Opex Forecasting Method

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A REPORT PREPARED FOR TRANSGRID

December 2014

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Tables and figures

Executive summary

I, Rajat Sood, of Frontier Economics have prepared this report for TransGrid on the appropriate method for forecasting transmission network operating expenditure.

Two broad approaches for forecasting controllable opex under a building block regulatory regime are:

- 'Bottom-up' approach of summing estimated efficient costs of relevant operating and maintenance
- 'Base-Step-Trend' approach of projecting future costs based on the observed actual costs from an historical 'base year'.

A bottom-up approach to estimated future controllable opex has the advantage that it can be based on the most recently available information from the network business. This means that, in principle, a bottom-up forecasting approach can be more accurate than an approach based on a rolling forward of historical costs. The key disadvantage with a bottom-up approach to forecasting opex is the incentives and ability of the regulated business to overstate its forecast efficient expenditures.

The advantage of a base-step-trend approach is that when combined with an efficiency benefit-sharing scheme so as to ensure the network faces a continuous incentive to reduce costs, opex forecasts derived in this manner should enable TNSPs to recover their efficient costs. The disadvantages of a base-step-trend approach is that it does not ensure that a TNSP will have a reasonable opportunity to recover its efficient costs where future required opex is substantially higher than past opex.

As noted in my January 2014 report for the AER in relation to SP AusNet's controllable opex, the rationale for using businesses' revealed costs in forecasting efficient opex is grounded in the informational asymmetry between regulators and regulated businesses, noted above.

My report suggested that a base-step-trend approach to forecasting opex using a single base year could be appropriate if three conditions were met:

- The regulated business has incentives to minimise total controllable opex.
- The business does not have incentives to 'game' the regulatory process, such as by shifting expenditure within a RCP.
- Total controllable opex needs to be broadly recurrent, and not exhibit major secular or long-cyclical trends or 'long waves' similar to capex.

In my view, the conditions for the appropriate application of a single year base-step-trend approach to forecasting total controllable opex appear to be broadly met in TransGrid's case.

However, I disagree with the AER's approach of excluding categories of opex from base year expenditure on the basis of seeking to derive the most stable formulation of base opex. If TransGrid's opex is forecast using a base-step-trend approach, the base year expenditure should include MOPS, long-service leave and defined benefits superannuation payments.

For the AER to exclude defined benefits superannuation payments on the basis that the historical path of residual opex is "much more stable" with it removed would be to engage in the same sort of 'cherry-picking' I warned against in my previous report for the AER. In my view, it is not relevant that the remainder of past opex is somewhat more stable with defined benefits superannuation expenses excluded. If total opex is broadly recurrent, then one should expect opex categories that rise over time to be more or less offset by opex categories that fall over time.

To provide incentives for TNSPs to adopt efficient part-capex and part-opex options under a base-step-trend forecasting approach, the AER should augment the network business's capex allowance and also incorporate the additional opex required for the option as a step change in the business's opex allowance.

1 Introduction

1.1 Background

I, Rajat Sood, of Frontier Economics (Frontier) have been asked by TransGrid for advice on the appropriate method for forecasting transmission network operating expenditure (opex). My CV is provided an attachment to this report.

In particular, I have been asked to:

1. Assess TransGrid's methodology for forecasting opex against good practice.
2. Assess the AER's methodology for forecasting opex against good practice, including whether the AER's application of the Frontier Economics advice entitled, *Opex forecasting and EBSS advice for the SP AusNet final decision* (January 2014) is appropriate.
3. Provide advice on the most appropriate forecasting method for TransGrid's opex allowance for 2014/15 to 2018/19.

In addressing these questions, TransGrid has specifically requested me to consider the following matters:

1. The appropriateness of the AER's application of its test for forecasting method, which is essentially based on a 'smoothness' or 'recurrence' fit.
2. Categories of expenditure for which a base-step-trend forecasting method is most appropriate and categories of expenditure for which a bottom-up forecasting method is most appropriate.
3. Appropriate consideration of capex/opex trade-offs in conjunction with the forecasting method.
4. Interaction with the EBSS, including the appropriate EBSS mechanism to be applied to the relevant categories of expenditure depending on forecasting method.
5. The discretion and incentives created by each forecasting method, with respect to behaviours such as: cost shifting of major operating projects (MOPS) over time, cost shifting between MOPS and other opex categories and cost shifting between MOPS and capex.

1.2 Structure of this report

This report is structured as follows:

- Section 2 discusses the broad alternative approaches to forecasting opex.
- Section 3 discusses the application of the base-step-trend forecasting approach to TransGrid.

2 Approaches to opex forecasting

There are a number of approaches regulators may take to forecasting controllable opex under a building block approach to determining allowable revenues. Two broad approaches that have been used or considered in the NEM context are:

- 'Bottom-up' approach of summing estimated efficient costs of relevant operating and maintenance activities
- 'Base-Step-Trend' approach of projecting future costs based on the observed actual costs from an historical 'base year'.

These are discussed further below.

2.1 Bottom-up forecasting

A bottom-up approach to estimated future controllable opex has the advantage that it can be based on the most recently available information from the transmission network service provider (TNSP). This means that, in principle, a bottom-up forecasting approach can be more accurate than an approach based on a rolling forward of historical costs. Given that the revenue and pricing principles in the National Electricity Law (NEL) require that regulated networks should be provided with a reasonable opportunity to *at least* recover the efficient costs an operator incurs in providing regulated services, a bottom-up approach to forecasting opex is less likely than a base-step-trend approach to fall foul of the NEL Further, a bottom-up approach is more naturally suited to taking account of potential trade-offs between capex and opex because forecast capex and opex are derived on the basis of specific identified projects. Taking account of such trade-offs in setting future capex and opex allowances is necessary under clauses 6A.6.6(e)(6) & (7) and 6A.6.7(e)(6) & (7) of the National Electricity Rules (NER).

The key disadvantage with a bottom-up approach to forecasting opex is the incentives and ability of the regulated business to overstate its forecast efficient expenditures. Under an incentive-based building block approach to regulation, network businesses stand to gain from higher opex allowances because they are able to earn higher revenues than they would be permitted to earn otherwise.

Further, the business typically has much better information than the regulator about:

- the business's potential future efficient costs
- the cost-quality trade-offs involved in delaying expenditure and
- the trade-offs available between capital and operating expenditure.

This means that regulated network businesses may successfully be able to induce the regulator to provide the business with a higher opex allowance than necessary to recover the efficient costs of service.

2.2 Base-step-trend forecasting

A base-step-trend approach to forecasting opex involves using a nominated historical base year's opex as the foundation for estimating future opex. This base year opex is then adjusted for 'step changes' before being extrapolated forward using an appropriate rate of change.[1] The rate of change – the 'trend' element of the approach – is determined taking account of:

- Output growth – to account for changes in the scale of the TNSP's activities
- Real price growth – to account for changes in the real prices of inputs
- Productivity growth – to account for changes in the TNSP's efficiency in converting inputs to outputs.

Step changes are meant to reflect factors that reasonably ought to change efficient opex in ways that are not accounted for through the rate of change. For example, the AER has referred to unusual changes in a network business's regulatory obligations.[2]

The advantage of a base-step-trend approach is that when combined with an efficiency benefit-sharing scheme so as to ensure the network faces a continuous incentive to reduce costs, opex forecasts derived in this manner should enable TNSPs to recover their efficient costs. The disadvantages of a base-step-trend approach are in many ways the mirror of the advantages of a bottom-up forecasting approach. That is, a base-step-trend approach does not ensure that a TNSP will have a reasonable opportunity to recover its efficient costs where future required opex is substantially higher than past opex.

As noted in my January 2014 report for the AER in relation to SP AusNet's controllable opex, the rationale for using businesses' revealed costs in forecasting efficient opex is grounded in the informational asymmetry between regulators and regulated businesses, noted above.

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1 AER, *Better Regulation, Expenditure Forecast Assessment Guideline for Electricity Transmission*, November 2013, section 4, pp.22-24.

2 AER, *Better Regulation, Expenditure Forecast Assessment Guideline for Electricity Transmission*, November 2013, p.24.

My report suggested that a base-step-trend approach to forecasting opex using a single base year could be appropriate if three conditions were met:

- The regulated business has incentives to minimise total controllable opex, subject to meeting its stipulated objectives and providing levels of service performance valued by consumers.
- The business does not have incentives to 'game' the regulatory process. Such gaming could take the form of shifting expenditure within a regulatory control period (RCP) to or from the single base year in order to, for example, secure a higher forecast allowance or a higher future efficiency benefit.
- Total controllable opex needs to be broadly recurrent, in that past actual expenditure can provide (with the aid of transparent adjustments) a reasonable reflection of future efficient expenditure. In particular, for a base-step-trend approach to be appropriate, opex must not exhibit major secular or long-cyclical trends or 'long waves' similar to those exhibited by many networks' capex cycles. If opex did exhibit such patterns, a base-step-trend approach would not provide an appropriate forecasting approach and a bottom-up approach would be more suitable.

3 Application of base-step-trend forecasting approach to TransGrid

3.1 Are conditions for appropriateness broadly met?

In my view, the conditions for the appropriate application of a single year base-step-trend approach to forecasting total controllable opex appear to be broadly met in TransGrid's case.

In particular:

- The application of the EBSS means that TransGrid has incentives to minimise its total controllable opex and to make savings when available rather than to inefficiently shift expenditures from one year to another.
- TransGrid's total opex appears to be sufficiently recurrent to form the basis of a forecast of future efficient opex.[3]

I noted in my previous report for the AER that in deciding whether a single base year opex forecasting approach is appropriate, the test for recurrence is based on the stability of opex as *between* RCPs rather than *within* RCPs. The purpose of considering expenditure between RCPs is to work out whether the form of expenditure in question is broadly recurrent or whether it reflects major lumpiness or long-term 'waves', like capex. In my previous report, I said if controllable opex was broadly recurrent from RCP to RCP, it would be inappropriate for the AER to review each component of opex individually, as this could lead to 'cherry picking'. Having said that, I examined SP AusNet's asset works opex and noted that it also seemed to be broadly stable from RCP to RCP. In the present case, it appears that while TransGrid's historical MOPS expenditures exhibit some intra-RCP volatility, MOPS expenditure is broadly similar as between RCPs.

Therefore, I consider that while a bottom-up approach to developing TransGrid's opex forecasts could be used, a single-base year-step-trend approach could reasonably be applied to total controllable opex.

I now turn to the five specific questions I was asked to address.

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[3] See, for example, *AER Draft Decision, TransGrid transmission determination 2015-16 to 2017-18, Attachment 7: Operating expenditure*, November 2014 (Opex Draft Decision), Figure 7-4, p.7-32.

3.2 Appropriateness of the AER's application of the 'recurrence' test

In its Opex Draft Decision, the AER reviewed TransGrid's past opex and adjusted it by removing several categories of expenditure so as to produce a more 'stable' outcome than produced by total opex. The AER removed network support costs, movements in provisions and defined benefits superannuation costs.[4] However, the AER retained MOPS in the adjusted opex measure for a number of reasons. These were:

- Adjusted opex was broadly recurrent once the categories of categories noted above were removed; it was not necessary to also remove MOPS to produce a recurrent total opex series.
- Forecasting individual opex categories using a bottom-up method would not be consistent with the EBSS.
- Based on TransGrid's response to the AER, much of its MOPS underspend in the previous RCP was due to MOPS expenditure being reported as another class of opex. Without consistent reporting of MOPS expenditure, a bottom-up approach to forecasting MOPS could over-compensate TransGrid.
- TransGrid's actual average annual MOPS expenditure for the current RCP was closer to its revealed MOPS expenditure for the 2007-08 base year than TransGrid's forecast MOPS expenditure for the current RCP.[5]

I agree that if a single base year approach to forecasting opex is applied, MOPS expenditure ought to be included in the base year. However, I disagree with the AER's approach in the Opex Draft Decision of excluding categories of opex from base year expenditure on the basis of seeking to derive the most stable formulation of base opex.[6] As noted above, the purpose of the recurrence assessment is to check whether total controllable opex is broadly recurrent as between RCPs. In my previous report, where a single year base-step-trend approach is used, I explicitly rejected the approach of examining each component of controllable opex individually to check whether it was itself sufficiently recurrent to include in the base year for forecasting purposes. In my previous report, I undertook such an assessment of SP AusNet's asset works opex as an additional measure to show that it would not be inappropriate to include asset works opex in the base year for forecasting purposes. However, I did not believe

4 AER Opex Draft Decision, pp.7-31 – 7-32, 7-38 – 7-39.

5 AER Opex Draft Decision, Figure 7-5, p.7-36.

6 AER Opex Draft Decision, pp.7-31 – 7-32, 7-38 – 7-39.

it was necessary to undertake this exercise to validate the inclusion of asset works opex in the base year

Therefore, in principle, I consider that if TransGrid's opex is forecast using a base-step-trend approach, the base year expenditure should include MOPS, long-service leave and defined benefits superannuation payments. Given the broad stability of total opex across RCPs, there is no reason in principle to exclude any of these categories from the application of the base year forecasting approach. To the extent that TransGrid is able to pass-through network support payments, such payments need not be included in base year expenditure (if indeed any such payments arose).

For the AER to exclude defined benefits superannuation payments, for example, on the basis that the historical path of residual opex is "much more stable" with it removed would be to engage in the same sort of 'cherry-picking' I warned against in my previous report. In my view, it is not relevant that the remainder of past opex is somewhat more stable with defined benefits superannuation expenses excluded; nor is it relevant that TransGrid expects such expenses to decline over the 2014-18 period such that using TransGrid's base year contributions "would over-estimate [TransGrid's] recurrent opex".[7] If total opex is broadly recurrent, then one should expect opex categories that rise over time to be more or less offset by opex categories that fall over time.

3.3 Categories of expenditure for which a base-step-trend forecasting method is most appropriate

As explained in my previous report for the AER, I consider that all controllable opex should be forecast using a single base year-step-trend approach if total opex appears to be broadly stable from one RCP to the next. Conversely, a base-step-trend approach would not be appropriate if controllable opex exhibited a large degree of 'lumpiness' manifesting in secular shifts or long waves of increased expenditure. Therefore, I do not recommend – if a single year base-step-trend approach is used – examining the 'recurrence' of each category of controllable opex individually to determine whether it should be included in the base year for forecasting purposes or whether it should be forecast using a bottom-up approach.

The case for utilising a bottom-up approach to forecasting a category of opex in conjunction with a base-step-trend approach for the remaining opex categories requires, at a minimum, evidence that the relevant category of expenditure is likely to follow a capex-style long wave path across multiple RCPs in the future. In addition, the party suggesting a bottom-up approach – whether the network

7 AER Opex Draft Decision, p.7-39.

business or the AER – needs to demonstrate that the future path of the expenditure category is of such a magnitude that the observed historical stability of total opex is likely to change as a result of expected changes to the relevant opex category. Only under these circumstances should a bottom-up forecasting approach be considered for a single category or limited number of categories of opex.

3.4 Appropriate consideration of capex/opex trade-offs

As network businesses now face an even 30% incentive sharing rate for both capex and opex savings under the AER's Better Regulation Guidelines, network businesses should have incentives to make efficient expenditure trade-offs where available.[8] This is because if a saving of, say, $100 of capex requires additional opex of, say, $60, the network should in net terms enjoy a benefit of approximately $12 (being 30% of the net saving of $40).

The main caveat to this desirable incentive structure arises where the network has identified in its regulatory proposal a more efficient opex-based alternative to a capex option. For example, I understand that TransGrid has proposed a lower cost part-capex, part-opex alternative to replacing a 132 kV transmission line. I further understand that TransGrid's base year opex (and entire previous RCP opex) has no expenditure of a similar nature. This means that a strict base year-derived approach to forecasting opex would under-compensate TransGrid for pursuing such an alternative. If TransGrid were under-compensated for pursuing such a part opex-based alternative, it would have strong perverse incentives in future to avoid giving proper consideration to any project that was not 100% capex-based.

Under these circumstances, the AER should augment the network business's capex allowance and also incorporate the additional opex required for the option as a step change in the business's opex allowance, in order to fully reflect the full likely costs of an efficient alternative.

3.5 Appropriate benefit-sharing mechanism

To the extent that a category of opex is included in base year expenditure and forecast using a base-step-trend approach, the opex EBSS should provide a reasonable mechanism of sharing the benefits of any savings made within the relevant category.

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8 AER, *Better Regulation: Expenditure Incentives Factsheet*, November 2013.

If a category of opex is forecast using a bottom-up approach, then it would be appropriate to apply a separate benefit-sharing mechanism to that category of expenditure, with the annual expenditure targets set according to the expected efficient expenditure levels of that category.

3.6 Discretion and incentives created by each forecasting method

As indicated above, I believe that network businesses should have appropriate incentives to make efficient capex-opex trade-offs so long as the AER augments the business's capex and/or opex allowances to the extent described.

If the AER makes the appropriate provision for both capex and opex, then firms should not face perverse incentives to either make inefficient capex-opex trade-offs or engage in inefficient cost-shifting of one opex category (such as MOPS) to another or to or from capex.

Attachment: Curriculum Vitae

NAME:	RAJAT SOOD
Profession:	Economist

Rajat is a founding member of Frontier Economics and is a qualified solicitor, as well as a trained economist. Rajat has a broad range of experience in advising state and national governments, regulatory bodies and businesses on issues arising in access regulation, market design, cost-benefit analysis and competition evaluation, especially in relation to the energy sector. In recent years, Rajat has been a key advisor to institutions such as the Australian Energy Market Commission (AEMC), the Australian Energy Regulator (AER), the New Zealand Electricity Commission, the New Zealand Commerce Commission and the Singapore Energy Market Authority.

Prior to working as an economist, Rajat was a solicitor at the law firm Freehill Hollingdale & Page in Melbourne where he worked on commercial and trade practices issues in a range of areas, including being part of the team advising the Commonwealth Government on the sale of the first tranche of Telstra shares.

Clients benefit from Rajat's advice, through his:

- Clear framework for applying economics to real-world problems
- Deep understanding of utility economics and regulation
- Detailed knowledge of the National Electricity Market and overseas electricity markets
- Strong ability to communicate difficult concepts clearly and precisely.

KEY EXPERIENCE

Energy network regulation

Electricity network regulation

- ***Ergon Energy network pricing:*** Rajat is advising Ergon Energy on the development of appropriate network pricing principles and the transition of its existing tariffs to a new structure that is more consistent with those principles. His role included the preparation of a Tariff Implementation Report for Ergon and overseeing the modelling of potential revised tariff structures (2013 – ongoing).

- ***Metering competition:*** Rajat advised the AEMC on the implications of opening up of metering activities to competition for the competitiveness of retail electricity supply and the supply of energy services. As part of this work, Rajat presented to the AEMC Commissioners and spoke at an AEMC Public Forum (2014).
- ***Transpower New Zealand:*** Rajat was part of the Frontier team supporting Transpower through a review by the Commerce Commission on the approach to estimating the cost of capital. This included preparing a number of reports setting out the conceptual, empirical and regulatory evidence for choosing a WACC value above the midpoint of the estimated WACC range (2014).
- ***New Zealand Default Price-Quality Path distribution reset:*** Rajat was part of the Frontier team advising the Electricity Networks Association of New Zealand on:
  - the formulation and testing of econometric models that identify and quantify the drivers of network capital and operating expenditure for the Electricity Distribution Businesses' (EDBs') default price-quality path (DPP) resets; and
  - potential approaches for making use of EDBs' Asset Management Plan forecasts in their DPP resets. This included the scope for adopting innovative 'menu regulation' in New Zealand (2013-2014).
- ***SP AusNet controllable opex:*** Rajat advised the AER on the appropriateness of the application of a single base year approach to forecasting SP AusNet's total controllable operating expenditure, including SP AusNet's 'asset works' opex (2013-2014).
- ***Jemena distribution pricing Rule change:*** Rajat prepared a report for Jemena Electricity Networks discussing the pros and cons of alternative means of the recovering distribution network businesses' sunk costs not recovered through charges reflecting long run marginal cost. His report compared and contrasted Ramsey pricing and postage stamp pricing as well as equity-based pricing approaches (2013).
- ***AER Expenditure Incentives Guidelines:*** Rajat advised the AER on the development of network expenditure incentive guidelines as part of the AER's 'Better Regulation' work program (2013).
- ***AER cost of capital:*** Rajat helped advise the AER on the nature and extent of risks to which Australian energy networks are exposed. This work fed into the AER's work on defining the "benchmark efficient entity", an important part of its regulatory framework and element of its 2013 Rate of Return Guidelines as part of the AER's 'Better Regulation' work program (2013).

- ***AER RIT-D:*** Rajat advised the AER on the development of the Regulatory Investment Test for Distribution (RIT-D) and the RIT-D Application Guidelines. The RIT-D is an economic cost-benefit test for assessing distribution network augmentations, which requires augmentation options to be compared against DG and demand-side response options (2013).
- ***New Zealand Transmission Pricing Methodology:*** Rajat prepared a report for Mighty River Power reviewing the New Zealand Electricity Authority's proposed Transmission Pricing Methodology. The Authority proposed introducing two new transmission charges – a 'beneficiaries-pay charge' and a 'residual charge' (2012-13).
- ***Power of Choice Review:*** Rajat provided advice to the AEMC on amending the distribution pricing principles in the National Electricity Rules to provide better guidance for businesses to develop efficient and flexible tariff structures that support demand-side participation (2012).
- ***Smart meter rollout:*** Rajat advised the Victorian Department of Treasury and Finance on the regulatory consequences of halting, suspending or modifying the rollout of smart meters in Victoria. His advice covered issues such as the potential avenues for changing the rollout, cost recovery implications, timing implications and the need to maintain good regulatory practice (2012).
- ***Connection Initiatives project:*** Rajat assisted the Australian Energy Market Operator on the development of policies for (i) the management of multiple connection applications and (ii) cost-sharing arrangements at terminal station hubs. His advice helped the AEMO to develop connection arrangements that promote economic efficiency, especially in an environment of increasing connection applications, particularly from wind farms. In doing so, he helped AEMO to meet its statutory objectives (2011).
- ***Basslink conversion:*** Rajat was part of the Frontier team investigating the benefits and costs of converting the Basslink market network service into a prescribed service, on behalf of Hydro Tasmania. This work included calculating the market benefits of Basslink and determining the potential value of the regulated asset base that would apply to Basslink should it be converted. Rajat also advised Hydro Tasmania on the potential Rule changes that may be required to preserve the System Protection Scheme, which helps to maintain the non-firm transfer capacity of Basslink (2011).
- ***United Energy Distribution operating expenditure:*** As part of the Victorian electricity distribution determination process, the AER examined United Energy Distribution's (UED's) operating expenditure forecasts. UED was implementing a new business model in which it outsourced fewer services and undertook more activities in-house in order to improve the quality and flexibility of its service performance. Frontier was asked to advise

Johnson Winter & Slattery about the meaning and interpretation of clause 6.5.6(c) of the National Electricity Rules in relation to how it applied to UED's proposed operational expenditures under its new business model. The AER quoted approvingly from Frontier's report in its Final Determination (2010).

- ***Transmission Frameworks Review:*** Rajat provided preliminary advice to the Northern Generators in relation to formulating their submission to the AEMC's Transmission Frameworks Review Issues Paper (2010).
- ***AER RIT-T drafting:*** Rajat advised the AER on the appropriate drafting of the proposed Regulatory Investment Test for Transmission (RIT-T), which replaced the Regulatory Test, and the accompanying RIT-T Application Guidelines (2009 – 2010).
- ***Climate Change impacts on transmission:*** Rajat assisted a group of NEM participants on the appropriate response to the AEMC's recommended changes to transmission pricing and congestion management in light of climate change policies (2009 – 2010).
- ***NERGs advice:*** Rajat advised the AER on the economic efficiency and regulatory implications of the AEMC's proposed options for a new regulatory regime for dealing with new generator-serving transmission network extensions (NERGs) (2009).
- ***Victorian AMI audit:*** Rajat advised the Victorian Auditor-General's Office (VAGO) on VAGO's performance audit of the Victorian Government's decision to mandatorily roll-out smart meters across Victoria from 2009. Frontier's analysis fed into VAGO's report, which was tabled in the Victorian parliament in November 2009 (2009).
- ***NZ Transmission pricing:*** Rajat prepared a report for the New Zealand Electricity Commission (now the Electricity Authority) on the economics of transmission pricing, international experience and potential 'high-level' options for consideration as part of the Commission's Transmission Pricing Review. Our report is available on the Electricity Authority website (2009).
- ***Prescribed and negotiated transmission services:*** Rajat advised VENCorp on the interpretation and application of those aspects of the National Electricity Rules that deal with the delineation between regulated (or 'prescribed') and unregulated (or 'negotiated') transmission services (2009).
- ***Multi-sector utilities:*** Rajat was primary author of a report for the New Zealand Commerce Commission on international approaches to the regulation of multi-sector utilities (2008).
- ***Inter-regional transmission charging:*** Rajat drafted a report for the AEMC advising on the pros and cons of different approaches to inter-regional transmission charging in the NEM (2008).

- ***EnergyAustralia Rule Change:*** Rajat assisted the AEMC with the analysis of a proposed Rule change from EnergyAustralia concerning the appropriate regulatory treatment of EnergyAustralia's transmission assets. This included preparing a draft of the AEMC's Draft Decision and the Rule change itself (2008).
- ***Regulatory Test amalgamation:*** Rajat advised the AEMC on the merits of various options for amalgamating the "reliability" and "market benefit" criteria of the Regulatory Test, pursuant to a direction from the Ministerial Council on Energy (MCE). Also advised on aspects of the new "RIT-T" to replace the Regulatory Test (2007-08).
- ***Regulatory Test Guidelines:*** On behalf of the AER, Rajat developed guidelines for the application of the Regulatory Test by network service providers, as required by a Rule change instituted by the AEMC. Also advised the AER on appropriate revisions to the Regulatory Test following the Rule change (2007).
- ***Real options:*** Frontier and SFG Consulting is advising the Victorian transmission planner, VENCorp, on how a real options analysis can be used to guide investment decisions in easements in advance of developing network augmentations (2007).
- ***Transmission pricing:*** Rajat advised the AEMC on its review of transmission pricing in the NEM. This included the preparation of a scoping paper for the review, Working Papers explaining various technical topics, an Issues Paper for stakeholder consultation and leading the development of the Commission's Rule Change Proposal, Draft Determination and Final Determination (2006).
- ***Revenue Rule Proposal:*** Rajat advised the AEMC on a range of matters relating to the AEMC's Rule Change proposal on the regulation of transmission revenues in the NEM. Specifically, this included advice on the appropriate treatment for network asset depreciation, large 'contingent projects' and transmission incentives (2005-06).
- ***ACCC metering:*** Analysis of the costs and benefits of maintaining a distributor monopoly over small customer electricity metering services for the ACCC (2004).
- ***NZ Grid Investment Test:*** Development of a draft "Grid Investment Test" (GIT) for the New Zealand Electricity Commission. The GIT is a cost-benefit test for transmission investment and will be applied to significant economic and reliability transmission investments by Transpower. Frontier made recommendations on the types of costs and benefits to be included in the GIT assessment, such as generation cost savings, reliability benefits and environmental benefits and taxes – available here (2004).

- ***NZ Transmission pricing methodology:*** Development of a transmission pricing methodology on behalf of the New Zealand Electricity Commission to apply to the recovery of existing and new investment costs by Transpower – available here. The Board of the Commission used Frontier's work as a basis for consultation with stakeholders on an appropriate pricing methodology (2004).
- ***Regulatory Test competition benefits:*** Theoretical and empirical report for the ACCC on amendments to the Regulatory Test for transmission augmentations to allow for the inclusion of competition benefits in the assessment of transmission investments. Frontier modelled competition benefits from an actual transmission investment in the National Electricity Market (NEM). Frontier's report is on the AER website here (2003).
- ***Transmission policy paper:*** On behalf of the NSW jurisdiction, drafted a policy discussion paper for the NEM Ministers' Forum on the role and governance of networks in the NEM examining the economic characteristics of networks and governance models for network service provider incentives (2002).
- ***SNI appeal:*** Key member of the NSW Minister for Energy's team on the South Australia- New South Wales Interconnector appeal, addressing issues such as:
  - the interpretation and application of the ACCC's Regulatory Test and
  - network governance and revenue regulation, including treatment of capital expenditures and asset optimisation (2001-02).

Gas network regulation

- ***Transmission depreciation methodology:*** Rajat advised the Australian Energy Regulator on the implications of APA GasNet's proposed approach to depreciation of their Victorian gas transmission assets as part of APA GasNet's 2013-17 access arrangement. In particular, Rajat advised the AER on whether APA GasNet's proposed approach was likely to lead to reference tariffs that would vary, over time, in a way that promotes efficient growth in the market for reference services (2012-13).
- ***Services contract buyout:*** Rajat advised the Australian Energy Regulator on the appropriate regulatory treatment of the costs incurred by APT Petroleum Pipelines Ltd in the buyout of a contract for services from Agility. Our advice was cited by the AER in its Final Decision (2012).
- ***Multinet forecasting efficient operating expenditure:*** Rajat helped prepare a report for Multinet Gas in Victoria challenging the AER's approach to forecasting the distributor's level of efficient operational expenditure in the 2013-17 arrangement period. Our report was submitted as part of the distributor's response to the AER's Draft Decision (2012).

- ***WA gas access arrangement revisions:*** Rajat provided economic advice to the Western Australian Economic Regulation Authority on revisions to the Access Arrangements of the Goldfields Gas Pipeline and the Mid-West and South-West Gas Distribution Systems (2009-2011).
- ***VENCorp real options application:*** With SFG Consulting, Rajat advised VENCorp on the application of a real options analysis framework to the acquisition of easements for potential future gas pipelines (2007-2009).

Wholesale electricity market design and reform implementation

- ***Capacity mechanisms:*** Rajat prepared a report for the AEMC on the role of electricity market design in facilitating efficient generator entry and exit in the NEM and other electricity markets (2014).
- ***New Zealand single buyer model:*** Rajat drafted a report for Meridian Energy on the opposition Labour and Greens parties' proposal to abolish the New Zealand wholesale electricity market and replace it with a single buyer known as 'NZ Power' (2013).
- ***CarbonNet Project:*** Rajat advised the Victorian Department of Primary Industries on the implications of the proposed CarbonNet carbon capture & storage project on participant incentives and price outcomes for the Australian National Electricity Market (2012-13).
- ***Transmission Frameworks Review – Optional Firm Access:*** Rajat advised the National Generators' Forum on the economic impacts of the proposal for Optional Firm Access contained in the Australian Energy Market Commission's Second Interim Report for its Transmission Frameworks Review. Rajat's response was attached to the NGF's submission and he subsequently met with the AEMC to explain the points highlighted in the report (2012).
- ***Transmission Framework Review options critique:*** Rajat prepared a paper that formed the basis of a submission from the National Generators' Group to the Australian Energy Market Commission's First Interim Report for its Transmission Frameworks Review. Rajat's response highlighted the shortcomings of the AEMC's proposed five options for congestion management (2012).
- ***Tasmanian electricity reform:*** Rajat was part of the Frontier team advising the Tasmanian Electricity Supply Industry Expert Panel (the Panel) on its investigation into the current position and future development of Tasmania's electricity industry. There were two key aspects to Frontier's advice:
  - An assessment of the effectiveness of the wholesale electricity sector. Frontier examined historic outcomes in the wholesale sector, and

undertook market modelling, to assess the extent of market power in the Tasmanian wholesale electricity sector. Frontier found that there was no evidence of sustained market power being exercised in the wholesale sector even though there is significant potential for sustained market power to be exercised.

- Advice on structural, regulatory and governance options to reform Tasmania's electricity industry, and analysis of anticipated changes in the performance of the market. Among other things, Frontier found that disaggregating bidding control of generation assets in Tasmania would diminish the potential for sustained market power to be exercised

  Rajat's role included assistance in drafting the Panel's report to the Tasmanian Government (2011-12).

- ***Generator market power:*** Rajat drafted a report for the National Generators Group responding to questions and issues raised in the Australian Energy Market Commission's Consultation Paper on generator market power in the National Electricity Market (2011).

- ***Increasing the MPC and CPT:*** Rajat was the primary author of a report for the AEMC discussing the non-reliability implications of increasing the Market Price Cap and Cumulative Price Threshold in the NEM. This included the implications for generator investment, wholesale prices, financial contracting, incentives to exercise market power, demand-side response and prudential requirements – available here (2010).

- ***Victorian system force majeure dispute:*** Rajat advised TRUenergy on the economic interpretation of the system force majeure provisions in the Victorian Gas Market and System Operation Rules in relation to a dispute with VENCorp before the gas industry Dispute Resolution Panel. This advice included quantification of the impact of a gas interruption on the Victorian gas market. Rajat also acted as an expert witness for TRUenergy before the Panel. The Panel decided in favour of VENCorp. (2009)

- ***Wholesale Market Review:*** Advised the Economic Regulation Authority on the preparation of their second and third reports to the Minister on the effectiveness of the Wholesale Electricity Market in Western Australia. (2008 – 2009).

- ***AEMC generator nodal pricing:*** Rajat drafted a paper reviewing the theory and practice of generator nodal pricing for the AEMC as part of the Congestion Management Review – available here (2008).

- ***AEMC Congestion Management Review:*** Rajat was an advisor to the AEMC on approaches to congestion management in the NEM pursuant to a review reference from the MCE. Rajat's role included coordinating Frontier's market and risk modelling contributions to the CMR and assisting with the

drafting of various AEMC publications. Rajat was involved in all stages and facets of the CMR, including:

- Understanding the nature of the physical and financial trading risks created by congestion;
- Describing existing arrangements in the NEM for managing the trading risks created by congestion;
- Estimating and assessing the materiality of congestion in the NEM, including by undertaking relevant market modelling of the economic cost of congestion in dispatch;
- Proposing and assessing options for improvements to the congestion management regime in light of the materiality of the problem; and
- Assistance with drafting the AEMC's CMR publications (2006-08).

- ***Snowy region boundary change proposals:*** Rajat advised the AEMC on the three proposals put forward by participations for redrawing the Snowy regional boundaries in the NEM. Rajat coordinated Frontier's modelling for the assessment of all three proposals, drafted the AEMC's modelling appendix and provided drafting assistance for the AEMC's draft and final determinations (2007).
- ***Victorian coal royalty increase:*** Preparation of a paper for Loy Yang Marketing Management Company discussing the likely ability of Victorian brown coal generators to 'pass through' an increase in the coal royalty to customers via spot or wholesale prices (2005).
- ***Victorian energy cross-ownership laws:*** Developing a submission on the review of Victorian energy cross ownership laws for the Energy Users Association of Australia (2005).
- ***Singapore EMA and EDB embedded generation:*** Prepared a report jointly for the Singapore Energy Market Authority (EMA) and the Economic Development Board (EDB) with the assistance of engineers SKM, assessing the efficiency of the existing regulatory arrangements for embedded generation in the Singapore National Electricity Market and recommending potential improvements (2004).
- ***Reliability Panel guidelines for NEMMCO intervention:*** Drafted a report for the AEMC assessing and refining the Reliability Panel's proposed guidelines for NEMMCO's reserve contracting powers (2005).
- ***Remuneration for system restart services:*** Development of a submission for Macquarie Generation on the appropriate remuneration for system restart services in the NEM (2005).
- ***Singapore EMA embedded generation:*** Drafted a report for the Singapore EMA on the appropriate regulatory treatment of *existing* embedded

generators in the Singapore National Electricity Market. The recommendations of the report were implemented by the EMA (2004).

- ***'Snowy' trial of CSP/CSC arrangements:*** Contributor to a submission from Macquarie Generation to the ACCC on the merits of introducing constraint support pricing (CSP) and constraint support contracts (CSC) arrangements within the Snowy region of the NEM (2004).
- ***NETA:*** Paper for the Japanese Central Research Institute of the Electric Power Industry (CRIEPI) describing the origin and workings of the England and Wales New Electricity Trading Arrangements. The paper also examined recent regulatory developments and price outcomes, as well as recent transactions in the UK power sector (2003).
- ***NSW MIG and MEU:*** Rajat was a key member of the Frontier team advising the New South Wales Market Implementation Group and Ministry of Energy and Utilities of a range of electricity market, regulation and governance issues (1999-2003).
- ***Queensland electricity reform:*** Part of the team advising the Queensland Electricity Reform Unit in relation to issues arising in the Queensland Interim Market (1998).

Greenhouse policy analysis

- ***Generator Impacts of Climate Change Policies:*** Rajat was the primary author of a report for the AEMC assessing the impacts of the CPRS and the enhanced RET on generator bidding, contracting and investment decisions in the NEM for the AEMC – available here (2008).
- ***Western Australian and Northern Territory impacts of climate change policies:*** Rajat drafted a report for the AEMC on the potential implications of the CPRS and RET for the Western Australian and Northern Territory energy markets – available here (2008).
- ***ETS auction design:*** Rajat advised the National Generators Forum (NGF) on the Federal Government Green Paper's proposed CPRS auction design, with Frontier's report forming an attachment to the NGF's submission – available here (2008).

Retail electricity market reform and implementation

- ***AEMC Financial Resilience Review:*** Rajat advised the AEMC on the assessment of potential options for limiting the risk of 'financial contagion' in the NEM as a result of the failure of a large electricity retailer. Rajat's analysis builds on and extends the AEMC's work in its First Interim Report for the Financial Resilience Review (2014).

- ***ERAA costs of interval metering:*** Critical review of retailers' costs of accommodating interval meter roll out across Australian and international jurisdictions. This has included a wide-ranging literature review of interval meter analyses across NEM and international jurisdictions, as well as a critique of cost-benefit studies that have been undertaken to date (2006-07).
- ***Ofgem:*** Part of a team working for the England and Wales gas and electricity markets regulator examining certain developments in the retail electricity market (2003).
- ***Full retail competition in NSW:*** Key member of the team implementing FRC in electricity in New South Wales and undertaking a range of assignments, including development of the small customer protection framework and rules for interaction between retailers and local network businesses (2000-2003).

Competition analysis

- ***AGL proposed acquisition of Macquarie Generation:*** Rajat was part of the Frontier Economics team advising AGL's lawyers, Ashurst, on competition issues raised in the proposed acquisition of Macquarie Generation. AGL were successful in the Australian Competition Tribunal (2014).
- ***ACCC vertical integration:*** Rajat drafted a paper for the ACCC on the competition and efficiency implications of vertical mergers in electricity, with specific reference to the acquisition of TXU Australia (a retailer, distributor and generator in the NEM) by Singapore Power (the owners of Victoria's transmission network) (2004).

CAREER

1999 to present	Consultant, Frontier Economics
1998 to 1999	Consultant, London Economics
1997 to 1998	Articled clerk, then solicitor, Freehill, Hollingdale & Page

EDUCATION

1990 – 1995	LLB (honours), University of Melbourne
1990 – 1993	B.Com (first class honours), University of Melbourne

Rajat maintains an Australian legal practising certificate and is a Barrister and Solicitor of the Supreme Court of Victoria.

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