



Consultation

on

PRICE DISCOVERY UNDER 100% RENEWABLE
ELECTRICITY SUPPLY

ISSUES DISCUSSION PAPER

Submission by

Electric Power Optimization Centre

The University of Auckland

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<https://www.epoc.org.nz>

March 16, 2022

Executive Summary

1. The move towards a 100% renewable electricity (100%RE) system will have implications for the design and operation of the New Zealand wholesale electricity market. EPOC welcomes the work of the Market Design Advisory group (MDAG) on this issue, and the opportunity to comment on the Issues Discussion paper.
2. EPOC generally supports the development of wholesale market monitoring models based on perfectly competitive optimization benchmarks (rather than measuring competition using market concentration indices). We advocate counterfactual models to investigate changes in system behaviour as it moves towards 100% RE.
3. EPOC takes the position that wholesale prices which are close to perfectly competitive levels are required to improve consumer confidence in the wholesale market. Without this confidence, consumers are unlikely to accept the need for high scarcity-prices during shortages.
4. EPOC sees a need for more responsive demand-side behaviour as renewables grow. This will be needed to deal with capacity shortfalls in operations (e.g., no wind periods) and energy shortfalls over a longer time-scale (e.g., dry winters).
5. Demand-side response derivative contracts with firm delivery obligations will enhance the ability of energy-limited and capacity-limited generators to reduce risk.
6. Without prejudicing the outcomes of such studies, EPOC believes that MDAG should investigate both two-settlement (day-ahead and balancing) markets as well as “capacity” markets for firm capacity and firm energy.

Submission from Electric Power Optimization Centre

	Question	Page references	Comment
1	<p>Do you agree with the broad conclusions that emerge from the simulations in relation to spot price levels and volatility, in particular:</p> <p>(a) significantly more spot price volatility is likely with a 100%RE system, especially shorter-term weather-driven volatility?</p> <p>(b) New Zealand's sizeable hydro generation base is likely to moderate the growth in volatility to some extent, making extreme oscillations between zero and shortage spot prices relatively unlikely?</p>	p18, p61	<p>EPOC does not have a view on the conclusions of the simulations, apart from agreeing with the general direction of volatility increases. We do note that the market simulations assume offering strategies for hydro generators that are based on historical offer curves. It is possible that these do not represent optimal or even realistic offers for hydro agents in a 100%RE system. EPOC recommends that simulations adopt a perfectly competitive assumption where marginal water values can be determined by system optimization.</p> <p>EPOC commends the appended report by Grant Read on marginal water values, and his explanation of how these are distinct from offer prices. As Dr Read observes, marginal water values emerge as shadow prices from the optimal solution of a stochastic optimization problem (corresponding to a perfectly competitive equilibrium). They are often presented as a (discretionary) decision variable of an offering generator, even though this might not be an optimal choice. Using this terminology is unhelpful in discussions of markets with stored hydro where the term has a precise technical meaning.</p>
2	<p>If you disagree, what is your view and the reasoning for it?</p>	p18, p61	No comment

<p>3</p>	<p>Do you agree that in a 100%RE system there will be many diverse and disaggregated resources to coordinate, and that a wholesale market will be the preferred mechanism to coordinate plans and actions among all the resource owners? If you disagree, what is your view and the reasoning for it?</p>	<p>p18, p65</p>	<p>EPOC is a supporter of competitive wholesale markets for allocating resources and setting prices. We agree that there will be many diverse and disaggregated resources to coordinate. Whether this makes central dispatch impractical will depend on the degree of aggregation of small producers and consumers.</p> <p>We note that the coordination of a market by prices alone (as alluded to by Hogan) is not straightforward in practice, because traded instruments for some products are not available. Because of this market incompleteness (e.g., there is no traded instrument for transmission capacity) the NZ wholesale market is dispatched by an optimization model (i.e., SPD). This enables prices to be determined for untraded instruments, and efficient economic dispatch.</p> <p>Hogan's conclusion on p 64 is that coordination of many resources will be impossible using a central dispatch model such as SPD. We disagree and believe that this will be important to retain to deal with incompleteness issues. Having said this, one should observe that the additional short-term volatility from RE generation will increase the complexity of managing a central dispatch.</p> <p>It is also important to recognize the limitations of real-time pricing, when tentative offers are made by competing agents in a sequence of price discovery steps before gate closure. This tatonnement process does not always lead to efficient outcomes, even if agents behave as price takers (see Philpott, Price discovery can be inefficient, www.epoc.org.nz).</p>
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<p>4</p>	<p>Do you agree that these are the key issues in relation to real-time coordination? If you disagree, what is your view and the reasoning for it?</p>	<p>p20, p69</p>	<p>The growth of energy storage mechanisms will require tighter coordination than that allowed simply through prices. For example, dispatch of generating stations on river chains is currently coordinated over time by changing single period offer prices before gate closure. This can lead to inefficient use of headpond storage (see 3, above). In a similar fashion, battery storage with solar input would ideally be optimized in one solve over a cycle period (e.g., 24 hours) rather than by changing single period offer prices.</p> <p>This points to a daily dispatch model like the original WEM design, perhaps implemented day-ahead with a second real-time market to enable this coordination.</p> <p>EPOC proposes that such a two-settlement design be studied. It is not clear how large amounts of wind generation would fare in such a market where forecasts of output a day-ahead are difficult to make. This is where two-settlement markets in overseas markets with wind generation might provide some guidance.</p>
<p>5</p>	<p>Do you agree that these are the key issues in relation to ancillary services with 100%RE? If you disagree, what is your view and the reasoning for it?</p>	<p>p21, p74</p>	<p>No comment</p>

6	Do you agree that these are the key issues in relation to price signalling with 100%RE as summarised in paragraph 3.42 above? If you disagree, what is your view and the reasoning for it?	p24, p88	<p>We remark that price signals in the NZEM will differ in their formation from those in purely capacity-limited jurisdictions.</p> <p>Thus, if droughts are driving the scarcity, in equilibrium the risk-adjusted expected prices should reflect the investment costs of long-term storage (or the cost of purchasing firm-energy contracts from demand). However, if wind volatility is driving shortage, then prices perhaps should reflect the cost of short-term storage (or the cost of enabling instantaneous demand-response).</p>
7	Do you agree that the preconditions in paragraph 3.38 would need to be in place for an energy-only market design to be effective? If you disagree what is your view and the reasoning for it?	p24, p88	<p>Our attention is drawn to condition (3.38 b) that states that consumers must have confidence in the level of competition. The corollary to consumers accepting high prices in times of scarcity is them paying competitive prices when supply is plentiful. Levels of competition as measured by concentration indices do not reassure consumers that this is the case. Prices should be monitored in comparison with perfectly competitive counterfactual models.</p>
8	Do you agree that we should take forward to the next stage of the process (options identification and analysis) the measures referred to in paragraph 3.43 above? If you disagree, what is your view and the reasoning for it?	p24, p88	<p>EPOC reiterates our response above. Any publicity campaign promoting awareness of the need for high spot prices will be futile if the market is not deemed to be close to perfectly competitive. If that is demonstrated, then consumers are more likely to be convinced by the theory to accept occasional scarcity prices.</p> <p>EPOC further believes that consumers will be disinclined to accept the workable competition hypothesis if entry by investors is delayed in high price periods because they are deemed to be outliers of future price distributions. The theory that new entry disciplines energy offers will appear less attractive if the entry does not emerge for several years.</p>

			Without prejudicing the outcomes of such a study, EPOC welcomes the exploration of backstop measures such as firm energy/capacity markets. We believe that industrial and aggregated demand response should play a role in such mechanisms. We see a potential role for a mechanism that rewards technology for provision of both capacity and energy.
9	Do you agree that these are the key issues in relation to demand-side flexibility with 100%RE? If you disagree, what is your view and the reasoning for it?	p25, p93	EPOC believes that demand response is a key ingredient in setting competitive prices. The Issues Discussion Paper focuses on short-term demand response when capacity is limited (e.g. if wind is absent). It is important to recognize the need for a demand-side response to energy shortages over longer time periods (e.g. dry winters). These should be firm reduction commitments contingent on observed events such as a trigger electricity price or national reservoir volume (and accompanied by firm commitments of energy use) that enable hydro generators to use storage more aggressively.
10	Do you agree that these are the key issues in relation to contracts markets with 100%RE? If you disagree, what is your view and the reasoning for it?	p26, p98	EPOC agrees that contract markets are essential ingredients to enable risk reduction by market participants. The technical paper by Grant Read appended to the Discussion Document draws attention to the welfare result that a central planning solution that maximizes expected welfare corresponds to a perfectly competitive (partial) equilibrium. This result extends to risk-averse agents under the assumption that markets for risk are complete. This assumption is unrealistic in practice, but numerical experiments show that rich and liquid contract markets make competitive equilibrium nearly as good as the optimal social plan (which maximizes risk-adjusted social welfare). Observe that, in general, trading in hedge products will not remove all risk; there will

			<p>still be some residual risk (e.g., of energy shortage) to be borne by the system as a whole.</p> <p>As mentioned in (9) above, contracts that commit contract sellers (i.e., consumers) to provide firm energy during shortage events (by load reduction) should be part of the contract mix.</p>
11	Do you agree that these are the key issues in relation to transition to 100%RE? If you disagree, what is your view and the reasoning for it?	p28, p102	No comment
12	Are there any other 'lumpy' issues that warrant specific consideration in the transition to 100%RE?	p28, p102	No comment
13	Do you agree that we should analyse how competition in the wholesale market is likely to be affected by a shift to 100%RE, in particular, in competition for seasonal flexibility services? If you disagree, what is your view and the reasoning for it?	p29, p104	It depends on how competition is measured. EPOC is sceptical of the use of concentration indices (such as HHI) to measure competition in the New Zealand wholesale electricity market. We believe that competition is best assessed by comparison with perfectly competitive counterfactual models. General implementations of these models exist; they can be populated with data under various assumptions of 100%RE and the results compared with outcomes in practice.
14	What other key areas of opportunity or challenge (if any) will arise in the wholesale electricity market with 100%RE that are likely to have a significant impact in relation to achieving the statutory objective of the Authority, which is to “promote competition in, reliable supply by, and the efficient operation of, the electricity industry for the long-term benefit of consumers”?	p29, p104	No comment