TRANSMISSION SYSTEM AND SCALING FACTORS

This short paper discusses various aspects of the transmission system modelling in the BRCI calculations for 2009-10, as follows:

- A brief overview discussion of how the CEMOS model used by CRA models the transmission system;
- Whether the generation system is built on a pre-transmission or post-transmission loss level;
- Implications of new generation siting on transmission system costs;
- How new transmission requirements are addressed in the model;
- Whether transmission loss factors can be changed over the analysis horizon; and
- Consistency of scaling factors used in the modelling.

How the transmission system is modelled in CEMOS

In the CEMOS model, the transmission capacity ***between the connected NEM regions*** is the current transmission system, i.e. CEMOS represents the regions of the NEM including the transmission interconnections between them. Committed but not yet commissioned transmission projects are added to the transmission capacity at their respective expected commissioning dates – these are obtained from the latest SOO[1] published by NEMMCO. This is not a greenfield approach to interconnection between NEM regions. Further economic or reliability augmentations are assessed manually. In order to ensure that the overall system energy balance is correct when scheduling transfers of energy between NEM regions, CEMOS applies a loss factor based on a calculation of the average of the losses implied by the inter-regional loss equations as published in NEMMCO's "List of Regional Boundaries and Marginal Loss Factors for the 2008/09 Financial Year".

Within a NEM region, the loss factor that applies to each generator in CEMOS which is modelled under the greenfield approach to generation is an average of the marginal losses for generators in the region, as published in NEMMCO's "List of Regional Boundaries and Marginal Loss Factors for the 2008/09 Financial Year".

CEMOS has two groups of transmission ***constraints***:

- ***Governing the flow of power in a transmission line***: Flow in either direction along a line must not exceed the line capacity, as specified in the latest SOO; and

1 NEMMCO's 2007 Statement of Opportunities is currently used; the 2008 Statement of Opportunities will be used when it is available.

- ***Balancing of flows into and out of a node***: Total line flows into and out of each regional reference node must equal the difference between the generation flowing into the node and the off-takes. Thus, the nodal balance constraints equate demand, generation, losses, electricity flows to/from the node.

Whether the generation system is built on a pre-transmission or post-transmission loss level

CEMOS operates to meet the demand forecast in the SOO which is on a ***post-transmission loss basis*** within each region. Accordingly, the model then uses a lossless intra-regional representation and average loss representation between regions to build the generation portfolio with the order of scheduling of generation determined by generator offer prices scaled by MLFs..

Whether the implications of new generation siting on transmission system costs can be addressed, perhaps by adding a representative capital charge to each generation plant type that is likely to have material impacts on transmission system costs (e.g. geothermal plant which will be located far from the grid and will require substantial investment in transmission extension)

As stated above, within a NEM region, the loss factor that applies to each generator in CEMOS which is modelled under the greenfield approach to generation is an average of the marginal losses for generators in the region, as published in NEMMCO's "List of Regional Boundaries and Marginal Loss Factors for the 2008/09 Financial Year". In the BRCI greenfield approach, we do not know where new generation will be sited, and therefore have little choice but to continue to adopt the average loss factor that exists in the current transmission network. We are open to adopting an alternative approach if one can be developed in the time available.

Consistent with the greenfield approach, we do not make allowances for additional transmission costs that will be incurred due to new generation technologies. New generation capacity is assumed to be connected to the transmission system without reference to transmission costs. Additional costs could be added to the capital cost of those generators where it is believed that they will have a material impact on transmission system costs. However, adding a specific transmission charge to the cost of a new plant would imply that this was the charge that the particular plant would face. If installation of that plant was of system-wide economic benefit then under the shallow connection regime in the NEM, the plant would not face the full cost of additional transmission – although it would be borne by participants through transmission charges. This is at the heart of debate about the future transmission planning regime and allocation of costs.

How new transmission requirements are addressed in the model, and whether that characterisation could be improved

As mentioned above, the transmission system in CEMOS is based on transmission capacity that is currently in place, and new transmission lines (or expansions to current lines) that have been committed, as per the latest SOO. This means that our model is based on actual current and planned transmission capacity. There is currently no function to optimise expansions or new builds in the transmission system, which in practice may or may not be built in the timeframe under consideration. We note in this regard that the BRCI is undertaken for a nine-year period, which is a relatively short period from the perspective of transmission system planning. However, we do monitor the level of flow and price differences between the regions to consider if it is appropriate to add additional transmission.

As the greenfield generation system solution gets less like the existing planting, it becomes less likely that the nature and location of the existing transmission system would be the transmission required by the greenfield generation system. We need to recognise that the philosophy of the BRCI – and particularly the LRMC section of it – is not necessarily trying to quantify the costs that a retailer will face, but rather the change in the optimised costs that retailers would face from year to year. This makes the relativities in costs more important than the actual values.

Whether transmission loss factors can be changed over the analysis horizon in reaction to where and how much generation is added

Transmission loss factors can be changed over the analysis horizon in response to where and how much generation is added. However, as discussed above, there is no basis for knowing what the meshed network would look like if we construct a full greenfield network, and hence no basis for knowing what the loss factors would be.

Ensure the transmission loss factors used in the modelling are internally consistent

There are two types of scaling factors used in our modelling:

- Scaling factors are used to convert between generation terminal basis and sent-out basis (i.e. to account for the house load of generators) in the LRMC calculations; and
- In the energy purchase cost calculation, a scaling factor for Queensland is used in order to adjust settlement prices for the effect of transmission losses between the Queensland reference nodes and the transmission nodes where energy is supplied.

These are very different scaling factors, and are discussed in turn below.

The ***LRMC*** is calculated using CRA's CEMOS model, which simulates investment and dispatch over the nine-year time horizon. NEMMCO's jurisdictional scheduled maximum demand (MW) projections are on a generator terminal basis while the energy (GWh) projections are on a sent-out basis. CEMOS models on a sent-out basis so a scaling factor for each jurisdiction is used to convert between generator terminal basis and sent-out basis. The factor varies between jurisdictions because the average house load varies with the technology type. A single factor is used for each jurisdiction because the demand estimates are provided on that basis.

The source for the factors to apply to the CEMOS modelling is the 2008 ANTS Consultation: Final Report (Table 8, page 41). These scaling factors are reproduced in Table 1 below. We note that these values are unchanged from the previous 2007 values.

Table 1: Scaling factors to convert sent-out energy to generator terminal basis

Region	ANTS 2008 consultation paper scaling factor
QLD	1.060
NSW	1.060
VIC	1.100
SA	1.041
TAS	1.000

In the ***energy purchase cost calculations***, the scaling factor for Queensland is used in order to adjust settlement prices to account for transmission losses between the Queensland reference node and the transmission nodes where energy is supplied. Previously it was calculated from data provided by Powerlink in the 2008 Annual Planning Report (Table 3.8, page 34). However, this data shows average rather than marginal losses, and NEM settlement is based on marginal losses. Therefore we are now instead using a scaling factor based on a volume weighted average of the marginal losses for supply nodes in the region, as published in NEMMCO's “List of Regional Boundaries and Marginal Loss Factors for the 2008/09 Financial Year”. This is equivalent to calculating the retailer’s settlement at each transmission node and amalgamating the results.