# 6 Empirical evidence of network efficiency

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| Key points |
| * The scale of network capacity expansion has varied by a wide margin between networks. While much of the recent increase in network capacity appears to be related to peak demand, it is not clear that increased investment was an efficient response. * Expanding capacity has been more costly in some states than others, in that larger expansions in the regulated asset base (RAB) have occurred for a given increase in network capacity. This is partly attributed to differences in replacement capital expenditure, which is an area of expenditure that should be investigated further. * Much of the recent increase in network revenues reflects the coincidence of increases in the weighted average cost of capital and increasing capital expenditure. This particularly applies to New South Wales. * Some network businesses may have benefited from being able to exceed regulatory allowances for capital expenditure in the previous regulatory period. Not only has this expenditure been rolled into the subsequent regulated asset base, but it has also influenced the regulator’s decisions about what is reasonable expenditure in future periods. It is possible that some of this overspend could have reasonably been reduced or deferred. * There are significant differences in the behaviour of network businesses and in the apparent efficiency between state and privately owned networks. Reliability standards are also likely to be a factor. |
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While the Commission has not undertaken elaborate benchmarking analysis, it found it useful to consider whether there is a prima facie case that significant inefficiency exists. That would shore up the basis for further benchmarking — and for it to play a greater role in future regulation. However, in light of the many qualifications emphasised in chapter 4, the results are indicative, and certainly would not constitute a reliable basis for any downward adjustment in revenue allowances in imminent regulatory determinations. In particular, this chapter has concentrated on partial indicators. None of the partial indicators would themselves provide definitive evidence of inefficiency, but collectively they may provide more robust evidence.

This chapter first outlines the prevailing evidence on network inefficiency, including some of the more contentious findings (section 6.1). Section 6.2 considers further evidence on various contested issues, such as the relative role of changes in the regulated weighted average cost of capital (WACC), (largely outside the control of individual businesses, save for the appeals mechanism), and increases in expenditure (which is largely controlled by the business). On the decisions made by network businesses, this chapter discusses various arguments including:

* how decisions on physical augmentation have related to peak demand (section 6.3)
* whether measures of the regulated asset base can be useful as indicators of efficiency, and how these relate to both growth capital expenditure (capex) and replacement capex (section 6.4)
* the significance of overspending, given the incentives outlined in chapter 5 (section 6.5)
* whether the state-owned networks operate differently from the privately-owned businesses (section 6.6).

## 6.1 Existing evidence and arguments

As discussed in chapter 2, the electricity supply chain as a whole has recorded negative productivity growth in recent years. Topp and Kulys (2012) note the negative growth phase in multi-factor productivity coincided with a trend of rising peak demand, as well as declining network capacity utilisation. As such, the increase in network capacity is likely to have been a factor in the recent fall in productivity.

The expansion in network-related costs is confirmed by data that shows network revenue allowances have risen significantly in the current determination period (figure 6.1). This expansion is expected to have a significant effect on electricity prices — the Australian Energy Market Commission (AEMC 2011a) estimated that distribution charges will account for 42 per cent of the expected electricity price increases between 2011 and 2014, with transmission accounting for 7 per cent.

Figure 6.1 Approved network revenues have risen**a**

Percentage rise in approved revenues from the previous to current regulatory period

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a Current regulatory period revenues are forecasts in regulatory determinations amended by the AER for merits review decisions by the Australian Competition Tribunal. It should be noted that in contrast to the figures published by AER (2012q), CitiPower et al. (sub. DR90) calculate the increase in revenue as being 4 per cent for CitiPower and 12 per cent for Powercor (p. 24). This difference is likely due to methodological differences, as CitiPower/Powercor use actual revenues in their calculations as opposed to approved revenues.

*Data source*: AER (2012q).

### Some studies suggest there is widespread inefficiency

The AER (2011a) questioned the efficiency of recent expenditure increases in its rule change proposal to the AEMC.

Recent increases in network charges have been driven in part by the need for increased investment to replace ageing assets and to meet increased peak demand, growing customer connections and higher reliability standards. Higher forecasts to cover expected increases in labour and materials costs have also contributed to increases in network prices. However, these drivers do not fully account for the level of observed increases. (p. 6)

There are legitimate reasons for some increases in capex from previous levels. However the sharp and significant step change in expenditure forecasts draws into question whether the current framework is meeting the [National Electricity Objective] in ‘promoting efficient investment’ or whether it is stimulating investment above efficient levels. (p. 8)

The AER cites as evidence the large and rapid increases in both forecast and actual expenditure. For instance, capex forecasts in the AER’s first round of distribution determinations were 64 per cent higher on average than the actual expenditure incurred in the previous period, while operating expenditure (opex) forecasts were 34 per cent higher.

Several other commentators have also characterised recent network expenditure as inefficient, with network over-expenditure contributing significantly to price outcomes. For instance, Garnaut stated:

There have been large recent electricity price rises that are not related to a carbon price, and without changes in the regulatory arrangements this would continue. The increases are mainly because of large investments in the networks of poles and wires that distribute electricity, and the high rates of return on those investments that are recouped without risk from consumers. (2011a, pp. 149‑50)

Mountain and Littlechild (2010) and Mountain (2011) provided more extensive evidence on the degree of potential inefficiency by comparing selected Australian States and the United Kingdom. They found that:

* revenue and expenditure allowances (on a per customer basis) were substantially higher in New South Wales and Queensland than in Victoria and South Australia, and increasingly so
* state-owned networks (New South Wales and Queensland) were more costly in terms of their regulated asset base, revenue and expenditure per customer compared to private networks (Victoria and South Australia). This remained the case when they were split into urban and country networks
* in comparisons with New South Wales and Victoria, the United Kingdom appeared to have much lower allowed revenues, expenditure and regulated asset base (RAB) per customer.

The estimated efficiency gaps were also particularly large (box 6.1). Mountain summarised the outcomes of the quantitative work:

Efficiency benchmarking using regressions shows that government owned distributors are, on average, half as efficient as the privately owned distributors. In other words, their total expenditure would need to halve to reach the level of efficiency of the privately owned distributors. … Furthermore, comparison with the performance of electricity distributors in Britain suggests that Australian distributors are lagging behind: distributor revenues per connection are twice as high in Victoria, three times in South Australia and four times as high in Queensland and New South Wales. (Mountain 2011, p. vi)

It is doubtful that these gaps genuinely reflect differences in the underlying productive efficiency of the businesses alone. This is because it is very likely that other factors, such as differences in the cost of capital, exchange rates, and some important environmental factors would also contribute — criticisms that are addressed in the next section. Nevertheless, even if the apparent inefficiency of the New South Wales businesses (as measured against a Victorian benchmark) were to be reduced significantly — by 75 per cent, for example — it would still amount to a high level of inefficiency.

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| Box 6.1 Contentious findings |
| Mountain and Littlechild (2010) compared partial productivity indicators of New South Wales, Victoria and Great Britain. The variables used included allowed revenue per customer; allowed capex and opex per customer; RAB per customer, and the WACC. The latest available exchange rate was used, which was 56 pence per dollar. They found that allowed annual revenue per customer in Victoria was about 61 per cent of the level in New South Wales in 2010. They also found that network revenue in New South Wales was around twice that of Great Britain in the year 2000, and would be nearly four times as much in 2014.  If New South Wales had assumed the same level of opex per customer as Great Britain in the third price control, the allowed revenue per customer in 2014 would have been 24 per cent lower. If it had used the same WACC as applied to Great Britain, the allowed revenue per customer for New South Wales would have been 21 per cent lower. The combination of capex and RAB accounts for the remaining 28 per cent difference.  In a report for the Energy Users Association of Australia, Mountain (2011) found that state owned distributors had 60 per cent more capex allowed per customer than privately owned distributors in 2002, and this was expected to rise to almost 300 per cent in 2014. The allowed revenues per customer in New South Wales and Queensland are expected to be of a comparable level in 2014, at roughly 1.5 times the level in South Australia, twice the level in Victoria and four times the level in Great Britain.  In a separate report for the Energy Users Association of Australia, Mountain (2012a) compared household electricity prices between Australia and various countries. In 2011-12, average household electricity prices in Australia were around $0.25 per kWh — this was 12 per cent higher than average prices in Japan, 33 per cent higher than the European Union average, 122 per cent higher than the United States average; and 194 per cent higher than Canadian average. However, Mountain also shows that the results are somewhat sensitive to the choice of exchange rates. Using 2007 exchange rates, Australia was on par with the European Union average, while still around 30 per cent higher than Japan. Under Purchasing Power Parity, Australia’s average price was below those of Japan and the European Union. Other estimates such as those of the Department of Resources, Energy and Tourism suggest that Australia’s *household* electricity prices were either below or marginally above the OECD average in 2011 (SSCEP 2012). |
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Other benchmarking studies of Australian network businesses, many of which were undertaken or commissioned by regulators, suggest that performance has varied significantly between businesses at various points in time (box 6.2).[[1]](#footnote-1) The degree to which some networks outperform other networks depends on which measures are used, indicating the importance of the choice of indicator.

### Has the case for inefficiency been made?

As Yarrow (2012) observed, opposing commentators in the industry often cite different forms of evidence, and so it is not surprising that some of the studies mentioned above have been strongly disputed.

While Mountain and Littlechild did not draw direct conclusions on the differences in efficiency between distributors (Mountain, sub. DR49), Mountain (2011) goes further in concluding that state-owned distributors had undertaken ‘wasteful expenditure’ (p. 61).

Network businesses have acknowledged that both prices and expenditures have risen, although they have collectively argued that the increases are in response to peak demand, replacement of ageing infrastructure and changes to regulatory compliance. The Electricity Networks Association (ENA), for example, said:

The ENA contends that … the increases are efficient because the regulatory framework under the Rules accurately reflects a range of relevant changes including:

* increases in the prevailing cost of capital due to the global financial crisis;
* increases in the need to replace assets due to an increasingly significant proportion of asset stock reaching the end of its economic life;
* changes to network planning standards; and
* continuing increases in peak demand that outstrip growth in energy usage due, for example, to the increased penetration of air conditioning. (sub. 17, p. 7)

In particular, network businesses have questioned the conclusions of Mountain’s various studies. NERA, on behalf of the ENA (sub. 17, appendix B), examined the various Mountain studies, concluding that:

Our assessment of the analysis undertaken in Mountain strongly suggests that it provides an insufficient basis for such conclusions. Failure to consider the many legitimate reasons for variances in costs and a reliance on inappropriate comparisons has resulted in Mountain drawing unsubstantiated conclusions about the relative efficiency of DNSPs. (p. i)

NERA’s criticisms of Mountain’s studies were far-reaching.

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| Box 6.2 Efficiency gaps identified by recent studies |
| Several studies examined partial indicators of efficiency:   * BRW (2004) undertook several comparisons between Energex and various other distributors for the Queensland Competition Authority. Indicators included reliability measures, and various expenditure ratios. Compared to the three most comparable firms, Energex had the lowest opex per circuit km, opex per customer and opex per GWh (with EnergyAustralia being 85–99 per cent higher than Energex in these measures). This helped to explain why Energex’s opex grew by around 63 per cent over the subsequent three years. * Meyrick (2005) undertook comparisons between Western Power and all other Australian distribution networks who remained unidentified. Meyrick used a number of partial productivity measures, although mainly reported rankings. Opex productivity indexes ranged from around 0.6 to 1.8, while capex productivity ranged from around 0.6 to 1.5. * Wilson Cook (2009) made several partial productivity comparisons between Western Power and the distribution businesses in several other states. Comparisons were made of opex ratios, although the comparisons did not offer a consistent conclusion on the size of efficiency gaps between networks. Victoria had a similar level of opex per customer as South Australia, which was around one third less than Western Power, New South Wales/ACT, and Queensland. However, when comparing opex per circuit km, Victoria was close to on par with Queensland, and more than one third higher than South Australia. * The Independent Review Panel on Network Costs assessed the performance of Queensland distribution network expenditure against other Australian distributors (IRPNC 2012). Comparisons were made with regard to capex per customer and opex per customer, while controlling for customer density. Ergon tended to be a higher cost network in terms of operating and capital expenditure when compared with other networks with comparable customer densities. Comparisons of corporate overhead costs also showed the Queensland distributors to be ‘amongst the least efficient’ (p. 10). |
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| Box 6.2 (continued) |
| Comprehensive indicators of efficiency have also been used with Australian networks:   * London Economics (1999) compared New South Wales to other distribution networks using data envelopment analysis (DEA) and total factor productivity (TFP) methods. The comparisons were made to distribution networks in the United States, England, Wales and New Zealand. Based on adjusted DEA scores, it was estimated that New South Wales distribution networks would need to reduce their input use by between 13–41 per cent to meet the efficiency frontier. * Meyrick (2005) undertook multilateral TFP comparisons, where Western Power is ranked sixth out of thirteen, and is 6 per cent below the group average. * ESC and PEG (2006) estimated Total Factor Productivity (TFP) trends for distribution networks in four Australian States. They estimated that from 1995 to 2003, TFP trends have grown at about 2.14 per cent per annum in Victoria, compared to about 1.8 per cent in Tasmania, 0.14 per cent in New South Wales and -0.03 per cent in South Australia. * IPART (2010) assessed the productivity of New South Wales state owned corporations including electricity network operators. Among distributors, it estimated a TFP decrease between 2001-02 and 2008-09 of between 17 and 24 per cent. Using an alternative model specification, it measured decreases of between 7 and 19 per cent. * The Independent Review Panel on Network Costs reported some results from confidential benchmarking exercises undertaken by the International Transmission Operations and Maintenance Study (ITOMS) (IRPNC 2012). The results showed that Powerlink compared favourably with other transmission operators in regard to a composite measure of line and substation maintenance, as well as overall service provision. * AMP Capital undertook a linear regression analysis using Australian private sector distribution networks (sub. DR55). The regulated asset base was regressed against customer numbers, network length and peak network demand. The resulting estimates were then used to forecast RAB values for both private and state-owned distribution networks within Australia, as well as distribution networks in the United Kingdom. They found that the actual RABs of New South Wales and Queensland distributors were 2.5 to 5 standard errors higher than the model forecasts. |
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#### Mountain’s Australian evidence

NERA raised several issues with Mountain’s 2011 study, (particularly the regression analysis), including that it:

* used a model specification that ignored the fixed costs of networks (by setting a zero intercept in his regression model)
* failed to report any specification tests
* did not systematically consider the ratio of peak to average demand or the lumpy nature of investment
* did not control for all differences in the operating conditions between firms.

Of these points, the first two are correct, albeit it is not clear that much of a bias is associated with Mountain’s assumption about the intercept. Statistical tests could have been used to assess the statistical significance of the dependent variables and of the model as a whole, and to test for model misspecification.

The third point is true in terms of the regression analysis since Mountain did not include a measure or proxy for peak demand as a regressor. Whether its omission matters is an empirical issue.[[2]](#footnote-2) In any case, Mountain (2011 p. 35) did consider the role of peak demand when assessing the outcomes in Victoria (which was rated as the state with the most efficient businesses). He did not find peak demand as an important driver of the difference in investment levels between New South Wales and Victoria.

The fourth point is true, but inevitably so for any model based on a limited sample.[[3]](#footnote-3) Perhaps one of the most important concerns is the fact that, ideally, benchmarking analysis should take account of business’s need to replace assets close to the end of their lives. Instead, Mountain compared the (weighted average) remaining life of assets of distribution network businesses in Victoria and South Australia with businesses in New South Wales and Queensland (finding the latter longer). NERA’s concern is that what matters is the quantum of assets getting close to the point of expiry, not the weighted average age.[[4]](#footnote-4) NERA provides data comparing the distribution of asset lives for Ausgrid and SP AusNet, which suggests that Ausgrid would need a greater capex expansion rate given its asset vintage distribution. However, the expansion rate in New South Wales is not just moderately higher than Victoria. Mountain finds that the New South Wales distributors received four times more capex per customer to replace ageing assets than Victorian businesses. If nothing else, this is an issue warranting further investigation.

#### The UK–Australia comparisons

In the case of the international comparisons of Australia with the UK, NERA correctly pointed out that both Mountain (2011) and Mountain and Littechild (2010) used market exchange rates, not purchasing power parity rates (for which there is more theoretical justification). It noted that peak demand was higher in Australia. Finally, it speculated that different accounting practices might also be present and that the asset replacement cycle might have been different between the two countries.

However, to assess some of these criticisms, the Commission adjusted for purchasing power parity rates (figure 6.2). It appears that the RAB per customer for every Australian distribution business (after controlling for customers per kilometre of lines) is higher than that for distribution businesses in the UK. It is also apparent that the dispersion in apparent inefficiency scores (measured against the best practice performer) is much greater in Australia than in the UK. Many of the higher relative inefficiency scores relate to state-owned corporations, though there may be other variables correlated to ownership that lead to this pattern.

NERA is correct to point out the differences in peak demand between Australia and the UK as a potentially important driver of network costs, although they do not mention other factors that may lead to countervailing cost pressures, such as a greater degree of undergrounding in the UK.

There are significant drawbacks in international comparisons (chapter 4) and, as such, Mountain’s results and figure 6.2 are best seen as providing an indicator to be weighed up against others, rather than as a robust measure of relative efficiency.

Figure 6.2 Australian versus UK asset bases per customera

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a Note the importance of taking care when interpreting RABs, as discussed in section 6.4 of this chapter. Purchasing power parities have been used to convert currencies. SOC denotes a state-owned corporation.

*Data source*: Commission estimates.

Some participants questioned whether the studies should be given *any* weight in policy considerations (NSW DNSPs, sub. DR85, attachment B). However, it is not the case that Mountain’s results were technically incorrect — rather, there are limits to what may be concluded from them. In this sense, all empirical results have limitations, and further analysis is always desirable. The key concern is whether there are persuasive reasons why they are materially wrong.

The case against Mountain’s results would be strong were an alternative, econometrically convincing model to find contrary results. The Commission is not aware of any such modelling exercise. In fact, more recent studies that have undertaken relatively simple benchmarking exercises have found results that were in the same direction as Mountain’s general findings, though with econometric caveats of their own (IRPNC 2012, AMP Capital sub. DR55).

While there are limitations to what may be concluded from Mountain’s evidence, the counter-evidence has not been so strong as to invalidate (or reverse) the basic thrust of his conclusions. If nothing else, his results provide reasonably suggestive evidence of a problem, while simultaneously being an advertisement for the difficulty of making specific policy-relevant conclusions based on high-level comparisons. In its recent draft determination for the AER’s Rule change proposal, the AEMC (2012a) reached much the same conclusion:

… no analysis has been provided which would challenge Mountain's conclusion that the average privately-owned DNSP [distribution network service provider] is more efficient than the average state-owned DNSP. (p. 97)

#### But more evidence is needed

Several commentators have highlighted the need for more detailed evidence of inefficiency (ENA, sub. 17, appendix A or B; Yarrow 2012). For example, Yarrow noted that:

… much more specificity in the identification of causal links is required, even to [begin] to pin down the elements of the wider system of relationships that might usefully be considered to be candidates for reform.

… In relation to capital costs for example, it can be asked: if there is a tendency for networks to over-forecast, why do a number of utilities then tend to over-spend relative to such inflated forecasts?

… Is it that utilities simply take on too many projects, or that they over-engineer projects? Or is it that utilities undertake the wrong projects? Or then again, is it just that whatever they do, they do it at a higher cost than necessary? None of this is very clear. (pp. 10‑11)

The Commission has identified many data and model development problems (chapter 4 and 8), for which resolution would be the necessary precursor for more definitive benchmarking. However, there is some evidence — beyond that analysed by Mountain — that provides further information about the cost drivers behind recent network price increases.

## 6.2 The relative impacts of the WACC, capex and opex

As noted earlier, the network business does not *determine* the regulatory WACC (while of course trying to maximise it through the regulatory process). As a result, movements in the revenue allowances from changes in the WACC do not have direct relevance for efficiency, though they do potentially undermine the incentive regime (chapter 5). Accordingly, it is useful to separate the effects of the WACC from other influences, such as the levels of capex and opex.

In a report prepared for the ENA (sub. 17, appendix A), NERA undertook an extensive analysis of these drivers between the current and previous regulatory periods.[[5]](#footnote-5) NERA’s calculations first involved considering what network prices would have been if both the WACC and expenditure allowances had remained constant from one regulatory period to the next. It then calculated the percentage difference between this price and the actual network charge, noting the percentage contribution from changes in capex allowances, opex allowances and the WACC (table 6.1).

In explaining the expenditure increases, NERA found that ‘real cost escalators’[[6]](#footnote-6) had a small negative effect on the capex allowance since the last period, meaning that the unit costs associated with capex had fallen. Hence, with respect to capex, the main drivers were likely to be the increased scope and number of capex projects rather than their cost escalators. At the same time, real cost escalators had a significant effect on opex, resulting in increased opex allowances. They contributed between 1.9 and 2.4 per cent to distribution opex allowances, and up to 3.5 per cent for transmission allowances (ENA sub. 17, appendix A p. 48).

NERA’s analysis usefully indicates that WACC changes — which are outside the control of the business — played an important role in changes in costs from regulatory period to period. However, NERA’s estimates do not take account of the multiplicative interactions or ‘mix’ effects between the WACC and capex (appendix G). (NERA made its estimates by holding one variable constant and measuring the impact of another variable.[[7]](#footnote-7)) As such, there is some amount of revenue that is attributable to both capex and WACC, but that NERA includes into a separate ‘other’ category in table 6.1.

NERA’s analysis implicitly used the previous regulatory period as a benchmark. This is a reasonable specification for NERA, given that the analysis focused on the impact of the new regulatory framework on costs. However, in considering the efficiency of networks more generally, other benchmarks could be used. For instance, the analysis could reasonably be extended to prior regulatory periods.

Table 6.1 NERA’s breakdown of network charge increases from previous regulatory period to current regulatory period**a**

Percentage contribution to overall network price increases

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| Network operator | Ex ante capex allowance | Ex ante opex allowance | WACC | Otherb | Total |
|  | Per cent | Per cent | Per cent | Per cent | Per cent |
| Ausgrid | 18.6 | 15.6 | 14.6 | 12.2 | 58.3 |
| Endeavour | 9.5 | 9.9 | 11.2 | 3.8 | 32.9 |
| Essential | 15.7 | 20.2 | 11.4 | 4.5 | 49.7 |
| TransGrid | 9.4 | 4.3 | 8.7 | (2.8) | 18.2 |
| Ausgrid (transmission) | 29.9 | 4.9 | 16.0 | 3.7 | 46.8 |
| Energex | 8.8 | 2.7 | 18.9 | 14.2 | 42.6 |
| Ergon | 7.2 | 7.9 | 17.8 | 16.2 | 47.5 |
| ETSA | 10.6 | 10.0 | 10.4 | 7.8 | 36.4 |
| ElectraNet | 8.5 | 2.7 | 14.1 | 10.3 | 33.9 |
| ActewAGL | 4.6 | 18.2 | (0.6) | 0.7 | 22.7 |
| Transend | 9.1 | 10.6 | 7.5 | 5.9 | 32.5 |
| CitiPower | 1.2 | 1.2 | 4.9 | (5.5) | 1.4 |
| Powercor | 3.4 | 3.7 | 4.1 | (4.4) | 6.3 |
| Jemena | 1.6 | (3.6) | 6.6 | 6.8 | 11.0 |
| SP AusNet (distribution) | 6.8 | 9.2 | 6.3 | 2.3 | 19.2 |
| United Energy | 4.2 | 2.8 | 3.8 | (4.9) | 5.6 |
| SP AusNet (transmission)c | 3.1 | 1.1 | 3.2 | 5.5 | 15.3 |

a For distribution companies, NERA analysed the regulatory period corresponding with the first AER distribution determination for that region, and with the prior determination of the relevant state regulator. Aurora Energy is not included in the analysis, as their first determination by the AER had yet to be completed. For transmission companies, NERA analysed the regulatory period in each region which was current in 2012, as well as the immediately prior regulatory period. b ‘Other’ factors contributing to network charge increases include capex and opex overspends. For networks subject to price cap regulation, ‘other’ factors may also be attributed to differences in forecast and actual demand. When decomposing the percentage change in a multiplicative measure, there are ‘mix’ effects that pick up the interactive movement of the variables. ‘Other’ factors also includes these ‘mix’ effects. Overall, the implication is that the effects on network charges of the WACC, capex, and opex are likely to be larger than identified above. c It is unclear whether SP AusNet’s transmission capex would account for ‘separable’ projects. As such, their capex may not be directly comparable to that of other transmission networks.

*Source*: ENA sub. 17, appendix A.

The analysis of prior regulatory periods would be particularly useful, given that the recent growth in network revenue and expenditure has not been confined to the current regulatory period. For example, the scale of capital expenditure has been increasing for a number of years, including the years prior to the AER’s role as the network regulator (figure 6.3). And while expenditure in the largest states of the National Electricity Market, (New South Wales and Queensland), has increased several times since 2002, so too has the expenditure of some private networks.

Importantly, neither the analysis of NERA nor the trends in figure 6.3 are designed to distinguish between efficient and inefficient expenditures. They are helpful only in indicating the relative impact and scale of expenditure — which is sufficiently large that it requires further analysis.

Figure 6.3 The scale of recent capital expenditure for distribution networks

Annual capital expenditure

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a The first year of the AER’s responsibility for regulation of distribution networks was: 2009-10 for New South Wales and ACT; 2010-11 for Queensland; 2011 for Victoria; 2011 for South Australia; 2012-13 for Tasmania. Some networks’ data are based on fiscal years, others on calendar years. The index is uses 2002 as a base year.

*Data source*: AER unpublished data.

## 6.3 Demand driven augmentation

Recent decades have seen the rise of peak demand (Topp and Kulys 2012). This has been evident in most jurisdictions, although Queensland has had a particularly rapid increase, with its peak load doubling since the early 1990s (figure 6.4). Growth in peak load levels has slowed in most states since 2008-09, and has been lower than forecast in New South Wales and Queensland (NSW Government 2010).[[8]](#footnote-8)

Figure 6.4 Rising peak demand, 1988-89 to 2010-11

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*Data source*: ESAA Electricity Gas Australia, various issues.

Unsurprisingly, the capital expenditure increases in New South Wales and Queensland were mainly on system assets — this includes network augmentation and replacement, and excludes non-system assets such as monitoring and IT systems. Since 2001, expenditure on system assets has accounted for more than two-thirds of New South Wales capex and over 84 per cent in Queensland. As Nuttall notes:

To counter these external pressures, a very large augmentation program has been undertaken in Queensland. … In both Queensland and NSW, the majority of the [transmission] line developments have occurred since 2006 – noting that this is during the period when growth rates have been at their lowest and actual peak demand has been lower than forecast. (AEMO, sub. 42, p. 5)

The result can be seen in indicative comparisons of ratios of network capacity per unit of peak load (figures 6.5 and 6.6).[[9]](#footnote-9) [[10]](#footnote-10) For example, Queensland experiences a drop in distribution network capacity per unit of peak load in 2001, and steadily increases its capacity thereafter through ongoing network augmentation (figure 6.5).

Figure 6.5 Index of distribution network capacity per unit of peak load**a**

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a Network capacity is calculated as the length of network line (km) multiplied by transformer capacity (MVA). The graph shows the ratio of network capacity per unit of peak load. Peak load is a state-wide measure, and was not corrected for weather. The ratio is indicative only, and is intended to compare trends.

*Data source*: ESAA Electricity Gas Australia, various issues.

Not all networks have taken the same approach. While peak demand has also risen in Victoria, its augmentation levels have been relatively lower than New South Wales and Queensland. As AEMO have described:

Victoria, on the other hand, has seen relatively modest augmentation levels, making use of load shedding control schemes, line uprating opportunities, and additional capacity released through the real-time rating system adopted in Victoria. [Transmission level] transformer capacity over 2000 to 2011 increased by around 25 per cent, with line capacity only increasing by approximately 3 per cent. (sub. 42, p. 5)

The same is true of South Australia — while peak demand has almost doubled since the late 1980s (figure 6.4), measures of network capacity do not show the kind of growth that has been evident in Queensland (figures 6.5, 6.6).

The comparisons suggest that trends in network augmentation relative to peak demand have historically differed between states, and that these differences have not been created solely by the events in the last regulatory period. This high-level evidence also suggests that while Queensland had changed its approach during the last decade, the increases in peak demand of the last decade are unlikely to explain *all* of the physical differences between networks, particularly between Victoria and New South Wales. A similar conclusion was reached by the EUAA (2012b), which found significant differences between States in augmentation expenditure per unit of peak demand.

Figure 6.6 Index of transmission network capacity per unit of peak load**a**

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a Network capacity is calculated as the length of network line (km) multiplied by transformer capacity (MVA). The graph shows the ratio of network capacity per unit of peak load. Peak load is a state-wide measure, and was not corrected for weather. The ratio is indicative only, and is intended to compare trends. ESAA reports do not make any note of distinction between contestable and non-contestable transmission projects in Victoria — as such, the Commission assumes that physical measures of network characteristics relate to the whole state network, regardless of actual financial stake and ownership.

*Data source*: ESAA Electricity Gas Australia, various issues.

The main form of augmentation in Queensland has been through the rapid increase in transformer capacity. Queensland has increased its transformer density in response to peak demand (AEMO, sub. 42). In the ten years from 2001, transformer capacity in Queensland grew by 130 per cent — more than it had grown in the preceding 23 years. Based on these high-level data, Queensland has not simply adjusted for recent increases in peak demand, but has also increased its transformer capacity relative to peak load.

This change in trend appears to have begun after a dip in the transformer capacity per unit of peak load in 2001 (figure 6.7). For much of the 1990s, the ratio of transformer capacity to peak load was similar between Queensland and Victoria. However, following a surge in the utilisation of transformer capacity, Queensland has maintained a strong expansion whereas Victoria has not.

#### The need for more detailed information on asset utilisation

There are limitations to what can be decisively inferred from high-level comparisons of average network utilisation. As Grid Australia said:

The difficulties associated with comparing outcomes across transmission networks means that caution is required when comparing the relative performance of transmission networks. That said, there are a number of shortcomings with the measure of relative utilisation that has been used to test the pressure for augmentation and efficiency of transmission planning across the states.

First, the use of asset utilisation at an aggregate level is misleading and inappropriate. The driver of augmentation expenditure is the utilisation of individual assets. The Evans & Peck’s analysis demonstrates that, on an individual asset basis, jurisdictions outside of Victoria have higher utilisation than indicated by AEMO’s analysis. (sub. 44, pp. 3‑4)

Grid Australia illustrate this point with the use of more detailed asset utilisation data, showing that the utilisation rates of Victorian transmission assets are at times lower (figure 6.8). That is, while Victoria has a higher utilisation rate with regard to substations, the same does not appear to be true for lines. As such, it is difficult to make an overall ranking of state performance.

Figure 6.7 Transformer capacity in Queensland and Victoria relative to peak loada

Transmission and distribution level transformers

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a Includes distribution and transmission level transformers. Transformer capacity per unit of peak load is calculated using annual figures. ESAA reports do not make any note of distinction between contestable and non-contestable transmission projects in Victoria — as such, the Commission assumes that physical measures of network characteristics relate to the whole state network, regardless of actual financial stake and ownership.

*Data source*: ESAA Electricity Gas Australia, various issues.

Figure 6.8 Transmission asset utilisation**a**

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a Grid Australia also calculated peak and average utilisation for individual circuits and substations. While they had presented the above chart, they noted their general concern in using average utilisation as a benchmark.

*Data source*: Grid Australia, sub. 44.

The need for analysis of more detailed data is similarly true of distribution networks.[[11]](#footnote-11) Hence, while the analysis in this section may be indicative of the growth of distribution networks in relation to demand, more accurate comparisons could be made if further data were made public.

#### Are the different approaches efficient?

It is clear that networks have taken different approaches to augmentation and network capacity in recent years. There is a question of whether the levels of augmentation undertaken in states such as New South Wales and Queensland was justified by demand growth, given that Victoria also experienced rising levels of peak demand.

In a report for Grid Australia (sub. DR91, attachment 1), Evans and Peck examine similar measures of growth in physical assets for transmission networks. While they also find an accelerated growth in Queensland’s transformer capacity, they assume that Queensland was ‘underbuilt’ at the beginning of the 2000s.[[12]](#footnote-12) Mountain, who observes a similar growth trajectory,[[13]](#footnote-13) implicitly assumes Queensland’s transmission network was not ‘underbuilt’ at that time (EUAA 2012b). In any case, the concept of being underbuilt is not well defined, and hence it is difficult to judge from these comparisons whether the networks are now ‘adequately built’ or ‘overbuilt’.

There is also a question relating to where the appropriate benchmark would be for having adequate capacity relative to peak demand. What has been deemed reasonable by networks has differed by a wide margin across states. This suggests that it should be possible for some networks to reduce their rate of expansion and still have a level of capacity utilisation that would be within a reasonable range. This question is related closely to the issue of reliability standards (discussed in chapters 14 to 16).

A further question relates to whether it is efficient to continue to build networks to keep up with forecasts of peak demand. This relates to the drivers of peak demand and the potential efficiency gains of managing demand (discussed in chapters 9 to 12).

## 6.4 What does the RAB tell us?

Recent increases in the RAB have not uniformly reflected the increases in network capacity (figure 6.9). There are several possible reasons for this.

* Some states have a larger stock of depreciated assets than others. This means that their RAB does not reflect the full scale of their network, and also means that greater replacement capex is required.
* Increased undergrounding adds value to the RAB but not necessarily longer lines (and hence is not captured by calculations of network capacity).
* Some asset installations may be more difficult and expensive in particular regions.
* In Victoria, some transmission network augmentations are ‘contestable’, meaning that AEMO issues a tender to build, own and operate those particular assets.[[14]](#footnote-14) As such, at a given point in time, there may be some network assets that do not form part of SP AusNet’s transmission RAB.
* Some states have made better use of non-network options, such as load shedding control schemes or line uprating opportunities. This includes the real-time rating system in Victoria.

Not all of these factors would indicate inefficiency. With the analysis of more detailed data than is currently available, it would be possible to determine the contribution of each of these factors. It would also help determine whether firms have simply differed in the unit costs of assets and services. On this issue, the AER is currently collecting further data on relevant unit costs.

### What does the RAB say about efficiency?

The size of a network’s RAB is highly relevant to the discussion of efficiency, given that networks are remunerated on the basis of their asset base. However, inferring efficiency on the basis of the size of the RAB is difficult for several reasons:

* the RAB itself is a culmination of various decisions made over time
* the size of the RAB will be related to many drivers that are unlikely to be influenced by managerial discretion, including the size of the serviced area; aspects of its topology; the number of customers; and levels of demand
* the RAB is also related to drivers that may or may not be influenced by managerial discretion, such as the levels of network capacity; the types of assets purchased; the prices paid for assets; and the timing of capital expenditures

Figure 6.9 Percentage changes in RAB and network capacity for distribution networks**a**

Difference between previous and current regulatory periods

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a The change in RAB is measured as the difference between the opening RAB at the beginning of the previous regulatory period and the opening RAB at the beginning of the current regulatory period. Network capacity is calculated as the length of network line (km) multiplied by transformer capacity (MVA).

*Data source*: AER determinations.

* the RAB is depreciated over time, and this can pose a considerable measurement risk where:
* accounting decisions regarding rates of depreciation are *not* uniform across firms (as is the case among electricity networks)
* the depreciation of an asset in accounting terms does not reflect its physical or practical depreciation. Many networks have assets still in use which have outlived their standard lives (figure 6.10). The RAB would therefore not account for the ongoing value of these assets, nor their replacement costs. For one distribution company analysed by the Commission, the *replacement value* of assets which had reached or surpassed their standard lives amounted to 20 per cent of their reported asset base (AER unpublished data).

Figure 6.10 Number of poles that have depreciated to zeroa

Approximate number of poles in use that have exceeded their accounting life

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a This comparison is indicative only. It assumes that the reported standard life is commensurate with accounting life for depreciation purposes. The data for networks A to D were taken from the latest available point in time for each network, and refer to various years between 2008 and 2010.

*Data source*: AER unpublished data.

#### Replacement capex and asset vintage

An in-depth understanding of asset vintage would not only aid in assessing levels of the RAB, but also in the analysis of replacement capex — though this has been difficult using publicly available data. The AER has only used its replacement-capex (Repex) model in determinations for Victoria and Tasmania, and is only beginning to collect data on asset vintage from other networks. Even with data on asset vintage, it is difficult to forecast replacement capex without reliable estimates of standard asset life. Over time, the AER’s Repex model will itself improve the accuracy of estimates of asset life.

Asset age distributions differ between networks (figure 6.11). Mountain (2011) noted that privately owned networks tended to have a higher weighted asset age than state-owned networks, and that they should be expected *a priori* to spend more on replacement capex. However, in any given year, the level of replacement capital expenditure is a small fraction of the replacement value of assets that have reached the end of their asset life. Again, this relates to the difference between standard asset lives and the useful life of an asset.

Figure 6.11 Network assets follow different age distributions

Age distribution of poles

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*Data source*: AER unpublished data. The data for network A and B were taken from the latest available point in time for each network, and refer to 2008 and 2009 respectively.

Moreover, standard asset lives may be more useful as an indicator of asset replacement for some categories of assets than for others. For example, a network may only have a small number of transformers of a particular category, which makes it more difficult to forecast failure rates. The Commission has also been told by stakeholders that given the high unit costs of transformers, they would be more likely to be replaced based on condition rather than age. An example of how decisions can be made regarding condition-based replacement was given by Ausgrid with respect to the failure of a particular circuit breaker during the previous regulatory period:

This equipment had been identified for replacement in EnergyAustralia’s regulatory submission but rejected by the regulator. Following identification of the failure mechanism, similar defects were found in the remaining population requiring the immediate replacement of all remaining equipment of this type. (Parsons and Brinckerhoff 2012, p. 14)

The timing of replacement capex remains a significant factor in determining the efficiency of network expenditure, and for many networks it has followed a similar trajectory as growth-related capex. For one state-owned distribution network, annual replacement capex was 300 per cent higher in 2010 than in 2000 (figure 6.12). At the same time, demand related capex had grown by a similar scale.

Figure 6.12 Breakdown of capex for one state-owned distribution network

Annual capital expenditure associated with Demand Growth, Asset Replacement, and Other Areas

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*Data source*: AER unpublished data.

Replacement capex is of even greater significance for transmission networks. For example, the five-year expenditure forecasts across the NEM at the transmission level showed that replacement capex comprised around 54 per cent of expenditure, with the remainder comprised almost equally of network augmentation and maintenance expenditure (Grid Australia, sub. DR101, p. 10).

Whereas growth capex may be examined in light of publicly available forecasts of peak demand, the drivers for replacement capex are more obscured. The coincident increases in both replacement capex and growth capex in some networks have led to significant additional revenue for networks, although there is little independent verification of whether any of the replacement capex could have been deferred.

The overall differences in replacement capex between networks may not be visible for some years. Even if some state-owned networks have replaced assets prematurely, their replacement capex may eventually slow down. Networks that have deferred asset replacement will eventually have to increase their rate of replacement capex. At the very least, benchmarking will be an important retrospective tool for determining whether previous expenditures were premature or excessive.

## 6.5 Expenditure, allowances and timing

As in the case of replacement capex, the timing of capital expenditure more generally has important implications for efficiency. It has been suggested that recent high levels of capex have been partly influenced by time-sensitive incentives. That is, the transitional Rules governing capex overspends allowed for the full rollover of capex into the RAB for the subsequent period (NSW Government 2010, AER 2011a). To the extent that the timing of capital expenditures was brought forward unnecessarily, this would be associated with inefficient investment.

#### Spending above capex allowances

There is still incomplete information on the overspending[[15]](#footnote-15) of ex ante capex allowances for the current regulatory period (where the AER has regulated distribution networks). Nevertheless, there are data for prior regulatory periods, (which were overseen by State regulators), although the availability of data differs somewhat between states.[[16]](#footnote-16)

There is some evidence that above-allowance expenditures have differed between state-owned and private networks. For example, capital and operational expenditure levels for Victorian distribution networks had generally been below both regulatory allowances and network forecasts between 1996 and 2006 (AER 2010b). In comparison, all of the New South Wales distribution networks had exceeded capex allowances between 1999 and 2004 (IPART 2004).

During the regulatory period immediately prior to the AER’s commencement as the network regulator, capital expenditure exceeded allowances by a significant amount, particularly (but not exclusively) for state-owned distribution networks (figure 6.13). As the New South Wales Government (2010) noted:

The [NSW distribution and transmission network] businesses overspent by about $1.4 billion in the previous price period with more than half the overspend occurring in the final year (2008/09) … All businesses have spent less than their capital expenditure allowance in 2009/10. (pp. 33‑4)

The evidence suggests that many businesses had overspent, but particularly so as the regulatory period progressed.

Figure 6.13 Annual distribution capital expenditure above allowances in the period prior to AER regulationa

Actual distribution capex as a proportion of capex allowance

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a This bar chart shows the pattern of actual expenditure over time relative to regulatory allowances in the regulatory period immediately prior to the AER’s commencement as the distribution network regulator. For each firm, the bar chart includes observations from the five years immediately prior to the AER’s commencement as the distribution network regulator. The chart does not distinguish between cost-pass through events and other overspends.

*Data source*: Parsons Brinckerhoff (2009a, 2009b, 2010, 2012); Jemena (2009); Wilson Cook (2008); AER (2010b); CitiPower et al., sub. DR90.

There are several factors that may contribute to the overspending of capex allowances, some of which network business could not control. For example, new licence conditions relating to planning criteria and reliability were introduced in 2005 for New South Wales networks (discussed in chapter 16) — this was associated with a cost pass-through provision that accounted for around half of the overspend by New South Wales distributors (Wilson Cook 2008, Parsons Brinckerhoff 2012). As such, much of the overspend was due to decisions by the New South Wales Government rather than the networks.

To some degree, however, overspends appear to be subject to operational decisions by networks, as described by Ausgrid for example:

A major contributor of the overspend in the [2004-09] period was the decision by the business that it was necessary to address asset replacement needs over the period, despite insufficient funding being provided for this purpose by the regulatory determinations. (Ausgrid as quoted by Parsons and Brinckerhoff 2012, p. 14)

To the extent that allowance overspends result directly from network decisions, the overspends should be considered in light of the prevailing incentive framework.

The AER (2011a) estimates that the above-allowance expenditure in New South Wales and Queensland accounted for roughly 25 per cent of the subsequent price increases. Furthermore, high levels of expenditure also influenced subsequent determinations by the AER. For example, where evidence is lacking in a determination, an emphasis is sometimes placed on historical trends:

There is little information presented that supports the scale of the increase in the current period. … That said, given that the next period appears to be broadly in line with the historical trend (2006-2008), the forecast for the next period is not unreasonable. (Nuttall 2010a p. 196)

As such, although it is often unclear whether the level of incurred expenditure of the previous period was justified, they are often treated as such. None of the network businesses experienced a decrease in their capex allowance in the most recent determinations compared to the actual expenditures of the previous period (figure 6.14). These findings appear to be consistent with inefficient overspending induced by the flaws in incentive regulations discussed in chapter 5.

Figure 6.14 Increase in network forecasts relative to previous period actual capex

Percentage difference between network forecasts of capex and the actual capex in the previous period

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a Transmission network augmentation in Victoria is comprised of both separable and non-separable projects, the former of which is subject to competitive tender for construction, operation and ownership and may not be included in SP AusNet’s regulatory asset base. The AER did not include any note on the treatment of such projects in the publication of this data. As such, the growth in capex shown in this figure for SP AusNet (transmission) may not be directly comparable with other transmission networks, given that some capex projects may not be included.

*Data source*: AER (2011a).

## 6.6 Public and private ownership

Chapter 5 points out that state-owned businesses often face weaker incentives than private businesses to control costs. The empirical evidence discussed in this chapter generally suggests that there are differences in the way private and state-owned businesses operate. For example:

* state-owned businesses in New South Wales and Queensland have increased their network capacity to levels well above those of private firms in Victoria for a given level of peak demand
* state-owned businesses have had relatively large increases in the RAB for a given increase in network capacity.

While these points are not proof of inefficiency, it is unclear whether the scale and timing of the expenditure has been entirely justified.

More specific analysis of expenditure further illustrates the divergence between private and state-owned firms, such as the relationship between expenditure per circuit kilometre and customer density (figure 6.15).[[17]](#footnote-17)

Figure 6.15 Opex and customer density for state-owned and private firms

Opex per km by customer density for distribution networks

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*Data source*: Data requested from the AER based on AER (2011b), p. 64.

The available evidence also suggests that operational practices differ between state-owned and private networks. For example, state-owned networks generally have a lower ratio of customers per employee after accounting for customer density (figure 6.16). During the previous regulatory period, staff numbers for the New South Wales networks rose by 42 per cent (NSW Government 2010). Some increases in the labour force of the New South Wales and Queensland networks reflected increases in capital works over recent years.

The share of in-house labour to contractors also seems to differ between state-owned and private firms, with the ratio being much lower for some private firms (figure 6.17). That is, expenditure on labour, materials and contractors (LMC) is allocated to both capex and opex. None of the state-owned networks spent less than 13 per cent of LMC capex on in-house labour, which was the average share spent by private firms. State-owned networks also spent an average of 47 per cent of LMC opex on in-house labour, compared to 32 per cent for private networks. This suggests that some operational and labour practices may differ between state-owned networks and profit-motivated private networks.[[18]](#footnote-18)

These high-level comparisons do not indicate the causes of operational differences between state-owned and private networks. In regard to labour conditions in particular, there are different opinions on what the underlying differences may be. On the one hand, the Electrical Trade Union stated that wages and conditions were ‘virtually identical’ between states (ETU 2012). On the other hand, the NSW Auditor General (2012) noted that levels of overtime payment in Ausgrid were high and required close monitoring, while the independent panel examining electricity networks in Queensland (IRPNC 2012) also expressed concern about high overtime payments. Data on wages (chapter 2) also suggest a margin between state-owned and private businesses. The New South Wales Government also suggested that overtime payments were ‘excessive’ and that several labour practices were ‘inefficient’ (NSW Government 2012b p. 3). These issues are discussed further in chapter 7.

Figure 6.16 Customers per employeea

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a For firms where data is available. Unlike data collected by regulators, figures included in annual reports are often representative of an entire company rather than for the distribution business alone.

*Data source*: Network annual reports.

Figure 6.17 Relative importance of in-house labour compared to materials and contractorsa

Range and averages for state-owned corporations and private firms

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a Expenditure on in-house labour as a proportion of the total expenditure on labour, materials and contractors. Highest and lowest firm results are presented, as well as group average.

*Data source*: AER unpublished data.

## 6.7 Conclusions

The empirical evidence based on the best available data shows that performance, as measured by a number of indicators, varies significantly between networks. This is unsurprising, as previous benchmarking studies have concluded that some networks perform more efficiently than others. More detailed data would be useful in quantifying the impacts of various drivers (improvements to data access are discussed in chapter 8).

The evidence suggests that both network expenditures and the WACC have had a significant effect on network revenues. To the extent that the WACC has been a driver, the efficiency of overall network revenue outcomes will depend partly on the processes involved with setting the WACC.

Network revenue outcomes are also heavily dependent on the investment decisions made by networks. For example, networks tend to differ significantly in their capacity utilisation, and in recent years, some networks have expanded their network capacity relative to peak demand while others have not. Capital expenditures have also differed by a wide margin, although this relates to the scale of both augmentation and asset replacement.

Judging whether the various levels of expenditure have been efficient would be strengthened by further information, such as the engineering justification of particular capital works, longer-term comparisons between firms and more authoritative benchmarking. However, from the high-level evidence analysed in this chapter, it appears that the levels of expenditure observed for some networks are not easily justified. Where firms have overspent ex ante regulatory allowances (and in some cases, may have profited from it), there is uncertainty about whether that expenditure has been reasonable. Furthermore, the timing of capex overspending is consistent with suggestions that some inefficiency has been induced by flaws in incentive regulations. Still, the Commission has not presented a single definitive quantification of the efficiency gaps between networks.

Several issues raised in this chapter warrant further consideration.

* The significant impact of the WACC on network revenues warrants particular attention, not only with regard to the methods used in its calculation (chapter 5), but also in the role of the Australian Competition Tribunal in determining it during merits reviews (chapters 5 and 21). At least in relation to the former, the recent Rule changes (AEMC 2012r) provide the AER with the discretion to examine these issues without undue constraints from the Rules.
* Reliability standards have had a significant effect on expenditure levels in those States using deterministic standards. Unless modified, these standards will continue to influence the way in which networks respond to increases in peak and average demand. As such, it is necessary to consider whether these standards are set efficiently, and whether the resulting costs of augmentation are commensurate with value of reliability for consumers (chapters 14 to 16).
* Network decisions on expenditure are also subject to the various incentives inherent in the regulatory framework (discussed in chapter 5). These incentives are particularly relevant to network forecasts of demand and the timing of expenditure. There is potential to improve the regulatory incentive framework, particularly through the use of benchmarking (chapters 5 and 8). Beyond this, networks may also be able to play a larger role in influencing the actual rates of peak demand — to this extent, demand side policies should also be investigated (chapters 9 to 12).
* While firms have taken different approaches to network capacity, the networks that have undertaken the most rapid expansion have been under state ownership. The potential issues with public ownership are discussed further in chapter 7.

1. These studies did not compare networks using the same parameters as Mountain and Littlechild (2010) or Mountain (2011), and so are not directly comparable. Nevertheless, they tended to find smaller gaps in the relative performance of the businesses than Mountain and Littlechild. [↑](#footnote-ref-1)
2. Mountain indicated that peak demand was collinear with the other explanators. In this instance, omission of the variable may bias the coefficients on the remaining explanators, but will not bias the in-sample prediction errors of the regression. [↑](#footnote-ref-2)
3. It is also not necessarily a damning finding. Any regression model will have omitted variables. If important causal variables are left out of the model, this leads to ‘omitted variable bias’. If, for example, there are several important variables omitted, then the inclusion of some (or one) of them may reduce the bias or simply change the magnitude or direction of the bias — the effect is not necessarily clear (Clarke 2005). [↑](#footnote-ref-3)
4. Mountain rightly points out that it is difficult for those outside network companies to accurately estimate the quantum of assets that is close to expiry (sub. DR49, p. 4). Detailed data on asset condition, age and expiry is not generally available, and moreover, asset lives may be extended to some degree. [↑](#footnote-ref-4)
5. NERA analysed the regulatory period corresponding with the regulatory period in each region current in 2012, as well as the regulatory period immediately prior to that. The analysis measures increases in network prices using the AER’s Post Tax Revenue Model. The increase is measured as a step change which encapsulates all of the incremental increases which would occur in each year of the period (that is, the analysis assumes the X-factor is set to zero for the final four years of the regulatory period). [↑](#footnote-ref-5)
6. Real cost escalators are indices representing the change in prices faced by network businesses. These may include prices for materials, construction costs, and wages. [↑](#footnote-ref-6)
7. NERA acknowledged that the results from its decomposition analysis ignore these interaction effects, but considered that their approach was the most appropriate method available. [↑](#footnote-ref-7)
8. Although data is unavailable on an individual network basis, it is likely that each distribution network experiences a different level of peak demand even where they exist within the same state. [↑](#footnote-ref-8)
9. Network capacity is measured by the product of total installed transformer capacity (measured in MVA) and the aggregate length of network lines (in circuit km). It is a physical measure of network supply capacity — a similar measure is used by Topp and Kulys (2012). The ratio of network capacity to peak load is used as an indicative measure only, to illustrate the trends in network capacity relative to trends in peak load and to make relative comparisons between networks. It is not intended to be an accurate measure of asset utilisation levels. [↑](#footnote-ref-9)
10. The ratio of network capacity to peak load is represented in figures 6.5 and 6.6 such that the index is higher for networks with more capacity per unit of peak load. That is, South Australia tends to have the least network capacity in relation to the amount of peak load it experiences, while New South Wales has the most network capacity compared to its peak load. [↑](#footnote-ref-10)
11. The Commission had also undertaken comparisons of line capacity between distribution networks, using four different sets of conversion factors as set out in Parsons Brinckerhoff (2003, p. 12). The results did not provide consistent comparisons between networks, nor did they provide consistent levels of capacity. Hence, it was not possible to make a sufficiently reliable estimate of line utilisation (a comparison of line capacity and peak load). [↑](#footnote-ref-11)
12. Evans and Peck cite as evidence the jurisdictional differences in installed transformer capacity per MW of load (MVA/ MW) in the years 2000 and 2011. They find that, per megawatt of load, Victoria had the most installed transformer capacity in 2000, with New South Wales having roughly 75 per cent of the Victorian capacity, and Queensland having 43 per cent. By 2011, Victoria’s capacity had decreased slightly, while Queensland’s capacity had become marginally greater than Victoria’s. Evans and Peck conclude directly from this comparison that Victoria was in ‘good shape’ in the year 2000, while Queensland was ‘under built’, while noting that this conclusion is ‘subject to the need for very rigorous analysis’ (Grid Australia, sub. DR91, attachment 1, p. 6). This conclusion is restated later in the report (p. 7, 9). [↑](#footnote-ref-12)
13. EUAA (2012b) measures the growth of financial measures such as the RAB and expenditure, while accounting for some physical variables such as demand. This differs from Grid Australia (sub. DR91), who use physical measures such as MVA. [↑](#footnote-ref-13)
14. In Victoria, separable transmission projects are subject to a process of competitive tendering. The business that wins the tender then builds that particular network augmentation project, and is responsible for its operation for a number of years in return for the agreed (tendered) amount (appendix F). The outcomes of these tenders are commercial in confidence and are not communicated to the AER, and the expenditure is therefore not incorporated in the regulated asset base at the start of the next regulatory period. In all likelihood, these projects may account for a small proportion of SP AusNet’s total RAB. Nonetheless, SP AusNet’s RAB is not directly comparable to that of other transmission network businesses. [↑](#footnote-ref-14)
15. In this section, the term ‘overspending’ is not intended to imply that the expenditure is prima facie inefficient. The term is used is used in a similar vein by Parsons Brinkerhoff (2012). [↑](#footnote-ref-15)
16. There have also been some discrepancies between the data published on capex overspends. For example, the capex overspends reported in figures may not be directly compatible between AER (2010b), Jemena (2009), AER (2012b) or Parsons Brinckerhoff (2012). Further data on actual expenditure held by the AER were considered confidential. As such, the Commission has made indicative comparisons based on the available data. [↑](#footnote-ref-16)
17. Similar trends are observed for capex. [↑](#footnote-ref-17)
18. It is unclear from these data whether private network businesses are strictly more cost efficient than state-owned networks, as the increased use of contractors may account for the decreased use of in-house labour among private businesses. What is clear is that the state-owned network businesses appear to differ from private businesses in terms of hiring and procuring. [↑](#footnote-ref-18)