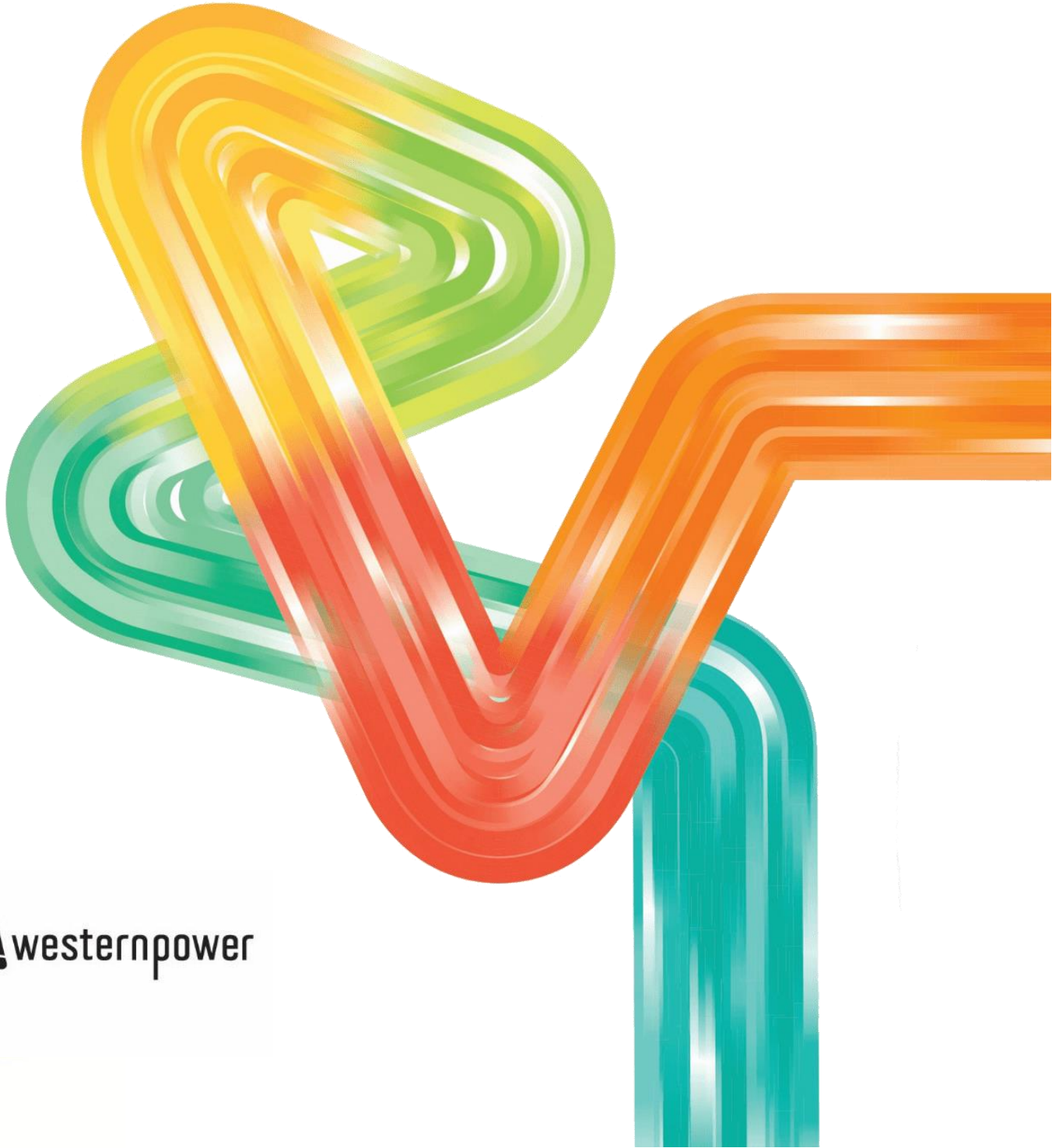
Attachment 8.1

AA5 Forecast capital expenditure report

Access Arrangement Information

1 February 2022



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Abbreviations

The following table provides a list of abbreviations and acronyms used throughout this document. Defined terms are identified in this document by capitals.

Term	Definition
AA4	Fourth access arrangement
AA5	Fifth access arrangement
AAI	Access arrangement information
ACMA	Australian Communications and Media Authority
AECSF	Australian Energy Sector Cyber Security Framework
ALARP	As low as reasonably practicable
AMI	Advanced metering infrastructure
AMS	Asset Management System
Capex	Capital expenditure
CCTV	Closed circuit television
CRAM	Cost and Revenue Allocation Methodology
DER	Distributed energy resources
DLVCS	Distribution Low Voltage Connection Scheme
DSLMP	Dedicated streetlight metal poles
DSO	Distribution system operator
EAC	Electronic access control
EDC	Equivalent distribution calculator
ENSMS	Electricity Network Safety Management System
ERA	Economic Regulation Authority
ESP	Economic Stimulus Package
FIP	Fire indicator panel
HIA	Housing Industry Association
HV	High voltage
ICT	Information and communications technology
LGA	Local government authority
LV	Low voltage
MRL	Mean replacement life
NFIT	New facilities investment test
NPV	Net present value

Term	Definition
NOC	Network operations control
NRUP	Network Renewal Undergrounding Program
PoA	Proof-of-Authority
POE	Probability of exceedance
OCSC	Overhead customer service connections
RAB	Regulated asset base
RMU	Ring main units
RTU	Remote terminal units
SCADA	Supervisory Control and Data Acquisition
SSAM	Service standard adjustment mechanism
SSB	Service standard benchmarks
SST	Service standard targets
STRM	Short term risk management
SUPP	State Underground Power Project
SVC	Static vars compensators
SWIS	South West Interconnected System
VESDA	Very early smoke detection apparatus
VPP	Virtual power plants
WEM	Wholesale Energy Market
ZSS	Zone substation

1. Introduction

1. The purpose of this report is to provide further detail on Western Power's capital expenditure (**capex**) forecast for the fifth access arrangement period (**AA5**). This document is attached to, and should be read in conjunction with, the main access arrangement information (**AAI**) document.

2. This report provides information on:

   - the drivers for investment
   - the risk based asset management approach
   - forecast expenditure by regulatory category for the AA5 period.

3. Unless otherwise stated, all capex amounts in this report are presented in real dollars at 30 June 2022, **excluding forecast labour cost escalation and excluding indirect costs**. Note that totals provided in the tables may not sum due to rounding.

4. The forecasts for the AA5 period in this capex report are presented by the regulatory capex categories as required by section 4.4.1 of the Economic Regulation Authority (**ERA**) Guidelines for Access Arrangement Information.[1] The forecast values in this report are presented as base capex – without labour cost escalation and indirect costs – as it allows for a more accurate comparison of expenditure in each regulatory category between the AA4 and AA5 periods.

5. Calculation of labour escalation and indirect cost forecasts is discussed in Chapter 7 of the AAI (forecast operating expenditure).

1.1 Summary of forecast capex

6. During the AA5 period, Western Power will invest total capex of $5,375.6 million, including labour cost escalation and indirect costs. This is comprised of:

   - $4,629.1 million base capex
   - $103.8 million labour escalation
   - $642.7 million indirect costs.

7. As noted above, this report details the $4,629.1 million of base capex only, disaggregated by regulatory expenditure category.

8. Western Power will invest $4,629.1 million of capital to deliver covered services. Of this, approximately $910.2 million will be recovered directly from customers in the form of either capital contributions or gifted assets. We forecast $3,718.9 million will be added to the regulated asset base (**RAB**) and recovered through reference tariffs.

9. Table 1.1 summarises the total capex forecast for the AA5 period, split between the investment in the transmission network, distribution network[2] and corporate support.

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1 ERA, *Guidelines for Access Arrangement Information, Electricity Networks Access Code 2004*, December 2010.

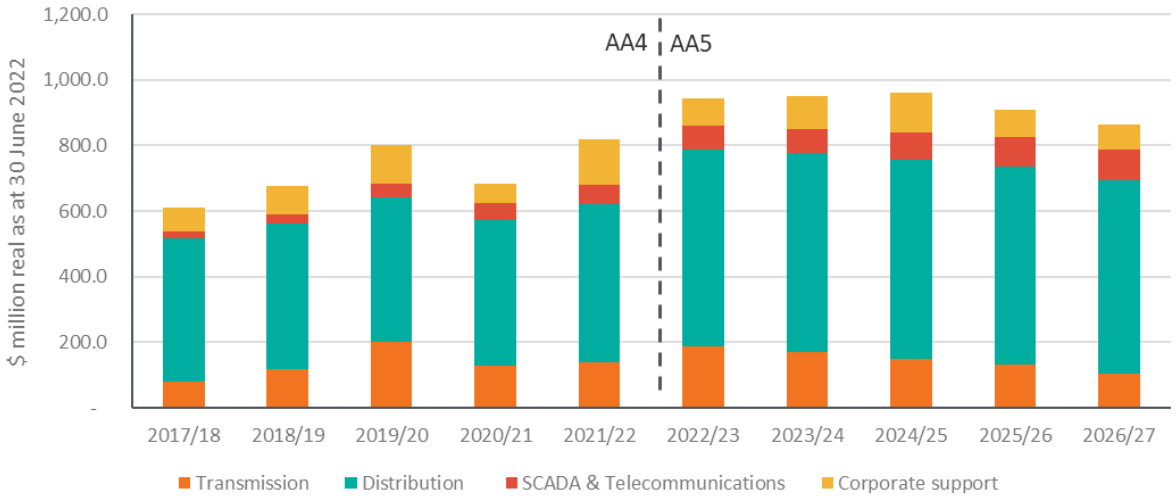
2 The Western Power Network is split between the transmission and distribution networks we own and operate for the purposes of the access arrangement.

Table 1.1: AA5 forecast capex summary, $ million real, 30 June 2022[3]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5	% of gross capex
Transmission network	188.0	172.1	147.9	133.0	105.0	745.9	16.1%
Distribution network	600.6	604.9	609.1	603.6	588.6	3,006.8	65.0%
SCADA & Telecommunications	72.0	72.4	84.3	90.1	94.4	413.1	8.9%
Corporate support	83.6	101.1	119.5	82.5	76.7	463.3	10.0%
Gross capex	**944.2**	**950.5**	**960.7**	**909.1**	**864.6**	**4,629.1**	**100.0%**
Less contributions	191.9	173.8	183.8	192.7	168.0	910.2	
Net AA5 capex added to RAB	**752.3**	**776.7**	**776.9**	**716.4**	**696.6**	**3,718.9**	

10. Figure 1.1 shows how the AA5 forecast capex compares with that incurred during the AA4 period.

Figure 1.1: AA4 actual and AA5 forecast gross capex[4], $ million real, 30 June 2022



11. Capex for the AA5 period is forecast to increase by 29 per cent relative to actual capex in the AA4 period. This is driven by forecast increase in investment in the distribution network (up 33.6 per cent), the transmission network (up 11.6 per cent) and the SCADA and Telecommunications network (up 110.3 per cent). Investment in corporate support in the AA5 period is expected to fall by 2.9 per cent compared to the actual capex in the AA4 period.

12. Forecast capex by regulatory expenditure categories is summarised in section 1.2 below.

[3] Excluding forecast labour escalation and indirect costs.

[4] Excluding forecast labour escalation and indirect costs. Capex in the final year of the AA4 period is based on budgeted data for 2021/22.

1.2 Regulatory capex expenditure categories

13. The ERA's *Guidelines for Access Arrangement Information* require Western Power to present forecast capex for the AA5 period in the following discrete regulatory categories:

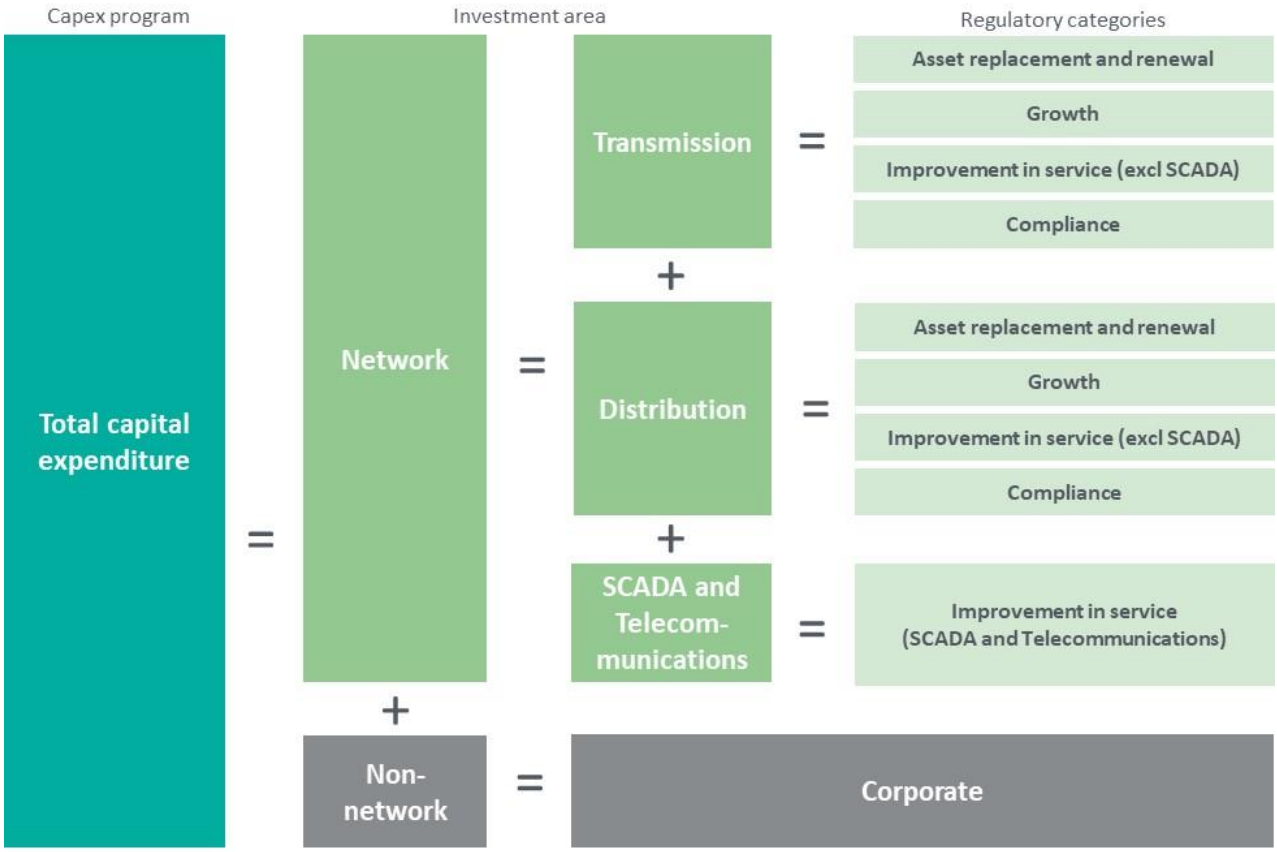
- Asset replacement and renewal
- Growth
- Improvement in service
- Compliance
- Corporate.[5]

14. Western Power has grouped transmission and distribution projects into activities and then grouped the expenditure by sub-category into the four network expenditure categories. Corporate capex, which captures the non-network capex, has been separated into information and communications technology (**ICT**) and business support.

15. Investment in SCADA and Telecommunications was previously included in the 'Improvement in service' category for the transmission and distribution networks. For the AA5 period, Western Power has shown this separately given the significance of the SCADA and Telecommunications capex program.

16. Western Power's regulatory capex categories are illustrated in Figure 1.2.

Figure 1.2: Regulatory capex categories



[5] ERA, *Guidelines for Access Arrangement Information, Electricity Networks Access Code 2004*, December 2010.

17. The capex forecast presented in this report is based on Western Power's 10-year Business Outlook, re-cut into the regulatory capex categories required by the ERA's guidelines.

18. The following sections describe the drivers for investment in each of the regulatory expenditure categories.

1.2.1 Asset replacement and renewal

19. The ERA guidelines define this category as the capex required for the purposes of replacing assets in the distribution and transmission networks and maintaining service levels.

20. Expenditure in this category is driven by the need to maintain network safety, security and reliability, meeting the challenges of maintaining the existing network whilst transforming to a modular grid. The key factors influencing this are asset condition and risk.

21. Western Power's Corporate Strategy and objectives guide the asset management strategies that guide investment. These asset management strategies define the management plans for each asset type and ultimately determine the forecast levels of replacement and renewal. Detailed asset management plans have been established for each class of asset on the Western Power Network. All asset classes are continually assessed to ensure the asset management objectives are met for the transmission and distribution networks.

22. Risk management is an integral part of asset management strategies and is incorporated into asset management plans in accordance with Western Power's Network Risk Management Standard.

23. The costs attributed to volumetric asset replacement programs (such as distribution pole replacements or reinforcements) are forecast using unit rates and replacement volumes. Standalone projects are forecast using a cost build-up approach based on a defined scope and where applicable, compared with similar projects.

24. Volumetric program unit rates are formulated using detailed cost structures and current work practices. Western Power has developed cost structures which break down field work into units such as labour, fleet, contractor and materials. These units are based on current work practices, labour, fleet and material costs, and include contractor rates.

25. Major transmission network replacement projects are outsourced via competitive tender, with forecast costs developed using a cost build-up approach based on a defined scope, informed by similar projects that have been delivered in the past. Minor projects are forecast through the use of standard estimating tools and historical projects.

1.2.2 Growth

26. Growth capex is defined in the ERA guidelines as capex for the purposes of increasing the capacity of assets or construction of new assets to meet growth in demand.

27. Expenditure in this category is primarily driven by energy demand and customer growth forecasts. Load forecasts for each zone and distribution substation are prepared based on energy demand and customer numbers. The consideration of growth forecast by individual distribution substation means investment can be targeted to parts of the network that are growing, even if average demand across the entire network is flat. As a result, growth (and augmentation) capex is typically one of the largest categories of network capex even during periods of flat demand growth or declining average consumption.

28. Customer-driven transmission projects, for example connection of generators or large loads, also have a major influence on growth capex. Transmission projects generally require detailed analysis and substantiation both from a timing and cost perspective. Western Power develops customer-driven capex

forecasts using a cost build-up approach based on a defined scope and comparisons to similar projects. We also consider current and expected upcoming technical issues[6] facing the transmission network, including voltage and thermal management due to customer growth, and incorporate the impact of these issues into forecast expenditure profiles.

29. When assessing upgrades to distribution substations and feeders, Western Power considers average demand profiles and maps these against specific areas of the network. This allows us to identify parts of the network that are experiencing growth and ensures investment is appropriately targeted. Feeder loadings are also impacted by changing demand patterns, which we factor into investment plans.

30. Expenditure relating to distribution network customer connections also falls into the growth category. Western Power's Contributions Policy is the overarching document that establishes the nature of the connection services we offer and the charges that may apply for those services. The forecasting methodology for customer connections varies by segment:

- residential, sub-division and minor commercial connections are forecast using historical trend analysis, taking into account actual costs of similar recent projects
- major commercial connections are forecast using a cost build up approach based on a defined scope.

1.2.3 Improvement in service

31. This category of capex is defined in the ERA guidelines as the capex for the purposes of improving service levels and reliability to meet regulatory requirements and customer preferences.

32. This expenditure category is driven by Western Power's obligation to achieve the specific service standards defined in the access arrangement. The access arrangement contains:

- a series of minimum service standards (known as service standard benchmarks (**SSBs**)) that Western Power must achieve in providing services
- a service standard adjustment mechanism (**SSAM**) that contains a series of service standard targets (**SSTs**), which are set at a higher standard than the SSBs. The SSAM provides for a financial reward if Western Power exceeds the SSTs and a penalty if it falls below.

33. The SSBs and SSTs relate to aspects of service including transmission and distribution network reliability, call centre performance and streetlight repair times.

34. When developing improvement in service capex, Western Power considers the minimum amount of investment required to achieve the SSBs and maintain performance on average at the SSTs.

35. It should be noted that Western Power proposes to maintain current levels of service for the AA5 period, therefore there is no expenditure targeted at improving overall service levels. Instead, the SSTs are being set at a level consistent with maintaining today's level of service, and network investment is designed so that Western Power achieves the SSTs (rather than exceed or fall below the SSTs) such that the business receives no overall rewards or penalties at the end of the AA5 period.

1.2.4 Compliance

36. Compliance capex is defined in the ERA guidelines as the capex for the purposes of meeting regulatory obligations relating to the Western Power Network.

[6] Current and expected issues are outlined in the Network Development Plan. This plan is updated annually.

37. Expenditure in this category is driven by the cost required by Western Power to meet its licence requirements, safety and environmental obligations, and other legislative and regulatory obligations. Forecasts are based on achieving compliance with applicable regulatory obligations (unless otherwise agreed with the relevant authorities) and maintaining current network compliance risk rating.

38. Any new or amended compliance requirement that is not known at the time of making our AA5 proposal (for example, those elements of the Energy Transformation Strategy that are yet to be implemented), are treated as unforeseen events during the period, with opportunity to recover those costs in future access arrangement periods.

1.2.5 Corporate

39. Corporate capex is defined in the ERA guidelines as the capex for corporate activities.

40. Corporate capex is forecast at a whole of network level and then allocated between the distribution and transmission networks using the cost allocation methodology contained in Western Power's Cost and Revenue Allocation Methodology (**CRAM**). Western Power uses a bottom up approach for each category of expenditure.

41. Asset replacement such as ICT, buildings and fleet are validated based on the forward works programs and employee numbers. Specific projects are validated individually according to the process outlined in Western Power's Investment Governance Framework (**IGF**).

Business support

42. Business support capex incorporates the cost of Western power's property and fleet.

43. Property capex generally incorporates:

- security upgrades
- property, plant and equipment expenditure
- compliance with regulatory requirements (other than those covered above)
- leasehold improvements.

44. Historical trends and forward-looking costs are used to inform property investment. The network capital works program and associated workforce movements are key inputs.

45. Property is acquired through market purchases and new facilities are designed and costed via a market driven tender process. Property expenditure is supported by detailed businesses cases prepared in accordance with the IGF.

Information and communications technology

46. Expenditure must cover current technologies and new technologies that drive system upgrades, be cost efficient and be in line with customer requirements. Western Power's ICT strategy establishes the business requirements for ICT equipment and services.

47. Asset replacement is based on a life-cycle management approach to maximise utilisation and minimise cost. ICT assets are replaced or upgraded when:

- the likelihood and consequence of failure becomes intolerable
- support costs exceed replacement costs
- unacceptable cyber risks arise from expiry of vendor support.

48. Systems reaching the end of their useful life are assessed and either replaced or upgraded to improve operational efficiency and maintain vendor support.

49. Investment in any new technology must be subject to a cost benefit analysis and net present value (**NPV**) assessment. Competitive tendering is used in the supply of hardware, software and service provision.

1.3 Summary of forecast capex by regulatory category

50. Western Power will invest $4,629.1 million of capital (including capital contributions) to deliver covered services during the AA5 period. Overall forecast investment for the AA5 period will be above that undertaken in the AA4 period, with total forecast capex being around $1,036.2 million (29 per cent) higher than actual capex in the AA4 period[7].

51. The $4,629.1 million is base expenditure, meaning it does not include labour cost escalation or capitalised indirect costs. Labour cost escalation is estimated at $103.8 million and capitalised indirect costs are estimated at $642.7 million.

52. The profile of the investment program has increased compared to the AA4 period, reflecting the changing energy landscape and support for the implementation of the Energy Transformation Strategy. Western Power is proposing an increase in each expenditure category other than Corporate.

53. Table 1.2 summarises total AA5 period forecast capex by regulatory category.

Table 1.2: AA5 forecast capex by regulatory category, $ million real, 30 June 2022[8]

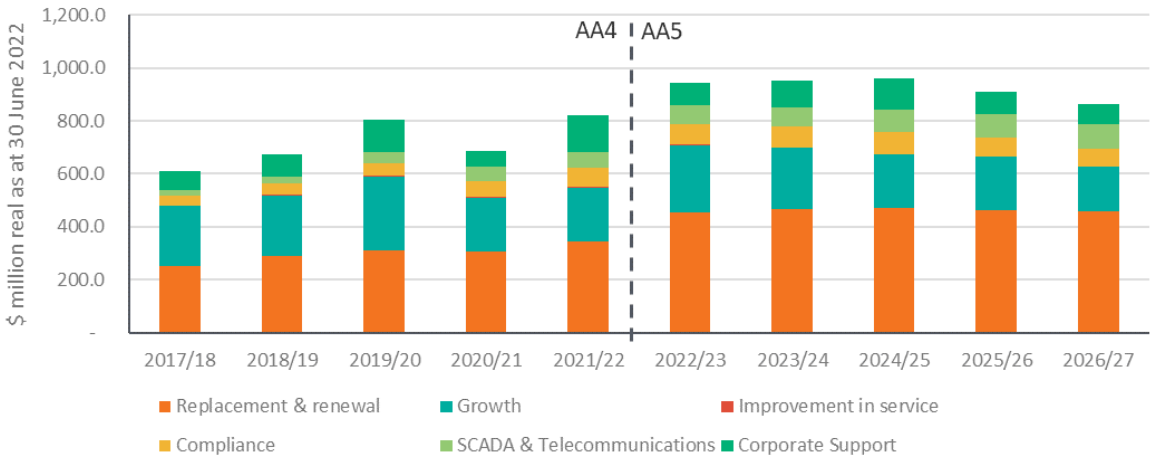
Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
Asset replacement and renewal	454.3	467.9	469.8	461.1	458.1	2,311.0
Growth	255.0	229.8	203.9	205.3	171.2	1,065.2
Improvement in service	0.2	0.0	0.0	0.0	0.0	0.2
Compliance	79.2	79.3	83.3	70.2	64.3	376.3
SCADA and Telecommunications	72.0	72.4	84.3	90.1	94.4	413.1
Corporate	83.6	101.1	119.5	82.5	76.7	463.3
Gross capex	**944.2**	**950.5**	**960.7**	**909.1**	**864.6**	**4,629.1**
Less contributions	191.9	173.8	183.8	192.7	168.0	910.2
AA5 capex to be added to the RAB	**752.3**	**776.7**	**776.9**	**716.4**	**696.6**	**3,718.9**

54. Figure 1.3 shows how forecast capex for the AA5 period compares with historical levels.

7 Unless otherwise noted, capex presented for the AA4 period in this report is based on actual capex for 2017/18 to 2020/21 and budget forecast for 2021/22.

8 Excluding forecast labour escalation and indirect costs.

Figure 1.3: Gross capex by regulatory category, AA4 actual and AA5 forecast, $ million, real at 30 June 2022



55. Table 1.3 summarises the change in total capex from the AA4 period.

Table 1.3: Comparison of total AA4 and AA5 forecast capex by regulatory category, $ million real, 30 June 2022[9]

Expenditure category	AA4 Period total	AA5 Period total	% Change from AA4
Asset replacement and renewal	1,505.5	2,311.0	53.5%
Growth	1,136.3	1,065.2	-6.3%
Improvement in service	16.6	0.2	-98.6%
Compliance	261.0	376.3	44.2%
SCADA & Telecommunications	196.4	413.1	110.3%
Corporate Support	477.1	463.3	-2.9%
Gross capex	**3,592.9**	**4,629.1**	**28.8%**

56. The following chapters provide further details on forecast capex by investment area (transmission / distribution / SCADA & Telecommunications / corporate) and by regulatory expenditure category. As noted previously, investment in the SCADA and Telecommunications network is shown separately, and is not included in the respective capex forecasts for the transmission and distribution networks.

[9] Excluding forecast labour escalation and indirect costs.

2. Approach to developing the capex forecasts

57. The AA5 capex program has been developed using Western Power's business as usual processes, which uses a combination of bottom up build and top down assessment, tailored for each investment type / asset class. Insights from our customer engagement program have helped shape our plans for the next five years and beyond.

58. The following sections provide further information on the Asset Management Framework, customer insights regulatory requirements and planning processes that have informed the forecast capex investment plan for the AA5 period.

2.1 Asset Management Framework

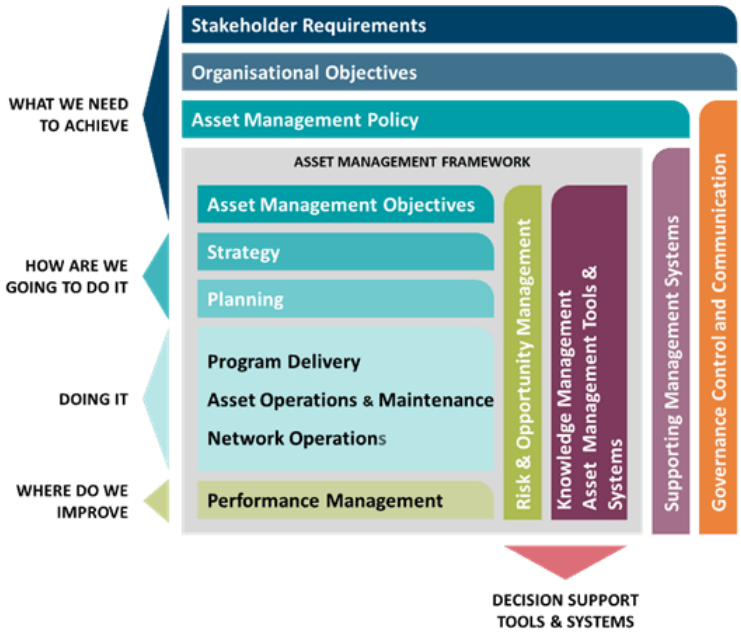
59. Western Power's Asset Management Framework is set within the context of the Australian and International Standard on Asset Management (ISO55001), ERA Audit Guidelines, *Electricity (Network Safety) Regulations 2015* and Electricity Network Safety Management Systems standard (AS 5577).

60. This framework underpins Western Power's Asset Management Policy and defines the structure of Western Power's Asset Management System (**AMS**). Western Power's AMS has been built on this framework and is a collection of strategies, standards, specifications, procedures, processes, tools and systems used for asset management.

61. The AMS supports risk-based decision making and sustainable management of network assets, as per the requirements of Western Power's transmission and distribution licences and other compliance requirements. This encapsulates all Asset Management documentation, responsibilities and supporting systems. The AMS is a structured tool for fulfilling due diligence requirements and achieving continuous improvement in asset management performance.

62. The structure of Western Power's Asset Management Framework is shown in Figure 2.1. The AMS is built upon this structure.

Figure 2.1: Western Power's Asset Management Framework



63. Western Power's AMS and Electricity Network Safety Management System (**ENSMS**) are applied to the development of the Network Management Plan and Grid Strategy that the network investment components of the AA5 proposal are based on. These have undergone a range of independent assessments for maturity, adequacy and application.

64. Recent significant audits of these systems have included:

- The AMS review (AMSR) (completed in September 2020), which found that "*Western Power has developed a sophisticated, well-structured and disciplined Asset Management System*"[10]
- Certification of Western Power's AMS to the International Standard for Asset Management ISO 55001 in August 2019. The ISO55001 assessment (completed in July 2019) found that "*Western Power has a number of industry leading practices, particularly in the areas of asset risk management and the "line of sight" linkages to organisational objectives, as well as the optimisation and prioritisation of programs and projects"*[11]
- The ENSMS audit (concluded in April 2017), which found that the Western Power's ENSMS is compliant with the requirements of AS5577 (the applicable Australian Standard for the Electricity Network Safety Management System), is appropriate and is effectively implemented.[12]

2.1.1 Grid Strategy

65. The objective of the Grid Strategy is to manage systems across their lifecycle to deliver an optimal balance of cost, performance and safety while satisfying short and long term expenditure constraints and minimising constraints on customer choice. It supports the realisation of Western Power's vision for a modular grid.

66. The purpose of the Grid Strategy is to:

- provide an overview of current performance, issues and drivers for investment on the network
- provide an overview of currently available and emerging solution options to address these drivers (i.e. design, maintenance and operational options)
- outline the current strategies that are applied across the network
- outline high level considerations for investment planning.

67. The Grid Strategy includes a collection of strategies grouped into:

- **Performance Strategies:** that address performance of networks (i.e. reliability, voltage, utilisation, protection and power quality) across the lifecycle. Grid performance strategies drive project-based network planning studies and investigations. They are typically focussed on short to medium term responses to existing and emerging issues and provide an input to long term strategy development and planning
- **Transformation Strategies:** that target changes to networks when they reach end of life. These include SPS, undergrounding, 66 kV rationalisation and transmission de-meshing. They typically focus on longer term responses to emerging and future issues although they still drive planning actions in the short term.

68. The Grid Strategy also sets out the grid vision for the transmission and distribution networks.

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10 AMCL, *Western Power 2020 Asset Management System Review*, Review Report, 30 November 2020, p.23.
11 Lloyd's Register, *Stage 2 Assessment Report for: Electricity Networks Corporation trading as Western Power*, July 2019
12 CutlerMerz, *Electricity Network Safety Management System (ENSMS) Independent Audit Report*, May 2017

- The transmission future grid vision is for an efficient and sustainable long term vision for the future state of the transmission network that delivers optimised outcomes for the whole of the energy sector, effectively manages risk, leverages technology and promotes opportunities and minimises costs to customers
- The distribution grid vision is defined in terms of the target future state – the modular grid – comprising a tightly meshed urban network in metropolitan areas, an autonomous network for remote customers and a hybrid network in between those.

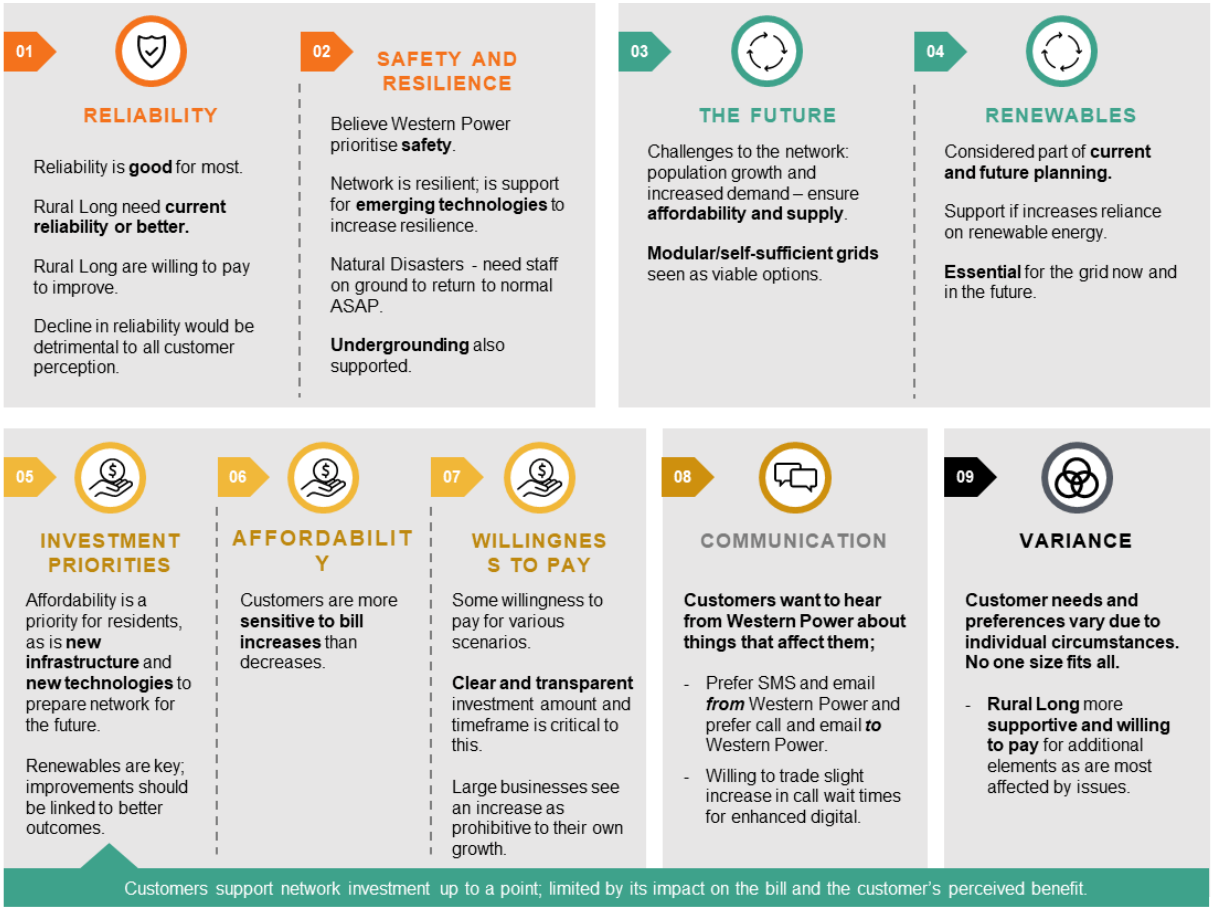
69. Further information on the strategy for the transmission and distribution networks is provided in sections 3.1 and 4.1, respectively. A copy of the Grid Strategy is provided at Attachment 8.3.

2.2 Customer insights

70. Western Power undertook an extensive customer engagement program in 2021. The core focus of our customer engagement was to understand our community's attitudes towards electricity, network performance and safety, network tariff preferences, affordability of services, future opportunities, new technologies, climate change and access to renewables.[13]

71. A summary of our customer insights is provided in Figure 2.2.

Figure 2.2: Summary of customer insights



Source: Kantar Public, 2021, *Community and Customer Engagement Program Report*

13 The customer engagement program is discussed in detail in Chapter 4.

72. It is clear that our customers' main priorities are:

- **affordability:** residential customers are sensitive to price increases
- **support of renewables:** management of solar connections to the network, with some willingness to accept small bill increases to increase future investment in new technologies and renewables, and to increase network reliability
- **future focus:** building new infrastructure to cope with future demand and investing in new technologies for the evolving network
- **maintenance of reliability standards:** maintaining or improving reliability of the power system against outages.

73. Safety is considered critical by customers. Should the level of service surrounding safety decline, it would be detrimental to customer perceptions of Western Power. Customers believe there is already significant importance given to safety and do not prioritise additional investment in this area.

74. Western Power is perceived to be performing well in areas of safety, customer service and to a large degree reliability, but the community expects these areas to be maintained at current levels as a minimum. There is no willingness to trade-off safety for cheaper bills or greater reliability or increased sustainability.

75. The customer engagement program found that customers are sensitive to price increases but support prudent investment particularly in integrating renewables, new technologies and (for rural customers) improved reliability. Likewise, the community understands the impact of climate change and there is strong community support for further investment to support an increased reliance on renewable energy.

76. Customers are open to increased investment, particularly in new technologies (such as community batteries, SPS and microgrids), but remain cautious as to how much additional cost they are willing to absorb. Modelling clearly shows that customers are willing to pay more to enable these investments, however, they need to understand the impact on their bill.

77. These insights allowed Western Power to understand community requirements and preferences, and has helped inform our investment plan. The insights have shaped our thinking on the services we will provide and the technology solutions we will invest in over the AA5 period. In particular:

- forecast capex is designed to maintain the current level of safety performance associated with our network assets, consistent with our customers' views that they do not prioritise additional investment in this area given the significant importance we already give to safety
- proposed investment during the AA5 period is designed to maintain current overall reliability levels rather than incur additional costs to improve reliability across the network
- investment is targeted at pockets of the network that have the poorest reliability, have high failure risks (e.g. aging assets) and have high network security risks
- we are integrating and piloting new solutions to test their suitability as part of the evolving network, such as SPS, community batteries, DER integration and management technologies, microgrids and digital substation
- all expenditure forecasts have been subject to top down review and assessment to ensure they represent a network business efficiently minimising costs and take price impacts into account.

2.3 Regulatory requirements

78. Western Power's capex forecast is required to meet the Access Code objective, which is:

> *to promote efficient investment in, and efficient operation and use of, services of networks in Western Australia for the long term interests of consumers in relation to:*
>
> *(a) price, quality, safety, reliability and security of supply of electricity;*
>
> *(b) the safety, reliability and security of covered networks; and*
>
> *(c) the environmental consequences of energy supply and consumption, including reducing greenhouse gas emissions, considering land use and biodiversity impacts, and encouraging energy efficiency and demand management.*[14]

79. Section 6.51 of the Access Code states that forecast capex may be included in the forward looking and efficient costs of providing covered services to the extent that it relates to investment that is reasonably expected to satisfy the new facilities investment test (NFIT).[15]

80. The NFIT in section 6.52 of the Access Code was amended in September 2020 to include an assessment of alternative options for all capital investments. The Access Code was also amended to require the ERA to publish guidelines for valuing the net benefits of expenditure by a service provider (see section 6A.6) and also on what factors it will take into consideration in making an NFIT determination (see section 6.56).[16] The ERA has yet to develop these guidelines at the time of preparing the AA5 proposal.

81. The Access Code was also amended to include a requirement for Western Power to publish a Network Opportunities Map by 1 October each year. The Network Opportunities Map is to provide a range of information to service providers to facilitate procurement of alternative solutions, such as 5-year forecast for loads on zone substations, connections, energy consumption, output of embedded generation, emerging network constraints and risks, planned investment and priority projects. Our proposed investment in DSO capabilities will facilitate our obligations under the Access Code to facilitate alternative solutions.

82. Western Power published its inaugural Network Opportunities Map in October 2021. The report provides:

- a snapshot of the SWIS' condition and our challenges and objectives for the next 10 years
- insight into how Western Power plans, develops and maintains the network and the forecasting methods used to inform this.

83. Western Power assesses all capex against the new facilities investment test (**NFIT**)[17] as part of its IGF. In all cases, we consider which limb of the NFIT is satisfied before undertaking any investment. To ensure the investment program efficiently minimises costs, we also consider deliverability, economies of scale or scope, and forecast movements in market prices of labour and materials. Further information on the development of our capex forecast is provided in section 2.4.

84. The expenditure forecast developed for Western Power's AA5 proposal is drawn from the forecasts produced for the 10-Year Business Outlook. While the capex forecasts have been reviewed and reclassified by regulatory expenditure category for this AA5 proposal, the forward program of work was developed as

14 See section 2.1 of the *Electricity Networks Access Code 2004*

15 See sections 6.51 and 6.51A of the *Electricity Networks Access Code 2004*

16 Western Australian Government, *Electricity Networks Access Code Amendments (No.2) 2020*, WA Government Gazette, No.157, 18 September 2020.

17 See section 6.4.2 of the Access Code.

part of the normal planning process. Western Power does not plan network investment by access arrangement period, rather it is an ongoing annual process.

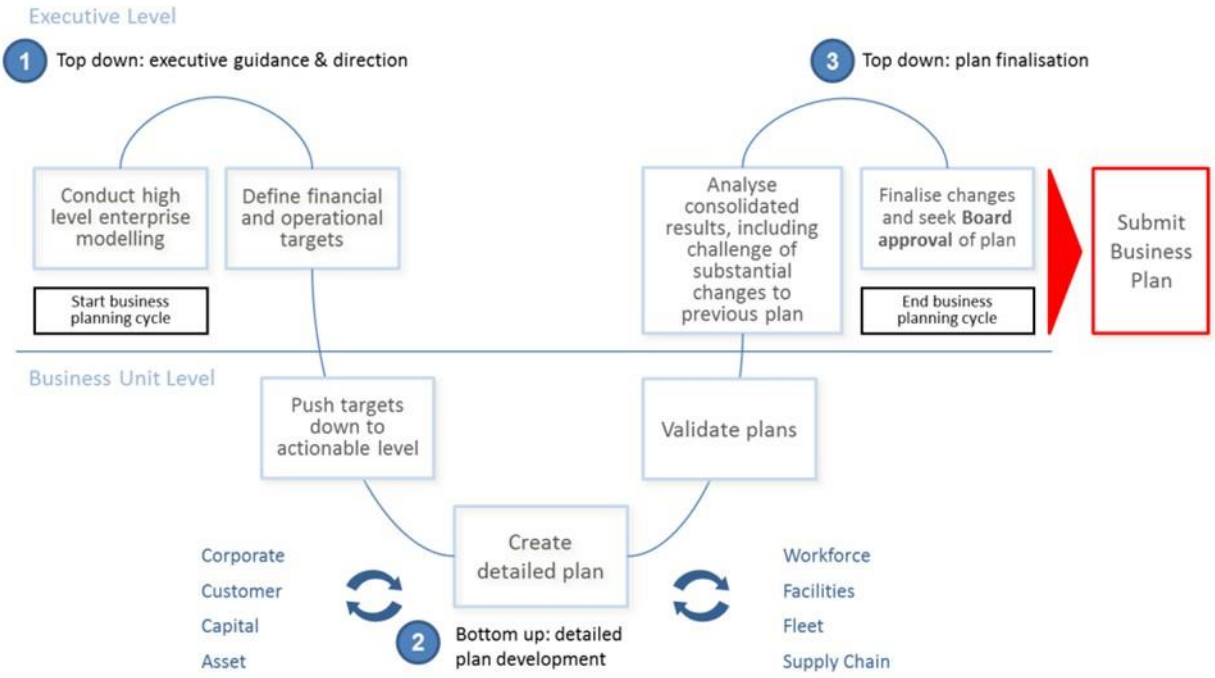
85. The 10-Year Business Outlook is a focal point of our investment process and, in combination with our IGF, helps ensure the expenditure we are undertaking is prudent, efficient, and reflects customer expectations.

2.4 Planning processes

86. The AA5 capex forecast has been developed using the business as usual planning process outlined in Figure 2.1 Western Power's investment planning process uses a combination of bottom up build and top down assessment, tailored for each investment type/asset class. Insights from our customer engagement program have been incorporated into our forecasting methodology and have helped shape our plans for the next five years, and beyond.

87. Figure 2.3 summarises our business as usual approach to business planning and investment governance.

Figure 2.3: Western Power's business planning approach



88. Our business as usual business planning is informed by our AMS, and a suite of strategic documents, including the Network Management Plan and Grid Strategy (see Attachment 8.2 and 8.3 respectively). These key inputs are refined and scrutinised regularly, which means the information in this AA5 proposal has already been subject to considerable challenge internally.

89. In addition to the business as usual planning and governance practices, our AA5 proposal has been subjected to additional assessment. Key features of this include:

- forecasts and historical expenditure are based on robust business cases[18], which have been reviewed for compliance with the Access Code
- all relevant drivers of a particular forecast have been taken into account, and the underlying data used to derive forecasts is provided with this proposal

[18] For those that have reached this point in the investment governance process.

- a wide range of regulatory requirements, for example, safety regulations, environmental regulations and cyber security regulations, are considered
- we have leveraged key experience in the industry to inform our proposal and used independent expert advice to prepare some of our forecast information.

90. Western Power is required to submit its expenditure forecasts by regulatory expenditure categories defined by the ERA. The capex forecasts developed through our business as usual processes have been reclassified by regulatory expenditure category to satisfy this requirement.

91. The following sections provide further information on the development of our capex forecasts for the AA5 period.

2.4.1 Demand forecasts

92. The capex forecast presented in this AA5 proposal is based on demand, energy consumption and customer number forecasts produced as at December 2021.

93. Western Power will update the demand, energy consumption and customer number forecasts as part of the next annual planning process, and this data is expected to be available for our response to the ERA's draft decision on our proposal.

94. Based on recent trends, Western Power does not expect the integration of the most recent forecasts to materially impact our capex forecast for the transmission network, as:

- for the transmission capex program there are few projects that are dependent on the load forecast
- the bulk of the transmission spend is driven by optimised asset replacement, which is agnostic to changes in the load forecast.

95. The forecast capex for the distribution network is generally more sensitive to load growth. Any necessary adjustments to the AA5 period distribution capex forecast will be assessed as part of our annual planning cycle and will be factored into our response to the ERA's draft decision.

2.4.2 Adjusting for movements in the market price of labour

96. Western Power has escalated the capex forecast for forecast growth (on a real basis) in the cost of labour. The labour cost escalations were developed by independent experts Synergies Economic Consulting and is in line with recent ERA assessment. Synergies' report is provided in Attachment 7.3.

2.4.3 Forecasting capital contributions

97. Western Power charges some customers a contribution towards the cost of connection. It also receives gifted assets from certain connecting parties, such as developers of new residential estates.

98. Contributions are charged where the capital costs associated with a new connection are not fully offset by the incremental revenue we expect to be earned from the connection over the relevant period as outlined in the Contributions Policy. The difference between these two amounts is charged as a contribution. This is consistent with the requirements of section 5.14(a) of the Access Code.

99. We have forecast AA5 capital contributions using the same approach used to forecast AA5 period expenditure. For customer-driven capex, we have used average historical expenditure and contributions to estimate likely contributions over the AA5 period. This forecasting approach is consistent with the Access Code and is appropriate given the uncertainty and limited control we have over customer requirements.

100. We have forecast AA5 capital contributions separately for:

- customer initiated transmission capital works
- customer initiated distribution capital works
- the Network Renewal Underground Program (NRUP) works
- the State Underground Power Program (SUPP) works
- gifted assets from developers when new network segments are constructed (e.g. urban subdivisions)
- metering.

101. The method for estimating each form of contribution is as follows:

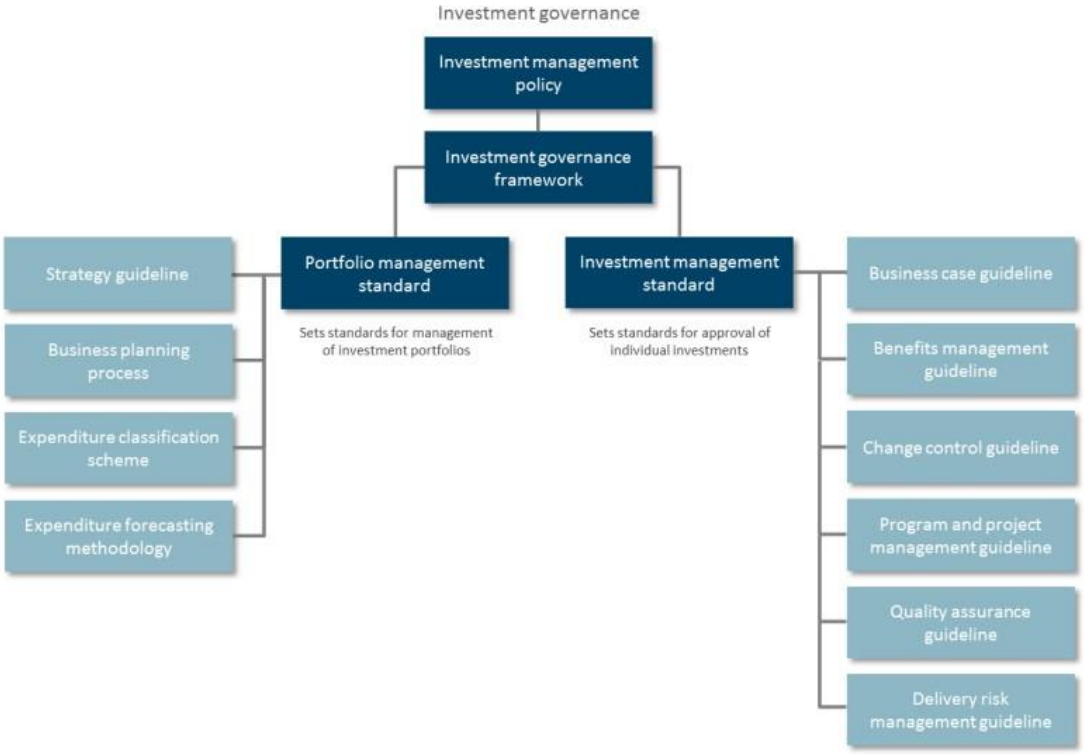
- **Transmission contributions:** Western Power assumes a 100 per cent contribution for transmission customer-driven works (relocations) and 69.5 per cent for transmission customer-driven works (access)
- **Distribution contributions:** Western Power assumes approximately 74 per cent contribution rate for distribution customer-driven works. This reflects the average actual recovery for the past two years
- **NRUP contributions:** Under the NRUP, the customer contribution is the incremental costs of undergrounding relative to a like-for-like replacement of the overhead network
- **Gifted assets:** Western Power forecasts gifted assets based on historical volumes. The gifted assets contribution is based on an internal estimate of the fair value of the construction costs, rather than on the actual cost incurred by the third party. This helps to ensure our assets are appropriately valued and not overstated
- **Metering contributions:** Western Power assumes a contribution rate of 3.5 per cent for standard meters based on historical volumes.

2.4.4 Investment governance

102. Western Power has a comprehensive investment governance structure to ensure our investment decisions are prudent and efficient. The structure is established through the Investment Management Policy, which is supported by the IGF.

103. Figure 2.4 outlines Western Power's investment governance structure.

Figure 2.4: Investment governance structure



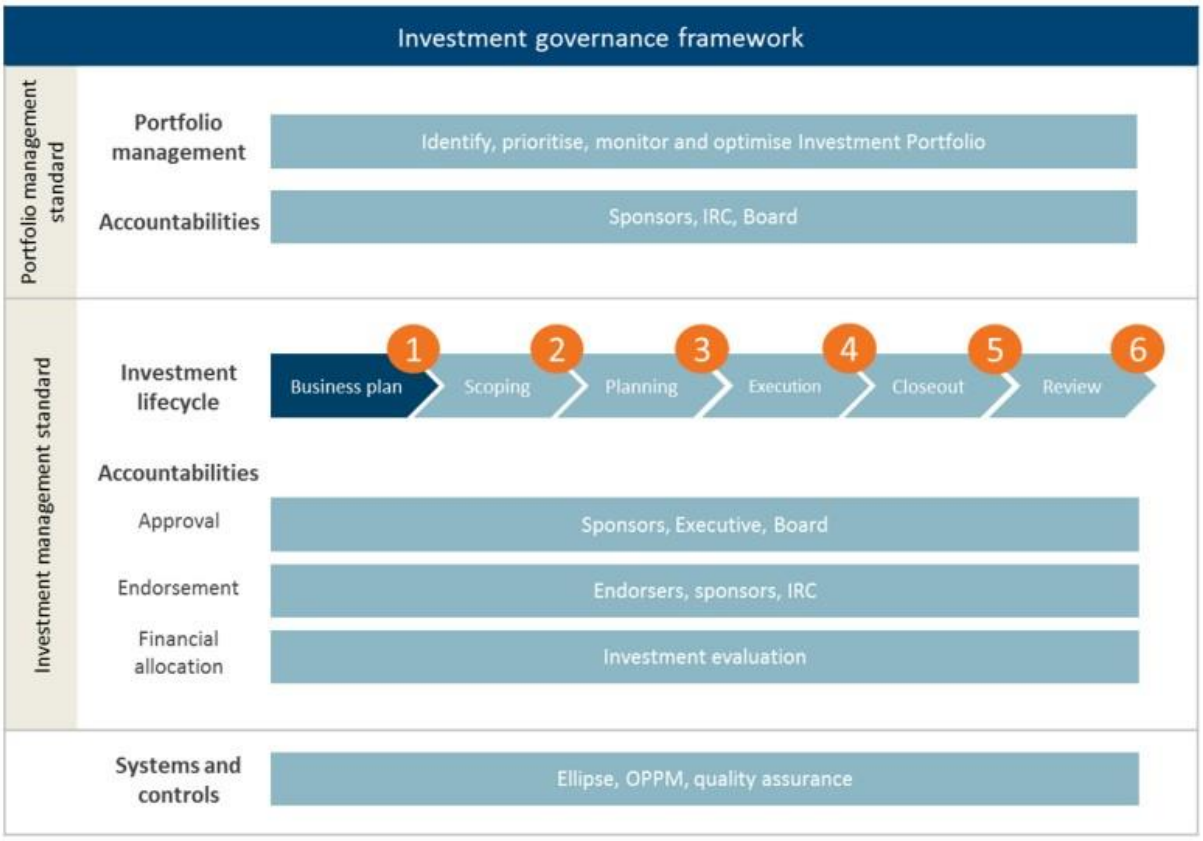
104. The planning process for individual investments is managed through the IGF. This framework outlines the control and governance practices in place to ensure all capital investment proposals are correctly evaluated, approved and, following approval, monitored through their full lifecycle.

105. In summary:

- the development of investments within Western Power is governed by its Asset Management System
- investment governance is maintained through the IGF and the investment governance structure
- investment approvals (business cases) are governed through the Investment Review Committee (**IRC**). This committee comprises executive managers including the Chief Executive Officer and Chief Financial Officer. Ultimate approval of business cases is dependent on levels of delegated financial authority (**DFA**) issued and updated by the Board.

106. The IGF is outlined in Figure 2.5.

Figure 2.5: Investment Governance Framework structure



107. The gated process set out in the framework is designed to implement controls that provide assurance that investments deliver their intended outcomes. The controls are:

- **approval:** this control is designed to ensure there is commitment from an accountable business owner (or sponsor) to deliver specific benefits. Having the same sponsor through the lifecycle of an investment allows continuity and consistency of the validation process. Sponsor approval is aligned to the limits set out in the DFA
- **endorsement:** this control is designed to validate that the quality standards are met by checking each gate's deliverables against their specifications
- **compliance:** this control is designed to ensure that the expenditure meets regulatory requirements, and verifies that allocation of financial resources is prudent, efficient and optimised within and across expenditure categories.

108. Controls are monitored to ensure an audit trail is kept and financial records are duly maintained.

3. Transmission network capex

3.1 Overview of transmission capex

109. The transmission network comprises assets used in the transmission of electrical power at voltages of 66 kV and above. It allows bulk transfer of power between generators and substations and serves both the energy needs of the distribution network as well as customers directly connected at transmission voltage levels such as power generating stations and large industrial consumers of electricity (e.g. refineries).

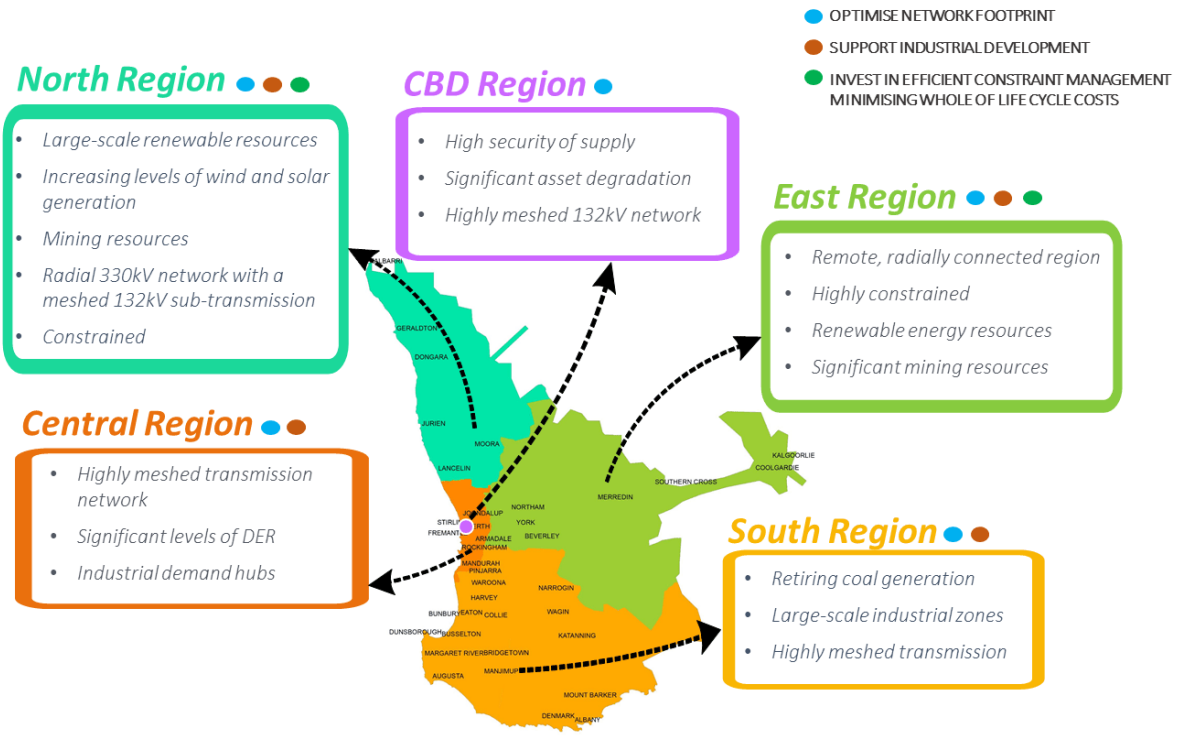
110. A key challenge for the transmission network is the retirement of coal generation, which is shifting the mix of generation from large scale synchronous in the South-East to non-synchronous (i.e. wind and solar) renewable generation in the North and East Country. Augmentations to the transmission system are required to encourage future renewable generation.

111. The transmission network as it exists today is based on second generation design that commenced in the 1950s, when various voltages were introduced to manage the load growth and to cover the vast land area in the SWIN. The reliable operation of the transmission network – which functions as the backbone of the system – is fundamental to ensuring grid stability of the SWIN.

112. Western Power has developed a suite of regional strategies that cover the North, South, Central, East and CBD regions of the Western Power Network. These strategies have been developed to ensure any investment made in these regions is aligned with the future vision for these regions as set out in the Grid Strategy. These regional strategies incorporate asset, customer, stability, and network growth drivers (i.e. load) together with changes in the regional distribution network. The aim is to ensure the most optimal investment outcomes whilst minimising the risk of stranded assets.

113. Figure 3.1 summarises the distinct characteristics and strategic goals for each of the transmission planning regions.

Figure 3.1: Transmission planning regions



114. Internal and external benchmarks indicate that, despite the performance of the transmission network being within committed targets, it has been deteriorating over the past few years. Internal metrics indicate plant functional failures, pole top fires and incidents that cause system disturbances and load loss have been increasing (e.g. 49 per cent more pole top fires and 69 per cent increase in load loss due to power transformer functional failure).

115. The most recent International Transmission Operations and Maintenance Study (ITOMS)[19] performed in 2019, shows that the transmission network has experienced three times as many outages as the average Australian utility. The number of outages reported in this study has increased by 170 per cent in the last four years whilst maintenance costs have increased 20 per cent in the same period.

116. The transmission network topology as well as current operational practices have helped in mitigating the effects of performance issues on individual assets without experiencing any catastrophic system-level event. However, the deteriorating performance of certain asset classes in conjunction with constraints in accessing the network to perform planned maintenance continue to put pressure on network performance as measured by the SSBs.

117. Our key challenge is to balance customer affordability against the scale and age profile of the transmission network. Life extension techniques such as refurbishments, digital asset management techniques and delivery optimisation have underpinned our proposed capex investment plan to ensure current levels of network performance are maintained.

118. The network investment profile reflects the early works required to deliver complex transmission investments with long lead times and realise required in-service dates to mitigate network risk.

119. The proposed investment for the AA5 period years requires an uplift on historic spend to adequately address asset condition and risk associated with the following asset classes:

- **power transformers:** the investment decisions in this category utilise a risk-based framework that accounts for condition and criticality of each asset. The majority of the proposed investment is centred around the application of refurbishment techniques and life extensions in order to manage the condition of as many transformers as possible for the optimum amount of investment.
- **primary plant:** this category accounts for primary plant[20] assets other than power transformers and switchboards within transmission substations. The proposed delivery plan addresses asset condition in the most opportune and cost effective manner by utilising optimised delivery and, where practical, digital technologies and refurbishment.
- **protection:** assets in this category perform the critical function of monitoring abnormal conditions by applying the necessary actions to isolate a failure and prevent it from affecting larger segments of the transmission network. Protection assets are also the last line of defence in mitigating potential safety risks. A large portion of this asset base is obsolete and no longer supported by the manufacturer.
- **other:** additional investments are required to enable customers to keep connecting more generation[21] to the transmission network (e.g. improvements to planning capability), as well as to address emerging grid stability issues caused by the high penetration of renewable resources in the distribution network.

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19 ITOMS is a consortium of Australian and international transmission companies, which was established in 1994 to identify and share industry best practice. A benchmarking survey of members is completed every two years by UMS Group (https://www.umsgroup.com/Americas/What-we-do/Learning-Consortia/ITOMS.html, Accessed 22 August 2021).

20 Transmission substation contain primary plant assets (used in the primary function of transmitting power), secondary system assets (used to support and protect the primary functions) and lines assets (underground and overhead lines network interface)

21 There is minimal additional investment required as Western Power is currently operating under Generator Interim Access (GIA) arrangements, which provides for Western Power to issue curtailment instructions to generators. These arrangements will be in place until constrained access commences in 2023.

120. With the degradation of assets in the network and generally minimal growth rates, there are opportunities available to retire the existing 66 kV transmission network and decommission aged substations reducing ongoing maintenance costs and avoid the need to replace assets. Western Power endeavours to remove all transmission assets where practicable and economically feasible to do so, considering the implications to the residual risk (e.g. environmental impacts from oil leaks).

121. Network maturity is used as a quantitative indicator of the remaining life of a network where factors such as condition, performance, economic value and replacement cost are considered. These are also the key factors that drive the 66 kV rationalisation strategy, which targets the decommissioning of existing 66 kV network assets that are approaching end of life with a smaller number of higher capacity 132 kV assets, effectively reducing the volumes of assets requiring maintenance and operating expenditures.

122. Western Power will invest $745.9 million of capital in the transmission network during the AA5 period, representing 16.1 per cent of the gross Western Power capex. This includes $163.0 million of forecast capital contributions from customers in the AA5 period.

123. Table 3.1 summarises AA5 period forecast transmission capex by regulatory expenditure category.

Table 3.1: AA5 forecast transmission capex by regulatory category, $ million real, 30 June 2022[22]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
Asset replacement and renewal	63.5	62.4	55.9	55.1	56.2	293.2
Growth	88.4	72.9	52.2	51.0	27.2	291.7
Improvement in service	0.0	0.0	0.0	0.0	0.0	0.0
Compliance	36.1	36.8	39.7	26.9	21.5	161.0
Gross capex	**188.0**	**172.1**	**147.9**	**133.0**	**105.0**	**745.9**
Less contributions	57.5	31.3	31.3	31.3	11.7	163.0
AA5 capex to be added to the RAB	**130.5**	**140.9**	**116.6**	**101.7**	**93.3**	**583.0**

124. Figure 3.2 shows how forecast transmission capex for the AA5 period compared with historical levels.

[22] Excluding forecast labour escalation and indirect costs.

Figure 3.2: Comparison of AA4 actual and AA5 forecast transmission capex by regulatory category, $ million real at 30 June 2022

125. Table 3.2 summarises the change in transmission network capex from the AA4 period.

Table 3.2: Comparison of total AA4 and AA5 forecast transmission network capex by regulatory category, $ million real, 30 June 2022[23]

Expenditure category	AA4 Period total	AA5 Period total	% Change from AA4
Asset replacement and renewal	204.4	293.2	43.4%
Growth	355.2	291.7	-17.9%
Improvement in service	2.7	0.0	-100.0%
Compliance	105.9	161.0	52.1%
Gross capex	**668.2**	**745.9**	**11.6%**

126. Forecast transmission capex for the AA5 period is $77.7 million (11.6 per cent) higher than that incurred during the AA4 period. The mix of capex projects has also changed, with a reduction in growth capex compared to the AA4 period and higher investment in asset replacement and compliance projects.

127. Growth related projects accounted for 53 per cent of transmission capex in the AA4 period compared to 39 per cent of forecast transmission capex in the AA5 period. In contrast, asset replacement and renewal capex accounted for only 31 per cent of actual capex in the AA4 period, but is forecast to account for 39 per cent of capex in the AA5 period.

128. The forecasts for the AA5 period are based on optimised asset replacement and capacity expansion planning methodologies, and have been informed by our customer engagement program.

129. All investments are only undertaken where section 6.52(b)[24] of the Access Code is met. The Network Management Plan outlines the asset and risk management practices as well as the strategies that are in place to manage the network assets to ensure the asset management objectives of the covered network are met.

[23] Excluding forecast labour escalation and indirect costs.

[24] The requirement that a new facility provides a net benefit in the covered network over a reasonable period of time.

130. Optimisation of asset replacement to help minimise costs, consistent with the requirements of section 6.52(a)[25] of the Access Code.

3.2 Transmission asset replacement and renewal capex forecast

131. The asset replacement and renewal capex covers expenditure on poor condition or obsolete transmission network assets. This expenditure is necessary to ensure the ongoing safety and security of the transmission network.

132. The transmission network is operating in a more challenging environment to support Western Power's move to a modular grid and integrate DER. These challenges include access to the network to perform maintenance; manage aged and obsolete assets to deliver required outcomes while minimising whole of lifecycle cost; and ensure treatments also cater for transition to decarbonisation.

133. Assets in poor condition or obsolete are targeted for replacement or life extension with a solution that is aligned with Western Power's Corporate Strategy.

134. Western Power uses a risk-based approach to asset renewal. The risk-based approach is informed by asset criticality and condition. Criticality reflects the importance of the asset for the transmission network and the consequences of asset failure while asset condition indicates the likelihood of failure. Assets are selected for treatment based on risk reduction and whole of lifecycle costs.

135. Optimisation activities include bundling renewal and maintenance activities across asset classes as set out in the Asset Management Strategy Standard (**AMSS**). There is also optimisation between different categories of investment such as growth, customer-driven and compliance. Discussion of Western Power's optimisation process for asset replacement and renewal is provided in Chapter six of the Network Management Plan.

136. For the transmission network:

- investment in transmission lines is mostly for maintaining the integrity of the transmission structures. This is primarily driven by safety risks, but also has reliability impacts (for example due to pole top fires or failure of transmission structures)
- investment in plant assets and secondary system assets is primarily driven by workforce safety, network security and reliability risks
- all asset replacement investment improves the integrity of the network assets and therefore also contributes to maintaining the network reliability performance
- capital investment is predominantly targeted at critical assets.

137. Western power will invest $293.2 million in transmission asset replacement during the AA5 period (see Table 3.3).

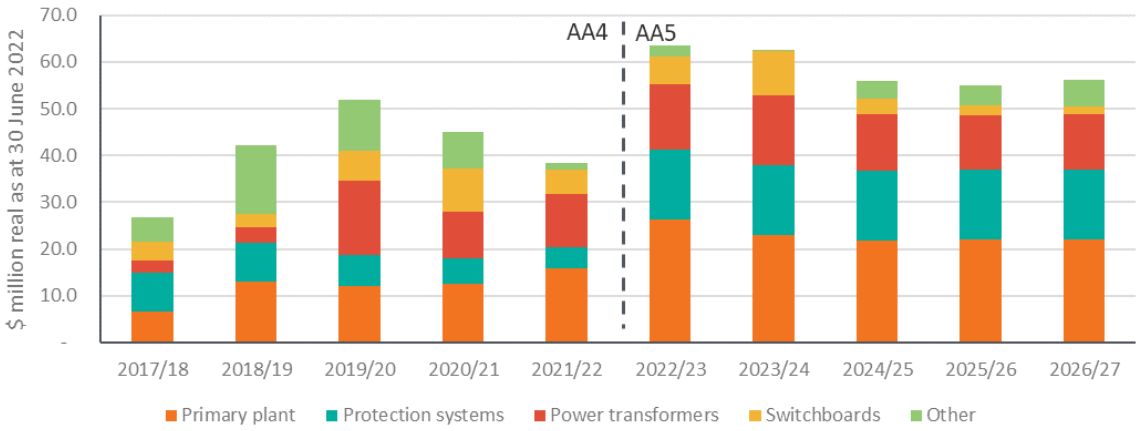
[25] The requirement that the investment does not exceed the amount that would be invested by a service provider efficiently minimising costs.

Table 3.3: AA5 forecast transmission asset replacement and renewal capex, $ million real, 30 June 2022[26]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
Primary plant	26.3	23.0	21.9	22.0	22.0	115.1
Protection – replacement	15.0	15.0	15.0	15.0	15.0	74.8
Power transformers	14.1	15.0	12.0	11.6	11.9	64.5
Switchboards	5.7	9.4	3.4	2.4	1.6	22.5
Other	2.5	0.0	3.7	4.2	5.8	16.3
Gross capex	**63.5**	**62.4**	**55.9**	**55.1**	**56.2**	**293.2**
Less contributions	0.0	0.0	0.0	0.0	0.0	0.0
Net AA5 capex added to RAB	**63.5**	**62.4**	**55.9**	**55.1**	**56.2**	**293.2**

138. The forecast investment in transmission asset replacement and renewal capex in the AA5 period is $88.7 million (43 per cent) more than actual expenditure during the AA4 period (see Figure 3.3).

Figure 3.3: Historical and forecast transmission asset replacement and renewal gross capex, $ million real at 30 June 2022



139. Table 3.4 summarises the change in transmission asset replacement and renewal capex from the AA4 period.

[26] Excluding forecast labour escalation and indirect costs.

Table 3.4: Comparison of total AA4 and AA5 forecast transmission asset replacement and renewal capex, $ million real, 30 June 2022[27]

Expenditure category	AA4 Period total	AA5 Period total	% Change from AA4
Primary plant	60.3	115.1	90.9%
Protection systems	33.2	74.8	125.4%
Power transformers	42.9	64.5	50.3%
Switchboards	27.8	22.5	-19.0%
Other	40.3	16.3	-59.6%
Gross capex	**204.4**	**293.2**	**43.4%**

140. The increase in transmission asset replacement capex compared to the AA4 period is due to three material increases:

- **primary plant**: increase of expenditure (compared to the AA4 period) to address an increase in the number of assets in poor condition; to instal condition monitoring devices to improve Western Power's knowledge of asset condition; and to comply to current design standards (install surge arrester with primary plant)
- **protection:** high replacement rates of protection devices is required during the AA5 period to help maintain network reliability and stability, and to manage asset obsolescence (ensure maintainability). Historically, spend on secondary systems has been low. Forecast expenditure on protection replacement for the AA5 period is $74.8 million, up $41.6 million from the AA4 period
- **power transformers:** increase of expenditure (compared to the AA4 period) to address the increasing number of bad and poor condition transformers. Most (80 per cent - 34 out of 43) transformers are addressed through alternative remediation solutions such as refurbishment.

141. Further information on the forecast asset replacement and renewal capex subcategories is provided in the following sections.

3.2.1 Primary plant

142. Primary plant includes outdoor circuit breakers, instrument transformers, surge arrestors, disconnectors and earth switches. There are four separate asset classes[28], each with their own profile, condition and strategy information.

143. Western Power proposes to invest $115.1 million on primary plant replacement and renewal during the AA5 period. This is 91 per cent higher than the capex incurred in the AA4 period for this expenditure category. Proposed investment is driven by:

- the 19 per cent increase in the number of conditions that require treatment compared to the AA4 period, which is a result of the ageing of the network
- the increase in the number of interruptions and load loss caused by primary plant failure
- a risk of partial or full system black incident if the risk index is not managed below the target[29]

[27] Excluding forecast labour escalation and indirect costs.

[28] Disconnectors and earth switches are in the same asset class, with the same strategy.

[29] The target is the maximum value the index can be to maintain performance. By managing the risk below target, Western Power is maintaining performance at historic levels.

- the need to maintain the risk index of outdoor circuit breakers, instrument transformers, disconnectors and earth switches below the maximum value to avoid a material increase in customers risks (capacity and failure to supply)
- the fact that surge arresters failures would be expected to increase 250 per cent if surge arresters are only replaced on failure
- the potential risk to public and workforce safety from surges affecting primary plant.

144. Limited network access due to internal and external factors and Western Australian (**WA**) labour market have also resulted in an increase to replacement cost for primary plant due to more contingency, more switching, and more time to complete the work due to shorter recall times in a more competitive labour market.

145. The asset renewal strategies for primary plant are risk-based and involve inspections and repairs at regular intervals.

Digital substations

146. Digital substations are online condition monitoring devices.

147. Western Power conducted a 6-month trial that involved the deployment of online condition monitoring devices across several transmission substation assets. The main driver behind this approach was to optimise the use of existing assets while reducing system outage requirements by monitoring asset condition online. It was expected to improve accuracy, accessibility and timeliness of condition and operational data for substation assets to increase reliability, safety, network flexibility and resilience.

148. The scope of the trial included evaluation of technologies that are proven to allow the reduction in cost for plant condition monitoring and maintenance, while preserving or increasing the current level of reliability of this asset base.

149. The trial successfully achieved its objectives and has proven that real-time condition monitoring data of transmission primary assets can be obtained via a digital communication network.

150. Western Power plans to install condition monitoring devices in approximately 40 power transformers during the AA5 period to better plan and optimise for the changing energy landscape.

Outdoor circuit breakers

151. The circuit breaker is a switching device that can make, carry, and break currents under design service conditions (including design short circuit conditions) to connect or disconnect circuits. The state of circuit breakers can be monitored both locally and remotely. Outdoor circuit breakers are subject to environmental factors, which may result in moisture ingress, lightning damage, external interference, pollution, heat stress and mechanical stress.

152. There are 1,591 outdoor circuit breakers in Western Power's fleet. Approximately 13 per cent of the outdoor circuit breakers are operating beyond their Mean Replacement Life (**MRL**). As of 30 June 2020, there were 615 defects awaiting action, of which approximately five per cent is expected to require replacement (at an annual rate of 30).

Instrument transformers

153. Instrument transformers convert current and voltage from its primary levels to secondary levels, of a defined magnitude, frequency and phase to allow the measurement of current and voltage present on the primary circuit. Most instruments are oil-insulated, with SF6 gas being the alternative.

154. There are 6,733 instrument transformers in Western Power's fleet. Approximately 12 per cent of instrument transformers are operating beyond their MRL and consequently are more exposed to the potential effects of electrical and mechanical stresses. As of 30 June 2020, there were 312 defects awaiting action, of which approximately 15 per cent is expected to require replacement (at an annual rate of 48).

Surge arrestors

155. Surge arrestors are protective devices that limit surge voltages by diverting surge currents to earth and thereby preventing exposure of the protected primary plan or line from severe over-voltages. Their application includes protection against lightning surges (non-direct strike), switching surges and transient voltages. This functionality is important for safe and reliable operation of the network.

156. There are 2,392 surge arrestors on the Western Power Network. Approximately 10 per cent of surge arrestors are operating beyond their MRL and consequently have been more exposed to pollutants, corrosion, UV radiation and other stresses, resulting in approximately 16 surge arresters requiring replacement annually. Surge arresters are also installed with other primary plant.

157. Western Power will install surge arresters with primary plant installed in the network (green or brownfield). This mitigates the risks associated with surges caused by lightning strikes, protecting not only the instrument transformers, but also the surrounding equipment. An explosive failure can cause safety impacts from shrapnel, long outages, network instability and high replacement costs due to cascade asset failure.

Disconnectors and earth switches

158. Disconnectors and earth switches are mechanical switches that provide isolation and earthing to un-loaded and un-faulted equipment, circuits, plants and busbars. They are critical for the safe and reliable operation of the transmission network.

159. There are 10,423 disconnectors and earth switches on the transmission network. Approximately nine per cent of disconnectors are operating beyond their MRL. As of 30 June 2020, there are 740 disconnector and earth switches defects, of which approximately 5 per cent require replacement (at an annual rate of 39).

160. The asset renewal investment in the AA5 period will target the 66 kV and 132 kV networks, which are reaching the end of life. This will leverage the network rationalisation and standardisation strategies to identify situations where substations will be decommissioned or assets converted from 66 kV to 132 kV and implement solutions that facilitate these network strategies.

3.2.1 Protection - replacement

161. Protection assets consist of protection and control relays, fault recorders, operational metering, battery banks and AC systems in the substations. Assets in this category perform the critical function of monitoring abnormal conditions and applying the necessary actions to isolate a failure and prevent it from affecting larger segments of the transmission network.

162. There are 11,086 protection relays on the Western Power Network.

163. Western Power proposes to invest $74.8 million in protection asset replacement and renewal during the AA5 period. The main drivers for the proposed protections systems investment are:

- approximately one-third of the fleet is obsolete without manufacturer support and with limited industry skills to perform repairs
- around 43 per cent of the fleet is beyond the MRL

- obsolete relays not having all the functionalities required to operate a contemporary network
- high safety risk due to potentially catastrophic consequences of a failure of the main and back up protection
- inability to limit the impact of faults on the network
- compliance with the Access Code and Technical Rules.

164. Failures associated with this asset class typically cause extended outages and lead to unsecure network states. Minimal investment was allocated to this category in the AA4 period and the proposed investment is necessary to meet safety and reliability objectives. Without treatment, there will be an increase to the risk of failures and the associated consequences.

3.2.2 Power transformers

165. Power transformers convert electrical power from one level of voltage and current to another. By increasing voltage and reducing current, they minimise losses and enable the efficient and affordable transmission of power. They also provide fault and earth current reference for the protection devices on the transmission and distribution network.

166. Western Power proposes to invest $64.5 million on transformer replacement and renewal during the AA5 period.

167. The network has 332 in-service power transformers, 19 spare transformers and 4 rapid response transformers.

168. Power transformers have a medium impact on reliability or safety of the network but have significant impact on system security and compliance. Western Power's strategy is to mitigate the risks due to failure of these assets based on their condition and criticality. Where the condition has been assessed as bad or poor, Western Power can either replace or refurbish the transformer if practical (and effective).

169. As of 30 June 2020, approximately 27 per cent of the power transformer population was categorised as poor or bad, requiring major intervention (replace or refurbish). This issue is compounded by:

- an ageing asset population, particularly on the 66 kV network where 21 per cent of power transformers are operating beyond their MRL
- limited manufacturer support, with eight per cent of assets without support available
- environmental risks from insufficient bunding required to prevent oil leaks
- pitch-filled cable boxes that are at risk of explosive failure
- increasingly constrained access to the network, making it more difficult to access the transformers for maintenance and refurbishment.

170. As the network is divided into regions with different characteristics and network strategies, and the supply of electricity changes towards more decentralised generation with increasing reliance on renewable energy, the power transformer fleet is likely to be submitted to more demanding operational requirements while investments must be carefully considered and aligned with the future vision of the region.

171. The investment decisions for power transformers utilise a risk-based framework that accounts for asset condition, criticality and lifecycle strategy. The majority of the investment is centred around the application of refurbishment techniques in order to manage the condition of as many transformers as possible for the optimum amount of investment. For example, if a transformer is approaching its end of life and is

scheduled to be decommissioned in the future, the intention is to extend its asset life via refurbishment (rather than replace). Network driven growth is factored in these decisions to optimise asset replacements.

172. Failure of transmission assets and their potential failure contribute to unplanned network outages and place pressure on network performance and system security. Over a 10-year period with no treatment of the above assets, more failures will occur which will pose a threat for Western Power's ability to manage the network and fulfill its licence obligations. It is expected that without treatment, the resulting increase in failures would result in negative reliability impacts (i.e. an increase in frequency and duration of outages) and instability of the transmission network (presenting system security challenges). This would result in increased likelihood of system black type events due to the tendency of transmission asset failures to have flow-on effects on the network.

173. Western Power intends to replace 13 transformers, refurbish 36 and purchase two spares during the AA5 period.

3.2.3 Switchboards

174. Transmission indoor main switchboards and gas insulated switchgear provide switching and isolation between the transmission and distribution networks. Switchboards consist of a variety of switching and interrupting equipment and associated control, metering, monitoring and protective devices mounted to one or more switchboard panels. Their function is critical to the safety and reliability of the network as well as in protecting critical equipment during network faults.

175. Western Power proposes to invest $22.5 million in switchboards during the AA5 period.

176. The proposed investment in switchboards in the AA5 period is 18.1 per cent lower than the actual capex on switchboards in the AA4 period. Western Power conducted a review of treatment options and has identified an option of managing the risk with refurbishment and spares management, leading to a significant cost reduction to extend the life of the assets.

177. Leveraging improvements in asset condition monitoring technologies, Western Power has implemented mobile inspections for transmission plant assets, which allows electronic recording of conditions and standard job assignment.

178. Approximately eight per cent of the 129 switchboards in Western Power's fleet are operating beyond their MRL and are therefore more vulnerable to age-related failure modes. It should be noted that the switchboard asset renewal strategy is risk-based (rather than age-based) and involves inspections and repairs at regular intervals. By placing emphasis on condition rather than age, this risk-based approach avoids potential overspend on assets that are aged, but in reasonable condition.

179. Western Power has two types of obsolete switchboards in its fleet with limited manufacturer support. At the commencement of the AA5 period, there will be five obsolete switchboards operating in the transmission network and a further two switchboards are approaching their MRL with limited manufacturer support. Given the importance of the switchboards and potential reliability consequences from failure, the risk of operating these assets without intervention is unacceptable. Western Power will manage these risks through a combination of refurbishments, replacements and acquisition of spares for critical components.

180. Western Power's strategy is to mitigate the risks due to failure of these assets based on their condition, criticality and maintainability. During the AA5 period, Western Power will:

- replace three switchboards, refurbish 12 and purchase four spares
- monitor the condition of switchboards via routine maintenance and repair/treat defects prioritised by risk

- purchase one spare mobile switchboard which can be deployed rapidly in the event of switchboard failure
- maintain a stock of component spares in inventory based on assigned minimum and maximum stock on hand values.

3.2.4 Other transmission network assets

181. Western Power plans to invest $16.3 million in other transmission asset replacement and renewal in the AA5 period. This relates primarily to investment in replacement and renewal of transmission conductors and static vars compensators (**SVCs**).

182. All overhead transmission conductors are operating within their MRL and will remain within their MRL for the duration of the AA5 period. Nevertheless, Western Power plans to undertake one conductor replacement project in the latter half of the AA5 period as conditions requiring replacement are expected to manifest as conductors approach their MRL (conductors will start reaching MRL in the AA6 period).

183. Western Power plans to complete the replacement of the West Kalgoorlie Terminal SVC and commence the replacement of the Southern Terminal SVC secondary system in the AA5 period. SVCs are an integral part of providing dynamic reactive power on the high voltage network. Failure to replace SVCs at the end of their life will jeopardise Western Power's ability to control the voltage, harmonics and stability of the transmission system.

3.3 Transmission growth capex forecast

184. Growth capex is generally focused on increasing the capacity of existing assets or the construction of new assets to meet growth in demand, which is primarily driven by forecasts of energy demand and customer growth and the optimisation of assets (e.g. replacement of an ageing substation in one location with a new substation in a different location). These investments are influenced by the network strategies for the regions and are optimised against asset condition drivers, the retirement of the aged 66 kV network and the de-meshing of the 132 kV networks.

185. Western Power will invest $291.7 million in transmission growth projects during the AA5 period, including $163.0 million in capital contributions (see Table 3.5).

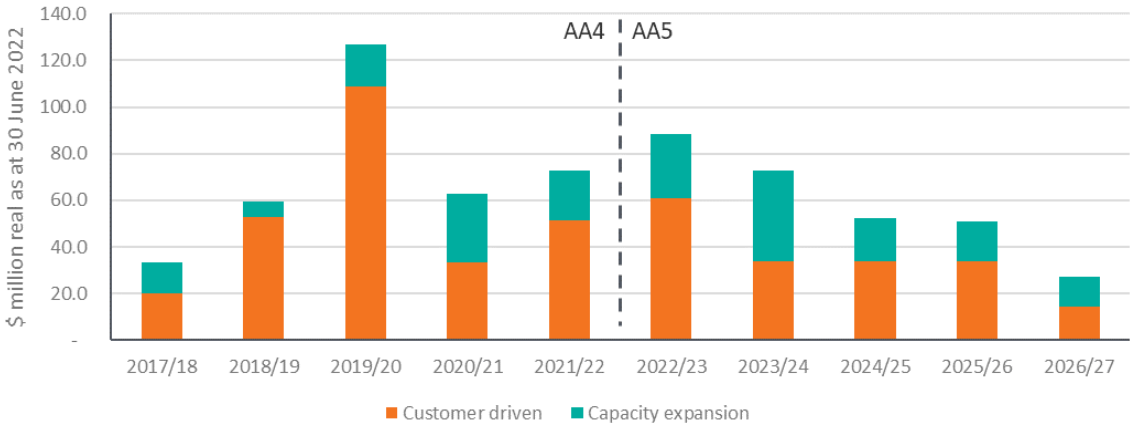
Table 3.5: AA5 forecast transmission growth capex, $ million real, 30 June 2022[30]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
Capacity expansion	61.0	34.0	34.0	34.0	14.5	177.6
Customer-driven	27.4	38.9	18.2	16.9	12.8	114.2
Gross capex	**88.4**	**72.9**	**52.2**	**51.0**	**27.2**	**291.7**
Less contributions	57.5	31.3	31.3	31.3	11.7	163.0
Net AA5 capex added to RAB	**30.8**	**41.7**	**21.0**	**19.7**	**15.6**	**128.8**

30 Excluding forecast labour escalation and indirect costs.

186. The forecast investment for the AA5 period is $63.5 million (18 per cent) less than that incurred in the AA4 period (see Figure 3.4).

Figure 3.4: Historical and forecast transmission growth gross capex, $ million real at 30 June 2022



187. Table 3.6 summarises the change in growth capex for the transmission network from the AA4 period.

Table 3.6: Comparison of total AA4 and AA5 forecast growth capex by regulatory category, $ million real, 30 June 2022[31]

Expenditure category	AA4 Period total	AA5 Period total	% Change from AA4
Customer driven	267.0	177.6	-33.5%
Capacity expansion	88.2	114.2	29.4%
Gross capex	**355.2**	**291.7**	**-17.9%**

188. Approximately 61 per cent of forecast transmission growth capex for the AA5 period is for customer driven projects, with the balance being for capacity expansion. Further information on the forecast growth capex subcategories is provided in the following sections.

3.3.1 Customer driven

189. The customer driven expenditure category comprises all the capex required to augment the transmission network to facilitate customer access or customer driven projects. In terms of access, this includes where customers seek to connect new facilities and equipment, increase consumption or generation at an existing connection point, or modify their existing facilities. Facilitating customer driven projects predominantly involves asset relocations. For the transmission network, projects typically relate to network extensions to connect generation or to cater for larger industrial customers.

190. Western Power is required to use all reasonable endeavours to provide network access to customers, while remaining compliant with the Technical Rules and safety requirements. Customer driven capex is entirely shaped by customer requirements and is inherently difficult to forecast. This is because customer driven capex tends to be heavily influenced by overarching economic conditions and trends in specific industry types.

[31] Excluding forecast labour escalation and indirect costs.

191. Western Power regularly engages with stakeholders regarding potential new loads and other impacts on the transmission network. We have recently been working closely with customers at the extremities of the grid to facilitate access and understand future connection requirements.

192. The customer driven expenditure category comprises all the capex required to augment the transmission network to facilitate customer access. This includes where customers seek to connect facilities and equipment or increase consumption or generation at a new connection point or modify their facilities.

193. Western Power proposes to invest $177.6 million during the AA5 period on transmission customer driven projects, including contributions of $163.09 million. The proposed investment is primarily for relocations ($129.7 million, 73 per cent), with the balance being for transmission access projects ($47.8 million, 27 per cent).

194. Table 3.7 shows forecast transmission customer driven growth capex for the AA5 period.

Table 3.7: AA5 forecast transmission growth (customer driven) capex, $ million real, 30 June 2022[32]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
Transmission access	11.2	9.2	9.2	9.2	9.2	47.8
Transmission relocations	49.7	24.9	24.9	24.9	5.3	129.7
Gross capex	**61.0**	**34.0**	**34.0**	**34.0**	**14.5**	**177.6**
Less contributions	57.5	31.3	31.3	31.3	11.7	163.0
Net AA5 capex added to RAB	**3.4**	**2.8**	**2.8**	**2.8**	**2.8**	**14.6**

195. The key customer driven projects for the AA5 period are:

- Undergrounding relating to the East Perth Power Station redevelopment project. The undergrounding will be 100 per cent customer funded and has a required in service date of December 2022
- Relocation of assets to facilitate the Oat Street level Crossing Removal project, which is part of the economic stimulus package (**ESP**) for Metronet. This project will be 100 per cent customer funded and has a required in service date of November 2022.

196. The proposed investment for customer driven projects in the AA5 period also includes $78.3 million for the relocation of transmission assets to support the WA Government's ESP.[33]

197. The remaining forecast for other customer funded projects, both major and minor, is based on historical trends as information about individual projects becomes less certain over the medium to longer term.

3.3.2 Capacity expansion

198. Capacity expansion investment for the transmission network is focused on optimising against asset condition and region strategies. Given the age of the transmission network, a significant portion of the 66 kV networks are approaching their MRL. Therefore, a common underlying theme in these regions is the need to decommission aged 66 kV networks and associated zone substations and maximise the utilisation

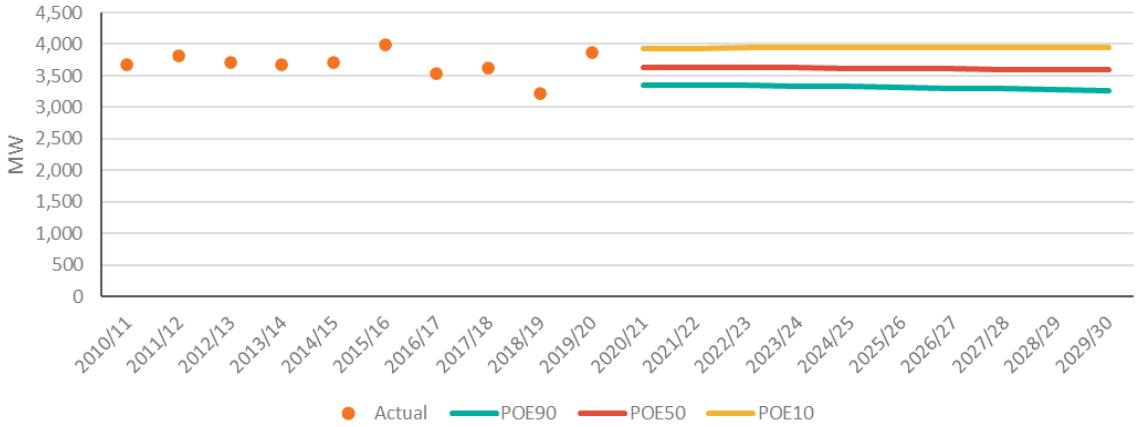
32 Excluding forecast labour escalation and indirect costs.

33 Further information on the ESP is available from the WA Government website: COVID-19 coronavirus: Western Australian Government response (www.wa.gov.au)

of the higher voltage networks. This is further emphasised by the concept of de-meshing networks which balances the utilisation between 132 kV and 330 kV networks. This will also facilitate new customer connections providing for the 'right-size' network to meet customer needs.

199. While peak demand has historically been a key driver of capacity expansion capex, peak demand growth rates have been falling for the past 10 years. For the 10 years from 2021/22, the Australian Energy Market Operator (**AEMO**) is forecasting peak demand in the Wholesale Electricity Market (**WEM**) to increase at an average annual rate of just 0.2 per cent (in the expected demand growth scenario), with a range of -1.0 per cent (low demand growth) and 1.7 per cent (high demand growth (see Figure 3.5).

Figure 3.5: Peak demand growth projections



200. The flattening of peak demand growth in recent years is due to decreasing economic activity in WA (particularly in the resources sector), the uptake of rooftop solar generation, improved efficiency of electrical appliance and changes in consumer behaviour.

201. Western Power is forecasting peak demand to fall slightly over the AA5 period under both the low and (POE90) and medium (POE50) demand scenarios, and to remain flat under the high (POE10) demand scenario.

202. Western Power will invest $114.2 million during the AA5 period on transmission capacity expansion projects. The proposed investment is primarily for supply projects ($104.0 million, 91 per cent), with the balance being for distribution-driven projects, thermal management and voltage management.

203. Table 3.8 shows forecast transmission capacity expansion growth capex for the AA5 period.

Table 3.8: AA5 forecast transmission growth (capacity expansion) capex, $ million real, 30 June 2022[34]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
Distribution driven	0.7	0.0	0.1	0.8	0.8	2.3
Supply	26.0	37.9	18.1	14.8	7.3	104.0
Thermal management	0.3	0.2	0.0	0.0	0.0	0.5
Voltage management	0.4	0.8	0.0	1.4	4.8	7.3
Gross capex	**27.4**	**38.9**	**18.2**	**16.9**	**12.8**	**114.2**
Less contributions	0.0	0.0	0.0	0.0	0.0	0.0
Net AA5 capex added to RAB	**27.4**	**38.9**	**18.2**	**16.9**	**12.8**	**114.2**

204. The key supply projects for the AA5 period are:

- installation of transformers:
  - installation of a third 132/22 kV transformer at Black Flag substation to address a current capacity short fall and N-1 non-compliance, whilst enabling new customer connections given the significant growth in customer demands. The required in-service date is 2025/26
  - installation of a third 132/11 kV transformer at Cook Street substation to facilitate the decommissioning of Wellington Zone substation and East Perth 66 kV switchyard and incentivise new customer connections at Perth City Link and Edith Cowan University CBD campus. This project is interlinked with the East Perth Power Station redevelopment, which is a priority project for the WA Government. The required in-service date is 2023/24
  - installation of a new 330/132 kV transformer at the Kemerton terminal substation to address the asset condition issues of the existing transformer. This transformer has been assessed as having the maximum criticality score for post failure fault response compared to all other transformers on the network. The transformer will facilitate new growth opportunities such as Abermarle and reference services to Bininup. The required in-service date is 2021/22
  - installation of a third 132/22 kV transformer at Henley Brook substation to address approximately 8 MW of capacity short fall under N-1 conditions. The required in-service date is 2027/28
  - Installation of a third 132/22 kV transformer at Clarkson substation to address approximately 6 MW of capacity short fall under N-1 conditions. The required in-service date is 2026/27
- installation of new transmission lines:
  - a new 132 kV connection between Kwinana and Leith Rd Substation which will provide reliability to existing customers, facilitating network security and future network de-mesh plans for the Kwinana load area. The required in-service date is 2023/24
- asset decommissioning / retirement:
  - decommissioning of Coolup substation and the Picton to Coolup (PIC-CLP 71) 66 kV transmission line (70 km) due to asset condition issues and low demand forecasts (~6 MVA). This demand at

[34] Excluding forecast labour escalation and indirect costs.

Coolup will be resupplied from the adjacent Wagerup substation. The required in-service date is 2024/25

- decommissioning of Mundaring Weir substation and the transmission lines from Cannington Terminal to Northam substation (total 88 km) due to low demand forecasts. The required in-service date is 2023/24

- grid stability:
  - investment in solutions (such as Wide Area Monitoring Protection & Control) to provide increased visibility on the network and allow for more informed operational and planning investment decisions. Greater visibility will enable Western Power to more effectively identify and implement risk mitigation solutions to address grid stability challenges resulting from having limited to no visibility on issues of system strength.

205. Western Power also plans to invest $15.0 million to increase capacity at Busselton and Capel by installing reactive support at Busselton for voltage management. Assets in poor condition will be addressed whilst these works are being conducted. Initial plans for the 132 kV conversion of the existing 66 kV transmission line between Picton and Busselton substations have been deferred to AA6 (deferment of $40 million) based on the application of prudent risk-based planning techniques.

206. The proposed investment in the AA5 period is informed by the Western Power 66 kV Rationalisation Strategy, which provides guidance on investment decisions related to the replacement of the 66 kV networks. It highlights the opportunities that are available to reduce costs when replacing the 66 kV networks with a smaller number of higher capacity 132 kV assets. In the long term, it is anticipated that all the 66 kV assets will be removed from the network, reducing the volume of assets requiring maintenance.

207. Most of the 66 kV networks are at or near their MRL and, in some cases, their design capacity levels. As a result, a portion of 66 kV network assets will require replacement in the short to medium-term. This provides an opportunity to improve the medium to long term affordability by converting to a higher capacity 132 kV network, and at the same time reducing the number of assets to replace and maintain.

3.4 Transmission improvement in service capex forecast[35]

208. This expenditure category covers reliability-driven capex that is designed to achieve improvements in reliability and power quality service standard targets for the transmission network.

209. In line with customer feedback, Western Power does not plan to increase the reliability and power quality standards during the AA5 period and, hence, no additional investment is required for improvement in service.

210. Western Power notes that forecast investment to meet current reliability and power quality standards is included in the asset replacement and renewal expenditure category. Furthermore, the investment in the modular grid and the technologies therein (i.e. SPS and microgrids) will significantly improve the level of reliability and resilience and this will be delivered with a lower cost technology than traditional poles and wires (due to the long rural feeders required to service customers dispersed over large distances).

3.5 Transmission compliance capex forecast

211. Western Power has a range of compliance obligations relating to safety, environmental, power quality, and network security obligations for the transmission network, including under the following instruments:

[35] Excluding SCADA and Telecommunications, which is covered in Section 5

- *Electricity (Supply Standards and System Safety) Regulations 2001*
- *Electricity (Network Safety) Regulations 2015*
- *Electricity Industry (Network Quality and Reliability of Supply) Code 2005*
- Technical Rules.

212. Forecast capex on transmission compliance requirements during the AA5 period is $161.0 million (see Table 3.9).

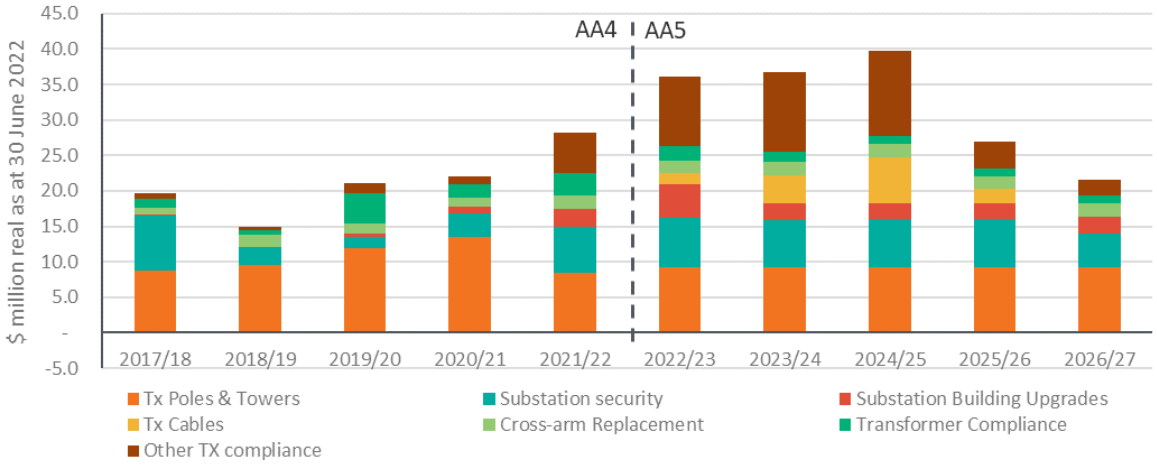
Table 3.9: AA5 forecast transmission compliance capex, $ million real, 30 June 2022[36]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
Tx Poles & Towers	9.3	9.3	9.3	9.3	9.3	46.3
Substation security	6.9	6.7	6.7	6.7	4.8	31.8
Substation Building Upgrades	4.8	2.3	2.3	2.3	2.4	14.0
Tx Cables	1.5	4.0	6.5	2.0	0.0	14.0
Cross-arm Replacement	1.9	1.9	1.9	1.9	1.9	9.3
Transformer Compliance	2.1	1.5	1.1	1.0	1.0	6.7
Other TX compliance	9.7	11.2	12.0	3.8	2.2	38.9
Gross capex	**36.1**	**36.8**	**39.7**	**26.9**	**21.5**	**161.0**
Less contributions	0.0	0.0	0.0	0.0	0.0	0.0
Net AA5 capex added to RAB	**36.1**	**36.8**	**39.7**	**26.9**	**21.5**	**161.0**

213. The forecast investment in the AA5 period is $55.1 million (52.1 per cent) more than that incurred during the AA4 period (see Figure 3.6).

[36] Excluding forecast labour escalation and indirect costs.

Figure 3.6: Comparison of AA4 actual and AA5 forecast transmission compliance capex



214. Table 3.10 summarises the change in transmission compliance capex from the AA4 period.

Table 3.10: Comparison of total AA4 and AA5 forecast transmission compliance capex by regulatory category, $ million real, 30 June 2022[37]

Expenditure category	AA4 Period total	AA5 Period total	% Change from AA4
Tx Poles & Towers	52.4	46.3	-11.6%
Substation security	21.3	31.8	49.0%
Substation Building Upgrades	4.3	14.0	228.7%
Tx Cables	0.0	14.0	n.a.
Cross-arm Replacement	7.4	9.3	26.1%
Transformer Compliance	11.1	6.7	-39.6%
Other TX compliance	9.5	38.9	311.6%
Gross capex	**105.9**	**161.0**	**52.1%**

215. The increase in transmission compliance capex during the AA5 period is due to mainly to increases in transmission cable compliances and other transmission compliance (such as asbestos removal and substation security).

216. Proposed transmission compliance capex projects are detailed below.

3.5.1 Poles and towers (compliance)

217. Western Power will invest $46.3 million in transmission poles and towers replacement and reinforcement to meet compliance requirements in the AA5 period.

218. This activity covers treatment (replacement and reinforcement) of transmission wood poles. This program addresses Western Power's obligations under:

[37] Excluding forecast labour escalation and indirect costs.

- Part 4 of the *Electrical (Supply Standards and System Safety) Regulations 2001* to operate and maintain a safe and reliable transmission network by minimising public safety risk from asset failure in the transmission overhead network and maximisation of reliability performance
- *Electricity (Network Safety) Regulations 2015* to adopt AS5577 (2013) ENSMS and 'eliminate safety risks so far as is reasonably practicable (SFAIRP), and if it is not reasonably practicable to do so, reduce those risks to as low as reasonably practicable' (i.e. ALARP).

219. Transmission structures support overhead conductor and/or equipment in the overhead transmission network to provide:

- safe electrical and physical clearances (vertical and horizontal) from the ground and other conducting equipment
- mechanical strength to withstand forces (e.g. short circuit, wind).

220. Transmission structures include wood poles, non-wood poles (steel, concrete), auspoles (steel butted wood poles), steel lattice towers, crossarms / crossbeams (steel, wood), stay systems, foundation systems and insulators. Transmission structures are installed in lines with voltages between 66 kV and 330 kV (and four 33 kV lines).

221. The poles and structures in the transmission network include:

- 26,565 wood poles (including auspoles). Approximately 2% of transmission wood poles are operating beyond their MRL and are therefore more exposed to deterioration (fungus, termites, carroty rot, etc)
- 6,892 non-wood poles. Approximately 1% of transmission non-wood poles are operating beyond their MRL. These poles are more exposed to corrosion deterioration
- 6,417 lattice towers on Western Power's fleet. No lattice tower is operating beyond its MRL.

222. Defects treated by capex investment are normally identified in wood poles. Non-wood poles and lattice towers are mostly treated through repairs (i.e. opex). As treatments require line outage, maintenance is impacted by an increasingly challenging access to the network.

223. Transmission poles and tower conditions are treated based on risk, with a combination of condition (replacement and reinforcement) treatments. As of 30 June 2020, 7,450 wood poles had defects, of which six per cent are expected to required capex treatment. Approximately eight per cent of the wood pole population will require age-based reinforcement in the AA5 period.

224. The detection rate of poles requiring reinforcement has been declining in the second half of AA4, therefore the volumes for pole reinforcement have reduced and this is reflected in the network plan. Poles marked for reinforcement or replacement in extreme and high fire risk zones are treated before the start of the bushfire season (treated by 30 of November).

3.5.2 Substation security (compliance)

225. Western Power will invest $31.8 million in transmission substation security to meet compliance requirements in the AA5 period. This includes investments in:

- **security fence replacements:** to replace substation fences that have reached the end of their economic life and are due for replacement or fences that have a high risk of unassisted failures. This also includes replacing poor condition and non-conforming fence types with best industry practice fence types. Compliant security fencing is also an important barrier for preventing access to substations by those who seek to commit vandalism or self-harm. Western Power has a duty of care to ensure members of the public cannot gain access into substations for both safety and security reasons

- **Electronic Access Control (EAC):** which are required to provide the right level of authorised and manageable access into substations
- **closed circuit television (CCTV) systems:** which provide data for security incident analysis and provide support to security guard management. CCTV analytics systems automatically analyse CCTV footage for "out of band" motion, reducing the number of security guards required
- **key management system:** which provides accurate and secured substation key access by gradually migrating from a mechanical key system to an electronic access card system, which allows for better access control. This mitigates the risk of substation break-ins.

226. Substation buildings and grounds are essential facilities that house primary and secondary substation equipment. Substations must comply with the National Guidelines for Protecting Critical Infrastructure from Terrorism and the proposed reforms to the requirements of the *Security of Critical Infrastructure Act 2018* which are anticipated to come into effect in AA5, as well as the statutory requirements applicable for buildings, workforce safety and building envelop.

227. Without this investment, substations would be vulnerable to unauthorised access (break-ins and opportunistic), which could lead to safety incidents causing harm to intruders and the public. It would expose primary and secondary systems to failure due to physical tampering (e.g. copper theft) or cyber-attacks, potentially causing major outages, network instability and further safety incidents.

3.5.3 Substation building upgrades (compliance)

228. Western Power will invest $14.0 million in transmission substation building upgrades to meet compliance requirements in the AA5 period. This includes investments in:

- **Very Early Smoke Detection Apparatus (VESDA) systems replacement:** to meet statutory requirements for VESDA systems calibration every 10 years. These systems are replaced every 10 years
- **Fire Indicator Panel (FIP) upgrade works to VESDA systems:** where the FIPs have become obsolete and require upgrading to VESDA systems
- **new FIP / VESDA systems installations:** for those sites that currently do not have fire systems but will require one in the future
- **structure defects rectification works:** which are required to mitigate against structural collapse, which is a high safety and reliability risk, which also impacts Western Power's financial exposure and reputation.

229. This investment addresses Western Power's obligations under the *Electricity (Network Safety) Regulations 2015* to eliminate safety risks to SFAIRP or ALARP. It is required to provide early fire detection, which will protect the network equipment from damage and continue to maintain network reliability. Treatment of structural defects will prevent catastrophic consequences from occurring, thus maintaining current performance.

230. The forecast investment in substation compliance in the AA5 period includes $4.6 million for the removal of asbestos, which is a key safety concern. Western Power plans to address asbestos removal at a rate of 30 sites per annum.

3.5.4 Transmission cables (compliance)

231. Western Power will invest $14.0 million in transmission cables to meet compliance requirements in the AA5 period.

232. This includes replacement of transmission underground cables (including fluid filled cables) that are aged, present poor performance (reliability / availability / environment) and can no longer be cost efficiently maintained using opex treatments. It also includes replacement of cable accessories, such as joints and terminations and the pressuring equipment used to monitor the fluid within the cable at a positive pressure.

233. There is a total of 55.9 km of underground transmission cables in the Western Power Network. Approximately 29 per cent of the underground cables (by network length) are operating beyond their MRL. Western Power has identified eight cable circuits that need to be replaced. Of these, six will be decommissioned and two will be replaced during the AA5 period.

234. Western Power is obligated under the *Electrical (Supply Standards and System Safety) Regulations 2001* to maintain the safety and reliability of the network. Assets with known issues, active failure modes, obsolescence and deteriorated conditions have higher likelihood of failure and has an adverse impact on reliability, safety, and environment. The risk of Western Power not meeting its obligation under the Code is "high". Therefore, investment is required to maintain safety and reliability of the network.

235. This program addresses Western Power's obligations under Part 4 of the *Electrical (Supply Standards and System Safety) Regulations 2001*.

3.5.5 Other transmission compliance

236. Other transmission compliance investments for the AA5 period include:

- **cross arm replacements** ($9.3 million): which involves the replacement of transmission cross arms and cross beams, based on condition and prioritised risk. This investment is required to meet Western Power's asset and business objectives as well as obligations under the *Electrical (Supply Standards and System Safety) Regulation 2001* (Part 4)
- **transformer compliance** ($6.7 million): which covers a combination of noise mitigation, bunding and fire wall works. Noise mitigation works are required to comply with the Environmental Protection Authority and Department of Environment and Conversation's *Protection (Noise) Regulations 1997* and the *Electricity (Network Safety) Regulations 2015*. Bunding involves installing or sealing bunds of transmission transformers at brownfields sites to address environmental legislation compliance. Fire wall works provide for the erection of a fire wall between close proximity transformers, thus minimising the risk of fire spreading from one asset to the next
- **other** ($38.9 million): which is focused primarily on the implementation of the grid stability toolkit, under frequency load shedding (**UFLS**) mitigation, integrated grid planning systems, network monitoring and remote black start operations.

4. Distribution network capex

4.1 Overview of distribution capex

237. The distribution network transports electricity from zone substations to individual customers at voltages ranging from 240 V to 33 kV. The distribution network investment is made up of two distinct categories:

- overhead corridor (structures, overhead conductors, pole mounted equipment)
- ground mounted plant, service connections, public lighting and underground cables.

238. Our key challenge is to maintain customer affordability given the scale and age profile of the distribution network. At a rebuild value of approximately $23 billion (including $7 billion of underground assets), it constitutes two thirds of the value of the Western Power Network. A considerable portion of these assets were constructed as the State population grew in the 1970s and 80s.

239. The distribution network also faces a number of uncertainties and challenges as customers embrace DER technology such as PV systems, smart homes and EVs. Western Power's response to the changing needs of our customers is focussed on the development and implementation of a Grid Strategy with a future grid vision, a Network Rebuild Strategy and developing new capability to turn this vision into reality.[38]

240. Our Grid Strategy is based on long term scenario planning for evolving customer preferences and needs, which identifies the optimum solution of technology to use at the right place and time. This approach provides a vision and roadmap for the grid vision which minimises whole of life cycle costs and regrettable investment.

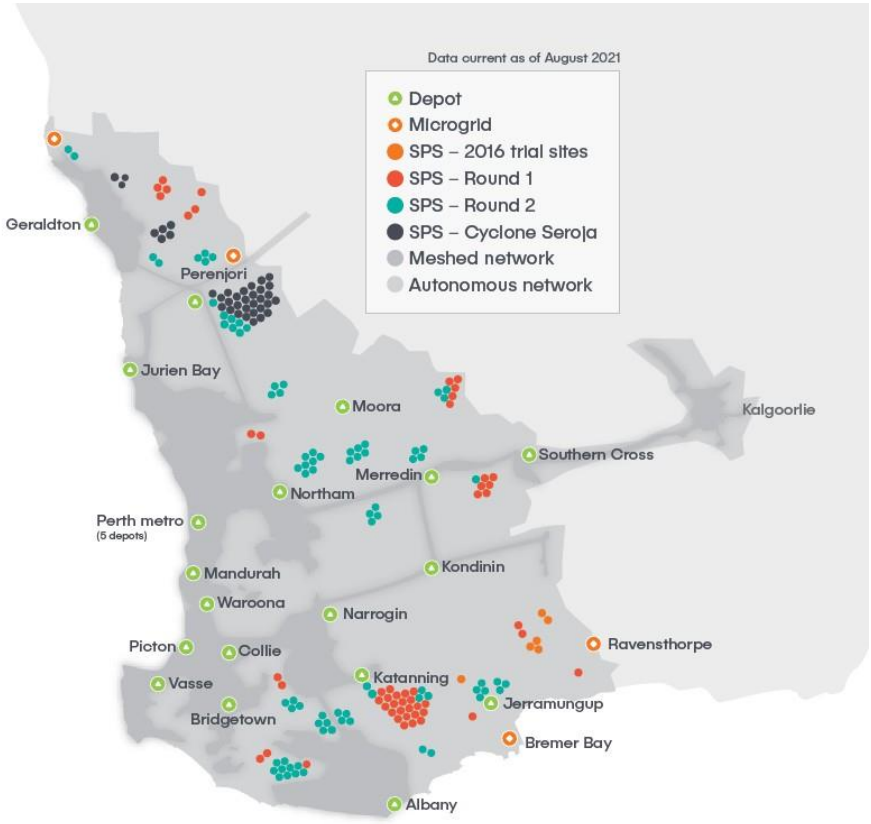
241. Western Power is developing a modular grid that comprises three zones:

- **tightly meshed urban network:** for metropolitan customers, Western Power will focus on undergrounding assets where possible and facilitating ever increasing amounts of renewables and DER, such as rooftop solar
- **hybrid network:** for those customers between the metropolitan and regional areas, Western Power will maintain a network of mostly overhead assets, with new technologies like SPS and microgrids where they make economic sense for the community
- **autonomous stand-alone network:** for remote customers, the modular grid will mean a new way of delivering power, like SPS and microgrids. However, the regional depots will remain to enable Western Power to maintain and respond to faults and outages on the ageing rural overhead network.

242. This is illustrated in Figure 4.1, which shows the indicative zones of the modular network.

[38] Further information on the Grid Strategy and Network Rebuild Strategy are provided section 4.2

Figure 4.1: Illustrate future grid vision



243. The proposed increase in distribution investment for the AA5 period focuses on the following:

- **Distribution overhead**: increased expenditure is required for the increasing deployment of SPS and to achieve a 'maintain performance' objective. The application of the new distribution overhead Network Rebuild Strategy has mitigated against further increases in the medium term as the network continues to age. Provision has also been made for discrete investments in underperforming reliability 'hot spot' areas to meet the SSB performance
- **Underground cables**: an increasing asset failure rate within this category has also contributed negatively to the SSB. The investment is to apply a proactive and targeted cable replacement strategy to avoid the risk of poor reliability performance in high customer density parts of the network (e.g. Perth CBD)
- **Ring Main Units (RMUs):** a particular type of RMU has been identified with a manufacturing defect that poses both a workforce safety risk and reliability risk. This investment is for a like-for-like replacement of these impacted assets with new, non-defective units
- **Metering:** increased expenditure reflects the acceleration of the AMI deployment (with completion of the program aimed for 2027) and replacement or re-configuration five-minute capable metering to support the mandated implementation of five-minute settlements in the WEM
- **Future capability**: provision has been made to fund commitments made in the DER Roadmap and ensure an efficient grid which is fit for customer needs and emerging technology trends. The investments include two disconnected microgrids[39], provision to support Project Symphony and associated network-level devices to monitor bi-directional flows on the distribution network.

[39] One of these will be a trial, with the subsequent investment being business as usual investment (pending the outcome of the trial).

- **Loading and voltage**: the number of over-utilised feeders is forecast to increase compared to previous years of flat or negative growth, mainly due to increased economic conditions. Investment will be required to cater for excess load and avoid rolling blackouts, depending on customer responses to hot weather events. Additionally, we expect to see a continuing uptake of PV on rooftops and a continuing decline in daytime minimum load on the network. This minimum load increases the possibility of localised over-voltages which requires investment to mitigate the risk of non-compliance.

244. Western Power proposes to invest $3,006.8 million of capital in the distribution network (including capital contributions) during the AA5 period.

245. This investment is required to meet safety obligations (as per the requirements of Western Power's ENSMS) and Technical Rules obligations. Without this investment, there will be significant pressure on the reliability service standards and a failure to invest for the future, thus increasing whole of life cycle costs.

246. Table 4.1 summarises AA5 period forecast distribution capex by regulatory category.

Table 4.1: AA5 forecast distribution capex by regulatory category, $ million real, 30 June 2022[40]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
Asset replacement and renewal	390.7	405.5	413.8	406.0	401.8	2,017.9
Growth	166.6	156.9	151.7	154.3	144.0	773.4
Improvement in service	0.2	0.0	0.0	0.0	0.0	0.2
Compliance	43.1	42.5	43.5	43.2	42.8	215.2
Gross capex	**600.6**	**604.9**	**609.1**	**603.6**	**588.6**	**3,006.8**
Less contributions	134.3	142.5	152.6	161.5	156.3	747.2
AA5 capex to be added to the RAB	**466.3**	**462.3**	**456.5**	**442.1**	**432.3**	**2,259.6**

247. Figure 4.2 shows how forecast distribution capex for the AA5 period compares with historical levels.

[40] Excluding forecast labour escalation and indirect costs.

Figure 4.2: Historical and forecast distribution capex by regulatory category, $ million real at 30 June 2021

248. Forecast distribution capex for the AA5 period is $755.5 million (34 per cent) higher than that incurred in the AA4 period. The main reason for this is the increase in distribution replacement and renewal capex. Growth capex is forecast to fall by three per cent, but still remains a significant overall component of the forecast investment in the distribution network.

249. The following table compares the total expenditure in the AA4 and AA5 periods.

Table 4.2: Comparison of total AA4 and AA5 forecast distribution capex by regulatory category, $ million real, 30 June 2022[41]

Expenditure category	AA4 Period total	AA5 Period total	Change from AA4
Asset replacement and renewal	1,301.1	2,017.9	55.1%
Growth	781.1	773.4	-1.0%
Improvement in service	13.9	0.2	-98.4%
Compliance	155.1	215.2	38.8%
Gross capex	**2,251.2**	**3,006.8**	**33.6%**

250. Further information on the forecast investment in the distribution network is provided in the following sections.

4.2 Distribution asset replacement and renewal capex forecast

251. Distribution assets include wood and non-wood structures (poles), overhead conductors and underground cables, overhead and underground customer service connections, public streetlighting, metering assets and stand-alone power systems.

252. Western power will invest $2,017.9 million in distribution network asset replacement and renewal during the AA5 period (see Table 4.3).

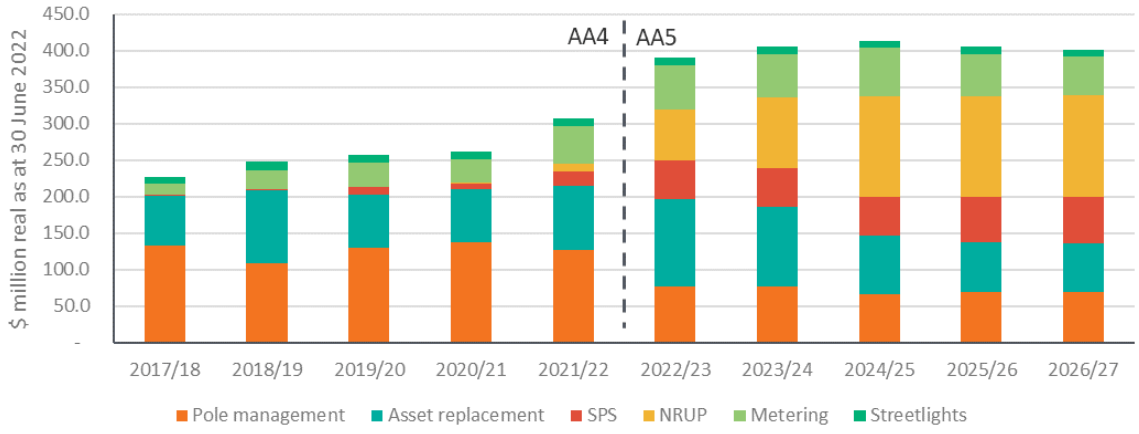
41 Excluding forecast labour escalation and indirect costs.

Table 4.3: AA5 forecast distribution asset replacement and renewal capex, $ million real, 30 June 2022[42]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
Pole management	77.7	77.9	67.1	70.1	69.9	362.7
Asset replacement	119.7	107.7	80.3	67.6	66.1	441.5
SPS	51.9	53.2	52.4	62.3	63.5	283.3
NRUP	70.5	97.8	138.4	137.8	138.9	583.4
Metering	60.9	59.0	65.6	58.2	53.4	297.0
Streetlight	10.0	10.0	10.0	10.0	10.0	49.9
Gross capex	**390.7**	**405.5**	**413.8**	**406.0**	**401.8**	**2,017.9**
Less contributions	27.3	35.5	45.5	54.4	56.4	219.2
AA5 capex to be added to the RAB	**363.4**	**370.0**	**368.3**	**351.6**	**345.5**	**1,798.7**

253. Figure 4.3 shows how forecast distribution capex for the AA5 period compares with historical levels.

Figure 4.3: Comparison of AA4 actual and AA5 forecast distribution replacement and renewal capex



254. The following table compares the total expenditure in the AA4 and AA5 periods.

[42] Excluding forecast labour escalation and indirect costs.

Table 4.4: Comparison of total AA4 and AA5 forecast distribution asset renewal and replacement capex, $ million real, 30 June 2022[43]

Expenditure category	AA4 Period total	AA5 Period total	Change from AA4
Pole management	637.7	362.7	-43.1%
Asset replacement[44]	402.5	441.5	9.7%
SPS	38.2	283.3	640.9%
NRUP	12.6	583.4	4520.0%
Metering	159.6	297.0	86.1%
Streetlights	50.4	49.9	-0.9%
Gross capex	**1,301.1**	**2,017.9**	**55.1%**

255. The forecast asset investment in asset replacement and renewal for the distribution network is driven by Western Power's Grid Strategy and the Distribution Overhead Network Rebuild Strategy, which are detailed below.

256. Further information on the distribution asset replacement and renewal capex subcategories is provided in the subsequent sections.

Grid Strategy

257. The purpose of the Grid Strategy is to:

- provide an overview of current performance, issues and drivers for investment on the network
- provide an overview of currently available and emerging solution options to address these drivers (i.e. design, maintenance and operational options)
- outline the current strategies that are applied across the network
- outline high level considerations for investment planning.

258. This strategy forms part of Western Power's AMS. It is one of a suite of strategies that collectively respond to our business and asset management objectives.

259. The Grid Strategy identifies a range of solution options that are available for short, medium and long term planning for the distribution network. Microgrid and SPS have been introduced as alternative supply solutions in recent years. Microgrids can be permanently disconnected from the SWIN or connected allowing for temporary disconnection through switching. SPS are permanently disconnected and may serve one or more customers.

260. It recognises that the scale and reach of the distribution grid necessitates that transformation strategies be based on repeatable rules that can be adapted around the unique characteristics of each distribution network. The transformation strategies are defined at the two key points in the distribution network lifecycle where transformative changes are typically undertaken, i.e. at the time of creation and at end of life.

[43] Excluding forecast labour escalation and indirect costs.
[44] This category includes distribution assets other than poles, such as conductors, switchgear and cables.

261. Asset renewal and replacement capex for the distribution network is informed by the end of life strategy rules, as set out in the following table.

Table 4.5: End of life strategy rules, distribution network

Network area	End of life strategy
Dx Autonomous | SPS	Remove feeder | spur | service connection → Install SPS
Dx Autonomous | Microgrid	Remove non-town feeder | spur | service connection → Install SPS | Microgrid
	Upgrade town feeder | spur | service connection
Dx Mesh | Overhead	Upgrade overhead feeder | spur | service connection
	Upgrade underground feeder | spur | service connection
Dx Mesh | Underground	Remove overhead feeder | spur | service connection → Install underground[45]
	Upgrade underground feeder | spur | service connection

262. For both the autonomous and mesh grid strategies it is critical to optimise investment in systems as they approach end of life while maintaining acceptable safety and reliability performance. This requires a range of maintenance approaches depending on whether the system will be retained, transformed or removed. Western Power's Distribution Overhead Network Rebuild Strategy (see below) defines a range of maintenance approaches available for distribution overhead networks.

Distribution Overhead Network Rebuild Strategy

263. Cognisant of the future network vision, changing electricity market and increasing customer choice, Western Power is implementing a refreshed framework – the Distribution Overhead Network Rebuild Strategy - to renew/ rebuild the network. It also facilitates the transformation to the modular grid and undergrounding, while minimising regrettable investment through Short term Risk Management (**STRM**).

264. The Distribution Overhead Network Rebuild Strategy allows for system upgrades to be performed incrementally (slow rebuild) or as a system (fast rebuild). Replacement of discrete assets under a slow rebuild or for maintenance allows flexibility to adopt 'like for like' or a 'modern equivalent' approach to ensure that investment is optimised across the system lifecycle.

265. This is applied at an asset system level, with the optimal asset system being a switchable section. The renewal of switchable sections considers the "maturity" of the assets within the switchable section by assessing whether the:

- assets have realised their economic lives, and
- long term risk of the switchable section are normalised by the rebuild cost of the section.

266. This long term risk rating is used to prioritise the selection of switchable sections to be treated.

267. The refreshed framework also recognises that the renewal of Western Power's network will take years, and in some cases decades. To maintain the performance of these networks (switchable sections) whilst it is "in transition" to the renewed network, Western Power addresses the risk posed by these networks through STRM.

[45] Underground installations require LGA funding commitment – install overhead if not provided.

268. STRM addresses all "high risk" conditions on the network, including:

- assets which pose an Unacceptable risk to our network (in the context of ALARP Safety (fatality) risk
- assets where the cost of addressing the ALARP Safety (fatality) risks is proportionate to the risk mitigated
- treating all "high risk" defects (safety risks)
- treating the assets (either replacement or repair) with the highest likelihood of failure to enable Western Power to maintain performance – specifically the number of failures – to current levels.

269. All the above considerations of risk in the STRM take known asset condition into account in determining the likelihood of failure of the asset.

270. The Distribution Overhead Network Rebuild Strategy produces delivery portfolios for investment scenarios by varying the balance between risk, cost, and performance of the distribution overhead network, and optimising the risk reduction for the given investment.

4.2.1 Pole management

271. Poles are a critical element of the distribution overhead network, providing the function of supporting overhead conductors. Failures of poles can potentially cause physical impact injury and property damage. More importantly, it may also cause conductors to fail or to come into contact with vegetation or the ground and cause fire, electric shock and / or service disruption.

272. Western Power will invest $362.7 million in wood pole replacement and reinforcement in the AA5 period. This is $275.0 million (43.1 per cent) less than incurred on wood pole management in the AA4 period.

273. The investment in pole management includes both:

- **reactive replacement** of assets that fail while in service. The reactive forecast is based on expected wood pole failures in service (both assisted and unassisted failures). Forecasts for assisted failures are based on historical performance data using a simple forecasting methodology. The unassisted failure forecast considers the 10-year treatment plan and asset treatment volumes and uses the Equivalent Distribution Calculator (**EDC**)
- **proactive replacement and reinforcement** of assets selected through the application of the Distribution Overhead Network Rebuild Strategy.

274. Western Power plans to replace 34,974 wood poles and reinforce a further 27,500 wood poles during the AA5 period.

275. The proposed investment contributes to the following objectives:

- maintains overall safety of the network in line with jurisdictional obligations (eliminate / reduce risk to ALARP)
- maintain current service standard levels, as measured by SSBs, whilst ensuring ongoing sustainability of the network
- optimise the transition to the modular grid.

276. Further information on the replacement and reinforcement strategies and outcomes are provided in the Network Management Plan at Attachment 8.2.

4.2.2 Asset replacement

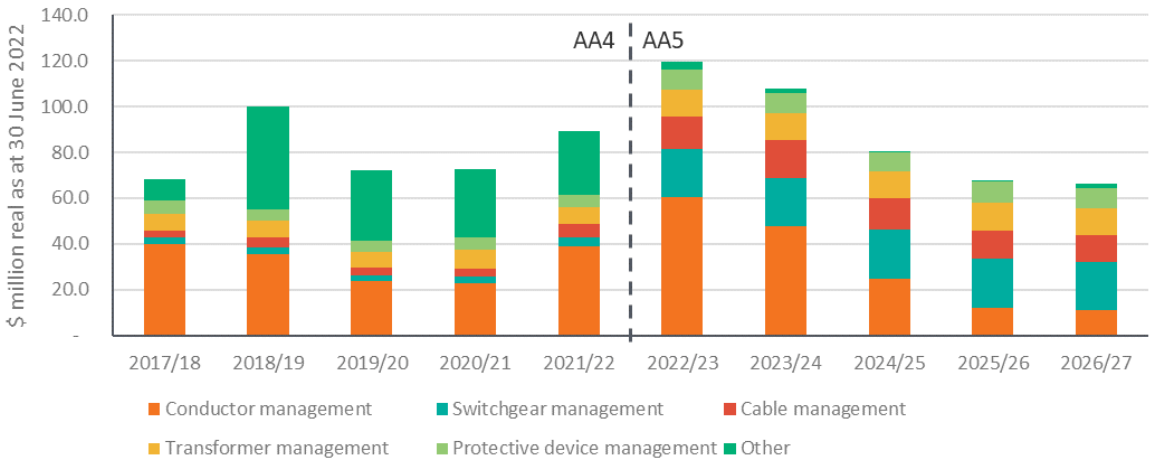
277. The asset replacement sub-category covers replacement and renewal of the following distribution assets: overhead conductors, distribution transformers, switchgear, protection devices and underground cables. The largest component of this expenditure sub-category is conductor management, accounting for $156.3 million of the $441.5 million proposed capex (see Table 4.6).

Table 4.6: AA5 forecast distribution replacement and renewal capex, $ million real, 30 June 2022[46]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
Conductor management	60.5	47.5	25.0	12.3	11.0	156.3
Switchgear management	21.1	21.1	21.1	21.1	21.1	105.3
Cable management	14.2	16.8	13.9	12.5	11.6	68.9
Transformer management	11.8	11.5	11.7	12.4	11.8	59.2
Protective device management	8.6	8.8	8.6	8.9	8.6	43.5
Other	3.6	2.0	0.1	0.5	2.0	8.2
Gross capex	**119.7**	**107.7**	**80.3**	**67.6**	**66.1**	**441.5**
Less contributions	0.0	0.0	0.0	0.0	0.0	0.0
AA5 capex to be added to the RAB	**119.7**	**107.7**	**80.3**	**67.6**	**66.1**	**441.5**

278. Figure 4.4 shows how forecast distribution asset replacement capex for the AA5 period compares with historical levels.

Figure 4.4: Comparison of AA4 actual and AA5 forecast distribution other replacement and renewal capex



[46] Excluding forecast labour escalation and indirect costs.

279. The following table compares the total expenditure in the AA4 and AA5 periods.

Table 4.7: Comparison of total AA4 and AA5 forecast asset replacement capex, $ million real, 30 June 2022[47]

Expenditure category	AA4 Period total	AA5 Period total	Change from AA4
Conductor management	161.2	156.3	-3.1%
Switchgear management	15.2	105.3	591.0%
Cable management	19.8	68.9	247.9%
Transformer management	37.1	59.2	59.3%
Protective device management	26.3	43.5	65.7%
Other asset replacement	142.8	8.2	-94.2%
Gross capex	**402.5**	**441.5**	**9.7%**

280. The reduction in the conductor management capex from the AA4 to the AA5 period reflects the transition to the modular grid, with this capex largely being for conventional rebuild of the overhead network in the hybrid region. Conductor management capex is being increasingly displaced by NRUP and SPS in the meshed and autonomous regions, respectively.

281. The following sections provide further information on the forecast capex for the other distribution asset replacement and renewal subcategories.

Conductor management

282. Western Power plans to invest $156.3 million on distribution conductor management in the AA5 period.

283. Distribution overhead conductor refers to any bare or insulated wires that are predominantly used for carrying electrical current, suspended between two or more structures (with the exception of the final lines connecting properties to the distribution network). As at 30 June 2020, there was approximately 66,300 km of distribution overhead conductor in the distribution network. Of that, around 12 per cent was classified as ‘urban’, 15 per cent as ‘rural short’ and the majority, 73 per cent, as ‘rural long’.

284. Overhead conductors can age and deteriorate from a range of factors including the environment (e.g. lightning, corrosion), electrical stresses (overloading, or fault current) causing heating in the conductor beyond its melting point, and / or mechanical stresses exceeding the conductor’s residual tensile strength.

285. Distribution overhead conductors are a critical element of the network in providing the function of transporting energy. Failure of the conductors cause customer supply interruptions and reliability impacts. They can also potentially cause public safety hazards of fire, electric shock, physical impact and property damage. The safety risk for overhead conductors has been assessed as high. Thus, the proposed investment program is critical for maintaining the safety of the network in accordance with our ENSMS, while allowing for the network transformation.

286. The proposed investment covers the replacement of overhead conductors on the distribution network, including both HV and LV mains conductors, but excludes any customer service conductors and underground cables. It also includes the associated conductor scoping and validation activities required to select and design the individual assets that will be treated.

47 Excluding forecast labour escalation and indirect costs.

287. Western Power is implementing the Distribution Overhead Network Rebuild Strategy to determine the distribution overhead conductor assets to be treated during the AA5 period.

288. Whilst the STRM component for distribution overhead conductors generally will call for opex type treatments (e.g. repairs), there may be occasions where a capex treatment (i.e. replacement) may be called for (e.g. multiple STRM treatments within a switchable section).

Switchgear management

289. Switchgear includes equipment used for switching, isolation and connection between Western Power's distribution network and a customer's electrical installation. In addition to their switching functionality, these assets help maintain supply reliability and network safety (reduced risk of fire and electric shock) by isolating faulted sections of the LV network and allowing maintenance and flexibility of network operation.

290. Switchgear management includes equipment which is either mounted on distribution structures (poles) or installed as a standalone asset. Western Power assets within this expenditure category include RMUs, overhead LV disconnectors, LV distribution frames, load break switches and capacitor banks.

291. Western Power plans to invest $105.3 million on switchgear management in the AA5 period.

292. This investment is targeted at ring main units (**RMUs**) and ground mounted indoor metering unit replacements.

Switchgear - RMUs

293. RMUs are ground mounted high voltage switchgear that perform isolation and protection of the distribution system. Their functionality is critical to safety and the reliability of supply. As with many other switchgear assets they are vulnerable to ageing from environmental, electrical and mechanical stresses. Where these stresses lead to defects that result in asset failure, the main consequences are:

- increased number of supply outages due to delays in identifying faulted sections and the inability to reconnect/reconfigure the network
- equipment damage/stress on other, healthy, assets
- increased likelihood of equipment fire and physical impact from debris
- environmental impacts from equipment oil and gas leaks.

294. As at 30 June 2020, Western Power has 7,812 RMUs and 515 high voltage (HV) ground mounted metering units in the distribution network. Approximately eight per cent of RMUs are beyond their MRL. If these are only replaced when they fail, nine per cent of RMUs will be beyond their MRL by the end of the AA5 period and this proportion increases to 17 per cent by the end of the AA6 period.

295. There are approximately 2,025 RMUs, manufactured between 2011 and 2016, that are more prone to gas leaks due to a manufacturing defect. The failure rate of these RMUs has been increasing dramatically over the last view years.

296. To minimise the likelihood of catastrophic failures, Western Power has placed operational restrictions on RMUs that are found to have a low gas condition. Furthermore, RMUs identified with the manufacturing defect are required to be inspected more frequently to assess the condition

297. Western Power plans to replace approximately 1,000 RMUs with the identified manufacturing defect during the AA5 period, with the replacement prioritised by risk. The intent is to replace all these assets by the end of the AA6 regulatory period with a suitable equivalent not susceptible to the manufacturing defect.

298. For the balance of the population of RMUs is managed through a combination of reactive replacement (for units that have failed) or proactive replacements carried out for known defects and from condition assessments completed during routine inspection (level 'A' visual inspections and level 'C' intrusive inspections) and maintenance programs. Western Power forecasts that 180 RMUs will be replaced based on condition and risk during the AA5 period.

299. This replacement investment is targeted primarily at addressing the reliability risks posed by the impacted RMUs due to the operational limitations imposed on the low-gas units. The investment also provides additional safety and environmental risk mitigation through treatment of these assets.

Switchgear – LV switchgear

300. Distribution LV switchgear is used to achieve switching, isolation, protection and connection between the distribution network and a customer's electrical installation. They include:

- LV OH switchgear including fuse disconnectors, LV disconnectors, LV Circuit Breakers (CB) and LV fuses for service connections and streetlights on Dx poles
- LV distribution frames - a stand-alone assembly or enclosure that supports and houses low voltage switchgear, and may include fuse disconnectors, disconnectors and circuit breakers.

301. They are either mounted on distribution structures (i.e. poles), form a part of distribution substations or installed as standalone assets with operating voltages of 240V or 440V. In addition to their switching functionality, distribution LV switchgear help maintain supply reliability and network safety (reduced risk of fire and electric shock), by isolation of the faulted sections of the LV network.

302. Overhead LV disconnectors can age due to normal and abnormal electrical and mechanical stresses or environmental factors. Typical impacts of ageing include corrosion, high resistance joints leading to hot spots, arcing, mechanical breakdown or deterioration of specific parts of the switchgear.

303. Failure of LV disconnectors can have the following impacts:

- potential equipment damage/stress on healthy assets due to undetected faults
- poor power quality due to voltage imbalance, flickers and voltage deviation
- increased likelihood of equipment/ground fire and electric shock.

Cable management

304. An underground distribution cable is an insulated conductor that is used to carry electrical current and is installed either in conduit, cable tunnels or directly buried in the ground. The main functions of underground distribution cables are to distribute power from zone substations to street mains circuits and services. The asset type includes distribution cables and their accessories (joints and terminations that comprises of feeder exit cables installed within zone substations). It excludes service cables supplying streetlights, cables owned by customers, underground service connections, pilot/communication cables and control cables.

305. Western Power plans to invest $68.9 million on underground distribution cable management in the AA5 period, including both the underground cables (83 per cent) and zone substation exit feeder cables (16 per cent).

306. The proposed investment covers both reactive and proactive programs:

- the reactive cable replacement program is for treating poor condition cables identified during in-service cable failures and related faults and operations (e.g., damaged insulation during inspection or excavation of adjacent assets)
- the proactive cable replacement program is for the replacement of critical cables that have been identified as having severe defects (detected via the K1KB testing program) that require replacement prior to an imminent fault from occurring.

307. The expenditure on exit feeders is driven by transmission projects (switchboard replacement or refurbishment) undertaken in the AA4 and AA5 periods.

308. Western Power reviews asset performance, maintenance history, asset failure data and condition information to identify emerging issues with individual assets or asset types/classes. Where assets are not performing to the required levels, or a change in failure rates has been identified, maintenance strategies are reviewed to identify if the issue can be effectively managed via maintenance.

309. However, where the issue cannot be efficiently mitigated through operational maintenance practices, a decision to replace a section of the cable may be required. The need to replace an asset arises when its condition unacceptably compromises reliability performance or safety.

310. There are over 28,274 km of distribution underground cables in the Western Power Network. Of these, around 8.4 per cent are currently operating beyond their MRL. This would increase to 20.7 per cent by 30 June 2027, should no asset replacement be undertaken.

311. There has been a deterioration in the underground cable performance. Distribution underground cable failures are impacting the SSB targets contributing up to 50% of the total SAIDI and SAIFI performance. These impacts are mainly felt in the built-up CBD and urban areas, with minimal impacts in the rural regions.

312. Underground distribution cable failures have an impact on asset management objectives. Failures can result in customer outages, as well as impact on safety. Western Power manages its underground cables to achieve its business objectives in relation to safety and reliability. Treatment of cables through this activity intends to address Western Power's obligations under the *Electricity (Network Safety) Regulations 2015* (refer to Western Power's ENSMS).

313. The primary business benefit driver for this investment is the targeted improvements to reliability performance of critical cables. The risk of distribution underground cable failures is assessed as "Medium". The replacement programs aim to maintain the overall risk of distribution cables at this level.

Transformer management

314. Distribution transformers are installed in the network to meet the load requirements of domestic, commercial and industrial customers. They are used to transform the distribution network voltages to a level required by network configuration.

315. Western Power plans to invest $59.2 million on distribution transformer replacements in the AA5 period.

316. The proposed investment relates to replacement of transformers that fail in-service (reactive) and / or have been identified with conditions or defects that require a replacement (proactive) in accordance with applicable asset management strategies.

317. As of 30 June 2020, there were 2,895 treatable conditions awaiting action and a further 180 untreatable conditions. The treatment for an unrepairable condition is replacement.

318. Approximately 75 per cent of distribution transformers are pole-mounted. The proportion of pole-mounted transformers are expected to decrease over time as Western Power progressively removes its overhead assets from its autonomous network to support the introduction of SPS, and the continued undergrounding of a tightly meshed urban network.

319. Currently, approximately 16 per cent of pole-mounted transformers and 11 per cent of ground-mounted transformers are beyond their MRL. Transformers are subject to ageing from their exposure to environmental factors, as well as normal and abnormal electrical stresses (load and short circuit currents). The effect of ageing can be seen through corrosion, loss of insulation and insulation degradation, and these defects can lead to risk of failure.

320. Distribution transformers are usually located in public areas, and it is important to manage the safety risks associated with these assets. There is also a substantial environmental risk posed from transformer oil leaks. Western Power's approach to managing the risk is a mix of managing transformers on condition (where they present a safety or environmental risk) and replace on failure (where safety and environmental risks are low).

Protective device management

321. Protective devices include distribution assets that provide protection to the primary assets. They include:

- drop-out fuses, which are used to protect transformers, cables and network spurs from overload and fault conditions. Under fault conditions, when the current flow exceeds the rating of the fuse, the fuse carrier 'drops out' of a fuse bracket. The hanging fuse carrier facilitates identification of a blown fuse and assists repair crews to identify faults quickly
- sectionalisers, which operate as isolating devices. They count the number of operations of the recloser in the event of a fault. After a pre-set number of operations of the recloser, the sectionaliser will open its contacts whilst the network is in a de-energised state, so as to isolate the faulted section of the network. Surge arrestors
- surge arrestors, which are a protective device that limit surge voltages by diverting surge currents to ground, thereby preventing exposure of the protected primary plant or line to severe over voltages from voltage surges caused by events such as switching and lightning. The existence of surge arrestors within the distribution network enables selection of primary plant with optimal basic insulation level (thus reducing primary plant capital cost
- reclosers, which provide the functionality to interrupt permanent faults and limit interruptions due to transient faults to a very short duration, thereby preventing asset damage and reducing the impact of potential network outages. The incorrect operation, failure, or absence of reclosers will have an adverse impact on reliability, power quality, safety and bushfire mitigation strategies.

322. Replacement of these assets is targeted at reducing the safety risk (ground fires, electric shock and physical impact) associated with failures of HV protective devices and associated components.

323. Western Power plans to invest $43.5 million on protective device management in the AA5 period.

324. The proposed investment covers both reactive and proactive replacements:

- reactive replacement includes assets that fail in service. This includes faults, as well as assets that have conditions (e.g. recloser gas leaks) that cannot be repaired but are still supplying load
- proactive replacements include assets selected through the application of the Distribution Overhead Network Rebuild Strategy.

325. This equipment ages due to normal and abnormal electrical and mechanical stresses (switching load and short circuit currents) and environmental stresses. In addition, defects may exist due to poor manufacturing, installation or past maintenance. Typical impacts of ageing include corrosion, loss of insulation (SF6 or oil), high resistance joints leading to hot spots, arcing, mechanical breakdown, mis-alignment of contacts or deterioration of specific components of the switchgear.

326. The outcome of this investment program is the continued safe and reliable performance of protective devices. It also allows Western Power to renew its network in line with the grid vision, and to maintain risk and failure performance of protective devices to current levels.

4.2.3 Standalone power system

327. SPS are energy supply units made up of a renewable energy source or sources, energy storage, back up generation (in most cases) and an interactive inverter to optimise and manage the energy supply. The unit operates independently of the main electricity grid to store and deliver reliable power to a household or business. SPS provides an alternative source of power supply to customers in regional areas with low customer and energy density to increase compliance, improve reliability and remove risks associated with extensive sections of distribution overhead network serving limited customers.

328. Western Power plans to investment $283.3 million in SPS during the AA5 period, representing 14 per cent of the overall forecast distribution replacement and renewal investment in the AA5 period.

329. Consistent with the Grid Strategy and Corporate Strategy, SPS will be deployed during the AA5 period where the SPS solution is determined to the least cost solution over the long term, as an alternative option to replacing the overhead network when it reaches end of life.

330. The deployment sequence for SPS targets sections of the network that have the optimal balance of asset deterioration and cost efficiency. As this solution is implemented, large geographical areas of overhead network will be decommissioned.

331. The deployment of SPS is also driven by the medium and long term benefits they provide, including an inherent reduction in electric shock and bushfire risk, increased reliability, improved network access, lower whole of life costs and supporting decarbonisation of the economy.

332. Western Power plans to transition 4,000 existing connection points to either SPS or proactive supply abolishment by 2031. Approximately 1,861 SPS units or equivalent are scheduled for deployment in the distribution area over the AA5 period. This includes 1,630 SPS equivalents for the SPS program and 230 SPS equivalents to enable microgrids.

333. Cost efficiency will be facilitated through competitive tendering processes to select vendors for the provision of turnkey SPS solutions.

334. The deployment of the SPS will be undertaken over several rounds, with each round of asset replacement addressing the network risk posed by the distribution overhead assets that are in deteriorated condition and that have been identified for replacement in the relevant asset strategy. Analysis conducted during the scoping and planning phases of each round needs to demonstrate that replacing the overhead assets with SPS is the recommended option, providing the following benefits:

- reduction of bushfire and electric shock risk associated with the targeted assets
- improved customer experience (reliability)
- lower net present cost than a like-for-like replacement.

335. These benefits are aligned with the strategic objective of meeting future demand for safe and reliable power that efficiently meets customer needs.

4.2.4 Network Renewal Undergrounding Program

336. The NRUP involves the targeted conversion of overhead areas to underground power. These projects are proposed for areas in the meshed urban network where:

- the overhead assets are deteriorated and require replacement, and
- underground replacement presents as a comparable cost to a like for like replacement.

337. Where a funding gap in proposed projects is identified, Western Power will seek to underground the network through financial partnerships with local communities (via the relevant local governments).

338. The need for this investment is driven by a significant part of the metropolitan overhead network reaching the end of its service life. NRUP projects are timed to address the largest proportion of overhead assets that require treatment.

339. The benefits of this investment program are lower total cost of ownership of Western Power assets (through gifted assets), improved reliability and safety, enhanced customer choice and increased capacity to support future customer demand (e.g. electric vehicles). Furthermore, the proposed investment aligns with the strategic objective of meeting future demand for safe and reliable power that efficiently meets customer needs.

340. Western Power plans to investment $583.4 million in the NRUP during the AA5 period, including $209.8 million in capital contributions.

341. Western Power will invest in undergrounding only where it makes economic sense. Customers' willingness to pay any incremental costs (the capital contribution) will be determined on a case-by-case basis for each area, in consultation with the relevant local government. Project selection will take into account the required contribution from local governments to ensure external requirements are satisfied.

342. Customer and community expectations are for an affordable contribution to facilitate the underground transformation. Where the incremental cost is not supported by the local government or the community, the undergrounding project will not proceed and an alternative risk mitigation solution will be implemented.

4.2.5 Metering

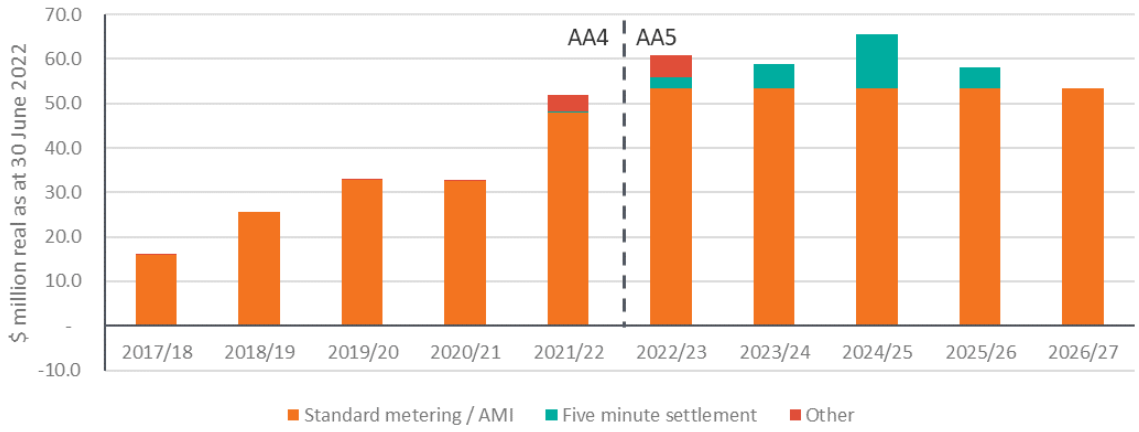
343. Western Power will invest $297.0 million (including capital contributions) in metering asset replacement and renewal in the AA5 period. This covers meters to support the introduction of five-minute settlement, advanced metering infrastructure (**AMI**) deployment) and communications (replacement of Telstra's 3G service) (see Table 4.8).

Table 4.8: AA5 forecast distribution metering capex, $ million real, 30 June 2022[48]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
Standard metering / AMI	53.4	53.4	53.4	53.4	53.4	266.9
Five-minute settlement	2.5	5.6	12.2	4.8	0.0	25.1
Other	5.0	0.0	0.0	0.0	0.0	5.0
Gross capex	**60.9**	**59.0**	**65.6**	**58.2**	**53.4**	**297.0**
Less contributions	1.9	1.9	1.9	1.9	1.9	9.3
AA5 capex to be added to the RAB	**59.0**	**57.1**	**63.7**	**56.3**	**51.5**	**287.6**

344. Figure 4.5 shows how forecast distribution metering capex for the AA5 period compares with historical levels.

Figure 4.5: Comparison of AA4 actual and AA5 forecast distribution metering capex



345. The following table compares the total metering capex in the AA4 and AA5 periods.

Table 4.9: Comparison of total AA4 and AA5 forecast metering capex, $ million real, 30 June 2022[49]

Expenditure category	AA4 Period total	AA5 Period total	Change from AA4
AMI	155.2	266.9	71.9%
Meters for five-minute settlement	0.3	25.1	9952.0%
Other	4.1	5.0	21.7%
Gross capex	**159.6**	**297.0**	**86.1%**

346. The following sections provide further information on the forecast capex for the distribution metering subcategories.

48 Excluding forecast labour escalation and indirect costs.
49 Excluding forecast labour escalation and indirect costs.

Advanced metering infrastructure

347. AMI refers to digital meters with a communication device installed. Advanced meters can automatically and remotely read electricity flows and provide early detection of connection faults and supply issues. AMI provides the network visibility we need - a clearer picture of the power quality data, including the voltage and current levels, and how much renewable energy is being fed back into the network.

348. AMI has been integral to Western Power being able to implement SCCM, which has been established as a prudent option to monitor and manage the electric shock risks posed by service connections. Investment in this technology in conjunction with continuation of the AMI program, has allowed Western Power to reduce expenditure in service connections that would have otherwise been requested to manage public safety.

349. AMI plays a key role in a range of emerging network requirements which require increased visibility (and potentially control) of the distribution network, including both customer and network, and technology connected to it. AMI is a critical enabler for the effective integration of DER, solutions for mitigating the risk of low load, flexible tariffs and allowing customers to actively participate in the energy market.

350. Western Power commenced deployment of AMI in 2019, with the deployment aimed for completion in 2027. An estimated half a million advanced meters will be installed by June 2022, with a further 795,130 scheduled to be installed during the AA5 period.

351. Investment in AMI is forecast at $266.9 million for the AA5 period, including capital contributions of $9.3 million. This will allow the continued deployment from the current basic meter standard to the advanced meter standard. Metering capex also includes the associated communications infrastructure and IT system costs to allow Western Power to access interval data and meter alarms remotely.

352. The Access Code was amended in September 2020[50] to enable cost recovery of AA4 AMI expenditure relating to communications and ICT. The amendments allow recovery of AMI expenditure through a separate building block, similar to how deferred revenue is recovered.

Meters for five-minute settlement

353. Western Power will invest $25.1 million in the AA5 period for metering to support the mandated implementation of five-minute settlements in the WEM.[51] This is separate to the AMI deployment investment (see above).

354. Western Power has estimated that around 20,984 existing meters will need to be replaced with five-minute meters and around a further 7,604 will be reconfigured to provide five-minute data required to support five-minute settlement. The replacements and reconfigurations are planned for 2022/23 to 2023/24, with five-minute settlements to commence in October 2025.

355. Drafted amendments to the *Electricity Industry (Metering) Code 2021* are expected to be approved by the Minister in 2021, enabling the recovery of expenditure associated with the implementation of ICT system uplifts and meter deployment and reconfiguration.

Other

356. Western Power will invest $5.0 million in the AA5 period to upgrade communications in meters that currently use the 3G network, which is scheduled to discontinue service. These services will be upgraded to

50 https://www.wa.gov.au/government/electricity-networks-access-code-tranche-1-amendments

51 The implementation of five-minute settlements also requires investment in SCADA and Telecommunications and ICT, which are included in the respective expenditure categories.

5G services or the Western Power telecommunications network, pending the outcome of the options analysis.

4.2.6 Streetlight management

357. Public lighting assets comprise Dedicated Streetlight Metal Poles (**DSLMP**), luminaires, streetlight underground cables and streetlight control boxes.

358. Illumination is provided by luminaires. In areas of underground power, luminaires are typically supported using DSLMP. In areas with overhead power, luminaires are typically mounted via brackets on Western Power distribution power poles (e.g. wood poles). A small number of luminaires are mounted on transmission poles. Streetlight control boxes are used to control groups of luminaires. These are typically connected to streetlight underground cable circuits, which are a legacy standard in Western Power.

359. As of 30 June 2020, there were 274,217 streetlights (luminaires) connected to the distribution network. There were 152,421 DSLMPs, 2,463 km of underground cabling for streetlights and 1,785 streetlight control boxes. The number of luminaires mounted on DSLMP is increasing, reflecting the increasing proportion of the distribution network being undergrounded.

360. Public lighting provides illumination for roads and public areas to enhance public safety and security. Benefits of public lighting include:

- improved safety for drivers, cyclists and pedestrians
- enhanced security in urban areas
- increased liveability by artificially extending the hours of light, thus encouraging activity within the population
- provide an opportunistic mounting platform for street signage by reducing ‘street furniture.’

361. Failure of streetlighting assets can result in ground fires, electric shock and DSLMPs falling across paths or roadways.

362. Western Power plans to invest $49.9 million on streetlight replacement and reinforcement in the AA5 period, including:

- planned and reactive replacement and reinforcement of metal streetlight poles that have failed or been identified for treatment via inspection
- reactive luminaire replacement at end of life / failure
- streetlight cable replacement (usually reactive)

363. The capex plan for streetlighting is driven by:

- growth in the number of streetlighting assets, reflecting increasing undergrounding, which means that there are fewer overhead distribution structures for mounting luminaires
- all new and replacement luminaires being LED.

364. As of 30 June 2020, 49% of public lighting (luminaires) are mercury vapour. Ratification of the Minamata Convention would result in Western Power being unable to procure new mercury vapour lamps (globes) to maintain the in-service mercury vapour luminaires. Western Power supports the ratification of objectives of the Minamata Convention and has developed a strategy to efficiently manage a transition away from mercury vapour lamps.

365. Public lighting assets are treated (e.g. replaced and reinforced) based on their condition. Public lighting assets age due to various factors including environment, normal and abnormal stresses (e.g. vehicle impact damage). Typical ageing impacts include corrosion, insulation loss, component failure (e.g. lamp or PE cells at end of life). Field based inspection is carried out on public lighting assets to identify defects associated with safety hazards and/or those that could lead to poor supply reliability performance.

366. There are currently more than 6,800 conditions awaiting action, including 4,452 DSLMP requiring repair, 1,243 requiring reinforcement and 1,150 requiring replacement.

367. The streetlight expenditure program enables Western Power to:

- comply with jurisdictional safety obligations by maintaining current safety performance
- manage the public lighting network to maintain compliance with the minimum service standards for reliability performance
- address higher risk assets
- support decarbonisation and reduce environmental impacts through transition to LED
- provide a reliable and efficient public lighting service.

4.3 Distribution growth capex forecast

368. Western Power will invest $773.4 million in distribution growth projects during the AA5 period. Of this, $528.1 million will be recovered via customer contributions and gifted assets (see Table 4.10).

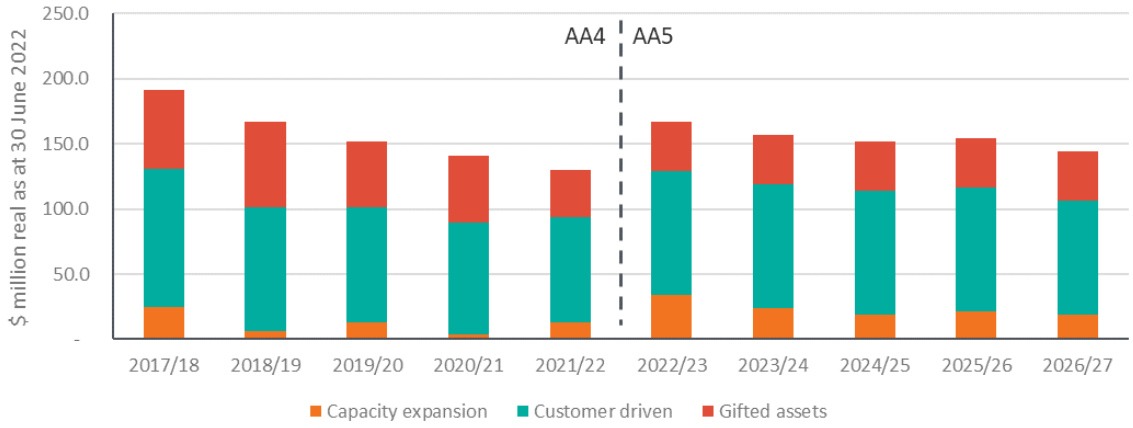
Table 4.10: AA5 forecast distribution growth capex, $ million real, 30 June 2022[52]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
Capacity expansion	34.0	24.3	19.1	21.7	18.4	117.5
Customer driven	95.0	95.0	95.0	95.0	87.9	468.0
Gifted assets	37.6	37.6	37.6	37.6	37.6	188.0
Gross capex	**166.6**	**156.9**	**151.7**	**154.3**	**144.0**	**773.4**
Less contributions	107.0	107.0	107.0	107.0	99.9	528.1
AA5 capex to be added to the RAB	**59.6**	**49.9**	**44.7**	**47.3**	**44.0**	**245.4**

369. Net distribution growth capex is $245.4 million, which is comparable to that incurred during the AA4 period, as shown in Figure 4.6.

[52] Excluding forecast labour escalation and indirect costs.

Figure 4.6: Comparison of AA4 actual and AA5 forecast distribution growth capex



370. The following table compares the total expenditure in the AA4 and AA5 periods.

Table 4.11: Comparison of total AA4 and AA5 forecast distribution growth capex by regulatory category, $ million real, 30 June 2022[53]

Expenditure category	AA4 Period total	AA5 Period total	Change from AA4
Capacity expansion	59.5	117.5	97.3%
Customer driven	457.2	468.0	2.4%
Gifted assets	264.3	188.0	-28.9%
Gross capex	**781.1**	**773.4**	**-1.0%**

371. The majority of forecast distribution growth capex is for customer driven projects (including contributions), with the balance being for capacity expansion. Further information on the forecast growth capex subcategories is provided in the following sections.

4.3.1 Capacity expansion

372. Western Power will invest $117.5 million to expand the capacity of the distribution network.

373. Capacity expansion projects for the distribution network will continue to address future loading and voltage obligations based on Western Power's forecast customer demand for load over the AA5 period. As indicated above, the number of over-utilised feeders is forecast to increase compared to previous years of flat or negative growth in areas. Investment will be required to cater for load growth and avoid rolling blackouts, depending on customer responses. Additionally, we expect to continue to see PV uptake on rooftops, resulting in a continued decline in daytime minimum load. The future minimum load increases the probability of localised over-voltages and requires investment to mitigate the risk of non-compliance.

374. Table 4.12 summarises AA5 period forecast distribution capacity expansion growth capex by regulatory category.

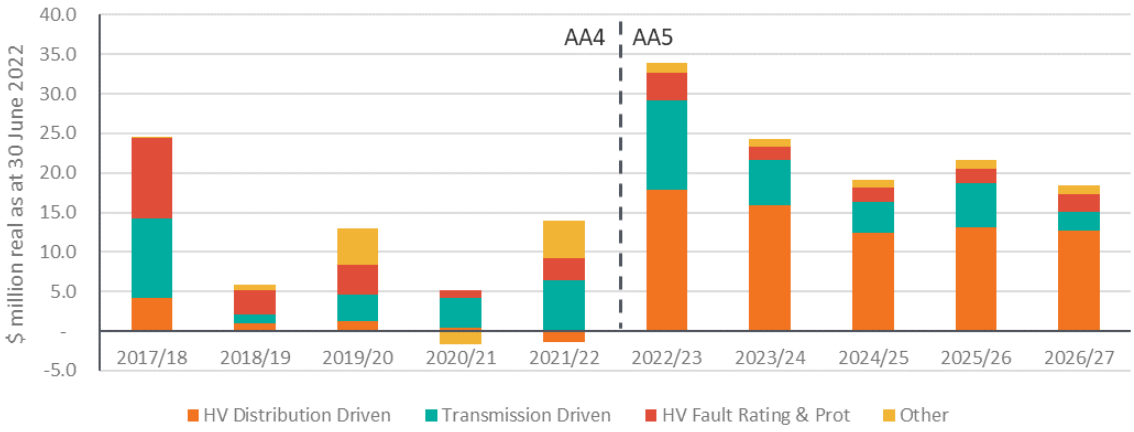
[53] Excluding forecast labour escalation and indirect costs.

Table 4.12: AA5 forecast distribution capacity expansion growth capex, $ million real, 30 June 2022[54]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
HV Distribution driven	17.8	15.9	12.4	13.1	12.7	72.0
Transmission Driven	11.3	5.8	3.9	5.6	2.4	29.0
HV Fault Rating and Protection	3.6	1.7	1.9	1.8	2.1	11.1
Other	1.3	0.9	0.9	1.2	1.2	5.5
Gross capex	**34.0**	**24.3**	**19.1**	**21.7**	**18.4**	**117.5**
Less contributions	0.0	0.0	0.0	0.0	0.0	0.0
AA5 capex to be added to the RAB	**34.0**	**24.3**	**19.1**	**21.7**	**18.4**	**117.5**

375. Figure 4.7 shows how forecast distribution growth capex for the AA5 period compares with historical levels.

Figure 4.7: Comparison of AA4 actual and AA5 forecast distribution capacity expansion growth capex



376. The following table compares the total expenditure in the AA4 and AA5 periods.

Table 4.13: Comparison of total AA4 and AA5 forecast capacity expansion growth capex by regulatory category, $ million real, 30 June 2022[55]

Expenditure category	AA4 Period total	AA5 Period total	Change from AA4
HV Distribution Driven	5.5	72.0	1197.0%
Transmission Driven	24.5	29.0	18.3%
HV Fault Rating & Protection	21.0	11.1	-47.3%
Other	8.5	5.5	-35.7%
Gross capex	**59.5**	**117.5**	**97.3%**

54 Excluding forecast labour escalation and indirect costs.
55 Excluding forecast labour escalation and indirect costs.

377. The following sections provide further information on the forecast capex by capacity expansion subcategory.

HV distribution driven

378. During the AA5 period, Western Power will invest $72.0 million on HV distribution driven projects. HV distribution driven expenditure is designed to ensure the parts of the network that are experiencing growth have sufficient capacity and that the following requirements in the Technical Rules are met:

- the distribution feeders do not exceed optimal utilisation levels
- the voltage is within the required limits
- the load on the network is balanced across the three phases
- there is the required level of redundancy in the network.

379. The forecast investment for the AA5 period is $66.4 million (1,197 per cent) higher than that incurred in the AA4 period.

380. Actual investment in the AA4 period was relatively low, reflecting economic conditions taking a downturn, resulting in fewer new homes and appliances, and the mild summers experienced during the AA4 period. This meant that the expected number of MV feeder over-utilisations did not occur and investment in MV feeder capacity reinforcement for required for only a limited number of feeders at Henley Brook and Rangeway zone substations.

381. Investment in MV feeder is forecast to increase in the AA5 period to address an increasing number of over-utilised feeders due to the low investment in the AA4 period, heatwaves becoming more frequent, working from home becoming more common and increased economic activity.

Meeting voltage limits

382. Voltage limits are specified in the Technical Rules to ensure the safe and efficient operation of customer equipment. The voltage across distribution feeders typically reduces over the distance of the feeder from the zone substation (**ZSS**) when the load supplied via the ZSS to the feeder increases. Conversely, as more PV or generation is added to distribution feeders, at times of low load, voltages at the end of the feeder rise and then fall as the feeder nears the zone substation from reverse energy flows. This has become a more common occurrence, as PV penetration increases and the feeder is of overhead construction due to higher network resistance. Voltages near the end of the feeder may increase to a level that is outside the allowable range. If no action is taken to reduce the voltage, it may increase to the extent that connected customer equipment will not function correctly or even at all.

383. Western Power analyses the performance of the network and identifies where the voltage may be outside the limits using power simulation software and network peak loading data. Once LV feeders are identified, we plan for remedial measures to maintain voltage support of the feeders. Such measures include the reinforcement of distribution needers, installation of capacity banks, voltage regulators, or the transfer of load to other parts of the network.

384. Western Power plans to invest $12.2 million in the AA5 period on reinforcing feeders to address over / under voltage issues. This includes investment in Western Power's annual program to proactively manage over-voltages on the medium voltage network driven by DER connections, as well as reactively mitigating undervoltage to manage customer complaints.

Maintaining balanced loads

385. Western Power's distribution network is predominantly a three-phase configuration (with three conductors per circuit). In certain rural areas we have established extensive single-phase networks which are sufficient to support the electricity needs of the area or locality (and where a more costly higher capacity three-phase network cannot be justified).

386. Single-phase networks can lead to a load imbalance on the three-phase network that supplies them. This will in turn lead to a voltage imbalance on the three-phase network. This affects the quality of the supply to customers that are supplied by the three-phase network upstream and can cause electrical interference with any nearby telecommunications circuits affecting their ability to function correctly. If the voltage unbalance is not corrected, it could lead to mal-operation of the customer's equipment or prevent new customers from connecting.

387. Voltage unbalance is identified by power simulation software and network peak loading data or through customer complaints of poor power quality. Two approaches adopted by Western Power to resolve this issue are the installation or upgrade of isolation transformers at the three-phase to single-phase transition on the network, or the upgrade of the single-phase networks to three-phase.

388. Western Power will continue to aim to reduce the number of metropolitan distribution feeders that are loaded above 80 per cent[56], thereby significantly reducing the number of customers at risk from long duration outages. We will reduce the maximum utilisation of feeders in the Perth CBD under normal operating conditions to 50 per cent, to provide the higher level of network security required by the Technical Rules.

389. This ensures that, if a fault occurs on a feeder, the affected load can be supplied by other feeders without exceeding their rating. Supply is able to be maintained after a brief outage during the fault event. Customers will be able to remain connected to the network whilst repairs are being made to rectify the fault. The ability to resupply customers minimises the reliability risk on the network.

390. Western Power uses risk-based planning techniques to address overloaded feeders as part of the annual planning process.

391. Typical solutions to address overloaded feeders consists of:

- upgrading the existing feeder to a higher capacity cable (keeping within current standards)
- installing a new feeder
- rebalancing or transferring the loads to existing interconnected feeders
- demand side management solutions.

392. Western Power plans to invest $27.1 million in the AA5 period on addressing overloaded feeders. This includes investment in the annual program to proactively manage MV feeder loading to ensure target utilisation levels are met at locations that have positive growth in demand. In addition to meeting utilisation targets, this investment can also result in improvements to reliability.

Project Symphony

393. Western Power will invest $5.1 million the AA5 period on Project Symphony.

[56] The level of interconnection of distribution feeders in the Perth metropolitan area allows a target utilisation of 80 per cent. This is higher than the national benchmark level of 66 per cent.

394. Project Symphony, an active DER demonstration project, will inform the evolution of the Distribution System Operator (**DSO**) role and contribute to understanding and building of required capability within Western Power. It is a key project under the State government's DER Roadmap.

395. Project Symphony is a collaborative project between Energy Policy WA, Western Power, AEMO and Synergy, with funding from the Australia Renewable Energy Agency. It aims to build industry capability by developing and testing the end-to-end customer, market and technical capabilities and functions required to safely and securely integrate DER within the SWIS:

- **Technical**, focusing on how DER can be used to manage security and reliability issues on the SWIS
- **Customer**, focusing on understanding customer preferences around DER products and services
- **Market,** focusing on DER participation in the wholesale market to reduce system costs.[3]

396. The Project Symphony pilot, which will create virtual power plants (**VPPs**) by aggregating solar panels, batteries and other controllable appliances, commenced in April 2020 and is due for completion in December 2022.

397. The investment in the AA5 period will cover Western Power's role until the completion of the project as well as implementation post project completion.

Other HV distribution driven

398. Other investments planned for the AA5 period include:

- installation of GridLab at the South Metro Depot for the testing of renewables and future technologies for education purposes and reduce future reliance on external service providers for testing
- an annual program to improve medium voltage grid telemetry and automation, including RMU and distribution transformers for new Technical Rules compliance and enable DSO and improve reliability through network parameter capture, storage and retrieval using PoA
- development of two microgrids and development of the original microgrid to determine how issues such as reliability, voltage, power quality, loading and protection can be most efficiently address, thereby optimising replacement of the overhead network
- an annual program to retrospectively install inverter disconnection capability to existing customer inverters. This is to assist managing local over-voltages primarily on the LV but can also benefit voltage compliance for the MV grid and other LV networks it supplies, as well as being a DSO enabler.

Transmission driven

399. During the AA5 period, Western Power will invest $29.0 million on transmission driven projects that will be undertaken in conjunction with the relevant transmission capacity expansion projects. This is $4.5 million (18 per cent) higher than that incurred in the AA4 period.

400. This investment arises from the need to:

- provide distribution capacity to accommodate new zone substation capacity and interconnection
- provide distribution feeder load transfer capability that enables utilisation of existing zone substations capacity
- maintain clearances between distribution and transmission assets as transmission lines are developed or augmented

[3] Energy Policy WA, *Leading Western Australia's brighter energy future*, Energy Transformation Strategy, Stage 2: 2021-2025, July 2021.

- reinforce the distribution network to cater for a change in voltage levels from the zone substation
- provide distribution capacity to resupply a decommissioned zone substation.

401. Transmission driven expenditure is directly linked to transmission investment and forecast feeder requirements to meet Technical Rules. Transmission work required complementary activity on the distribution network to ensure the transmission capacity can be delivered to the distribution network.

402. Example projects to be undertaken during the AA5 period include:

- decommissioning of Wundowie zone substation, with customers to be supplied via a new Sawyers Valley 132 kV distribution feeder ($4.4 million)
- reinforcement of the Black Flag distribution feeder to support the third power transformer which was installed to address capacity shortfall at Black Flag ($7.3 million)
- transferring load off the Wellington Street zone substations to facilitate the accelerated decommissioning of the east Perth 66 kV assets ($4.5 million)
- reinforcing the distribution network to support the decommissioning of the Tate Street zone substation, which has been identified as the preferred solution for addressing asset conditions issues with Tate Street power transformers 1 &3 ($2.5 million)
- support for the decommissioning Kellerberrin and Carrabin and resupplying associated customers from Merredin ($8.4 million).

HV fault rating and protection

403. During the AA5 period, Western Power will invest $11.1 million to address rising fault levels at certain locations on the distribution network as a result of the connection of new generation, network upgrades and changes in network topology and the need for more sensitive protection settings as the growth in PV displaces synchronous generation. This level of investment is $9.9 million or 47 per cent lower than that incurred in the AA4 period.

404. The majority of the proposed investment for the AA5 period is for annual programs to address:

- underfault rated conductor, device grading and minimum clearance times (set out in Technical Rules) across the distribution network [TM1000649]
- protection sensitivity and backup sensitivity across the distribution network, driven by reducing minimum fault levels from PV displacing synchronous generation. [TM 1000651]

405. When faults occur on the electricity network, a current path to earth is established. The current that flows is referred to as the fault current, and is generally much higher than the normal load current. The maximum fault current that may flow is referred to as the fault level.

406. The equipment in the distribution network is designed to withstand a certain fault level. If the fault current exceeds this fault level, the physical characteristics of the conductor will be adversely affected. This may lead to conductor failure or a permanent sagging, which is a public safety risk.

407. As the electricity network grows over time, the fault levels rise. If the fault levels rise to a level that exceeds the fault level rating of the equipment, action needs to be taken to reduce the fault levels, replace the equipment with equipment that has a higher fault level rating, or increase the level of protection on the relevant section of conductor to prevent damage.

408. To ensure equipment is not damaged when faults occur, protection devices are set to isolate the fault. Many protection devices installed may no longer be sufficiently sensitive to detect (and initiate isolation of)

faults in the extremities of the distribution network. If this occurs, faults may remain on the network until (for example) the conductor burns to break the circuit and isolate the fault. This presents a safety and fire risk.

409. This issue can be resolved by investing in additional protection devices on the network and/or adjusting the sensitivity of devices that are already in service. Detailed protection studies are undertaken periodically to confirm the extent of the issue. Where an under-fault rated conductor is identified, the appropriate remedial action will be taken on a case-by-case basis.

Other

410. Other capacity expansion investment includes $5.5 million for addressing overloaded distribution transformers to ensure that service levels are maintained in accordance with the Access Code. As distribution transformers become overloaded, there is an increasing likelihood of failure resulting in public safety risk and disruptions to customer supply.

411. Key projects to address this issue include:

- a bi-annual program of works to identify and address overloaded distribution transformers, which may involve an offload to contiguous LV networks or upgrading to a larger rated distribution transformer. The current targeted distribution transformers in this scope have a rating >= 100 kVA. [N0541568]
- an annual program (beginning in 2023/23) to identify and address overloaded distribution transformers, which may involve an offload to contiguous LV networks or upgrading to larger rated distribution transformers. The current targeted DSTR in this scope have a rating >=100 kVA. [TM1000193]
- an annual program to identify and address overloaded distribution transformers, which may involve an offload to contiguous LV networks if available close by or upgrading to larger rated distribution transformer. The current targeted distribution transformers in this scope have a rating <100 kVA, which are primarily driven by the connection of multiple PV installation to a low rated distribution transformer in rural areas. [TM1000477]

4.3.2 Customer driven

412. Distribution customer driven capex includes all work associated with connecting customer loads or generators, and the relocation of distribution assets at the request of a third party. Projects range from small residential connections (pole to pillar), through to network extensions to cater for large industrial customers. This category of investment generally includes high volumes of low cost works, thus historical expenditure tends to be a good indicator of future investment.

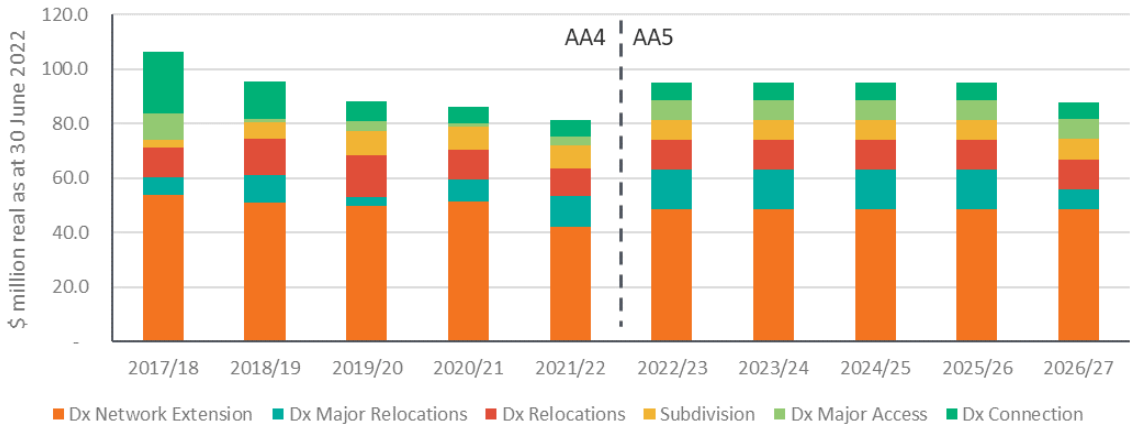
413. Western Power estimates it will invest $468.0 million (including capital contributions) during the AA5 period on customer driven distribution projects, as shown in Table 4.14.

Table 4.14: AA5 forecast distribution customer driven growth capex, $ million real, 30 June 2022[57]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
Network extension	48.6	48.6	48.6	48.6	48.6	243.1
Major relocations	14.3	14.3	14.3	14.3	7.2	64.5
Relocations	11.0	11.0	11.0	11.0	11.0	54.9
Subdivision	7.4	7.4	7.4	7.4	7.4	37.1
Major access	7.2	7.2	7.2	7.2	7.2	36.2
Connection	6.4	6.4	6.4	6.4	6.4	32.1
Gross capex	**95.0**	**95.0**	**95.0**	**95.0**	**87.9**	**468.0**
Less contributions	69.4	69.4	69.4	69.4	62.3	340.1
AA5 capex to be added to the RAB	**25.6**	**25.6**	**25.6**	**25.6**	**25.6**	**127.9**

414. The forecast investment in customer driven capex is $10.8 million (2.4 per cent) more than that incurred during the AA4 period (see Figure 4.8).

Figure 4.8: Comparison of AA4 actual and AA5 forecast distribution customer driven growth capex



415. The following table compares the total expenditure in the AA4 and AA5 periods.

[57] Excluding forecast labour escalation and indirect costs.

Table 4.15: Comparison of total AA4 and AA5 forecast customer driven growth capex by regulatory category, $ million real, 30 June 2022[58]

Expenditure category	AA4 Period total	AA5 Period total	Change from AA4
Dx Network Extension	248.2	243.1	-2.1%
Dx Major Relocations	39.0	64.5	65.5%
Dx Relocations	60.4	54.9	-9.1%
Subdivision	34.7	37.1	6.8%
Dx Major Access	19.6	36.2	84.4%
Dx Connection	55.2	32.1	-41.8%
Gross capex	**457.2**	**468.0**	**2.4%**

416. For customer driven works, the connecting customer contributes the part of the investment that does not meet the new facilities investment test (**NFIT**) (typically the incremental revenue test in the Access Code). The contribution is charged in accordance with relevant policies, such as Western Power's Contributions Policy and the DLVCS.

417. New facilities investments in distribution customer access projects are undertaken only where section 6.52(b)(i) of the Access Code is met or the connecting customer contributes that part of the investment that does not meet section 6.52(b).

418. Section 6.52(b)(i) of the Access Code requires that the anticipated incremental revenue for the new facility is expected to at least recover the new facilities investment. The connecting customer contributes that part of the investment that does not meet the incremental revenue test, in accordance with the Contributions Policy developed under sections 5.12 to 5.17 of the Access Code.

419. Relocation of existing access generally does not satisfy section 6.52(b) of the Access Code and hence contributions are generally sought from the party requesting the relocation for the full amount of the efficient investment in these works.

4.3.3 Distribution gifted assets

420. In some instances, a third party (e.g. a land developer or major industrial load) may pay for the construction of new distribution assets to distribute electricity to their premises. Once the assets have been constructed, the third party transfers the ownership, and operation and maintenance, to Western Power. These are known as gifted assets.

421. Western Power expects to receive $188.0 million of distribution gifted assets during the AA5 period.

422. These assets are not added to the regulatory asset base (**RAB**) because we do not incur capital costs for their construction. However, the gifted asset forecast is a key part of Western Power's AA5 proposal as the business must ensure it collects sufficient revenue to recover the cost of operating and maintaining the gifted assets.

[58] Excluding forecast labour escalation and indirect costs.

4.4 Distribution improvement in service capex forecast[59]

423. This expenditure category covers reliability-driven capex, which is designed to achieve reliability and power quality service standard targets for the distribution network. The proposed investment focuses on improving reliability in hot spots (i.e. areas within the distribution network that are performing significantly below service standards).

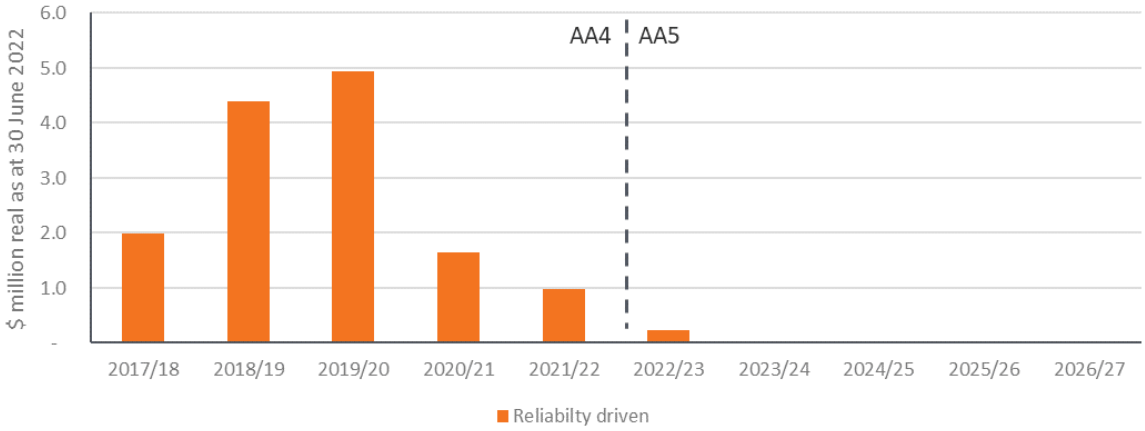
424. Western Power plans to invest $0.2 million in the AA5 period on addressing hotspots on the network primarily by upgrading and installing automated devices to sectionalise the network.

Table 4.16: AA5 forecast distribution improvement in service capex, $ million real, 30 June 2022[60]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
Reliability driven (improvement in service)	0.2	0.0	0.0	0.0	0.0	0.2
Gross capex	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.2**
Less contributions	0.0	0.0	0.0	0.0	0.0	0.0
AA5 capex to be added to the RAB	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.2**

425. Figure 4.9 shows how forecast distribution improvement in service capex for the AA5 period compares with historical levels.

Figure 4.9: Comparison of AA4 actual and AA5 forecast distribution improvement in service capex



426. The forecast distribution improvement in service capex in the AA5 period is $13.7 million (98 per cent) lower than that incurred in the AA4 period.

59 Excluding SCADA and Telecommunications, which is covered in Section 5

60 Excluding forecast labour escalation and indirect costs.

4.5 Distribution compliance capex forecast

427. Western Power must comply with a range of safety, environmental and service compliance obligations. These include requirements under the following instruments:

- *Electricity Act 1945*
- *Electricity (Network Safety) Regulations 2015*
- *Electricity Industry Metering Code 2012*.

428. The distribution regulatory and legislative obligations, and hence compliance expenditure, focus on the performance and management of distribution network assets, and is particularly centred on public safety, environmental management and power quality. Investment in this category often targets step changes, new obligations or identified issues with current compliance levels.

429. These investment programs are critical for public safety, providing a reliable supply and protecting the environment.

430. Forecast capex on distribution compliance requirements during the AA5 period is $215.2 million, as shown in Table 4.17.

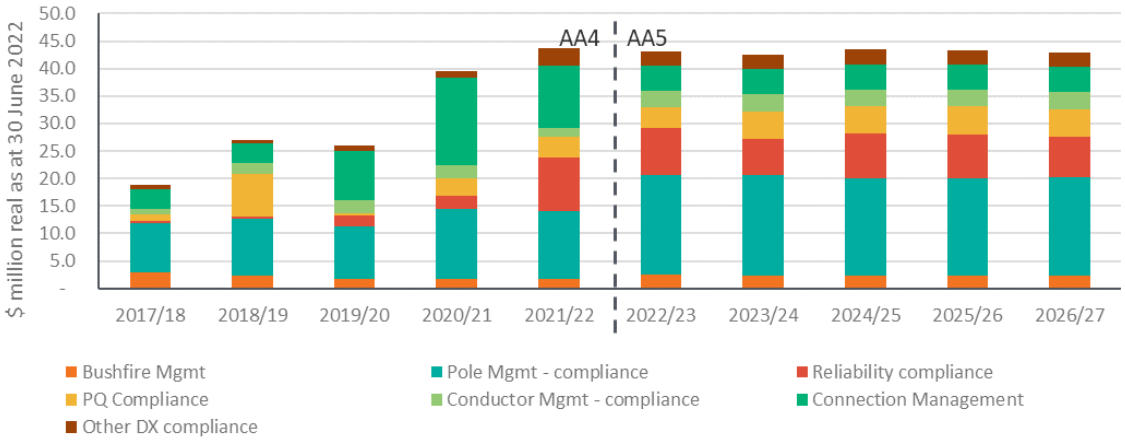
Table 4.17: AA5 forecast distribution compliance capex, $ million real, 30 June 2022[61]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
Bushfire management	2.6	2.4	2.3	2.3	2.3	12.0
Pole management	18.0	18.2	17.6	17.8	17.9	89.4
Reliability compliance	8.5	6.7	8.1	7.9	7.3	38.6
Power quality compliance	3.8	5.0	5.0	5.1	5.1	23.9
Conductor management	3.1	3.1	3.1	3.1	3.1	15.5
Connection management	4.5	4.5	4.6	4.6	4.7	22.9
Other distribution compliance	2.6	2.6	2.8	2.5	2.5	12.9
Gross capex	**43.1**	**42.5**	**43.5**	**43.2**	**42.8**	**215.2**
Less contributions	0.0	0.0	0.0	0.0	0.0	0.0
AA5 capex to be added to the RAB	**43.1**	**42.5**	**43.5**	**43.2**	**42.8**	**215.2**

The forecast investment in compliance capex for the distribution network is $60.1 million (39 per cent) more than that incurred during the AA4 period (see Figure 4.10).

61 Excluding forecast labour escalation and indirect costs.

Figure 4.10: Comparison of AA4 actual and AA5 forecast distribution compliance capex



431. The following table compares the total compliance capex in the AA4 and AA5 periods.

Table 4.18: Comparison of total AA4 and AA5 forecast compliance capex by regulatory category, $ million real, 30 June 2022[62]

Expenditure category	AA4 Period total	AA5 Period total	Change from AA4
Bushfire Mgmt	10.3	12.0	16.1%
Pole Mgmt - compliance	54.1	89.4	65.5%
Reliability compliance	14.8	38.6	160.7%
PQ Compliance	16.5	23.9	44.5%
Conductor Mgmt - compliance	9.3	15.5	66.6%
Connection Management	43.2	22.9	-47.0%
Other DX compliance	6.9	12.9	87.3%
Gross capex	**155.1**	**215.2**	**38.8%**

432. New facilities investments in distribution regulatory compliance are only undertaken where section 6.52(b)(iii) of the Access Code is met. Section 6.52(b)(iii) of the Access Code requires that the new facility must be necessary to maintain the safety or reliability of the covered network or its ability to provide contracted services.

433. Proposed distribution compliance capex projects are discussed below.

4.5.1 Bushfire management

434. Western Power plans to invest $12.0 million on bushfire management in the AA5 period.

435. This investment is focused on mitigating the risk of overhead conductors coming into contact with each other (conductor clashing) and causing either conductor failure, damage to the conductor or causing sparks that could lead to ground fires. It includes proactively installing LV spreaders on bays that are likely to clash, proactively treating spreader defects and reactively treating HV and LV bays that have clashed in service.

62 Excluding forecast labour escalation and indirect costs.

436. There are two programs under this activity and are broken down by their voltage level:

- to mitigate HV clashing, the solutions used include installing HV spreaders (across the conductors that have clashed or are likely to clash), installing longer cross arms, installing mid-span poles, re-tensioning the line or complete redesign of the bay
- to mitigate LV clashing, the solution applied is fitting LV spreader rods across the conductors that have clashed or are likely to clash.

437. Bushfire management investment is critical as the public safety risk from a groundfire caused by conductor clashing is high.

438. The forecast for the HV Clashing Mitigation program is based upon the strategy of addressing bays that are known to have clashed and are therefore at a higher likelihood of clashing in the future. This is in addition to field scoping activities on bays identified to be likely to clash.

439. The HV clashing performance over the last 6 years has been constant at ~37 HV clashes reported per annum. To maintain this performance, the forecast expenditure for this program has been kept constant at average expenditure levels based upon FY17/18 -FY21/22. This program is not volumetric as the solutions are varied and come at different costs.

440. The forecast for the LV Clashing Mitigation program is based upon reactively treating the LV bays that clash in service, proactively identifying sites that are likely to clash, and proactively treating LV Spreader defects identified by inspections in Extreme and High Fire Risk Zones. The forecast volume of LV spreader treatment is 500 per annum.

4.5.2 Pole management (compliance)

441. Western Power plans to invest $89.4 million on pole management in the AA5 period. This includes investment in cross arms, stays and insulators replacements.

442. Reactive replacement of insulators accounts for approximately 36 per cent of the forecast pole management compliance capex. Insulators provide support and separation for live conductors on structures. Failure of insulators may lead to a compromise of clearances of conductors, clashing conductors, pole top fires or a combination thereof. These may lead to consequences including ground fire, electric shock, physical injury, property damage and / or service disruption.

443. The distribution network contains approximately 477,000 cross arms. Cross arms support the overhead infrastructure. Failure may lead to range of adverse safety impacts including ground fire, electric shock, physical injury and property damage. Failure of cross arms can also result in service disruption.

444. Cross arms are exposed to a range of environmental factors that can cause defects, such as corrosion and splits, that reduce the structural integrity of the cross arm.

445. As replacement work can also result in service disruption, Western Power often replaces cross arms when the associated pole is replaced. We consider this approach to be efficient given that sending a work team to site is a significant component of the cost associated with asset replacements. This cost is included in the cost of the pole replacement and is forecast under that expenditure category.

446. A substantial proportion of Western Power's 157,780 stay systems are in extreme and high fire risk zones and very high and high public safety zones. Due to the high risk consequences, corroded or unserviceable (under-rated) stays are treated through condition-based replacement. For all other zones, condition-based replacements of stay poles and stay systems are only carried out when the main pole is being replaced, while loose stays are repaired.

447. This activity involves replacement of missing, underrated or unserviceable stay wires and stay insulators. Failure of stays may lead to failure of main poles, which may lead to consequences including ground fire, electric shock, physical injury, property damage and/or service disruption. Failure of stays can also cause physical injury or property damage without any failure of the main pole.

4.5.3 Reliability compliance

448. Western Power plans to invest $38.6 million to improve compliance with legislative and regulatory obligations relating to reliability and voltage. This is $23.8 million higher than that incurred in the AA4 period.

449. The program proposed under this activity is to carry out a portfolio of reliability-driven projects designed to ensure reliability performance complies with the minimum service levels (SSBs). Typically, the locations chosen for reliability-driven projects are those experiencing reliability performance well below the network wide average.

450. The scope of the activities proposed are:

- system performance studies and root cause analysis (targeted at poor performing areas)
- asset replacement in addition to proposed investment in asset replacement (regulatory category)
- network reinforcement or improving number of interconnection work
- undergrounding of overhead lines or use of alternative (network or non-network) strategies
- automation and telemetry
- microgrid, SPS and HVIU/ERG deployments.

451. Reliability performance can be improved by reducing the number of customers impacted by and duration of an incident (i.e. mitigation), by taking measures to reduce the frequency of incidents (i.e. elimination) and / or by taking action before an incident occurs.

452. Under section 11.1 of the Access Code and section 14 of the *Network Quality and Reliability of Supply Code 2018* (Significant interruptions to small use customers) and section 15 (Standards prescribed for particular areas), Western Power is obliged to meet certain minimum service levels (SSBs) of supply. Carrying out these activities will mitigate the risk faced by the business in complying with these requirements.

453. The Service Standard Adjustment Mechanism (SSAM) is a regulatory tool to:

- encourage Western Power to achieve, or exceed, the SSBs for reference services
- ensure that the incentives for Western Power to improve service performance (where that is economically efficient) are not outweighed by the incentives to reduce expenditure.

454. This activity is driven by Western Power's Corporate Strategy and from the opportunity for Western Power to earn a financial reward for exceeding the customers' expectations for network performance, and not being financially penalised for not exceeding the minimum reliability performance SSBs.

4.5.4 Power quality compliance

455. Western Power plans to invest $23.9 million in the AA5 period to address customers' power quality complaints. This is an increase of $7.4 million (45 per cent) from AA4 investment levels.

456. Complaints typically stem from issues such as over-voltage, under-voltage, overloading, voltage imbalance and harmonics on the LV networks.

457. This program is ongoing and is a compliance requirement under the *Electricity Act 1945*, *Electricity Industry (Network Quality and Reliability of Supply) Code 200*5 and Technical Rules:

- Western Power has an obligation under the Supply Code and the *Electricity Act 1945* to supply customers in a reliable and safe fashion and can be liable for damages that result from poor power quality
- Western Power has an obligation under section 24 of the Supply Code to investigate any complaints by customers in relation to the quality of their electricity supply impacting on their equipment. If the investigation identifies that we are not compliant with the Supply Code requirement or Technical Rules, we are obliged to rectify the non-compliance
- Western Power has an obligation under the *Electricity Act 1945* and *Electricity Industry (Network Quality and Reliability of Supply) Code 2005* to monitor the quality of the power supply.

458. This investment also mitigates the adverse impacts on public safety reliability and the customer experience.

4.5.5 Conductor management

459. Western Power plans to invest $15.5 million on conductor management in the AA5 period.

460. This activity addresses the rectification of substandard ground clearances of distribution overhead mains conductors assessed against the prescribed clearance requirements in AS/NZS 7000: 2016. The focus of this activity is on road, rail and river crossings, where the likelihood of contact with the conductors is increased. It does not cover vegetation clearances, which are addressed by the line easement vegetation maintenance opex program. It does not include clearance to other overhead conductors, which is addressed by the HV conductor clashing program.

461. Bays that exhibit substandard clearances have an increased likelihood of coming into contact with vehicles, structures and livestock, with the potential to cause electric shock, property damage (due to collision impact or electrical damage) and service disruption. Contact with the conductors can also lead to conductor damage and failure.

462. The forecast volume of substandard clearance bays to be treated in the AA5 period is based on known LiDAR low clearance conditions.

463. The expected outcome of this program is to mitigate known substandard conductor ground clearances that present the highest risk to public safety on the distribution network so as to maintain the safety risk.

4.5.6 Connection management

464. Western Power plans to invest $22.9 million on safety-related connection management in the AA5 period. This covers the replacement of overhead customer service connections (**OCSCs**) that have failed or are in poor condition as identified through routine inspection. This expenditure also covers underground residential distribution (URD) pillars that are replaced under failure conditions and the maintenance of cable pits located in road reserves.

465. This category describes forecast expenditure for service connections – i.e. the connection that links the LV distribution network to the customer's premises or connection point. Approximately half of Western Power's service connections are overhead and half are underground.

466. Overhead connections can develop defects due to their exposure to environmental factors, ageing, and other threats such as third party damage, vegetation or poor work practices for example. Defects can result in corroded, loose or burnt connections, and/or insulation loss, leading to asset failure.

467. Failure of service connections can result in:

- localised outages (i.e. to a single customer)
- electric shock due to contact with live conductors or contact with normally safe parts of the customer property that have become live due to fault conditions (i.e. loss of neutral leading to energised household objects, such as taps)
- ground fires due to live conductors coming into contact with dry vegetation
- physical injury or property damage due to service connection equipment falling to the ground.

468. The main benefit of the early detection and remediation of failures is reduction in the expected number of electric shock incidents from service connections. To this end, underground connections are generally inspected on a reactive basis following a fault incident or an enquiry from the customer. For overhead connections, Western Power undertakes periodic inspections of these assets to assess their condition.

469. Service connections are the largest contributor to electric shock counts on Western Power's distribution network. Therefore, effective management, via the proposed investment program, is required to provide a safe supply of electricity and meet our Annual Network Safety Performance Objectives.

470. The OCSC sub populations that exhibited a higher rate of electric shocks than the overall OCSC population were targeted in AA4 by the investment in Service Connection Condition Monitoring (SCCM) and AMI. This is now complete and these sub populations of OCSC are expected to have a lower number of electric shocks through the AA5 period and beyond, relative to the AA4 period. Any remaining OCSC not targeted by the initial investment will have SCCM deployed when a communicating advanced meter is installed.

471. This has resulted in a step change reduction in the forecast capex for connection management. The proposed investment is based on forecast defects based on historical find rates through the inspection process and historical failure rates (e.g. car v pillar, OCSC replacement volumes).

5. SCADA and Telecommunications capex

472. Western Power's SCADA and Telecommunications assets provide the services required to protect, operate and manage the Western Power Network and the WEM. The SCADA and Telecommunications system is comprised of:

- the SCADA master station – operated from the control centre from where Western Power centrally operates and manages the transmission and distribution networks
- substation SCADA and distribution automation – field monitoring and control of electronic equipment to operate plant and equipment at every substation (as well as across overhead and underground distribution networks)
- the telecommunications network – providing the voice and data infrastructure required to transfer information between the electricity network, substations, depots and the control centre.

473. The SCADA and Telecommunications network is integral to the safe, reliable and efficient operation of the Western Power Network by provision of services including protection, monitoring, control, operational voice, meter reading, remote management and maintenance. The SCADA and Telecommunications network consists of more than 10,000 assets and over 5,000 km of communication cables and links.

474. The information gathered and communicated via SCADA infrastructure effectively acts as the 'eyes and ears' of the network, informing system and network operators of vital details about how the network is performing. The information also allows for proactive management to maintain safety and reliability.

475. The SCADA and Telecommunications network has grown and evolved over the past 40 years through a combination of technological advancement and as a result of organic growth and augmentation of Western Power's networks. However, the infrastructure deployed during the 1980s was mainly analogue and now needs to be upgraded to integrate with the digital network.

476. Much of the early digital technology is also at end of its useful life or is no longer compatible with current requirements. In general, the MRL of SCADA communications assets is about one-third that of transmission and distribution assets, so SCADA assets need to be renewed approximately three times during the life span of these other assets.

477. Compounding these factors are additional emerging factors, including customer demands and expectations, the uptake of DER (including solar PV, batteries and electric vehicles), the expanding AMI fleet, technology standards and compliance requirements, and emerging cyber security threats.

478. As a result, the asset life cycles for SCADA communications assets are decreasing and will be expected to be required to be refreshed in ever-shorter cycles. Western Power needs to act now to invest in cycled refreshing of its SCADA assets.

479. Over previous regulatory periods, Western Power's SCADA and Telecommunications network has been maintained on a reactive basis. It has now reached the point where technical obsolescence has become an issue for almost 70 per cent of SCADA assets, meaning that support for the assets is becoming increasingly difficult to source. The rates of obsolescence vary between SCADA assets. For example, as at June 2021, the rate of obsolescence was:

- 94 per cent for grid automation assets in the CBD
- 68 per cent for UHF/VHF radio assets.

480. The condition of the SCADA and Telecommunications network has also impacted the reliability of those assets, with most operating well below their target availability. For example, the current availability of

microwave radio, telecom multiplex, UHF/VHF radio and remote terminal unit (RTU) assets is around 97.56 per cent, against a target reliability of 99.99 per cent.

481. Extending the asset life further of these SCADA assets will lead to:

- lower reliability and asset availability
- higher opex and workforce impacts
- inability to meet emerging requirements relating to cyber security, DSO, DER and Technical Rules.

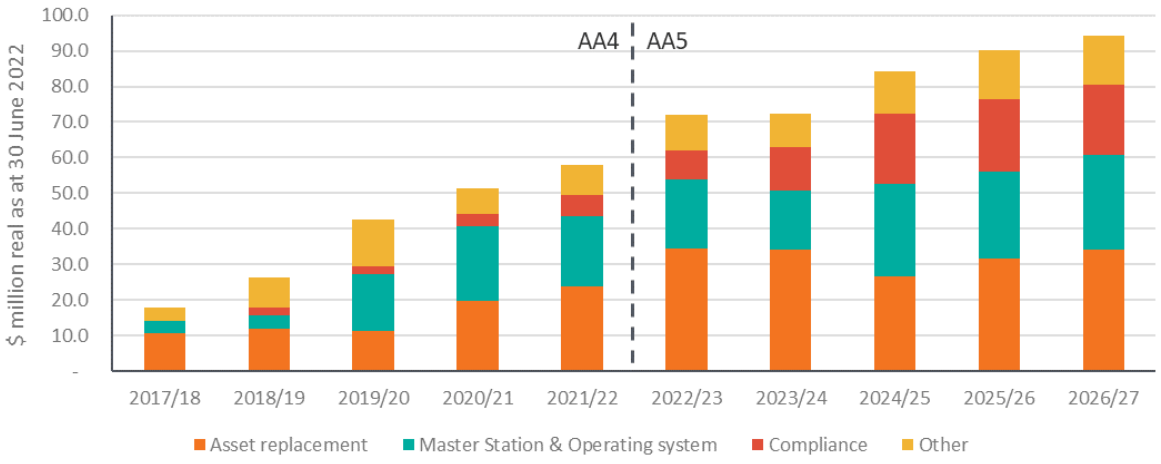
482. Accordingly, Western Power plans to invest $413.1 million in the SCADA and Telecommunications network during the AA5 period, as shown in Table 5.1.

Table 5.1: AA5 forecast SCADA and Telecommunications capex$ million real, 30 June 2022[63]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
Asset replacement	34.5	34.2	26.7	31.5	34.2	161.2
Master Station and operating system	19.4	16.6	26.0	24.5	26.5	112.9
Compliance	8.2	12.2	19.7	20.5	19.9	80.4
Other	9.9	9.4	11.9	13.6	13.8	58.6
Gross capex	**72.0**	**72.4**	**84.3**	**90.1**	**94.4**	**413.1**
Less contributions	0.0	0.0	0.0	0.0	0.0	0.0
AA5 capex to be added to the RAB	**72.0**	**72.4**	**84.3**	**90.1**	**94.4**	**413.1**

483. The forecast investment in the SCADA and Telecommunications network is $216.7 million (110 per cent) more than that incurred in the AA4 period, as shown in Figure 5.1.

Figure 5.1: Comparison of AA4 actual and AA5 forecast SCADA and Telecommunications capex



63 Excluding forecast labour escalation and indirect costs.

484. The following table compares the total SCADA and Telecommunications capex in the AA4 and AA5 periods.

Table 5.2: Comparison of total AA4 and AA5 forecast SCADA and Telecommunications capex by regulatory category, $ million real, 30 June 2022[64]

Expenditure category	AA4 Period total	AA5 Period total	Change from AA4
Asset replacement	77.5	161.2	108.0%
Master Station and operating system	64.0	112.9	76.5%
Compliance	13.9	80.4	477.8%
Other	41.0	58.6	42.9%
Gross capex	**196.4**	**413.1**	**110.3%**

485. The following sections provide further information on the proposed investments in the AA5 period for each of these subcategories.

5.1 Asset replacement (improvement in service)

486. During the AA5 period, Western Power proposes to invest $161.2 million to replace critical SCADA and Telecommunication network infrastructure that is obsolete and unsupported. Obsolete assets include pilot cables, microwave radio transceivers and remote terminal units.

487. The proposed investment in the AA5 period will replace assets predominantly within the telecommunication network access, radio systems, control automation cabling, DC power system and grid automation asset classes.

488. As shown in a Table 5.3 significant proportion of these assets are obsolete and have a “high” risk rating. The obsolete assets are no longer manufactured and are not supported by the supplier. Furthermore, spare parts are no longer available for purchase or refurbishment.

Table 5.3: Asset risk rating, as at June 2021

Asset class	Asset type	% of asset class obsolete (June 2021)	Risk rating
Telecommunications Network Access	Tele-protection, multiplexers, operation IP (Tx)	64%	High
Radio System	Microwave radio (Tx)	40%	High
	UHF / VHF Radio (Dx)		
Control Automation Cable	Pilot cable (Tx)	100%	High
DC Power System	DC rectifiers and standby batteries (Tx)	41%	High
Grid Automation	CBD Remote Terminal Units (**RTU**) (Dx)	68%	High

489. Continued deferral of required replacements poses a risk to safe and reliable performance of the Western Power Network, as well as compromising the ability to manage cyber security threats and integrate new technology and alternative network solutions into the electricity system.

64 Excluding forecast labour escalation and indirect costs.

490. To address these issues, Western Power proposes to undertake the following projects during the AA5 period for the transmission network:

- a staged program of replacing the obsolete telecommunications network access, microwave and DC power systems assets ($55.4 million)
- complete stage 4 of the replacement of pilot cables, which will be the final phase resulting in all pilot cables being phased out by the end of AA5[65] and the risk rating will fall to "low" ($19.1 million)
- replace telecommunications standby batteries and site infrastructure such as shelters and fences ($3.6 million).

491. For the distribution network, Western Power plans to undertake the following projects during the AA5 period:

- replacement of grid automation RTUs in the CBD (Stage 3) ($9.3 million)
- complete the replacement of UHF/VHF radio systems (including the mobile radio) and associated infrastructure in the South West region of the SWIS ($25.5 million)
- commence the next stage of the replacement of UHF/VHF radio systems (including the mobile radio) and associated infrastructure in the northern and eastern regions of the SWIS ($37.6 million)
- replacement of distribution automation assets in the metropolitan area ($6.9 million)
- replacement of site infrastructure such as shelters and fences at distribution telecommunication sites ($2.4 million)
- replacement of DC rectifiers and batteries at distribution telecommunications sites ($1.5 million).

492. The asset replacement program is staged to optimise the asset life by retrieving spares to extend the life of assets, maximise Western Power project delivery capability and compliance to Western Power's IGF to ensure investments are prudent and efficient.

5.2 Master Station and operating systems

493. Western Power plans to invest $112.9 million in the master station and operating system in the AA5 period.

494. The master station is the foundation information and decision support system for the operations and management of the Western Power Network and WEM.

495. The master station is a suite of software applications underpinned by an electronic model of the network incorporating electrical connectivity information. The current state of each element in the model network is updated either in real time from SCADA or near real time by manual updates by Network Operations Control (**NOC**). It is the foundational information and decision support system for the deployment of intelligence in a transmission network, providing NOC with tools for faster and more informed decision making and improving the efficiency of the network, minimising outage times. The master station also allows for remote and automated control of the network. The functions performed by the master station include switching management, outage management, state estimation, network and contingency analysis, network optimisation, generator dispatch and network automation.

496. The master station and operating system are Western Power's highest consequence asset for cyber-attack as their failure can result in a SWIN blackout. Therefore, it is critical to ensure these systems remain supported to ensure no cyber security vulnerabilities.

[65] This outcome is dependent on the replacement of associated pilot protection relay, which is part of the transmission asset replacement and renewal capex program.

497. The forecast master station and operating system investment for the AA5 period includes expenditure to:

- maintain the master station applications and infrastructure, including upgrades of all software and the applications within four to five years. This includes the Advanced Distribution Management System, the Transmission Management system (which is being replaced), the Communications Network Management System and the emergency telephone systems
- implement new capability to manage the increasing penetration of renewables and DER, including visibility of the low voltage network, and capability for emergency curtailment or control and improved operational intelligence to support orchestration of DER, such as short term operational forecasting and operational analytics to maintain situational awareness
- implement new functions that allow for business improvement resulting in risk reduction or efficiencies, such as the second stage of the upgrade communications network management system (**CNMS**) project and the deployment of additional AMI-related modules to enable medium voltage distribution automation devices to communicate of the RF mesh communications network (where feasible).

498. This investment in the master station and operating system is required to:

- deliver efficiencies, for example in switch plan production and validation checks, and streamlining interactions between NOC and field staff
- better meet targets relating to reliability, quality and reporting
- provide more up-to-date and granular network and asset performance data, as well as outage information for customers
- improve ability to operate assets to capacity and perform load transfer decisions through greater accuracy, in real-time, of load calculations on the network, whilst also improving business continuity and disaster recovery responses
- improve safety through improved integrity for data on the status of the network.

499. The investment in the master station is also required to meet the following legislative and regulatory performance requirements:

- operate the SWIS in accordance with the Power System Operation Procedure and the Technical Envelope for the applicable SWIS Operating State (WEM Rules, Section 3.2.8)
- monitor power system performance to meet power system performance standards (Technical Rules, Sections 2.2, 2.3.9 and 3.2.1)
- provide operational coordination of the power system, which includes the requirement to “coordinate high voltage switching procedures and arrangements in accordance with good electricity industry practice in order to avoid damage to equipment and to ensure the safety and reliability of the power system” (Technical Rules, Section 5.3.1)
- use remote switching to restore supply to those sections of the CBD not directly affected by a fault (Technical Rules, 2.5.4.2)
- coordinate emergency recovery efforts so as to restore the SWIS from an emergency operating state as soon as possible (WEMR 3.5.5 and 3.5.6)
- distribution network operation and co-ordination responsibilities which includes (Technical Rules, section 5.3.1):
  - coordinate high voltage switching procedures
  - operate all equipment within operational or emergency limits

  - disconnect equipment during emergencies
  - coordinate any supply interruptions
  - investigate and review any major transmission and distribution network operational incidents
- operate and maintain a trouble call fault management system (Electricity Distribution Licence, clause 25)
- minimise the duration of customer supply interruptions (Supply Code, Section 10 (1))
- provide a reliable means of communications for isolated (i.e. field) workers (Regulation 3.3. of the *Occupational Health and Safety Regulation 1996 (WA)*
- meet current and prevailing cyber security obligations (*Security of Critical Infrastructure Act 2018* and *Security Legislation Amendment (Critical Infrastructure) Bill 2020*).

500. Western Power submitted a proposal to the ERA in July 2021 to amend certain provisions of the Technical Rules, some of which relate to the technical requirements for the SCADA and operating system. The outcome of the review by the ERA may impact the above compliance requirements.

5.3 Compliance

501. Western Power plans to invest $80.4 million in compliance capex for SCADA and Telecommunications for the Western Power Network. This investment is focused on the replacement and addition of SCADA and Telecommunications assets to achieve compliance with regulatory and legislative obligations, such as the WEM Rules and Technical Rules, and manage the associated residual risks to ALARP. This activity includes installing active electronic equipment such as remote terminal units, microwave radio, control cabling, telecommunications structures and shelters, and DC power systems.

502. Western Power plans to reinforce the communications network to address the following requirements:

- Technical Rules section 2.9 compliance – Some of the existing SCADA and Telecommunications assets do not meet current Technical Rules (section 2.92(a)(1)) requirements. This is mainly due to the change of the requirements since the assets were installed
- Australian Communications and Media Authority (**ACMA**) embargo 47 and 49 – In the northern region (Geraldton), frequency embargoes are in place as issued by ACMA severely limiting the allocation of new microwave radio frequency licences in the area. Given these limitations, provision of additional capacity over microwave radio systems in Geraldton region is not possible. This investment will explore the use of alternative fibre technologies to provide a cost-effective means of deploying optical fibre cabling by utilising existing transmission or distribution infrastructure.

503. Western Power will also invest in upgrading substation SCADA to meet the requirements of the AEMO Data Communication Standard for the WEM. Approximately 180 sites (75 per cent) do not meet the requirements of this standard. This work will be completed as part of Western Power's Upgrade Substation Automation program., which seeks to address issues related to obsolete equipment, limited spares and support, and meeting cyber security requirements.

504. Western Power will address anticipated cyber security requirements for in-service field assets as required by proposed amendments to the *Security of Critical Infrastructure Act 2018* and *Security Legislation Amendment (Critical Infrastructure) Bill 2020*. This investment will:

- address preparedness for, and ability to respond to, cyber security threats and incidents
- uplift asset availability to the required level as per technical regulation and industry best practices
- improve safety and ability to monitor and collect data for improved business and asset management.

5.4 Other SCADA and Telecommunications capex

505. Other investment proposed for the AA5 period for SCADA and Telecommunications includes:

- $18.9 million to develop Western Power's capability to meet DER and DSO integration requirements that cannot be addressed with the existing renewal and replacement projects, including Project Symphony. This includes projects to address potential capability shortfalls relating to field automation, communications and the DSO operational platform. This investment is to ensure there is suitable SCADA and Telecommunications infrastructure to support DER and DSO, including monitoring and control of primary assets (e.g. transformers, batteries, solar) on the medium and low voltage networks

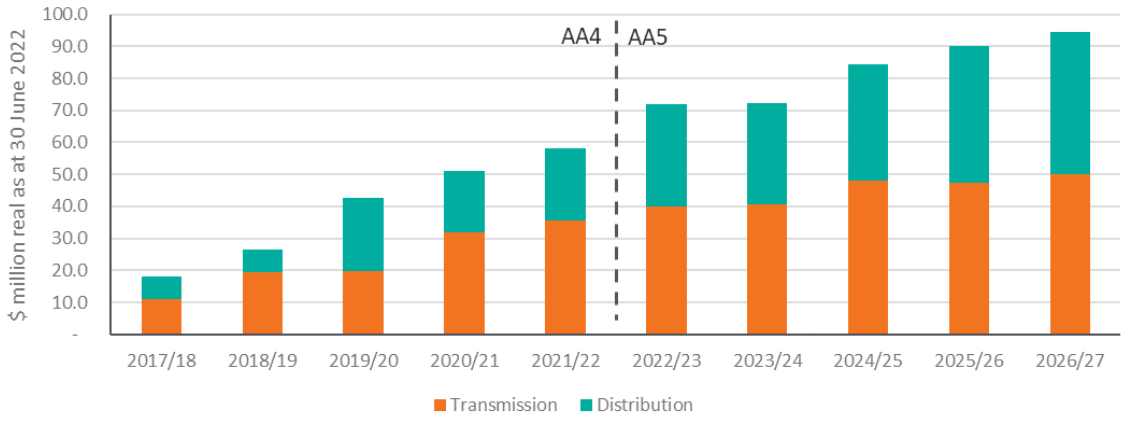
  The evolving role of Western Power as the DSO and the technical specifications around the level of automation and control and how DSO / DER will be integrated is yet to be fully defined. Accordingly, the forecast capex requirement is based on Western Power's understanding of the future requirements of the DSO role and expected level of DER integration
- $33.7 million for the replacement and addition of SCADA and Telecommunications assets to support Western Power's Corporate Strategy to increase the asset output, reduce the asset costs and increase the asset reliability and life span. These investments are targeted at improving security at substations, supporting the Depot Optimisation and Consolidation Program (**Depot Program**), facilitating field automation and additional radio mesh equivalent to support the AMI deployment
- $6.1 million to address external technological changes, including actions by third parties, affecting SCADA and Telecommunications service delivery. This expenditure is required to react to changes outside of the electricity industry that have significant impacts on the asset base. The majority of planned investment for the AA5 period results from the Telstra's decision to discontinue the 3G service, which is currently used by a number of Western Power's devices. These devices will be transitioned from Telstra 3G services to Telstra NextG services. The planned investment for the AA5 period also includes expenditure related to the transition of copper telephony services at substations.

5.5 SCADA and Telecommunications by network

506. The purpose of this section is to provide a breakdown of the forecast SCADA and Telecommunications network capex by transmission and distribution network to facilitate comparison of expenditure between the AA4 and AA5 periods.

507. While the capex forecast for the SCADA and Telecommunications network has been split between transmission and distribution in this report for the above purpose, the overall SCADA and Telecommunications system serves both networks.

Figure 5.2: Comparison of AA4 actual and AA5 forecast SCADA and Telecommunications capex



508. The majority of the SCADA and Telecommunications capex for the transmission network is for asset replacements ($78.1 million, 35 per cent) and compliance capex ($75.5 million, 33 per cent). The balance comprises capex for the master station and operating system ($49.9 million, 22 per cent) and other SCADA assets ($22.1 million, 10 per cent).

509. Table 5.3 summarises AA5 period forecast transmission SCADA and Telecommunications capex.

Table 5.3: AA5 forecast transmission SCADA and Telecommunications capex, $ million real, 30 June 2022[66]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
Asset replacement	17.0	17.2	14.9	15.0	14.0	78.1
Master Station and operating system	12.4	7.4	10.4	7.7	11.9	49.9
Compliance	7.7	11.2	18.6	19.4	18.7	75.5
Other	2.7	4.9	4.0	5.2	5.2	22.1
Gross capex	**39.9**	**40.7**	**47.9**	**47.2**	**49.9**	**225.6**
Less contributions	0.0	0.0	0.0	0.0	0.0	0.0
AA5 capex to be added to the RAB	**39.9**	**40.7**	**47.9**	**47.2**	**49.9**	**225.6**

510. The majority of the SCADA and Telecommunications capex for the distribution network is for asset replacements ($83.1 million, 44 per cent) and the master station and operating system ($63.0 million, 34 per cent). The balance comprises capex for compliance capex ($4.9 million, 3 per cent) and other SCADA assets ($36.5 million, 19 per cent).

511. Table 5.4 summarises AA5 period forecast distribution SCADA and Telecommunications capex.

66 Excluding forecast labour escalation and indirect costs.

Table 5.4: AA5 forecast distribution SCADA and Telecommunications capex, $ million real, 30 June 2022[67]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
Asset replacement	17.5	17.0	11.8	16.5	20.2	83.1
Master Station and operating system	6.9	9.2	15.5	16.8	14.5	63.0
Compliance	0.5	1.1	1.1	1.1	1.1	4.9
Other	7.2	4.4	7.9	8.5	8.6	36.5
Gross capex	**32.1**	**31.8**	**36.4**	**42.9**	**44.4**	**187.5**
Less contributions	0.0	0.0	0.0	0.0	0.0	0.0
AA5 capex to be added to the RAB	**32.1**	**31.8**	**36.4**	**42.9**	**44.4**	**187.5**

[67] Excluding forecast labour escalation and indirect costs.

6. Corporate support capex

512. Western Power proposes to invest $463.3 million of capital in corporate support during the AA5 period. This represents around nine per cent of total capex for covered services. Corporate capex comprises business support investment and ICT investment.

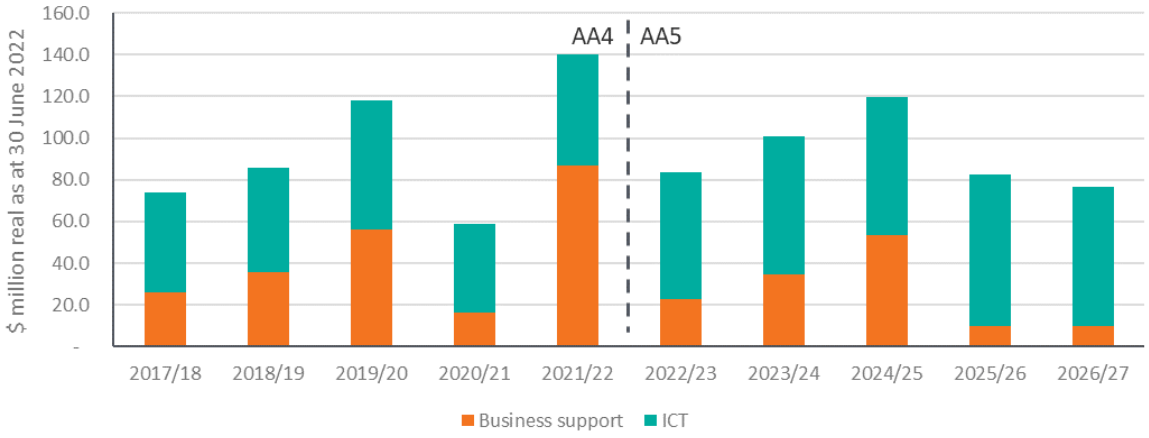
513. Table 6.1 summarises AA5 period forecast corporate capex by regulatory category.

Table 6.1: AA5 forecast corporate capex by regulatory category, $ million real, 30 June 2022[68]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
Business support	22.7	34.6	53.7	9.7	9.7	130.5
ICT	60.9	66.4	65.8	72.7	66.9	332.8
Gross capex	**83.6**	**101.1**	**119.5**	**82.5**	**76.7**	**463.3**
Less contributions	0.0	0.0	0.0	0.0	0.0	0.0
AA5 capex to be added to the RAB	**83.6**	**101.1**	**119.5**	**82.5**	**76.7**	**463.3**

514. Figure 6.1 shows how forecast corporate capex for the AA5 period compared with historical levels.

Figure 6.1: Historical and forecast corporate capex by regulatory category, $ million real at 30 June 2021



515. The following table compares the total expenditure in the AA4 and AA5 periods.

Table 6.2: Comparison of total AA4 and AA5 forecast corporate support capex by regulatory category, $ million real, 30 June 2022[69]

Expenditure category	AA4 Period total	AA5 Period total	Change from AA4
Business support	221.2	130.5	-41.0%
ICT	255.9	332.8	30.1%
Gross capex	**477.1**	**463.3**	**-2.9%**

68 Excluding forecast labour escalation and indirect costs.
69 Excluding forecast labour escalation and indirect costs.

516. Forecast corporate capex for the AA5 period is equivalent to that incurred in the AA4 period. However, the mix of investment has shifted, with a greater proportion of the corporate capex in the AA5 period being for ICT projects.

6.1 Business Support

517. Forecast business support capex includes expenditure on corporate real estate and property plant and equipment. Business support capex for the AA5 period is $130.5 million.

6.1.1 Corporate real estate

518. Forecast investment in corporate real estate is $125.3 million in the AA5 period. It is focused primarily on the Depot Program, which commenced at the start of the AA4 period.

519. Western Power's current office and depot accommodation portfolio is largely at end of life and in need of major rebuild or refurbishment. This means that there is a health and safety risk, and it results in unsafe work practices. They are also inefficient in their operations. The continued investment to modernise our depots is vital to deliver the benefits associated with the program and to ensure our depots of the future are efficient, more versatile, adaptive and in line with operational requirements.

Depot Program

520. Current depot infrastructure is outdated and unsuited to support the future operational requirements.

521. The Depot Program commenced in the AA4 period and will continue into the AA5 period. It will support fewer, more modern and larger depots that fit with Western Power's operational requirements. In alignment with this, Western Power will seek to automate manual processes and deliver efficiency improvements across depot design and physical security.

522. The Depot Program has two key objectives:

- update Western Power's ageing depots to meet current workplace safety practices
- improve financial efficiency of Western Power's depots through redevelopment of regional depots and consolidation of the number of depots in the Perth Metropolitan and South West region of WA.

523. The Depot Program seeks to address safety risks and issues impacting the financial and operational efficiencies of Western Power depots. It contributes to Western Power's strategic direction through:

- improving safety and operational efficiency within depots through delivery of modern, fit-for-purpose depot facilities
- enhancing physical security measures to protect our personnel, property and network assets
- reducing on-going expenditure in the delivery and maintenance of facilities and accommodation
- provision of accommodation to meet future operational requirements in a changing economic environment
- consistent and efficient property management practices, reducing costs in delivery of property services
- setting up depots for the future, with an ability to expand operational capacity.

524. By the end of the AA4 period Western Power will have delivered three newly built depots under the Depot Program being the Vasse, Pinjarra and Albany Depots, and will have completed the South Metro Depot

within the first six months of AA5. The South Metro depot is scheduled for completion prior to December 2022, with COVID-19 relates issues impeding full delivery within the AA4 period.

525. In addition to these, the Depot Program has also delivered a significant rebuild and refurbishment of the Merredin and Northam Depots respectively.

526. Western Power will deliver the following depot projects during the AA5 period:

- Balcatta Depot: the redevelopment of Western Power's northern metropolitan depot. The existing Balcatta Depot is past end of economic life and represents a financially and operationally inefficient facility.
- Forrestfield Depot: the location of a new dedicated Western Power training facility to replace the aged training facility currently located in Jandakot. The existing training facility is past end of economic life and represents a financially and operationally inefficient facility. Further, the existing training facility is located in an area that has no mains water or sewerage and any rebuild on this location would require significant costs to bring mains water and sewerage to the site.
- Picton Depot: the redevelopment of the Western Power depot in the major regional town of Bunbury. The existing facility is past end of economic life and represents a financially and operationally inefficient facility. Further, the Picton Depot is the location of a main Western Power Fleet Workshop, with this facility providing sub-standard and very poor accommodation, with the dimensions and size of the fleet building being unable to accommodate work practices to service heavy fleet. Standard fleet work practices associated with servicing modern heavy fleet equipment and vehicles are severely restricted due to standard of the accommodation provided.
- A number of small regional depots, the location of which will be determined once the full impact of the modular grid is known.

527. Western Power has previously adopted a care and maintenance approach for the depots. However, this approach is no longer sustainable given the depots are exceeding their engineering life. This means that ongoing capital and operating expenditure will need to increase to extend the life of these depots. The proposed investment in the AA5 period will extend the economic life of Western Power depots by 50 years and will reduce the requirement for increasing levels of capex and opex to provide short term extensions to the life of the depots.

Other corporate real estate

528. Other proposed investments in the AA5 period include:

- expanding the capacity of the Hope Road logistics facility in Jandakot, which currently has insufficient warehouse space available
- redeveloping regional depots and supporting accommodation for staff with the sequencing of these developments to align with operational requirements
- undertaking capital maintenance work on the Head Office building.

6.1.2 Property plant and equipment

529. Western Power plans to invest $5.2 million in ongoing operational capex requirements to ensure the safe and efficient delivery of the works program during the AA5 period. The forecast is based on historical spend.

530. Investment in PPE is required to ensure both safe and effective delivery of Western Powers works program. The forecast investment is required for low value capital equipment that is used by Western Power's

operational workforce in delivering the annual works program. The equipment is generally replaced at the end of its useful life or if new technology emerges that can be utilised in delivery. Examples of PPE include:

- specialist testing equipment used to analyse, test and recover sulphur hexafluoride gas (**SF6**) present within circuit breakers
- primary equipment used to test and commission protection assets
- three phase testing equipment for power and distribution transformer testing
- automated unit for locating both core and ground faults on LV cables
- portable power quality analyser used to measure a range of power quality parameters.

6.2 ICT

531. As the use of digital technology expands, Western Power will maximise value from technology investments by increasing agility and reducing time to benefits, targeting operational efficiencies and effectively managing cyber security risk. Western Power is required to ensure that its systems, applications and hardware remain current, reliable and vendor supported to meet a changing market and new customer demands.

532. Forecast capex on ICT during the AA5 period is $332.8 million. This includes investment in:

- business-driven ICT (66 per cent), which covers investment in the various enterprise systems used by Western Power
- infrastructure and maintenance ICT (34 per cent), which covers investment in core IT infrastructure including computers, operating systems and desk top applications.

533. Table 6.3 summarises AA5 period forecast corporate ICT capex by regulatory category.

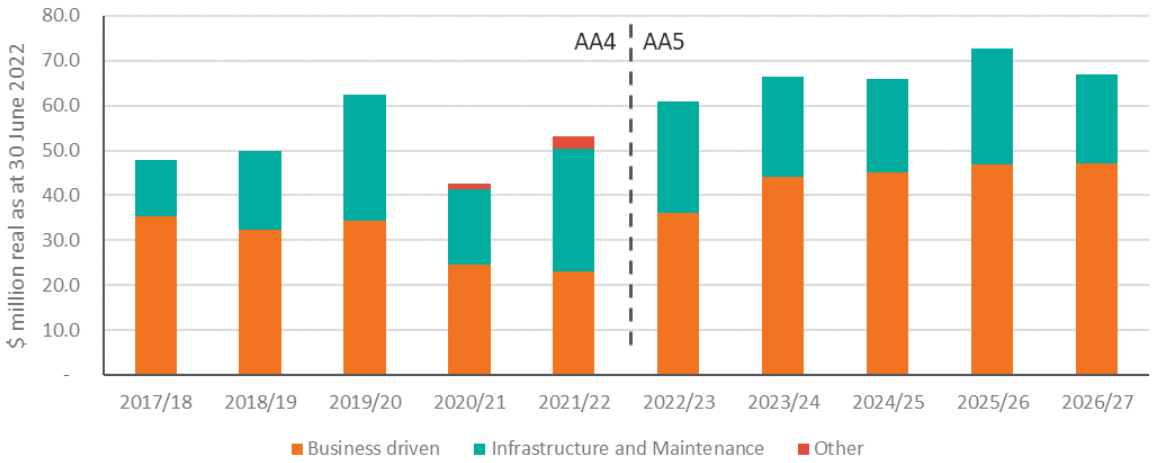
Table 6.3: AA5 forecast corporate ICT capex, $ million real, 30 June 2022[70]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
IT Business Driven	36.2	44.2	45.1	46.9	47.1	219.5
Infrastructure & Maintenance ICT	24.7	22.3	20.8	25.8	19.8	113.3
Gross capex	**60.9**	**66.4**	**65.8**	**72.7**	**66.9**	**332.8**
Less contributions	0.0	0.0	0.0	0.0	0.0	0.0
AA5 capex to be added to the RAB	**60.9**	**66.4**	**65.8**	**72.7**	**66.9**	**332.8**

The forecast investment in ICT is $81.0 million (32 per cent) more than that incurred in the AA4 period, as shown in Figure 6.2.

[70] Excluding forecast labour escalation and indirect costs.

Figure 6.2: Comparison of actual AA4 and AA5 forecast ICT corporate capex



534. The following table compares the total expenditure in the AA4 and AA5 periods.

Table 6.4: Comparison of total AA4 and AA5 forecast ICT capex by regulatory category, $ million real, 30 June 2022[71]

Expenditure category	AA4 Period total	AA5 Period total	Change from AA4
Business driven	149.6	219.5	46.7%
Infrastructure and Maintenance	102.2	113.3	10.9%
Gross capex	**251.8**	**332.8**	**32.2%**

535. The following sections provide further information on the ICT capex programs.

6.2.1 Business-driven

536. The business-driven ICT capex program covers investment in the various enterprise systems used by Western Power. This expenditure is required to:

- meet regulatory or other compliance requirements
- address environmental factors, such as responding to system low voltage and high DER penetration
- enable Western Power improvement and strategy, such as reducing risk, improving efficiency and meeting customer requirements.

537. Western Power will invest $219.5 million in business-driven ICT during the AA5 period, as shown in Table 6.5.

[71] Excluding forecast labour escalation and indirect costs.

Table 6.5: AA5 forecast business driven ICT capex, $ million real, 30 June 2022[72]

Expenditure category	2022/23	2023/24	2024/25	2025/26	2026/27	Total AA5
ICT Network Planning & Asset Management	8.4	18.0	21.0	18.8	17.3	83.4
ICT Works Mgt	2.0	5.1	5.1	6.1	9.2	27.5
ICT Customer	4.1	4.6	3.6	8.1	8.1	28.5
ICT Corporate	8.3	6.7	6.8	5.8	4.9	32.5
ICT Growth	7.6	7.6	8.6	8.1	7.6	39.7
ICT Regulatory reform	5.8	2.2	0.0	0.0	0.0	8.0
Gross capex	**36.2**	**44.2**	**45.1**	**46.9**	**47.1**	**219.5**

538. The following sections provide further information on the business driven ICT capex programs.

Network planning and asset maintenance

539. Western Power's proposed investment in ICT for network planning and asset management will ensure this function has the right tools, systems, and applications to extend the operating lives of existing assets and support transitional changes to the grid. Western Power proposes to update its existing asset management tools and systems to address current deficiencies and support the future network.

540. Western Power has utilised modelling applications for some time to develop optimised asset management strategies. These applications build on traditional asset system models that consume and forecast condition, risk, performance, and cost profiles through to industry leading modelling tools such as the Grid Transformation Engine which is planning the forward evolution of Western Power's distribution network. Model outputs are used at all levels from determining the future grid vision, supporting the Grid Strategy, and assessing life cycle management costs of the assets extending to the efficient planning of works delivery.

541. Western Power must ensure its asset management capability (including relevant tools, systems, and applications) delivers best practice asset management practices. This includes traditional processes such as asset condition monitoring to predict network risk (failure and consequence likelihood) with sufficient coverage of critical network assets whilst extending these capabilities to manage uncertainty through scenario-based modelling to optimise longer term direction.

542. Western Power proposes to update its existing asset management tools and systems to address current deficiencies and support the future network. This includes:

- updating Asset Investment Planning tools to allow the analysis of cost and risk within the asset class as well as across portfolio investments to optimise benefits
- extending data warehouse capabilities through the integration of existing data with time series data provided from new sensors where the information can be exploited for both traditional and advanced analytics
- enhancing advanced analytics tools to provide:
  - forecast asset condition, performance, and failure

[72] Excluding forecast labour escalation and indirect costs.

  - process large volumes of data and uncover insights not forthcoming from traditional techniques
  - model options and scenarios to refine asset strategies and investment plans; and
  - asset health indices and visualisations to support rapid decision making.
- improving asset risk understanding by using advanced analytics tools
- developing enhanced network transformation strategies through improved scenario modelling of the demands on the network to take into consideration external factors.

543. This proposed investment for the AA5 period supports network planning and asset management through capturing, monitoring, interpreting and reporting on the health of network assets. Accurate information regarding the characteristics and health of assets is essential to determining risk and effectively forecasting capital and operational investment requirements.

544. The proposed investment is critical for supporting the transition to the modular grid and the integration of DER as it provides the necessary insight to make appropriate risk-based asset management decisions and modelling of the future network.

Works management

545. The role of Works Management is to plan efficiently and effectively, schedule, dispatch, execute and close-out the works program established through the network planning process, across planned and unplanned maintenance and major projects.

546. Western Power has multiple systems and processes in place to support the planning, allocation, and scheduling of work programs. Using multiple systems has led to a lack of enterprise-wide visibility of the plan and the status of work as it moves through to the execution phase. The existing systems include a mix of standalone databases, systems with limited integration to enterprise systems and bespoke systems that are limited in functionality and outdated.

547. The proposed investment for the AA5 period covers the development and implementation of a works management future technology road map to deliver a broad range of improvements across Western power's planning, scheduling, works management and project management processes. This will include replacement or enhancements of solution for these processes, as follows:

- **Work planning and scheduling**: a new solution is required to facilitate greater visibility of work programs and crew capacity and demand, optimise resource allocation (workers and equipment) and provide metrics on crew performance to support continuous improvements. Providing a capacity versus demand view linked to resource rosters, materials inventory, and the ability to match work and resource requirements will lead to significant improvements in the execution of field work. Information detailing capacity and requirements of work types is fundamental to the ability to optimise and automate the allocation of work
- **Project management support tool:** enhancement or replacement of the current Oracle Primavera Portfolio Management (OPPM) solution. Improved integration to enterprise systems is required to provide a timelier view of work status and cost updates, which will further support better governance and corrective action. Consolidating all work into a central project/program management system will enhance data quality, while introduction of a centralised planning view will provide a single view of work demand, enabling more effective resource planning
- **Field mobility:** an upgrade to, or replacement of, the field mobility application is required to support additional work types, provide access to all relevant information whilst in the field and enhance the user experience. At a time when natural disasters and more frequent, the field mobility tool is critical to manage all work and provide communications to customers on status updates

- **Works management data warehouse:** a centralised data repository for data captured through the planning, scheduling, and delivery of programmed work is required to enable improved analytics and reporting on key performance metrics to drive better decision making.

548. These improvements will reduce the cost of delivering work programs across all work types through automation and improved data-driven decision making.

Customer

549. The proposed investment in Customer ICT in the AA5 period includes capex to enhance our customer service platforms.

550. Western Power will enhance customer systems to ensure we have the right capabilities to operate in a more complex future where big data, visibility and online digital communications will be paramount.

551. Customer experience expectations have increased in line with the advancements of consumer technology. At the same time our customers are becoming more tech savvy and are more active and more engaged in the management of their electricity. The next decade will see an increase in the adoption of renewable energy at a time where technology development is rapidly reducing the cost of non-wires alternatives. This is driving a need to enhance our customer service platforms.

552. The projects identified to support our changing customer requirements will be delivered through the following initiatives:

- **Customer Connections:** This initiative will establish a gateway for customers to safely connect to the Western Power Network to gain access to up-to-date information on their account and in-flight projects
- **Customer Self-Service Technology:** Leveraging the foundation of the customer management system, a customer self-service portal will enable Western Power's customers to request services electronically, through a two-way flow of communication. This will enable customers to receive faster and easier service, gain better information on activities impacting their electricity supply and manage their service requests
- **Customer Analytics:** The AMI deployment will provide greater visibility of customer data in near real time. This will allow Western Power to analyse customer data through a customer view, to provide proactive feedback on cost-effective services or open cases. The AMI data can also be used to support customer self-service technology
- **Digital Offering:** Enhance our digital offering and make it consistent across all channels. Our channels need to be frictionless, digital, and integrated into the customers preferred platform, i.e., website, social media or 3rd party.

553. The proposed investment will deliver continued enhancements to the customer management platforms including customer relationship management, customer data integration from AMI, self-service portal, improved view of the customer through near real time analytics and expanding the footprint of our digital offering for customer communications.

554. It will deliver a significant improvement in the customer experience from interactions with Western Power, including a consistent, single source of data to answer customer queries via their preferred communication channel. The investment in the digitisation of customer systems and the other enabling processes will strengthen Western Power's customer service offering.

Corporate

555. The proposed investment in Corporate ICT in the AA5 period includes capex to support property & fleet and metering (AMI deployment and implementation of five-minute settlements).

Property & fleet

556. The proposed ICT investment for the AA5 period supports the upgrade of Western Power's Property & Fleet facilities, consistent with the Corporate Strategy to support the changing landscape and to provide our field workers with a safe more modern work environment. This includes:

- continuing roll out of the ICT elements of the Depot Modernisation Program
- new digital capabilities that will automate current manual processes to deliver efficiency improvements
- managed services covering physical and cyber security to reduce operational risk and improve workplace safety
- using data from advanced Telematics to improve fleet utilisation
- continuing the transition of passenger fleet to hybrid electric vehicles
- continuing the Heavy Fleet Replacement and Overhaul Program to further improve efficiencies and cost savings over time.

557. The proposed expenditure will improve Western Power's ability to provide operational support to network assets. Furthermore, the proposed investment is critical for delivering the benefits associated with Western Power's Depot Modernisation Program and the Heavy Fleet Replacement and Overhaul Program.

Metering

558. The proposed ICT capex for the AA5 period supports both the AMI deployment and the implementation of five-minute settlements in the WEM.

559. Western Power's proposed ICT investment for the AA5 period supports the deployment of AMI with investment in the information and operational technology elements of the solution. These include the Network Management Solution (NMS) that manages the last mile meter communications and services as the gateway to integrate to the meter as well as the integration and changes to the backend ICT systems such as the Meter Data Management Systems and Billing Systems.

560. The proposed investment provides for all project costs (project management, software and hardware procurement, design build & test, project go live support) required for:

- scaling infrastructure for AMI head-end, billing and metering
- increasing licenses for AMI head-end, billing, and metering in line with the AMI deployment.

561. This investment to support the AMI deployment is in alignment with Western Power's Corporate Strategy to support DER and other renewable energy devices to meet customer expectations. When fully implemented, AMI data will be fully integrated into Western Powers operations to reduce security risk and improve decision making outcomes.

562. Drafted amendments to the *Electricity Industry (Metering) Code 2021* are expected to be approved by the Minister in 2021, enabling the recovery of expenditure associated with the implementation of ICT system uplifts for five-minute settlements.

6.2.2 Infrastructure & maintenance ICT

563. ICT applications require regular upgrades to remain within vendor support parameters, as well as to take advantage of improved functional and technological capabilities. Similarly, ICT infrastructure must be regularly refreshed to remain current and supportable. Unsupported applications create cyber security vulnerabilities.

564. Western Power adopts a disciplined approach to ICT application and infrastructure investment, consistent with the ICT Strategic Plan[73] and ICT Asset Management Guidelines. For the AA5 period, Western Power has established programs of work to deliver the following goals:

- Infrastructure - To build a flexible and responsive infrastructure capability, focused on continuous improvement and improving productivity for Western Power's technology investment
- Applications - Maintain currency of IT Applications within vendor support parameters to leverage new and updated technology capabilities that deliver operation improvements and lower costs
- Cyber Security – contain cyber security risk within Western Power's corporate risk appetite by achieving an improved cyber security Maturity Indicator Level (**MIL**) across Australian Energy Sector Cyber Security Framework (**AECSF**) domains, and consider additional amendments proposed to the *Security of Critical Infrastructure Act 2018 (Cth)*.

565. Western Power will invest $113.3 million in upgrading and replacing business infrastructure ICT systems in the AA5 period. The business infrastructure ICT capex category covers expenditure on core IT infrastructure including computers, operating systems, and desk top applications.

566. The proposed investment in the ICT application and infrastructure refresh program is expected to deliver the following benefits:

- lowering of support costs by maintaining currency of hardware and software applications
- cost avoidance relating to extended or higher support costs
- avoidance of risk to Western Power's business operations, and the avoidance of the associated cost to mitigate the risk
- achievement of increased AESCSF maturity
- enable maintenance of the current level of safety risk by maintaining service levels for asset management systems
- contain the risk of interruption, caused by failure of essential ICT systems/infrastructure, at an acceptable level
- avoid escalating maintenance costs and vendor support fee rises
- provide for organic growth where required
- ensure sufficient capacity to meet business needs
- introduce new technology that assists in maintain the overall ICT support cost with a growing portfolio of business applications
- ensure continued access to vendor support services.

567. The following sections provide further information on the proposed investment in infrastructure and maintenance ICT in the AA5 period.

[73] The ICT Strategic Plan will be replaced with the Digital Capability Strategy from 1 July 2022

Infrastructure upgrades – hardware

568. Western Power invests annually in the ICT hardware that underpins Western Power ICT services to ensure that sufficient capacity exists to meet business demand, hardware can be supported cost-effectively by vendors and service providers, cyber-security threats are managed, and performance and reliability meet the requirements of the business.

569. Western Power adopts a risk-based approach to hardware replacement. This is accomplished by assessing ICT hardware assets annually against a set of criteria defined in the ICT Asset Management Guidelines, replacing only those assets that exceed a defined risk threshold. The infrastructure refresh process incorporates an assessment of the technology marketplace to capitalise on opportunities to execute ICT strategies (e.g., consolidation, virtualisation, cloud solutions etc.) to absorb growth or reduce capex expenditure.

570. During the AA5 period, Western Power will experience new challenges and opportunities from a changing landscape that will impact the way the business operates today. To meet these challenges, Western Power must adapt through innovation, automation, bimodal delivery and best practices and standards for security. Therefore, the focus in the AA5 period is to adapt and enhance ICT infrastructure to deliver the following outcomes:

- increase business value from technology investments.
- increase agility and reduce time to benefit.
- operate more efficiently
- management of cyber security risks.

571. Infrastructure upgrades of existing ICT assets are planned to address the periodic refresh of ICT assets according to asset lifecycle, technological or operational requirements, with the overarching objective to provide a quality, reliable and secure platform for users to conduct day-to-day operations at the lowest possible cost:

Infrastructure upgrades – software

572. ICT infrastructure software assets are defined as the software required to operate ICT hardware assets (e.g. drivers, HW vendor monitoring tools), software required to manage the ICT environment (e.g. CMDB) or software shared across multiple applications (e.g. operating systems, Oracle DB software). This software is required to operate an enterprise ICT environment and associated enterprise systems.

573. ICT Infrastructure software assets are evaluated on their ability to deliver functionality that meets Western Power's ICT strategy, the original requirements and service levels. As part of the annual planning cycle, the infrastructure software assets are evaluated to ensure that they will remain under mainstream vendor support and are relatively up-to-date and current within the Western Power environment during the next forecast period, and the functional capability of the software continues to meet both the original requirements and any new additional one's associates with business change.

Application upgrades

574. Enterprise software assets (applications) are defined as the systems and platforms required for the operations of Western Power. These systems that provide the full range of capabilities required to run the business, including, but not limited to financial management, asset management, network planning, works management (delivering the works program), human resource management, customer engagement, commercial management and risk management. The enterprise software assets are considered in the context of the portfolio, due to the potential impact of software currency of one enterprise system on

others (e.g. failure to maintain currency of the Enterprise Document Management system can limit the ability to maintain currency of the Microsoft Office product suite).

575. Business-driven initiatives can result in the implementation of new COTS, SaaS solutions or upgrades to existing enterprise software assets in the Western Power environment. These systems are implemented via the project process and are subject to business case justification which includes their ongoing operational costs. Western Power manages the ongoing maintenance and support of these assets in accordance with the service management tiering criteria (service catalogue), and budgets for the associated capital expense.

576. As part of the annual planning cycle, COTS, SaaS-based applications and enterprise software assets are evaluated to ensure that they remain under mainstream or extended vendor maintenance and remain reasonably up-to-date and current during the next forecast period, and that the functional capability of the software continues to meet the original and future requirements of the business. The enterprise software assets are considered in the context of the portfolio, due to the potential impact of software currency of one enterprise system on others (e.g. failure to maintain currency of the Enterprise Document Management system can limit the ability to maintain currency of the Microsoft Office product suite).

577. With a move to SaaS cloud-based applications, support costs associated with upgrades and infrastructure are effectively mitigated as SaaS cloud solutions always maintain currency and are typically hosted by the software vendor. On a cost comparison basis, SaaS cloud solution can be up to 20 per cent lower over a 5-year total cost of ownership comparison. This supports a preference to move to a SaaS cloud offering when

Cyber security

578. Due to an increase in the number and sophistication of cyber-attacks against critical infrastructure, the security and reliability of the network have fallen under increasing attention recently. In response to the increasing threat landscape, Western Power has aligned to the AESCSF as the primary control and maturity framework to manage cyber risks.

579. Western Power has established its Cyber Security Program in 2018 as part of the Cyber Security Strategy to progress the delivery of projects to address cyber security risks and uplift our cyber security maturity. The program has established improved processes across scoping, planning and delivery to improve delivery outcomes for Western Power and help secure our energy transformation journey.

580. The Cyber Security Program has two key objectives:

- drive an improvement in our foundational cyber security controls to contain our cyber security risk within our corporate risk appetite
- achieve an improved cyber security MIL across AECSF domains, in-line with proposed reforms to the *Security of Critical Infrastructure Act 2018 (Cth)*.

581. The Cyber Security Program commenced delivery of Phase 1 in 2018 as part of the Cyber Security Strategy. Over the course of 2019 and 2020, the program has progressed in the delivery of projects to address cyber security risks and uplift Western Power's cyber security maturity. Strategic risk has been contained to a rating of ‘High’ (down from ‘Extreme’), and progress on maturity uplift was assessed in December 2021 (following completion of Phase 2) and is anticipated to reach MIL2.

582. Successful projects include the design of the Functional Operating Model, which will provide significant capability to improve cyber security in the organisation and sustain AESCSF requirements. The Cyber Security function will operate as a Centre of Excellence and support the business to manage cyber security as well as provide end-to-end cyber security services.

583. Cyber security investment relates to various aspects of Western Power's proposed investment for the AA5 period, including:

- providing an uplift in cyber security as part of the Depot Program
- replacement and augmentation of SCADA and Telecommunications assets to enable compliance with the cyber security requirements
- meeting all current and proposed compliance requirements contained within the *Security of Critical Infrastructure Act* and related reforms
- enabling a secure transformation to a modular grid, by improving our foundational cyber security controls and adopting a secure by design approach to the introduction to new and emerging technologies.