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Submission on price discovery under 100% renewable electricity supply: Issues

Introduction

1. This is Vector Limited's (Vector's) submission on the Market Development Advisory Group's (MDAG's) issues discussion paper, *Price discovery under 100% renewable electricity supply* (the Discussion Paper)[1], dated 2 February 2021.

2. Vector is an innovative New Zealand energy company that runs a portfolio of businesses delivering energy and communications services to more than one million homes and commercial customers across Australasia and the Pacific. Vector is leading New Zealand in creating a new energy future through its Symphony strategy which puts consumers at the heart of the energy system. Vector owns the largest electricity network in New Zealand, and is majority-owned by Auckland's electricity consumers. The Vector group also includes Powersmart, an established solar developer operating in New Zealand and the Pacific, and HRV, one of New Zealand's leading in-home energy solutions providers.

3. The investigation MDAG is undertaking is critical to ensuring New Zealand's electricity system is able to transition towards 100% renewables and continue to deliver long-term benefits to New Zealand's electricity consumers.

4. Vector's Symphony strategy aligns with the scenarios painted by MDAG in the Discussion Paper, in which millions of smaller-scale, distributed energy devices are working in harmony with a much smaller number of larger, grid-connected resources, with elements on both the demand and supply sides of the system optimised to maintain equilibrium. Consumers will be able to engage much more fully in the electricity system, and have their wide-ranging needs met in a variety of ways.

5. Vector's primary interest in the Discussion Paper is to ensure the delivery of affordable, low-carbon electricity to consumers now and in the future. The future price of electricity will be a function of choices and costs across the whole supply chain – including, critically, in new renewable generation. As consumers rely more on electricity as part of a low-emissions energy system, we must take a whole-of-system approach to future investment.

6. We want to ensure that market conditions are in place to encourage electricity system growth and evolution that will increase our reliance on renewables as efficiently, and securely, as possible, without compromising the level of service New Zealand's consumers expect. In the case of new generation, this requires us to unlock the potential of localised and diverse sources of renewable generation and consider the total system cost of new investments. This

[1] Available online at https://www.ea.govt.nz/development/work-programme/pricing-cost-allocation/100.html

can help support affordability for our consumers and support New Zealand's emerging independent generation market.

7. Reports such as MDAG's are critical to identifying the questions we need to be asking collectively to support an efficient transition to a low-emissions energy system, and in helping to determine the answers. While New Zealand has always had a relatively high penetration of renewable generation, complete removal of fossil-fuelled generation from the system would represent a significant shift away from the paradigm contemplated when the original generations of wholesale market design – from dispatch to new investment – were developed internationally in the 1990s.

8. Given the magnitude of the transition it is vital that we continue to ask deep and probing questions of this design, and openly question whether it will deliver efficient investment in the large quantities of renewable generation required – which is the real prize for consumers – as well as efficient operation of the system. We owe it to our consumers to do more than look back at what the existing market has achieved, or to compare its performance to inferior models internationally. Rather, we need to look forward to the future and to the model that will deliver the best outcomes for generations of New Zealand energy consumers to come.

Our understanding of MDAG's conclusions

9. We commend MDAG for its wide-ranging and thorough analysis of a range of key questions relating to wholesale market operation under 100% renewables, and for calling on a number of national and international experts in doing so. We support the open, transparent and engaging approach MDAG has taken with stakeholders, and the depth to which it has gone in order to identify issues.

10. Underpinned by analytical evidence, MDAG concludes that a 100% renewable system is both physically and financially possible, but will be different to what we know today in a number of important ways, especially in relation to the operation of stored hydro resources. It notes that system operation and market participation will need to evolve considerably, a point with which we agree.

11. Critically, MDAG concludes that a wholesale market will still be needed under 100% renewables. As the number of dispatchable devices connected to the New Zealand electricity system increases exponentially, MDAG concludes that the role of accurate and actionable price signals will become even *more* important, not less. This requires increased demand flexibility – which in turn requires the right digital platforms to be in place to enable dynamic demand response.

12. In answering the questions set out in its project proposal[2], MDAG has identified the following key areas of opportunity or challenge[3]:

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

    b) The role and evolution of the ancillary services required to deliver secure and reliable supply will require a close focus as the system's stability needs evolve

    c) Accurate spot price signals are critical to incentivising active demand-side participation, contracting and investment

[2] Available online at https://www.ea.govt.nz/assets/dms-assets/28/MDAG-proposed-scope-price-discovery-under-100-renewables.pdf

[3] As set out in the Executive Summary of the Discussion Paper.

d) Demand-side flexibility from electricity users is a huge prize to be unlocked; a more engaged and interactive demand side can deliver huge benefits to consumers over the long term

e) The contracts market will need to evolve and do more "heavy lifting", particularly in relation to underpinning investment in new generation and demand-side initiatives

f) A "disorderly" exit of fossil-fired thermal generation could pose threats to system reliability

g) Thriving competition will be vital to delivering on the 100% ambition and to maintaining trust and confidence that market prices are reasonable, and that the market is delivering long-term benefits to New Zealand's electricity consumers.

Vector's key points of submission

13. In response to the views put forward by MDAG in the Discussion Paper, summarised above, Vector's key points of submission are as follows:

a) Despite differences in circumstances and performance, there is much that can be learned from overseas experience to inform the optimal design of New Zealand's wholesale electricity market, and its electricity markets more generally. While MDAG's review of international experience and the literature is commendable, international work Vector has supported can further inform both MDAG's problem definition and its solutions.

b) As identified by MDAG, distributed energy resources (DERs), such as controllable electric vehicle (EV) chargers, controlled hot-water heating and household batteries, have the potential to contribute value to multiple parts of the electricity value chain. The deeper these resources are in the network, the more opportunities they have to provide value. We support the use of these resources being optimised across the full "value stack" of benefits, and support initiatives that bring to light the whole electricity system cost of different resources at different points of time and location. This allows an "apples with apples" comparison between different types of resources, on both the demand and supply sides. However, we cannot lose sight that reliable supply is critical to meeting consumers' needs.

c) We agree with MDAG that thriving competition in the wholesale market is critical to the transition to a low-emissions energy system that delivers for New Zealanders. We fully support MDAG (and the Electricity Authority (the Authority)), in its *Wholesale market competition review*) thoroughly exploring whether there are material disincentives to established generators efficiently adding to their portfolios, or to new investors developing theirs. Removal of any barriers to new-entrant generators connecting to and operating in the system should be a top priority.

d) Given that access to the wholesale market will become more sophisticated, open and democratised, the scope of MDAG's review should include system operation, the frequency of settlement, use of high-frequency data and the system operator's scheduling, pricing and dispatch tool (SPD). New Zealand's wholesale electricity market has been in place in practically the same form since its original design over 25 years ago. While this does not necessarily mean either the design or the existing dispatch algorithm is flawed, we support the design being examined from first principles. We also encourage MDAG to highlight the risks inherent in relying on a greater proportion of DER for system stability.

14. Each of the points above is expanded upon and discussed in turn in the remaining sections of this submission.

New Zealand can learn from international experience

15. New Zealand is not alone in pursuit of higher penetrations of renewable generation. As a matter of good regulatory practice, we were pleased to see that MDAG had reviewed international experience and international literature on 100% renewable electricity systems – albeit noting that New Zealand's combination of circumstances and market design is unique, and that New Zealand will be at the "bleeding edge" of a transition to 100% renewables within a deregulated market environment.

16. Over the past two years, Vector has been part of an international group working in association with a UK-based think tank, *Challenging Ideas*, to consider regulatory and market frameworks that can support the transition of energy systems towards a low-carbon future. We note that this work was not canvassed in MDAG's review of the international literature.

17. The consortium, led by former UK MP Laura Sandys CBE, has published a number of thought pieces[4] that highlight the significant issues associated with the existing regulation and structure of electricity systems, and promote new ways of designing markets to deliver an efficient transition to net-zero energy systems that deliver for consumers.

18. The reports highlight the changing nature of the generation mix, away from assets with low capital costs and high operating costs and towards renewable assets with high capital costs and very low running costs, and the opportunities inherent in that shift to deliver new value to consumers.

19. The final report in the *ReCosting Energy* series[5] (RCE Report) highlights a number of issues with current electricity system planning and operation internationally that need to be addressed. These include:

    a) The investment focus globally to date has been on generating *more* electricity, whereas increased focus needs to be placed on storage – especially longer-term storage. Without sufficient storage, the increased demand for electricity, and intermittency from renewables, will have to be delivered by building *more* renewables (i.e. the "overbuild" approach). Storage can do for electricity what refrigeration has done for food in aligning supply and demand efficiently – as stated in the RCE Report, "*the commodity needs processing*"[6].

    b) Long periods of low spot prices, due to surpluses of non-dispatchable renewables supported by mechanisms outside the market, have the potential to increase perceptions of the risk of revenue inadequacy for new investment in renewables

    c) The risks associated with balancing large quantities of intermittent renewables are not necessarily borne by those who own that generation, and instead are being funded by consumers

    d) As an increase in non-dispatchable renewables causes wholesale energy prices to fall, other costs in the system, such as system balancing and ancillary service costs, will increase, and may again be borne by consumers rather than those parties creating the costs

    e) System planning or investment decision-making for new generation on the sole basis of the generation's own levelised costs can ignore other costs imposed on the system by that generation (for example back-up or balancing costs, for intermittent renewables)

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4 Available online at http://www.challenging-ideas.com/publications/

5 Available online at http://www.challenging-ideas.com/wp-content/uploads/2021/01/ReCosting-Energy-Powering-for-the-Future.pdf

6 RCE Report, page 6

f) Fossil-fired generation is still the dominant form of back-up generation globally, and mechanisms to retain such back-up risk slowing the pace of transition – rather than incentivising new forms of non-fossil back-up

g) Investment in digital tools for efficiency and optimisation may be suppressed due to longer periods of low spot prices, lessening the uptake and benefit of digitised flexibility

h) Demand-side participants / initiatives do not have the same access or incentive to participate in wholesale markets – in particular, to take advantage of low or negative prices – or the ability to access support mechanisms.

20. While some of these issues are clearly more applicable to overseas jurisdictions like the UK, a number of them are clearly relevant to MDAG's investigation – and indeed have been highlighted in the Discussion Paper, as noted above. We would therefore encourage MDAG to review the work of *Challenging Ideas*, and the solutions suggested, as a key input into its subsequent work to develop options.

It is important to bring to light and consider the whole electricity system cost

21. A key concept introduced in the RCE Report is the "whole electricity system cost" (WESC).

22. As stated in the report, "*Silos still dominate, with whole system costings rare. Cost impacts from one actor are passed onto others with few penalties or sanctions. Demand assets are still marginalised in terms of support, regulation and market design*".[7]

23. The WESC refers to the value (or cost) of a unit of demand reduction or supply being calculated as the sum of its impacts across the *entire* electricity value chain, not just in individual components or silos.

a) For example, a flexible EV charger can bring benefits not just in terms of spot market balancing and pricing arbitrage (and, ultimately, reducing requirements for peaking generation), but also to deferring transmission and distribution investment.

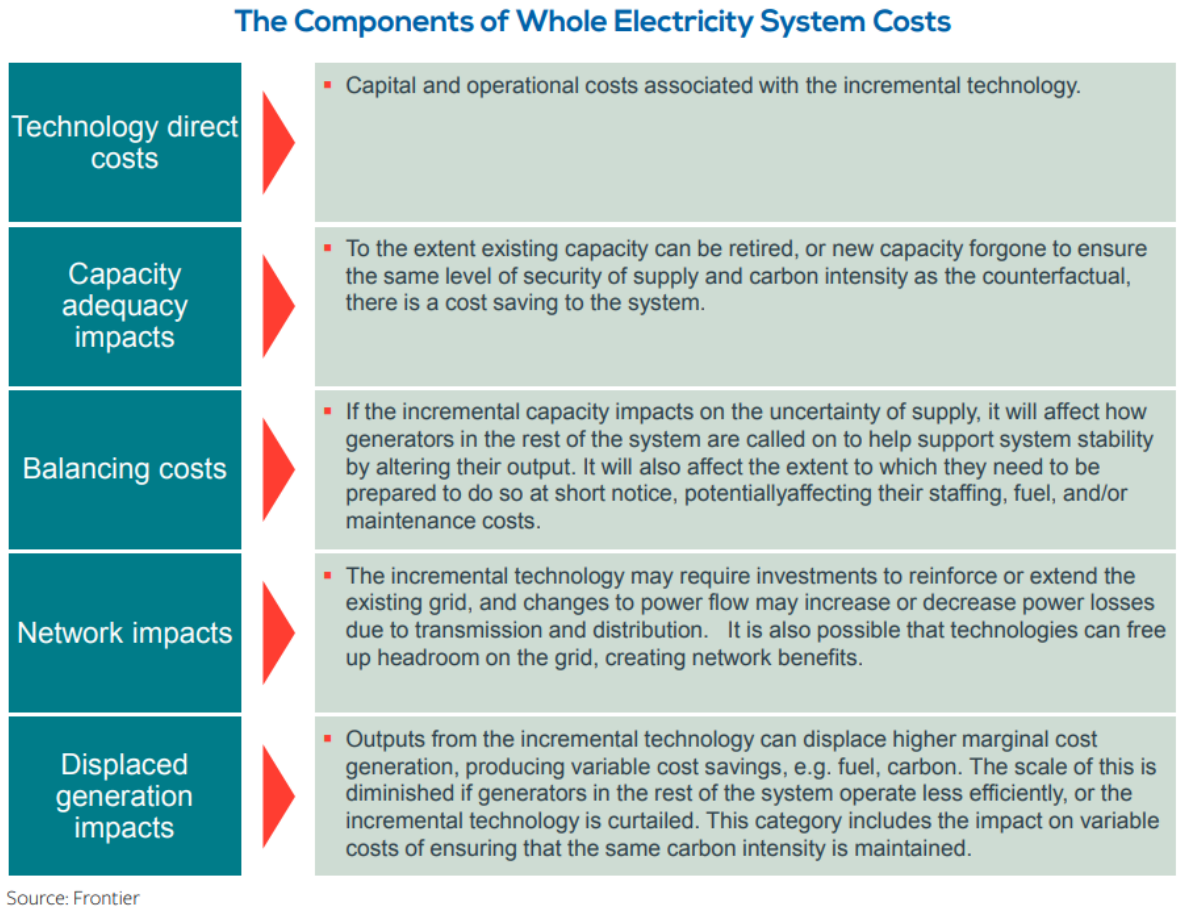
b) Similarly, a unit of generation can provide greater benefits if located closer to load and connected into a distribution network than if it is located remotely and connected to the transmission network. Measures of investment cost for new generation do not always contemplate or bring to light the costs of enabling transmission upgrades.

c) While an incremental unit of non-dispatchable generation like wind or solar may decrease energy prices, its intermittency may mean that it also increases system balancing or other ancillary service costs.

24. Calculating the WESC allows an apples-with-apples comparison between units of generation and demand flexibility at various times and points in the electricity value chain.

25. As set out in the RCE Report[8], the components of the WESC include:

[7] RCE Report, page 37
[8] RCE Report, page 38



26. This concept is similar in principle to, and consistent with, the concept of "value stacking". DERs like household batteries, hot water cylinders and EV chargers have the potential to add value and provide services to multiple parts of the value chain, and hence can have a high whole-of-system benefit.

27. Whilst we acknowledge that the wholesale electricity market design already promotes cost-reflectivity and transparency of the value of the energy generated by various technologies at different locations, it is important that similar levels of cost-reflectivity are promoted across the other parts of the value chain – especially for enabling transmission upgrades[9].

28. We agree with MDAG that as the composition of the generation mix changes, ancillary services that were previously un-costed or plentiful may become scarce, causing new constraints in supply to bind. It will be important that these costs are considered (and managed) by investors in the market so as not to unnecessarily burden consumers.

    a) As has been noted in the Authority's *Future Security and Resilience* (FSR) workstream, not all generators are created equal in terms of their performance characteristics. Consideration will need to be given in future to which system services or characteristics are mandated via standards, which are provided for free by those generators that can provide them (i.e. whether exemptions to standards are given), and which services will be costed and remunerated. Approaches to forecasting and offering of various types of

[9] We note with interest recent discussion on the use of integrated system planning in the New Zealand context, and the potential introduction of renewable energy zones (REZs). As REZs could be a key enabler of investment in new renewable generation, we think it is important MDAG offers a view on how REZs would work within, or complement, the existing investment frameworks for generation and transmission upgrades. It will be important that the frameworks continue to work together in an optimised way to enable the most cost-effective combination of generation and transmission investment, minimising costs to consumers.

technology may also need to be reconsidered in light of the increased penetration of variable renewables.

29. As mentioned in the RCE Report, the changing nature of market dynamics suggests that the levelised cost of energy (LCOE) for new generation should no longer be used in system planning, or it at least needs to be expanded to include the costs to the whole value chain – including transmission, ancillary services, etc.

30. Whilst we acknowledge that the LCOE metric is not generally used in New Zealand as a basis for making decisions on generation investment, it is widely used globally. The report highlights that a narrowly-defined LCOE has formed the basis for selection of which new generation technologies to incentivise, and what the incentive payments should be, regardless of the other system costs that the generation has created – which end up being borne ultimately by consumers. This is an example of the kind of decision-making risk that can occur if decisions are undertaken within single silos of the value chain, and investors are neither receiving the full system benefit of their investment, nor are exposed to the whole system cost of their decisions.

    a) In New Zealand, generation investment decision-making is decentralised[10], and investment decisions are not made on the basis of a straight comparison between the simple LCOE of a project and the baseload futures price. Instead, investors typically calculate the [net present] value of their project on the basis of all costs incurred by the project over its economic lifetime, compared against all forecast revenues earned, discounted over time.

    b) Forecast revenues from the energy market will account for location factor and the GWAP/TWAP ratio of the generator. Other revenue will include, if applicable, ancillary service revenue and any network benefits (e.g. avoided transmission and/or distribution). Project costs will include transmission and distribution charges as appropriate, but *may not* include ancillary service charges if the generator is not exposed to them.

    c) In this way, not all the costs imposed by generation on the system are paid for by that generation, or accounted for in investment decision-making – which is the key justification for the WESC. The WESC illustrates the importance of taking a whole-systems approach to new generation investment.

31. A key conclusion from the work on calculating the WESC that has been undertaken in the UK to date is the importance of demand-side investments being valued on a consistent basis with generation investments[11]. We believe the demand side has a critical role to play in unlocking New Zealand's decarbonised future, and are pleased its value has been highlighted and assessed by MDAG.

32. While flexible demand has always been seen to have significant potential to contribute to the system, we believe that with the advent of new affordable and capable technology we are on the cusp of seeing significant increases in demand-side flexibility. This requires the right market conditions and regulatory settings. It is therefore critical that demand and supply continue to be treated equivalently in the wholesale market, are exposed to and have access

[10] We note that, depending on the outcome of the NZ Battery Project (noted by MDAG), a degree of centralised decision-making may return to New Zealand's generation mix. MDAG will need to test how robust its subsequent recommendations are to different outcomes of the NZ Battery Project.

[11] In 2021 we commissioned Frontier Economics to assess the whole-of-system value to the New Zealand system of various demand-side initiatives, compared with new generation investment. This assessment is available online at https://blob-static.vector.co.nz/blob/vector/media/vector-regulatory-disclosures/annex-3-whole-system-costs-in-nz.pdf

to the same, transparent price signals[12], and that any support or contracting arrangements made available to generation are also made available to demand flexibility[13].

Wholesale market competition, and competition for new entry, are critical

33. We were pleased to see MDAG highlight the criticality of thriving competition in the wholesale market to delivering an efficient transition to 100% renewables, and long-term benefits to consumers. This complements the work of the Authority in its *Wholesale market competition review*[14].

34. Marginal pricing is a core part of the existing market design, ensuring all forms of demand and supply receive the same price signal, can compete on a level playing field and can be compared "apples with apples". However, the existing market design also raises some pertinent competition concerns regarding the incentives of established generation players to invest in new generation, versus new entrants.

35. *Ceteris paribus*, any economic new generation added to the system will expand the market supply curve and therefore *should* reduce marginal prices across the entire country, at least in the periods in which it is generating[15]. While adding a single MW would clearly have a negligible impact on prices, the effect is amplified for:

    a) Additions of large quantities of capacity, in the order of hundreds of MW

    b) Additions of generation in export- or import-constrained sections of the grid

    c) Additions of generation on relatively "weak" parts of the network, and/or regions in which the new generation is large relative to the load.

36. It follows that new generation added to the grid will reduce the operating revenues of all existing generators that operate in those trading periods. If the revenues of these existing generators fall far enough, this could bring forward the retirement of one or more of them. This effect of new generation lowering energy prices, combined with increased transmission capacity into the upper North Island, influenced the retirements of thermal generators Southdown, Otahuhu B and Huntly unit 3 in the past decade.

37. An owner of existing generation considering adding to its portfolio through development will have to account for this effect[16] in its business case for new investment. In other words, its total increase in net revenue will include the revenue increase from the *new* generation, less the *decline in revenue* in all other parts of its generation portfolio. A new entrant holding the

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12 As we understand, following the Authority's *Dispatchable demand* project, large consumers have been able to bid their demand into the wholesale market since 2014, but, as noted by Dr Batstone in his report for MDAG, uptake has been extremely limited. Household consumers in nearly all parts of the country already have the ability to switch to a spot-exposed retail offering, if they choose, but again uptake has been very low (time-of-use offerings, like specific hours of free electricity, have been more popular). Aggregated smaller-scale demand response and other DER will be able to participate in the spot market through the new *Dispatch Notification* product introduced in early 2023 alongside real-time pricing; experience to date suggests uptake will need to be actively encouraged.

13 Some stakeholders in New Zealand and overseas have advocated that consumers should be able to be *paid* for reducing consumption in real time, rather than simply having their demand dispatched off, and/or they should be given availability payments for demand response. There are pros, cons and practical considerations for each. MDAG should give unequivocal views on these alternatives in its options paper.

14 See https://www.ea.govt.nz/monitoring/enquiries-reviews-and-investigations/2021/wholesale-market-competition-review-2/

15 Marginal prices may be reduced in other periods too, if (for example) generation from new capacity in some periods allows more hydro generation to be shifted into other, higher-priced periods.

16 This effect is analogous to the impact on real-time spot prices of offering in generation at a low price, as was discussed in relation to the UTS Claim for 9 August 2021.

same development option would not have to account for any reduction in revenue in its business case.

38. It may therefore be the case that existing generators are incentivised to *delay* otherwise profitable investment if the projected loss of revenue on their existing portfolio from adding generation is significant enough. Taken further, it is possible this incentive could extend to delaying or withholding investment that might bring forward the retirement of other participants' thermal plant, in order to prolong the occurrence of the high marginal prices set by those thermal plant when they are operating (especially with high fuel and carbon prices, as is the case currently). This incentive to delay would only exist for an investor who already owned an existing portfolio of generation – a new entrant has no incentive to withhold investment that might be profitable on a standalone basis, even if it leads to a fall in prices.

39. The portfolio incentive is particularly pronounced for new renewable generation with the same fuel source as existing generation on the system. In the case of wind generation, the output of every MW of wind capacity in New Zealand is correlated to some extent with every other MW of wind, impacting marginal prices with the phenomenon referred to commonly as the "merit order effect". The more wind is added to the system, the lower the GWAP/TWAP ratio will fall for *every* MW of wind on the system[17]. This reflects the diminishing marginal benefit from adding more capacity that is correlated to existing capacity. An existing owner of wind generation will have to ensure the profit from any additional wind capacity more than offsets the loss of earnings from their existing wind farms[18]. Again, a new entrant holding the same development option would not have this concern.

40. Of course, if one assumes there is limited *demand* for new investment by the market, this also creates something of a first-mover *advantage* for renewable developers, counteracting the benefits of delay. Those who invest first will be able to take advantage of higher prices for longer than those who delay. If an established generator can announce and commission before new entrants, they may be able to forestall their competitors' entry.

41. Secondly, the owner of an existing generation portfolio considering delaying a new investment would have to assume there is some reason why other potential investors will not enter the market in response to their choice to delay. If the reduction in market prices (and potential retirement of thermal generation) due to the commissioning of new generation is inevitable, then there would be little benefit to the owner of the generation portfolio delaying their investment.

42. This highlights the importance of ensuring there is thriving competition in the market for new investment.

43. Generation investment business cases are typically calculated using discounted projected cashflows over periods of 25 years or longer, meaning the prices in the current forward curve are less relevant to profitability than long-term price projections, However, under present market conditions – with very high fossil fuel and carbon costs inflating wholesale electricity prices – the incentive to enter is very strong. Participants may view the current market conditions as a limited window in which to enter as quickly as possible and front-load recovery of costs, which is influential given the lower discounting applied to early years' cashflows in a business case.

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[17] MDAG discuss this effect in the Discussion Paper, as does Dr Batstone in his accompanying literature review. Slides 25-26 in MDAG's modelling results also illustrate the effect empirically. It applies to wind, solar and hydro generation in New Zealand, and has been experienced and discussed in electricity markets in New Zealand and overseas for at least the past two decades – see, for example: https://www.energynews.co.nz/column/8834/20-wind-penetration-2030-can-we-make-it-pay.

[18] The effect is more pronounced for additions of highly correlated generation capacity – for example adding more wind turbines on the same hillside as an existing wind farm, more solar panels in the same region as existing solar farms, or more generating capacity on a river chain that already has some existing hydro generation.

44. This is being borne out with recent market activity. As MDAG points out, advances in solar technology in particular mean that the barriers to new-entrant investment are lower than previously, as is the construction risk and the lead time to commissioning[19].

45. In summary, we agree with MDAG that thriving competition in the wholesale market is critical to the transition to a low-emissions energy system that delivers for New Zealanders. There is a range of incentive effects at play in new investment dynamics, some of which may cause the development of new projects to be delayed, but those can be mitigated by ensuring there is robust competition for new investment.

46. We fully support MDAG (and the Authority, in its *Wholesale market competition review*) thoroughly exploring the various effects at play, determining how material they are, and prioritising at least the removal of barriers to new-entrant generators connecting to the system. To this end, we look forward to assisting the Authority with the project announced in its *Annual Corporate Plan* for FY22[20] to "*identify, triage and address any barriers that exist to the connection and operation of new renewable generation in New Zealand's electricity market*".

Evolution of system and market operation will be a key enabler of a 100% renewable power system

47. Another key theme in the RCE Report is the increased need to digitalise the new dispatchable energy resources that are being connected to the power system, regardless of their size. This will enable them to participate in markets for services across the full value stack. As the RCE Report states, markets need to be open and democratised, with "*new varied tailored and accessible markets developed to unlock value throughout the supply chain*".[21]

48. Ensuring consumers benefit from advances in technology and digitisation should be a key recommendation of MDAG's. This will require constant upskilling and investment by market participants and the system operator, as well as by the Authority in terms of its market monitoring. The RCE Report contains a blueprint for how this can be achieved.

49. We are an active participant in Australia's energy market as a provider of smart electricity metering and data services, and we, along with participants, have been evolving our systems and data-handling capability to enable five-minute settlement of the spot market. As the Australian Energy Market Commission states on its website, "*Five-minute settlement provides a better price signal for investment in fast response technologies, such as batteries, new generation gas peaker plants and demand response*".[22]

50. We suggest that, following the introduction of real-time pricing later this year, evolution of the New Zealand market from half-hourly to five-minute settlement should be something MDAG considers for recommendation to the Authority. Many of the drivers for the change in Australia are present in New Zealand, and this could be a key enabler of demand-side participation.

51. Regardless of whether five-minute or half-hourly prices are used for settlement, it would appear critical that wholesale market transactions are settled and reconciled on the basis of high-frequency meter data, where it is available. Our understanding is that a large proportion of retail loads are still settled on the basis of average profiles, despite half-hourly data being widely available. The kinds of innovations in other jurisdictions MDAG referenced in its paper would seem to be possible only if customers' smart meter data is used for settlement and

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19 While this suggests that competition in the market segment for non-dispatchable resources should increase, we share MDAG's concerns about the potential for the market for longer-term flexibility to become highly concentrated as fossil-fuelled generators exit the system.

20 Available online at https://www.ea.govt.nz/about-us/strategic-planning-and-reporting/our-work-programme/

21 RCE Report, page 48

22 See https://www.aemc.gov.au/rule-changes/five-minute-settlement

reconciliation. Further, the benefits of much of the Authority's recent reforms – for example, real-time pricing, transmission pricing and distribution pricing – rely on high-frequency data being used to the greatest extent possible. Again, MDAG should make this a clear recommendation to the Authority.

52. As demand-side participation increases in the spot market, and control of loads at consumer premises becomes more granular, it may be desirable to revisit the values of lost load used in the market, and for grid planning, and the price levels set for scarcity pricing. The installation and maintenance of under-frequency relays are not costless, and could be considered in revised calculations.

53. As we raised in our submission to the Authority in its recent consultation on the Settlement Residual Allocation Methodology[23], MDAG appears to have taken without question that the use of locational marginal pricing is the most efficient and effective means of coordinating grid-connected and distributed resources in the wholesale market, and that this coordination through the system operator's SPD model is being done in a way that delivers long-term benefits to consumers.

54. While we acknowledge that MDAG's approved project scope[24] explicitly excludes "*revisit[ing] the New Zealand electricity market design from first principles*", and explicitly assumes a full nodal spot market, we think it would be remiss of MDAG not to recommend to the Authority that the use of SPD, in its current form as a linear program, is reviewed.

55. At its core, the SPD algorithm has fundamentally not changed since the market started in 1996. The concept of using a linear program as the market-clearing and coordinating algorithm (and as the means of surfacing locational marginal prices) was developed well before that. Neither the Authority nor system operator appears to have questioned since that time whether new technology has enabled a more sophisticated and effective means of coordinating resources than the traditional SPD model.

56. While we are not questioning the objective of the existing algorithm to minimise cost, or its requirement to have some measure of costs as its key inputs, it seems unlikely that, with all the technological advancement over the past 25+ years, there are not more effective means of coordinating resources than a linear program. Reviewing the use of a linear program as the market-clearing algorithm, with all its inherent assumptions and limitations, could have been a key component of MDAG's activity.

57. Even assuming that a 26-year-old linear program is the most effective algorithm for coordinating resources, the linear DC approximation of the grid in use has only been enhanced incrementally since 1996. The way in which losses on transmission assets are calculated can lead to overestimates of losses, increases in marginal prices, and overpayments by consumers. While the number of loss tranches in SPD was increased in 2015[25], advances in computing power must now have made the development of a non-linear formulation for SPD, which could model line losses more accurately, at least worth considering.

58. We note MDAG's view, informed by several international experts and its review of the international literature, is that a spot market with clear and actionable price signals becomes even *more* important as the number of dispatchable devices connected to the power system increases exponentially. If this is indeed the case, we suggest firmly that MDAG recommends to the Authority that the Authority and system operator collectively review the way in which

[23] Available online at https://www.ea.govt.nz/assets/dms-assets/29/Vector-Submission-SRAM-2022.pdf

[24] See https://www.ea.govt.nz/assets/dms-assets/28/MDAG-proposed-scope-price-discovery-under-100-renewables.pdf

[25] See https://www.ea.govt.nz/about-us/what-we-do/our-history/archive/dev-archive/work-programmes/market-wholesale-and-retail-work/improving-transmission-loss-modelling-in-spd/outcome/implemented-increase-in-loss-segments-at-midnight-on-31-march-2015/

New Zealand's resources are coordinated and optimised at the wholesale level. Failing that, there should be a first-principles review of the formulation of SPD to determine whether a more efficient and effective means of modelling the grid would be possible.

59. The implementation of real-time pricing later this year, and the introduction of Dispatch Notification early in 2023, will both be key enablers of DER participation in the wholesale market. We suggest MDAG recommends to the Authority that, following these reforms, it revisits the potential role of multiple trading relationships to enable innovation in consumer offerings related to DER, and to support peer-to-peer trading. Enabling specific types of DER to participate in, or bypass, the wholesale market could create niches that specific players target, as opposed to managing consumers' entire energy portfolios.

60. Relatedly, as the reliance on DER for maintaining system stability becomes greater, this significantly multiplies the number of connected devices that will play a role in balancing the grid. In our minds, this heightens the risk of material cyber security breaches, which could disable entire fleets of DER on the system concurrently. While this cyber risk has been highlighted in the Authority's FSR workstream, and is high on the Security and Reliability Council's priority list, it is worth MDAG adding its support to this risk being an ongoing area of focus.

Concluding comments

61. We appreciate the depth, breadth and quality of the work MDAG has put into identifying challenges and opportunities arising from the transition towards 100% renewables, and thank MDAG for the opportunity to feed into this highly important conversation. We look forward to continuing the conversation.

62. We are happy to discuss any aspects of this submission with MDAG members and/or the MDAG secretariat. Please contact me on +64 21 472 943 or james.tipping@vector.co.nz in the first instance.

63. No part of this submission is confidential, and we are happy for the Authority to publish it in its entirety.

Yours sincerely

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