

Metering Systems Renewal and Maintenance Strategy

Summary

This strategy guides the management of TransGrid's existing Metering Systems assets.

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Contents

1.	Purpose	3
2.	Positioning within the Asset Management Framework.....	3
3.	Definitions	4
4.	Asset Management Strategy ‘Line of Sight’.....	4
5.	Review of Previous Renewal, Disposal and Maintenance Strategies	6
5.1	Review of Renewal and Maintenance Initiatives	6
5.2	Review of Maintenance Program	8
5.3	Past Performance – Asset Management Performance Indicators.....	8
6.	Metering Systems Asset Overview	8
6.1	Scope of Assets	8
6.2	Asset Base.....	8
6.2.1	NEM Market Meters	8
6.2.2	TUOS Meters	10
7.	Market Metering Asset Review	12
7.1	Implementation of the Renewal and Maintenance Decision Process	12
7.2	Discrete Component Meters Asset Review	12
7.3	Microprocessor Meters Asset Review	13
7.4	NEM Market Meters Asset Review	14
7.5	TUOS Meters Asset Review	16
7.6	Emerging Issues, and Renewal and Maintenance Initiatives	16
7.7	Maintenance Program	19
8.	Future Outlook	20
8.1	Forecast Expenditure	20
8.2	Anticipated Changes to the Asset Base	20
8.2.1	NEM Market Meters	21
8.2.2	TUOS Meters	22
9.	Spares	23
10.	Asset management capability and continual improvement.....	23
11.	Implementing the Strategies	24
12.	Monitoring and review	24
13.	Roles and Responsibilities to Develop this Asset Strategy.....	25
14.	Change history.....	25
15.	References	25
16.	Attachments	25

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1. Purpose

This document defines the renewal and maintenance strategies for TransGrid's Metering Systems fleet. In doing this it applies the overarching asset management strategy and objectives, and relevant Lifecycle Strategies.

The document identifies the emerging issues with TransGrid's Metering Systems assets, and details the renewal and maintenance initiatives to be implemented in response to these issues. The output of the strategy is the asset management program of works, which is derived via distinct paths as follows:

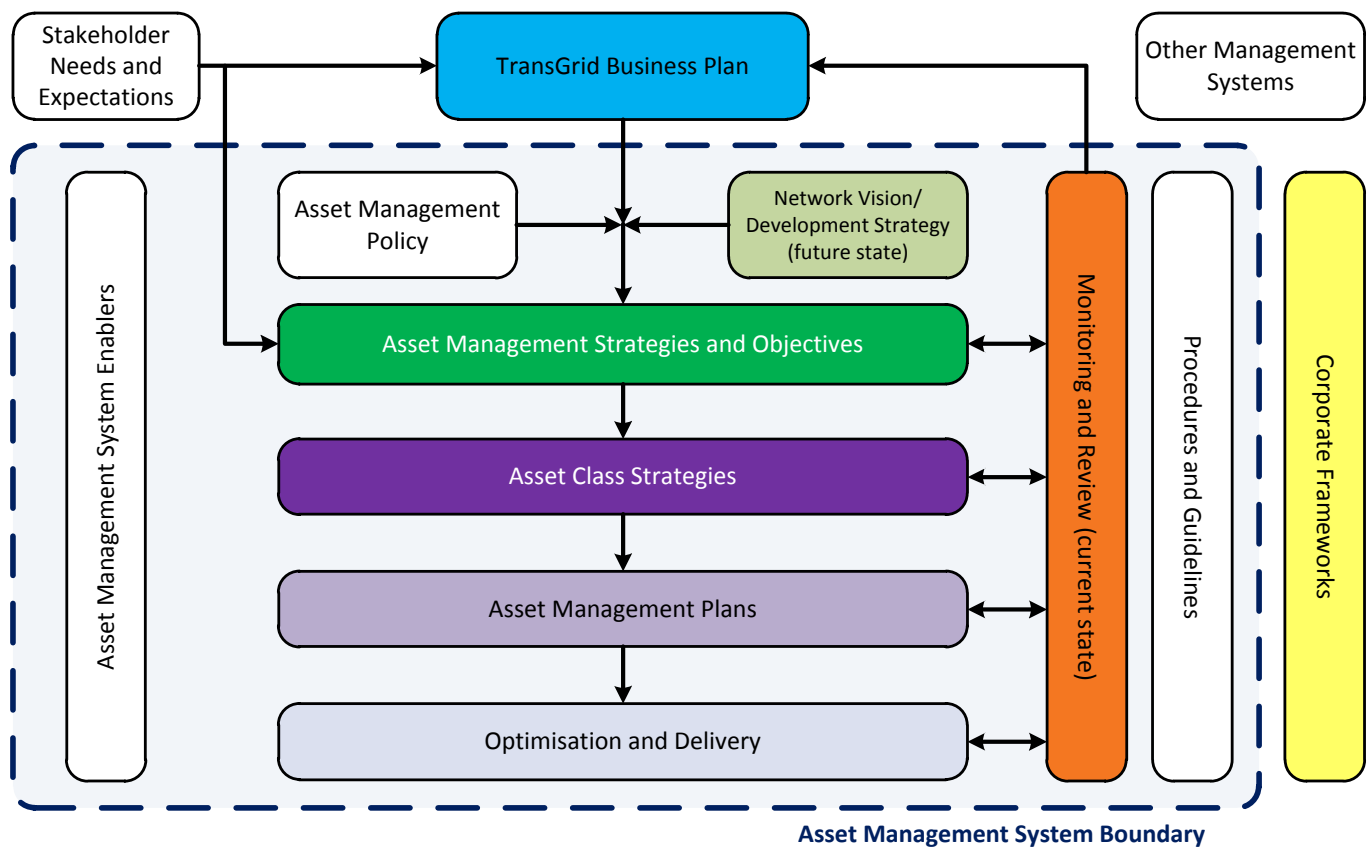
- The renewal and disposal initiatives are considered through the prescribed capital investment process and managed through the Portfolio Management group, which then leads to the resource-optimised capital works program.
- The maintenance initiatives directly drive the maintenance regimes which are detailed within the Metering Systems Maintenance Plan. The maintenance plans are then resource-optimised through TransGrid's Enterprise Resource Planning (ERP) system, *Ellipse*.

The strategies contained in this document cover the period to June 2023.

2. Positioning within the Asset Management Framework

The *Metering Systems Renewal and Maintenance Strategy* document is one of several that comprise the Asset Management Strategies within TransGrid's Asset Management System. This document sits below the Asset Management Strategy and Objectives document as shown in Figure 1.

Figure 1: Asset Management System Document Hierarchy



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3. Definitions

Table 1: Definitions

Term	Definition
Asset Management Objectives	<ul style="list-style-type: none">• Specific and measurable outcomes required of the assets in order to achieve the Corporate Plan and objectives; and/or• Specific and measurable level of performance required of the assets; and/or• Specific and measurable level of the health or condition required of the assets; and/or• Specific and measurable outcomes or achievement required of the asset management system.
Key Hazardous Events	They events of most concern associated with the assets that prevent the achievement of the corporate and asset management objectives.
Emerging Issues	Newly identified issues with an asset that pose a risk to the achievement of the corporate and asset management objectives.
Metering Systems	Systems for the measurement and reporting of energy consumption for the purposes of billing. Covers NEM Metering and TUOS metering
NEM Metering	National Electricity Market Metering as defined in the NER
TUOS Metering	Transmission Use of System Metering for the measurement and billing of non-prescribed connection arrangements
MSP	Metering Services Provider. Defined under NER
NER	National Electricity Rules
RP	Responsible person as defined in the NER

4. Asset Management Strategy ‘Line of Sight’

The renewal and maintenance strategic initiatives set out in this document support the achievement of the strategies set out in the Asset Management Strategy and Objectives document. The strategic alignment of the initiatives in this document to the Asset Management Strategy and Objectives document is shown in the tables below.

Table 2: Secondary System Asset Outcomes

Asset Management Objectives	Asset Management Performance Indicators
<ul style="list-style-type: none">National Electricity Rules Compliant	1. Zero non-compliance incidents

Table 3: Secondary System Asset Contribution to Financial Outcomes

Asset Management Objectives	Asset Management Performance Indicators
<ul style="list-style-type: none">Improve CAPEX Performance	2. Improve Capital project performance
<ul style="list-style-type: none">Improve OPEX Performance	3. Perform within 1% of Asset Management Program of Works relevant to secondary system assets

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5. Review of Previous Renewal, Disposal and Maintenance Strategies

This section discusses the progress of the previous renewal and maintenance initiatives, and their effectiveness at meeting the asset management objectives.

5.1 Review of Renewal and Maintenance Initiatives

The tables below outline the ongoing renewal and maintenance initiatives from the previous iteration of this strategy.

Table 4 - Renewal Initiatives Historical Expenditure (\$m)

Asset Type	Expenditure Type	2013/14 ¹	2014/15	2015/16
Market Meters	Forecast	1.87	0.909	0.0416
	Actual	Unavailable	0.00	0.00

Renewal initiatives have had an effect on the population of Market Meters within the network. Changes to age profiles have been summarised below in respect to the RIN categories as historical age profile data has not traditionally been maintained for individual assets. Average age profiles are summarised in the tables below:

Table 5 Renewal Initiatives Age Profile Effects (Average Age Years)

Asset Type	2013/14	2014/15	2015/16
Market Meters	10.8	10.7	6.8

The historical expenditure in renewal initiatives has resulted in improved maintenance capabilities of assets as new assets are provided with current manufacturer support and the availability of parts for repair and refurbishment. Modern assets have additionally provided the capability for remote monitoring and diagnostics resulting in reductions in maintenance requirements.

Due to the nature of Metering Systems assets, the criticality is generally driven by the energy throughput which they serve and as such no changes in the asset base can effectively change the criticality of the assets. However, as age profile, health, and condition of assets improves, the result is a lower risk profile for the NEM billing which translates to improvements in the reliability and security of the billing of the market.

¹ Actual expenditure for FY 2013/14 is unavailable due to changes in recording and reporting processes. While the information can be extracted, it is labour intensive.

Table 6: Previous Renewal and Maintenance Initiatives

Asset	Asset Management Objective	Strategic Initiative	Current Issues	Progress (completion and expenditure)	Reference Documents
<ul style="list-style-type: none"> Electromechanical, discrete component and microprocessor meters identified for replacement 	<ul style="list-style-type: none"> National Electricity Rules Compliant 	<ul style="list-style-type: none"> Replace obsolete assets with limited self-checking capability to reduce the likelihood of consequence for non-compliance. Replace assets where TransGrid's ability to repair and maintain is either compromised or limited in order to reduce the consequence of failure. 	<ul style="list-style-type: none"> Historically, replacements have occurred based on factors other than risk, leading to an imbalance in the risk profile of remaining assets. 	Current asset replacement initiatives will be completed by June 2018.	PAD-00000610 PAD-00000619 PAD-00000611 PAD-00000630

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5.2 Review of Maintenance Program

The table below highlights the 205/16 financial year's expenditure on maintenance initiatives for Metering systems:

Table 7 2015/16 Maintenance Initiatives (\$k)

Asset Type	Expenditure Type	Preventative	Corrective	Condition
Market Meters	Forecast	187	3.14	0.00
	Actual	160	108	0.582

The historical expenditure in maintenance initiatives has resulted in a lower risk profile for the NEM which translates to improvements in the reliability and security of billing for the market. This has come about mainly due to increasing confidence in the health and condition statistics of the various assets and the identification and replacement of failed assets before any associated consequence is realised.

5.3 Past Performance – Asset Management Performance Indicators

Asset Management Performance Indicator	Past Performance
1. Maintain average age of asset class population to a sustainable level	<ul style="list-style-type: none">Average age at 50% nominal as recorded in most recent RIN

It can be seen that in 2016 the average age of the population has reduced and at approximately 50% of the nominal life of Microprocessor Meters, this is deemed a manageable age.

The installation of modern intelligent assets has introduced the capability for remote interrogation and monitoring of new assets and this has resulted in the immediate knowledge of a failed asset which allows Operators to address the failure immediately, limiting the potential for catastrophic failure and a resultant non-compliance incident.

6. Metering Systems Asset Overview

6.1 Scope of Assets

The following assets are within the scope of this strategy:

- > NEM Market Meters
- > TUOS Meters

The following assets are outside the scope of this strategy:

- > Telecommunications Assets
- > SCADA Metering Assets
- > QOS Metering Assets
- > Statistical Metering Assets

6.2 Asset Base

6.2.1 NEM Market Meters

NEM Market Meters are those assets for which TransGrid is the MSP these can either be metering assets that are owned by TransGrid or by third parties. The MSP has responsibilities as defined in the NER. These meters can be

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broken down into their throughput levels as Type1, Type2 or Type 3 metering installations with varying accuracy and maintenance requirements and can be connected to various primary assets including:

- > Transmission Lines
- > Transformers
- > Reactors
- > Capacitors

The assets are comprised of two technology categories with different estimated standard lives for each as outlined below:

- > Discrete Component Meters - 25 years
- > Microprocessor Meters - 15 years

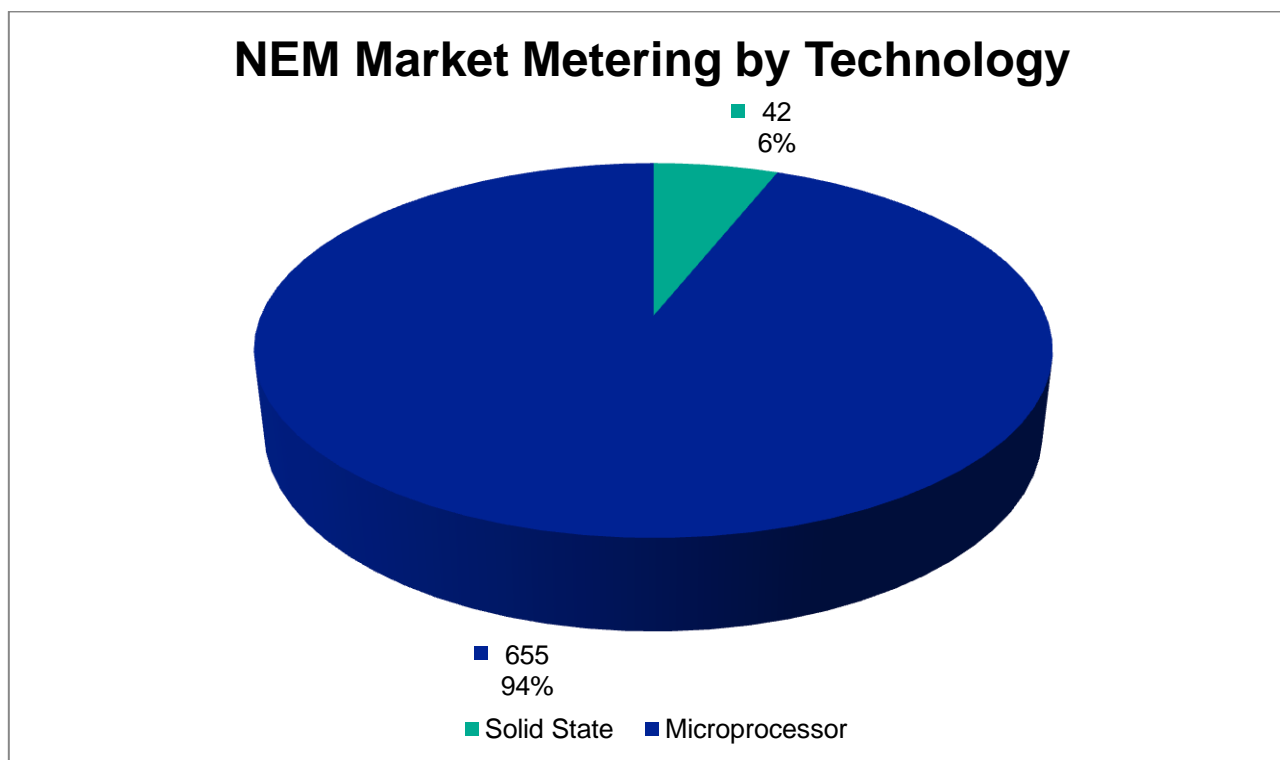


Figure 2 NEM Market Metering Population by Technology

TransGrid maintains approximately 700 NEM Market Metering assets. The majority of assets are within their estimated standard lives with some assets having exceeded this value as summarised below:

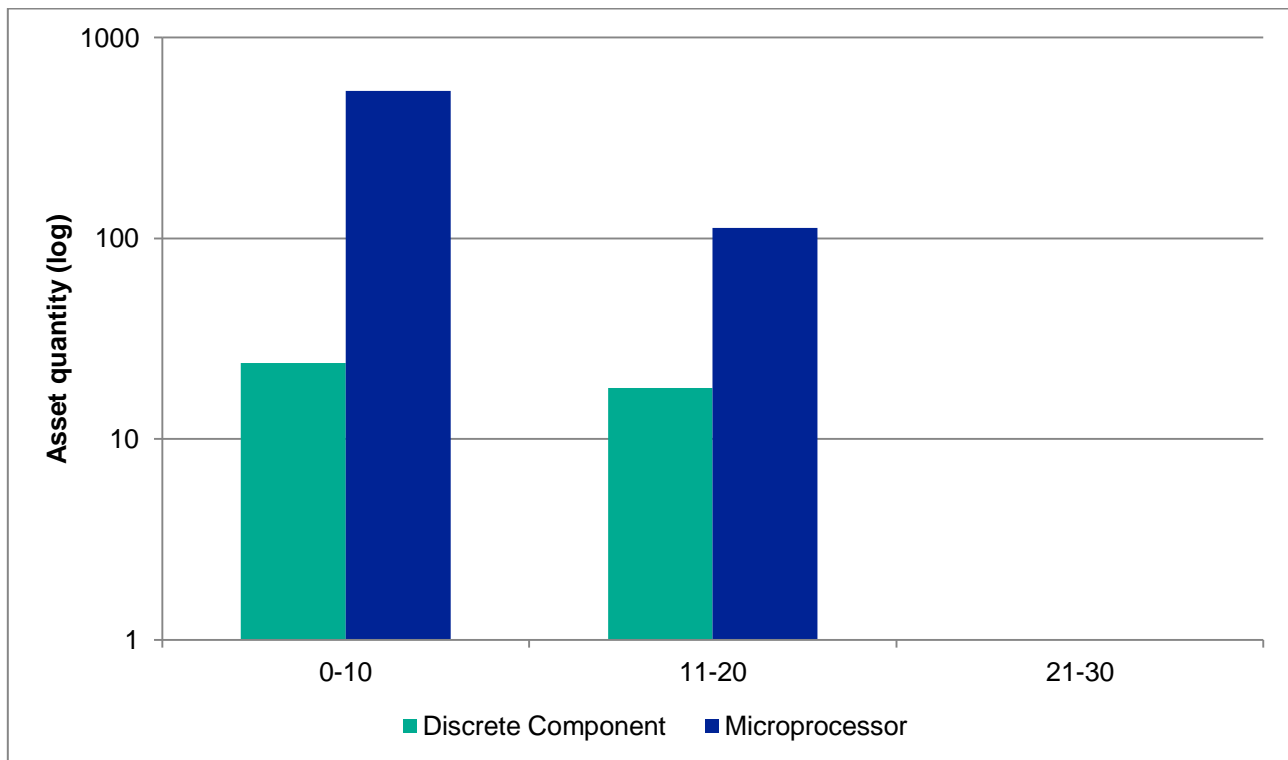


Figure 3 NEM Market Metering Age Profile by Technology

6.2.2 TUOS Meters

TUOS Meters are those assets which are used by TransGrid in agreement with connection points for the settlement of energy transfers outside of the NEM requirements. These meters are broken down into their throughput levels as per NEM Market Metering installations with varying accuracy and maintenance requirements and can be connected to various primary assets including:

- > Transmission Lines
- > Transformers

The assets are comprised of two technology categories with different estimated standard lives for each as outlined below:

- > Discrete Component Meters - 25 years
- > Microprocessor Meters - 15 years

TUOS Metering by Technology

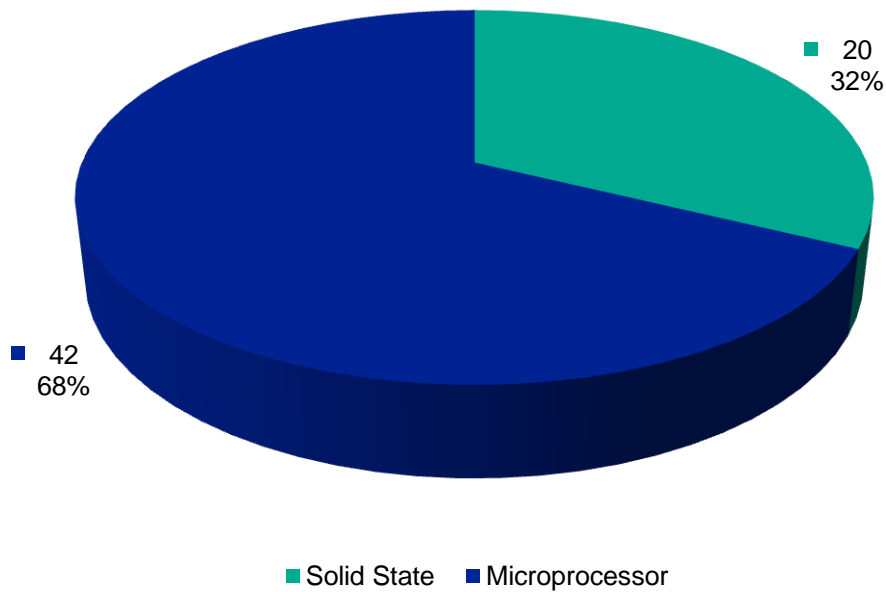


Figure 4 TUOS Metering Population by Technology

TransGrid maintains approximately 60 TUOS Metering assets. The majority of assets are within their estimated standard lives with some assets having exceeded this value as summarised below:

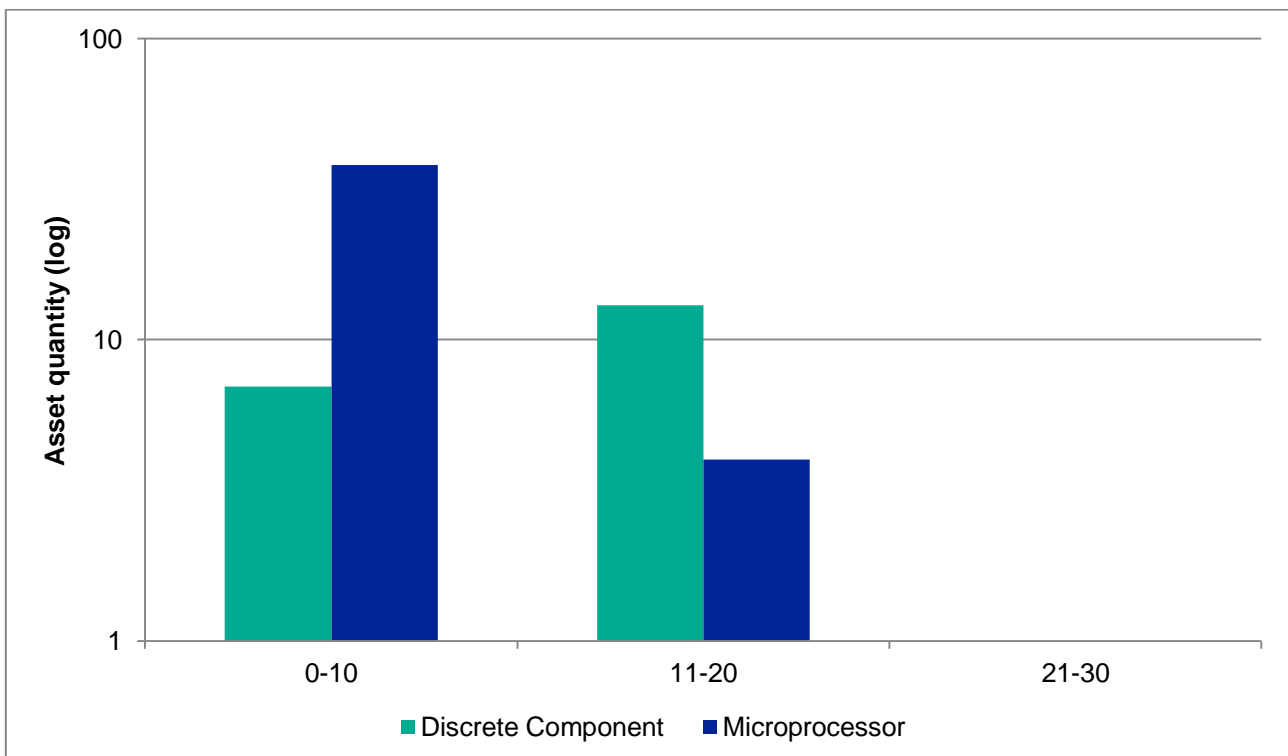


Figure 5 TUOS Metering Age Profile by Technology

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7. Market Metering Asset Review

This section details the emerging issues with the Market Metering assets, and the renewal and maintenance initiatives to be implemented to address the issues. These are derived through the renewal and maintenance decision process outlined in the *Asset Management Strategy and Objectives* document.

All strategic initiatives with respect to TransGrid's Metering assets are outlined in this section, including the renewal and maintenance initiatives that contribute to the asset management program of works. Further details can be found in the relevant Metering Systems Maintenance Plan, and the referenced governance documents.

7.1 Implementation of the Renewal and Maintenance Decision Process

Asset Health and Asset Criticality have been combined using a scoring methodology to provide a ranking for all assets. Criticality is scored on the basis of the consequence of the failure of the asset. Asset Health is calculated as per the Network Asset Health Framework.

Whereas asset criticality is inherently dependent upon the primary assets that are serviced by the secondary systems Metering assets, asset health analysis is based upon spares availability, known issues, self-monitoring capabilities as well as age. Asset health has been categorised as three levels;

- > OK - assets not requiring any actions at this time as there are no known issues, and a failure of a unit can be addressed immediately.
- > Investigate - assets where should an asset fail, it may not be addressed adequately to meet legislative requirements under the current configuration and therefore either replacement or acquisition of spares holdings.
- > Replace - assets where immediate replacement is recommended due to the lack of ability for TransGrid to address asset failures within a reasonable timeframe to return an asset to service.

7.2 Discrete Component Meters Asset Review

Early electronic Metering systems based on discrete electronic components installed on printed circuit boards. The majority of these systems were installed between 1970 and 2006. The installations are displaying signs of degradation due in particular to capacitor dielectric issues resulting in calibration issues affect the accuracy and reliability of the equipment.

TransGrid does not have the capability to repair this equipment and it is no longer supported by the original manufacturer.

Historical performance of this type of asset is summarised in the graph below as an average of percentage defects per population and provides forecast defect rate:

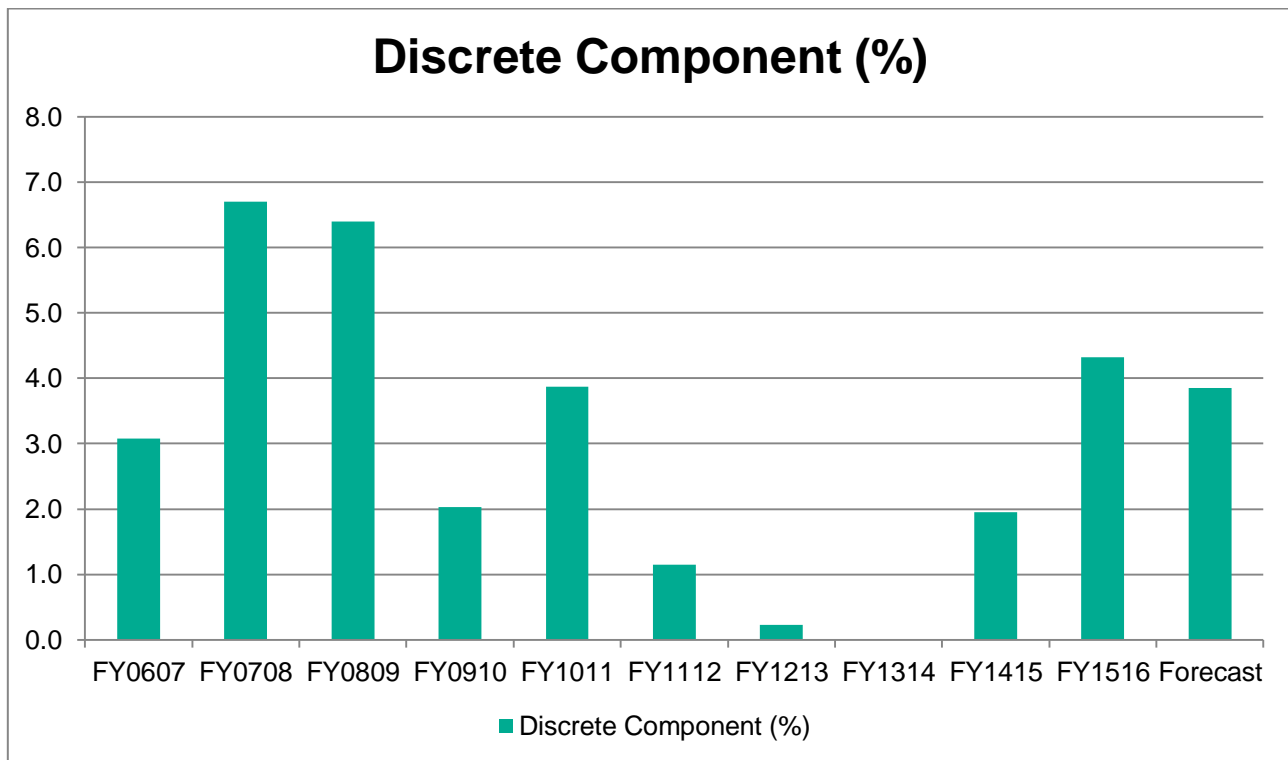


Figure 6 Discrete Component Metering Defect Rates

7.3 Microprocessor Meters Asset Review

This equipment utilises microprocessors to carry out metering calculations within one unit.

This type of meter does not degrade in functionality over time to provide an indication of pending failure, they tend to fail completely and require replacement.

TransGrid does not have the capability to repair this equipment and earlier versions are no longer supported by the original manufacturer.

Historical performance of this type of asset is summarised in the graph below as an average of percentage defects per population and provides forecast defect rate:

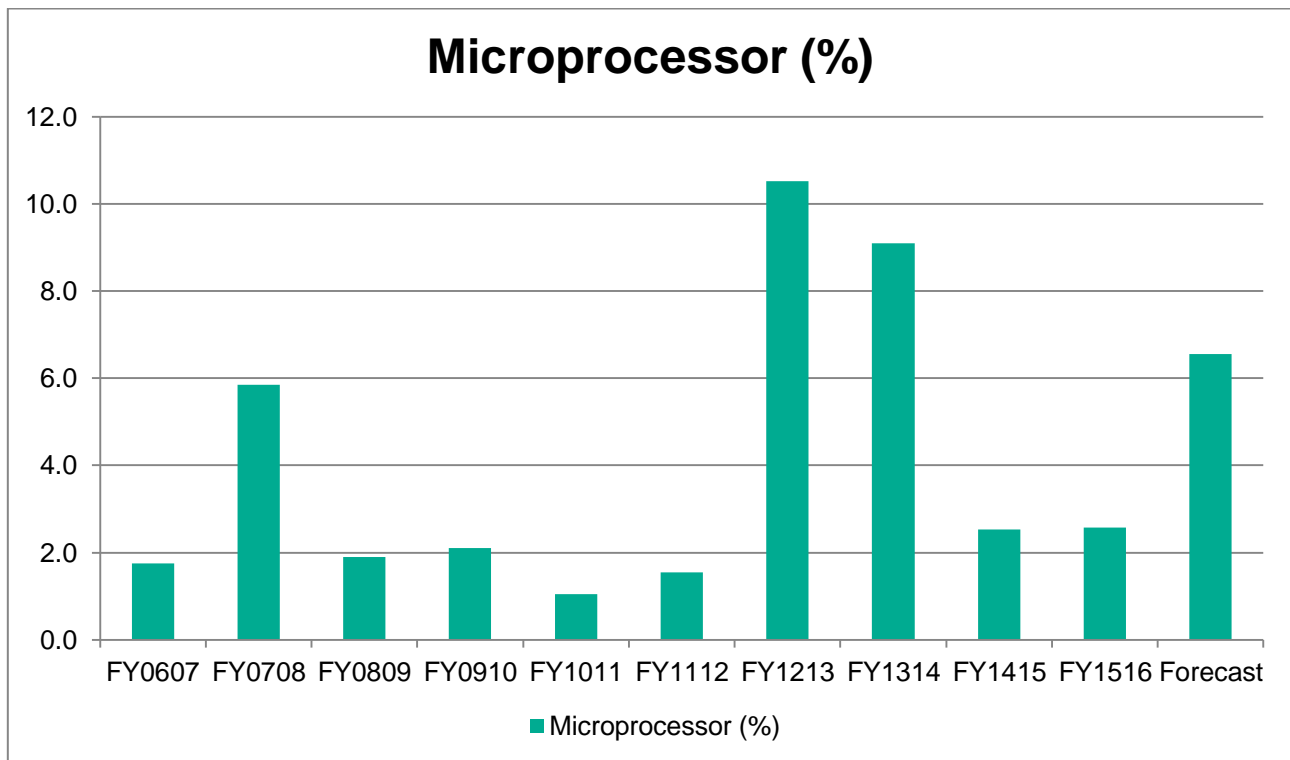


Figure 7 Microprocessor Meter Defect Rates

7.4 NEM Market Meters Asset Review

As NEM Market Meters are a product of the NER and as such are a legislative requirement to operate as a Network Service Provider, they are all deemed critical. However, for the purposes of decision making, the criticality levels have been broken down into the energy throughput levels as defined in the NER. The figure below illustrates the breakup of the asset population by criticality levels:

NEM Market Metering by Criticality

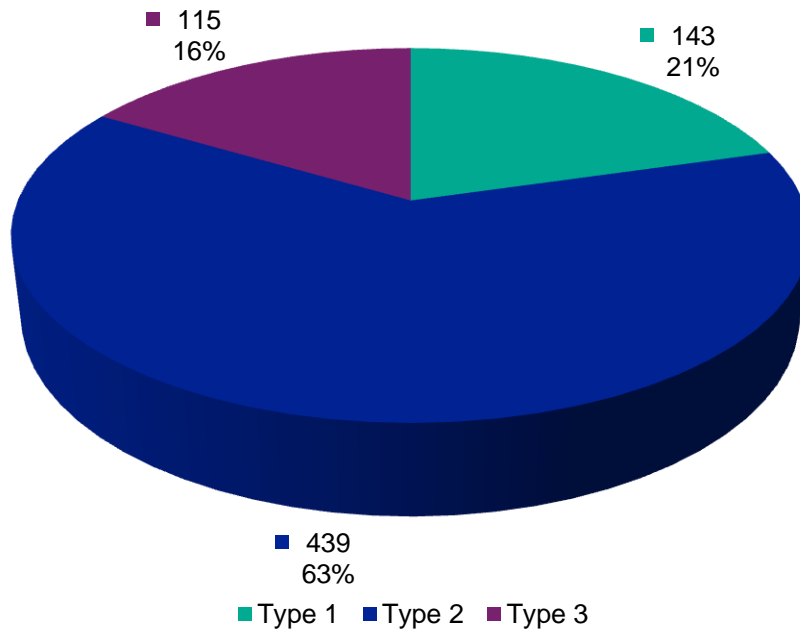


Figure 8 NEM Market Metering by Criticality

The health of these assets varies and is primarily dependant on manufacturer support, spares availability, forecast defect rates and the technical life of the assets. The health index has been used to identify the assets that require investigation and those that require replacement. Below is a summary of the current health of the assets:

NEM Market Metering by Criticality

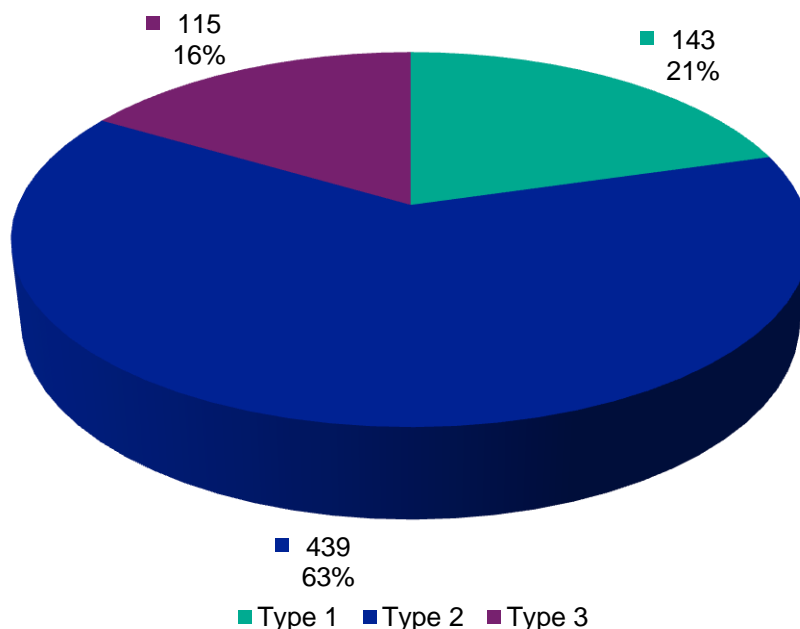


Figure 9 NEM Market Metering by Health

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7.5 TUOS Meters Asset Review

As TUOS Meters are a product of settlement requirements under a contractual agreement between TransGrid and third parties, the current philosophy is to assign all assets with a common criticality which sits overall one level below NEM Market Meters for the purposes of prioritisation of works.

The health of these assets varies and is primarily dependant on manufacturer support, spares availability, forecast defect rates and the technical life of the assets. The health index has been used to identify the assets that require investigation and those that require replacement. Below is a summary of the current health of the assets:

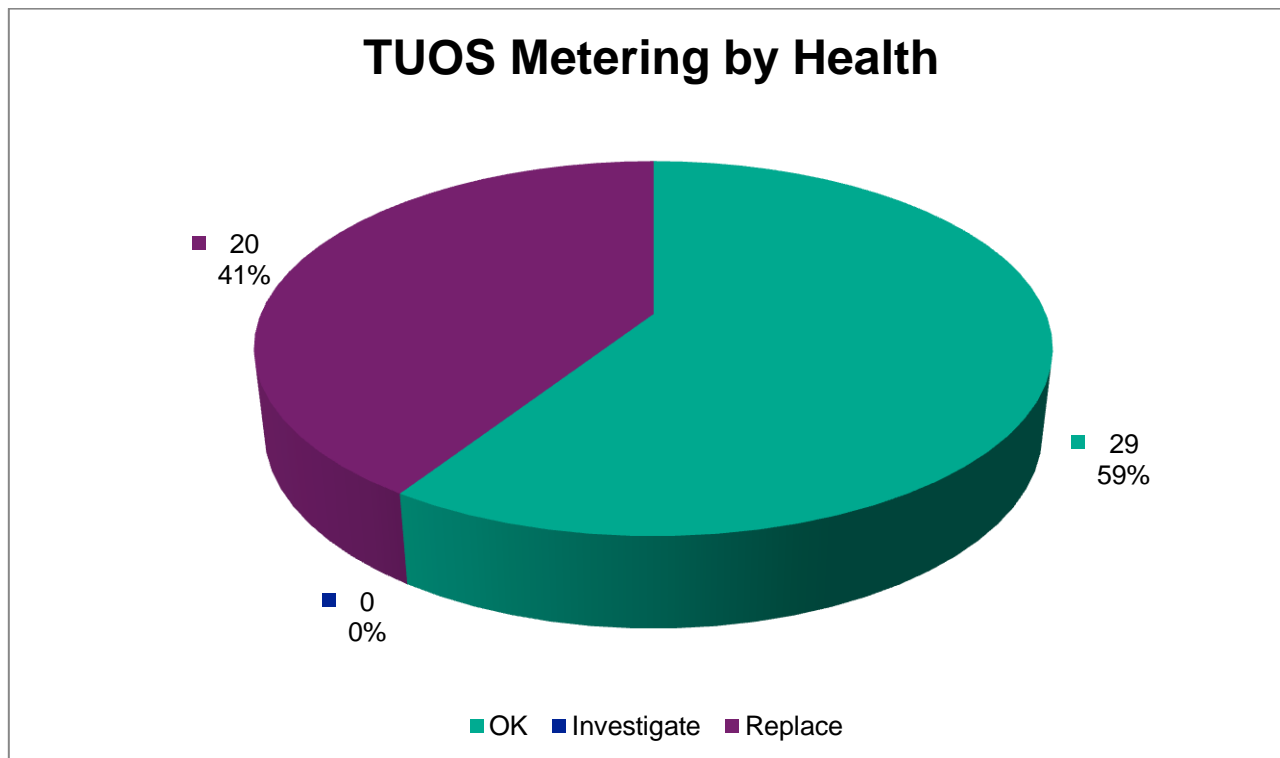


Figure 10 TUOS Metering by Health

7.6 Emerging Issues, and Renewal and Maintenance Initiatives

No specific renewal initiatives have been identified for these assets. Under the latest investment framework, an analysis of cost benefits has found that the optimal solution for TransGrid is to run to failure. Certain metering assets will be replaced, where warranted, as part of site wide secondary systems renewal projects.

The major emerging issue for metering assets is the continual transition to contestability and competition in this market. The renewal and maintenance of metering assets will require a greater focus on customer value to ensure TransGrid's services are retained. Efficiency and innovation, while maintaining compliance with the National Electricity Rules will be required as wholesale customers are provided with greater choice for metering services.

Another major issue currently emerging is the withdrawal of manufacturer support from various models of microprocessor meters within the network. The withdrawal of support introduces issues particularly surrounding the replacement of failed assets. Once spares are depleted, the MTTR of a failed asset increases beyond permissible outage times of a single metering unit and may result in the issue of a non-compliance incident from the regulator. This is mainly due to the need to develop new designs and build new metering panels, along with several days required for installation and commissioning.

Age profiles for these assets are progressing and as the ages increase annually, meters will need to be renewed in a timely manner to maintain the reliability and security of the network.

Assets continually reach end of life and require addressing, the withdrawal of manufacturer support is also an ongoing issue to be addressed as this leads to a lack of spares, an inability to repair, and an inability to connect to assets to carry out maintenance tasks as modern operating systems are not supported (e.g. Windows 7).

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The current emerging issues and the renewal and maintenance initiatives to be implemented in response to these issues are summarised in the table below.

Table 8: Emerging Issues, and Renewal and Maintenance Initiatives

Asset	Asset Management Objective	Strategic Initiative	Emerging Issues	Forecast Expenditure (\$m)	Reference Documents
<ul style="list-style-type: none">NEM Market Meters	<ul style="list-style-type: none">National Electricity Rules Compliant	<ul style="list-style-type: none">Replace on failure	<ul style="list-style-type: none">Asset health and age	NA	NA
<ul style="list-style-type: none">TUOS Meters	<ul style="list-style-type: none">Improve OPEX Performance	<ul style="list-style-type: none">Replace on failure	<ul style="list-style-type: none">Asset health and age	NA	NA

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7.7 Maintenance Program

Routine maintenance is based on periodic testing and inspection of metering installations to determine their adequacy for reporting the billing requirements for the NEM and Third Party Agreements. Routine maintenance is scheduled at regular intervals which are set to meet the requirements set out in the NER.

Different frequencies for routine maintenance activities are set dependant on the technology utilised in the TUOS Metering has been assigned the same maintenance requirements as those set for the NEM Market Metering Systems to protect TransGrid from any potential future disputes that may arise.

Failures that are identified during the normal operation of the meters are addressed in emergency replacement of the failed unit. This is to meet NER requirements and ensure that accurate billing of the NEM is maintained.

The maintenance program is reviewed annually and no changes have been identified or applied for this financial year (2016/17).

8. Future Outlook

8.1 Forecast Expenditure

The following highlights the forecast renewal initiatives expenditure to 2022/23 for specific Metering Renewal Plans. It is noted that various metering assets shall be renewed under site wide renewal strategies as outlined in the Site Installations Renewal and Maintenance Strategy. The associated expenditure with site renewals is not captured in this document:

Table 9 Forecast Renewal Initiatives Expenditure to FY 2022/23 (\$k)

Asset	FY 2016/17	FY 2017/18	FY 2018/19	FY 2019/20	FY 2020/21	FY 2021/22	FY 2022/23
Market Meters	0	0	0	0	0	0	0

The current AER REPEX model highlights expenditure based on age profile and can be seen summarised below. The model currently bundles all Secondary Systems and Communications Assets as one grouping and as such has been compared to the overall forecast costs for all four Renewal and Maintenance Strategies including this document (Metering Systems), Telecommunications Systems, Automation Systems and Site Installations.

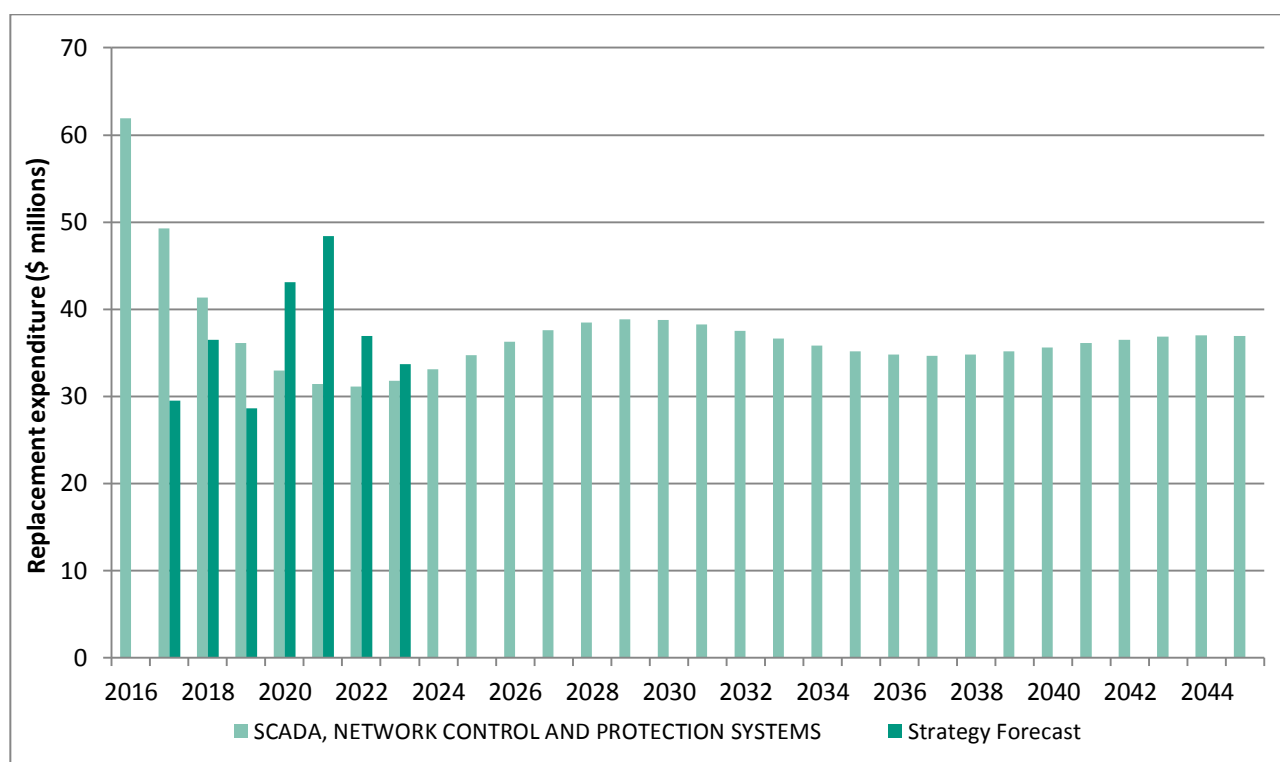


Figure 11 AER REPEX Model Forecast Expenditure

8.2 Anticipated Changes to the Asset Base

The figure below highlights the REPEX model's forecast age profile. The model shows a gradually increasing age profile of the assets over time.

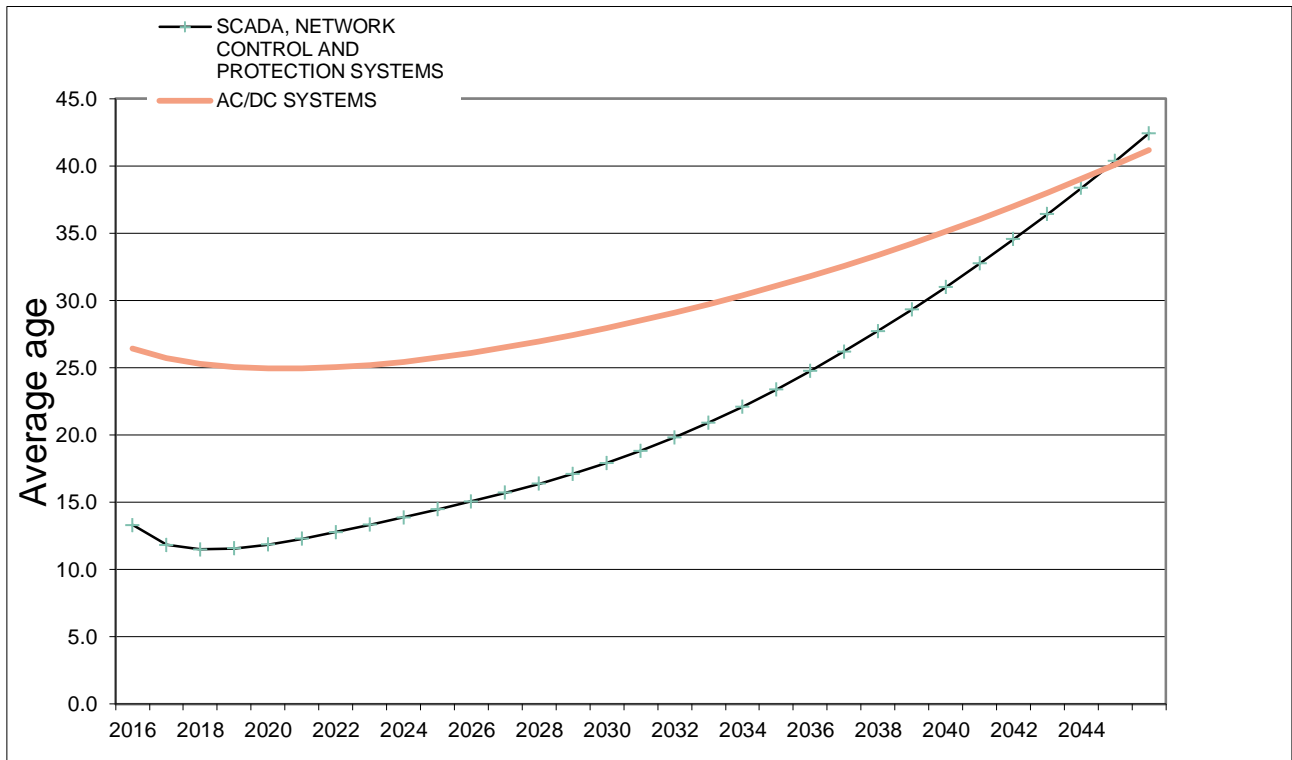


Figure 12 AER REPEX Model Forecast Age Profile

8.2.1 NEM Market Meters

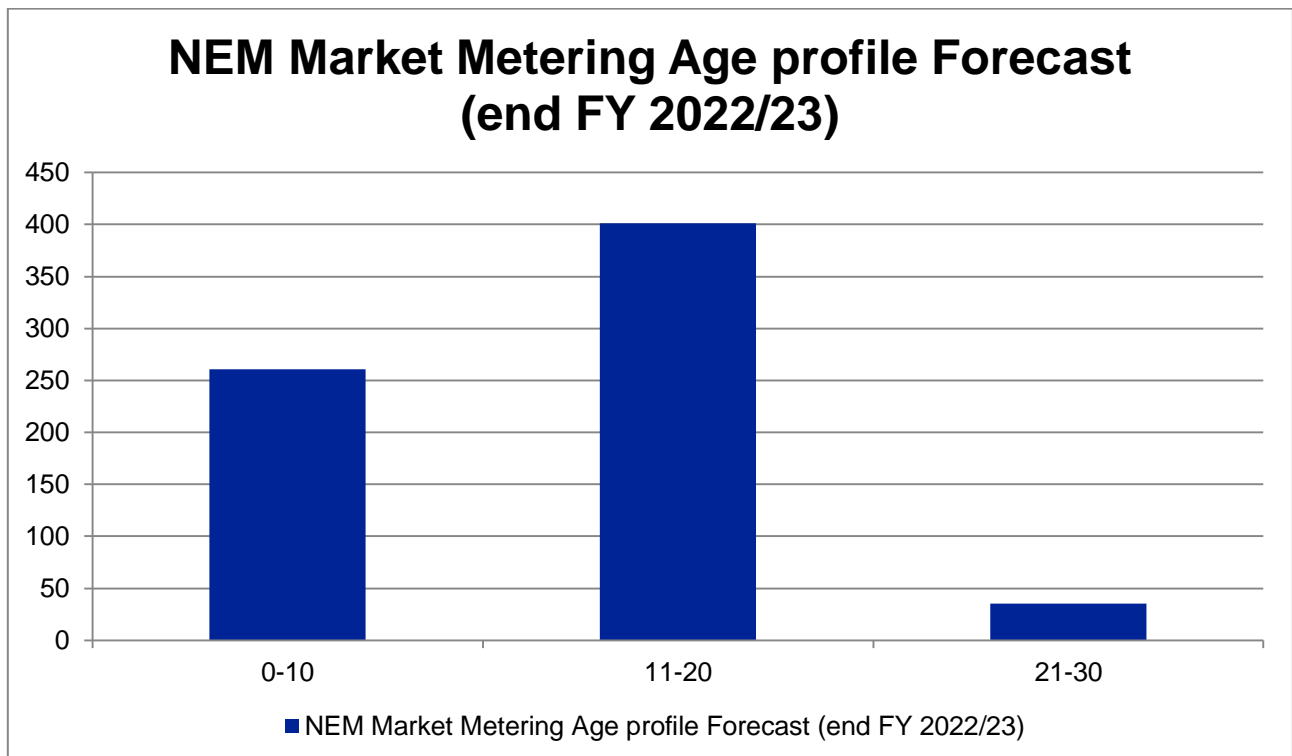


Figure 13 Forecast NEM Market Metering Age Profile (end 2022/23)

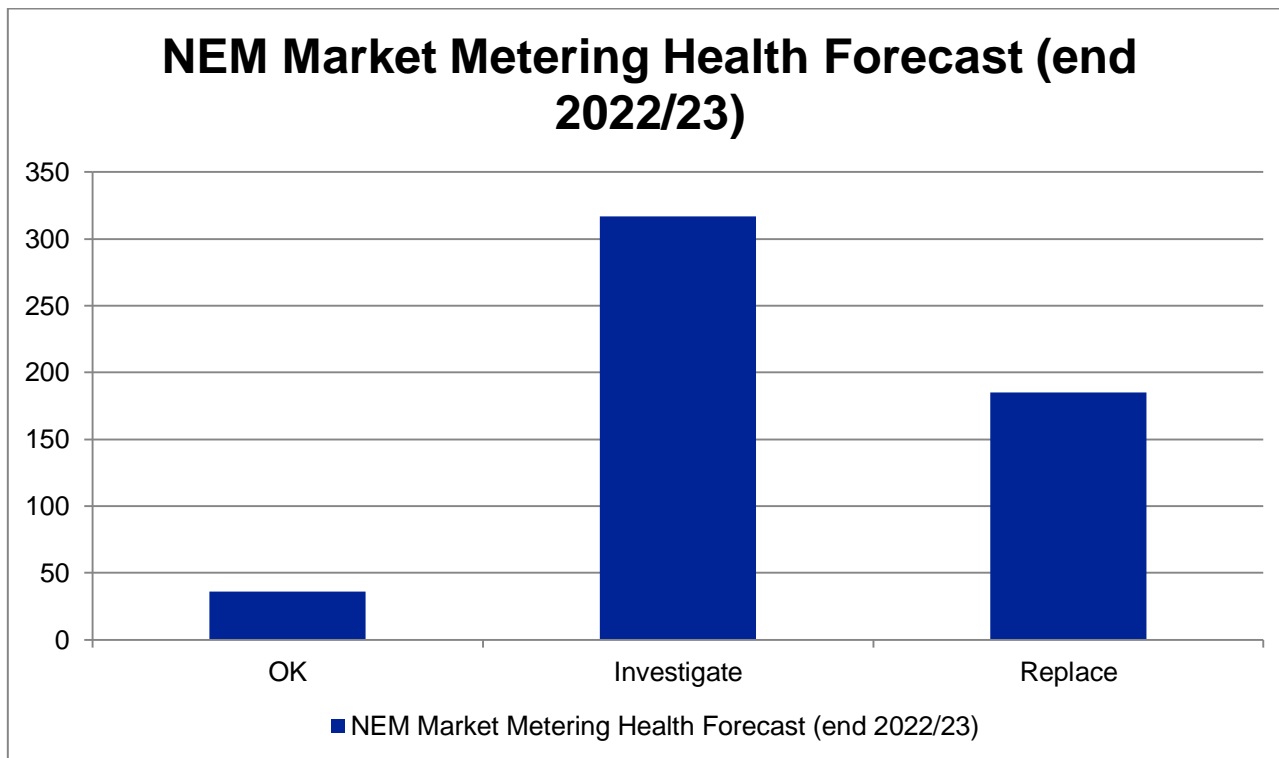


Figure 14 Forecast NEM Market Metering Asset Health (end 2022/23)

8.2.2 TUOS Meters

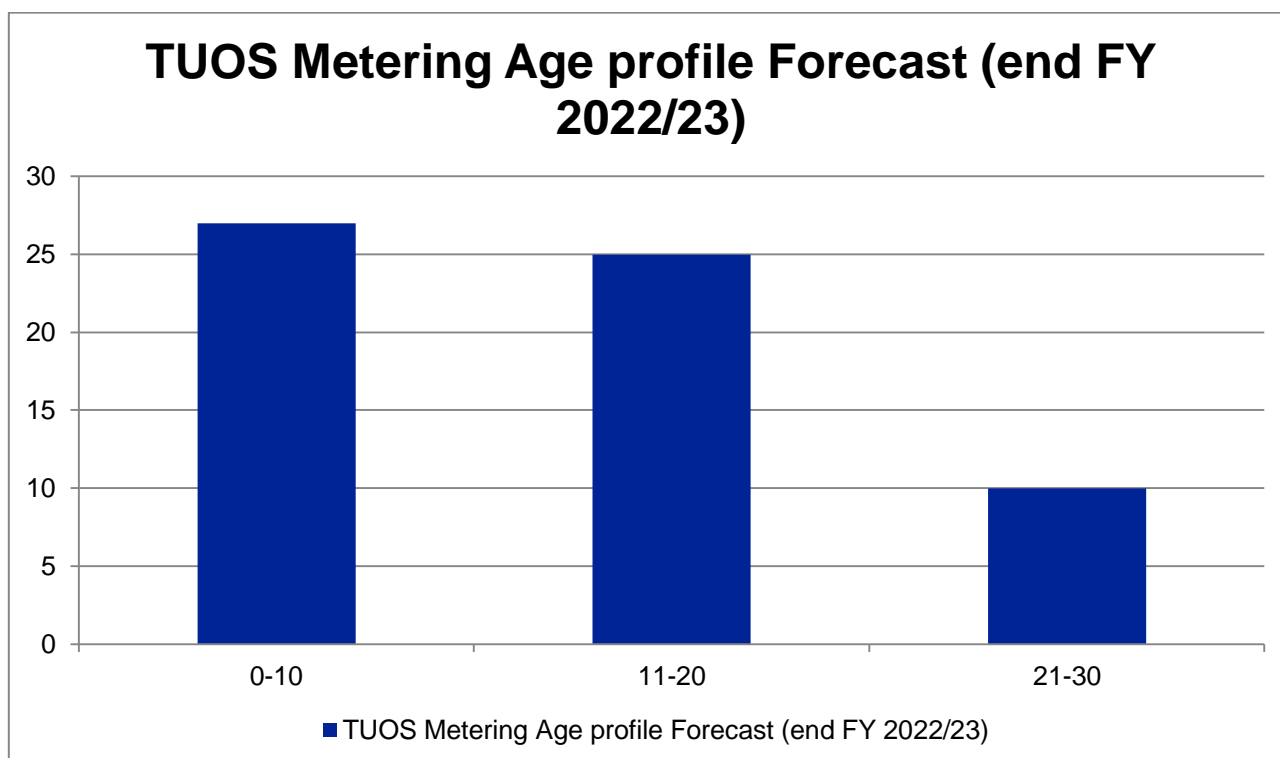


Figure 15 Forecast TUOS Metering Age Profile (end 2022/23)

TUOS Metering Health Forecast (end 2022/23)

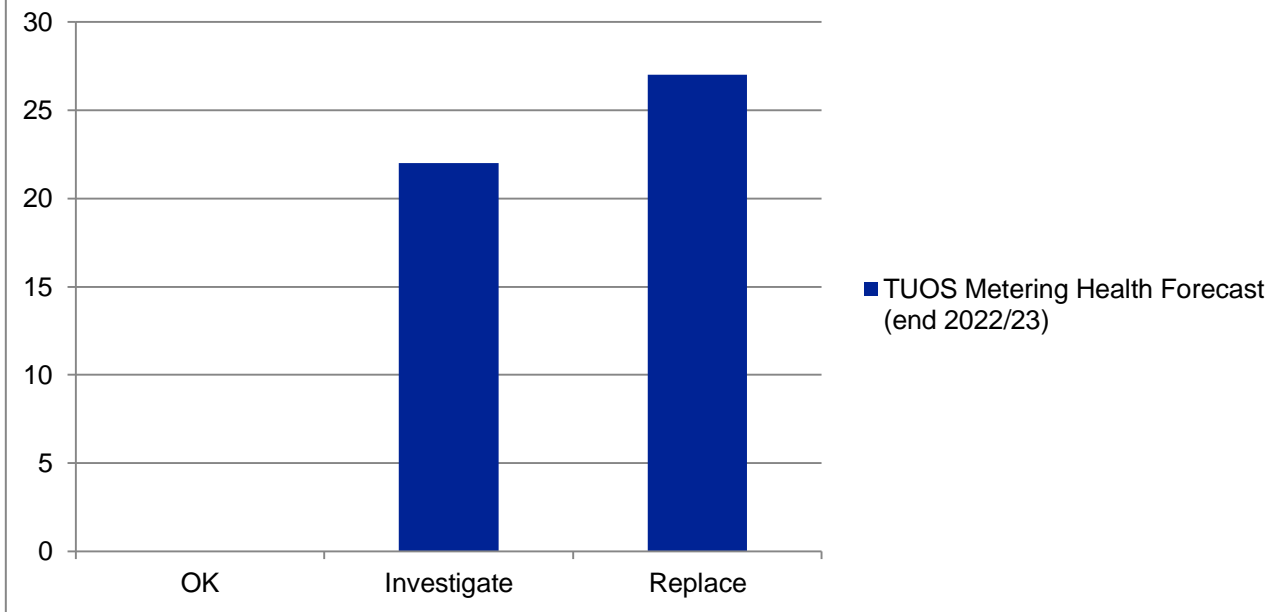


Figure 16 Forecast TUOS Metering Health (end 2022/23)

9. Spares

Spares are items of serviceable equipment that are booked into and stored in TransGrid's storage facilities for maintenance and project purposes. This document does not cover the spares required for project purposes.

TransGrid has purchased a range of strategic spare equipment to improve the organisations ability to restore supply and system security in a timely manner, following the major failure of an in-service unit.

The current spares strategy is to hold a sufficient percentage of spares in respect to the installed asset base, as well as the predicted defect rates of the different asset types with a minimum of 1 spare required for each critical asset within the network. Due to the varying numbers of different asset models utilised throughout the network and incomplete reporting systems in place, a forecast spares expenditure has not been provided at this time, this will become available in the next iteration of this strategy.

10. Asset management capability and continual improvement

Asset Management Objectives	Asset Management Actions	Status
<ul style="list-style-type: none"> Deliver a successful revenue determination 	<ol style="list-style-type: none"> Documentation required for RP2 submitted 	<ul style="list-style-type: none"> All documentation complete
<ul style="list-style-type: none"> ISO 55001 Compliant Continually improve the Asset Management System 	<ol style="list-style-type: none"> Asset information improvements (governance, data, reporting and systems) implemented Asset replacement life 	<ul style="list-style-type: none"> Utilisation of the risk tool to provide a more granular view of the pre and post-investment risks associated with renewing assets. ALARP analysis completed

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Asset Management Objectives	Asset Management Actions	Status
	optimised 4. Asset maintenance scope and frequency optimised 5. Asset management competency enhanced 6. Plant and design standards optimised	for proposed RP2 renewals. <ul style="list-style-type: none"> Asset data improved through incremental recording of assets in Ellipse. Overhaul of the Ellipse Data rules for Metering Systems is underway.
<ul style="list-style-type: none"> Improve CAPEX performance 	7. REPEX and risk scenarios understood 8. Investment governance/prioritisation/optimisation process enhanced	<ul style="list-style-type: none"> Utilisation of the risk tool to provide a more granular view of the pre and post-investment risks associated with building new or replacing assets. ALARP analysis completed for proposed RP2 renewals. NPV analysis completed on all solutions to ensure value for money.

Table 10: Continual Improvement Initiatives

Asset management capabilities are those elements that facilitate best practice asset management decision making. These include:

- > Risk management practices.
- > Asset information.
- > Staff skills and competency.
- > Continual improvement initiatives for the system.

11. Implementing the Strategies

To implement the strategic renewal and maintenance initiatives stemming from this document, actions are to be established via the:

- > Metering Systems Maintenance Plan: The maintenance plan outlines the routine maintenance tasks and frequencies for each asset type.
- > Capital Works Program: The capital works program outlines the approved asset renewal and disposal projects.
- > Other enabler plans detailing how the asset management capability improvements are being implemented

The Secondary Systems and Communications Asset Manager is responsible for preparation of the maintenance plans and referring the renewal and disposal initiative to the network investment process. Field Services is responsible for delivering the maintenance plans as per the Service Level Agreements, and Portfolio Management group/Project Services are responsible for delivering the renewal and disposal initiatives detailed in the approved capital works program.

12. Monitoring and review

Implementation of the Metering Systems Renewal and Maintenance Strategy is monitored and reviewed by the Secondary Systems and Communications Asset Manager, Manager/Asset Strategy and Executive Asset Strategy Committee annually.

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13. Roles and Responsibilities to Develop this Asset Strategy

The roles and responsibilities of those responsible for the development of this asset strategy are as follows:

- > The Manager/Asset Strategy is responsible for the approval of this strategy.
- > The Secondary Systems and Communications Asset Manager is responsible for the development and regular review of this strategy. The document will be reviewed biannually and as significant changes to investment needs become apparent.

14. Change history

Revision no	Approved by	Amendment
2	L. Wee Group Manager/Asset Strategy	Review and update to deliver the 2016/17 Business Plan and further enhance the strategy.
1	L. Wee Group Manager/Asset Strategy	Separated into standalone document, review and update to deliver the 2015/16 Corporate Plan and further enhance the strategy.

15. References

- > Asset Management Strategy and Objectives
- > Asset Management System Description
- > Secondary Systems Site Installations Renewal and Maintenance Strategy
- > Metering Systems Maintenance Plan

16. Attachments

NIL