Engineering Report

Meter Replacement Program

Abstract: This engineering report outlines the meter asset management framework that will be used for the Metering Equipment Asset Replacement program for the next AER regulatory control period from 2015 to 2020.

The framework fits with Ergon Energy's metering standards for compliance testing, end-of-life and obsolete meter assets and the Meter Asset Management Plan (MAMP) endorsed by the Australian Energy Market Operator (AEMO). The program aims to ensure Ergon Energy's metering assets are maintained in a fit for purpose state and we comply with the legal and statutory obligations under the National Electricity Law (NEL).

Keywords: meter asset replacement, end-of-life, obsolete, in-situ, in-service, compliance, testing

Engineering Report
Meter Replacement Program

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1 Overview

The aim of this engineering report is to outline the asset management framework that applies to the Metering Equipment Asset Replacement program for the next Australian Energy Regulator (AER) regulatory control period 1 July 2015 to 30 June 2020.

The framework fits with Ergon Energy's metering standards for compliance testing, end-of-life and obsolete meter assets and the 'Meter Asset Management Plan' (MAMP) endorsed by the Australian Energy Market Operator (AEMO). The program aims to ensure Ergon Energy's metering assets are maintained in a fit for purpose state and we comply with the legal and statutory obligations under the National Electricity Law. This document should also be read in conjunction with the 'Network Optimisation Metering Management Plan'.

1.1 Purpose

The purpose of this engineering report is to define the meter asset management framework that will be used for the metering equipment asset replacement program preferred option A for the regulatory control period 2015 to 2020.

1.2 Scope

The scope of this document is to outline the preferred option for a meter asset replacement plan and describe how this fits with a framework of Ergon Energy's standards and strategy for metering equipment. The components that are the building blocks and contribute to this framework are the following metering standards for:

- Meter asset in-service compliance testing.
- End-of-life asset replacement
- Obsolete asset replacement

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2 References

2.1 Ergon Energy controlled documents

Document number or location (if applicable)	Document name	Document type
STNW3357	Standard for End-of-life Metering Equipment	Standard
STNW3358	Standard for In-service Compliance Testing	Standard
STNW3359	Standard for Meter Refurbishment and Disposal	Standard
STNW3360	Standard for Obsolete Metering	Standard
NA000900R102	Meter Asset Management Plan	Reference
PLNW0001	Network Optimisation Metering Management Plan.	Plan

2.2 Other documents

Document number or location (if applicable)	Document name	Document type
AS1284.13	Electricity Metering – In-service Compliance Testing	Standard

3 Legislation, regulations, rules, and codes

Legislation, regulations, rules, and codes
National Electricity Rules Chapter 7 – Metering
National Metrology Procedures Part A

4 Definitions, acronyms, and abbreviations

4.1 Definitions

For the purposes of this engineering report, the following definitions apply:

Term	Definition
Small Customers	Small Customer is defined as those with electricity energy usage < 100 MWh's per annum

4.2 Acronyms and abbreviations

The following abbreviations and acronyms appear in this engineering report.

Abbreviation or acronym	Definition
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
BAU	Business As Usual
CAPEX	Capital Expenditure
CT	Current Transformer
DNSP	Distribution Network Service Provider
FRC	Full Retail Competition
IES	Inverter Energy System
DNSP	Distribution Network Service Provider
MAMP	Meter Asset Management Plan
NEM	National Electricity Market
NER	National Electricity Regulator
PPE	Personal Protective Equipment
RIN	Regulatory Information Notice
Repex	Replacement Expenditure
RWR	Recommended Works Request

5 Recommendations

It is recommended that the framework and meter asset replacement quantities outlined in Option A of this engineering report be adopted for the meter asset equipment replacement program of work for the next regulatory control period 2015 to 2020.

This approach is considered to be an efficient and prudent method to address non-compliant meter assets and the increasing population of aged meter assets to ensure that all metering is maintained in good functional order to:

- Maintain a compliant meter fleet
- Meet our Metering Provider obligations to market participants
- Comply with Meter Asset Maintenance Plans endorsed by AEMO
- Decrease operational costs associated with asset failures.

The recommended program provides some flexibility over the regulatory control period 2015 to 2020 to target priority one meter replacements identified as non-complaint, while commencing to remove end-of-life meter assets, with support from the obsolete meter provisions to perform additional work at some sites to address installation difficulties.

6 Background

Ergon Energy was formed on 1 July 1999 as an amalgamation of six different regional electricity distribution businesses that had different asset management systems, installation standards, application methods and different ways of managing meter asset records. Some of the assets currently used on the network for revenue metering purposes date back to the 1939.

The major portion of assets installed for revenue metering purposes are electro-mechanical meters of various makes and models that have been developed for the Australian market from the early 1900's. (Refer to Annex B - Major Milestones in Metering for EMMCO, Email, Email -Westinghouse meters). These early meters record energy only usage with separate meters being used to record usage for different tariff charges (i.e. separate tariff rates for light and power usage.) Few records exist of the asset types installed prior to the mid 1970s. The installation and use of electronic meters commenced in the early 1990s and were used in small volumes for large customers or special tariff applications that began to emerge. In the 1980s uniform state wide tariffs saw the installation of ripple control systems for control of hot water loads for demand management. The ripple control devices were also used to control two-rate time of use tariffs.

The National Electricity Market (NEM) was established in 1998 and progressed through various tranches as contestability was introduced to different customer segments. Full Retail Competition (FRC) commenced in Queensland on 1 July 2007. This coincided with the introduction of electronic meters for all new and replacement installations with the requirement to have load profile and remote communications capability.

The focus of this document relates to *small customers* where the responsibility for meter provision is a regulated component that rests with the Distribution Network Service Provider (DNSP).

Metering assets are quite different to other distribution asset categories, being relatively low cost, and subject to both dynamic and static movement depending on customer segments and locality. Replacement of meters occurs for a wide range of operational reasons, including:

- Customer requested tariff changes (including solar Inverter Energy Systems (IES)
- Government tariff reforms (i.e. introduction of new tariffs and phasing out old tariffs.)
- Meter equipment damage (i.e. storms, cyclones, floods, accidental)
- Customer switchboard upgrades, relocation, additional tariffs (additions and alterations)
- Removal of meters and services (*AS 1284.13 - Electricity Metering – In-service Compliance testing, supply abolishment*)
- Metering corrective maintenance (component failure i.e. display, battery etc.)
- Theft and tampering (holes in meters and removed security seals)
- Customer initiated accuracy tests (replaced where the meter fails the test).

In recent times, replacement of meters for operational purposes has had a large impact on the meter population principally due to customer requested tariff changes associated with the installation of solar panels to take advantage of government initiated solar bonus schemes.

Meter replacement for operational reasons is either: policy driven, customer driven or part of corrective maintenance that is not part of the targeted MAMP. These response activities are generally individual truck rolls and less efficient than targeted replacement programs.

The meter assets targeted for replacement under this engineering report will be those which form part of the MAMP and a framework that includes non-compliant, aged meter assets and obsolete equipment. This framework is based on three supporting standards that describe '*In-Service Compliance Testing', 'End-of-life'* and *'Obsolete' metering equipment*.

7 Corporate objectives

This engineering report is aligned with Ergon Energy's strategic objectives to:

- Deliver sustainable financial returns
- Provide efficient, prudent and timely delivery of capital and operating programs
- Network operation and investment that balances service and risk
- Our people are technologically enabled and have the right information to deliver great business outcomes
- Ensure meter assets are fit for purpose, and meet metrology limits
- Ensure meter equipment assets suitability and deliver customers tariff requirements
- Meet legal and regulatory obligations.
- Improve reporting accuracy and level of detail regulatory and legislative requirements

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8 Regulatory and legislative requirements

Ergon Energy has a regulatory obligation to ensure the meters purchased comply with pattern approval and type tests where applicable, and meet the metrology and accuracy requirements as specified in the National Electricity Rules (NER). Ergon Energy is also obliged to perform preventative maintenance plans in accordance with the MAMP to ensure meters record energy to the required accuracy and is fit for purpose. Ergon Energy has a regulatory and legal obligation to replace metering equipment that is found to be non-compliant.

9 Issues

The metering assets that will be considered under the meter asset replacement framework in the regulatory control period 2015 to 2020 consist of:

- Electro-mechanical meters (purchased between 1940 and 2007)
- Electronic meters (purchased from 1990 to current)
- Electronic ripple receivers. (purchased from 1980 to current)

For end-of-life treatment, the bathtub analogy described in the AER Repex model, applies to all three asset classes.

Electro-mechanical meters have high failure rates at the beginning and at the end of their life, with end-of-life being more related to unacceptable accuracy performance as the meters slow down, due to component wear of moving parts (i.e. bearing system, and display register) or speed up due to network operational impacts (lightning strikes, system over-voltage's). The bathtub lifecycle model represented in Figure 1 is more applicable to electronic devices such as electronic meters and ripple receivers, where the failure of individual components can render these devices inoperable. Beginning and end-of-life failure of these devices is more pronounced, with typical failures of components such as batteries, displays, capacitors and surge devices, which are sensitive to elevated temperatures, high humidity and network operating impacts (lightning strikes, voltage sags and swells etc.) which are all common across Ergon Energy's topography.

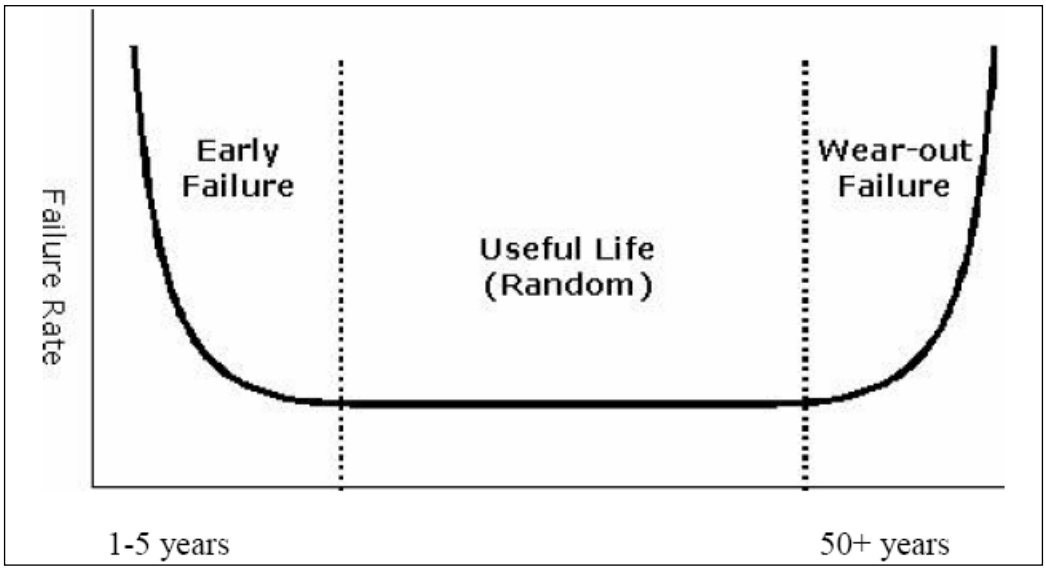

Figure 1 Asset age lifecycle chart from the AER Repex model outline

The current program of work for meter asset replacement is based on a condition based sampling program with targeted replacement being initiated when a family of meter assets is declared as 'non-compliant' or meter assets being replaced under corrective maintenance as they fail in-service. The replacement of non-compliant meter equipment is non-discretionary and required to meet regulatory obligations under the MAMP.

As time passes, the number of assets falling into the end-of-life category is increasing significantly each year. Commencement of an end-of-life meter asset replacement program is seen as an issue that needs to be included in the next regulatory control period. It is also recognised that targeted end-of-life meter asset replacement be used as an opportunity to replace obsolete or redundant meter assets to improve the efficiency of a site visit. In many instances the removal or relocation of meter assets is necessary to be able to perform the work on the customer's switchboard.

The obsolete metering standard provides guidelines required to support replacement programs and is seen as an opportunity to remove or correct a future maintenance issue while performing work at an installation where the cost of mobilisation to the installation, and arranging a customer outage has already been expensed. This includes the removal, relocation and minor wiring changes to facilitate the replacement of the targeted metering equipment and consolidation of multiple meters where appropriate.

9.1 Risk Analysis

Table 1 provides a summary of the risk assessment as presented in the meter replacement business case.

Table 1 Business Case Risk assessment

Evaluation / risk type	Consequence	Financial impact of consequence	Likelihood	Level of risk
Legal and Regulatory	Major	Violation of law which results in a fine and/or puts the business and/or individuals at risk of civil penalties. ($6,650,000)	Almost Certain 95%+	Extreme
Corporate Reputation	Minor	Local management involvement is necessary. Adverse media reports. Small reduction in reputation in the short term to the customer or the community. Low level parliamentary question. Negative questions at local council or local member level. Adverse media reports ($105,000)	Likelihood – Likely 75% probability	Medium

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10 Key inputs

The key inputs for the meter asset replacement framework, is based on Ergon Energy's submissions for the annual Regulatory Information Notice (RIN), and the extraction of data from historical and chronological historical details as presented in the associated standards. Ergon Energy's aged asset profile and meter equipment family details are collected from numerous sources including new purchase records since Ergon Energy's formation, historical records from suppliers, internal purchasing, field surveys, asset data collection during field work, and data recorded from disposal records. A significant amount of meter asset data improvement analysis has been concluded in the current regulatory control period.

Annex B provides a useful history for the EMMCO / EMAIL / EMAIL Westinghouse meter development in Australia. This is combined with installation connection dates, manufacturer's serial number ranges and regional numbering systems from disposal records to determine the age of meters by association with equipment property number ranges.

10.1 Data

The following graphs (Figure 2, Figure 3, and Figure 4) show the meter age profile for all revenue class meters and control equipment. The meter age profile is dominated by the large population of single phase electro-mechanical meters (81.2%) and recently by single phase electronic meters (13.3%), while the ripple receiver age profile shows large quantities installed when the rollout of these devices was mandated for hot water system load control from the mid to late 1980s. Quantities of time switches remain in service where these were not changed out for control of off-peak hot water systems. Some also remain in remote areas where there are no ripple control signals.

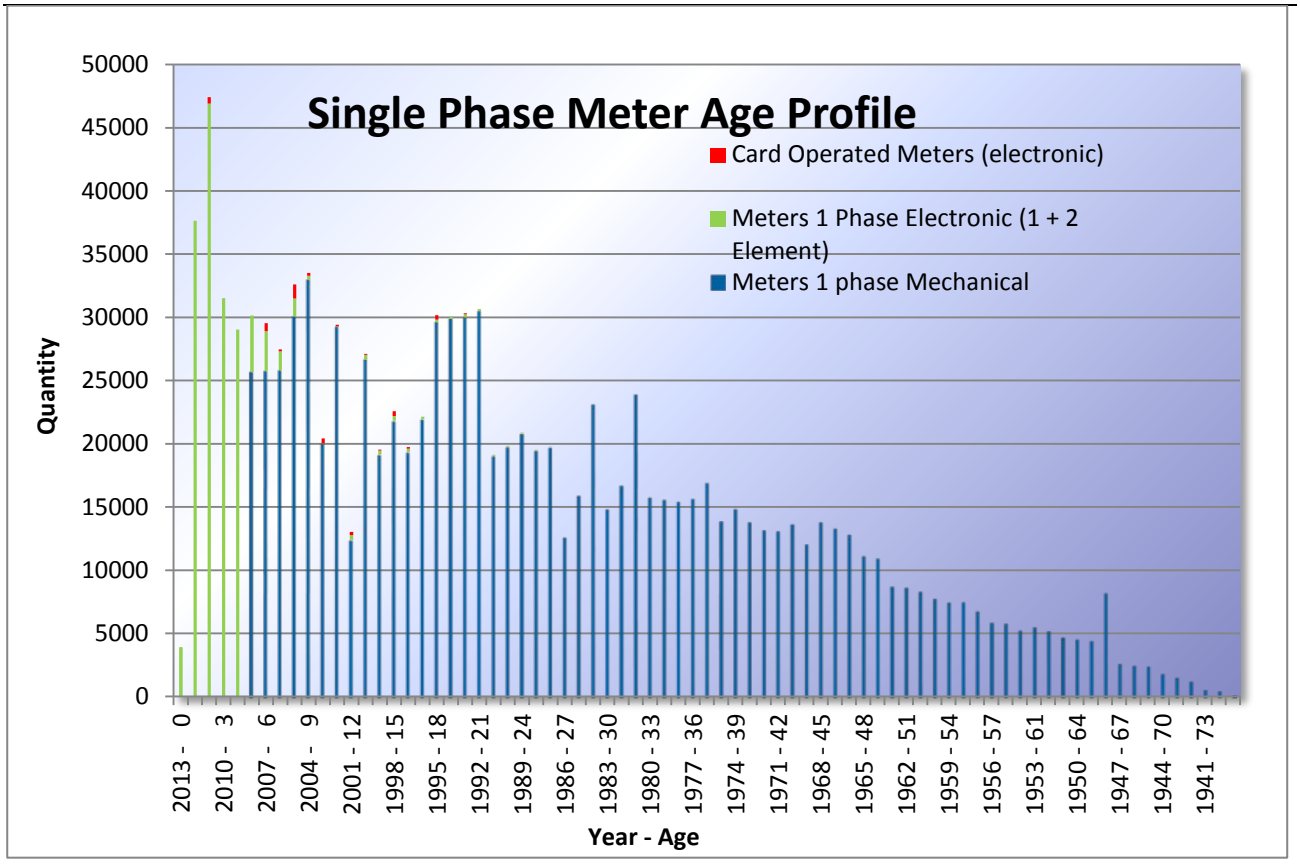

Figure 2 Single phase Electro-mechanical and Electronic Meters Age Profile

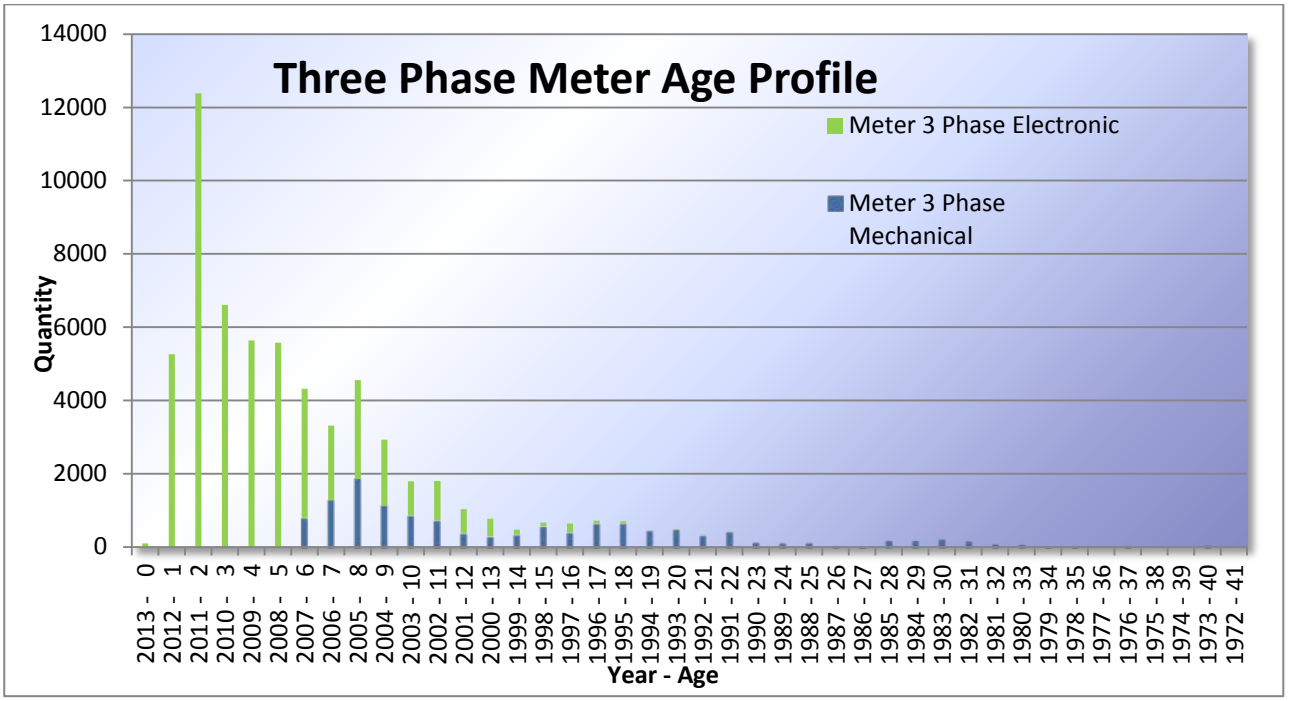

Figure 3 Three phase Electro-mechanical and Electronic Meter Age Profile

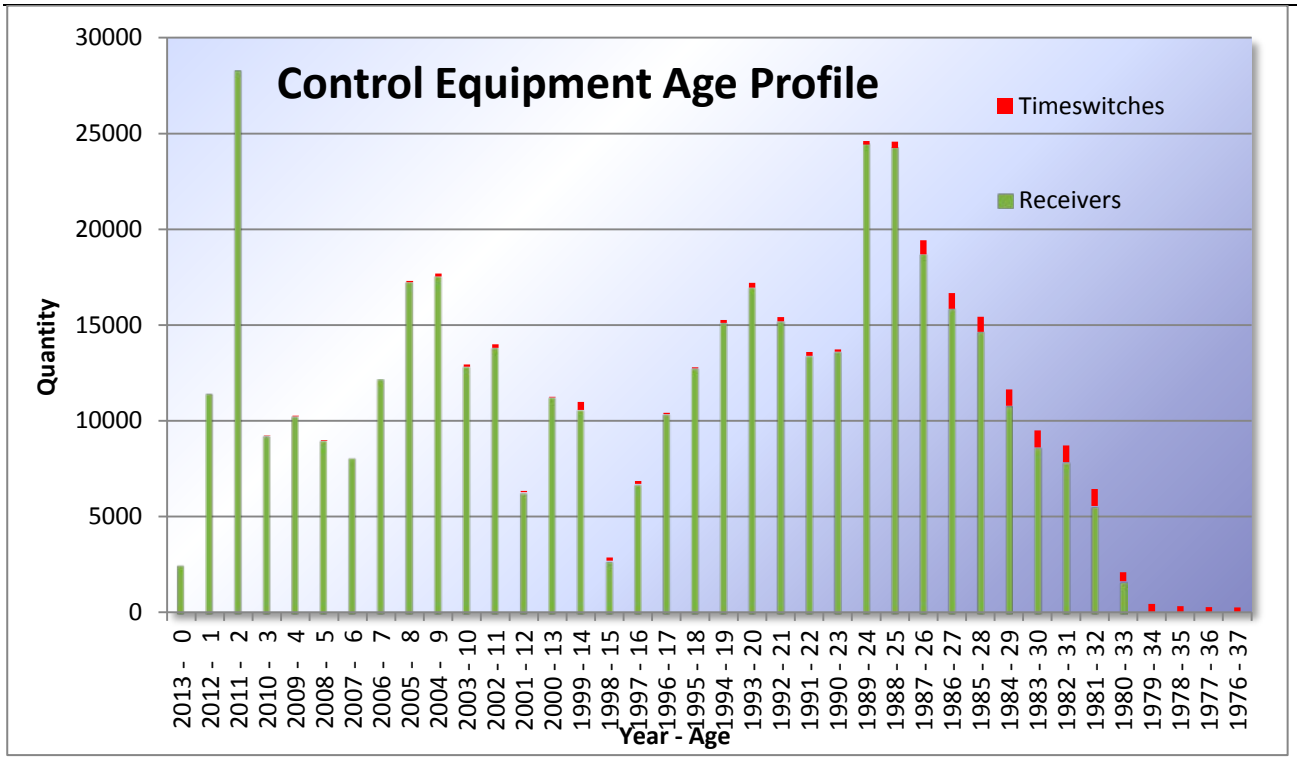

Figure 4 Control Equipment Age Profile

For each of the main equipment categories (electro-mechanical, electronic meters and control equipment) the following graphs[1] (Figure 5, Figure 6, and Figure 7) depict the growth in quantities reaching end-of-life during the regulatory control period 2015 to 2020, based on the above age profiles. These graphs show the natural growth in quantities over time without the application of aged asset or end-of-life replacement to these equipment categories.

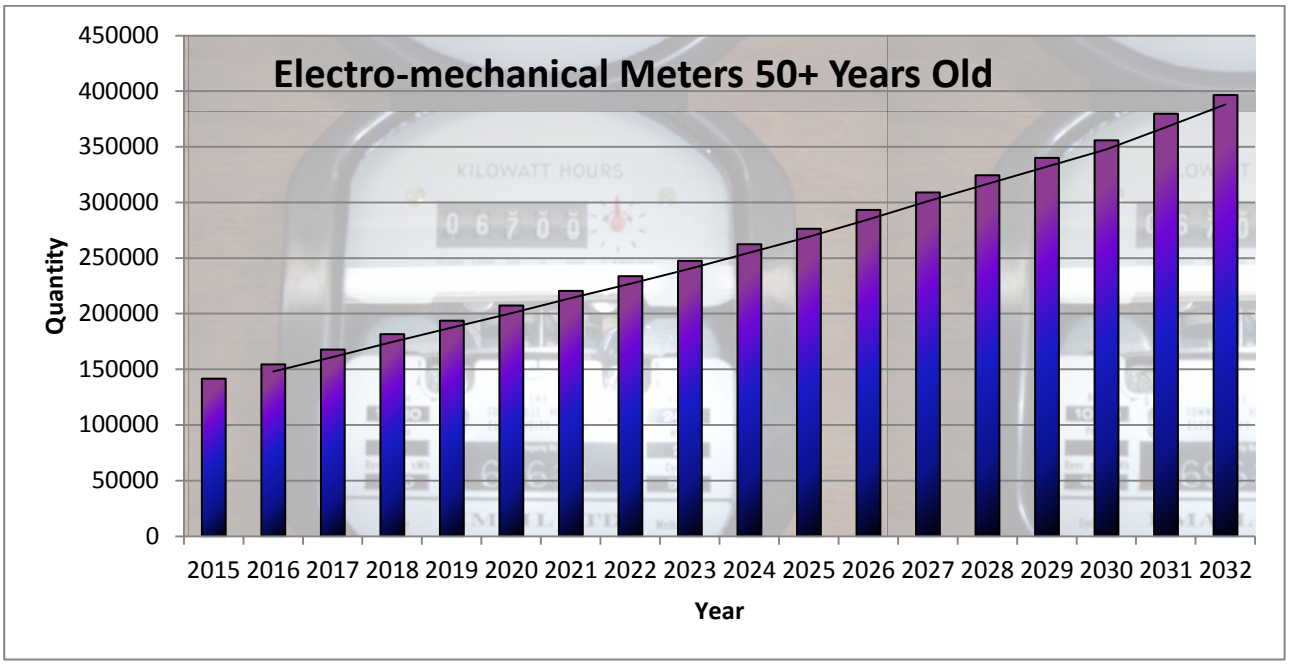

Figure 5 Electro-mechanical Meters older than 50 years after 2015

[1] Refer 2013 RIN data age profiles

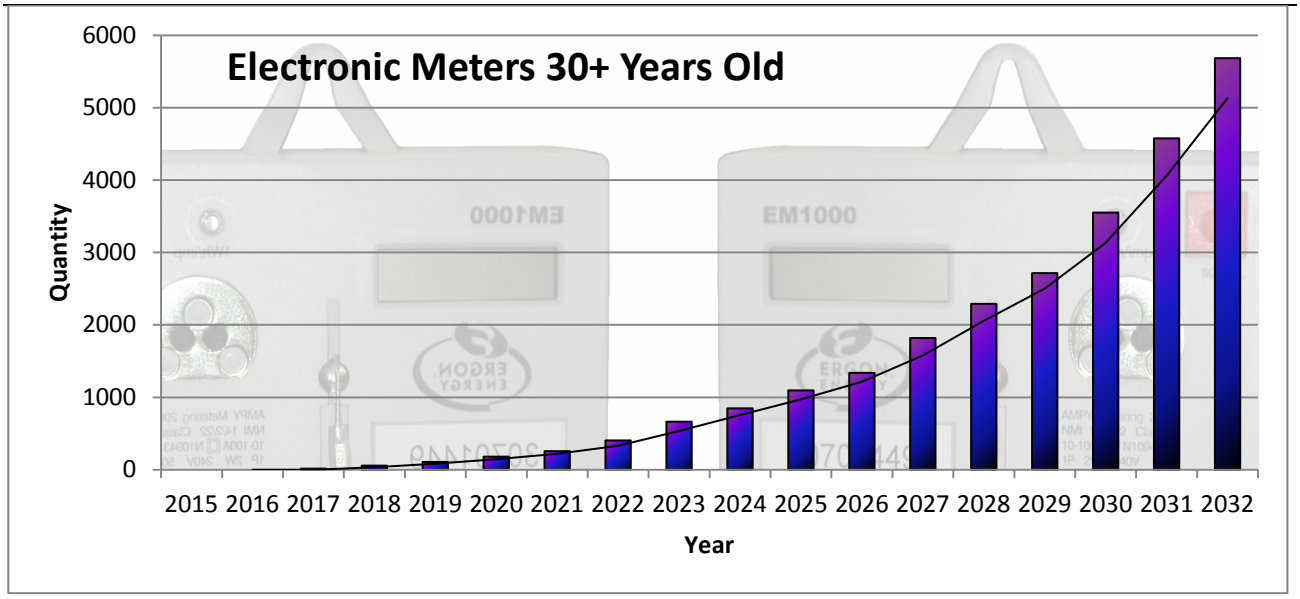

Figure 6 Three phase Electronic older than 30 years after 2015

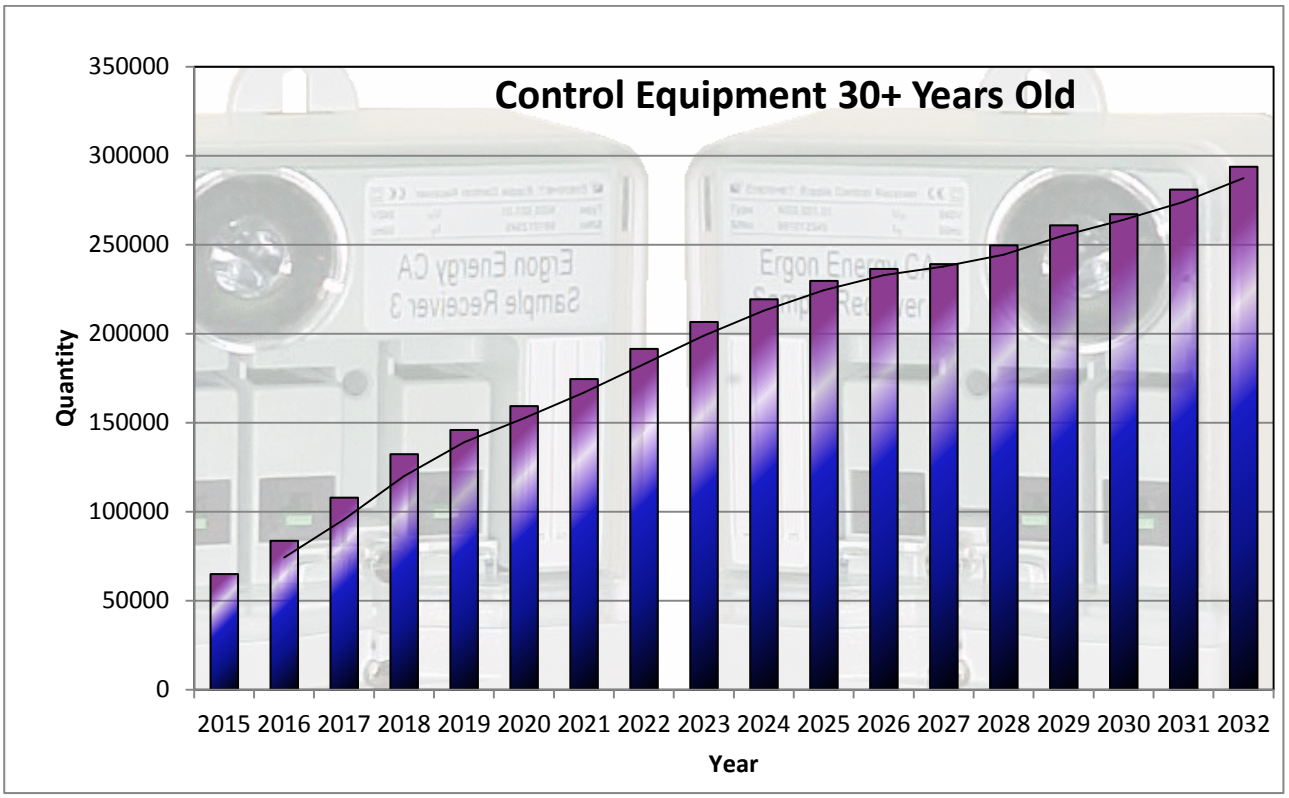

Figure 7 Control Equipment older than 30 years after 2015

10.2 Assumptions

Assumptions used in the analysis are as follows:

- Like for like meter replacement – the unit cost rates are based on replacing like for like e.g. a single phase electro-mechanical meter is replaced with an equivalent single phase electronic meter, ripple receiver or time switch with current ripple receiver, three phase electro-mechanical meter with three phase electronic meter etc.
- Ergon will at ongoing intervals review metering installation configurations based on commercially viable outcomes and the changing regulatory environment.

11 Engineering solutions

11.1 Solution A- Meter Replacement Framework

Figure 8 shows a framework for asset meter replacement programs for the regulatory control period 2015 to 2020 developed taking into account the following standards: '*Standard for In-Service Compliance Testing', 'Standard for End-of-life Meter Assets'* and *'Standard for Obsolete Metering Equipment.* This is the preferred meter asset replacement option.

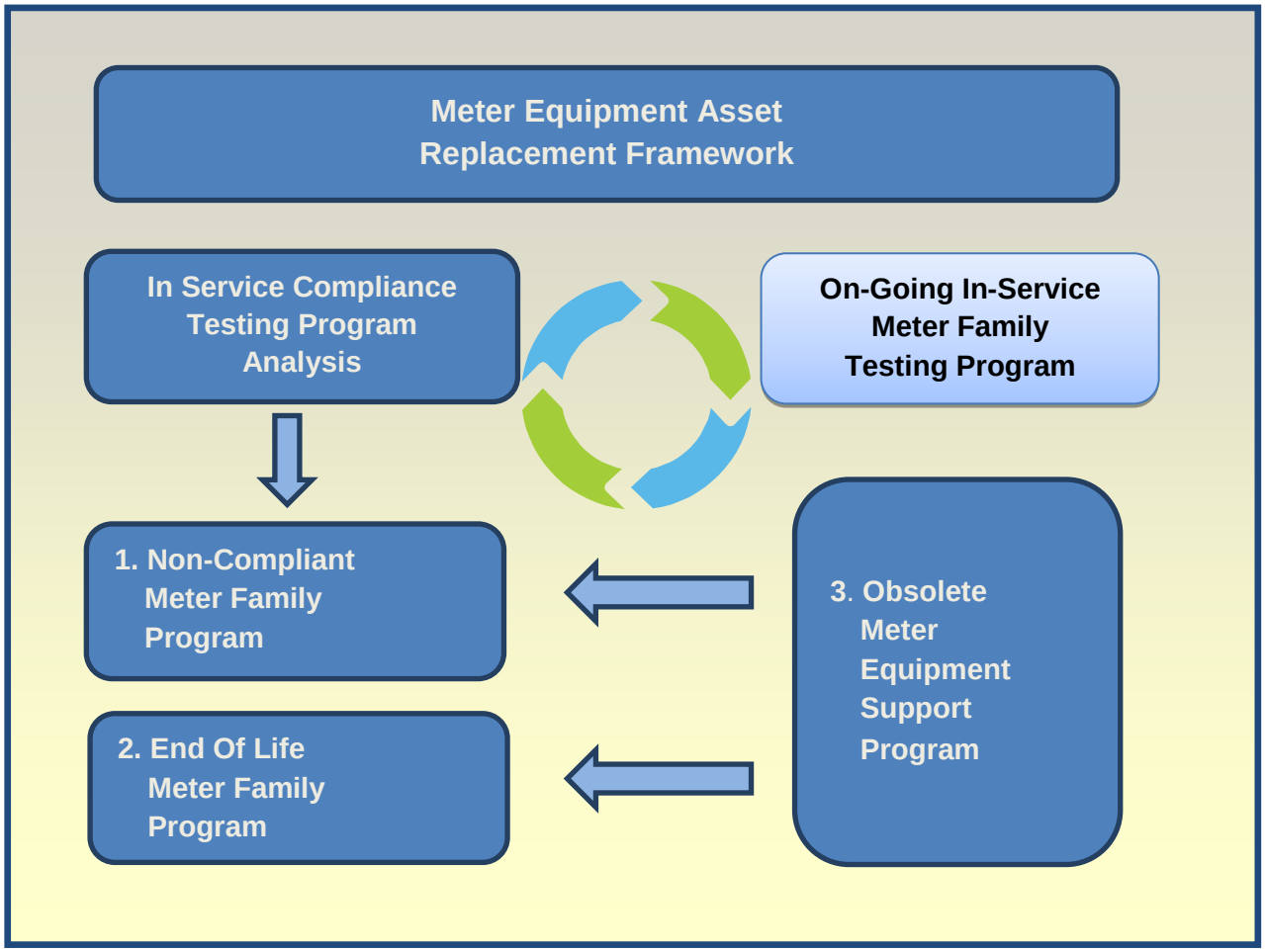

Figure 8 Meter Replacement Framework

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11.1.1 Non-compliant meter replacement program

The *Standard for In-Service Compliance Testing* outlines the guidelines used for the application of Australian Standard *AS 1284.13*.

For large families of direct connected meters, individual testing of meter equipment is not practical and in-service compliance testing is conducted in accordance with Australian Standard *AS1284.13*.

This involves scheduling in-service random sample testing of a quantity of meters based on the size of each meter family population. The analysis of the test results collected from the in-service compliance testing is used to determine if the meter family is performing to an acceptable level and is able to remain in service for an extended period of time before additional testing is required or the meter family is non-compliant and needs to be replaced. If a large meter family is deemed non-compliant consideration may be given to stratifying the meter population to limit the asset replacement cost.

The graphs in Annex A show the accuracy test results of two meter families that have been deemed non-compliant. It can be seen that the average error for all meters is within +/- 2% for general purpose meters however there is greater than the allowable quantity of meters outside limits at each end of the graph.

Projects have already been undertaken to replace 4,500 metal case EMMCO model MC3 and AZ meters and 14,000 Australian Sangamo model HMT non-compliant meters. Small quantities of these meter makes and models still exist where they have not been identified, and a small quantity of each model has been included to fund replacement of these when encountered.

From the latest in-situ meter test program the EMMCO BAZ meters installed on the network have been identified as an asset family that is non-compliant. Coincidently this meter family is also included in the total quantity count for end-of-life meters.

Project approval and work has commenced to replace the BAZ meters currently installed at approximately 14,000 sites in the South West (SW) region in the current regulatory control period. A number of these meters have already been replaced as tariff upgrades due to solar inverter system installations and it is estimated that 12,377 remain in service and replacement under the SW region BAZ replacement project will commence prior to the regulatory control period 2015 to 2020.

All remaining BAZ meters will be given priority for replacement as non-compliant meters in the first part of the regulatory control period 2015 to 2020. It is expected that the in-situ testing program being undertaken in 2013–14 will confirm the remaining BAZ meters in other regions as being non-compliant.

Two electronic meter families listed under the non-compliant program in Table 2 are exhibiting high failure rates and causing meter reading and meter validation issues. The columns show the estimated number of meters in service and the number allowed for replacement in the regulatory control period 2015 to 2020.

The Enermet K410/TK410 meters are causing billing issues, and exhibiting a failure mode where the meter over-registers 700 - 1200% energy consumption. These meters are electronic with mechanical stepper motor registers and were supplied between 2001 to 2004. A number of these meters have been sent to the supplier for investigation.

The second electronic meter exhibiting failure is the Nilsen Model EMS 2100 meters, which have failing LCD displays that go blank and cannot be read manually. This meter has a smaller mounting footprint to current like meters and this is causing some replacement issues particularly in multi-tenancy installations.

Table 2 Non-Compliant Meter Assets Targeted in the regulatory control period 2015 to 2020

Targeted Meter Type	Est In Service	No of Meters for 2015-2020
Make: EMMCO Model: BAZ meters (These are also end-of life)	73,596	73,596
Replacement Project in Progress (Included in Est in Service quantity)	0	-12,377
K410 / TK410 Meters	2,129	2,000
Nilsen EMS 2100	1,408	1,300
TOTAL Non-Compliant Meters	**77,133**	**64,519**

11.1.2 End-of-life Asset Replacement

End-of-life - Meters

The *Standard for End-of-life Meter Equipment* is based on the principals of the AER Repex Replacement Model handbook. Metering equipment will be classified as end-of-life metering where they are twice their recommended economic life and display characteristics of failure. Table 3 shows the quantity of meter assets twice the economic life during the next regulatory control period. The quantities in this table are derived from the 2013 RIN data age profiles.

Table 3 Meter Assets - Twice Economic Life during the next regulatory control period[2]

Meter Type	Year					
	2015	**2016**	**2017**	**2018**	**2019**	**2020**
Electro-mechanical Meters > 50 years old	141502	154356	167678	181521	193616	207272
Electronic Meters >30 years old	0	0	16	57	108	181
Control Equipment > 30 years old	49064	64922	83612	107846	132269	145876

[2] Based on 2013 RIN data

For electro-mechanical metering equipment the economic life is considered to be 25-years and for electronic metering equipment 15-years. A significant meter design change occurred in 1963 when meters changed from jewel bearing to magnetic bearing suspension. These meters are showing a greater tendency to failure (as already indicated by the non-compliant EMMCO BAZ meters). A total of 119,377 meters are older than 1963 and these, less the number of EMMCO BAZ meters identified as non-compliant, will be targeted for replacement as end-of-life during the regulatory control period 2015 to 2020. The non-BAZ meters older than 1963 are Warburton Franki Model WF2 meters. Tests to date show these meters are showing a tendency to failure and most likely to be the next non-compliant meter family. An allowance for meter replacements prior to the commencement of 2015 has been included.

Table 4 End-of-life Meter Asset replacement in the regulatory control period 2015 to 2020

Targeted END-OF-LIFE Meters	Est in Service	No equipment for 2015-2020
Total Quantity end-of-life Meters (>1963)	119377	119377
Make: EMMCO Model: BAZ included in Non-compliant Category	73596	-73596
Allowance for meter replacement prior to 2015	3000	-3000
Make: Warburton Franki Model: WF2		42781
Make: Ferranti Model TM2c	1038	1000
Make: EMMCO Model:MC1	-	50
Make: EMMCO Model :AZ	-	50
Make: Australian Sangamo Model: HMT	-	50
Total Quantity end-of-life Meters for 2015 - 2020		43931

End-of-life - Control Equipment

The information for end-of-life control equipment is included for completeness, however is not included as part of the business case funding in the 2015 to 2020 regulatory control period as testing to establish the equipment's tendency to failure has not been conducted.

The earliest Email model E1 and E2 ripple receivers in the Wide Bay region have been failing in large quantities, due to component failure that renders them in-operative and unable to switch loads in accordance with tariff provisions. A Recommended Work Request (RWR) has been issued to replace an estimated 12,311 E1/E2 identifiable receivers remaining in-service, out of an original purchase quantity of 39,000 between 1981 and 1987. This program of work will commence during 2014-15.

An estimated 86,782 Zellweger model RE1 ripple receivers were purchased and installed from 1980 to 1986 in three regions. The total estimated Zellweger model RE1 receivers remaining in service is 48,406. These ripple receiver's will be greater than 30 years old before 2020 and may need to be replaced in the regulatory control period 2020 to 2025. Sample testing of a quantity of in-service Model RE1 ripple receivers will be conducted to determine their tendency to failure. It is proposed to remove a sample and perform 'as found' laboratory testing to establish and determine the failure rate for this model. Ripple receivers are difficult to test in the field, and their failure may not result in an impact on customers supply. The failure of ripple receivers can affect Ergon Energy's demand response ability to reduce loads at peak load times. Demand response is a key strategy to improve utilisation and control peak loads and network investment. Should the failure rate indicate the need to replace these ripple receivers in the regulatory control period 2015 to 2020, this will be determined on a cost benefit analysis and the need for load reductions in the affected area. Table 5 shows the current quantity of ripple receivers being replaced and the estimated ripple receivers that may be replaced, should testing determine an unacceptable failure rate.

Table 5 End-of-life Control Equipment Asset replacement in the regulatory control period 2015 to 2020

Targeted end-of-life Control Equipment	Est in Service	No Equipment for 2015 to 2020
Email E1 & E2 ripple receivers (In Progress)	12,311	
Make: Zellweger Make RE1		48,406

11.1.3 Obsolete Meter Replacement Program

The *Standard for Obsolete Metering Equipment* will be utilised to support replacement of non-compliant and end-of-life meter equipment. All metering equipment that meets any one of the following criteria will be classified as 'obsolete' metering equipment.

- The metering equipment is not covered under the end-of-life asset category (i.e. is less than twice its depreciated life span, which is 50 years for electro-mechanical meters and less than 30 years for electronic equipment)
- Metering assets that are no longer supported by the appropriate meter vendor are required to be removed to facilitate any targeted asset replacement programs. This could include items that are redundant due to changes in tariff applications, installation standards, equipment choices, technology or corrective maintenance has identified the item as having a high failure rate or only a small quantity remains in service and this provides an opportunity to remove a meter family for asset management excellence process.
- Metering assets that need to be replaced to create sufficient space to accommodate targeted asset replacement programmes. Additional examples of items that may be classified as 'obsolete' metering equipment is contained in the *Standard for Obsolete Metering Equipment*.

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The allowance for obsolete meter equipment is based on a percentage of the number of targeted meter replacements. The percentage allowance for meters is 15% and if required, for control equipment is 5%. This is based on considerations of expected difficult sites that will be encountered during targeted replacements. Table 6 provides the estimated number of obsolete meter replacements allowed for in the regulatory control period 2015 to 2020 based on the number of targeted non-compliant and end-of-life meters in Table 2 and Table 4.

In the past, an allowance for obsolete meters was provided as a contingency amount in the project scope, however using a per unit costing approach for non-compliant and end-of-life meter equipment, an allowance for obsolete meter equipment is considered the best way to make provision for unexpected additional costs incurred while replacing targeted meter equipment. The unit costs for obsolete meter equipment are reduced by excluding the mobilisation component of the unit cost as this work is performed while already on site. The estimated quantity in Table 6 is based on the stated % x non-compliant or end-of-life quantities.

Table 6 Obsolete Meter Asset Replacement in the regulatory control period 2015 to 2020

Targeted Obsolete Meters	Total Targeted Non-compliant + end-of-life Meters	Obsolete Meter provision for 2015 - 2020
Obsolete Meters (based on 15% Non-compliant + end-of-life)	108,450	16,268

11.2 Do Nothing - Solution B

Ergon Energy's business as usual (BAU) meter replacement program includes normal operating corrective maintenance for:

- Meter items reported as defective. The estimated level of corrective maintenance is approximately 0.74% based on maintenance service orders. Many of these activities are initiated by meter readers reporting trouble codes.
- Individual preventative time based maintenance program for current transformer (CT) meter installations which results in corrective maintenance where items are found to be defective or not fit for purpose.
- Customer requested meter tests and tariff changes. Tariff changes due to solar Inverter systems has had a major impact of meter changes over the past four years.

Meter capital replacement programs where a meter family is deemed to be 'non-compliant' following a program of In-service meter testing as described in Option A.

The above BAU meter replacement activities are the minimalist option as detailed in the MAMP endorsed by AEMO.

The tables below are the estimated quantities for non-compliant meters and obsolete meters and control equipment for Option B.

Table 7 Non-Compliant Meter Asset Replacement in the regulatory control period 2015 to 2020

Targeted Meter Type	Est In Service	No of Meters 2015 - 2020
Make: EMMCO Model: BAZ meters (These are also end-of-life)	73,596	73,596
Replacement Project in Progress (Included in Est in Service	0	-12,377

Quantity)		
K410 / TK410 Meters	2,129	2,000
Nilsen EMS 2100/2650	1,408	1,300
TOTAL Non-Compliant Meters	77,133	64,519

Table 8 Obsolete Meter Asset Replacement in the regulatory control period 2015 to 2020

Targeted Obsolete Meters	Total Targeted Non-compliant Meters	Obsolete Meter provision for 2015 - 2020
Obsolete Meters (based on 15% Non-compliant in Table 7)	64,519	9,678

12 Options

12.1 Option A - Meter Assets Replacement Program of Works

The meter replacement framework option was outlined in section 11.1

The following benefits and risks are considered to be associated with Option A.

Table 7 Option A benefits and risks

Benefit	Risks
Provides a meter equipment replacement framework based on internal standards for Non-compliant, end-of-life and obsolete meter equipment	Availability to resource to perform the works program.
Starts to address end-of-life meters (and other equipment categories) which will grow substantially in quantity in the coming years.	Implementing new meter asset equipment register and customer information support systems during the regulatory control period 2015 to 2020 may impact ability to raise service orders
Provides funds to address obsolete meter issues while carrying out targeted works without additional mobilisation and customer supply interruption.	
Replaces meters at old installations in rural areas that are unlikely to be targeted through other activities.	
Reduce operational costs for aging meter equipment.	

The meter replacement framework is aimed at providing a works program that allows funding to replace meter equipment assets that are deemed to be non-compliant, end-of-life or obsolete.

The replacement of non-compliant meters as detailed in Section 11.1.1 is non-discretionary and required to meet regulatory obligations under the MAMP. Non-compliant meter families are allocated the highest priority for replacement and must be replaced as soon as practical.

The replacement framework aims to include and commence addressing the growing population of meters that are at end-of-life (as shown in Figure 5). Replacement of end-of-life meters can be programmed to occur in the absence of any meter families being deemed non-compliant, or delayed if unexpected non-compliant meter families are identified through in-service compliance testing during the regulatory control period and given priority.

The obsolete meter asset provision supports both the non-compliant and/or end-of-life meter replacement programs, by providing funding to rearrange difficult meter installations, remove obsolete or redundant meter equipment, and address future maintenance issues that would be more expensive to replace under a corrective maintenance truck roll. The obsolete meter asset provision is based on a percentage of the targeted non-compliant and end-of-life meter asset replacements, based on past meter replacement programs, and meter surveys. This provision is considered to improve the efficiency of targeted replacement meter programs, by addressing additional maintenance issues during a single site visit, and planned customer power outage.

In summary, Option A - Meter Asset Replacement Program of Works aims to fund a meter asset replacement capital works program that provides:

- Priority 1 to replace meter assets deemed to be ‘non-compliant’
- Priority 2 to replace meter assets deemed to be end-of-life.
- With provision for replacement of ‘obsolete’ meters and equipment while on site performing targeted meter replacement associated with Priority 1 and 2 work).

It is proposed that the total number of meter asset replacements targeted for the regulatory control period 2015 to 2020, under the Priority 1 and 2 categories will remain fixed, however the number of replacements performed under each category may vary due to the need to prioritise non-compliant meter assets. This could mean that replacement of targeted end-of-life meters may be delayed.

The basis of each program is outlined in each of the reference standards. The following sections provide a brief description of each Standard and the quantities proposed for the regulatory control period 2015 to 2020.

The estimated cost of Option A for the regulatory control period 2015 to 2020 is $36,261,913 exclusive of Business overheads.

12.2 Option B – Business as Usual Asset Replacement

The BAU option was outlined in section 11.2

This option includes meters replaced as corrective maintenance, customer requested tariff changes and meter tests (if the meter tests outside the limits), or tariff changes to meet tariff reforms, and removal of obsolete tariffs. This work is covered under 'Service to Customers' Opex budget allocations. Option B is expected to place pressure of operational costs as end-of-life meter quantities increase.

The key difference between Option A and Option B, is a targeted program of work to remove end-of-life meters and the associated provision for obsolete meter equipment associated with the estimated quantities. The need to replace a meter family deemed as 'non-compliant' is a non-discretionary expenditure to ensure meters are fit for purpose and maintained in good working condition to meet metrology requirements.

If Option B is adopted this will remove the opportunity to commence addressing the end-of-life meter assets as outlined in the AER Repex guidelines which will continue to grow in subsequence years. This option will also require additional regulatory funding approval should an additional non-compliant meter family be identified during the regulatory control period 2015 to 2020.

The cost for Option B has been estimated on the basis of replacing the non-compliant meter family during the regulatory control period 2015 to 2020 and the same targeted end-of-life meter population as BAU from 2015-16 to 2031-32 at $33,444,464 exclusive of Business overheads.

12.3 Financial Workings of Options

The financial workings and costings of the two options are included in *the AER Cost Benefit Analysis Meter Replacement Business Case* excel file. This document shows the workings for:

- Calculation of targeted meter population volumes
- Basic unit cost calculation
- Mobilisation uplift calculation
- Project management and support costs calculation
- Option A and B modelling and financial workings
- Other inputs required e.g. Contractor Uplift

12.3.1 Basic unit cost calculation

The basic unit cost consists of 'Labour' and 'Material' costs for a like for like meter replacement. The labour component consists of one (1) hour of 'Technical Service Person' labour for the meter replacement task. Materials are inclusive of a like for like meter replacement and miscellaneous material required (wiring, screws, metering isolation link). These costs have been calculated using a bottom-up build methodology.

12.3.2 Mobilisation uplift

Mobilisation costs relate to the cost for travel, transport and accommodation associated with the replacement program. The geographic location of the targeted meters and the workforce mobilisation to these locations are key cost drivers in the total completion costs of the estimated tasks. The program involves more travel time for personnel in between performing short repetitive tasks at multiple locations dispersed across vast areas of the network.

Derivation and factoring of mobilisation costs to the Meter Replacement program estimates is by:

- Obtaining historical data of proven estimate models that had similar travel requirements to each program being forecast
- Analysing the labour, transport, travel or accommodation cost elements as a proportion of total direct cost (exclusive of mobilisation)
- Calculating a percentage mobilisation uplift factor suitable for the program
- Applying the percentage mobilisation uplift to the applicable program estimates (bottom up estimate).

Option A mobilisation uplift applies to the in-situ and end-of-life Meter Replacement Programs at a rate of 40.42%. The Obsolete Meter Replacement Program is excluded from Mobilisation charges as personnal will already be onsite.

Option B Mobilisation uplift applies to the in-situ and end-of-life Meter Replacement Programs at a rate of 57.08%. The difference from Option A is the expected increase in costs for adhoc meter replacements where the effeciencies of a planned program replacement are not captured. The Obsolete Meter Replacement Program is excluded from Mobilisation charges as personnal will already be onsite.

Workings for the Mobilisation Factor are included in the *AER Cost Benefit Analysis Meter Replacement Business Case* spreadsheet,

12.3.3 Project Management and Support Costs

Project Management and Support costs relate to the cost of administering, managing the design, implementation, testing and reporting of the replacement programs.

Derivation and factoring of the project management and support costs to the program estimates is by:

- Obtaining historical data of proven estimate models that had similar replacement programs. i.e. Ergon Energy Capital Project Cost Estimating Tool for the SW BAZ Meter Replacement project
- Analysing the labour and mobilisation costs breakdown of the supporting functions required i.e. Design, project administration, testing and reporting.
- Escalating the costs from the project period to the current forecast years values
- Applying the additional costs of project management and Support to the unit estimate.

Project management and support costs apply to all meter replacement programs at a cost of $47.72 per meter replacement (prior to Contractor Uplift on the labour component).

Workings for the project management and support costs are included in the *AER Cost Benefit Analysis Meter Replacement Business Case* spreadsheet,

12.3.4 Contractor uplift

A contractor uplift has been applied to all labour costs to account for the overall contractor expenditure expected by Ergon Energy. This is calculated at a rate of 1.104%, and applies to labour cost components only.

13 Conclusions

This engineering report outlines a meter replacement framework, which builds on the current BAU meter asset replacement program (Option B) to include provision to replace end-of-life meter assets as part of the preferred replacement program of works for the regulatory control period 2015 to 2020. In-service compliance testing is used to determine the asset condition for new and existing meter families to determine if they are classified as non-compliant and need to be replaced or can remain in service for an extended period of time before further testing is performed. Large non-compliant meter families may be stratified into sub-populations to limit the size of a replacement program using additional meter attributes where test results show a bias towards an attribute (i.e. this could be a batch of meters, a group of meters in one year, a characteristic due to a meter design change etc.) The replacement program listed under Option B is considered non-discretionary and required to meet statutory and legal obligations.

A review of the age profile of meter assets indicates that single phase electro-mechanical meters and ripple receivers have significant quantities approaching and exceeding end-of-life, where this is based on twice the economic life of the asset. For meter assets the economic life is taken as the depreciation life of the assets which is 25 years for mechanical meters and 15 years for electronic meter equipment. Based on the 2013 RIN age profiles the quantities of assets exceeding twice the depreciation life in the regulatory control period 2015 to 2020 is given in Table 3.

Ergon Energy is not proposing to target all end-of-life meter assets during the regulatory control period 2015 to 2020, but to target electro-mechanical meters that are currently older than 1963. This coincides with a significant design change to the suspension bearing system used in these meters that is more prone to aging. The non-compliant meter family also fits within this age period.

For ripple receivers further sample testing is proposed to establish if the ripple receivers in the end-of-life category are displaying a tendency to failure. This failure rate will be used to assess the impact on network demand response. The earliest Zellweger model RE1 receivers are discrete component models and are likely to have aging components like the Email E1/E2 ripple receivers currently being replaced. During the regulatory control period 2015 to 2020 replacement of the aging RE1 ripple receivers will be assessed on a cost benefit analysis for load reduction impacts.

The meter equipment replacement framework provides some flexibility to reallocate some targeted replacement work to non-compliant meter families if these are detected, and delay replacement of aged meter assets to target meter assets with a higher priority should the need arise.

14 Implementation impact analysis

14.1 Financial impact

The meter replacement program comprises three main components which are based on condition-based information; obtained by in-service meter family testing, end-of-life meters (considered well beyond economic service life) and obsolete/redundant meters that aid the economic and efficient replacement of targeted meters. The cost estimates are based on average per unit costs, with identified non-compliant meters given priority for replacement over end-of-life meters. The program is proposed to operate and be equally spread over the five-year regulatory control period.

14.2 Legal impacts

Under the National Electricity Law, Ergon Energy has legal and compliance obligations to replace any meters declared as non-compliant in the earliest practical timeframe, and this is non-discretionary. Ergon Energy uses best endeavours to comply and maintain its meter asset fleet in accordance with the MAMP endorsed by AEMO. Failure to meet legal and compliance obligations, could result in fines, and/or deregistration as an accredited Meter Provider.

14.3 Taxation impacts

There are no known taxation implications.

14.4 Safety and environmental impacts

There are a range of safety and environmental issues that can be encountered while undertaking meter asset replacement work. These issues can include working on asbestos meter panels, working with live electrical equipment, exposure to dogs, wasps, snakes etc. Each activity and issue is addressed using workplace risk assessments, Personal Protective Equipment [PPE] and work practices to prevent personal injury.

If the condition of a customer's metering installation is likely to cause fire or shock, the installation may be disconnected until repairs are made to rectify unsafe wiring or switchgear. Where defects requiring repair are found, a defect notice will be issued to the customer to highlight the need for repairs. Five to ten percent of the work will be audited to ensure work is performed in accordance with work specification and good workmanship.

Staff performing work are required to report any damage to customer's installations and remove all environmental rubbish and leave customers installations as found. Photos of meter switchboards are taken before and after the work on site.

14.5 Human resource impacts

The meter asset replacement work proposed under this report may be resourced using both internal and external resources. A meter contractor panel is in place to undertake various meter work activities and shorten the time required to get work contracts in place. Internal resources will also be required to manage contracts, perform work audits, provide daily supervision, and provide subject matter experts support.

14.6 External approvals required

A MAMP endorsed by AEMO.

AEMO Meter Provider accreditation audits to review compliance.

Ergon Energy Corporation Limited ABN 50 087 646 062
Ergon Energy Queensland Pty Ltd ABN 11 121 177 802

Annex A – Test Results of non-compliant meter families

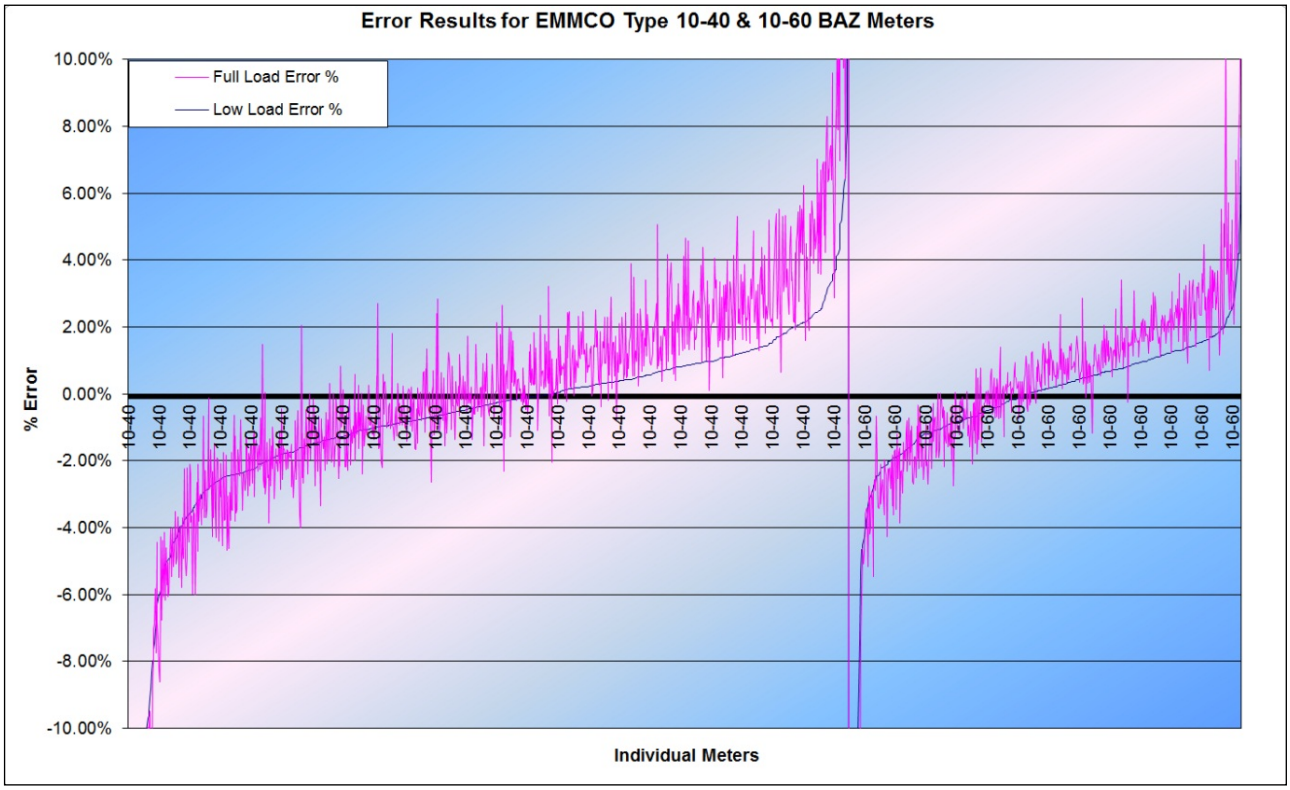

Figure 9 Error results for EMMCO Type 10-40 and 10-60 BAZ Meters

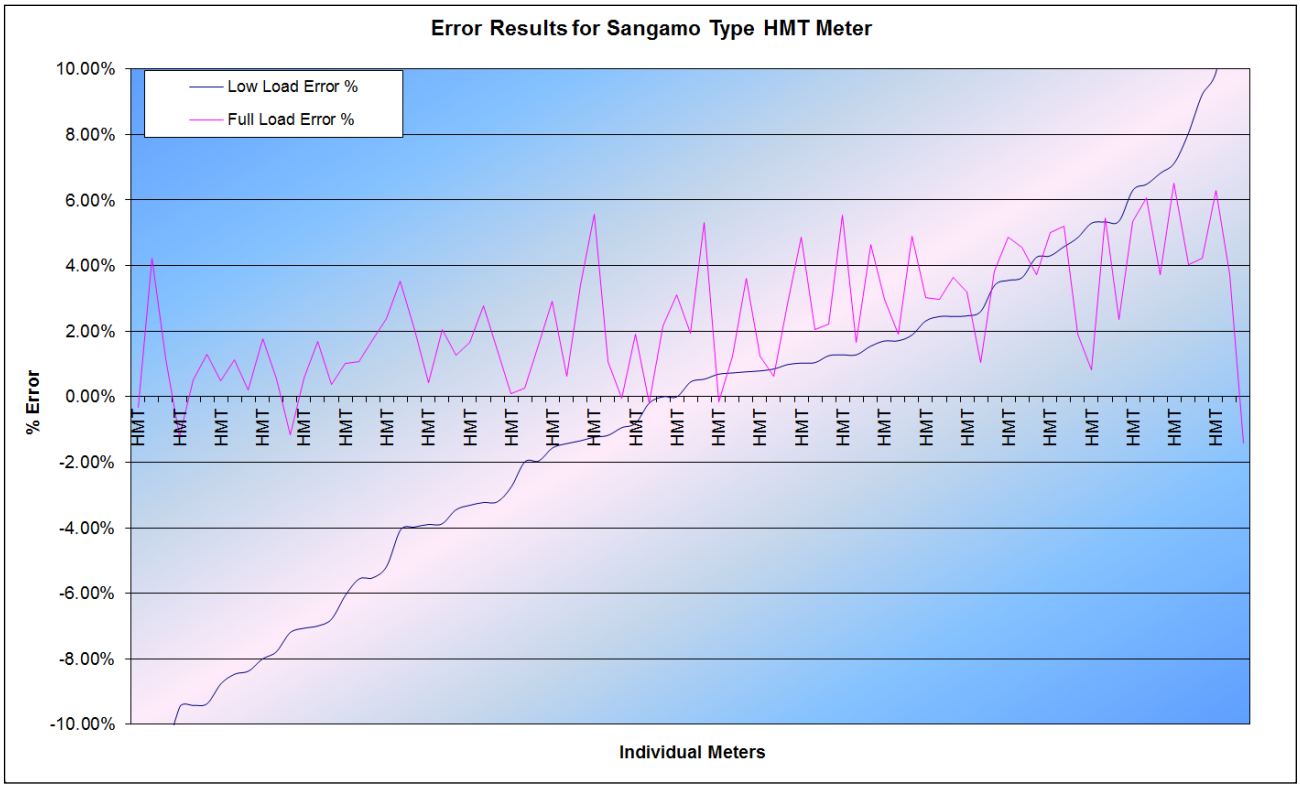

Figure 10 Error results for Sangamo Type HMT Metres

Annex B - Major Milestones in Metering

Table 8 Emmco – Email – Email Westinghouse Metering development timeline

Year	Milestone Event
1921	MC1 – First Australian manufactured Meter
1923	MC2
1925	PW Polyphase
1929	MC3
1930	NS Polyphase
1935	AZ – Every Feature from A to Z
1936	PAZ – Polyphase AZ
1937	BAZ – Bakelite AZ
1942	SD – Single Disc Polyphase
1954	BAZ – Pivot bearings replaced by double jewel
1955	BAZ – Chrome steel magnets replaced by Alnico in separate frame
1963	M1 – magnetic suspension, Alnico magnets in meter frame, aluminium frame
1963	Pointer Register – one piece dial plate introduced
1967	SDM Polyphase, magnetic suspension, Alnico magnets
1972	M2 – Extended current range 10-80
1977	M1S & M2S – Plug-in meters
1983	M3 & M3S – One magnet position (new frame)
1986	Pointer Register – one piece black plate (4 ratios)
1987	Geneva – All metal cyclometer register
1989	E1 – Solid State kWh Meter (prototype production)
1990	E1 – Solid State Polyphase (product launch)
1991	E1R – Solid State Real/Reactive (prototype production)
1992	Voltage electromagnet redesign
1998	M3B meter in rectangular base introduced
1999	Email designed magnetic bearing system introduced to replace ABB items
2000	