HOUSTONKEMP Economists

Memo

To	Bill Nixey, Network Pricing Manager, Ausgrid
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Subject	Long run marginal cost of import network services
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This note presents a brief summary of the methodology we applied to estimate the long run marginal cost (LRMC) of the import network services provided by Ausgrid.

On 14 July 2022, we provided Ausgrid with a version of this note which was submitted to the Australian Energy Regulator (AER) as part of Ausgrid's draft regulatory proposal for the 2024-29 regulatory control period. This version of the note contains a number of updates to this previous version, including:

- a new weighted average cost of capital (WACC) and inflation forecast, provided by Ausgrid; and
- additional representative case studies of upcoming replacement projects across six different locations on Ausgrid's network, extending on the single case study performed previously.

1. Long run marginal cost of import services

The LRMC of a service is the future change in cost caused by a small, permanent increase or decrease in the production of that service.

Network prices that are based on LRMC promote efficiency because they:

- encourage and assist customers to use the network when the value of further use exceeds any additional costs caused;
- enable customers to decide whether a change in their behaviour or an investment in a non-network alternative can better meet their needs at lower cost; and
- signal where customers value investment in additional network capacity or capability, where there is not a lower cost non-network solution.

The LRMC of providing a network service is not uniform across Ausgrid's network, it will be relatively:

- higher in areas of the network where capacity is constrained, since an increase in demand may bring forward the need for a planned investment; and
- lower in areas of the network where there is significant excess capacity and an increase in demand can be served by existing capacity.

Ausgrid has historically estimated LRMC on a network-wide basis, reflecting that its estimate will ultimately be translated into a price that is applied uniformly across its network (postage stamp pricing). In general, estimating LRMC across the entire network using the average incremental cost approach leads to a higher estimate of LRMC, since the netting-off of growing and falling demand in different areas acts to understate demand growth. When growth-related expenditure is divided by an understated level of demand growth, the resulting estimate of LRMC is higher.

Although Ausgrid and other distribution network service providers (DNSPs) continue to apply postage stamp pricing, it is appropriate at this stage of the tariff reform process to explore the variability in LRMC across Ausgrid's network. This assessment can then inform a more careful weighing of the trade-off inherent in setting a uniform, LRMC-based price that must necessarily be:

- too high in areas of the network where there is higher than average excess capacity; and
- too low in other areas where there is less than average excess capacity.

1.1 Areas where there is long term demand growth

In this section we describe the approach we applied to estimate LRMC in areas of Ausgrid's network where demand is forecast to grow over the next ten years.

Ausgrid provided us with a ten year forecast of augmentation expenditure and demand on its sub-transmission, high voltage and low voltage networks in 25 discrete areas that, together, comprise its entire network.

We allocated augmentation expenditure to each of the sub-transmission (ST), high voltage (HV) and low voltage (LV) tariff classes based on their contribution to coincident maximum on the levels of the network that are used to provide network import services.

We also included an allocation of avoidable operating expenditure equal to 1.88 per cent of augmentation expenditure. We calculated this percentage based on Ausgrid's historical operating expenditure as a proportion of its regulated asset base, and an estimate of the share of operating expenditure that is avoidable.

Ausgrid's demand forecast shows that, over a ten year evaluation horizon, 75 per cent of Ausgrid's load will occur in areas of Ausgrid's network where demand is growing.

However, in some areas different demand trends are expected to occur at different levels of the network. For example, there may be growth on the ST network from the expected connection of new large energy users such as data centres, whereas demand on the low voltage network may be falling at first, but then growing in future years in a 'U-shaped' time profile.

To ensure stable price signals for customers that accurately reflect the augmentation expenditure required to serve long term demand growth, our assessment drew upon a smoothed, ten year demand forecast.[1]

We then aggregated forecast augmentation and demand across those areas of Ausgrid's network where demand is growing, and estimated LRMC in those 'growing' areas of the network using the average incremental cost approach.

The average incremental cost approach involves estimating LRMC as follows, ie:

$$\frac{Present\ value\ of\ future\ growth\ expenditure}{Present\ value\ of\ demand\ growth}$$

[1] It is important when estimating LRMC using the average incremental cost methodology to use demand that reflects the long term growth profile between the start and end points, as this represents the increase in required capacity that, in turn, drives the required long term augmentation expenditure. In some cases, even though there was demand growth over ten years, a fall in demand in early years could give rise to non-sensical, negative estimates of long run marginal cost.

Since Ausgrid provided us with expenditure inputs in constant dollar terms, we undertook this present value calculation using a real WACC equal to 3.20 per cent.[2]

We present the resulting estimates of long run marginal cost in table 1.1.

Table 1.1: Estimates of long run marginal cost in growing areas of the network

Tariff class	Import LRMC ($2024 real)
Low voltage	$42.6 per kW pa
High voltage	$16.0 per kW pa
Sub transmission	$3.3 per kW pa

1.2 Areas where demand is falling

In this section we explore the extent to which LRMC may be different in areas of the network where demand is falling, rather than growing.

Since augmentation expenditure is driven by demand growth, in areas where demand is falling it is replacement expenditure that can be avoided by a permanent decrease in demand. The AER similarly explained that:[3]

> 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.

In areas of the network where demand is falling, a further reduction in demand could lead to:

- the downsizing of an asset upon its replacement; and/or
- the deferment of an asset replacement due to the relatively lower expected levels of unserved energy.

Our discussions with Ausgrid's network planners – and our experience of similar discussions with other networks – indicated that the downsizing of an asset upon replacement is often not an efficient option due to:

- the typically large increments in available asset sizes;[4]
- the economies of scale in undertaking asset replacements, which limits the available cost saving;[5] and
- the risk and cost associated with having to upsize that asset over its life due to an unanticipated future increase in demand.

[2] We sourced this real WACC from the distribution post tax revenue model provided to us by Ausgrid on 28 September 2023. It was calculated equal to the average real vanilla WACC over our ten year evaluation period.

[3] AER, *Better Regulation | Explanatory Statement | Expenditure Forecast Assessment Guideline*, November 2013, p 184.

[4] Assets are often purchased on international markets, where the available ratings are governed by the requirements in larger countries such as the United States and China.

[5] The significant role of installation costs in replacement projects gives rise to significant economies of scale in the replacement of assets.

An incremental reduction in demand in areas of the network where demand is falling is therefore more likely to result in the deferment of a planned replacement project. In practical terms, this deferment is likely to arise from the identification in Ausgrid's planning process that, following a downwards revision to its demand expectations, it is now at a later point in time that:

- the annualised benefits of avoiding network risks, ie, expected unserved energy, safety and repair risks; exceeds
- the annualised value of deferring the asset replacement investment.

This dynamic is not well-addressed by the average incremental cost approach, although we note that the standard approach can be augmented to derive an estimate of LRMC based on declining demand and avoidable replacement expenditure.

Instead, we derived an indicative estimate of the LRMC of a decrease in demand in areas of the network where demand is falling by applying the perturbation approach, which better-appeals to the theoretical foundations of LRMC.

The perturbation approach involves:

1. Forecasting demand over an extended period.
2. Developing a least-cost expenditure program that can satisfy that demand forecast.
3. Perturbing demand by a small, but permanent amount and recalculating the least-cost expenditure program to meet that perturbed demand.
4. Calculating the LRMC as the present value of the change in the least cost capital program plus the change in operating costs, divided by the present value of the revised demand forecast compared to the initial demand forecast.

It follows that the perturbation approach is burdensome to implement, since it requires carefully considered input from demand forecasting and asset planning teams. We therefore applied the perturbation approach to a number of representative case studies on upcoming replacement projects across Ausgrid's network.[6]

A description of the replacement project at the Lidcombe zone substation is provided in box 1.1.[7]

Box 1.1: Replacement of 11kV switchgear at Lidcombe zone substation

We understand from Ausgrid that the 11kV switchgear and 33kV HSL feeders at Lidcombe zone substation are nearing the end of their service life, and their deteriorating condition is leading to increasing condition, reliability and safety risks.

Ausgrid considered the construction of a new zone substation in the area, non-network options and transferring load to adjacent substations, but ultimately concluded that the efficient option was to replace the existing 11kV switchgear group one by installing new switchgear in a new switchroom at the existing site and replacing the 33kV HSL feeders.

[6] The representative case studies were performed at the Botany, Campsie, Leightonfield, Lidcombe, Miranda and Riverwood zone substations.

[7] We understand from Ausgrid that the nature of the replacement projects for all representative case studies are similar to that at the Lidcombe zone substation.

Ausgrid determines the need date of the replacement project by undertaking a cost benefit assessment. This cost benefit assessment can be undertaken using three different forecasts of future demand, ie:

- a low estimate of future demand, based on a P90 forecast;
- a base (or central) estimate of future demand, based on a P50 forecast; and
- a high estimate of future demand, based on a P10 forecast.

The project need date for each replacement project under each forecast specification based on Ausgrid's current expectations is presented in table 1.2, alongside the estimated cost of each replacement project. We note that the need date for these replacement projects occurs later when the future demand forecast is lower.

Table 1.2: Identified need date for replacement projects by demand forecast

Zone substation	Replacement expenditure ($2024 real)	Low forecast (P90)	Base forecast (P50)	High forecast (P10)
Botany	$7.1 million	*2030*	*2030*	*2029*
Campsie	$39.3 million	*2037*	*2033*	*2029*
Leightonfield	$7.1 million	*2034*	*2033*	*2031*
Lidcombe	$14.9 million	*2033*	*2031*	*2029*
Miranda	$15.6 million	*2038*	*2037*	*2035*
Riverwood	$14.4 million	*2035*	*2034*	*2033*

The difference between the low, base and high forecasts can be treated similarly to a perturbation of future demand expectations. That is, the low, base and high forecasts are differentiated by a small, permanent change in the level of maximum demand at each zone substation.

By way of example, when Ausgrid perturbs its future demand expectations at the Lidcombe zone substation downwards from the base (P50) to the low (P90) forecast,[8] the resulting change in expected unserved energy is sufficient to defer the project need date by two years to 2033. Using the same discount rate applied in the average incremental cost approach detailed above, we calculate the present value of (hypothetically) deferring this replacement project by two years and the present value of the reduction in demand over the evaluation period.

This analysis can be undertaken for three distinct demand perturbation sensitivities at each zone substation, ie, a downwards perturbation of demand from:

- the base (P50) forecast to the low (P90) forecast;
- the high (P10) forecast to the base (P50) forecast; and
- the high (P10) forecast to the low (P90) forecast.

It follows that the application of the perturbation approach results in an indicative estimate of the LRMC of a decrease in demand in areas of the network where demand is falling that ranges between $9.9 per kW pa to $33.5 per kW pa.[9]

[8] The low (P90) forecast at the Lidcombe zone substation is a downwards perturbation of approximately 1.5 megawatts (MW) each year relative to the base (P50) forecast.

[9] We note that the estimated indicative LRMC is equal to $0 per kW pa at the Botany zone substation when perturbing demand from the base (P50) forecast to the low (P90) forecast as this change in demand does not influence the timing of the expenditure.

We expect that this estimate represents an upper bound on the likely LRMC in these areas, since it is derived from circumstances akin to estimating LRMC in growing areas at a capacity constrained zone substation with an impending, costly augmentation project.

1.3 LRMC for pricing purposes

The analysis that we describe above indicates that LRMC is likely to be higher in areas of Ausgrid's network where demand is growing, ie, we estimate that the LRMC of import network services on the low voltage network is equal to:

- $43 per kW pa in areas of the network where demand is growing; and
- $33 per kW pa in areas of the network where demand is falling.

Given the diversity in demand trends and avoidable expenditure across Ausgrid's network, the LRMC-based price signal for some customers will necessarily be different to the actual LRMC of providing import services to those customers. We therefore considered how best to minimise this inconsistency in line with the national pricing objective and the long-term interest of Ausgrid's customers.

Important context to this decision is that:

- 75 per cent of Ausgrid's load over the next ten years occurs in areas of the network where demand is growing;
- demand in growing areas of Ausgrid's network is expected to increase by approximately 330 MW over ten years, whereas demand in declining areas of Ausgrid's network is expected to decrease by less than 35 MW;
- the effect on network costs of inefficient price signals in growing areas of the network is higher than in those areas of the network where demand is falling, ie, as reflected by the higher estimates of LRMC in growing areas; and
- our estimate of LRMC in areas where demand is falling is indicative, since it is based on a number of case studies.

In this context, in our opinion it is appropriate to set postage stamp prices based on our estimate of LRMC in areas of Ausgrid's network where demand is growing, as replicated below.

Table 1.3: Estimates of long run marginal cost in growing areas of the network

Tariff class	Import LRMC ($2024 real)
Low voltage	$42.6 per kW pa
High voltage	$16.0 per kW pa
Sub transmission	$3.3 per kW pa

1.4 Comparison of LRMC estimates between regulatory control periods

Our estimates of the LRMC of import services for the 2024-29 regulatory control period are lower than the estimates derived by Ausgrid in relation to the 2019-2024 regulatory control period, as illustrated in table 1.4.

Table 1.4: Comparison of LRMC between regulatory control periods ($2024 real)

Tariff class	2019-2024 regulatory control period	2024-2029 regulatory control period
Low voltage	$67.1 per kW pa	$42.6 per kW pa
High voltage	$43.0 per kW pa	$16.0 per kW pa
Sub transmission	$7.6 per kW pa	$3.3 per kW pa

The reduction in the LRMC of providing import services on Ausgrid's network reflects a range of factors, including lower expected demand growth, lower growth-related expenditure and an improvement in the level of growth-related expenditure required to meet each unit of demand growth.

We compare Ausgrid's forecasts of augmentation expenditure and demand growth for the current and upcoming regulatory control period in figure 1.1 and figure 1.2, respectively.

Figure 1.1: Comparison of planned future network augmentation expenditure

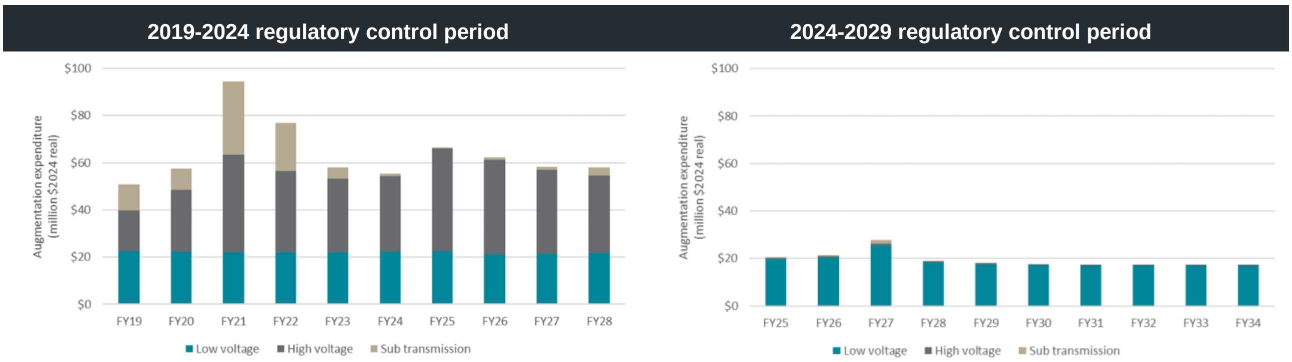

Figure 1.2: Comparison of forecast future growth in network maximum demand