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Electricity Authority
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By email: operationsconsult@ea.govt.nz

Wholesale market arrangements for battery energy storage systems

Introduction

1. Vector Limited (Vector) welcomes the opportunity to submit on the Electricity Authority's (Authority's) Issues and options paper on wholesale market arrangements for utility-scale battery energy storage systems (BESS).
2. The rapid growth in inverter-based renewable generation and electrification means Aotearoa New Zealand will increasingly rely on flexible resources, including BESS, to maintain security, resilience and affordability. Vector supports fit-for-purpose market arrangements that enable efficient investment and operation of BESS, reduce barriers to participation, and promote effective competition for the long-term benefit of consumers.
3. Vector's support is qualified by one critical point: as BESS deployment expands, a material proportion will connect to distribution networks (embedded BESS). When embedded BESS are dispatched or price-responsive at scale, they create operational interactions between national (TSO) objectives and local (DSO/EDB) constraints.
4. In effect, wholesale reforms that improve BESS controllability and participation **also move New Zealand further down the path of a 'hybrid' TSO/DSO model** – whether or not we choose to label it that way. Vector has consistently highlighted that the transition to millions of manageable devices requires greater distribution visibility, coordination mechanisms and, in some circumstances, stronger emergency management powers to keep networks safe and power quality within limits. We therefore consider the Authority should progress wholesale reforms in a way that is explicitly compatible with (and accelerates) the development of robust EDB/market interfaces and load management protocols.
5. In summary, Vector's key points are:
    i. Enable efficient wholesale participation of BESS, including embedded BESS, but do so with explicit recognition of distribution constraints and safety obligations. Wholesale signals and System Operator dispatch should not create unmanaged distribution risks, and any operation of embedded BESS must be within existing network limits – both thermal and power-quality.
    ii. Support improved dispatch obligations for BESS when charging, provided the arrangements include clear instruction hierarchy and practical compliance pathways for embedded BESS subject to EDB load management, outage and power-quality constraints.

iii. Support reforms that treat a BESS as a single entity that can both buy and sell, consistent with international best practice (e.g. participation models that allow storage to be dispatched and set price as both buyer and seller, and that account for physical characteristics through bidding parameters).

iv. For gate closure and state-of-charge (SoC) constraints, Vector supports changes that enable BESS to trade more efficiently without compromising system security. However, the Authority should ensure implementation is sequenced with the evolution of distribution visibility and coordination arrangements, to avoid creating a widening gap between what the System Operator can 'see' and what is physically feasible on distribution networks.

v. On constrained-off payments, Vector supports technology-neutral settings that do not compensate highly controllable assets in ways that distort bidding incentives. Any changes should be tested against unintended consequences for embedded BESS that may be constrained for distribution reasons (which are outside the System Operator's constrained-off framework).

6. It is worth the Authority, and owners of embedded BESS, noting that the Code already contains an obligation, in clause 13.9A (1), for offered quantities to be **physically feasible** at the relevant point of connection to the grid. This therefore requires coordination with the host distributor for the BESS owner to understand any limitations on their operation:

13.9A Offer not to exceed capability

(1) The total **MW** specified in each **offer** submitted by a **generator** must, in relation to the **generating plant** that is the subject of the **offer**, not exceed the total **MW** that the **generator** expects to be capable of generating at the relevant **point of connection** to the **grid** for the relevant **trading period**.

(2) Subclause (1) does not apply to an **intermittent generator**.

Clause 13.9A: inserted, on 29 June 2017, by clause 13 of the Electricity Industry Participation Code Amendment (Shortened Gate Closure and Revised Bid and Offer Provisions) 2017.

Clause 13.9A(2): inserted, at 12.00 pm on 19 September 2019, by clause 6 of the Electricity Industry Participation Code Amendment (Wind Offer Arrangements) 2019.

7. Finally, Vector encourages the Authority to continue drawing on proven international lessons. Storage integration reforms in jurisdictions such as the United States (FERC Order 841), Australia's National Electricity Market (Integrated Resource Provider / bidirectional unit reforms), and Great Britain's evolution of fast frequency response services have been underpinned by clear participation models, transparency of operational constraints (including SoC-related constraints), and careful attention to system operator visibility and instruction pathways.

8. No part of this submission is confidential. We are happy for it to be published in full. If you have any questions about this submission or would like to discuss any of the points we have raised, please contact me in the first instance.

Yours sincerely

J. Tipping

Dr James Tipping
GM Market Strategy / Regulation

Responses to consultation questions

Q1: Do you agree we have sufficiently identified the unique characteristics of BESS to assist in developing appropriate arrangements?

9. Vector broadly agrees the paper identifies the core wholesale-relevant characteristics of utility-scale BESS (bidirectional operation, limited energy duration, fast controllability, SoC dependence).
10. However, we recommend the Authority explicitly elevate one additional 'system characteristic' that is increasingly material in New Zealand: a growing share of BESS will be embedded in distribution networks, and therefore subject to local voltage / thermal / protection limits and EDB load management protocols that are not visible to the System Operator's dispatch tools. There will therefore be local conditions that constrain both charging and discharging behaviour that are invisible to the SO.
11. Recognising this characteristic up-front will help ensure options are assessed against whole-system feasibility, not just transmission-level feasibility.

Q2: Do you have any views on how BESSs should be defined in the Code?

12. Vector supports a clear, technology-neutral Code definition that recognises BESS as a single physical resource capable of both consuming and injecting electricity, with explicit reference to:
    a) power capacity and energy capacity,
    b) SoC / energy constraints, and
    c) Controllability / response characteristics.
13. They are therefore neither load nor generation, individually.
14. The definition should avoid embedding specific chemistry and should anticipate hybridisation (while noting hybrids are out of scope for this paper).
15. Internationally, participation models treat storage as a distinct resource category with bidding parameters that reflect physical constraints; a similar approach will help reduce barriers and improve dispatch integrity.

Q3: Do you agree that BESS can deliver the benefits described? Are there any other benefits that will assist us in assessing the size of benefits of different arrangements?

16. Yes. Vector agrees BESS can deliver the benefits described (arbitrage that can reduce average wholesale prices, flexibility to support variable renewables, and ancillary services that improve security and resilience).
17. We also highlight two distribution-relevant benefits that can be material for consumers if enabled safely:
    a) local congestion and voltage management that can defer distribution capex, and
    b) improved resilience / outage management when embedded BESS is orchestrated within distribution constraints.
18. These benefits are most likely to be realised where EDB visibility and coordination arrangements are mature; without these, BESS participation can create new operational and safety risks and drive inefficient 'insurance' capex.

Q4: Do you agree with our description of how BESSs are likely to operate and how this will change over time? If not, why?

19. Vector agrees with the Authority's broad description: BESS are likely to optimise against price expectations and SoC limits, with intra-day firming as a primary role.
20. Over time, we expect more co-optimisation across energy and ancillary services, and increased responsiveness to short-interval price and system signals.
21. For embedded BESS, operation will also be shaped by distribution constraints, outage patterns and EDB load management protocols. In practice this means 'optimal' operation for the market will frequently differ from 'feasible' operation for a local feeder at a given time. This divergence is the essence of the emerging hybrid TSO/DSO environment and should be explicitly considered in option design and sequencing.
22. Further considerations are required relating to EDBs' AUFLS and grid emergency requirements and how to treat feeders serving dispatchable assets that are participating in, and have been dispatched into, national wholesale markets.

Q5: Do you have any other insights about potential BESS operation that will help with assessing the benefits of our options?

23. Two practical insights may assist benefit assessment:
    a) At scale, embedded BESS response can be 'lumpy' and correlated / 'herded' (e.g., many assets responding simultaneously to the same wholesale or frequency signal), producing steep local ramps on distribution networks. This is particularly relevant following switching events or restoration from load control, where delayed or synchronized return can create surges.
    b) SoC is not only an economic constraint; it is also an operational constraint tied to warranties and thermal limits. Market designs that rely on frequent rebidding close to real time can increase cycling and complexity unless SoC parameters are integrated cleanly.
24. These insights reinforce the need for (a) high-quality telemetry and (b) coordination protocols between the System Operator and EDBs (and/or DER operators) to ensure safe operation.

Q6: Do you agree with the way we have framed the issues?

25. Partly. Vector agrees it is appropriate to consider dispatch-following obligations when BESS are charging, given high controllability. However, the framing should more explicitly recognise that for embedded BESS, 'following dispatch' is conditional on distribution feasibility.
26. If the market rules strengthen System Operator dispatch authority over embedded BESS without a corresponding strengthening of distribution visibility and load management coordination, the risk is shifted onto EDBs (and ultimately consumers) through increased safety and power-quality management burdens.

Q7: Do you agree with the Authority's preferred option? If not, what are alternative options that would better address the issues? Are there any particular risks with our preferred option that you would like to identify?

27. Vector supports the Authority's preferred option in principle – BESS should generally be required to follow dispatch instructions when charging – because it improves controllability and system security.
28. However, we recommend two refinements:

a) Embed an explicit 'distribution feasibility' overlay for embedded BESS, operationalised through clear protocols (and ultimately, data/telemetry) so that the System Operator's dispatch does not unintentionally create unsafe distribution outcomes.

b) Clarify instruction hierarchy and compliance expectations where EDB load management protocols, outages, or power-quality constraints require an embedded BESS to deviate.

29. Alternative/mitigation options include staged implementation (grid-connected first, embedded second), a compliance safe-harbour for distribution-directed deviations, and requirements for BESS / aggregators to maintain operational agreements with host EDBs where they participate in wholesale dispatch.

30. Key risks include unmanaged local ramping, voltage excursions, and increased restoration complexity if large fleets respond simultaneously to charging signals (i.e. herding).

Q8: Do you agree with how we have framed the issues?

31. Yes, broadly. Vector agrees the current separation of charging and discharging components is not well aligned with how a single BESS is physically operated and optimised. Treating BESS as a single entity that can buy and sell aligns with efficient investment signals and international practice.

32. However, the framing should be extended to explicitly include embedded BESS and the need for consistent, auditable interfaces between wholesale participation and distribution constraint management.

Q9: Do you agree with out preferred options? If not what other options would better address the issues identified?

33. Vector supports the preferred direction to enable a single offer/bid construct for BESS and dispatch as a single entity. This should reduce barriers and better reflect physical constraints.

34. We recommend the Authority ensure the design:

    a) supports SoC / energy constraints transparently,

    b) avoids duplicative compliance obligations, and

    c) is implemented in a way that does not undermine the development of EDB / DSO operational agreements for embedded assets. Australia's IRP / bidirectional unit reforms provide a helpful comparator for streamlining registration/participation for bidirectional resources.

Q10: Do you think further restrictions to BESS participation in MFK under the current arrangements would have any effect on their participation?

35. Vector expects further restrictions on BESS participation in MFK under current arrangements could reduce their participation, but would not address the underlying design issue (i.e., BESS being modelled and dispatched in a way that does not reflect bidirectional physical reality).

36. Restrictions can also create unintended consequences, including reduced competition in ancillary services and less efficient system outcomes. Structural reform to participation and dispatch modelling is preferable to incremental restriction.

Q11: Do you agree the issues identified by the Authority are worthy of attention? If so, do you agree with our framing?

37. Yes. The tension between flexible trading (which is economically efficient for storage) and security assessment (which must ensure feasibility) is central to BESS integration. Vector agrees with the framing that SoC-driven uncertainty and limited duration create unique challenges for gate closure and dispatch feasibility. We reiterate that embedded BESS adds a second layer of 'security' constraints at distribution level, reinforcing the need for strong coordination and data pathways.

Q12: Do you agree that BESS should have the same arrangements when charging and discharging, and that embedded BESS should have the same arrangements as grid connected BESS?

38. Yes, in principle. Consistent arrangements for charging and discharging are generally more efficient and reduce complexity.
39. Vector also agrees embedded BESS should not be disadvantaged simply because of connection point, provided equivalent security and feasibility can be maintained. However, 'same arrangements' must not mean 'same assumptions'. Embedded BESS participation must be accompanied by appropriate distribution feasibility mechanisms, otherwise identical wholesale settings can lead to unequal operational risk on distribution networks.

Q13: Do you agree with our preferred new arrangements for BESS?

40. Vector broadly supports the preferred new arrangements, particularly those that allow BESS to trade full capability at gate closure while maintaining system security through appropriate constraints. We consider SoC constraints are a pragmatic mechanism to improve feasibility and reduce conservative trading.
41. Our key condition is that the Authority sequences and implements these changes alongside work to improve the EDB/market interface (visibility, coordination, and load management protocols for embedded BESS), so that enhanced trading flexibility does not come at the expense of distribution safety and operability.

Q14: Do you see any issues with how we have defined state of charge constraints?

42. Yes – there are two areas to watch:
    a) First, SoC constraints need to be defined and implemented in a way that is robust to telemetry quality and does not create gaming opportunities.
    b) Second, for embedded BESS, **SoC feasibility is necessary but not sufficient**: network constraints (voltage/thermal/protection) may bind irrespective of SoC. The Authority should therefore ensure the SoC constraint framework does not inadvertently create a perception that dispatch feasibility has been 'solved' for embedded assets.
43. The Code already contains an obligation, in clause 13.9A (1), for offered quantities to be **physically feasible** at the relevant point of connection to the grid, which therefore requires coordination with the host distributor:

13.9A Offer not to exceed capability

(1) The total **MW** specified in each **offer** submitted by a **generator** must, in relation to the **generating plant** that is the subject of the **offer**, not exceed the total **MW** that the **generator** expects to be capable of generating at the relevant **point of connection** to the **grid** for the relevant **trading period**.

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Q15: Do you agree that the benefits of state of charge constraints likely outweigh the costs?

44. On balance, yes. Vector expects the benefits of SoC constraints (reduced schedule infeasibility, improved security assessment, and more efficient use of BESS capability) will likely outweigh implementation costs, particularly as BESS penetration increases.

45. We recommend the Authority explicitly quantify and monitor implementation/operational costs, including System Operator system changes and participant compliance costs, and ensure costs are proportionate to near-term benefits given the staged development of BESS in New Zealand.

Q16: Do you agree with how we have characterised the differences between various options?

46. Broadly yes. Vector encourages the Authority to ensure comparisons between options transparently reflect:

    a) security risk under forecast error and SoC uncertainty,

    b) likely behavioural responses (e.g., conservative bidding vs frequent revisions), and

    c) distribution impacts for embedded BESS.

47. If embedded BESS impacts and risks are not explicitly assessed, there is a risk of overstating net benefits or understating implementation risk.

Q17: Are there any other options that you think would better achieve the gate closure objectives?

48. Two additional options merit consideration (potentially as complements):

    a) A staged implementation pathway that applies new gate closure/SoC arrangements first to transmission-connected BESS, then to embedded BESS once distribution visibility/coordination mechanisms are demonstrably in place.

    b) Explicit requirements (in Code or incorporated documents) for embedded BESS / aggregators participating in wholesale markets to maintain operational agreements with host EDBs, including load management compliance and communications protocols, to reduce the need for ad hoc deviations post gate closure.

49. These options directly address the hybrid TSO / DSO operational reality and reduce unmanaged risk transfer.

Q18: Do you consider an interim solution is necessary? If so, do you agree with the potential solution we suggested?

50. Possibly. Vector can see a case for interim measures if the existing arrangements are already materially limiting efficient BESS operation and investment.

51. However, interim measures should be carefully scoped to avoid creating a 'temporary' solution that becomes enduring and inconsistent with the target design. If an interim solution is progressed, Vector supports approaches that are low-regret and that do not pre-empt the necessary work on embedded BESS coordination and distribution visibility.

Q19: Do you have any information that can help us better understand the benefits and costs of different options? This includes, for example, substantiating the system risks, and how to improve our modelling of benefits.

52. Vector can assist the Authority with qualitative and, where available, quantitative evidence on distribution-related risks and costs, including: the operational impacts of correlated DER response, restoration surges, and the practical requirements for telemetry/communications and load management protocols.

53. We encourage the Authority to incorporate distribution feasibility considerations into cost-benefit and risk assessment for embedded BESS options, and to engage with EDBs / ENA and FlexForum-type workstreams to ensure modelling assumptions reflect the distribution reality.

Q20: Do you agree the issues identified by the Authority are worthy of attention?

54. Yes. Constrained-off compensation settings can materially influence bidding/offer behaviour and investment incentives. For BESS, which are highly controllable and can be both purchasers and generators, settings should avoid over-compensating behaviour that is within participant control and should preserve technology neutrality.

Q21: Do you agree with our framing of the issue?

55. Broadly yes. Vector agrees with the Authority's framing that paying constrained-off compensation to BESS when charging may not be consistent with how controllable assets should be treated, and may distort incentives.

56. We also note constrained-off payments relate solely to System Operator constraints; they should not be used to 'solve' distribution constraints or compensate for distribution-directed curtailment. The latter requires separate arrangements and clear operational agreements. EDBs are not in any position to pay constrained-off payments to embedded BESS or any other dispatchable embedded assets.

Q22: Do you consider having constrained off payments would affect bidding and offering behaviour from BESS?

57. Yes. If constrained-off payments are available while charging, BESS could have incentives to position themselves in ways that increase the likelihood of being constrained (or to reduce incentives to manage their own controllability efficiently), which could undermine market efficiency.

58. Removing such payments may sharpen incentives to offer / bid in ways that reflect true opportunity costs and controllability. Any change should be monitored for unintended consequences, including whether it changes participation in ancillary services or creates new risk management behaviours.

Q23: Do you agree with our preferred solution?

59. Yes, with the caveat above. Vector supports the Authority's preferred solution that BESS should not receive constrained-off payments when charging, as this supports technology neutrality and efficient incentives for controllable resources.

60. We recommend the Authority confirm the change is implemented alongside clear guidance on the treatment of embedded BESS constrained for distribution reasons (outside the constrained-off framework), to avoid confusion and disputes at the interface between wholesale and distribution operations. As noted above, EDBs are not in any position to pay constrained-off payments to embedded BESS or any other dispatchable embedded assets.