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Review of the electricity allocation factor implications of the revised electricity supply contract between NZAS and Meridian

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Executive summary

Concept have been asked to evaluate the extent to which the electricity price in the renegotiated contract between Meridian and New Zealand Aluminium Smelters (NZAS) is likely to have been higher because of the carbon price in the ETS.

Our analysis shows that it is most likely there will have been no carbon-price-driven electricity price uplift in this contract price. Indeed, it is likely that the contract price agreed between Meridian and NZAS would have been higher in a world without a carbon price. In other words, the carbon-price-effect for the NZAS contract was *negative*.

This outcome is due to the changes to the electricity system, in particular that of Meridian's generation, had Tiwai exited. The removal of Tiwai's sizable demand would have led to significant surplus of generation with the following key dynamics:

- A collapse in wholesale prices in the South Island relative to the North Island, with the North Island also facing a (less significant) fall in wholesale prices. This situation would have significantly affected Meridian's profitability, giving them an incentive to negotiate a revised – albeit significantly lower – price than was agreed in 2015 i.e., better to get something, than nothing.
- A significant increase in the proportion of time when the North Island's marginal generator (the electricity price setter) would not be fossil-fuelled generation. In addition, it is likely that some (potentially all) remaining coal-fired generation would retire.

Our modelling demonstrates that these key dynamics give rise to the outcome that the lower bound of the price that Meridian would have been willing to receive to keep the smelter operational would be lower in a with-carbon-price world than in a without-carbon-price world.

It is therefore our strong recommendation that the Excel model used to determine NZAS's free allocation of NZUs use a value of $0/MWh electricity price uplift.

Given this dynamic of NZAS most likely not having faced any increase in electricity price due to the price of carbon in the ETS, continuing to use the current EAF approach used for allocating NZUs to NZAS would result in significant over-allocation to NZAS.

For example, if carbon prices out to 2024 were to follow the trajectory indicated by the Climate Change Commission, then continuing to use the approach that was chosen for estimating the carbon price effect for the 2015 contract agreed between NZAS and Meridian would:

- s 9(2)(b)(ii) [redacted]
- Result in NZAS receiving over one-quarter-of-a-billion dollars' worth of free allocation of NZUs to compensate for a supposed electricity price increase that it actually did not incur.

1 Background

1.1 EITE businesses who consume electricity receive industrial allocation units to compensate for carbon-driven higher electricity prices

As part of the industrial allocation process, emissions-intensive trade-exposed (EITE) parties are awarded NZUs to cover the electricity price increases that they may face as a result of the ETS.

This is currently achieved through multiplying the electricity intensity of the activity (expressed as MWh/unit of activity output), by an electricity allocation factor (EAF) expressed in tCO_2/MWh. This electricity allocation factor is intended to represent the emissions price intensity of the electricity sector as a whole, and assumes that the electricity price impact of a cost of carbon will be the carbon price multiplied by this factor.

Most EITE industrial electricity users receive NZUs via a 'standard' EAF. This is currently set at 0.537 tCO_2/MWh – which has been held constant for several years. However, it is due to change following recent consultation to an approach which sets an annual EAF. We understand the most likely value for 2020 will be 0.316 tCO_2.[1]

1.2 A separate process has been followed for the EAF to apply to NZAS' electricity purchases

A deviation from the application of the 'standard' EAF is that applied to the New Zealand Aluminium Smelter (NZAS) which has a specific EAF for all electricity purchased under the contracts between itself and Meridian.

Electricity is supplied to NZAS by Meridian under two separate arrangements:

- ***The 'main' contract*** covering supply of electricity to the three largest pot lines.

  This contract was first negotiated in 1994 and has had various amendments over the years. The version which applied until the end of last year was agreed in 2015. We refer to this as the '2015 main contract'.

- ***The 'fourth potline' contract*** for supply of electricity to the fourth, smaller pot line.

  This was agreed in 2018 and had a fixed term of four years and five months, ending 31-Dec-22

The fundamental rationale for having a specific EAF for these sales of electricity to NZAS is that:

- The standard EAF was developed using a conceptual framework which was based on a short-term price impact of carbon i.e. one which assumed that the price of carbon would not affect plant investment and retirement decisions. This is only appropriate (if at all)[2] for industrial allocation to compensate for electricity purchased from the spot market or via short-term contracts.
- However, the much longer-term of the NZAS contract (the 2015 main contract covered electricity sales until 31 December 2030) means that the nature of carbon price impact is likely to driven by long-term electricity price drivers. Specifically, the carbon price impact on long-term electricity prices will be driven by the impact on the long-run marginal cost (LRMC) of new-entrant generation.

[1] Based on email from s 9(2)(a) on 29 June 2021.

[2] Past Concept advice on this matter (as most recently detailed in our report "*High-level review of approaches for estimating a standard electricity allocation factor*", 1 May 2015) has consistently been that the standard EAF should be based on the price effect of carbon on the long-run marginal cost (LRMC) of the marginal new-entrant generation that sets electricity prices over the long-term.

1.3 A range of options was assessed for the methodology to calculate the NZAS-specific EAF for the 2015 main contract and fourth potline contracts

The current NZAS-specific EAF process applies specific fixed EAFs for electricity supplied under the main and fourth potline contracts. The rationale for the EAFs used in each case are set out in the following Concept reports:

- *"Review of electricity allocation factor for NZAS electricity contract"*, 15 November 2016; and "*Impact of the revised Meridian electricity contract on the emissions price intensity of aluminium produced by NZAS*", 16 January 2014. These detailed possible approaches for an EAF to apply to the 2015 main contract. This included:
  - A 'fixed value' approach whereby modelling and/or discussions with Meridian would have been undertaken to try and determine the extent to which the strike price in the contract was higher due to the ETS. Having determined this fixed $/MWh value, the EAF to apply to NZAS would be determined at the end of each year using the known carbon prices applying during the course of that year and setting the EAF to achieve the fixed $/MWh value. This was Concept's recommended approach in its 2014 report.
  - Various 'Fixed EAF' approaches, including:
    - Setting the EAF based on the emissions intensity of the type of new entrant generation that would drive prices over the long term.
    - Options based on the emissions intensity of the marginal operational plant at any moment in time (a 'short-term' approach which is fundamentally the approach used for the standard EAF).
    - A 'combined' approach (subsequently developed and put forward to Cabinet by MfE officials) which had an EAF which was the arithmetic average over the term of each contract for the following profile of year-specific EAFs:
      - Year 1 = The standard EAF applying to non-NZAS industrial allocation. Estimated to be 0.537 at the time of the 2016 analysis.
      - Year 6, and all subsequent years = An EAF based on the assumed emissions-intensity of the marginal new-entrant generator. This was set at 0.14, based on an estimation of the emissions intensity of geothermal generation.
      - Years 2 to 5 = linear interpolation between years 1 and 6.

  Cabinet, based on MfE officials' advice chose the 'Combined' approach which resulted in a figure of 0.206 tCO_2/MWh.

- *"Advice on carbon cost pass through in 2018 New Zealand Aluminium Smelter electricity contract"*, 11 September 2018. This detailed the rationale for the EAF to apply to the fourth potline contract which, purely on the grounds of methodological consistency with the approach chosen for the main contract, was also the Combined approach. This resulted in a figure of s tCO_2/MWh for electricity sold under this contract – higher than the 0.206 tCO_2/MWh value for the main contract due to the fourth potline contract's much shorter duration.

1.4 A new electricity contract has been signed

In July 2020, NZAS announced that the smelter was not profitable, and that it was terminating its contract with Meridian such that the smelter would close at the end of August 2021.

After this announcement, Meridian and NZAS entered negotiations culminating in a revised contract being signed on 14 January 2021. This revised contract covered supply of electricity to the smelter's three largest potlines starting from 1 January 2021, and replaced many of the terms (including price) in the 2015 main contract.

We refer to this revised contract as the ‘2021 main contract’.

MfE have asked Concept to advise on the implications of this revised contract for the setting of the NZAS-specific EAF.

2 Key differences between the 2021 and 2015 main contracts

The 2021 contract is not a completely new contract, but rather an amendment to the 2015 contract, which in turn was an amendment to an earlier version.

Most of the terms are unchanged. However, there are a few key differences:

- The term of the 2021 contract is much shorter, expiring on 31 December 2024 – a term of 4 years. The 2015 contract expiry date was 31 December 2030 – a term of approximately 15 years.
- The electricity price in the 2021 contract is substantially lower than the 2015 contract:
  - s 9(2)(b)(ii) [redacted]
- [redacted]
  - [redacted]
  - [redacted]

3 Estimating the likely effect of the carbon price in the ETS on the electricity price in the 2021 contract

3.1 The drivers behind the 2021 contract are such that the carbon price effect must be very low

Although the basic pricing mechanisms of the 2021 contract are substantially the same as the 2015 contract, applying the same 'combined' approach to estimating the effect of the carbon price on the electricity price in the 2021 contract would be completely inappropriate.

This is because the circumstances of the 2021 contract are such that the carbon price effect must be substantially lower – potentially even negative![3]

The key dynamics driving this outcome are:

- The Tiwai aluminium smelter is very large in the context of the New Zealand electricity system – almost 13% of national demand – and even larger as a proportion of Meridian's generation sales – approximately 42%.
- Had a revised contract not been renegotiated, the smelter would have closed at the end of August 2021. The consequences of this closure would be to push the New Zealand system into a situation of significant over-supply resulting in a significant fall in wholesale electricity prices.
- The fall in electricity prices would be a significant hit to Meridian's profitability. This provided them a strong incentive to renegotiate a contract which would prevent, or postpone, the smelter closing, even if the revised contract price was substantially lower than the 2015 contract price. The lower bound of what they would be willing to receive for this revised contract price would be the price at which their profitability would be the same whether the smelter stayed or exited. We refer to this lower bound as their 'point of indifference'.
- Had the smelter closed, there would have been a significant price dislocation between the North and the South islands due to substantially increased losses and constraints across the HVDC interconnector. Instead of South Island prices being approximately 11% lower than North Island prices – the historical average to-date – South Island prices would be likely to be at a substantially greater discount to North Island prices for the first few years after the smelter exited.[4]
  - Because over 80% of Meridian's generation is in the South Island, this would have a significant effect on their point of indifference for the renegotiated contract price.
  - In the context of working out the price effect of carbon on this contract price, the increased price separation between the islands would significantly reduce the price effect of carbon on North Island fossil generators on South Island prices. (Noting that the only fossil-fuelled generators are in the North Island.)
- Lastly, had the smelter closed, the subsequent over-supply would have resulted in sustained periods where no fossil generators would be operating (particularly during periods of low

[3] A negative carbon price effect means that the contract price in this with-carbon-price world is lower than would have been the case if there had been no carbon price.

[4] A key market observation supporting this assertion is based on the spread between Otahuhu (North Island reference) and Benmore (South Island reference) futures contracts traded on the ASX. Typically, Benmore prices are approximately 11% lower than Otahuhu prices, largely reflecting transmission losses with some relatively infrequent transmission constraints. However, shortly after NZAS's 9 July 2020 announcement that it was going to close the smelter from the end of August 2020, the price of Benmore contract futures collapsed, whereas those for Otahuhu contract prices fell much more modestly. The spread reflected Benmore prices being at a 40-45% discount to Otahuhu prices.

demand and high renewable generation production), and the likely retirement of many of the remaining fossil fuel generators, including some of the Huntly coal-fired Rankine units. This significant reduction in the amount (and carbon-intensity) of fossil generation operating on the system would have substantially reduced the carbon price effect on North Island electricity prices (as represented by the standard EAF).

3.2 A model has been developed to estimate the likely carbon price effect

Concept has developed a spreadsheet model ('NZAS_2021_Contract_Carbon_Price_Effect_v01') to determine the likely 2021 contract electricity price which would represent Meridian's point of indifference.

The model estimates the generation-weighted average price that Meridian would have received across their generation portfolio if Tiwai were to exit in August 2021. This estimated value is referred to as the whole-of-portfolio-sales-weighted average price. The calculation takes the following into account:

- Likely changes to North and South Island wholesale prices following an exit
- The extent to which some of Meridian's sales under longer-term contracts would transition more slowly to these future post-Tiwai-exit prices than spot market sales or shorter-term contracts.
- The effect of Meridian being able to receive some of the 'rentals' across the HVDC interconnector (via receiving the Financial Transmission Right (FTR) auction receipts), and how this will change in the future with the exit of the smelter and changes to the Transmission Pricing Methodology. Being able to receive some of the HVDC rentals has the effect of enabling some proportion of Meridian's South Island generation to receive North Island prices
- The likelihood that following a Tiwai exit, transmission constraints in the lower South Island would limit Meridian's South Island hydro generation's production, risking Meridian's hydro reservoirs breaching their maximum water level resulting in spill. The price received for spill is effectively $0/MWh. This effect would persist until the transmission network in the lower South Island is upgraded.

The model then determines what the 2021 Tiwai contract price would need to be in the 'Tiwai stays' future in order for Meridian to achieve the same profitability as in the 'Tiwai exits' future. This is based on the estimated whole-of-portfolio-sales-weighted average price being the same in the 'Tiwai exits' case and the 'Tiwai stays' case, thereby resulting in the point-of-indifference Tiwai contract price.

This calculation takes into account the extent to which wider New Zealand market outcomes would be different if Tiwai were to ~~stay,~~ stay including wholesale prices, flows across the HVDC, and avoided spilled generation.

The modelling of this point-of-indifference price is run in two modes:

- With-carbon-price: i.e. reflecting the actual situation
- Without-carbon-price: i.e. reflecting New Zealand wholesale price outcomes (and subsequent Meridian sales price outcomes) that would have occurred if there were no price of carbon.
  - For this mode, North Island electricity prices are assumed to be lower by the expected carbon prices at the time the contract was negotiated (assumed to be $50/tCO_2$ at the start of 2021,

rising to \$53.06/tCO_2 by the end of 2024)[5], multiplied the electricity price intensity factor (being 0.316 tCO_2/MWh if Tiwai stays, and falling to 50% of this level if Tiwai exits). This electricity price intensity factor is using the approach decided on by MfE for setting the standard EAF following its recent consultation – i.e. our model is entirely consistent with the framework used to compensate other EITE electricity consumers under the Industrial Allocation process.

– South Island electricity prices are equal to the North Island prices multiplied the South/North location factor – which is assumed to be the same in percentage terms in the with and without-carbon worlds.

The difference between this point-of-indifference-contract-price in the with and without carbon price futures reflects the carbon price effect.

3.3 The model results indicate the likely carbon price effect was *negative*

Under a central set of assumptions, our model indicates that Meridian's point of indifference was

- s 9(2)(b)(ii) [redacted]
- [redacted]

In other words, the carbon price effect described above has resulted in Meridian requiring a s [redacted]/MWh *lower* NZAS contract price in the with-carbon world. When compared against the average assumed carbon price expectation over the four-year contract term, this gives an effective EAF of 0.084.

To test the robustness of this outcome we explored key sensitivities:

- The greater the % drop in North Island electricity prices following a Tiwai exit, the lower the indifference price in both the with- and without-carbon-price worlds by the same absolute extent i.e. the \$/MWh price effect and effective EAF are unchanged.
- The greater the extent of price separation between the North and South Islands following a Tiwai exit, the lower the indifference price. The indifference price falls more for the with-carbon world, resulting in an even more negative \$/MWh price effect of carbon and effective EAF. Even if there were no change in price separation, the \$/MWh carbon price effect would still be negative (albeit smaller).
- The greater the carbon price expectation, the greater the difference in the indifference price between the with- and without-carbon price worlds leading to an even more negative \$/MWh price effect of carbon. In all scenarios of carbon price, the carbon price effect is negative.
- The greater the assumed price effect of carbon on North Island electricity prices, the greater the difference in the indifference price between the with- and without-carbon price worlds leading to an even more negative \$/MWh price effect of carbon. The \$/MWh magnitude of the carbon price effect moves proportionately to the assumed tCO_2/MWh price effect of carbon on North Island electricity prices.

The only situation where the carbon price effect on-Meridian's indifference price would be positive (i.e. the opposite to the usual case and sensitivities above) is in scenarios where it was assumed that the price effect of carbon on North Island electricity prices (i.e. the standard EAF) would not change following a Tiwai exit.

[5] The values are based on the effective price cap in the ETS from the operation of the cost containment reserve (CCR) mechanism that was in place at the time the contract was negotiated. (Noting that the CCR price cap settings have recently increased).

The threshold point where Meridian's indifference price would be unaffected by carbon prices is if the standard EAF only fell by 25% following a Tiwai exit. If the standard EAF were to fall by more than 25%, the carbon price effect on Meridian's indifference price would be negative and vice versa.

It seems implausible that there would be no change in the price effect of carbon on North Island electricity prices following a Tiwai exit given that the system would be moving from a situation where fossil fuel generators are operationally marginal for most of the time, to one where there would be significant periods of time when there would be no fossil fuel generators operational. Further, given that the proportional drop in coal generation is likely to be greater than that of gas-fired generation following a Tiwai exit, the reduction in the standard EAF is likely to be greater than if it were all gas-fired generation that was to be displaced.

We have chosen a central value of a 50% fall in the price effect of carbon on North Island electricity prices following a Tiwai exit based on simple high-level analysis on the change in the tCO_2/MWh emissions intensity of marginal generation.

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4 What if the EAF-estimation methodology used for the 2015 contract were applied to the 2021 contract?

Given that the pricing mechanisms of the 2021 contract are fundamentally no different to the 2015 contract or the Fourth Potline contract, it could be considered methodologically consistent to continue to use the 'Combined' approach.

This would be to have an EAF fixed for the duration of the contract, but with this value set as the arithmetic average over the term of each contract for the following profile of year-specific EAFs:

- Year 1 = The standard EAF applying to non-NZAS industrial allocation. We understand that MfE (following its consultation) is leaning towards a revised approach which would result in a standard EAF of approximately 0.316.
- Year 6, and all subsequent years = An EAF based on the assumed emissions-intensity of the marginal new-entrant generator. This was originally set at 0.14, based on an estimation of the emissions intensity of geothermal generation.
- Years 2 to 5 = linear interpolation between years 1 and 6.

If this approach were adopted, it would result in a value of 0.263 tCO_2/MWh.

To illustrate the extent to which this approach would result in outcomes which are radically different to our evaluation of the likely actual outcomes set out in section 3, we have estimated the impact of applying this approach if carbon prices follow the carbon price trajectory indicated by the Climate Change Commission as being necessary to achieve our net-zero-by-50 target – noting that the recent lifting of the effective price cap in the ETS would enable such a price trajectory.

This price trajectory would move from \$50/tCO_2 in 2021, to \$51.7/tCO_2 in 2022, and then rising linearly to \$73.4/tCO_2 in 2024.

If carbon prices followed this trajectory and a 0.263 EAF were used, s 9(2)(b)(ii) [redacted]

Based on the analysis we set out in Section 3, we think this level of price impact seems implausible, and thus the level of NZU free allocation unjustifiable.

That said, there are various parameters to the combined approach which could appropriately be altered:

- The time for the EAF to transition to the emissions intensity of the marginal new entrant generator is, in our view, too long. We think investment timescales for the market to respond to changes in expected demand or input prices would be more in the order of 2 to 3 years given a sufficient pipeline of potential wind projects with consents, and even shorter for utility solar projects.
- We think the current 0.14 tCO_2/MWh emissions intensity representing the marginal new entrant generator is too high:
  - This value was based on the expectation of the emissions intensity of new geothermal stations. However, the latest information published by MBIE[6] suggests that new geothermal stations will have an emissions intensity of 0.05 tCO_2/MWh.
  - Further, it is highly likely that geothermal stations will not be the marginal new entrant generator. While there will undoubtedly be new geothermal developments, the extent of geothermal development will be dictated by the finite nature of the resource. Rather, in the

[6] *"Future Geothermal Generation Stack"*, March 2020

long-term, the type of new-entrant generation whose extent of development will vary in response to changing market conditions will be wind and solar. These have no operational emissions. This view is consistent with various modelling exercises done for MBIE and the Climate Change Commission.

- Lastly, for reasons we have outlined in our previous reports, we think the methodology for determining the standard EAF will substantially overestimate the effect of carbon prices on electricity prices in the long-term.

We have set out the effect of different 'Combined' options with different parameters in Table 1 below.

Table 1: Effect of different parameters to use for 'Combined' approach on NZAS EAF

Option	Yr 1 EAF (tCO2/MWh)	Long-term EAF (tCO2/MWh)	Years to reach long-term	Resultant NZAS EAF (tCO2/MWh)	Implied contract price increase using CCC carbon price trajectory %	$/MWh	Value of NZUs given to NZAS ($m)
1	0.32	0.14	5	0.26	81%	15.6	274
2	0.32	0.14	2.5	0.22	59%	13.0	228
3	0.32	0.02	2.5	0.15	35%	9.1	159
4	0.20	0.02	2.5	0.10	21%	6.0	105
5	0.02	0.02	2.5	0.02	4%	1.2	21

2021 NZAS Allocation spreadsheet v01.xlsm

For the reasons we have articulated in Section 3, we think the true effect of the expected emissions price on the 2021 contract price will actually be negative.

5 Changes to the NZAS allocative baseline model

We have made some amendments to the allocative baseline model[7]:

- Enabling the effective EAF which applies to NZAS each year from 2021 onwards to be based on a fixed $/MWh electricity price impact. This is our recommended approach.
  - Our recommendation is that this electricity price impact be set to $0/MWh.
  - If a positive $/MWh number is chosen, this will require MfE to update the model with actual monthly carbon prices at the end of each year before determining NZAS's final allocation.
- We have also allowed for a continuation of a fixed EAF approach to be used for sales under the 2021 contract, even though this is not our recommended approach.
- Allowing for year-specific standard EAFs to be used to determine any allocation for potential 'spot' electricity purchases outside the Meridian contract. Strictly speaking these should be factored down by the location factor between North and South Island electricity prices. This could be easily introduced if MfE desired, although it would be inconsistent with the past approach to awarding units for electricity spot purchases where there was no such location factor adjustment.

We have not made any changes to the approach applied to sales for the fourth potline, as we understand that the contract terms for this have not change. MfE and NZAS will need to confirm that this is the case.

[7] The model has been renamed '2021 NZAS Allocation spreadsheet v01'

6 Summary recommendation

Our analysis indicates that NZAS likely suffered no adverse carbon-price impact on the electricity price negotiated in the 2021 contract.

As such, we would recommend that a $0/MWh price uplift value be used in the allocative baseline model used to determine NZAS's industrial allocation.

Given this dynamic of NZAS most likely not having faced any increase in electricity price due to the price of carbon in the ETS, continuing to use the current EAF approach used for allocating NZUs to NZAS would result in significant over-allocation to NZAS.

For example, if carbon prices out to 2024 were to follow the trajectory indicated by the Climate Change Commission, then continuing to use the approach that was chosen for estimating the carbon price effect for the 2015 contract agreed between NZAS and Meridian would:

- s 9(2)(b)(ii) [redacted]
- Result in NZAS receiving over one-quarter-of-a-billion dollars' worth of free allocation of NZUs to compensate for a supposed electricity price increase that it actually did not incur.