esr MDAG submission 220316

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To: Market Development Advisory Group (MDAG), Electricity Authority

Subject: Price Discovery under 100% Renewable electricity Supply – Issues Discussion Paper

Email: MDAG@ea.govt.nz

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Submission in response to: Price Discovery under 100% Renewable Electricity Supply – Issues Discussion Paper

Engineers for Social Responsibility Inc. (ESR) is an independent group of engineers who consider that being knowledgeable in the field of technology means that they also have a special obligation to the public at large in matters that relate to engineering, or that can be addressed using engineering approaches. Given the urgency of the issue, for some time now the organization has been particularly focused on how to respond to the climate crisis by reducing emissions and concentrations of greenhouse gases in the atmosphere.

The key authors of this report are members of ESR with strong experience and qualifications in engineering, and a broad knowledge in relation to global heating, what is causing it and how it can be addressed.

General

Clause 1.1 of the Discussion paper (P7) says that “The imperatives of climate change require us to urgently reduce emissions of greenhouse gases, both long-lived and biogenic methane”. Clause 1.3 then says that the increased electricity demand we can expect over the coming period “sums up to a ‘ramp’ of sustained investment in new renewable electricity out to 2050 (and probably beyond)”. Following that, Clause 1.8 (P8) says regarding the MDAG, “our task is to look at whether our wholesale electricity market design is set up to efficiently enable the expected electrification ‘ramp’”.

We very strongly agree with the need to take strong and immediate steps to limit climate change by reducing our greenhouse gas emissions. However, there are major issues regarding how the

electricity market currently operates that are related to this and require urgent attention, but do not seem to be specifically covered in the discussion paper.

Question 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" ?

1. Electricity wholesale purchasing system needs to change

Under the current electricity market system, which has been in place since the mid 1990s, over each half hour period, all generators feeding into the grid get paid the same price per kWh as was bid by the highest priced generator supplying the market at that time. This is often the Huntly Power Station, running on coal and sometimes natural gas. Other generating companies therefore take steps to keep Huntly in the market because it pushes up the prices they receive and increases their profits.

This market system is effectively encouraging the ongoing use of fossil fuels to generate electricity, and at the same time is severely retarding the development of renewable alternatives. For example, around 10 consented windfarms remain unbuilt, including one in the hills behind Huntly that alone could supply up to half the power that the Huntly Power Station does. Also at least one hydro company has been accused of deliberately spilling water in order to reduce hydro supply and keep Huntly in the market.

Electricity can often be generated at lower cost from renewable energy sources than from coal or gas. Despite this, because of the way the market currently works, Huntly Power Station continues to produce large amounts of electricity from fossil fuels, and its coal use has actually increased over the past couple of years.

In 2013 a proposal was made to address this issue by setting up a single buyer in the power market, NZ Power, that would purchase the electricity from the power companies at a price that reflected their generating costs. It was estimated that this would reduce the average New Zealander's power bill by up to $330 a year. A report by BERL economic consultancy also estimated that it would increase the GDP by $450 million, while creating 5,000 jobs.

This move would not effectively eliminate competition between suppliers, as they would presumably still submit supply price bids to the single buyer. However, the single buyer would need to be able to require them to lower their bid prices if these did not reflect their generating costs.

For reasons that are not known, the NZ Power single buyer proposal was not implemented. The need for action is now even more urgent than it was in 2013 – 9 years ago. Taking these steps would lead to a rapid increase in renewable generation capacity which we will need as we move away from fossil fuels.

Recommendation: We very strongly recommend moving to an electricity wholesale purchasing system under which payments to suppliers are based on their generating costs, as under the NZ Power single wholesale buyer proposal, and not on the bid put in by the highest priced supplier. Because this move can be expected to lead to a rapid reduction in electricity generation from fossil

fuels, accompanied by a rapid increase in electricity generation from renewable resources, it needs to be made as soon as possible. It can also be expected to reduce electricity prices for consumers and, based on previous assessments, to create new jobs and increase the country's GDP.

2. Priority needs to be given to renewably powered generation

In 1991, Germany started giving renewably generated electricity priority access to the grid. Its electricity generated from renewable resources has increased from 3.4% in 1990 to around 43% in 2021, with aims to move to 100% renewable by 2035. Meanwhile, our electricity from renewable resources only increased from around 81% to 84% over the 1990-2021 period

We need to follow the simple step Germany took in 1991, giving renewably generated electricity precedence in entering the grid over fossil fuel generation. Renewably generated electricity would then get priority over fossil fuel generation, even if the bid price was somewhat higher. The price margin between renewable-generated and fossil fuel-generated electricity would need to be regularly reviewed as our renewable generating capacity increased.

The single buyer proposal made in 2013 also addressed this issue, with NZ Power set to prioritise renewable generation and energy efficiency.

To make this workable, we also need to change the way our wholesale electricity purchasing system works, as covered under Point 1. Without this change, we may still not get appropriate action, and if we do, it may result in extremely high power prices.

Recommendation: We also very strongly recommend moving to a wholesale purchasing system under which renewably generated electricity gains priority access to the grid, even when the offer price is somewhat higher than from fossil fuel powered generators. As in the case of the recommendation above, this move can be expected to have a strong and immediate effect on the development of more renewably powered electricity sources, with Huntly and other fossil fuel-powered electricity generating stations rapidly moving to back-up status, and later to complete retirement from fossil fuel use.

3. Reduced electricity charges to consumers will speed up move away from fossil fuels

Domestic users are now paying, after adjusting for inflation, around 80% more per kWh of electric power that in 1990. This is primarily because we moved to a market system in which all electricity generators feeding into the market get paid the same price as the highest priced generator supplying the market at that time

Besides effectively being unfair to consumers, because what they pay does not relate back to actual generating costs, it is also a disincentive for them to use electricity as an option for moving away from reliance on fossil fuels. For the country as a whole, this type of electricity over-pricing is also economically inefficient. Moving back to a system where electricity prices reflect actual generating costs would address these issues.

Recommendation: We strongly recommend the changes needed to the electricity wholesale purchase system that will allow prices paid by consumers to relate back to generating costs.

4. Allow local electricity generation to feed into the grid at a realistic price

People and businesses with solar panels, or other systems for renewably generating electricity, are sometimes not given permission by their local electricity network company to feed excess power into the grid. If they are, they often receive quite low prices from their electrical retailer and sometimes have to pay for a separate company to read their export meter. Also, we understand that getting this grid connection is currently often quite costly and complicated.

This all needs to urgently change, as these local suppliers can potentially make a significant contribution to our total power needs. Local electricity networks that are not currently grid-connected also need to be allowed to connect into the grid, so that they can both buy and sell electricity via this system.

One mechanism we would like to see explored to encourage small and community generation schemes would be acceptance or approval of a minimum floor price in local power purchase agreement rates. This would remove a significant financial risk element for small or community groups.

Recommendation: In order to deal with this situation, there need to be some market-related regulations that require Transpower's national grid, and local lines companies connected to it, to accept locally produced electricity at an appropriate price. The setting or approval of a minimum floor price would also be a useful step in encouraging the development of local electricity generation. The connection and electricity measurement requirements for locally-produced electricity also need to be simplified.

5. Providing backup capacity and encouraging new forms of renewable generation

Beyond the proposals for changes to how the wholesale purchase of electricity works, as covered above, there is also the question of how to provide sufficient electricity supply when wind, solar or hydro capacity is low. To achieve this, it seems we need some sort of incentive for generating companies to create extra capacity that can be used as backup (i.e. insurance and storage services).

For example, consideration could be given to contracting these backup services directly, allowing for more targeted investment and faster delivery. This might be done through a capacity mechanism, where it is mandatory for contracted suppliers to have sufficient 'capacity' to cover their projected backup requirements for some years ahead. Once sufficient backup and storage capacity is in place to meet contracted requirements, suppliers could have the ability to sell capacity to the market if favourable environmental conditions create surplus resources. Indeed, the idea of using direct contracting or capacity mechanisms to support rapid development of backup infrastructure may be a short-term measure that can be phased out once the necessary storage infrastructure is established.

We also need an electricity wholesale purchasing system that operates in a way that encourages the development of new forms of renewable electricity generation. For example, power from tidal currents is a reliable energy source that only ceases to be available during fairly brief periods when the tide changes direction. In 2008 Crest Energy obtained a consent to place 100 turbines in the Kaipara Harbour, which was later increased to 200 turbines, with a total capacity of 200 MW. The project was dropped in 2013, reportedly because of uncertainties about the electricity market.

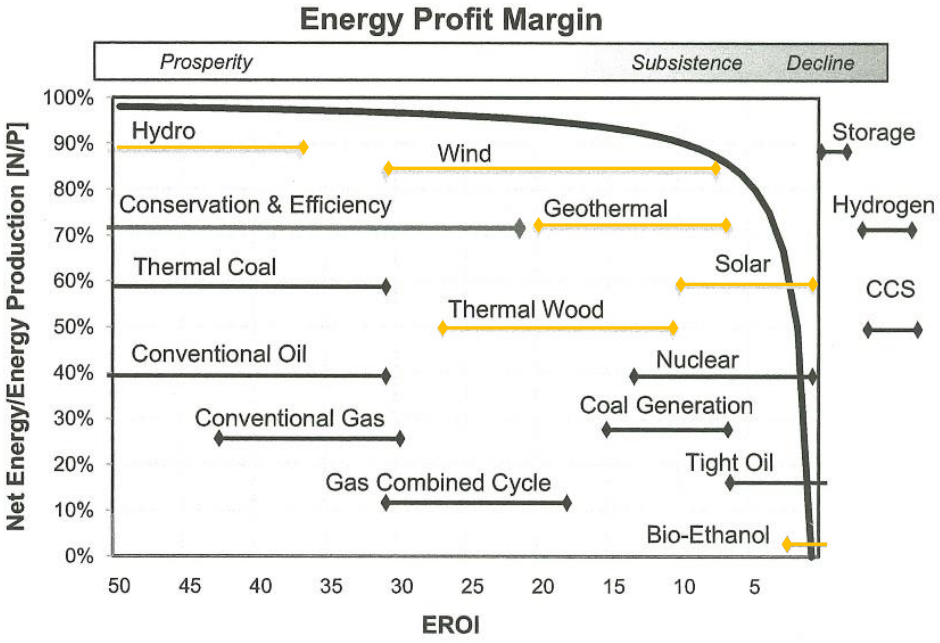
Also, experts tell us that tidal currents in Cook Strait could potentially be used to generate all of New Zealand's electricity. In 2009 Neptune Power received a consent to install a trial turbine there that would produce 1 MW of power. On the basis that this was successful, the plan was then to install 30 turbines that could generate 350 MW of power. However, the installation of the trial turbine never went ahead. This could also have been because of uncertainties about the electricity market.

Recommendation: We recommend setting up a wholesale electricity purchasing system that in some way financially encourages the development of backup generating capacity, and also the development of new forms of renewable electricity generation. Exactly how this would be achieved requires further consideration. For example, direct contracting of backup services could be considered as a way of supporting rapid development of new storage infrastructure.

6. Anticipating biophysical constraints in market design

The current MDAG discussion paper identifies many important issues related to both market and technical issues associated with physically operating a 100%RE generation system. However, we would also like to draw attention to the challenges presented by biophysical constraints on our future energy supply, and how these impact on market design (e.g. by emphasising the importance of demand-side management).

Energy Return on Investment (EROI) is an important biophysical parameter affecting economic prosperity. Also known as Energy Return on Energy Invested, EROI provides an indication of the surplus energy available for the economy to meet current demand, to provide maintenance and replacement, and to supply manufacturing and new construction. EROI is defined as the energy delivered by a system, divided by the energy input required to deliver that energy. EROI for various generation options are illustrated in the diagram below (Krumdieck, S. P. (2020), "Transition Engineering: Building a Sustainable Future").



Fossil fuels deliver an incredible amount of energy to the economy, currently meeting around 60% of New Zealand's energy needs. As the wider economy reduces its use of fossil fuels, the relative

scarcity of energy supply will drive an increased focus on energy returns from our investment in generation options. The potential for financial returns on investment to follow trends in energy return on investment needs to be taken into account in MDAG's assessment of future scenarios. For example, the diagram above:

- Shows that hydroelectricity has an excellent EROI. New Zealand's existing resources in this area provides a strong foundation for future energy prosperity when compared to other countries.
- Reinforces MDAG's conclusion that investments in demand-side management will be crucial, since conservation and efficiency are likely to deliver a superior EROI to investments in solar power, for example. It is important to acknowledge that peak-load options such as pumped storage, batteries, or hydrogen fuels represent a drain on the net energy in the system, delivering a negative energy return on investment. This does not mean that low EROI options have no value – solar energy can be particularly efficient in water heating, while energy storage and peaker plants will play an important role in the operation of a 100%RE system. However, it is crucial that the design of a 100%RE market acts as a catalyst for investment in the most energy efficient options in the system, including investment in demand-side conservation and flexibility.
- Reveals the risk that indefinite future growth in energy supply will result in a ***decrease*** in our energy prosperity, because it will need to rely on generation sources with ever-diminishing EROI returns. The market needs to be designed in a way that does not inappropriately favour investment in low-EROI energy supply options (e.g. favouring solar generation capacity over energy conservation or demand-side flexibility).

In summary, energy conservation has a better Energy Return on Investment (EROI) than solar electricity, battery use, and hydrogen peaker plants. This creates a strong argument for the market design to directly encourage investment in demand reduction (i.e. a downshift in energy consumption). If we carry on with business as usual where we pay generators for energy supply only, and assume indefinite growth in energy supply, it might give inappropriate support to generation options with ever-diminishing energy returns.

MDAG's draft discussion paper identifies the fact that demand-side flexibility will have increased importance in a 100%RE market - but does not develop many ideas for how this could be encouraged by the market (except for the negative incentive of customers taking steps to avoid high spot prices). The discussion paper makes mention of "capacity mechanisms" as a potential alternative to the current "energy only" spot price market, and it appears that this alternative market structure might create more opportunities to incentivise demand-side reductions. For example, market participants could enter contracts to deliver 'capacity' in the form of demand reduction as well as electricity supply.

We expect this would incentivise vertical integration, where generators work with retailers and their customers to introduce available demand-side management technology (e.g. real-time pricing, ripple control on water heating, solar water heating, distributed generation and battery storage, smart devices/vehicles etc). In theory, it would be possible for a wholesale purchaser with no generation capacity to enter this market by delivering peak 'capacity' in the form of demand reduction only, although obvious synergies will be achieved if market participants have the ability to influence both supply and demand to deliver the required 'capacity'.

Other biophysical constraints will also impact the market. These include limits on the availability and processing capacity of the raw materials used for battery storage and photovoltaic cells, which could affect the cost and availability of these options over the next 30 years.

Recommendation
Biophysical constraints like Energy Return on Investment and materials availability should be factored in to MDAG's analysis of future scenarios.

The market design must drive investment in demand-side management. To ensure this is achieved, demand-side management (including conservation, efficiency and flexibility) should be fundamentally embedded in the way the market operates. To put this another way, financial incentives need to be provided for investment in demand reduction (especially peak demand), and not solely linked to energy supply. There may be opportunities to make these incentives stronger than simply relying on consumers to take steps to avoid high 'energy only' spot prices.

Capacity mechanisms should be given further consideration, since it appears they may have greater potential to drive investment in demand-side management and energy conservation, compared to the 'energy only' pricing that is currently used (e.g. market participants could enter contracts to deliver 'capacity' in the form of demand reduction as well as electricity supply). There is not much detail about capacity mechanisms in the current discussion paper, and we recommend that more information be provided on the potential advantages and disadvantages of this approach.

In conclusion

The simple steps, covered in Items 1-5 above, will allow us to rapidly reduce the use of fossil fuels for electricity generation, and at the same time to rapidly increase our renewable generating capacity so that electricity can be used to replace fossil fuels as an energy source in other parts of our economy. Item 6 emphasises the importance of demand-side management, and the need to make this a fundamental driver in market design. The electricity market will need to deliver improvements in demand-side management (conservation, efficiency, flexibility) as well as increased generation and storage capacity as we move away from fossil fuel use for heating, transport and industrial uses.

In order to protect ourselves, our children and grandchildren, our planet, and the many other living species we share it with, we need to take these steps to move away from fossil fuel use, starting now.

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