Nuttall Consulting

Regulation and business strategy

Memo – Opex Escalation Review

Victorian Electricity Distribution Revenue Review

to the AER

28 October 2010

1.1 Introduction

The AER is assessing the DNSPs' revised regulatory proposals regarding the escalation of opex over the 2011-15 regulatory control period due to network scale.

The AER approach requires an assessment of the growth rates of selected network scale drivers (i.e. ZS capacity, line length (km) and number of distribution transformers).

The AER has requested Nuttall Consulting to advise on:

- whether historical growth rates for each driver are an appropriate basis for estimating the growth rates for 2011-15 or whether other factors may be relevant (e.g. impact of Nuttall Consulting recommendations on each DNSP's capex program for 2011-15, other comparable DNSP historical growth rates based on similar network configurations) and
- if so provide a view as to whether historical growth rates for the Victorian DNSPs should be adjusted and provide a forecast for 2011-15 for each of these growth drivers and the basis of these forecasts.

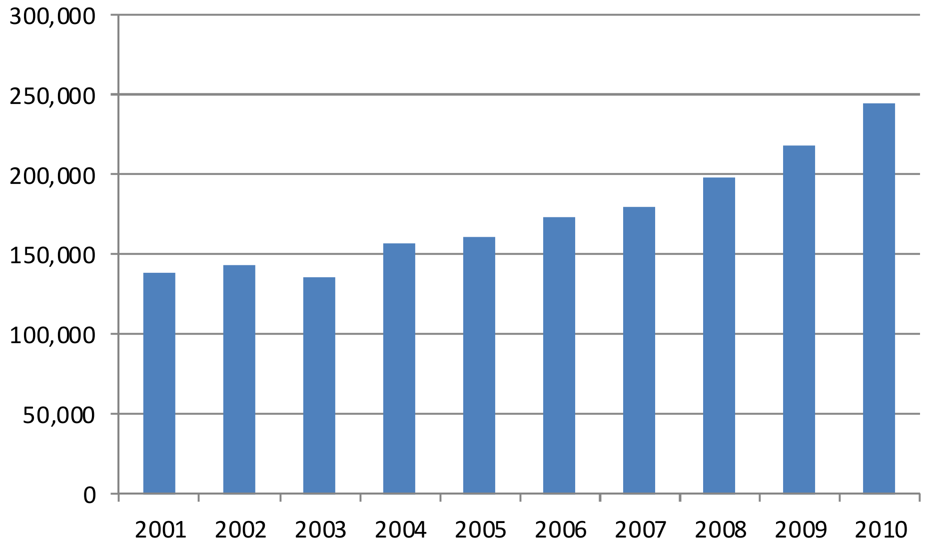
1.2 Background

The primary service provided by DNSPs is the connection of electricity customers. This is an asset intensive business requiring significant capital investment in long life assets. To ensure ongoing integrity of the service and assets, the DNSPs incur ongoing operating expenditures.

The AER is the economic regulator for this industry and is charged with (among other things) assessing the forecast operating expenditure proposed by the DNSPs.

Operating expenditure has historically proven to be relatively stable from year to year with significantly less fluctuations than capex.

Figure 1 - Historical Victorian opex



The AER has not accepted the opex forecasts proposed by the DNSPs for the next regulatory control period and is seeking to substitute a more reasonable set of values.

Australian[1] and UK experience[2] has shown that growth in line length and customer numbers provide statistically relevant proxies for operating expenditure growth. In its draft determination, the AER has included the proxies of zone substation capacity and the number of distribution transformers.

1.3 Historical rates

The AER is required to consider the operating expenditure forecasts provided by the DNSPs for the next regulatory control period. If the AER is not satisfied with that these forecasts reflect the NER objectives, then the AER must provide a substitute forecast.

In its draft determination, the AER applied a scale escalation of the forecast opex for each DNSP. The network scale drivers used in the escalation model were:

- line length (km)
- distribution transformers (number)
- zone substation (capacity).

The AER's network scale drivers have been applied to the following opex categories:

[1] Wilson Cook, Review of proposed expenditure of ACT & New South Wales electricity DNSPs: Energy Australia's submissions of January and February 2009, a report prepared for the AER, 31 March 2009, p. 14.

[2] Ofgem, Electricity Distribution Price Control Review Methodology and Initial Results Paper, Ref: 47a/09, 8 May 2009.

Table 1 – opex category escalation

Operating expenditure	
Network operating costs	Network scale drivers
Billing and revenue collection	Customer numbers
Customer service	Customer numbers
Advertising/marketing	Customer numbers
Regulatory costs	Customer numbers
Other network operating costs	Network scale drivers
GSL payments	Customer numbers
Maintenance Expenditure	
Routine maintenance	Network scale drivers
Condition based maintenance	Network scale drivers
Emergency maintenance	Network scale drivers
SCADA and network control	Network scale drivers
Other maintenance	Network scale drivers

The AER is seeking advice on the whether historical growth rates for each driver are an appropriate basis for estimating the growth rates.

The Nuttall Consulting approach to this review has been to consider:

- the assumptions and considerations taken as input to this review
- the mapping of major asset classes against the proposed network scale drivers
- the operating expenditure categories against the network scale drivers
- the consistency, accuracy and impact of external events on the network scale drivers.

1.4 Overall assumptions and considerations

As a starting assumption, Nuttall Consulting is working on the premise that the relative size of the network has a direct impact on operating expenditure. This is not a proven theory, but is well accepted by the DNSPs. All of the Victorian DNSPs (with the exception of United Energy) explicitly identified that the level of opex is linked to the size of the distribution network and that certain high level 'scale factors' should be applied to the revealed base year opex[3].

[3] Victorian electricity distribution network service providers, Distribution determination 2011–2015, Appendices, June 2010, Appendix J, Page 83.

The allocation of customer and network scale drivers identified in Table 1 above appears implicitly logical, although Nuttall Consulting has not reviewed the specific definitions and treatments of each opex category.

Nuttall Consulting has considered the relation of the proposed network proxies and overall asset base. The major categories of network asset are described below as well as their relationship to the proposed network drivers.

Table 2 – Asset mapping to scale drivers

Asset group	Relationship to scale drivers
Poles	Strong alignment with line length
Pole top structures	Strong alignment with line length
Overhead conductors	Strong alignment with line length
Underground cables	Strong alignment with line length
Zone substation switchgear	Strong alignment with zone substation capacity
Distribution transformers	Direct relationship with distribution transformers
Power transformers	Strong alignment with zone substation capacity
SCADA, network control, protection, secondary	Strong alignment with zone substation capacity
Service lines	More directly related to customer numbers. Question as to inclusion in line length definition.
Zone substation - other	Strong alignment with zone substation capacity
Distribution SWGR	Strong alignment with distribution transformers
IT assets	Aligned most strongly with customer numbers. Also weak relationship to asset volumes and capacity. Can be leased or capitalised.
Land and easements	Strong alignment with zone substation capacity
Tools and equipment	Weak relationship to asset volumes and capacity. Can be leased or capitalised (e.g. cars and vehicles).

The above table suggests a strong level of coverage between the scale drivers and the assets themselves. On the basis that asset volumes/capacity are a driver of operating expenditure, this suggests that the scale drivers selected provide good coverage of the overall network asset base.

It is noted that the network scale drivers selected have a relatively poor alignment with IT assets and tools and equipment. The differing capitalisation approaches on the DNSPs with respect to these assets suggest that a relating scale driver may not be appropriate and may provide the wrong incentives.

1.5 Review by opex category

This section considers the drivers of expenditure in each of the opex categories. The following table identifies the opex categories and the scale drivers proposed by the AER in the draft determination.

Table 3 – Operating expenditure categories

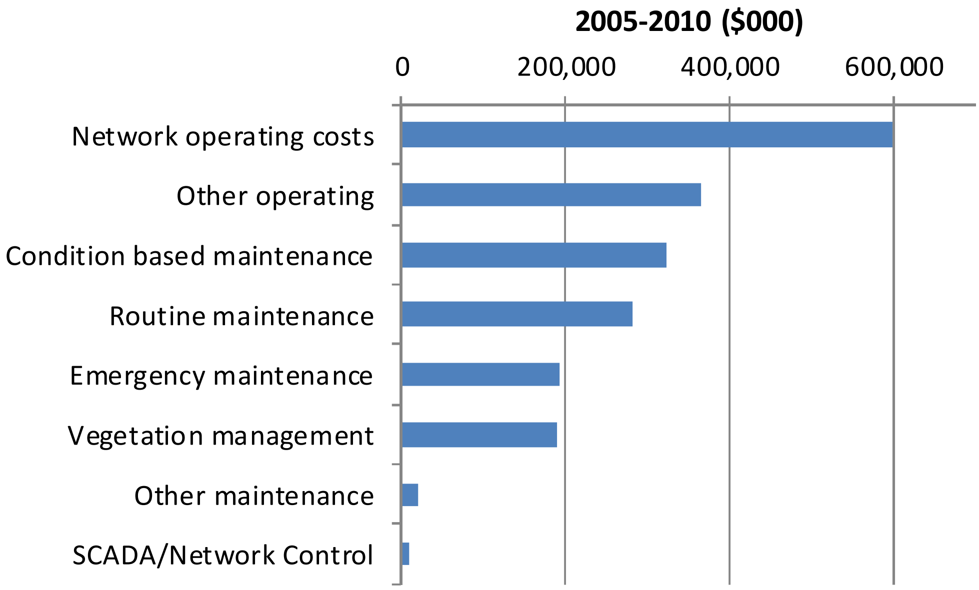
Operating expenditure	
Network operating costs	Network scale drivers
Billing and revenue collection	Customer numbers
Customer service	Customer numbers
Advertising/marketing	Customer numbers
Regulatory costs	Customer numbers
Other network operating costs	Network scale drivers
GSL payments	Customer numbers
Maintenance Expenditure	
Routine maintenance	Network scale drivers
Condition based maintenance	Network scale drivers
Emergency maintenance	Network scale drivers
SCADA and network control	Network scale drivers
Other maintenance	Network scale drivers

The AER has requested Nuttall Consulting to consider whether historical growth rates for each driver are an appropriate basis for estimating the growth rates for 2011-15. Nuttall Consulting has considered each of the opex categories identified above and reviewed the relationship between the opex category and the scale drivers. This has been undertaken at a high-level, as there are thousands of operating and maintenance activities within these categories.

The following chart highlights the relative proportion of each operating and maintenance expenditure category that is subject to the network scale drivers. Network operating costs and other operating cost represent the largest categories. Routine and condition based maintenance represent the next largest.

These categories and their relationships with the network scale drivers are considered in the following sections.

Figure 2 – Victorian operating expenditures



1.5.1 Network operating costs

The definition of network operating costs is as follows:

> *The operational costs associated with the operation of the network including, but not restricted to, the staffing of the control centre(s), operational switching personnel, outage planning personnel, provision of authorised network personnel, demand forecasting, procurement, logistics and stores, information technology (IT) costs directly attributable to network operation, insurance costs and land tax costs.*
>
> *Demand forecasting costs include labour, material and IT charges for the purposes of forecasting peak demand, energy growth and customer numbers in the Distribution Licence area, but do not include energy trading costs related to the wholesale purchase of electricity.*

These costs are not directly driven by the assets themselves. Overall expenditure levels should be relatively consistent for many aspects of network operating costs. Maintenance shutdowns, planned repairs and replacements will drive a significant proportion of these works. On this basis, a proportion of the costs will directly relate to the other opex categories of routine and condition based maintenance. Refer to the relevant sections below for discussions on these categories.

Other network operating costs will relate to the growth and expansion of the network. New capacity and extensions will also impact network operations suggesting that forecast demand will have an impact on this category.

Control centres, provision of authorised network personnel, demand forecasting, procurement, logistics and stores are all ongoing activities where historical expenditures would represent a reasonable basis for future expenditures.

It is not clear whether the asset management functions of the DNSPs are captured in this category or in the "other" category. The asset management function is obviously focussed on the network assets. There are aspects of this function that are forward looking (e.g. planning) and retrospective (e.g. asset performance).

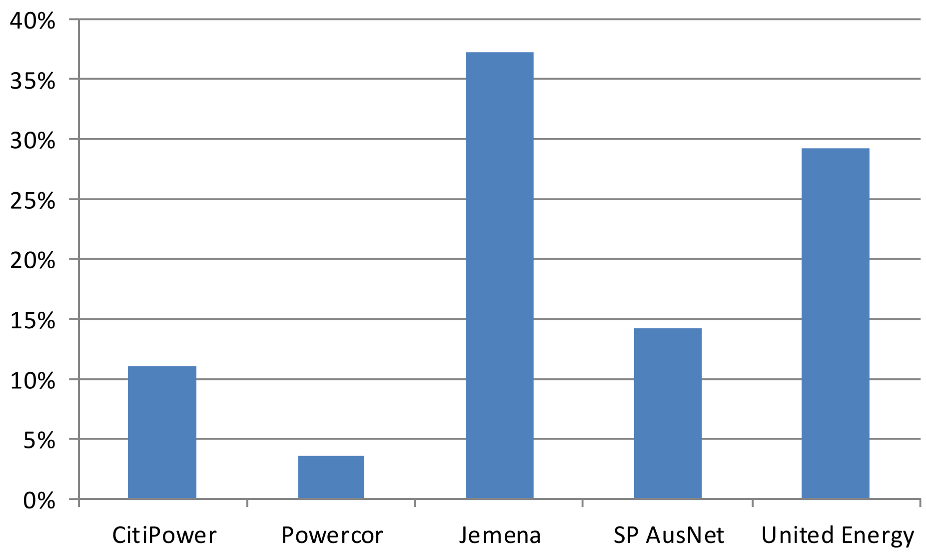
Asset volumes and asset capacities are both clearly linked to the volume of activities required in asset management.

1.5.2 Other network operating costs

A definition for this cost category could not be found. Nuttall Consulting assumes that this is a catch all for the remaining operating costs. Without a review of the costs allocated to this category by the DNSPs it is not possible to determine the most appropriate scale escalator.

It is clear that there is a significant level of variability between the DNSP in cost allocation to this category. The following figure shows the percentage allocated to other operating costs by each DNSP for the current control period.

Figure 3 – Other operating costs - DNSP allocations



1.5.3 Condition based maintenance

The definition for condition based maintenance is as follows:

> *Maintenance activities based on inspection and/or assessment of the condition of an asset. This excludes activities that are part of a recurring maintenance program.*

As discussed above, maintenance activities (routine and condition based) represent the largest operating expenditure categories for all DNSPs.

Condition based expenditures require a trigger event. Typically, this trigger is an observation from an inspection, test or completion of a number of duty cycles.

As with routine maintenance is that there is typically a honeymoon period following installation of a new asset where no maintenance is required. For example, a new pole will typically not require inspection for a period of 10 to 15 years following installation.

This suggests that historical growth rates will provide a more accurate representation of forecast expenditures than forecast growth rates.

1.5.4 Routine maintenance

The definition for routine maintenance is as follows:

> *Recurrent and/or programmed activities undertaken to maintain assets. Routine maintenance activities are performed regardless of the condition of the asset.*

Maintenance activities (routine and condition based) represent the largest operating expenditure categories for all DNSPs. Routine maintenance expenditures are directly related to asset volumes and are performed periodically, rather than dictated by condition. On this basis, these expenditures are highly predictable based on historical levels and asset volumes.

A key aspect of routine maintenance is that there is typically a grace or “honeymoon” period following installation of a new asset where no maintenance is required. This suggests that historical growth rates will provide a more accurate representation of forecast expenditures than forecast growth rates.

Vegetation management is a major expenditure area for all DNSPs, particularly the rural businesses. Vegetation management expenditure is directly related to the length of line that is exposed to vegetation. Increased awareness of the costs of vegetation management means that future lines are likely to be constructed to minimise vegetation management costs. This may lead to a decline in the overall relationship between vegetation management expenditure and line length. However, Nuttall Consulting considers that this decline is not likely to represent a material change in the relationship and that historical growth rates are an appropriate basis for estimating the growth rates for 2011-15.

1.5.5 Emergency maintenance

The definition of emergency maintenance is as follows:

> *Activities that restore a failed component to an operational state. All expenditure relating to the work incurred where supply has been interrupted or assets damaged or rendered unsafe by breakdown, making immediate operations and/or repairs necessary.*

The trigger event for emergency maintenance is the failure of an asset. Asset failures typically occur as the asset approaches the end of its useful life. As most network assets are long-life assets, this suggests that historical growth rates will provide a more accurate representation of forecast expenditures than forecast growth rates.

Faults are also caused by environmental factors and third parties. These faults will not be driven by network age. Although these faults are sporadic and difficult to predict, on aggregate they typically represent a consistent trend and would be relatively consistent from period to period.

1.5.6 SCADA and network control

The definition for SCADA and Network Control is as follows:

> *Expenditure associated with the replacement, installation and maintenance of Supervisory Control and Data Acquisition (SCADA) and network control hardware, software and associated IT systems.*

This is a relatively small expenditure category. Historically SCADA and Network Control has had a direct relationship with zone substation assets, although this is now changing to incorporate HV assets as well.

In the absence of a policy shift by the DNSP to rollout SCADA and Network Control to new areas, the historical trend should be an appropriate basis for estimating expenditure in the next period.

1.5.7 Other maintenance

The definition of "other maintenance" is as follows:

> *This category comprises finance, human resources, information technology and other costs that are directly attributable to or caused by the provision of distribution services by the Distribution Business in accordance with its Distribution Licence.*

Each of the activities listed in this category are indirect services relating to the provision of distribution services. They are not typically related to the assets and would not be greatly impacted by the incremental growth of the asset base.

The AER may wish to consider this category in a similar vein to billing and revenue collection, customer service, advertising/marketing, and regulatory costs. Each of these categories is escalated in relation to customer numbers.

1.5.8 Summary

Together, routine and condition based maintenance represent the most significant proportions of operating expenditure. For each of these categories, the historical installation of assets will have a material impact on future operating expenditure requirements. The time delay between the installation of a new asset and any routine or condition based expenditure suggests that historical asset growth rates may be more appropriate as a driver of escalation than future growth rates.

The operating expenditure categories (network operating and other) represent the next largest categories. These categories contain the asset management functions (assumed) and will be driven to a large degree by the volume of network assets and the scale of the network assets.

1.6 Network scale driver review

This section reviews each of the network scale drivers in relation to the use of their historical growth rates and relationship to operating expenditure. A previous review by Cadency Consulting has been referenced in reviewing the network scale drivers.

1.6.1 Line length

Line length is measured in kilometres and represents the total circuit length of each line. All line voltages are included (e.g. 66kV, 22kV, SWER and low voltage). Each span between poles may contain a single or a number of circuits and these are each considered separately.

The lengths of services to customer's premises are typically not captured in this measure, although this has not been verified by Nuttall Consulting.

Electricity distribution systems rely on overhead and underground lines to distribution electricity from the transmission system to the customer. Electricity lines and the associated asset represent the largest group of assets in the DNSPs RAB.

Electricity lines consist of overhead cables and underground conductor, poles, insulators and cross-arms. In addition to these assets, the overhead systems also provides location for switchgear, protection equipment, pole mounted transformers.

The customer density and capacities of these assets vary dramatically between DNSPs, but are relatively stable for each DNSP over time. The costs associated with sub-transmission lines, HV lines and LV lines vary considerable but should also be proportionally stable for each DNSP over time. The same applies to overhead and underground cables.

The collection and recording of line length is consistent with good industry practice and represents a basic knowledge of the distribution system. Length of the electricity network is a common reporting measure in DNSP annual reports. Although there may be some differences in definitions between businesses (e.g. capture of services, public lighting switch wires, route/circuit lengths, etc.), this is information that the DNSPs have collected and reported for many years. The GIS systems installed by the DNSPs in the 1990s specifically recorded line length information.

The forecasting of line length may however be problematic. The DNSPs have not forecasted this figure historically, and it is not likely that the planning and forecasting functions of the DNSPs have historically prepared forecasts of line length before. The AER has identified that the line length forecasts for the DNSPs are not consistent with the historical growth of these assets.

Nuttall Consulting notes that significant levels of SWER replacement are being considered for the next regulatory period. This replacement will not alter the overall line length in a material way unless new feeder routes are created. However, the opex (particularly routine and condition based) associated with these lines may reduce during the "honeymoon" period for the new assets. Nuttall Consulting has assumed that this impact will be accounted for in the assessment of these proposals and is not addressed here.

The implementation of new vegetation clearance requirements will also impact the opex associated with overhead lines. Additional vegetation management will reduce emergency maintenance and may result in a step change reduction in associated operating expenditure. Nuttall Consulting has assumed that this impact will be accounted for in the assessment of the new requirements and is not addressed here.

Based on the lack of experience in forecasting line length, the apparent inconsistency in the current forecast and the honeymoon period associated with new assets, Nuttall Consulting considers that historical growth rates for line length are an appropriate basis for estimating the growth rates for 2011-15.

1.6.2 Distribution transformers

Distribution transformers are typically the last level of voltage transformation before delivery to the customer[4]. Distribution transformers can vary in size from 10kVA through to 1500kVA. This capacity measure is typically consistent over time, although there are instances where classes of transformers have had their capacities reclassified.

The number of distribution transformers is not a defined term although Nuttall Consulting is not aware of any issues that may impact the overall count of distribution transformers. It is possible that current or voltage transformers may be included in this category, although this has not been an issue in Nuttall Consulting's experience.

The collection and recording of distribution transformers is consistent with good industry practice and represents a basic knowledge of the distribution system. The number of distribution transformers is regularly reported in DNSP annual reports. Information on distribution transformers has been collected and reported for many years. The GIS systems installed by the DNSPs in the 1990s specifically recorded distribution transformer locations.

Nuttall Consulting notes that "SP AusNet does not consider Distribution Transformer growth to be representative of opex growth due to the simple low maintenance nature of distribution transformers, which are in the main, operated on a run to failure replacement strategy. This issue is magnified as the AER uses a simple average, as the inclusion of Distribution Transformer growth reduces the overall composite network growth driver for SP AusNet."

The first SP AusNet point is that distribution transformers are typically run to failure and therefore incur very little opex. While this is true for most DNSPs and particularly rural businesses, a run to failure policy does not mean that opex is not incurred. For example:

[4] Noting sub-transmission and HV customers as exceptions

- SP AusNet itself employs the following inspection and monitoring of distribution transformers[5]:
    - inspect the condition of distribution transformers at five-year intervals.
    - inspect the civil aspects of kiosk, ground-type and indoor transformer installations at four month intervals.
    - monitor the electrical utilisation of three-phase transformers at 12-month intervals.
    - monitor operating temperatures, partial discharge emissions and dissolved gasses of three-phase transformers commensurate with electrical utilisation and consequences of failure.
- All DNSPs inspect (at least visually) pole-mounted transformers as part of the pole inspection programs.
- The switchgear and protections systems of a distribution transmission also require inspection and maintenance.
- Emergency maintenance is undertaken on distribution transformers and associated assets – possibly in greater proportions than other assets due to the run to failure policy.

The second SP AusNet point relates to the use of an average in the composite formula. Nuttall Consulting has not been requested to review this area.

The forecasting of distribution transformer numbers may be problematic. As with line length, the DNSPs have not forecasted this figure historically, and it is not likely that the planning and forecasting functions of the DNSPs have historically prepared forecasts of distribution transformer numbers before. The AER has identified that the distribution transformer numbers forecasts for the DNSPs are not consistent with the historical growth of these assets.

The AMI rollout would be expected to improve the accuracy of distribution transformer number forecasting. Accurate and timely information from each AMI meter combined with network mapping will enable significantly better information on transformer utilisation. This should in turn lead to better decision making in relation to transformer upgrades and additions.

The AMI rollout may also alter the relationship between operating expenditure and the distribution transformers. The AMI data will remove the costs associated with installing physical meters on substations for testing and load analysis. This information may also lead to better replacement strategies and reduced fault and emergency work associated with distribution transformers. This potential change in relationship suggests that this proxy could be given a lesser weighting to minimise the potential impacts of the AMI rollout on the opex forecasts.

Nuttall Consulting notes that the use of a capacity value, rather than overall number, would provide a better relationship with the value of assets and be more

[5] AMS 20-58 – Electricity Distribution Network. Distribution Transformers, Issue 5, 25/11/2009.

aligned with the respective operating expenditure. However, the availability of this information and the issue of minimum standard sizing may mitigate against the use of a capacity measure.

Based on the lack of experience in forecasting distribution transformer numbers, the apparent inconsistency in the current forecast and the honeymoon period associated with new assets, Nuttall Consulting considers that historical growth rates for distribution transformer numbers are an appropriate basis for estimating the growth rates for 2011-15.

1.6.3 Zone substation capacity

Nuttall Consulting is not aware of an agreed definition for this measure. Typically, zone substation capacity would be measured as the nameplate ratings of the power transformers operating in a zone substation enclosure.

This definition has become more problematic over time as DNSPs have moved to adopt winter and summer capacity limits and are moving to dynamic capacity management.

The infrastructure associated with zone substations also contribute to operating expenditure requirements. In addition to the transformers are the on-load tap changers, protection and switching equipment, busbars and cabling, metering, batteries, enclosures, security, capacity banks and earthing. The majority of zone substation opex relates to these non-transformer assets.

Some of these assets will be required irrespective of the capacity of the zone substation (e.g. enclosures, earthing, etc.). Whereas other assets will be more proportional to the capacity of the zone substation (e.g. switchgear and protection).

The number of zone substations in each DNSP is relatively small. Thus, the use of a “number of zone substations” measure would be inappropriate due to the large increment/change that would result from each additional zone substation.

The same issue applies to a lesser extent to the capacity measure. New zone substations are constructed to meet current and future demand. The capacity increase associated with a single zone substation will result in larger incremental changes to this measure than the other measures reviewed. This may suggest that a lower weighting should be considered for this measure.

The forecasting of zone substation capacity appears problematic. Although the DNSPs have forecast this figure historically, they do not appear to have done so with a great degree of accuracy[6]. The AER has also identified that the zone substation capacity forecasts for the DNSPs are not consistent with the historical growth of these assets.

Nuttall Consulting also notes that the honeymoon period applies to the majority of zone substation assets. Power transformer oil testing does not commence for many years after energisation, tap changer maintenance is typically based on the

[6] Observation of demand forecasts and actuals 2006 and 2001.

number of operations of the tap changer, earthing is tested every ten years, switchgear inspection and testing is based on operations and age, etc.

Some substation assets incur operating expenditure from the start of their operating lives (e.g. batteries). However, in general the honeymoon period applies to the majority of zone substation assets.

Nuttall Consulting notes that the AMI rollout is not anticipated to impact zone substation related operating expenditure as existing information at the zone substation level is fairly detailed already.

Based on the observed inaccuracy of forecasting zone substation capacity, the apparent inconsistency in the current forecast and the honeymoon period associated with new assets, Nuttall Consulting considers that historical growth rates for zone substation capacity are an appropriate basis for estimating the growth rates for 2011-15.

1.7 Summary

The AER has requested Nuttall Consulting to advise on whether historical growth rates for each driver are an appropriate basis for estimating the growth rates for 2011-15 or whether other factors may be relevant.

Based on the above review, Nuttall Consulting considers that the use of historical growth rates for the network scale drivers is more appropriate than the use of DNSP forecasts due to:

- analysis from the UK and Australia supporting the use of line length as a proxy for network operating expenditure
- the lack of experience in forecasting distribution transformer numbers and line length
- the historical inaccuracy in the DNSP forecasts of zone substation capacity
- the inconsistency between current and forecast driver growth amounts contained in the revised DNSP proposals
- the honeymoon period of reduced operating expenditure requirements associated with new assets.

Nuttall Consulting does not recommend any other factors in addition to those proposed by the AER. The current proxies map to the majority of network assets.

Noting the experience with line length in the UK, the AER may wish to consider adding additional weight to this factor.

Nuttall Consulting has identified a number of potential future requirements that may impact the relationship between operating expenditures and the proxy assets (lines, zone substations and distribution transformers). These future requirements include replacement of SWER, AMI rollout and line clearance regulations. Nuttall Consulting considers that the specific reviews of these changes should allow for the operating expenditure impacts, with the exception of AMI. On this basis, the network scale drivers will not need to be modified to address these items, with the possible exception of reducing the distribution transformer weighting.