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ELECTRICITY ALLOCATION FACTOR METHODOLOGY REVIEW

A REVIEW OF THE APPROACH TAKEN BY THE ELECTRICITY AUTHORITY IN 2024

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Document Information	
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1.0 Introduction

1.1 Purpose

Section 161FA of the Climate Change Response Act 2002 (Act) [1] requires the Electricity Authority Te Mana Hiko (Authority) to notify the Minister of Climate Change of the Electricity Allocation Factor (EAF) for a calendar year by 31 July each year. This is a new requirement that came into effect on 1 January 2024. Previously, industrial allocations have used the same administratively set EAF value since 2012. In August 2024, the Authority released an update of the EAF and presented their preferred approach being a modification of the Ministry of the Environment's (MfE) approach used in previous consultations, with enhancements made in regard to the offer adjustment process used to remove emission costs, recognizing that not all offers in the market are necessarily cost based.

Broad Solutions Limited (BSL) has been engaged by the Electricity Authority Te Mana Hiko (EA) to review their recent application of the Electricity Allocation Factor (EAF) methodology review. A key focus of the review is on the recent adoption of an **SRMC Threshold** for determining whether offers are to be adjusted or not.

The following key questions are addressed in this report:

- Does the methodology adopted by the Authority meet the requirements of Section 161FA of the Climate Change Response Act 2002?
- With respect to the implementation of a floor price to prevent offers going negative:
    - Comment on the alignment of the Authority's SRMC approach with Section 161FA
    - Is the Authority's SRMC approach aligned with how markets and generators would reasonably be expected to behave in New Zealand
    - Is the Authority's SRMC approach aligned with sound electricity market economics?

1.2 What we Bring

BSL has been operating as a consulting company in the NZEM since late 2010 across a range of market modelling and market risk engagements, including long-term market forecasting, investment decision support and market risk management framework development. Kevin Broad, the founder and Managing Director, has been involved in the energy industry since he completed his Master of Engineering research in 1996, which involved researching a new method for the long-term stochastic optimisation of hydro storage in the NZEM. Having worked both in management for Genesis Energy and Vector, as well as consulting to the sector (in NZ and in other markets including those based in Australia, Singapore, the US, the UK, Malaysia and the Philippines) for the majority of his career – in the areas of market modelling and market risk – Mr Broad has specific expertise in generator offer formation and strategy as well as understanding the impacts of the ETS which are of particular relevance to this assessment.

2.0 Assessment of EAF Methodology

2.1 Description of SRMC Approach

The current approach adopted by the Authority follows the same principles as what has been used previously by the MfE [2]:

- The vectorised Scheduling, Dispatch and Production (**vSPD**) model has been used as the basis of the analysis
- Analysis is conducted for the current calendar year based on market data from the financial year ending 30 June of the current year
- An adjustment approach has been adopted to remove carbon costs from thermal and hydro offers
- A price floor has been used on offer adjustments
- Geothermal plants are excluded as historical analysis shows that they either bid at must-run prices of $0.01/MWh or at arbitrarily high prices to avoid generating (e.g., $5000/MWh). This is consistent with our experience in the market and is mainly due to geothermal plants needing a stable level of generation for optimised well usage and reservoir operations
- The ETS impact is then calculated based on the change in load weighted average prices (with and without carbon costs) divided by the NZU price

There is then a postprocess aspect where the current year EAF is computed based on averaging the latest ETS impact with the previous two ETS impact calculations (being for the two prior July to June financial years).

The key changes in the recent approach taken by the Authority are:

- An SRMC Threshold for offer adjustment has been added:
    - A set of candidate thermal and cogeneration plants is established (**candidate thermal plants**). These are based on plants deemed to include cost-based offers with the criteria that these types of offers will exceed the SRMC of each plant. This criteria is also used for cogeneration where there are offers in addition to pure must-run ($0.01/MWh) offering (we'll refer to these as **must-run-bidding cogeneration**)
    - If a thermal offer is less than the SRMC of that plant, the thermal offer is not adjusted
    - If a hydro offer for a scheme with controllable storage is less than the lowest price SRMC of thermal offer plants in the set of candidate thermal plants, then the hydro offer is not adjusted
- The floor for thermal adjustments has been changed from $1/MWh to the SRMC of each thermal plant belonging to the set of candidate thermal plants
- The floor for hydro adjustments has been changed from $1/MWh to the lowest SRMC from the set of candidate thermal plants.

Note: in the Authority's paper "Determination of the 2024 Electricity Allocation Factor" [2], we believe the use of the word "floor" in relation to a plant's SMRC is misleading as it isn't clear that the SRMC Threshold is first applied meaning that any existing offers that fall below the SRMC of the relevant thermal plant are excluded from the adjustment process and hence the floor is not applicable in these cases (which can be seen in the code base[1]).

[1] https://github.com/ElectricityAuthority/2024_Electricity_Allocation_Factor/blob/main/vSPD_5.0.2/Programs_Sim2/EAFoverrides4.gms

2.2 Assessment of Overall Compliance

In terms of the first question, "*Does the methodology adopted by the Authority meet the requirements of Section 161FA of the Climate Change Response Act 2002?*", the key requirements relate to:

- Use of a market model in the analysis of the EAF
- Ensuring that the model and assumption data is publicly available
- Ensure that for the relevant year being appraised, the EAF is based on the average of three July to June financial years, with the latest ending 30 June of the current year, and the others being the previous two financial years

2.2.1 Market Model Requirement

The market model requirement in Section 161FA of the Act is that:

- A market model must be used to determine the ETS impact on the price of electricity, and this model must:
    - Be consistent with the market clearing algorithm set out in the Electricity Industry Participation Code 2010
    - use, as the counterfactual input, a reasonable estimate of the offers that would have been made for the electricity actually offered in the financial year if there were no liability to surrender units to cover emissions
    - comply with any regulations made under subsection (6).

Market Clearing Algorithm Consistency

The Authority has used vSPD for this update, as has been used previously. This is a precise replica of the market clearing algorithm used by the System Operator [3], and hence complies with this requirement.

Assessment: Complies.

Reasonable Estimation of offers that would have been made if there was no liability to surrender units

The Authority has taken actual offers from the market during the financial year of interest as the basis for their analysis. In assessing how these would change in regard to removing the liability imposed by the requirement to surrender units, the Authority has adjusted these existing offers as follows:

- Thermal offers that exceed the SRMC Threshold (and hence deemed to be "cost-based" in nature) have had the emission cost impact removed using plant specific characteristics and assumptions such as fuel costs, carbon intensity, heat rates, and fuel choice (in the case of Huntly rankine units where a gas and coal split must be assumed)
- Hydro offers for schemes with controllable water storage have had an overall capacity weighted carbon impact removed based on candidate thermal plants
- No other offer adjustments have been made (i.e., the process does not adjust other renewables, geothermals, or thermals that do not display SRMC type offering)

Assessment: Complies, but the following points should be noted:

- Our view is that it is reasonable to assume that cost-based thermal offers should have their emissions cost removed to estimate offers where there is no liability relating to the surrendering of units. A discussion around the definition of cost-based thermal offers is

made in Section 2.3 concerning the use of the SRMC Threshold. Our rationale is that any offer built up off costs – whether these are based on SRMC or LRMC – will incorporate a view of all variable costs associated with generation such as fuel, variable operating and maintenance (VOM), and carbon costs. Incorporating a view of costs into offering is common practice to ensure that these costs are at least covered in normal running of the plant. Where this is not applied in the Authority's modelling is the case where the offers fall below SRMC, and this is discussed in Section 2.3.

- The adjustments relating to hydro with controllable storage are further described in Section 2.3.1, but in principle we believe this is also compliant as hydro storage management can only be achieved through the use of water values which position hydro dispatch at different levels in the overall market offer stack, thereby allowing hydro generators the ability to manage their dispatch in relation to other generation. With thermal offers changing it is reasonable to assume hydro offers will also have to shift so that storage levels can continued to be managed, and shifting these using a related magnitude of change to the thermal offer deltas is a workable assumption.

Subsection(6) regulations

It is our understanding that the following is relevant to this: The Climate Change (Eligible Industrial Activities) Regulations 2010, Clause 6A, concerning "Modelling assumptions for market model used to determine allocation factors for electricity" [4], states the following assumptions should apply:

> (a) in the absence of the emissions trading scheme, thermal electricity generation would be offered at lower prices as generators' marginal costs would be lower:
> (b) as a consequence of the modelling assumption in paragraph (a), hydro-electricity generators that have controllable water storage would offer electricity at lower prices, because lower overall prices reduce the opportunity cost of stored water.
> *Regulation 6A: inserted, on 1 January 2024, by section 21 of the Climate Change Response (Late Payment Penalties and Industrial Allocation) Amendment Act 2023 (2023 No 49).*

The adjustments detailed above concerning the "reasonable estimation of offers" address these assumptions adequately.

Assessment: Complies.

2.2.2 Model and Assumption data to be Publicly Available

The Authority has vSPD available on their website, as well as providing Github access to the code, model inputs and logic used for the EAF update.

Assessment: Complies, but please note:

- Accessing the assumptions utilised in the analysis requires some GAMS expertise to interpret and assemble the data. However, these assumptions are generally at plant level
- Drilling into the most granular assumptions is less straightforward though in the most part still accessible to the public
- A number of market and professional service sites are accessed which involve varying degrees of registration requirements and costs. While in theory these may be accessible to the public through registration, it is not directly publicly available data. Such sources include: www.enerlytica.co.nz, www.emstradepoint.co.nz, from which carbon, gas and coal prices are derived. While these do flow through into the GAMS files provided in Github and hence are compliant in terms of plant level assumptions, the most granular assumptions that would be required to test the use of these assumptions in deriving plant

level data are not necessarily immediately available. In the case of carbon prices, which the Authority sources from emsTradepoint, alternative sources such as www.mynativeforecast.com (which presents historical carbon prices) have been assessed as reasonable alternatives, though not used by the Authority due to concerns raised by MfE about their reliability. Graphical views of the actual underlying data used are presented by the Authority in its paper "Determination of the 2024 Electricity Allocation Factor", thereby providing a reasonable level of compliance in this regard.

2.2.3 Application of 3 Financial Years in the calculation of the EAF

According to the Authority's EAF update documentation [2], it is clear that the approach taken was to evaluate the 2024 ETS impact using the year ending June 2024 vSPD analysis and to then average this with the ETS impacts for the preceding two years, being the years ending June 2022 and ending June 2023. It should be noted that while the averaging formula has been used correctly, the ETS impacts for these two previous years are actually set in legislation[2] as opposed to being assessed.

Assessment: Complies.

[2] Schedule 1AA, Section 42(2)(a) of the Climate Change Response Act 2002, https://www.legislation.govt.nz/act/public/2002/0040/latest/LMS282075.html

2.3 Assessment of the use of the SRMC Threshold and Floor

The second question BSL has been asked to respond to involves greater consideration of how the offers are adjusted and the use of a floor to prevent negative offers:

"With respect to the implementation of a floor price to prevent offers going negative

- Comment on the alignment of the Authority's SRMC approach with Section 161FA of the Climate Change Response Act 2002
- Is the Authority's SRMC approach aligned with how markets and generators would reasonably be expected to behave in New Zealand
- Is the Authority's SRMC approach aligned with sound electricity market economics?"

This section answers this through consideration of the SRMC approach adopted by the Authority. In response to the last two bullet points, we have combined these due to crossover in their considerations.

2.3.1 Description of SRMC Threshold and Floor

For thermal plant (and applicable non-must-run bidding cogeneration), the application of the SRMC Threshold and Floor is as follows:

- Thermal plant SRMC is calculated for each candidate thermal plant using either publicly available data or disclosed graphical data [2], comprised of the plant's heat rate, fuel costs, VOM, carbon intensity and carbon price spot exposure. This is also done for applicable cogeneration where offers are not limited to must-run price levels of $0.01/MWh
- The effective emissions price is computed for each candidate thermal plant based on its fuel type, associated carbon intensity of that fuel, the spot carbon price and the plant's heat rate
- Where a plant's offer tranche has a price greater than its SRMC, that offer price is reduced by the effective emissions price faced by that plant, reduced to a minimum based on the plant's SRMC (the price floor for that plant)
- Where a plant's offer tranche has a price less than or equal to its SRMC, the offer price is deemed to be non-cost based in its construction and hence the effective emissions price is not deducted, and it is considered to be free of any ETS impacts.

For hydro plant with controllable storage, the application of the SRMC Threshold and Floor is as follows:

- A weighted average effective emissions price is computed by weighting each candidate thermal plant's individual effective emission prices by its Maximum Output Megawatts[3] and dividing by the total of all Maximum Output Megawatts across the set of candidate thermal plants
- An SRMC Threshold for hydro offer adjustment is established based on the lowest SRMC computed from the set of candidate thermal plants

[3] This value is part of a thermal plant's offers and represents the maximum generation capacity available at the time of each offer

- Where a hydro plant's offer tranche has a price greater than this SRMC Threshold, the offer price is reduced by the weighted average effective emissions price, reduced to a minimum of the floor price
- Where a hydro plant's offer tranche has a price less than or equal to the SRMC Threshold, the offer price is deemed to be relative to other non-cost based offers in the market and hence the weighted average effective emissions prices is not deducted, and it is considered to be free of any ETS impacts.

All other plant offers are free of adjustment, including those offer prices applied to non-carbon emitting generation such as wind, solar, BESS and other hydro with uncontrollable storage, geothermal plants (considered to be must-run bidders), and cogeneration that are offered at must run prices of $0.01/MWh.

2.3.2 Alignment of SRMC approach with Sec. 161FA of the Climate Change Response Act 2002

The key to assess this lies in the following points from the legislation:

- "use, as the counterfactual input, a reasonable estimate of the offers that would have been made for the electricity actually offered in the financial year if there were no liability to surrender units to cover emissions" – from Section 161FA of the Climate Change Response Act 2002 [1]
- "The modelling assumptions are that,—

  (a) in the absence of the emissions trading scheme, thermal electricity generation would be offered at lower prices as generators' marginal costs would be lower:

  (b) as a consequence of the modelling assumption in paragraph (a), hydro-electricity generators that have controllable water storage would offer electricity at lower prices, because lower overall prices reduce the opportunity cost of stored water." – from Climate Change (Eligible Industrial Activities) Regulations 2010 Clause 6A [4].

The above makes specific reference to thermal offering being at lower prices due to "generators' marginal costs" being lower. This is of course true for offers which are built up from a cost-based perspective, including the cost due to the carbon liability arising from the requirement to surrender credits, as well as other variable costs faced by thermal generators, including fuel and VOM costs. In these instances, we regard the removal of the assumed carbon cost component as being a reasonable estimate of the type of offering to be expected in the absence of the ETS. However, in a situation where offers are not built up from a cost-based perspective, it is reasonable to assume these offers would be unchanged in the absence of the ETS.

In terms of cost-based offers, it is expected that an economically rational thermal player will offer into the market to ensure they at least recover their variable costs (i.e., short run marginal costs or SRMC), and even offer at higher prices to ensure recovery of variable and fixed costs (i.e., long run marginal costs or LRMC). In these cases, as mentioned above, it is reasonable to assume that the impact of the ETS can be attributed to these types of offers as the carbon cost impact due to the requirement to surrender carbon credits to cover CO2 emissions. Therefore, removing this carbon cost impact provides a reasonable estimate of offering in the absence of the ETS.

However, it is also observed in electricity markets that thermal plant often include offer tranches that are at prices which are not in line with SRMC or LRMC, particularly offer prices that fall below SRMC.

Prices above this are also possible, where a thermal operator bids at high enough prices to avoid dispatch.

In the cases where offers are not cost-based and hence not impacted by the ETS, we believe it is reasonable to leave these unadjusted when assessing market outcomes in the absence of the ETS.

The motivation to adjust hydro offers where operators have controllable storage is also in alignment with the specific assumptions required as part of the Climate Change (Eligible Industrial Activities) Regulations 2010 Clause 6A [4]. While there is potential to consider an approach that adjusts hydro offers in an optimised market sense, an approximation of hydro response based on reducing hydro offers by the weighted average cost of thermal emission costs is both reasonable and pragmatic.

We therefore believe that the Authority's SRMC approach is aligned with Section 161FA of the Climate Change Response Act 2002.

2.3.3 Alignment of SRMC approach with how Markets and Generators behave, and with Sound Economic Principles

The Authority's SRMC approach has attempted to better represent how emission related costs impact thermal offers. As discussed above, if an offer is deemed to not be cost-based, then it is reasonable to assume that emission costs will not impact that offer, and hence there would be no need for adjustment in the absence of the ETS.

There are several reasons for thermal generators to consider including offers being below SRMC. These include the following (references [5] and [6] discuss relevant supporting points in the context of the NEM):

- Avoidance of shutdown and startup costs and avoidance of startup delays: There are significant costs associated with shutting down and starting up thermal plants, as well as delays in bringing the plant back online. To avoid this risk during potentially low-priced periods, thermal operators often include a low-priced offer tranche to ensure continuity of operations. This is also done as a risk management practice, keeping plant at a minimum stable level during low priced periods (for instance overnight) to ensure the ability to quickly ramp up generation should prices spike
- Impact of hedging in the market: Hedging effectively insulates generators from the risk of low prices, and although it doesn't directly incentivise thermal running below SRMC, it helps provide cost cover should the generator desire to stay online given considerations as described in the above bullet point
- Fuel contracts that have take-or-pay conditions, meaning that fuel can be lost if unused. In these situations, the potential for pre-paid fuel to be lost effectively drives its cost to zero. Although in this instance, it is arguable that a low-priced offer could still be considered to be at SRMC due to the implied fuel cost being zero, the considerations under the first bullet point are often the key driver for continued operation, and as such, consideration of emission costs is unlikely to be a consideration

- Portfolio impacts of Gentailers: There may be cases where running below SRMC helps reduce overall spot prices and in doing so, creates significant savings across a gentailer's overall market purchase position in support of its retail sales.

The occurrence of these types of offers are clearly seen in offer data available from the market[4]. Furthermore, they are reasonably justifiable and expected given economic considerations and the management of spot exposure risk.

We believe that the approach is therefore aligned with how markets and generators behave as well as aligned with sound electricity market economics.

[4] https://www.emi.ea.govt.nz/Wholesale/Datasets/BidsAndOffers/Offers

References

[1] ‘Determining electricity allocation factors, Section 161FA of the Climate Change Response Act 2002’. Accessed Nov 11, 2024. [Online]. Available: https://www.legislation.govt.nz/act/public/2002/0040/latest/LMS935379.html?search=sw_096be8ed81eaa69e_161FA_25_se&p=1&sr=4

[2] ‘Determination of the 2024 Electricity Allocation Factor’. Accessed Nov 11, 2024. [Online]. Available: https://www.ea.govt.nz/documents/5348/Determination_of_the_2024_Electricity_Allocation_Factor.pdf

[3] ‘vSPD overview’. Accessed Nov 11, 2024. [Online]. Available: https://www.emi.ea.govt.nz/wholesale/Tools/vSPD

[4] ‘Modelling assumptions for market model used to determine allocation factors for electricity, Clause 6A of the Climate Change (Eligible Instrutrial Activities) Regulations 2010’. Accessed Nov 11, 2024. [Online]. Available: https://www.legislation.govt.nz/regulation/public/2010/0189/latest/LMS934530.html

[5] ‘Assessing The Viability Of Energy-Only Markets With 100% Renewables: An Australian National Electricity Market Case Study'. *Economics Of Energy & Environmental Policy*, *5*(1), 105–130. Accessed: Nov 11,2024. [Online]. Available: https://www.jstor.org/stable/26189401

[6] ‘The impact of congestion on bidding and inter-regional trade in the NEM Introduction and Summary’, 2012. Accessed: Nov 11,2024. [Online]. Available: www.aer.gov.au.

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