

Transmission network planning in the NEM

Main Storyline: Summary of the Final Report

13 December 2018





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Unprecedented changes in the energy market create new challenges and opportunities for electricity transmission networks

Technological changes and customers' needs are evolving rapidly...

Technological

Rapid reduction in the costs of intermittent renewable generation (notably solar PV and wind)

Reduction in cost of transmission infrastructure (notably high voltage DC cables)

Deployment of distributed 'behind-meter' generation, impacting the direction of power flows on the network

Customers' needs

Roll-out of smart meters, enabling customers to take greater control of their energy consumption

Digitalisation of energy services, enabling faster communication between all market participants

Prospect of large-scale transition from internal combustion engine to electric vehicles fundamentally altering the load shape (and volume)

...and this is changing the balance of costs and benefits of local versus wider transmission planning

Before the rise of renewables...



...prevalent generation technology was thermal generation with broadly similar marginal costs of production...

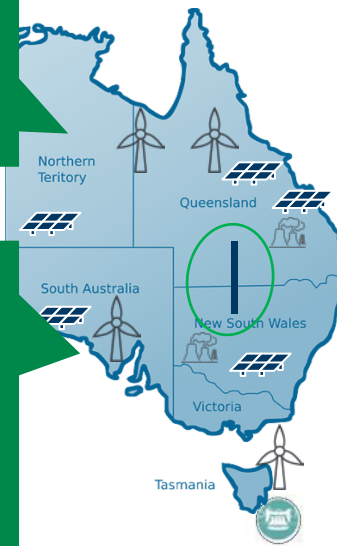
... so gains from power flows between regions more likely to be relatively low. Moreover, as generation was dispatchable, planners tended to focus on "keeping the lights on" in their own patch.

Benefits of localised planning (due to local system knowledge) likely to outweigh those of a wider geographic scope

However, since the rise of intermittent generation...

... cost of managing volatility in renewables generation can be dampened by flowing across greater distances

And sharing reserves of dispatchable generation across wider regions is likely to be a more cost effective way of maintaining security of supply rather doing so within individual TNSP regions



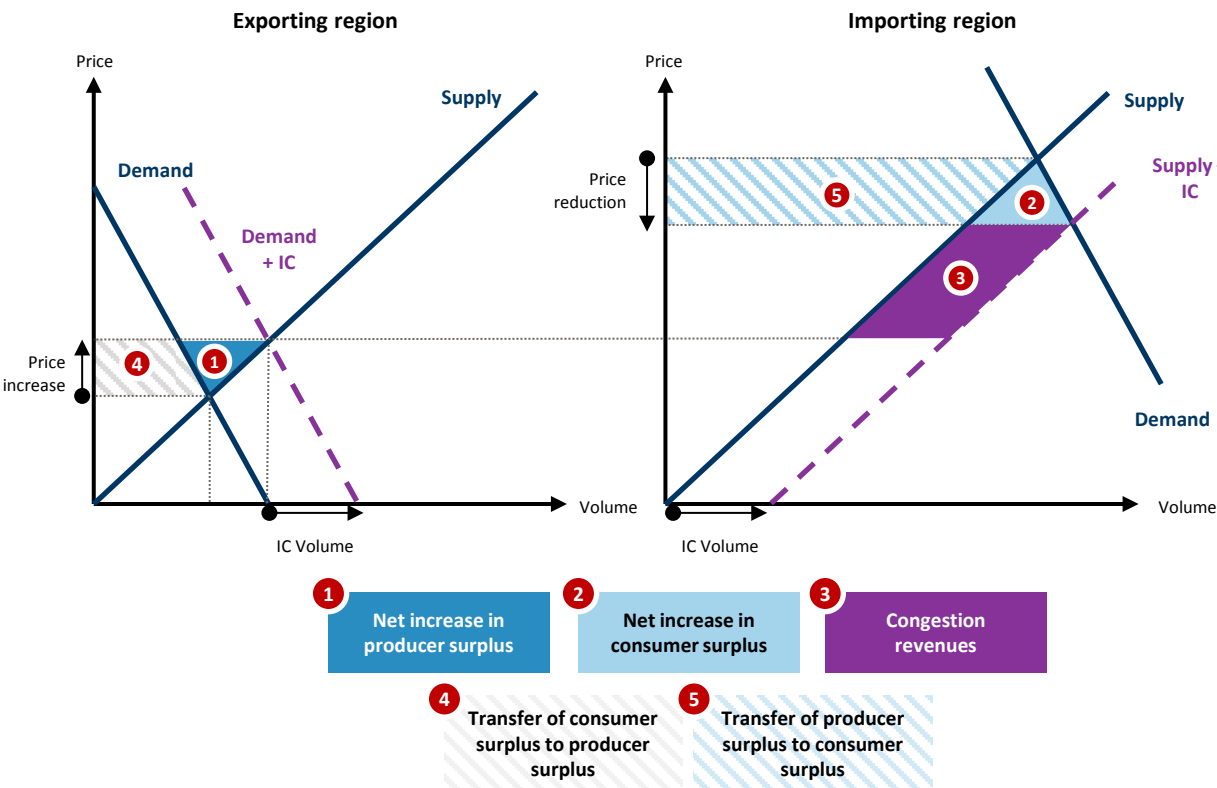
Benefits of centralised planning may now be more likely to outweigh those of local planning

- Australia may wish to consider moving to a NEM-wide transmission planning to reflect the changing balance of centralised vs local planning...
- ...as rise in renewables likely to increase potential gains of transporting electricity greater distances
- Potential downsides of less localised planning would need to be mitigated – by having state-level representatives involved to ensure that the local knowledge of the TNSPs is tapped into.

Competition in transmission development is subject to market failures and therefore regulation is required to maximise social welfare

Merchant investment in transmission relies on beneficiaries being able to capture the value created...

...but this approach does not work in the presence of market failures



- As illustrated opposite, between price zones (or price nodes), a transmission link delivers changes to consumer surplus, producer surplus, its own congestion rent, and may also impact other links at the same boundary.
- In theory, from a social point of view the investment in transmission should occur up to the point where the marginal revenue change (Areas 1+2+3 in the chart opposite) equals the marginal cost of building the asset.
- However, private investors would, in response to price signals, choose to invest in transmission assets that allowed them to capture the revenues from allowing low cost electricity to flow to meet demand served by higher cost electricity...
- ..and will therefore only seek to equalise the marginal revenue they retain (Area 3) with the marginal cost. As such, private investors may only deliver some (but not all) of the socially optimal investments.
- Overall, reliance on competitive models would, most likely, under-deliver the volume of transmission.

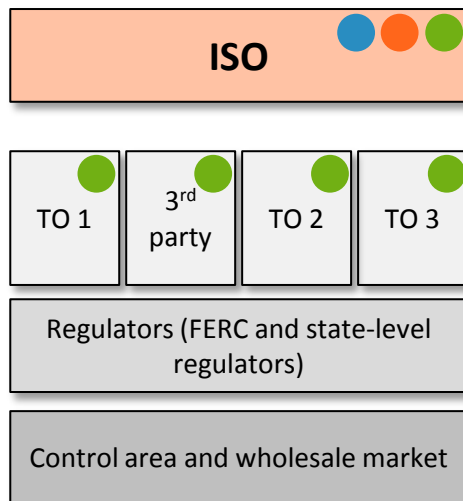
- Markets alone cannot be relied upon to deliver socially optimal level of transmission investment...
- ...hence some investments need to be regulated...
- ...which, in turn, means an ongoing centralised transmission planning function is needed to ensure that the transmission requirements of consumers are met appropriately

Other jurisdictions face the same problems of technological change and intermittency, but the approaches to planning differ significantly

US ISO model



Geographic coverage: single ISO footprint (e.g. PJM or NYISO)

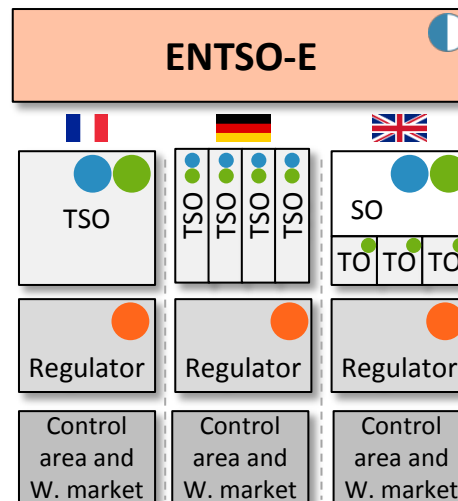


- ✓ Decision-making consolidated at ISO level, with high level of transparency and independence
- ✓ ISOs such as PJM are effective at delivering transmission investments that link TO footprints
- ✓ Different asset needs (reliability and economic) integrated into a “seamless” transmission plan
- ✗ Development of interregional assets (between different ISO footprints) is more complex, but FERC Order 1000 aims to provide supporting rules
- ✗ Regulatory treatment (i.e. investment cost recovery) varies state by state

Europe



Geographic coverage: multiple sovereign countries, each with a separate market operator

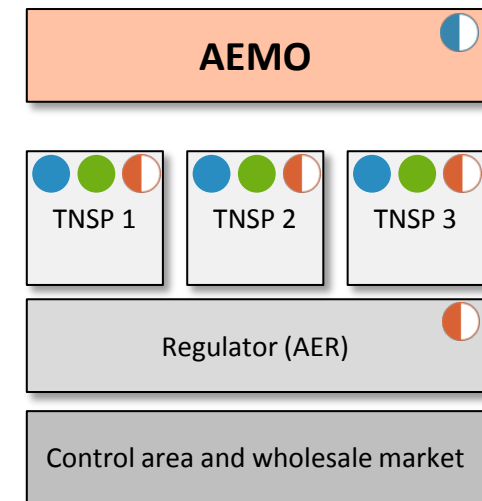


- ✓ ENTSO-E plays an advisory role, eliciting information from national TSOs, and aims to coordinate investments between independent jurisdictions
- ✗ However, national authorities retain the ultimate responsibilities for investment approvals, which complicates investment in cross-country interconnections
- ✗ Regulatory treatment (i.e. investment cost recovery) varies by country

NEM



Geographic coverage: multiple states, with a common market operator



- ✓ RIT-T process, run by TNSPs using AER-defined process is seen as relatively effective at delivering investments within individual TNSPs’ footprint
- ✓ Regulatory treatment (i.e. investment cost recovery) consistent across states
- ✗ However, in the absence of a central entity with visibility over the entire NEM footprint, investments linking different TNSPs are uncoordinated and challenging to deliver

Legend:



Scenario development and identification of system needs



Optioneering and identification of possible solutions



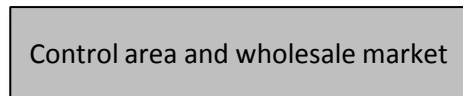
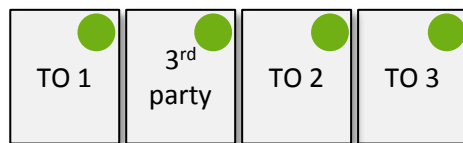
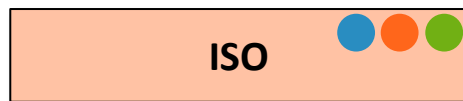
Decision-making on the preferred solution

The US 'blueprint' for transmission planning (such as PJM) appears to be the closest framework for NEM to learn from...

US ISO model

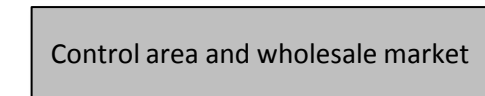
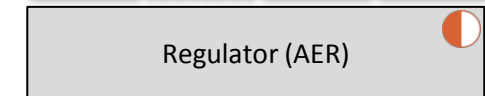
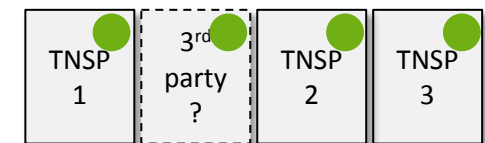
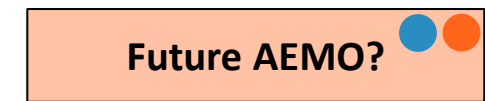


Geographic coverage: single ISO footprint (e.g. PJM or NYISO)



NEM

Geographic coverage: multiple states, with a common market operator



Consolidated decision-making and planning based on a consistent set of assumptions across ISO/future AEMO footprint level...
 ..supported by well-developed processes to ensure stakeholder buy-in.

TOs / TNSPs retain a critical role in identifying options for transmission network solutions based on their local knowledge.

Non-network solutions increasingly considered by TOs/TNSPs/3rd parties.

Single control area by the system operator and common wholesale market across SO footprint (in contrast to fragmented market across Europe)

...and the new model would have a number of advantages, but certain **Australia-specific features** would need to be reflected:

- Giving AEMO a stronger role in identification of system needs and making ultimate decisions about prospective investments seems likely to enable better coordination of investments among TNSPs.
- Linkages between AEMO and the insight from individual TNSPs would need to be strengthened (and possibly mandated/incentivised) to ensure that the local knowledge of the networks is appropriately leveraged at NEM level.

- In addition, to ensure AEMO can deliver on a single national plan, AEMO would need to be independent and transparent (and also to be seen as such).
- AER would retain a critical role of designing the rules for AEMO and other market participants to follow in delivering their new roles and responsibilities.
- AER would also need to retain a strong role in determining the regulatory treatment of the cost recovery process (including, for example, assessing the reasonableness of costs and how cost overruns are handled).

Legend:



Scenario development and identification of system needs



Optioneering and identification of possible solutions



Decision-making on the preferred solution

PJM “recipe book” for scenario development, identification of system needs and selection of a preferred solution is set out below

	1	2	3
ROLE	Scenario development	Identify system needs	Identify and select solution
	PJM – reviewed and assisted by TEAC	PJM and individual states (public policy assets)	TOs and/or 3rd parties; PJM
OUTPUT	Baseline Assumptions	Reliability, economic and public policy needs	Project proposals; Regional Transmission Expansion Plan (RTEP)
DETAILED RULES	<ul style="list-style-type: none"> ISO develops a base case for use in assessing reliability needs. This is a 15 year forecast of load levels, base power flows, and other metrics necessary to assess compliance with reliability standards. Local (low-voltage) transmission is led by the TOs, that then must be introduced to the PJM regional planning process. In addition, the ISO develops a five year near-term reliability analysis. The assumptions that feed into both forecasts are vetted with stakeholder committees before the final outputs are reviewed and approved by the PJM Board. Based on these assumptions, a series of power flow base cases are developed. These stakeholder committees collectively form the Transmission Expansion Advisory Committee (“TEAC”). To assess economic assets, PJM uses the same base case that was used to identify reliability needs, updated to reflect the latest available information. The identification of reliability and economic needs is performed sequentially. 	<ul style="list-style-type: none"> Reliability needs are identified by the ISO and based on PJM’s forecasts. Expected reliability violations for specific sites will be posted on PJM’s webpage in the form of Problem Statements. Economic needs are identified using the updated base case forecasts (see ‘Scenario development’ on the left) and by assessing if any of the selected reliability solutions could be accelerated or modified to also meet economic needs. These needs are also posted on PJM’s webpage and expressed in the form of expected congestion costs five years and eight years in the future. Public policy needs are determined via the State Agreement Approach. Entities authorised by their respective states (regulators, stakeholder groups, etc.), individually or jointly, propose such needs. In general, third parties themselves do not have a formal role in specifying asset needs, and must wait for the relevant authorities (SOs or state regulators) to specify them. However, they can proactively put forward specific projects (as solutions to ‘needs’ identified by the developers) in order to obtain regulators’ and stakeholders’ buy-in to the proposal. 	<ul style="list-style-type: none"> FERC Order 1000 prohibits incumbent TOs from having any Right of First Refusal on transmission investment. As a result, non-TO parties must be (and are) allowed to submit proposed solutions to identified needs, as well as to build and operate such assets. ISOs can also identify and propose their own solutions. TOs and 3rd parties must state the need specified by PJM they intend to address when proposing a solution. PJM effectively runs two separate investment tests, one for each type of need, but they may be interrelated in that a reliability asset can be considered an economic asset if it meets certain criteria. The same discount rate is used to assess all assets – a weighted average of the costs of capital of all the incumbent TOs in the PJM region. The individual test methodologies are briefly summarised as follows: <ul style="list-style-type: none"> Reliability need: PJM first evaluates if the proposed solution meets the identified need, and then evaluates the cost. The cost is the present value of the revenue requirement of the enhancement for the first 15 years of the asset’s life. PJM then assesses if any of the proposed solutions meet the criteria for an economic asset if they are enhanced or expanded (if they do, then they are included in economic needs assessment – see immediately below). Economic need: asset is constructed if its benefit-cost ratio is above 1.25. As with reliability assets, the cost is the present value of the revenue requirement for the first 15 years of the asset’s life. The benefits are the changes in costs of: fuel, operation and maintenance, and emissions of the dispatched resources in the PJM region if the asset is built. They also include expected effects on congestion, load and LMPs in each zone, expected effects on PJM’s capacity market, and price effects on energy bought from and sold to regions outside PJM. If a reliability need is not met by a reliability solution that has been upgraded to an economic asset (see bullet immediately above), then PJM will simply select the most cost-effective solution. Public policy need: are assessed via the State Agreement Approach. This is a separate process from PJM’s cost benefit assessment discussed above. Entities authorised by their respective states, individually or jointly, may agree voluntarily to be responsible for all allocation of costs of a proposed transmission investment that addresses some public policy requirement. These assets are included in the PJM RTEP, and not assessed by PJM directly. The output of PJM’s transmission planning, the PJM Regional Transmission Expansion Plan (“PJM RTEP”) is reviewed by PJM’s Board of Managers, who have the final authority for its approval and implementation (i.e. development and construction of the selected transmission solutions).

NEM has a good opportunity to move towards a more coordinated transmission planning approach to deliver benefits to consumers

There are clear parallels between the NEM and PJM...

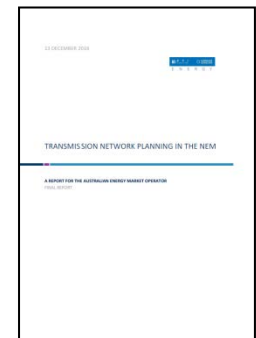
- Independent system operator (ISO / AEMO)
- Operation within a single country (but multiple states, and overseeing multiple transmission operators – TOs/TNPSs)
- Single wholesale market covered by the ISO/AEMO jurisdictions; the legal infrastructure could readily be extended to include a NEM-wide transmission planning role

...and several attractive features of the PJM model.

- Independence and transparency of the PJM ISO helps ensure that the transmission solutions are objective, credible and in the consumer interest.
- Balance between local planning (led by TOs, e.g. for assets below 100kV where benefits accrue to physically proximate customers) and PJM-wide planning for networks whether the benefits are more widely distributed.
- The role of a regional transmission planner is combined with the responsibility for balancing over the same footprint – potentially enabling better assessment of trade-offs between different solutions.
- Effective delivery of transmission investments that connect multiple TO footprints.
- Consistent and transparent scenario development helps align the market participants' expectations.
- Multiple asset needs (notably the linkages between reliability and economic needs) are rolled into a single integrated plan.
- Appropriate checks and balances are in place (through various committee roles) to validate the overall transmission plan.
- Possible solutions from 3rd party developers could also be considered by the transmission planner (as well as those from TNPSs).

- Given the changes in the energy markets there is a case for considering a more centralised planning of transmission than has historically been the case.
- Of the international examples we have studied, it seems that the European model may not be appropriate for the NEM.
- By contrast, given the parallels between NEM and PJM, it seems reasonable to explore further **how some of the attractive features of the PJM ISO transmission planning model could be applied in the NEM...**
- ...while ensuring that the key features of the NEM are retained.

A full FTI-CL Energy report is published alongside this presentation, which sets out in detail the analysis undertaken and the international precedents.





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