Coordination of generation and transmission investment (COGATI) review – technical working group quantitative modelling meeting
24 February 2020

The Australian Energy Market Commission (AEMC) is currently undertaking a review into the coordination of generation and transmission investment (COGATI review).

All enquiries on this project should be addressed to Russell Pendlebury on (02) 8296 0620.

A technical working group (TWG) has been formed by the AEMC to provide advice and input into the COGATI review.

On 24 February 2020 members of the group held a meeting to discuss the cost-benefit analysis modelling work being carried out by NERA Economic Consulting on the transmission access reforms being considered in the COGATI review.

The attendees of the meeting are listed below.

Member	Organisation
Andrew Kingsmill	TransGrid
Bill Jackson	ElectraNet
Craig Oakeshott	Australian Energy Regulator (AER)
Darryl Bigger	Australian Competition and Consumer Commission (ACCC)
Henry Gorniak	CS Energy
Jess Hunt	Australian Energy Market Operator (AEMO)
Joel Gilmore	Infigen
Kirsten Hall	AEMO
Robert Pane	Intergen
Ron Logan	ERM Power
Tom Geiser	Neoen
Tom Walker	AEMC – COGATI project team
Russell Pendlebury	AEMC – COGATI project team
Orrie Johan	AEMC – COGATI project team
George Anstey	NERA Economic Consulting
Will Taylor	NERA Economic Consulting
Vakhtang Kvekvetsia	NERA Economic Consulting

The meeting focussed on four areas:
1) a progress update on the modelling work
2) discussion of the assumptions and PLEXOS market simulation software to be used
3) discussion of initial views of modelling of generation and transmission investment locations over time
4) next steps for modelling and for the broader COGATI review.

Progress update

- NERA outlined their current progress on developing a nodal model to assess the costs and benefits of the COGATI reforms.

- NERA is currently building a detailed nodal model of the National Electricity Market (NEM).
- NERA's working model can currently be used to:
    - Model half-hour dispatch for efficient (cost-reflective) bidding behaviour on both a regional and a nodal basis
    - Calculate transmission losses dynamically based on the resistance and reactance of the connecting lines
    - Model construction of new (generation) capacity endogenously.
- NERA noted that they are currently at the stage of developing and investigating initial results.
- NERA also noted that they have not reached a final position on their recommended approach to navigate the complex trade-offs between different modelling approaches, such as ways to get the model to run in a sensible amount of time, and welcomed feedback on these trade-offs.

The PLEXOS platform and current operational assumptions

- NERA discussed the reasons for using PLEXOS for this project, including that:
    - It has a strong track record in the Australian market
    - Publicly available versions of this model for the NEM are accessible
    - It is a mathematical programming model that minimises the total cost of meeting demand by the available generators subject to constraints
    - PLEXOS is very flexible in defining constraints and other relevant variables.
- NERA's main assumptions come from:
    - AEMO's publicly available 2019 NEM Electricity Statement of Opportunities (ESOO) model
    - AEMO's Integrated System Plan (ISP) for future NEM transmission developments.
- The AEMC noted that it welcomes stakeholder views about the use of these ESOO and other assumptions for the modelling scenarios.
- Using PLEXOS to quantify the costs, benefits and distributional impacts of COGATI requires NERA to define tractable problems to address, as modelling exercises always require a trade-off between:
    - Granularity of the key elements
    - Run (and set-up) times
    - Data availability.
- NERA noted that because PLEXOS is an economic cost-minimisation algorithm and locational marginal pricing (LMP) is the economists' 'right answer', the PLEXOS modelling, by definition, will likely show benefits. The question NERA will explore is the extent of these benefits, and so whether these benefits exceed costs and the practical (but unmodelled) factors that could influence these estimates, and how the materiality of these benefits may change under different scenarios.
- Stakeholder questions on these areas (and responses from NERA and the AEMC) included:
    - What information on future transmission investments is being included in the model?
        - NERA stated that these investments are primarily the priority transmission projects that are included in the 2020 Draft ISP
    - How are you estimating the electrical properties of these yet-to-be-built lines?
        - NERA have some information on expected thermal properties and are working with AEMO to obtain further information on their reactance and resistance.
    - Is NERA going to assume that there is no new generation that will connect to the transmission network beyond committed generation?
        - No – in addition to the committed generation assumptions that are programmed in, there will also be endogenously modelled new entrant generation.
    - Are the ESOO assumptions only relevant to a non-COGATI world?
        - The AEMC and NERA both stated that these assumptions and inputs used are information such as the current fleet of generators, capacities, costs of

generator entry and fuel prices. This information would stay the same in both the baseline nodal world (COGATI) and counter-factual zonal world (non-COGATI).

Initial views of generation and transmission investment locations over time

- NERA notes that the current regime provides locational signals for new plant in the form of:
    - The risk of being constrained off or producing at less than full output (which can lead to distorted bidding behaviours)
    - Static annually set marginal loss factors.
- NERA suggested that COGATI may allow for better decision-making over the development of the transmission network by providing stronger locational signals for future investment.
- NERA mentioned that further consideration needs to be given as to how to best compare transmission investment between the baseline world and the counter-factual world.
- Stakeholder questions and comments on these areas included:
    - How are you dealing with the smaller transmission upgrades, such as dealing with thermal limits? Are you taking information from the ISP around these options for costs?
        - NERA responded that they are currently developing the baseline scenario and are still considering where to get the information on small transmission upgrades for both the baseline (COGATI) and counter-factual (non-COGATI) scenarios, including working with AEMO on this.
    - How will you co-optimise generation and transmission in the model? This requires the model to be able to run over a long-term period (like 20 years)
        - NERA noted that the model will be able to run over this timeframe, but assumptions will need to be made about transmission investment decisions under both modelled regimes. Analysis of the distortion to current locational signals for generator location will also be conducted.
    - Will a transmission expansion plan be needed for every single node? Each node will have different capacity factors for wind and solar generation.
        - For generation expansion, NERA would use PLEXOS's ability to define generators that are generic new entrants with generic cost assumptions that apply to certain nodes, then PLEXOS would build these new generators in places which are least cost or provide the most system benefits based on constraints. Marginal loss factors would also be used to differentiate capacities between different nodes. Power factor traces from the ESOO database would be used for renewable generators.
    - The ISP models several options for a future state. What makes the COGATI future state (which includes the ISP) improve over the ISP alone state?
        - The AEMC suggested that there's a risk that generators are not investing in optimal locations based on the current price signals and this leads to less-optimal transmission investment. COGATI could lead to improved price signals leading generators to locate in more optimal locations, which would be taken into account for future transmission investment decisions in the ISP. The modelling work is seeking to quantify any such improvements.
    - A member of the TWG noted that it would be a major step if the model (with plausible assumptions) shows clear benefits in the scale of $50 million.
    - To understand that this model is coming up with reasonable outcomes, stakeholders need to understand where the nodes are, the costs of the generation expansion at each node and the costs of transmission expansion from each node to a regional reference node or another location. These assumptions need to be circulated.
        - The AEMC mentioned that these assumptions (beyond those in the ESOO) are currently being determined, and intend to make these assumptions available after they have been developed.

Next steps

- The AEMC will report to the COAG Energy Council on the COGATI project ahead of the March 2020 meeting.
- The modelling will be continuing over this timeframe, with initial results expected in March. This work will continue following March.
- Stakeholders requested information on whether there will be a subsequent modelling session with the Technical Working Group. The AEMC intends to follow up on this as the modelling work progresses.

Action items

Stakeholders raised several options which NERA and the AEMC plan to explore. These include:

- Because a lot of the transmission network is radial, it could be worth reducing the network into a small sub-set of nodes where possible to reduce modelling computational complexity.
- Finding out from TNSPs which parts of the network they consider need to be augmented. This could be used to determine the main nodes to focus on for any simplifications.