Repex Model
Supporting Information

31 January 2019

Part of the Energy Queensland Group

Contents

1. Introduction

1.1 Background

The AER indicated in its Expenditure Forecast assessment guidelines for electricity distribution and transmission that it intends to use its Repex model to help determine the efficient costs of asset replacement (capital) expenditure over the forthcoming regulatory control period. Energy Queensland understands the AER uses the Repex Model as a threshold test to identify areas of potential difference from DNSP forecasts to inform areas for additional review.

Energy Queensland also uses Repex Modelling as one tool for top-down challenge and check of replacement capex bottom-up build forecast requirements. This is done both at an overall replacement capex level and at an asset category group level where applicable.

As optimal timing for asset replacement is not solely reliant on age, other factors such as safety, environment, changes in defect rates, and obsolesce issues must also be considered. Energy Queensland has a number of proactive asset replacement programs driven by emerging issues unrelated to the age of the assets that will not be fully captured in the Repex models of both Energex and Ergon Energy. Where differences are material they are noted and discussed in the Energex and Ergon Energy Justification Statements for modelled asset classes.

1.2 Purpose

This document provides response to information requested by the AER in Reset Regulatory Information Notice (RIN) Schedule 1 Section 5, Replacement Capital Expenditure Modelling. It describes the methodologies, assumptions and sources of information required to populate the AER's Repex model.

1.3 Structure

The document is set out in the following main sections:

- Asset categories
- Replacement life statistics
- Replacement unit costs
- Factors affecting replacement expenditure
- RIN Schedule 1 compliance checklist

1.4 Document terminology

Table 1-1 sets out the definitions used by Energy Queensland to clarify any terminology that may differ between that applied by Energex, Ergon Energy and the AER.

Table 1-1 Energy Queensland terminology

Term	Description
nailed/nailing	a metal support attached to a wood pole to give it extra support and defer replacement – also called staked/staking
NFM	Network Facility Management - the main database used by Energex to record and manage asset data and information regarding network outages
CBRM	Condition Based Risk Management - engineering models used to forecast asset condition

2. Asset categories

2.1 Asset category description

Energy Queensland has followed guidance provided in the AER's Electricity network service providers - Replacement expenditure model handbook (November 2013)[1] regarding asset groups and asset categories.

Energex and Ergon Energy's assets have been mapped to the AER's Repex asset categories as set out in Table 3-1. Where the assets are adequately described by the Repex asset categories they are noted *as described*.

Table 2-1 Mapping to AER Repex asset categories

AER asset group	AER asset category	Energy Queensland asset category
"POLES BY: HIGHEST OPERATING VOLTAGE ; MATERIAL TYPE; STAKING (IF WOOD)"	< = 1 kV; WOOD	* As described
	> 1 kV & < = 11 kV; WOOD	* As described
	> 11 kV & < = 22 kV; WOOD	* As described
	> 22 kV & < = 66 kV; WOOD	* As described
	> 66 kV & < = 132 kV; WOOD	* As described
	< = 1 kV; CONCRETE	* As described
	> 1 kV & < = 11 kV; CONCRETE	* As described
	> 22 kV & < = 66 kV; CONCRETE	* As described
	> 66 kV & < = 132 kV; CONCRETE	* As described
	< = 1 kV; STEEL	* As described
	> 1 kV & < = 11 kV; STEEL	* As described
	> 22 kV & < = 66 kV; STEEL	* As described
	> 66 kV & < = 132 kV; STEEL	* As described
	Staked Poles	Nailed < = 1 KV; WOOD
		Nailed > 1 KV & < = 11 KV; WOOD
		Nailed > 22 KV & < = 66 KV; WOOD
"POLE TOP STRUCTURES BY: HIGHEST OPERATING VOLTAGE"	< = 1 kV	* As described
	> 1 KV & < = 11 KV	* As described
	> 11 kV & < = 22 kV	* As described
	> 22 KV & < = 66 KV	* As described
	> 66 KV & < = 132 KV	* As described
"OVERHEAD CONDUCTORS BY: HIGHEST OPERATING VOLTAGE; NUMBER OF PHASES (AT HV)"	< = 1 kV	* As described
	> 1 kV & < = 11 kV	* As described
	> 11 kV & < = 22 kV ; SWER	* As described
	> 11 kV & < = 22 kV ; Multiple-Phase	* As described
	> 22 kV & < = 66 kV	* As described
	> 66 kV & < = 132 kV	* As described
"UNDERGROUND CABLES BY: HIGHEST OPERATING VOLTAGE"	< = 1 kV	* As described
	> 1 kV & < = 11 kV	* As described
	> 11 kV & < = 22 kV	* As described
	> 22 kV & < = 33 kV	* As described
	> 66 kV & < = 132 kV	* As described
"SERVICE LINES BY: CONNECTION VOLTAGE; CUSTOMER TYPE; CONNECTION COMPLEXITY "	< = 11 kV ; RESIDENTIAL; SIMPLE TYPE	* As described
	< = 11 kV ; COMMERCIAL & INDUSTRIAL; SIMPLE TYPE	* As described
	< = 11 kV ; RESIDENTIAL; COMPLEX TYPE	* As described
"TRANSFORMERS BY: MOUNTING TYPE; HIGHEST OPERATING VOLTAGE ; AMPERE RATING; NUMBER OF PHASES (AT LV)"	POLE MOUNTED ; < = 22kV ; < = 60 kVA ; SINGLE PHASE	* As described
	POLE MOUNTED ; < = 22kV ; > 60 kVA AND < = 600 kVA ; SINGLE PHASE	* As described
	POLE MOUNTED ; < = 22kV ; > 600 kVA ; SINGLE PHASE	* As described

[1] AER Replacement expenditure model handbook, November 2013

AER asset group	AER asset category	Energy Queensland asset category
	POLE MOUNTED ; < = 22kV ; < = 60 kVA ; MULTIPLE PHASE	* As described
	POLE MOUNTED ; < = 22kV ; > 60 kVA AND < = 600 kVA ; MULTIPLE PHASE	* As described
	POLE MOUNTED ; < = 22kV ; > 600 kVA ; MULTIPLE PHASE	* As described
	KIOSK MOUNTED ; < = 22kV ; < = 60 kVA ; MULTIPLE PHASE	* As described
	KIOSK MOUNTED ; < = 22kV ; > 60 kVA AND < = 600 kVA ; MULTIPLE PHASE	* As described
	KIOSK MOUNTED ; < = 22kV ; > 600 kVA ; MULTIPLE PHASE	* As described
	KIOSK MOUNTED ; > 22 kV ; < = 60 kVA	* As described
	KIOSK MOUNTED ; > 22 kV ; > 60 kVA AND < = 600 kVA	* As described
	KIOSK MOUNTED ; > 22 kV ; > 600 kVA	* As described
	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; < 22 kV ; < = 60 kVA ; MULTIPLE PHASE	* As described
	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; < 22 kV ; > 60 kVA AND < = 600 kVA ; MULTIPLE PHASE	* As described
	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; < 22 kV ; > 600 kVA ; MULTIPLE PHASE	* As described
	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; > = 22 kV & < = 33 kV ; < = 15 MVA	* As described
	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; > = 22 kV & < = 33 kV ; > 15 MVA AND < = 40 MVA	* As described
	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; > = 22 kV & < = 33 kV ; > 40 MVA	* As described
	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; > 33 kV & < = 66 kV ; > 15 MVA AND < = 40 MVA	* As described
	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; > 66 kV & < = 132 kV ; < = 100 MVA	* As described
	GROUND OUTDOOR / INDOOR CHAMBER MOUNTED ; > 66 kV & < = 132 kV ; > 100 MVA	* As described
"SWITCHGEAR BY: HIGHEST OPERATING VOLTAGE ; SWITCH FUNCTION"	< = 11 kV ; FUSE	* As described
	< = 11 kV ; SWITCH	The operational switch asset group has been defined as all other switches found within the Energex and Ergon Energy networks, which include the asset types: airbrake, disk link, link pillar, isolator, switch fuse, dropout, earth switch, fuse switch, sectionaliser, load transfer switch, ring main unit, link pillar and disconnect box.
	> 11 kV & < = 22 kV ; SWITCH	
	> 22 kV & < = 33 kV ; SWITCH	
	> 33 kV & < = 66 kV ; SWITCH	
	> 66 kV & < = 132 kV ; SWITCH	
	< = 11 kV ; CIRCUIT BREAKER	The circuit breaker asset category has been defined as all circuit breakers and reclosers within the Energex and Ergon Energy networks, excluding circuit breakers that form part of a ring main unit.
	> 11 kV & < = 22 kV ; CIRCUIT BREAKER	
	> 22 kV & < = 33 kV ; CIRCUIT BREAKER	
	> 33 kV & < = 66 kV ; CIRCUIT BREAKER	
	> 66 kV & < = 132 kV ; CIRCUIT BREAKER	
"PUBLIC LIGHTING BY: ASSET TYPE ; LIGHTING OBLIGATION"		
	LUMINAIRES ; MAJOR ROAD	* As described
	LUMINAIRES ; MINOR ROAD	* As described
	BRACKETS ; MAJOR ROAD	* As described
	BRACKETS ; MINOR ROAD	* As described
	LAMPS ; MAJOR ROAD	* As described
	LAMPS ; MINOR ROAD	* As described
	POLES / COLUMNS ; MAJOR ROAD	* As described
	POLES / COLUMNS ; MINOR ROAD	* As described
"SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS BY: FUNCTION"		
	FIELD DEVICES	This includes: • protection relays, • remote terminal units (RTUs) and • intelligent electrical devices (IEDs).
	LOCAL NETWORK WIRING ASSETS	* As described

AER asset group	AER asset category	Energy Queensland asset category
	COMMUNICATIONS NETWORK ASSETS	This includes: • Microwave links (links installed), DSS Head ends, • DSS Radios (including repeaters) and Multiplex (including MPLS nodes) • Telecommunication equipment which includes: P25 network; cellular data network; CoreNet, corporate communications, multiplexing, routing and communication switching equipment, point-to-point and multipoint data systems, land mobile radio systems, communications sites, infrastructure assets.
	MASTER STATION ASSETS	* As described
	COMMUNICATIONS LINEAR ASSETS	Includes copper and fibre optic pilot cables
	AFLC	* As described
OTHER ASSETS	33kV Instrument Transformer	* As described
	110kV Instrument Transformer	* As described
	Current Transformers	* As described
	Voltage Transformers	* As described
	Capacitor Banks	* As described
	Static VAR Compensator	* As described
	Return To Service	Ergon Energy term for all assets which are replaced due to failure in service.
	Transformer Bunding	* As described
	Ageing Cable Terminations	* As described
	Substation Batteries	* As described
	Substation Battery Chargers	* As described
	LV Safety & Visibility Network Monitoring	* As described
	Fire Suppression System / Water Misting	* As described
	Electric Fencing	* As described
	Asbestos Removal	* As described
	Substation Miscellaneous	Substation security fencing
	Reactive Work	Energex term for all assets which are replaced due to failure in service.

2.1.1 Boundary issues

There are no identified boundary issues between asset categories.

2.1.2 Age profile determination

Energy Queensland applied a range of assumptions to determine age profile quantities and these are summarised in the following sections. Assumptions can generally be applied across all asset categories of a given asset group so assumptions are listed by asset group. Where assumptions are specific to an asset category this is noted.

Poles

The following assumptions were applied by Energex to determine pole age profile quantities:

- The pole data does not include assets that are in store or held for spares.
- The pole data has been categorised by the highest voltage at the site. For example if a pole carries 33 kV and 11 kV conductors, then all poles at the site have been allocated as 33 kV poles.
- All poles have a year of commissioning based on the first year the current specification was allocated to the slot in NFM.
- A pole with a pole foundation type of staked and nailed has an age based on when the pole foundation was made staked and nailed and not the first year of current specification.
- Poles that have a material type of plastic (fibreglass) have been excluded.
- Aluminium poles have been combined with steel poles.
- Poles with a dedicated streetlight pole specification and contain a rate 1 or rate 2 streetlight have not been included in the asset group poles, but have been included in the public lighting asset group.
- All poles with no voltage such as cross-street (poles that support a service line across a street) and bollard (poles that support another pole) poles have been allocated to the ≤1 kV category.
- The total quantity and year of commissioning is a snapshot of all relevant assets as of 30 June 2018.
- All Steel Poles found in Substations are allocated to <=1KV category. These poles are not used for the distribution of electricity.
- All Steel Poles with a Voltage of <=1KV were moved to the unmatched category for data quality investigation.
- Poles have been allocated based on financial year, i.e. an asset captured in NFM on 5 July 2012 will have a commissioning period of 2012/13.

Pole top structures

Ergon Energy does not record cross arms as separate assets in corporate systems and consequently does not provide an age profile for pole top structures.

The following assumptions were applied by Energex to determine pole top structure age profile quantities:

- Pole top structures are defined to be cross arms fitted to poles. The following multipliers were applied against the figures calculated for pole assets to determine the quantity of cross arms and their initial ages. Multipliers have been determined from Energex maintenance department based upon field sampling conducted and knowledge of construction types and their application.

- All cross arms on poles installed prior to 1978/79 had been replaced with a consecutive 35 year life span. For example a 1977/78 start date is updated to 2012/13 to indicate that the asset has been replaced.

Overhead Conductors

The following assumptions were applied by Energex to determine overhead conductors age profile quantities:

- The conductor data does not include conductors that are in store or held for spares.

- Total quantities are reported in kilometres.

- The length of each conductor category is the total conductor route length and not each individual phase conductor length, noting:
  - 11 kV routes predominately consist of three conductors, but also include some single phase (two conductors) in the total length.
  - Low Voltage (LV) routes predominately consist of four conductors: three phases plus neutral, however the lengths provided include all variations.

Ergon Energy holds very little asset data on the installation date for overhead conductors. Where conductor phase and voltage are not populated in GIS, these are inferred from other attributes.

Ergon Energy has developed an estimate based on the following approach:

- Obtain the latest date the line was installed, upgraded or replaced in a Smallworld design.

- Obtain the earliest pole treatment year of poles the line is mounted on. If this date is within the date range specified for the construction in the CBRM QESI inferred date table, use this date.

- If the conductor is mounted on “Natural Round” poles and 1955 is within the date range specified for the construction in the CBRM QESI inferred date table, use 1955.

- If the conductor is in NQ (Northern Queensland) and its construction is one of ('200','203','204','205','207','208','211','212','213','214') use 1985.

- If the construction has a numeric value use the nominal year from CBRM QESI inferred date table for the construction.
- If the construction is non-numeric, use the alternative nominal year from CBRM QESI inferred date table for the construction.
- Date is unknown.

In developing this estimate, Ergon Energy has made the following assumptions:

- The energisation processes all installed new conductor.
- Conductor for which no age was able to be determined, was added to the amounts for aged conductor, in the same proportion as the aged conductor to the total age for each year.
- Ergon Energy inferred the natural round pole by assigning flat line age profile year between 1949/50 – 1961/62 for the following voltage categories.
  - < = 1 kV; Wood
  - > 1 kV & < = 11 kV; Wood
  - > 11 kV & < = 22 kV; Wood
- Therefore, a conductor may be mounted on natural round pole with assigned age between 1949 and 1962. The conductor inferring rule would assign same age of the oldest pole on the feeder. This gave a high volume of asset in the older range and less volume in the younger range. Due to this reason, Ergon Energy change the overhead conductor age profile between 1949/50 and 1961/62 by averaging the total length of conductor voltages in following categories and flat lined the age profile similar to natural round pole age profile.
  - < = 1 kV
  - > 1 kV & < = 11 kV
  - > 11 kV & < = 22 kV ; Single-Phase
  - > 11 kV & < = 22 kV ; Multiple-Phase

Underground cables

The following assumptions were applied by Energex to determine underground cable age profile quantities:

- The underground cable data does not include cables that are in store or held for spares.
- Total quantities are reported in kilometres.
- The length of each conductor category is the total cable route length and not each individual core length.

Ergon Energy holds very little asset data on the installation date for underground cables. Where conductor phase and voltage are not populated in GIS, these are inferred from other attributes.

Ergon Energy has developed an estimate based on the following approach:

- Obtain the installation recorded against the cable in GIS.

- Obtain the latest date the cable was installed, upgraded or replaced in a Smallworld design.
- Traverse the network downstream from the cable and determine the date as follows
  - Installation date of downstream cable.
  - Age of downstream switches.
  - Age of downstream transformers.
  - Age of supporting poles.
  - Age of ground-mounted substation or pillar.
- Nominal year assigned to the QESI code associated with the cable's construction.
- Date is unknown

Service lines

The following assumptions were applied by Energex to determine service line age profile quantities:

- Maximum age of a service line of 60 years has been used when estimating the age of the population.
- All LV service lines are a single span making them simple connections.
- All new overhead service line assets are type XLPE.
- A customer may have their own private network beyond a connection point. These assets are not included in the service line data.
- Based on the definitions in the Reset RIN, Energy Queensland has only LV service line assets. Where customers require connection at higher voltages and the assets are owned by Energy Queensland, they are included in other dedicated asset categories (such as 11 kV overhead conductor) and are not classified as service lines.

Ergon Energy holds very little asset data on the quantity and installation date for overhead and underground services, pillars and pits. In relation to service lines age, Ergon Energy has developed an estimate based on the following approach. For each service point a service line is assumed:

- If a service point is directly related through an overhead wire of less than 50 metres to a pole, a service line is assigned the inferred age of the pole.
- For non-directly related service points the nearest structure (pole, pit, pillar or GMS site) to the service point is found. If the nearest structure is a pole and within 50 metres, a service line is assigned the inferred age for that pole.

Transformers

The following assumption was applied to determine transformer age profile quantities:

- The transformer data does not include transformers that are in store or held for spares.

In relation to age profile Ergon Energy has developed an estimate based on the following approach:

- The year of installation is determined by following this hierarchy until an answer is found:
- COMM-DATE (Commissioning Date) nameplate against the asset in Ellipse.
- YOM (Year of Manufacture) nameplate against the asset in Ellipse.
- The “date_installed” attribute of the asset in Smallworld.
- The “date_installed” attribute of the associated substation in Smallworld.
- Treatment year nameplate against the pole the asset is mounted on
- The latest YOM or COMM-DATE nameplates against equipment at the GMS site the asset is mounted on.
- The earliest premise status date for customers associated with the asset substation.
- Where the above logic results in blank or a non-sensible value, those assets are distributed to the same shape distribution as the assets with a real or inferred age.

Switchgear

The following assumptions were applied by Energex to determine switchgear age profile quantities:

- The switchgear data does not include assets that are in store or held for spares.
- The circuit breaker asset category has been defined as all circuit breakers and reclosers within the Energy Queensland network, excluding circuit breakers that form part of a ring main unit.
- The operational switch asset group has been defined as all other switches found within the Energy Queensland network, which includes the asset types: airbrake, disk link, link pillar, isolator, switch fuse, dropout, earth switch, fuse switch, sectionaliser, load transfer switch, ring main unit, link pillar and disconnect box.

The following assumptions were applied by Ergon Energy to determine fuse age profile quantities:

- The age profile was estimated using the assumption that each distribution transformer has one set of HV and one set of LV fuses up until 2013/14. From 2017-18 onwards, only LV fuses have been reported against the “< = 11 kV FUSE” category as per AER response of 02/07/2016; “the omission of a category for ‘fuses >11kV’ is intentional. AER staff note the definition of ‘switch’ includes fuses at higher voltages. Because of the high number of fuses at the <=11 kV category, these are asked for separately. All other categories have been rationalised for each Asset Group with a single ‘other’ available for those categories not listed.

The following assumptions were applied by Ergon Energy to determine switch and circuit breaker age profile quantities:

- The COMM-DATE (Commissioning Date) nameplate against the switch physical in Ellipse.
- The YOM (Year of Manufacture) nameplate against the switch physical in Ellipse.
- The year the latest design, containing an Install, Upgrade or Replace action against the switch, was energised.
- The age of the site on which the switch is mounted, determined as follows
- For poles, obtain the inferred age for the pole using the logic described in the pole age profile above.
- For GMS sites, get the latest Year of Manufacture or Commissioning Date nameplate values for equipment mounted on the site.
- For zone substation sites, get the default CBRM date for equipment located at the zone substation.
- Where the above logic results in blank or a non-sensible value those assets are distributed to the same shape distribution as the assets with a real or inferred age.
- The HV fuses age profile has been estimated using the assumption that each distribution transformer has one set of HV and one set of LV fuses. From 2017-18 onwards, the HV fuses have been reported in the group "<= 11 SWITCH" category as per AER response of 02/07/2016; "the omission of a category for 'fuses >11kV' is intentional. AER staff note the definition of 'switch' includes fuses at higher voltages. Because of the high number of fuses at the <=11 kV category, these are asked for separately. All other categories have been rationalised for each Asset Group with a single 'other' available for those categories not listed."

Public lighting

The following assumption was applied to determine public lighting age profile quantities:

- The public lighting data does not include assets that are in store or held for spares.

SCADA, network control and protection systems

Energex's assumptions for control systems aged profiles are as follows:

- **Field Devices - Protection Relays**: The total number of protection relays installed in each year was determined by summing the number of individual relays assigned each year. Where multiple dates where available for an asset, the age of the asset was selected in the following order: 1) manufacturer date; 2) commissioning date; and 3) where the commissioning date was unknown, a set of rules was used to allocate this small population across the profile of directly allocated relays with known dates. Protection relays do not include assets that are in store or held for spares.

- **RTUs**: A review of SCADA control scheme configuration information was undertaken to identify the date when the hardware for each control scheme was changed or installed. By analysing the date when a control scheme was modified, this showed when a new asset was added. The age profile of RTUs was generated by summing the total number of hardware replacements or installations in each financial year.
- **Local Network Wiring Assets**: Energex has focused on data relating to substation multicore cabling, as this represents the primary local network wiring asset class. The total volume of multicore cables currently installed in substation assets was extracted from the Multicore Cable Schedule (MCCS) database (at 1 July 2018). The age profile is then generated by spreading the total installed amount in the same manner as the primary plant that it is connected to (substation transformers and switchgear).
- **Communications Network Assets**: The aged profile of installed assets was established by summing the asset volumes calculated for microwave links, DSS head end, radios and repeaters, Multiplex and MPLS assets.
    - Multiplex – An extract of the total population of multiplex assets was performed to establish total assets installed at 1st of July 2018. The age profile for multiplex assets was estimated by analysing the installation dates associated with fibre optic cables and then using these dates as a basis for apportioning the volume of multiplex assets installed for each year.

Ergon Energy's assumptions for control systems aged profiles are as follows:

- **Protection Relays**: Approximately 15% of the asset population do not have an installation date. For those assets without an installation date, an estimated date is assigned based on the relay type – Electromechanical; Static or Numeric.
- **Communications Network Assets**: Subject Matter Expert advice based on the technology of the assets installed in the latest year and the associated assets replaced in prior years.

2.1.3 Main drivers of replacement

The main drivers of replacement for each of the asset groups are shown in Table 3-2. The drivers of replacement for asset categories are consistent within each asset group.

Table 2-2 Main replacement driver

Asset Group	Main replacement driver
Poles	Asset condition
Pole top structures	Asset condition
Overhead conductors	Asset condition
Underground cables	Asset condition
Service lines	Asset condition
Transformers	Asset condition
Switchgear	Asset condition
Public lighting	Asset condition
SCADA, network control	Obsolescence and asset condition

Public lighting is included in table 2.2.1 of the Reset RIN, it should be noted that both Energex and Ergon Energy manage this asset group as an Alternate Control Service.

Asset condition considers asset metrics including age, environmental factors, inspection and test results and technical engineering risk assessments.

2.1.4 Explanation replacement unit cost

Replacement unit costs have not been requested by the AER as part of the Reset RIN. Energy Queensland assumes that the AER will:

- Calculate replacement unit cost for each asset category using data provided in Table 2.2.1 of the Reset RIN.
- Estimate replacement unit cost for the Repex model using total replacement expenditure divided by the total replacement volumes as per the Repex model calibration instructions[2].

Costs included in historic replacement expenditure provide for a complete replacement of an asset with its modern equivalent except for poles for which both Energex and Ergon Energy undertake pole nailing as a refurbishment activity to extend asset life. This activity is capitalised and is included as a separate asset category as per directions under clause 5.1.(b) of Appendix E of the Reset RIN.

[2] AER Replacement expenditure model handbook, November 2013, page 20

2.2 Proportion of assets replaced

This section provides an estimate of the proportion of assets replaced for each year of the current regulatory control period.

2.2.1 Replacements due to asset ageing

Asset replacement volumes due to asset ageing only include assets replaced under replacement projects. These are consistent with expenditure reported against Table 2.2.1 of Reset RIN. The estimate does not include the number of assets that were replaced under augmentation or customer initiated project codes.

Tables 2-3 and 2-4 show the assets replaced as a percentage of the total asset populations. This is reported at the asset group level to average out the variability found when reporting at the asset category level.

Table 2-3 Energex replacements due to asset ageing

Asset group	Energex proportion of assets replaced				
	2015-16	2016-17	2017-18	2018-19	2019-20
Poles (ea.)	1.69%	1.86%	1.45%	1.23%	1.28%
Pole top structures (ea.)	-	-	-	-	-
Overhead conductor (in km)	1.05%	1.15%	0.77%	0.48%	0.67%
Underground cables (in km)	0.24%	0.12%	0.13%	0.01%	0.06%
Service lines (ea.)	5.85%	6.79%	5.78%	3.19%	3.23%
Transformers (ea.)	1.73%	2.15%	1.45%	1.40%	1.47%
Switchgear (ea.)	1.41%	1.40%	1.07%	0.65%	0.71%
Public lighting (ea.)	-	-	-	-	-
SCADA, network control and protection systems (ea.)	0.02%	0.03%	0.02%	0.79%	1.70%

Table 2-4 Ergon Energy replacements due to asset ageing

Asset group	Ergon Energy proportion of assets replaced				
	2015-16	2016-17	2017-18	2018-19	2019-20
Poles (ea.)	0.55%	0.56%	0.73%	0.67%	0.65%
Pole top structures (ea.)	-	-	-	-	-
Overhead conductor (in km)	0.08%	0.14%	0.21%	0.17%	0.14%
Underground cables (in km)	0.13%	0.09%	0.12%	0.06%	0.06%
Service lines (ea.)	1.54%	1.39%	1.78%	2.71%	2.51%
Transformers (ea.)	1.54%	1.20%	1.45%	1.39%	1.22%
Switchgear (ea.)	1.52%	1.54%	2.00%	1.70%	1.54%
Public lighting (ea.)	-	-	-	-	-
SCADA, network control and protection systems (ea.)	1.92%	1.10%	0.76%	0.82%	0.99%

2.2.2 Replacement due to other factors

Energy Queensland has not reported asset replacements due to other factors.

2.2.3 Replacement due to network augmentation, extension, development

Augmentation projects can include an element of asset replacement due to:

- A combination of augmentation and asset replacement drivers on a specific asset, such as aged zone substation transformers being upgraded and replaced due to capacity.
- Associated assets also requiring replacement when the main asset is augmented, which occurs for two key reasons:
  - To meet a technical specification required for an augmented asset, for example, increasing the capacity of a transformer will require the transformer circuit breaker to carry more current; and
  - To bring forward replacement as part of a major project where the associated assets are in poor condition and financial modelling identifies improved efficiency.
- Technical issues that force asset replacement prior to end of life, such as increased fault levels
- Replacement to resolve safety concerns or changes to statutory requirements, such as protection system upgrades.

The volume of assets replaced through augmentation projects which would otherwise have been replaced due to condition are considered to be immaterial in value.

2.2.4 Additional assets due to other factors

In replacing assets, Energy Queensland is likely to consider or use different technology or the modern equipment relative to the original asset being replaced. The asset would still perform the same function. In some cases, network standards may require a different standard or design compared to the asset being replaced.

Energy Queensland has submitted a Low Voltage Network Safety strategic proposal which discusses introduction of additional network assets to address safety risks as well as enable life extension of existing assets.

Energy Queensland has not identified any other additional assets due to other factors.

3. Factors affecting replacement expenditure

3.1 Overview

The following sections describe factors that have changed network replacement expenditure requirements over the current regulatory control period, or are expected to affect replacement requirements in the forthcoming regulatory control period. These factors are expected to result in higher replacement volumes and/or increased unit costs and affect the suitability of using the Repex model to forecast replacement requirements.

3.2 Statutory requirements

The Energex and Ergon Energy Distribution Authorities establish a safety net standard for planning the network to manage the risk of high impact low probability events.

Refer to the Capex chapter of the Regulatory Proposal for a description of the drivers and factors that have impacted capex (including network replacement expenditure requirements).

3.3 Internal planning and asset management

Refer to the Capex chapter of the Regulatory Proposal.

Energy Queensland Asset Management Plans provide further detail on the main drivers of replacement by asset category, and are attachments to the regulatory proposal.

3.4 Asset factors

Energy Queensland Asset Management Plans provide further detail by asset category, and are attachments to the regulatory proposal.

3.5 External factors

Energy Queensland Asset Management Plans provide further detail on factors influencing replacement by asset category, and are attachments to the regulatory proposal.

Ergon Energy is subjected to the impacts of major weather events, in particular Tropical Cyclones. These require major network rebuild or restoration efforts which can have material impact on the planned or forecast asset replacement volumes due to a reprioritisation of work.

3.6 New technology

The capex chapter of the Regulatory Proposal notes that some of Energex's forecast replacement capex is driven by technical obsolescence, including where vendor or manufacturer support has been withdrawn and spares are exhausted. These issues particularly impact protection and control, and secondary systems assets where unavailability of support and/or spares can result in extended outages.

Energy Queensland has submitted a Low Voltage Network Safety strategic proposal which discusses use of technology to address safety risks as well as enable life extension of existing assets.

Future technology considerations are detailed in each of Energy Queensland's Asset Management Plans (AMPs) which are attachments to the regulatory proposal.

3.7 Other significant matters

There are no other significant matters relating to asset replacement activity reported in table 2.2.1 of the Reset RIN that will affect either Energex or Ergon Energy in the next forthcoming regulatory control period.

3.8 Identify Supporting Information

Further information with regard to different asset classes is detailed in Energy Queensland's Asset Management Plans (AMPs).

4. Additional replacement expenditure items

The AER has stated that the Repex model is aimed at modelling non-demand driven replacement of an asset with its modern equivalent, where the timing of the need can be directly or implicitly linked to the age of the asset.

This statement acknowledges that there are factors other than condition that trigger the need for asset replacement and that age cannot always be a good proxy for condition. In addition, the AER notes that DNSPs apply a number of alternative techniques and the Repex model does not replace those techniques.[3]

The following programs set out in Table 4-1 have not been included in table 2.2.1 of the Reset RIN due to:

- Asset replacement not being directly or implicitly linked to the age of the asset
- Affected assets not being included in the AER's Repex categories.

[3] AER guide to the Repex model, November 2013, Section 2

Table 4-1 – Unmodelled programs not included in Repex model

Unmodelled Programs	Description	Driver
Asset Replacement	Planned Substation Battery Replacement	Periodic replacement of the entire substation battery banks (six year cycle).
	Substation battery chargers	Proactive replacement based on technical life, asset condition and risk.
	Instrument Transformers Replacement	Replacement based on asset condition and risk.
	Capacitor Banks	Replacement based on asset condition and risk.
	Static VAR Compensator	Replacement based on asset condition and risk.
	Ageing Cable Terminations	Replacement of bitumen filled pothead cable terminations
Environmental	Transformer Bunding	Program to install oil containment bunding for substation power transformers.
Safety	LV Safety & Visibility Network Monitoring	Implementation of network monitoring to improve safety in the LV network.
	Fire Suppression System / Water Misting	Installation of fire suppression system (water misting) for critical substation power transformers.
	Electric Fencing	Upgrading existing fencing for bulk and zone substations.
	Asbestos Removal	Removal of asbestos materials from Energy Queensland network.
Return To Service / Reactive Work Program	Capital replacement of plant which fails in service, requiring quick turnaround.	Provision of fast-tracked capital replacement of critical system assets which fail in service.
SCADA, Control and Communications Systems	Field devices including protection relays, RTUs and IEDs.	Replacement based on asset condition and risk.
	Communications Network Assets including telecommunications, data networks and mobile devices.	Replacement based on asset condition and technical obsolescence.
	Communications Linear Assets including copper and fibre optic pilot cables.	Replacement based on asset condition and risk.

5. RIN Schedule 1 compliance checklist

Table 5-1 sets out the requirements and relevant reference for each of the Submission RIN Schedule 1 clauses relating to Repex modelling.

Table 5-1 – Compliance checklist

RIN Clause	Description	Section Reference
5	**REPLACEMENT CAPITAL EXPENDITURE MODELLING**	
5.1	In relation to information provided in Workbook 1 – Regulatory determination, *regulatory template* 2.2 and with respect to the AER's repex model, provide:	
5.1(a)	For individual *asset* categories set out in the *regulatory templates*, provide in a separate *document*:	
5.1(a)(i)	a description of the *asset* category, including:	2.1
5.1(a)(i)(A)	the *assets* included and any boundary issues (i.e. with other *asset* categories);	2.1.1
5.1(a)(i)(B)	an explanation of how these matters have been accounted for in determining quantities in the age profile;	2.1.2
5.1(a)(i)(C)	an explanation of the main drivers for replacement (e.g. condition); and	2.1.3
5.1(a)(i)(D)	an explanation of whether the replacement unit cost provides for a complete replacement of the *asset*, or some other activity, including an extension of the *asset's* life (e.g. *pole* staking) and whether the costs of this extension or other activity are capitalised or not.	2.1.4
5.1(a)(ii)	an estimate of the proportion of assets replaced for each year of the current regulatory control period, due to:	2.2
5.1(a)(ii)(A)	aging of existing *assets* (e.g. condition, obsolesce, etc.) that should be largely captured by this form of replacement modelling;	2.2.1
5.1(a)(ii)(B)	replacements due to other factors (and a description of those factors);	2.2.2
5.1(a)(ii)(C)	additional *assets* due to the *augmentation*, extension, development of the *network*; and	2.2.3
5.1(a)(ii)(D)	additional *assets* due to other factors (and a description of those factors).	2.2.4
5.1(b)	For the previous, current and forthcoming regulatory control periods, explain the drivers or factors that have changed network replacement expenditure requirements. Identify and quantify the relative effect of individual matters within the following categories:	
5.1(b)(i)	rules, codes, licence conditions, statutory requirements;	3.2

5.1(b)(ii)	internal planning and asset management approaches;	3.3
5.1(b)(iii)	measurable asset factors that affect the need for expenditure in this category (e.g. age profiles, risk profiles, condition trend, etc.). Identify and quantify individual factors;	3.4
5.1(b)(iv)	the external factors that can be forecast and the outcome measured (e.g. demand growth, customer numbers) that affect the need for expenditure in this category. Identify and quantify individual factors, covering the forecasts and the outcome (external factors to be discussed here do not relate to changing obligations which are covered in paragraphs 11.3 and 11.8);	3.5
5.1(b)(v)	technology/solutions to address needs, covering:	
5.1(b)(v)(A)	network; and	3.6
5.1(b)(v)(B)	non-network.	3.6
5.1(b)(vi)	any other significant matters.	3.7
5.1(b)(vii)	Identify and provide information or documentation to justify and support any responses to paragraph 5.1(b) (i)-(vi).	3.8