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FURTHER FEEDBACK ON CBA MODELLING

1 Introduction and summary

1.1 Introduction

1.1.1 Trustpower Limited (**Trustpower**) appreciates the opportunity to provide further feedback to the Electricity Authority (**the Authority**) on the cost-benefit analysis (**CBA**) supporting the Authority's proposed TPM guidelines (**TPM Guidelines**) in its second TPM issues paper (**Second Issues Paper**).

1.1.2 This letter should be read in conjunction with Trustpower's letter titled "*Feedback on the Q&A Session on the TPM CBA calculations*", also dated 4 April 2017 and submitted to the Authority contemporaneously (**Q&A session letter**).

1.2 New information in this letter

1.2.1 We have already provided a significant level of feedback to the Authority on the CBA prepared by Oakley Greenwood (**OGW**).

1.2.2 As noted in our Q&A session letter, on 23 March 2017 the Authority published a revised version of OGW's calculations of the benefits of removing the current HVDC link charge (**revised HVDC workbook**). This was provided three and a half working days before the deadline for questions to be submitted to OGW for the Q&A session.

1.2.3 We have completed only an initial analysis of this revised HVDC workbook, given the time available. Our initial conclusion is that, like the first workbook, it is subject to new errors and issues which have significantly inflated the estimated benefits of removing the current HVDC charge. As was the case with the original HVDC workbook, the issues mask net costs of removing the HVDC charge (despite the fact that, as we have discussed previously, the modelling is designed to produce a net benefit).

1.2.4 We have asked our expert advisors HoustonKemp to examine the revised HVDC workbook, and to suggest amendments to the workbook to account for any issues they found. We have prepared an adjusted workbook, containing these amendments, which is appended to this letter. HoustonKemp's initial conclusions are summarised in the following section.

1.2.5 In light of the significant number of errors we, other submitters and various experts have already identified in the OGW analysis, following the publication of the revised HVDC workbook we have also commissioned a New Zealand-based expert in electricity wholesale market modelling and forecasting (**market modelling expert**) to analyse in particular the capacity expansion modelling undertaken by OGW in that workbook, and in its original modelling of the benefits of introducing the area of benefit charge (**AoB charge modelling**). This expert has significant expertise in undertaking capacity expansion modelling in New Zealand, and is well respected within the industry.

1.2.6 Given the short timeframes, the market modelling expert has been unable to complete their review prior to the Authority's deadline for receiving final comments on the CBA Q&A session. However, they have agreed to us providing the Authority with a very early draft of their observations, providing that we do so on a confidential basis and that caveats around the early stage of the review are duly noted by the Authority.

1.2.7 The market modelling expert's initial views have also been summarised in the body of this letter.

2 Benefits in the revised HVDC workbook have been overestimated due to errors

2.1 Introduction

2.1.1 In preparing this letter we have received extensive advice from our experts HoustonKemp. If the Authority would be assisted by written advice from HoustonKemp on any of the matters covered, they would be happy to prepare a formal report. Please let me know if you would like us to make this request.

2.1.2 We asked HoustonKemp to review the revised HVDC workbook after it was published by the Authority on 23 March 2017.

2.2 Summary of HoustonKemp's conclusions

2.2.1 It is clear that OGW have addressed some of the concerns we identified with the original HVDC workbook, including the incorrect locations of a number of the new generation projects and the calculation errors in the spreadsheet.

2.2.2 However, the revisions to the workbook have introduced a number of new issues.

2.2.3 HoustonKemp have highlighted to us several concerns with the methodology used in the revised model. These are described in the remainder of this section.

2.2.4 *Errors in the timing of build in the "old" schedule* – two plant in the "old" schedule (i.e. the schedule without SIMI charges) were built a year later than they should have been. *Hawea_Control_Gate_Retrofit* should have been built in year 5, not year 6, and *Lake Coleridge 2* should have been built in year 28, not year 29. These errors have led to net benefits being overestimated by $5.4m. We have corrected these errors in the attached spreadsheet.

2.2.5 *Issues relating to the calculation of terminal values* – OGW's revised modelling includes terminal values at the end of the 30-year assessment period. The aim of terminal values is to consider only the capital expenditure that is 'used' in the assessment period. In other words, terminal values provide a refund for the residual value of capital that remains at the end of the assessment period. While we agree that terminal values should be included in the modelling, we have concerns about OGW's approach for applying terminal values:

a) The replacement of wind farms

Wind farms, and only wind farms, are replaced outside of the assessment period in OGW's revised model. OGW has decided to replace windfarms because their asset lives are significantly shorter than the other generator types (based on OGW's assumed lifespans), and

in order to "*place wind generation capacity on an equivalent basis to other generation investments*" (see OGW's response and further discussion from A.9.1 in the Q&A session letter).

However, the wind farms' shorter lifetimes are already accounted for in their lower terminal values, so windfarms should instead be treated as any other generator in the model. Including replacement along with terminal values for wind farms is inconsistent, and has led to net benefits being overestimated significantly, by $25.3m

The attached spreadsheet does not consider the replacement of any generators which reach the end of their useful lives outside the assessment period.

b) Consideration of opex incurred outside the assessment period

OGW's revised model includes the operational expenditure (opex) incurred for the generators for 50 years after they are built. However, the model considers only the capital expenditure (capex) incurred within the 30-year assessment period. These two methods for capturing opex and capex terminal values are inconsistent.

The effect of these inconsistent assumptions is that, for two assets with identical lifetime costs but a different weighting of capex and opex, OGW's model would understate the costs of the high-capex/low-opex asset relative to the low-capex/high-opex asset. This issue has led to net benefits being overestimated by $7.8m.

The attached spreadsheet assesses only opex and capex incurred within the assessment window in the attached analysis. Another possibility would be to broaden the assessment period to a much longer period – i.e. considering capex, opex and replacement costs over that longer period of time.

c) Depreciation method used for capital costs' terminal values

Depreciation is incorporated into terminal values, and calculates the proportion of the asset's capital cost that is 'used up' each year.

OGW applies straight-line depreciation, which 'front-loads' the recovery of capital costs. This means that a higher than proportional share of the capital costs of an asset are recovered in the first years of its life, i.e. the years within the assessment period. Straight-line depreciation estimates low terminal values consistent with this assumption.

The value of the services provided by generation assets is approximately constant over their useful lives – they provide the same capacity every year. The depreciation method used should reflect the assets' constant value, and the capital recovery should be evenly spread across the useful life. The annuity depreciation method is a standard tool for this requirement, and the attached spreadsheet uses this method to calculate terminal values.

This issue has led to net benefits being overestimated by $2.7m.

d) Asset lifespans

OGW's calculations of terminal values rely on the useful lives of the generators that are being built in the modelling period. However, the lives that OGW uses do not match the asset lifespans used by MBIE in its LRMC model, where OGW draws its inputs from, including its estimates of LRMC. Asset lives should be a consistent assumption across the modelling. The attached spreadsheet corrects for this inconsistency by adopting the MBIE asset lifetimes, which are significantly shorter than those assumed by OGW. Using MBIE's asset lifetimes actually increases net benefits in the model, by $8.7m.

2.2.6 *Other issues with the model* - Aside from those issues relating to the terminal value calculation, we have identified two further inconsistencies with OGW's revised modelling, which compromise its usefulness:

e) *Generator capacity and cost divisibility*

Unlike the generation build schedule in the original HVDC workbook, the build schedule in the scenario with the SIMI charge in OGW's revised HVDC model now builds generators *in instalments*, in some cases bringing only a proportion of the new generator's capacity onto the grid at one time. Correspondingly, the costs involved with building that generator are assumed to be divisible, and incurred across multiple years according to the portion of generation that has come online.

For example, the 240 MW *Rodney_CCGT_stage_1* plant is assumed to come online in three instalments: 17 MW in year 10, 35 MW in year 11, and the remaining 188 MW two years later in year 13. Capital costs are incurred in each of those three years on a pro rata basis. FOM and VOM costs are incurred from the year of the first instalment onwards (these are also prorated).

These assumptions do not reflect reality. While we understand that OGW's assumption is intended to align the capacity that is built each year between the scenarios with and without the SIMI charge, this is not consistent with the framework for analysis that it has devised, and will not promote comparability.

OGW's framework for analysis is to compare the present value costs of new generation with and without the HVDC charge. To do this requires estimates of the build order and timing of generation in each of these scenarios. OGW's assumption that the capital costs and capacity of a new generator can be smeared over up to four years distorts this framework. Instead, OGW's new model compares the present value of new generation without the HVDC charge to a shadow of this build schedule that reflects the build *order*, but not *timing*, of the scenario with the HVDC charge.

The reason that the capacity built in each scenario differs is because the characteristics of the generation plant assumed to be built in each scenario are different. In particular, the average capacity of generation plant built with the HVDC charge is higher than without the HVDC charge. In OGW's flawed modelling framework, this means that new generation is built later, on average, in the scenario with the HVDC charge, which explains why there is lower investment in that scenario.

OGW's framework for analysis means that it should end up calculating net benefits associated with removing the HVDC charge. The fact that it does not is because its framework for analysis is implemented poorly and in a way that is inconsistent with the assumptions that it imports from MBIE. The proposal to smear the capital costs and capacity of new generation over time is an ad-hoc adjustment that is inconsistent with reality, and with OGW's framework for analysis. It should not be implemented in the CBA. The focus of changes to OGW's CBA should be on improvements to the quality and robustness of the modelling that will refocus analysis onto the TPM Guidelines that it is supposed to assess.

OGW's new method of modelling capacity expansion has led to two material issues in the revised HVDC workbook.

1. Terminal values in the "new" schedule (i.e. including SIMI charges) are underestimated, as they assume a new plant's asset lifetime commences in the year in which the first portion of costs is incurred (even though this may only be a small fraction of the generator's total capacity). This issue has led to net benefits being overestimated by $36.4m.
2. As discussed above, the capital, VOM and FOM costs are all brought forward for those plant assumed to be built in instalments. This is inconsistent with the scenario without the SIMI charge, in which capital costs are only incurred in one year (the year in which the plant is built), and FOM and VOM costs are incurred each year thereafter.

This is also inconsistent with how OGW has modelled capacity expansion in other parts of its CBA. This issue has led to net benefits being overestimated by $42.8m.

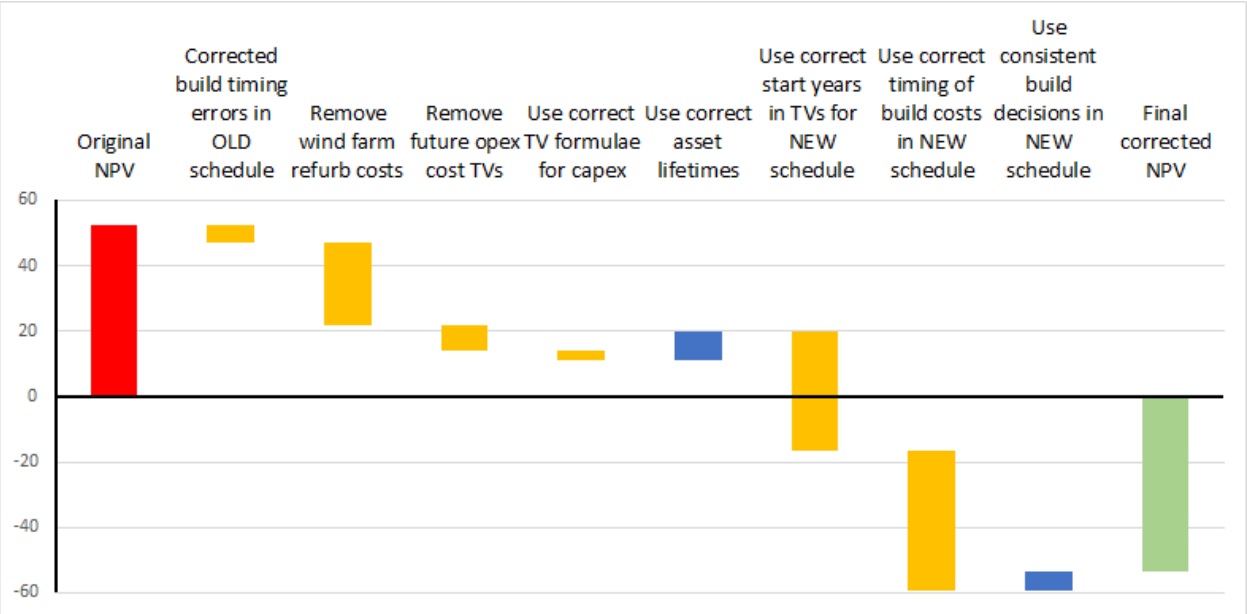
The attached spreadsheet applies the same rule for determining the timing of new generation entry (and cost allocation) in both scenarios.

f) Inconsistent use of the generator selection rule

In previous versions of OGW's modelling, it appeared that new generation was built when the unmet demand for electricity exceeded the capacity of the next generator. However, this rule is not applied consistently in the revised version – the 'no HVDC' schedule is different in the revised model than in the previous version, despite there being no changes to the underlying aim or assumptions of the modelling. The attached model corrects for this error by consistently applying the previous selection rule across both scenarios.

This inconsistency has led to net benefits actually being underestimated by $6m.

2.2.7 In summary, after amending the revised HVDC workbook to account for the errors and issues identified by HoustonKemp, we calculate a **net cost of $53.3 million** from removing the current HVDC charge, instead of the net benefit of $52.3 million estimated by OGW. The waterfall chart of the differences between the two estimates is shown below:



3 New review reveals more material concerns with the CBA modelling

3.1 Introduction

3.1.1 As discussed in the introduction to this letter, we have engaged a New Zealand-based market modelling expert to review the capacity expansion modelling performed by OGW.

3.1.2 We wish this further review to appraise the CBA modelling afresh, without regard to views or analysis already undertaken by Trustpower or any other industry participant. To ensure the new review achieves this objective, we have selected an expert who has not been involved in the recent consultation rounds on the TPM.

3.1.3 The market modelling expert's draft report is appended to this letter, on a strictly confidential basis. The expert has included caveats in their report which emphasise that the review has not been completed as at the date of this letter, due to the significant time constraints in the consultation process.

3.1.4 At the Authority's request we will provide it with the finalised report once it has been completed.

3.2 Summary of expert's preliminary views on OGW's capacity expansion modelling

3.2.1 In the short time they have had available, the expert's review has highlighted a number of issues with the modelling which further impact the extent to which it can be relied upon by the Authority (noting the expert's caveats). These include that:

a) The modelling does not appear to conform to the expert's views of best-practice principles for modelling capacity expansion. In particular, the fact that the models use a measure of energy cost (LRMC, in MWh) to rank and select which plant will meet increases in peak demand (in MW), appears to confuse and conflate two aspects of best-practice modelling;

b) The scenarios examined in the modelling to determine the benefits of removing the HVDC charge are not the same as those used to assess the benefits of introducing AoB charges;

c) The scenarios across which the modelling has been assessed do not encompass the scenarios for which industry participants are typically accounting in their analysis – including low demand growth, a Tiwai exit, and changes in the relativity of the costs of different generation technologies (driven by, among things, gas prices);

d) The list of new projects used by OGW, and the demand assumptions, do not appear to be fit for purpose;

e) There are risks that the HVDC charge has been double-counted in the ordering of LRMCs in the revised HVDC workbook, as they may have been included in MBIE's LRMC calculation already; and

f) The costs of fuel and carbon emissions have not been accounted for in the generation cost cashflow analysis (despite OGW's recent response to the contrary, set out in the Q&A session letter).

4 Conclusions

4.1.1 The initial issues identified by the market modelling expert, and the errors and issues identified by HoustonKemp in the latest HVDC workbook further highlight the unreliability of the OGW CBA, and that OGW's recent attempt to bolster its CBA and in part correct previously identified errors has done little to improve the accuracy and reliability of the market modelling or overall benefits claimed.

4.1.2 In making its decision on how far the OGW CBA can be relied on to support the AOB charge modelling, or otherwise, we would urge the Authority to take into account the market modelling expert's initial views and final report (once provided), and HoustonKemp's recent analysis of the revised HVDC workbook, alongside earlier analysis of related aspects of the CBA.

4.1.3 For any questions relating to the material in this letter, please contact me on 07 572 9888.

Regards,

JAMES TIPPING
MANAGER STRATEGY AND REGULATION

Appendix A Amendments to the HVDC workbook

[workbook attached, for publication]

Appendix B Draft report on Oakley Greenwood's capacity expansion modelling

[draft report attached, but **provided on a confidential basis only**]