Estimating the long run marginal cost of providing electricity distribution network services

A review of Evoenergy's proposed methodology

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HoustonKemp.com

Report Authors

Dale Yeats

Ann Whitfield

Contact Us

Sydney
Level 40
161 Castlereagh Street
Sydney NSW 2000

Phone: +61 2 8880 4800

Singapore
8 Marina View
#15-10 Asia Square Tower 1
Singapore 018960

Phone: +65 6817 5010

Disclaimer

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1. Introduction

This report has been prepared at the request of Evoenergy. Its subject is Evoenergy's proposed methodology for estimating the long run marginal cost (LRMC) of providing electricity distribution network services for the purpose of setting network prices for the regulatory control period commencing 1 July 2019. In particular, Evoenergy has asked us to review its proposed methodology for estimating LRMC for compliance with the requirements of the National Electricity Rules (the rules).

The estimation of LRMC is a foundational element of a distribution network service provider's (DSNP's) network pricing methodology under the rules. By way of example, the Australian Energy Market Commission (AEMC) explained that:[1]

> LRMC will be the first step for DNSPs in developing their network tariffs under the new pricing principles. This is important as LRMC will form the basis of the pricing signals that should be sent to consumers and therefore should be the starting point for tariff design.

The rules do not prescribe a particular methodology to be applied in the estimation of LRMC[2] and it is therefore important that Evoenergy's estimation methodology is:

- compliant with the requirements of the rules;
- consistent with the economic concepts and theories on which those rules are based; and
- reflects the particular circumstances of Evoenergy's network and customers.

The remainder of our report is structured as follows, ie:

- in section 2, we explain the economic concept of LRMC and describe alternative estimation methodologies;
- in section 3, we describe the relevant requirements of the rules and Evoenergy's proposed methodology for estimating LRMC; and
- in section 4 we evaluate Evoenergy's estimation methodology for compliance with the requirements of the rules.

[1] AEMC, *Rule Determination – National Electricity Amendment (Distribution Network Pricing Arrangements) Rule 2014*, November 2014, p.139.

[2] AEMC, *Rule Determination – National Electricity Amendment (Distribution Network Pricing Arrangements) Rule 2014*, November 2014, p.160.

2. The concept of LRMC and its estimation

In this section we explain the economic concept of LRMC and alternative methodologies for estimating LRMC.

2.1 The concept of LRMC

LRMC is a forward-looking concept and amounts to a measure of the additional cost incurred as a result of an incremental (or relatively small) change in output, assuming all factors of production are able to be varied. The concept of LRMC applies equally to an incremental increase or decrease in output and, as Turvey notes:[3]

> Marginal costs between upwards and downwards changes may differ.

As a matter of principle, setting prices equal to LRMC will promote efficient use and production of network services because:

- it ensures that customers face price signals that reflect the resource cost of providing network services, which encourages use of the network when the benefit to customers exceeds the cost of provision; and
- it provides signals to DNSPs as to the value customers place on network capacity, and thereby plays an important role in planning and financing that capacity.

The forward-looking nature of LRMC arises from the observation that historical costs cannot be affected by changing current behaviour. However, future costs pertaining to a change in the size of a network can be affected by changes in demand. Indeed, Kahn (1988) notes that:[4]

> Marginal costs look to the future, not to the past: it is only future costs for which additional production can be causally responsible; it is only future costs that can be saved if that production is not undertaken.

In the context of electricity network services, the LRMC of network services may vary depending on:

- the time at which the electricity is supplied;
- the geographic location within the network; and
- the part or level of the network, eg, low or high voltage.

2.2 Estimation methodologies

LRMC is an economic concept and, as such, it can be estimated using a range of alternative approaches. Two commonly considered approaches are:

- the average incremental cost (AIC) approach; and
- the perturbation approach, which is also referred to as the Turvey approach.[5]

We briefly explain each of these approaches below.

[3] Turvey, R., *What are Marginal Costs and How to Estimate them?*, March 2000, p.3.

[4] Kahn, A, *The Economics of Regulation: Principles and Institutions*, Massachusetts Institute of Technology, volume 1, page 98.

[5] In reference to the seminal article by Ralph Turvey on the concept of marginal cost. See Turvey, R., (1969), *'Marginal cost'*, The Economic Journal, Vol. 79, June, pp.282-99.

2.2.1 The average incremental cost approach

The AIC approach involves estimating LRMC on the basis of the average change in forward looking operating and capital expenditure that would result from an increase in demand. Its application involves:

1. estimating future growth-related operating and capital costs required to satisfy the expected increase in demand;
2. estimating the forecast increase in demand served; and
3. dividing the present value of future costs by the present value of the increase in demand over the time horizon.

Algebraically, this calculation can be expressed as follows:

$$LRMC = \frac{NPV(growth\ related\ capital\ and\ operating\ costs)}{NPV(additional\ demand\ served)}$$

The key advantage of the AIC approach, and the reason it has been applied by a number of DNSPs to date, is that it is administratively straight forward to implement. However, it does involve using an ‘average’ cost to approximate the marginal cost change, which is reasonable where expenditure is relatively smooth through time, but can have adverse implications where expenditure is lumpy.

2.2.2 The perturbation approach

The perturbation approach evaluates the costs that would occur or be avoided if current forecasts of demand were ‘perturbed’ by a fixed and permanent increment or decrement in demand. This perturbation triggers a change in capacity requirements, and so results in a change in total supply costs.

In essence, application of the perturbation approach involves:

1. estimating forward-looking total capital and operating costs for each year over a planning horizon;
2. re-estimating forward looking operating and capital costs for each year over the planning horizon as a consequence of a small but permanent change, or perturbation, in demand; and
3. dividing the difference between the present value of the expenditure plans in (1) and (2) above by the present value of the increment in demand.

The principal advantage of the perturbation approach is that it better reflects the theoretical construct of the concept of LRMC and can be applied irrespective of whether demand is growing or falling, as compared with the AIC approach. However, its application requires forecasting expenditure under a revised demand forecast, which requires the designers of the capital and operating expenditure programs to identify the required change in the existing expenditure plan. The perturbation approach therefore requires more information, as compared with the AIC approach.

3. Evoenergy's proposed methodology

In this section we set out the requirements of the rules, explain the methodology adopted by Evoenergy to estimate LRMC (including the research undertaken by Evoenergy in the development of its methodology) and comment on whether that methodology reflects the requirements of the rules and the economic principles discussed in the previous section.

We note that our understanding of Evoenergy's methodology is based on the information provided by Evoenergy. We have not undertaken a detailed audit of the application of that methodology, such as reviewing the determination of the specific inputs used.

3.1 The requirements of the rules

Consistent with the discussion in section 2.1, the rules define LRMC to be:[6]

> …the cost of an incremental change in demand for direct control services provided by a Distribution Network Service Provider over a period of time in which all factors of production required to provide those direct control services can be varied.

A 2014 rule determination by the AEMC strengthened the requirement on distribution network service providers (DNSPs) to set tariffs by reference to LRMC. Under the previous rules, DNSPs were required to 'take into account' the LRMC of providing network services when setting prices, whereas the amended pricing rules require that:[7]

> Each tariff *must be based on* the long run marginal cost of providing the service to which it relates to the retail customers assigned to that tariff… [Emphasis added]

The rules go on to provide that the methodology for estimating LRMC and the manner in which it is applied must be determined having regard to: [8]

> (1) the costs and benefits associated with calculating, implementing and applying that method as proposed;
>
> (2) the additional costs likely to be associated with meeting demand from retail customers that are assigned to that tariff at times of greatest utilisation of the relevant part of the distribution network; and
>
> (3) the location of retail customers that are assigned to that tariff and the extent to which costs vary between different locations in the distribution network.

Notably, the rules do not prescribe a particular methodology to be applied in the estimation of LRMC and the AEMC explained that:[9]

> The final rule instead focuses on providing guidance for DNSPs on what the LRMC methodology should target in terms of sending efficient pricing signals. This approach allows for more sophisticated methodologies, such as the perturbation methodology, to be used where the benefits exceed the costs of doing so.

[6] The rules, Chapter 10, definition of long run marginal cost.

[7] The rules clause 6.18.5(f).

[8] The rules clause 6.18.5(f).

[9] AEMC, *Rule Determination – National Electricity Amendment (Distribution Network Pricing Arrangements) Rule 2014*, November 2014, p.129-130.

3.2 Evoenergy's research on demand and replacement expenditure

In principle, all expenditure affected by changes in demand – including any demand-affected replacement expenditure – should be included in the calculation of LRMC.

We understand that a key focus in the development of Evoenergy's proposed methodology has been concerned with whether, and if so to what extent, replacement expenditure is affected by demand and should be reflected in the estimate of LRMC used to set network prices. This research has suggested that there is considerable variation in the level of LRMC across Evoenergy's network, namely between areas in which demand is growing and the areas in which it is declining.

Since Evoenergy proposes to apply postage stamp pricing, this means that the price signal provided to some customers will necessarily vary from a reasonable estimate of the forward-looking costs that could be avoided in that location. Therefore, this research provides important context to Evoenergy's methodology for minimising this inconsistency, consistent with the national pricing objective and the long-term interest of its customers.

3.2.1 In what circumstances can demand affect replacement expenditure?

The AER's Expenditure Forecast Assessment Guideline states that:[10]

> Replacement expenditure is the *non-demand driven capex* to replace an asset with its modern equivalent where the asset has reached the end of its economic life. [emphasis added]

It follows that, in areas of the network where demand is growing and it is efficient to upsize an asset upon replacement, the demand-driven component of that expenditure would be classified as augmentation expenditure. On the other hand, in those areas of the network where demand is growing an incremental reduction in demand (consistent with the LRMC estimation framework) would give rise to less demand growth, rather than a net reduction in demand. This means that in areas of the network where demand is growing a decrement in demand would give rise to less growth-related expenditure, rather than less replacement expenditure.

For these reasons, replacement expenditure is not likely to be affected by either an increment or decrement in demand in areas of the network where demand is growing.

In contrast, in areas of the network where demand is forecast to decline, an incremental reduction in demand may enable the downsizing of an asset upon replacement.

We understand that demand is forecast to decline at only four of Evoenergy's fifteen zone substations over the next regulatory control period. As a consequence, it is only in these four areas that replacement expenditure could be potentially affected by a reduction in demand.

3.2.2 How does a reduction in demand affect replacement expenditure?

At the outset, it is relevant to highlight that it is not possible to downsize all assets that comprise Evoenergy's network. By way of example, pole replacements account for approximately 34 per cent of replacement expenditure in the forthcoming regulatory control period, where there is only one asset size for poles. This suggests that at least a third of Evoenergy's replacement expenditure (in areas where demand is declining) would be unlikely to be affected by an incremental reduction in demand.

We also understand that Evoenergy standardises the size of some of its assets so as to realise cost savings associated with design, inventory management and spare parts. These costs savings are possible because of the relatively low difference in the cost of different sized assets in some circumstances, and such standardisation is consistent with general industry practice.

[10] AER, *Explanatory Statement – Expenditure Forecast Assessment Guideline*, November 2013, p.184.

Nevertheless, in areas of the network where demand is declining *and* there exists scope to downsize an asset upon replacement, network planners should undertake a comparative evaluation of:

- the potential cost saving from downsizing an asset upon replacement; against
- the corresponding risk that a future unexpected increase in demand necessitates augmentation expenditure that exceeds the initial cost savings.

What are the potential cost savings?

Although there exists a theoretical relationship between the extent of use and the useful life of electricity network assets, Evoenergy's network planners advised that, in practice, this relationship is rarely observed. This means that the potential to downsize an asset upon replacement is the principal means by which a reduction in demand has the potential to affect replacement expenditure.

The potential benefit to customers of Evoenergy downsizing an asset upon replacement arises from the associated cost saving, which is ultimately passed on to customers. The magnitude of this cost saving depends on the difference in cost between a like-for-like and lower-rated replacement asset. Of particular relevance, Evoenergy identified that:

- the difference in the cost of different sized assets is generally low, as compared with the total cost of the asset itself; and
- a material proportion of replacement expenditure can relate to the cost of labour and civil works.

The asset cost component of replacement projects varies with the nature of the project. By way of example, the asset cost component of replacing a distribution transformer (which is relatively rare on Evoenergy's network) can be as much as 89 per cent. On the other hand, the need for civil works, eg, in connection with underground feeders, can mean that civil works can comprise as much as 84 per cent of replacement costs for some projects.

The two factors listed above combine, generally, to establish economies of scale in the replacement of assets at the end of their useful life. This means that the proportion of replacement expenditure that can be avoided by downsizing an asset is generally low, as compared with the total replacement cost, and that a reduction in the size of an asset upon replacement elicits a smaller relative reduction in replacement costs, as illustrated by the case study in Box 1.

Box 1 – Case study: Underground feeders

The Sternberg underground feeder was replaced in 2017 with a 11 kV 3c/400mm2 Al XLPE cable with rated capacity of 5.1MVA. The replacement cable was commissioned in August 2017 and the total cost of the replacement came to $3.6 million, where only 6 per cent of that cost related to the underground feeder cable itself.

If Evoenergy had instead replaced the underground feeder with a 11 kV 3c/300mm2 Al belted cable, the cost of the underground feeder cable would have been $30,000 lower, but the feeder would have had a lower rating of 4.1MVA.

Assuming all other replacement costs would be the same, this suggests downsizing the rating of the underground feeder by 16 per cent would elicit a reduction in the total replacement cost of less than one per cent.[11]

[11] Calculated equal to $30,000 divided by $3.6 million.

We note that this case study is likely to reflect a relatively extreme example, owing to the significant civil works generally involved in the replacement of underground feeders. However, it does illustrate the point that in practice a relative change in demand can have a much lower relative effect on replacement expenditure.

What are the potential risks?

Downsizing an asset upon replacement gives rise to a potential risk that an unforeseen increase in demand over the life of the replacement asset – typically in the order of 40 years – necessitates augmentation expenditure that could otherwise have been avoided. Further, the additional cost associated with such an augmentation may exceed the upfront cost saving because of:

- the potential labour and civil costs associated with asset installations; and
- the low difference in cost between assets with different ratings, as compared with their total cost.

This risk, and the potential cost consequences for customers, is an important factor in network planning decisions concerning downsizing assets upon replacement.

3.2.3 Summary and indicative estimate

On the basis of the information provided by Evoenergy, in our opinion it is reasonable to conclude that:

- replacement expenditure is only avoidable in areas where demand is falling;
- not all replacement expenditure in areas of falling demand is potentially avoidable;
- the relationship between demand and replacement expenditure is generally not linear, ie, a proportional reduction in demand would be expected to give rise to a relatively lower proportional reduction in replacement expenditure; and
- downsizing an asset upon replacement must be weighed against the risk of future augmentation expenditure, which may exceed the initial cost savings upon replacement and could otherwise have been avoided.

Nevertheless, so as to gain insight as to the potential magnitude of LRMC in areas of falling demand (where some replacement costs are avoidable) Evoenergy derived an indicative estimate of LRMC in those areas.

Box 2 – An indicative estimate of LRMC in areas of declining demand

We understand Evoenergy adopted a conservative assumption that there exists a linear relationship between demand and replacement expenditure, ie, it assumed a five per cent reduction in demand would elicit a five per cent reduction in replacement expenditure. It also assumed that all replacement expenditure in those areas of the network is potentially avoidable.

Evoenergy apportioned replacement expenditure to those zone substations where demand is forecast to fall and then calculated LRMC by modifying the AIC calculation as follows, ie:

$$LRMC^{declining} = \frac{PV(total\ capital\ and\ operating\ repex\ at\ zone\ substations\ where\ demand\ is\ declining)}{PV(total\ demand\ at\ zone\ substations\ where\ demand\ is\ declining)}$$

We understand this indicative analysis suggested that, in areas of Evoenergy's network where demand is forecast to decline, the LRMC of providing network services to the low voltage residential tariff class is less than \$10 per kilowatt (kW) per annum (p.a.). This contrasts with Evoenergy's estimate of LRMC in areas of growing demand of \$172 per kW p.a..

In reviewing Evoenergy's LRMC estimate across the four zone substations where demand is falling we note that the underlying assumption that there is a linear relationship between demand and replacement expenditure is highly conservative, and so the LRMC of a decrease in demand may be even lower in these areas than Evoenergy's indicative $10 per kW p.a estimate.

Further, we understand the numerator to this calculation included all categories of replacement expenditure, including those for which different asset sizes do not exist, eg, electricity poles. Pole replacements account for approximately 34 per cent of replacement expenditure over the next regulatory control period, and so the removal of those costs (and any other such costs) would act to further reduce this estimate of LRMC.

On the basis of Evoenergy's research, in our opinion it is reasonable to conclude that the LRMC of providing network services in areas of Evoenergy's network where demand is falling is materially lower than that in other areas of the network where demand is growing.

3.3 Evoenergy's proposed methodology

Evoenergy is proposing to estimate LRMC by means of an AIC approach, consistent with the general approach adopted in its first tariff structure statement (TSS). However, Evoenergy is proposing to implement a number of refinements to its methodology for estimating LRMC, as compared with that applied in its first TSS. These refinements include:

- advancing its understanding of the relationship between demand and replacement expenditure and the resulting diversity in LRMC across its network, as well as developing a framework for considering how best to account for that variation in setting network prices in the context of postage stamp pricing;
- improving the precision of its estimate of LRMC by refining both the expenditure and demand inputs to its calculation; and
- deriving and setting network prices by reference to distinct LRMC estimates for each tariff class, whereas it set prices by reference to a single estimate of LRMC in its first TSS;

In our view these improvements represent an advancement in the sophistication of Evoenergy's LRMC methodology and a rigorous application of the AIC methodology.

We set out our understanding of Evoenergy's methodology and comment on its consistency with the relevant economic concepts below.

3.3.1 Estimating LRMC in areas of the network where demand is growing

The research undertaken by Evoenergy and summarised in section 3.2 identified that there is considerable diversity in LRMC across its network. In particular, the LRMC in areas of its network where demand is growing may be as much as 17 times greater than that in areas of its network where demand is declining (where LRMC reflects avoidable replacement expenditure).

Since Evoenergy is proposing to apply postage stamp prices in the next regulatory control period, the provision of distinct LRMC-based prices in different areas of its network is not feasible. This means that the price signal provided to some customers will necessarily vary from a reasonable estimate of the forward-looking costs that could be avoided in that location.

Evoenergy therefore had to decide how best to minimise this inconsistency, consistent with the national pricing objective and the long-term interest of its customers. In simple terms, it could estimate and set prices by reference to estimates of LRMC in areas of the network where demand is growing, in areas of the network where demand is declining, or by taking some average of LRMC across those areas.

We understand Evoenergy is proposing to estimate and set network prices by reference to estimates of the LRMC of additional demand on its network, or growth, because:

- an approximate 5 per cent increase in network demand is forecast over the next regulatory control period;
- demand at only four of its 15 zone substations is forecast to decline over the next regulatory control period;
- demand growth in the next regulatory control period is expected to be approximately five times greater than the decline in demand (in other areas of the network);
- the additional network costs arising from the potential for inefficient consumption decisions in areas of the network where demand is growing are significantly greater than the potential network cost savings sacrificed by any inefficient consumption decisions in areas of the network where demand is declining; and
- the reduction in peak prices that would result from reflecting in prices, either in whole or part, LRMC in areas of declining demand would require:
  - the recovery of more residual costs from fixed charges, with potential adverse customer impacts; and/or
  - the recovery of more residual costs from less efficient, or more distortionary, non-LRMC based variable charges.

On the basis of Evoenergy's research and the above reasons, in our view it is reasonable to base network prices on the LRMC of additional demand in areas of the network where demand is growing.

3.3.2 The average incremental cost approach and a ten year evaluation period

Evoenergy is proposing to estimate LRMC by means of an AIC approach. The AER accepted the AIC approach in its final decision on Evoenergy's first TSS. The AIC approach is also the approach that has been applied by most DNSPs to date.

Adoption of the AIC approach avoids Evoenergy needing to develop additional demand and cost forecasts to support a perturbation approach. We understand Evoenergy concluded that the incremental benefits associated with adopting the perturbation approach did not outweigh the additional administrative costs. This reflects the requirement of the rules that, in selecting its methodology, Evoenergy has regard to:[12]

> …the costs and benefits associated with calculating, implementing and applying that method…

In this context, application of an AIC approach is appropriate and will likely give rise to a reasonable estimate of LRMC.

Further, we note Evoenergy proposes to apply the AIC approach so as to derive a separate estimate of LRMC for each tariff class, which will improve the efficiency of the price signals provided to customers assigned to each tariff, as compared with the approach applied in its previous TSS.[13]

A ten-year evaluation period

In theory, all future costs that may be affected by a change in demand are relevant to an estimate of LRMC. However, in practice it is not feasible to evaluate costs and demand over a period spanning many decades, ie, because of the increasing uncertainty arising from the lengthening of the time horizon.

[12] The rules, clause 6.18.5(f)(1).

[13] The rules clause 6.18.5(f).

Evoenergy has evaluated the cost and demand inputs to its estimate of LRMC over a ten year evaluation period. This is consistent with the approach adopted by other DNSPs and the AER's guidance that a ten year evaluation period:[14]

> …is long enough to allow a significant number of factors of production to change, such as the level of capacity in the network, and is in line with the long lives of network assets.

3.3.3 Refining expenditure forecasts

As explained in section 2, the estimation of LRMC involves an evaluation of the causal relationship between a change in demand and the resulting change in future costs required to service that level of demand. Therefore, it is important that the expenditure forecasts underlying the LRMC estimates appropriately reflect costs that are driven, or caused, by the contemplated change in demand.

A first-principles review of the drivers of expenditure

The expenditure inputs to Evoenergy's calculation of LRMC comprise:

- forecast annual growth-related expenditure in each year of the evaluation period, annuitised over an assumed useful life; and
- growth-related operating expenditure, assumed to be equal to 2 per cent of growth-related capital expenditure in each year.

Evoenergy allocated capital costs to each tariff class on a project-by-project basis and by reference to the extent the cost of each project was driven by the demand of customers in each tariff class.

Evoenergy undertook a review of the drivers of all capital expenditure projects considered for inclusion in the estimation of LRMC to ensure all the relevant expenditure is driven by demand growth. This importance of such a review is demonstrated by the planned augmentation projects at the East Lake and Fyshwick zone substations.

Box 3 – Case Study: The East Lake and Fyshwick zone substations

The Fyshwick Zone Substation was commissioned in 1982 and the primary assets are approaching the end of their economic lives and so require replacement. The East Lake zone substation was commissioned in 2013 with one 132/11 kV 30/55 MVA transformer and one 11 kV switchboard.

At present, there is an augmentation project planned that involves the addition of a second transformer at the East Lake zone substation, the installation of high capacity express 11 kV feeders from East Lake to Fyshwick and the decommissioning and conversion of the Fyshwick zone substation to an 11 kV switching station only.

However, this project is not entirely driven by demand growth, it is in part driven by the Fyshwick Zone Substation approaching the end of its useful life. In other words, this augmentation project in part reflects the fact that it is the most efficient approach to replacing the Fyshwick zone substation.

Consequently, Evoenergy did not include the full cost of this augmentation as 'growth related capital expenditure' in its estimation of LRMC.

Evoenergy's first-principles review the drivers of all expenditure inputs to its LRMC calculation is consistent with the economic concept of LRMC and represents best-practice application of the AIC approach.

[14] The AER, *Final Decision – Tariff structure statement ActewAGL*, February 2017, p.51.

Accounting for end-effects

The period over which it is practical to forecast demand and expenditure is much shorter than the infinite horizon over which inputs and outputs should, in theory, be evaluated for the purpose of estimating LRMC.

This can give rise to an end-effects problem, which arises if the cost inputs to the calculation are included in full in each year of the evaluation period, but the additional demand served as a result of that expenditure extends beyond the evaluation period. This establishes an asymmetry between the measurement of inputs (expenditure) and outputs (additional demand served) reflected in the estimate of LRMC.

By way of illustrating this point, take the final year of the evaluation period, where growth-related costs are included in full in the present value calculation in the numerator of the AIC formula, but where only one year of additional demand served as a result of that expenditure is reflected in the denominator. In essence, this reflects circumstances where all expenditure in that year was required to serve additional demand in one year only. This is not an accurate representation of the relationship between demand and costs in the context of long-lived assets, ie, where growth-related capital costs incurred in one year assist in serving demand for a period of up to forty years.

Not properly accounting for such end-effects can give rise to an upwards bias in the estimate of LRMC.

To address this potential bias, Evoenergy annuitised growth-related capital expenditure in each year over an assumed operating life of the underlying assets. This approach is equivalent to subtracting the residual book value of all assets from total costs at the end of the evaluation period.

This annuitisation of capital expenditure to address potential end-effects represents best-practice in the application of the AIC approach and will improve the precision of Evoenergy's estimate of LRMC.

3.3.4 Refining the demand inputs

As discussed in section 2, the estimation of LRMC involves an evaluation of the causal relationship between a change in demand and future costs required to service that level of demand. In the context of an AIC approach, it is therefore important that the demand forecast underpinning the analysis reflects the level of additional demand that is driving the growth-related expenditure forecast.

In the past, Evoenergy estimated LRMC by reference to forecast growth in network demand, which may comprise areas of the network where demand is growing and other areas of the network where demand is falling.

However, where LRMC is estimated by reference to a forecast of network demand, the existence of any areas of the network where demand is declining will to some extent offset measured demand growth. This will understate the additional demand served by the growth-related expenditure reflected in the numerator of the AIC calculation and, potentially, give rise to an upwards bias in the estimate of LRMC.

Consequently, Evoenergy has adopted an approach where the demand forecast reflected in the AIC calculation reflects only demand at those substations where demand is forecast to increase over the evaluation period. This will give rise to a more accurate estimate of the LRMC of demand growth on Evoenergy's network, as compared with its previous approach.

3.4 Converting LRMC into network price signals

The AIC approach results in an LRMC estimate for each network service expressed in dollars per kilovolt-amp (kVA) p.a.. However, many customers are not (and cannot) be charged on the basis of their contribution to the network's maximum demand. For the purpose of setting prices based on LRMC, it is therefore necessary to convert the dollars per kVA p.a. estimate of LRMC to the basis on which the relevant charges are levied.

For charges levied on a per kW or kilowatt-hour (kWh) basis, Evoenergy first converted its estimate of LRMC from a KVA p.a. basis to a kW p.a. basis using the power factor for the applicable tariff class.

We understand Evoenergy then translated its LRMC estimates into LRMC-based network price levels:

- for non-time of use (ToU) charges as follows, ie:

$$LRMC\ estimate\ (\$\ per\ kWh) = \frac{LRMC\ (\$\ per\ kW\ p.a.)}{\text{Total}\ hours\ in\ the\ year};$$

- for ToU peak energy charges as follows, ie:

$$LRMC\ \ estimate\ (\$\ per\ kWh\ ) = \frac{LRMC\ (\$\ per\ kW\ p.a) \times Prob.\ of\ \text{maximum}\ demand\ occurring\ during\ time\ period}{Total\ number\ of\ hours\ in\ time\ period\ in\ the\ year}; \text{ and}$$

- for ToU demand charges as follows:

$$LRMC\ \ estimate\ (\$\ per\ kW\ per\ day) = \frac{LRMC\ (\$\ per\ kW\ p.a) \times Prob.\ of\ MD\ occurring\ during\ time\ period}{Number\ of\ days\ in\ the\ year}.$$

In circumstances where Evoenergy considered the resulting LRMC-based prices would give rise to unacceptable network bill impacts from year-to-year, we understand it developed a transitional path that addressed those impacts.

4. Compliance with the requirements of the rules

Our review of Evoenergy's methodology for estimating LRMC identified that it is consistent with the economic concept of LRMC and the requirements of rules, ie:

- it applies an AIC approach, having regard to:[15]

  > …the costs and benefits associated with calculating, implementing and applying that method…

- it bases prices on a distinct estimate of LRMC for each tariff class, which improves the efficiency of the price signals provided to customers assigned to each tariff;[16]
- it adopts an evaluation period of ten years, which is consistent with previous statement by the AER as to the meaning of 'long term';[17]
- it evaluates demand and avoidable capital and operating costs over the evaluation period for each tariff class with particular attention to refining its demand and expenditure inputs to better assess the causal relationship between demand and avoidable costs, ie, to evaluate:[18]

  > …the additional costs likely to be associated with meeting demand from retail customers that are assigned to that tariff at times of greatest utilisation of the relevant part of the distribution network.

- it considers the extent to which the LRMC of providing network services varies across its network and how best to account for that variation in setting network prices in the context of postage stamp pricing, ie, it considered: [19]

  > …the location of retail customers that are assigned to that tariff and the extent to which costs vary between different locations in the distribution network.

Further, Evoenergy's estimation methodology reflects the particular circumstances of its network and customers, as demonstrated by the analysis underpinning its decision to estimate the LRMC of growth in demand and its consideration of the extent to which replacement expenditure is avoidable. In our opinion, the proposed methodology represents an advancement in the sophistication of Evoenergy's estimation of LRMC and a rigorous application of the AIC methodology.

Finally, we note that Evoenergy applies a sound approach to converting to efficient network price levels its estimates of the LRMC of providing network services to customers in each tariff class. We also understand Evoenergy exercised the discretion afforded it by the rules by applying a transition path to those efficient network price levels where it considered the customer network bill impacts of immediately adopting those price levels would be unacceptable. We have not reviewed the customer bill impacts and transition path, but note that a departure from purely LRMC-based network prices reflects the requirement of the rules that:[20]

> A Distribution Network Service Provider must consider the impact on retail customers of changes in tariffs from the previous regulatory year and may vary tariffs from those that comply with paragraphs (e) to (g) to the extent the Distribution Network Service Provider considers reasonably necessary…

[15] The rules, clause 6.18.5(f)(1).

[16] The rules clause 6.18.5(f).

[17] The AER, *Final Decision – Tariff structure statement ActewAGL*, February 2017, p.51.

[18] The rules, clause 6.18.5(f)(2).

[19] The rules, clause 6.18.5(f)(3).

[20] The rules, clause 6.18.5(h).

HOUSTONKEMP
Economists

Sydney
Level 40
161 Castlereagh Street
Sydney NSW 2000

Phone: +61 2 8880 4800

Singapore
8 Marina View
#15-10 Asia Square Tower 1
Singapore 018960

Phone: +65 6817 5010