

Draft rationale for determining there is limited value in enhancing locational signals for economic investments

For approval by TPAG

9 March 2011

1 Context

1.1.1 This paper has been prepared to address an action point arising at TPAG meeting of 24 February:

Prepare a paper for TPAG approval on the conclusion that there is no justification in augmenting existing locational signals for economic investments, the role of the GEM analysis in this conclusion and what environmental and market conditions are causing the results. Paper should include what is causing the results of the GEM analysis.

2 Stage 1 and stage 2 conclusions

2.1.1 The focus of Stage 1 of the transmission pricing review (Review) was on whether transmission pricing needed to provide enhanced locational signals for generators and loads, and the stage 1 consultation paper particularly considered this issue from an economic theory point of view. An enhanced locational signal would be in addition to the signal provided by nodal pricing, the application of the relevant grid investment test and the shallow and deep connection definitions. A central part of the Stage 2 analysis was to build on this to assess whether there were potential benefits in introducing further locational signalling. The Generation Expansion Model (GEM) was a key tool in this analysis.

2.1.2 The results from the GEM analysis were surprising to the extent that people expected to see a bigger benefit from locational signalling. The results suggest there is limited value in providing for enhanced locational signals to generators to ensure co-optimisation of economic transmission investments and generation. From this, the Electricity Commission (Commission) formed a preliminary view that there may be little justification for imposing additional transaction costs on the industry in order to introduce further locational signalling in respect of economic investments.

2.1.3 This conclusion is pivotal to the direction of the Review. TPAG therefore asked for a presentation on the use of GEM and the assumptions and mechanisms that underpin the model. This paper recommends that on the basis of the presentation and discussion at the TPAG meeting, the work undertaken by the Commission and the Electricity Authority (Authority) and the largely supportive submissions from participants TPAG supports the conclusion that there is limited justification in augmenting existing locational signals for economic investments.

3 Context for GEM

3.1.1 As noted above the Review analysis to date has considered whether there would be a benefit to transmission pricing providing enhanced locational signals for generation and load to encourage co-optimisation of investment in generation, load and transmission. The Review considered the potential benefits of further locational signalling to generation and load from two perspectives:

- (a) For signalling in respect of future economic transmission investments; and
- (b) For signalling in respect of deferral of future reliability transmission investments.

3.1.2 The GEM analysis considered the potential benefits for further locational signalling to generation and load for signalling in respect of future economic transmission investments¹.

¹ It is likely that the different tests for investment in economic and reliability investment will be removed in the Commerce Commission's new Capex Input Methodology but this does not affect the validity of the outcomes from GEM which only address economic investments.

4 The Generation Expansion Model

- 4.1.1 GEM was used to derive an estimate of the national benefit, measured as a reduction in system costs, which could be obtained from an enhanced locational price signal for generators.
- 4.1.2 GEM is a long term capacity expansion planning model used for long term analyses of the New Zealand electricity sector. It is usually formulated and solved as a mixed integer programming problem, a type of optimisation model. The model yields a solution which minimises total system costs while satisfying a range of technical, economic and policy constraints. It was constructed to support the development of grid planning assumptions and grid investment approvals but has been used as an analytical tool in the context of problems such as the impact of electric vehicle uptake; the impact of schemes to reduce peak demand; and the impact of renewable generation on alternative regimes for funding investment in transmission.
- 4.1.3 In this instance to simplify the analysis the Commission has focussed on modelling the trade-off between remote generation requiring transmission investment and generation located close to load requiring no or more limited transmission investment. Transmission investment in this context is concerned with realising the economic benefit of reduced generation costs and is accordingly categorised as economic investment. As a result GEM does not address the question of whether enhanced locational signals would support the avoidance or deferral of the costs of reliability investments.
- 4.1.4 Appendix 3 to the Stage 2 Paper provides a description of GEM and more detail on the model is available at <https://gemmodel.pbworks.com>.

5 TPAG deliberations

- 5.1.1 TPAG has reviewed the analysis undertaken in stage 1 and stage 2 of the Review and has spent some time understanding GEM, its limitations and the factors driving its results.
- 5.1.2 In particular TPAG questioned whether GEM was an appropriate tool to test whether locational signals through transmission pricing might be beneficial and whether there had been sufficient validation of the model. TPAG has been assured by Authority staff that GEM “suggests sensible building patterns that are to a significant extent being played out in reality”. Submissions² on the Stage 2 Consultation Paper outlining the GEM analysis and its conclusions were largely supportive of the Commission’s approach.
- 5.1.3 Not all submissions supported the GEM approach. Norske Skog agreed with the conclusion that there was limited justification in augmenting existing locational signals for economic investments but not on the basis of the GEM results. They were concerned that GEM contained too many assumptions to be a valid input into decision making. Their view was that the costs of generation investment and operation were of orders of magnitude greater than transmission investment and that transmission charges would have little bearing on generation investment decisions. In their view the use of GEM “was unnecessary to reach this common sense conclusion”.

² See submissions from Contact, EECA, Meridian, Mighty River Power, Trustpower, Vector, Powerco and Transpower.
<http://www.ea.govt.nz/document/12634/download/our-work/consultations/transmission/tpr-stage2options/submissions/>

- 5.1.4 In discussions TPAG members also noted that the value of transmission build is low compared to generation build, and that some technologies are highly location-specific and that these factors have a significant bearing on decision making. For example, hydro and geothermal resources cannot be relocated and of the factors influencing a decision to invest in such generation transmission pricing will not be a primary factor.
- 5.1.5 In response to submissions the Authority has undertaken additional analysis using the GEM model but with amended assumptions. These further reruns of GEM have altered results slightly but not materially enough to alter the conclusion that there is limited benefit in augmenting existing locational signals for economic investments. . For instance, depending on the particular rerun being considered, total system costs may differ by as much as \$500 million (out of around \$20 billion) in NPV over a 31 year planning horizon, but the benefit of enhanced locational signals for economic transmission investments remains in the zero to \$30 million range.
- 5.1.6 The key assumption that has been revised in GEM since the Stage 2 consultation paper was prepared relates to the peak capacity constraints. These constraints ensure that GEM builds sufficient capacity to meet peak winter demand when there is little wind availability and in the presence of certain other contingencies, e.g. HVDC or plant outages. Upon reflection, the Authority has determined that the constraints as configured for the 2010 SOO and the analysis reported in Stage 2 were harsher than required. They have since been revised to operate more along the lines of the winter capacity margin. As noted above, this change causes total system costs to be reduced by a substantial amount over the entire modelled horizon. But the benefit of enhanced locational signals for economic transmission investments turns out to be \$13.5 million in net present value terms – practically the same as that reported in the Stage 2 analysis.
- 5.1.7 A number of TPAG members were familiar with the work of the CEO Forum. The CEO Forum had also concluded there was little value in pursuing locational signals although they took a different analytical approach to that of the Commission. The coalescing of the conclusions provides further verification and comfort that the GEM approach is valid.
- 5.1.8 In its discussions TPAG noted that in the event it concluded there was value in augmenting existing locational signals (nodal pricing, deep connection and the relevant grid investment test) it would need to be confident the benefits of making such a change outweighed the transaction costs of implementing the change. The marginal benefits of such a change, as presently suggested by GEM make it difficult to justify the development of enhanced locational signals because of the associated costs. Implementing locational signals could be expected to be costly, complex and time consuming. As with any such change it is also likely to result in unintended consequences which may be expensive to fix. In addition most of the potential pricing methodologies that have been considered (such as ‘tilted postage stamp’, augmented nodal, load flow based approaches, etc) involve risks of unintended short term distortions and are unlikely be fully effective in optimally coordinating transmission and generation given the lumpy nature of the investments, the practical difficulty in coordinating the different lead time frames of transmission and generation investment.

6 Recommendation

- 6.1.1 It is recommended that TPAG supports the preliminary conclusion reached by the Commission that GEM analysis and economic and market conditions support the conclusion that there is no or limited justification for augmenting existing locational signals for economic investments in transmission assets.