals	2023	Mid 2024
B2	Market-making for longer dated futures (for price discovery)	Improves investment signals	2024	Mid 2025
B3	Publish aggregated information on pipeline of new developments, energy and capacity adequacy	Improves information for contracting and investment decisions	2023	2024
B4	Enhance stress testing regime	Encourages appropriate forward contracting	2023	2024

12.24 These measures are described and evaluated in earlier sections of this paper.

16. Do you agree the measures in Table 18 should be prioritised to help ensure a smooth transition to a renewables-based system? If not, why?

17. What, if any, other measures should be considered to facilitate a smooth transition to a renewables-based system?

13. Getting the work done

13.1 This paper proposes a substantial volume of work to better prepare the electricity market for a renewables-based future. In this chapter we briefly comment on processes for carrying it forward, and on the resource implications of the proposed work programme.

Multiple approaches for undertaking the work

13.2 Many of the initiatives proposed in this paper are 'bread and butter' regulatory measures. They should fit well with the typical approaches used by the Authority when considering possible amendments to the Code – i.e. analytical work (possibly including an advisory group or targeted stakeholder engagement) followed by formal consultation and then decision-making on the final form of any amendments.

13.3 However, some of the proposed options are more in the nature of market acceleration or facilitation measures rather than regulatory instruments. For example, work on standardised shaped products or certain measures to quicken the development of demand side response.

13.4 For these types of options, we suggest the Authority undertake a facilitation and sponsorship role. This means more of the onus would be placed on stakeholders to co-design solutions, working with a framework established (and monitored) the Authority. The Electricity Authority (and its predecessors) have successfully used market facilitation approaches in the past, especially for issues that were relatively complex and in an early stage of development.

13.5 The Telecommunication Carriers Forum's (TCF) process for developing codes covering non-price elements for competitive access to the 'monopoly' local telecom wires[154] may be a useful point of reference for developing a (non-price) code for access to flexible supply contracts (B6 and D3). Success in this multilateral process relied (among other things) on wide participation of market participants, a rigorous analytical framework[155] and a shared commitment to a disciplined process in which all participants understood that a co-designed common-good solution would better than the regulated alternative[156].

13.6 There may also be a case for using a hybrid approach in some cases with market facilitation followed (if necessary) by regulation. This would allow issues to be initially explored in a less formal (and hopefully more collaborative) environment, followed by Code development to address outstanding issues. An example where a hybrid approach may be useful is development of a flexibility access code **Option B6/D3**.

154 In 2006/07, the TCF delivered a suite of significant agreements on non-pricing terms for access seekers using Telecom's local loop network. These TCF agreements were substantially reflected in the relevant Commerce Commission standard terms determinations (STDs) issued during 2007 and 2008. The role and framework of the industry's working groups are set out in sections 2 and 3 of this TCF report –www.tcf.org.nz/assets/reports/2006-12-phase-1-report.pdf. The Government of the day backed the industry's process –see www.beehive.govt.nz/release/telco-forum-praised-llu-agreement.

155 With clearly defined objectives and criteria focused on efficient outcomes for the long term benefit of consumers.

156 In the TCF process, the Commerce Commission had the power to prescribe an access code.

Table 20: Proposed measures and process for implementation

TOPIC	CODE	MEASURE	MDAG	WMR	BCG	CODE	CO-DESIGN	HYBRID
Reliable and efficient operational coordination	A1	Improve short-term forecasts of wind, solar and demand	●	○	●	✓		
	A2	Strengthen governance for next phase of FSR project	●	○	○	✓		
	A3	Update shortage price values	●	○	●	✓		
	A4	New reserve product to cover sudden reduction from intermittent sources	●	○	●			✓
	A5	Offer price reductions after gate closure	●	○	○	✓		
	A6	Investigate + develop ahead market	●	○	◐	✓		
	A7	Remove UTS over-ride of trading conduct provisions	●	○	○	✓		
	A8	Negative offers/prices	◐	○	○			
	A9	Centralised commitment based on complex offers	◐	○	○			
	A10	Warming contracts	◐	○	◐			
Effective risk management and efficient investment	B1	Greater transparency of hedge info (esp non-base load) covering offers, bids + agreed prices	●	●	◐			✓
	B2	Market-making for longer dated futures (for price discovery)	●	●	●	✓		
	B3	Publish aggregated information on pipeline of new developments, energy and capacity adequacy	●	●	●	✓		
	B4	Enhance stress testing regime	●	○	○	✓		
	B5	Develop standardised ‘shape’ product(s)	●	◐	○		✓	
	B6	Develop flexibility access code (non-price elements)	●	●	●			✓
	B7	Extend trading conduct rules to hedge market	●	●	○	✓		
	B8	Market making in caps or other shaped products	◐	◐	●			✓
	B9	Capacity mechanisms	◐	○	◐			
	B10	Strategic reserve	◐	○	◐			

● SUPPORTS OPTION ◐ DOES NOT SUPPORT OPTION ◐ PARTIALLY SUPPORTS OPTION ○ OPTION NOT DISCUSSED

Table : Proposed measures and process for implementation (cont'd)

TOPIC	CODE	MEASURE	MDAG	WMR	BCG	CODE	CO-DESIGN	HYBRID
Lift demand side participation	C1	Monitor provision + uptake of DSF-rewarding tariffs (incl automation)	●	◐	○		✓	
	C2	Sunset profiling if smart meters in place	●	○	◐	✓		
	C3	Require retailers to offer DSF tariffs	◐	○	●			
	C4	Develop standardised shape-related hedge products to reward DSF	●	○	○		✓	
	C5	Provide significant funding for pilots/trials to kick-start dynamic tariff use	●	○	○		✓	
	C6	Use Customer Compensation Scheme to reward DSF	▲	○	◐			
	C7	Negawatt scheme for wholesale market	▲	○	○			
	C8	FSR – improve DSF visibility and remove Code barriers	●	○	○	✓		
	C9	FSR – accelerate new ancillary services for DSF uptake	▲	○	○			
	C10	Procurement process for high-scarcity DSF (RERT)	◐	○	●			
	C11	Ensure distribution pricing reflects network needs	●	○	●		✓	
	C12	Investigate extending LMP into distribution networks	◐	○	○			
	C13	Provide info to help large users with upcoming DSF investment decisions	●	○	○		✓	
	C14	Provide info to help domestic customers with DSF decisions	●	○	○		✓	

● SUPPORTS OPTION ▲ DOES NOT SUPPORT OPTION ◐ PARTIALLY SUPPORTS OPTION ○ OPTION NOT DISCUSSED

Table : Proposed measures and process for implementation (cont'd)

TOPIC	CODE	MEASURE	MDAG	WMR	BCG	CODE	CO-DESIGN	HYBRID
Strengthen competition	D1	Develop dashboard of competition indicators for flexibility segment of wholesale market	●	●	◐			✓
	D2 (=B1)	Greater transparency of hedge info (esp non-base load) covering offers, bids + agreed prices	●	●	◐			✓
	D3 (=B6)	Develop flexibility access code (non-price elements)	●	●	●			✓
	D4 (=B7)	Extend trading conduct rules for hedge market	●	●	○	✓		
	D5 (=B8)	Market making in caps or other shaped products	◐	◐	●			✓
	D6	Physical disaggregation of flexible generation base	▲	▲	○			
	D7	Virtual disaggregation of flexible generation base	◐	◐	○			
	D8	Price caps applied in the electricity spot market	▲	▲	○			
Increase public confidence	E1	Structured information programme for wider stakeholders	●	○	○	✓		
	E2	Regular briefings for Ministers and officials on current and expected conditions	●	○	○			✓
	E3	Increase inter-change with international experts	●	○	○		✓	
	E4	Enhance monitoring with more autonomy	●	○	○	✓		
	E5	Periodic warrant of fitness review for independent regulatory agencies	●	○	○	✓		

● SUPPORTS OPTION ▲ DOES NOT SUPPORT OPTION ◐ PARTIALLY SUPPORTS OPTION ○ OPTION NOT DISCUSSED

18. Do you agree with the proposed categorisation of how measures should be progressed between Code-processes, market facilitation and hybrid approaches in Table 20 If not, why?

Resources for market development work

13.7 This report is proposing a wide range of measures to prepare for a renewables-based system. Furthermore, we think fast progress is needed on many of these issues because the transition is well underway. In short, there is a need to make a step-change in the rate of development of electricity sector arrangements.

13.8 Most of the development work would fall to the Electricity Authority to undertake or lead. It is possible that the Authority may be able to free up some resources by reprioritising existing activities. However, reprioritisation alone is very unlikely to free up the level of resource needed to undertake the proposed work. It is therefore imperative that the resourcing for the Authority be reviewed to enable implementation of the workplan with urgency.

Appendix A

Options not considered in detail

A.1 A range of options that have been raised in the past were not examined in detail in this project because earlier studies and analysis indicated they were unlikely to have net benefits. These options are:

(a) Moving to a pay-as-bid approach for the spot market auction

(b) Adopting a single-buyer model for the wholesale market

(c) Abolish nodal pricing.

Appendix B

Submitter name:

Please answer the following questions in your submission.

1. Do you agree that, weighing costs and benefits, our preferred options in Table 7 above are likely to best address the operational coordination issues described in that chapter? If not, why not?
2. What is your view of the proposed sequencing and timing of measures to strengthen operational coordination?
3. What, if any, other options should be considered to strengthen operational coordination?
4. Do you agree that, weighing costs and benefits, our preferred options in Table 10 above are likely to best address the risk management and investment issues described in that chapter? If not, why not?
5. What is your view of the proposed sequencing and timing of measures to improve risk management and investment?
6. What, if any, other options should be considered to improve risk management and investment?
7. Do you agree that, weighing costs and benefits, our preferred options in Table 13 above are likely to best address the demand side flexibility issues described in that chapter? If not, why not?
8. What is your view of the proposed sequencing and timing of measures to improve demand side flexibility?
9. What, if any, other options should be considered to improve demand side flexibility?
10. Do you agree that, weighing costs and benefits, our preferred options in Table 15 above are likely to best address the competition issues described in that chapter? If not, why not?
11. What is your view of the proposed sequencing and timing of measures to strengthen competition?
12. What, if any, other options should be considered to strengthen competition?
13. Do you agree that, weighing costs and benefits, our preferred options in Table 17 above are likely to best address the public confidence issues described in that chapter? If not, why not?
14. What is your view of the proposed sequencing and timing of measures to increase public confidence?
15. What, if any, other options should be considered to increase public confidence?
16. Do you agree the measures in Table 19 should be prioritised to help ensure a smooth transition to a renewables-based system? If not, why?
17. What, if any, other measures should be considered to facilitate a smooth transition to a renewables-based system?
18. Do you agree with the proposed categorisation of how measures should be progressed between Code-processes, market facilitation and hybrid approaches in Table 20? If not, why?