APPENDIX 28

Network reliability strategic plan

Energex

Network Reliability Strategic Plan

2015-20

Asset Management Division

energex

positive energy

Version control

Version	Date	Description
1	25/09/2014	Final for Regulatory Submission

Energex Limited (Energex) is a Queensland Government Owned Corporation that builds, owns, operates and maintains the electricity distribution network in the growing region of South East Queensland. Energex provides distribution services to almost 1.4 million domestic and business connections, delivering electricity to a population base of around 3.2 million people.

Energex's key focus is distributing safe, reliable and affordable electricity in a commercially balanced way that provides value for its customers, manages risk and builds a sustainable future.

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1 Purpose and Structure

1.1 Purpose

The purpose of this Strategic Plan is to identify:

- The strategic objectives and operational requirements of the business over the next regulatory period;
- Existing network reliability compared to standards;
- Forecast of network reliability in the next regulatory control period; and
- The proposed reliability program of work required to comply with standards.

This Strategic Plan is prepared in compliance with Energex's Corporate Strategy.

1.2 Structure

To achieve its purpose, the Strategic Plan is structured according to the following sections:

1) Strategic Objectives – provides an overview of the strategic planning process and explains how the corporate strategic objectives are translated into operational initiatives and outcomes to be delivered by this Strategic Plan;

2) Standards – details compliance requirements for network reliability

3) Existing Performance – details current compliance of network reliability compared to the standards

4) Future Requirements – specifies the core deliverables, changing environment, options and program initiatives

5) 2015-20 Program initiatives – provides detailed costs of the reliability program of work over the five year regulatory period;

6) Governance & Review – sets out the governance arrangements associated with this Strategy Plan.

2 Strategic Objectives

This Strategy is part of an overall strategic planning process that ensures that the corporate strategic objectives are operationalised within the business. This framework is characterised by the inter-linkages detailed in Figure 1.

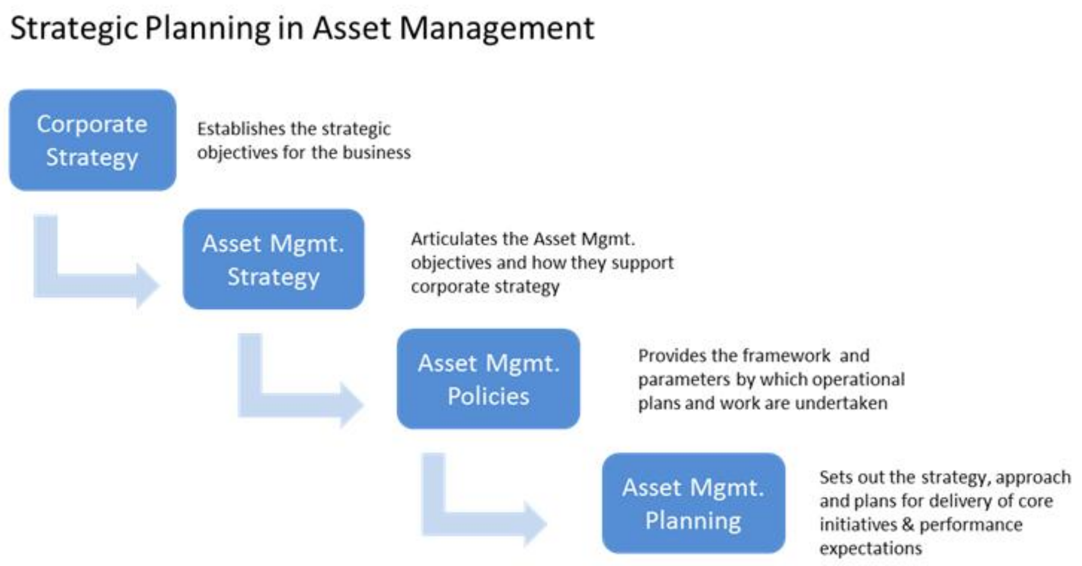


Figure 1: Energex's Strategic Planning Process

2.1 Network Asset Management Strategy

Energex's network asset management strategy aims to achieve the following objectives:

- compliance with statutory obligations including safety, environment, and regulation and Energex Distribution Authority, policies and standards
- business outcomes achieved and customer and stakeholder expectations met including acceptable levels of network reliability
- investment principles and optimised asset investment plans that balance network risk, cost and performance (service) outcomes
- a focus on asset life cycle management including asset data and information and communication technology (ICT) initiatives (data adequacy and quality)
- modernisation of the network to meet required business and customer outcomes
- further development of Energex's asset management system (practice).

Section 2.2 details how the Reliability Strategic Plan directly contributes to these objectives.

2.2 Network Reliability Strategy

This strategy aligns to the Energex Network Asset Management Strategy in the following ways:

- compliance with reliability standards outlined in Energex's Distribution Authority
- expected business outcomes & fulfilment of stakeholder expectations by maintaining current average reliability performance and improving reliability to the worst performing feeders
- balanced commercial outcomes by ensuring the investment in network reliability is optimised to address risk, cost and performance.

The network risks being managed as part of this strategic plan will be assessed in accordance with the Network Risk Framework. Detailed network risk information will be incorporated in the specific project/program planning documentation.

3 Standards

3.1 Minimum Safety Standard Limits

Energex has obligations under its Distribution Authority to use reasonable endeavours to ensure it does not exceed the minimum service standards (MSS) shown in Table 3.1. The MSS is an average performance standard for the CBD, urban and rural network. The limits specified in the Authority are inclusive of both planned and unplanned events. Exceedance of the same MSS Limit three years in a row is considered a “systemic failure” and constitutes a breach of the distribution authority.

Energex’s network reliability is measured using the System Average Interruption Duration Index (SAIDI) and the System Average Interruption Frequency Index (SAIFI). These indices are defined as follows:

- SAIDI is the total average outage duration for each customer served over a one year period; and
- SAIFI is the average number of interruptions that each customer would experience over the same period.

Table 3.1 shows the standard applicable to the end of the current regulatory period 2010-15 and the next regulatory period 2015-20. Prior to the 2014/15 financial year, the standards were defined in the Queensland Electricity Industry Code which was administered by the Queensland Competition Authority (QCA). Although the original MSS was an improving standard, this was changed to a ‘flat-line’ standard as part of the Electricity Network Capital Program (ENCAP) review finalised in 2012, which recommended maintaining the standards at the 2011/12 levels. Subsequently, in 2013, the Independent Review Panel on Network Costs recommended the following:

- Remove MSS from the Code and instead include them in Energex’s Distribution Authority (Recommendation 6).
- Set MSS at the levels applying at the commencement of the current regulatory period (Recommendation 7).

Therefore, from 2014/15 onwards, the MSS are included in Energex’s Distribution Authority and are set at the 2010/11 levels.

Table 3.1 – SAIDI / SAIFI Minimum Service Standards 2010-15 and 2015-20

SAIDI Targets	2010-15					2015-20
	2010-11	2011-12	2012-13	2013-14	2014-15	
CBD	15	15	15	15	15	15
Urban	106	102	102	102	106	106

SAIDI Targets	2010-15					2015-20
	2010-11	2011-12	2012-13	2013-14	2014-15	
Rural	218	216	216	216	218	218

SAIFI Targets	2010-15					2015-20
	2010-11	2011-12	2012-13	2013-14	2014-15	
CBD	0.15	0.15	0.15	0.15	0.15	0.15
Urban	1.26	1.22	1.22	1.22	1.26	1.26
Rural	2.46	2.42	2.42	2.42	2.46	2.46

3.1.1 MSS Statistical Variability

Energex's performance against the MSS limits is measured as the 12 month normalised SAIDI and SAIFI result at 30 June each year, which allows for the removal of exclusion events, including the impact of severe weather (using the 2.5 beta method). Unplanned SAIDI and SAIFI can vary from year to year due to seasonal changes in weather patterns and the occurrence of normal random events in the network. Although the 2.5 beta method adopted in the Distribution Authority (based on IEEE Standard 1366) does remove some of the variation, it tends to be less sensitive to events affecting the rural network due to the lower contribution to system SAIDI.

To allow for this variation, ENERGEX must target performance levels better than the MSS limits to reduce the risk of non-compliance.

Although exceedance of the same MSS limit three years in a row constitutes a breach of the distribution authority, Energex's planning criterion is to limit the risk of breaching the MSS to the 90th percentile, which equates to a 10% probability of exceedance (10PoE), or one in ten years. This is applied individually to the Urban and Rural SAIDI and SAIFI parameters to ensure that no individual parameter exceeds its limit three years in a row.

To determine the risk of exceeding the MSS limits, the historical normalised daily SAIDI and SAIFI over the last five years has been statistically analysed using a Monte Carlo bootstrap method. A figure of 5000 simulation years was chosen, sufficient to create a distribution representing a wide variety of possible random outcomes. By choosing a random day sample comprising the system, urban, rural and CBD SAIDI and SAIFI values, account is taken of the co-dependence of these parameters.

Given the co-dependence of the parameters, the probability of one or more of the parameters breaching the MSS is theoretically greater than the 10% PoE planning criterion applied to the individual parameters. A statistical analysis using the 5000 simulation years indicates that the PoE could increase to around 25%. However, in reality the PoE will be closer to 15% as urban SAIDI and SAIFI PoE is currently close to zero due to the significant improvements achieved over the 2010-2015 regulatory period.

The cumulative probability distributions are given in Appendix 1. The modelling provides an indication of the degree of dispersion or variance range of performance (shape) between the 90th percentile, 95th percentile and the 50th percentile ("variance ratio"), with a summary provided in Table 3.2. This ratio is used to determine the targeted level of performance to meet the 10% PoE planning criterion.

Table 3.2 – Normalised Variance Ratio*

Category	Variance Ratio $90^{th}/50^{th}$	Variance Ratio $95^{th}/50^{th}$
CBD	N/A	N/A
Urban SAIDI	1.08	1.11
Urban SAIFI	1.10	1.13
Rural SAIDI	1.09	1.12
Rural SAIFI	1.11	1.14
Average	**1.10**	**1.12**

* Includes planned outages

3.2 Worst Performing Feeders

The Minimum Service Standards represent a measure of the average performance of the network. However, this means that there are groups of customers receiving performance which is worse than the average. A feeder with poor performance may not contribute significantly to MSS if there are a small number of customers impacted. This could lead to this feeder being overlooked for performance improvements if the objective is to achieve MSS. Defining "worst performing feeders" allows monitoring of the performance of those feeders which have relatively poor performance compared to the average, and corrective action can be taken where appropriate.

Under its Distribution Authority, Energex has obligations to implement a program to improve the reliability on the worst performing 11 kV feeders. A feeder must meet the following two criteria for inclusion in the program:

1. Be in the 10% of worst performing feeders based on its three year average SAIDI/SAIFI performance; and

2. The feeder's SAIDI/SAIFI outcome is 150% or more of the MSS SAIDI/SAIFI Limit applicable to its category.

The requirement to monitor worst performing feeders and report on their performance was previously a requirement of Energex's Network Management Plan. However, in 2013 the Independent Review Panel on Network Costs recommended the Energex continue to monitor worst performing feeders and report on their performance in its annual report and the Distribution Annual Planning Report (Recommendation 9). Subsequently, Energex included this requirement in its Distribution Authority.

4 Existing Performance

4.1 MSS Limits

Energex's network reliability has been generally favourable to MSS over the last five years. SAIDI and SAIFI performance against MSS over the last five years is shown in the following charts. The charts also show the equivalent 10PoE target for the urban and rural networks. The actual performance has been broken down into planned, storm and non-storm causes to show the contribution of each category to the overall reliability.

Figure 4.1 – CBD Reliability

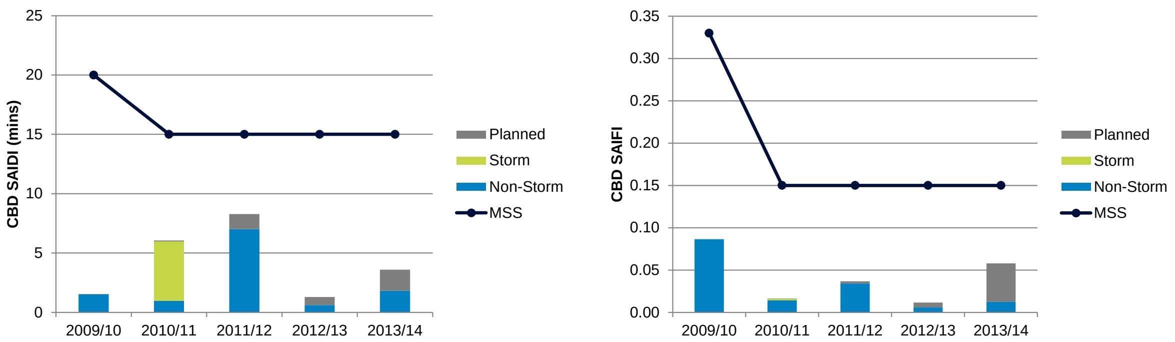


Figure 4.2 – Urban Reliability

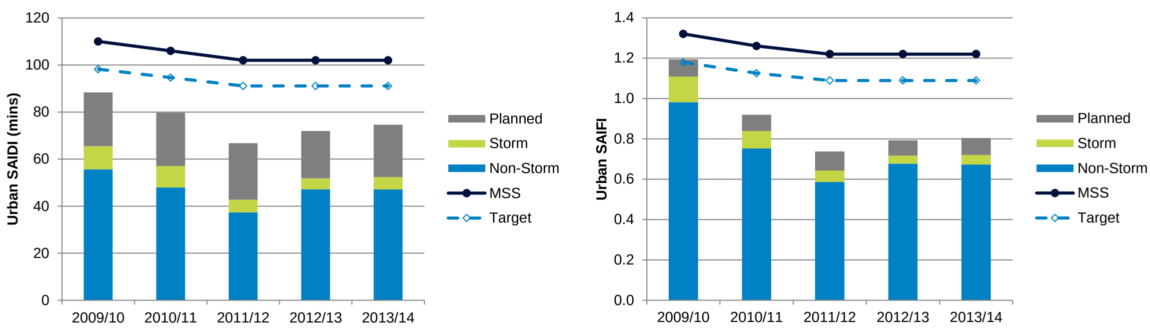
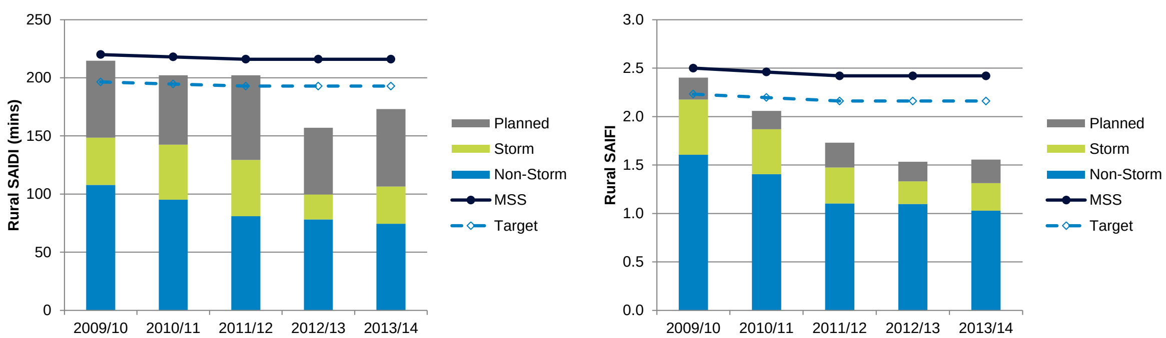


Figure 4.3 – Rural Reliability



4.2 Worst Performing Feeders

The following graphs show the distribution of feeder performance based on three years of data to 2012/13.

Figure 4.4: 3 Year Average Urban Feeder SAIDI Distribution – 2012/13

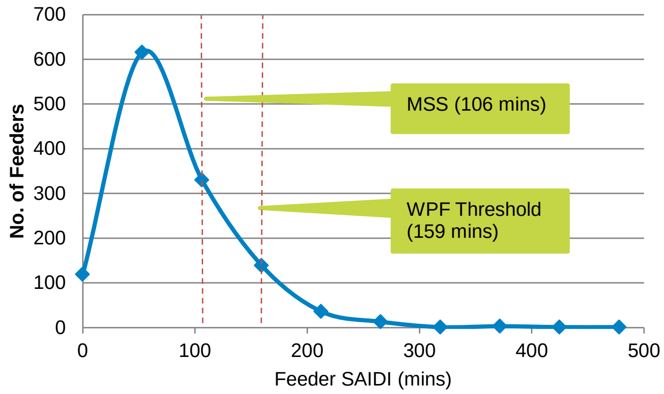
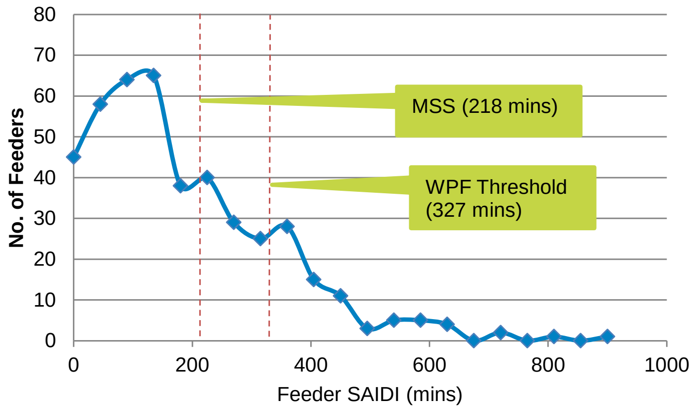


Figure 4.5: 3 Year Average Rural Feeder SAIDI Distribution – 2012/13



The performance of the 2013/14 worst performing feeders is summarised in the following table:

Table 4.1 – 2013/14 Worst Performing Feeders

Category	No. of Feeders	Total Customers	3 Year Avg Feeder SAIDI (mins)		
			Minimum	Average	Maximum
Urban	62	42,527	160	328	1859
Rural	63	38,661	327	429	711

5 Future Requirements

5.1 2015-20 MSS 10% PoE Funded Targets

Table 5.1 and Table 5.2 provide the individual targets for the urban and rural SAIDI and SAIFI parameters based on an overall PoE target of around 10% (using the "95th/50th variance ratio") applied to the 2015-20 MSS limits. These targets are used to establish the level of funding required to meet the MSS as part of a gap analysis. Further details on the gap analysis are provided in the following section.

Table 5.1 – MSS 10% PoE Funded SAIDI Targets

SAIDI Targets	2015-20 ENCAP				
	2015-16	2016-17	2017-18	2018-19	2019-20
CBD	-	-	-	-	-
Urban	95	95	95	95	95
Rural	195	195	195	195	195

Table 5.2 – MSS 10% PoE Funded SAIFI Targets

SAIFI Targets	2015-20 ENCAP				
	2015-16	2016-17	2017-18	2018-19	2019-20
CBD	-	-	-	-	-
Urban	1.13	1.13	1.13	1.13	1.13
Rural	2.20	2.20	2.20	2.20	2.20

5.2 Funded Gap Analysis

Table 5.3 shows the forecast performance for the starting year of the new regulatory period (2015/16) based on analysis of the three key components of planned outages, non-storm unplanned outages and storm unplanned outages. At this stage no allowance has been assumed for any deterioration in network performance, however, there are some risks to degradation in performance arising from Energex's proposed Customer Outcomes Standard. These risks are outlined in the next section of this document.

Table 5.3 – Forecast 2015-20 Starting Year Performance

Forecast Performance 2015/16	Urban SAIDI	Urban SAIFI	Rural SAIDI	Rural SAIFI
Planned	21	0.08	67.0	0.26
Non-Storm	45	0.60	73.5	0.96
5 yr Average Storm	6.7	0.07	38.5	0.39
Total	**72.7**	**0.75**	**179**	**1.61**

Table 5.4 and Table 5.5 show the expected reliability funding gap based on the 10% PoE derived IRP targets and the forecast performance for the starting year. A positive gap means funding is required while a negative gap means no funding is required. This shows that no investment will be required to address the reliability gap on either the urban or rural networks.

Table 5.4 – Forecast Urban Gross Reliability Gap

Year	SAIDI				SAIFI			
	MSS	Target	Forecast	Gap	MSS	Target	Forecast	Gap
2015-16	106	95	72.7	-22.3	1.26	1.13	0.75	-0.38
2016-17	106	95	72.7	-22.3	1.26	1.13	0.75	-0.38
2017-18	106	95	72.7	-22.3	1.26	1.13	0.75	-0.38
2018-19	106	95	72.7	-22.3	1.26	1.13	0.75	-0.38
2019--20	106	95	72.7	-22.3	1.26	1.13	0.75	-0.38

Table 5.5 – Forecast Rural Gross Reliability Gap

Year	SAIDI				SAIFI			
	MSS	Target	Forecast	Gap	MSS	Target	Forecast	Gap
2015-16	218	200	179	-21	2.46	2.22	1.61	-0.61
2016-17	218	200	179	-21	2.46	2.22	1.61	-0.61
2017-18	218	200	179	-21	2.46	2.22	1.61	-0.61
2018-19	218	200	179	-21	2.46	2.22	1.61	-0.61
2019-20	218	200	179	-21	2.46	2.22	1.61	-0.61

5.3 Customer Outcome Standard

In 2012, the Independent Review Panel (IRP) on Network Costs delivered recommendations that included a response to increased capital programs stemming from prescriptive system design standards such as N-1 security based input standards. The Panel noted that entrenching of the standards within State licences and through Government direction also limited the ability of the economic regulator, the Australian Energy Regulator (AER), to adequately assess the prudence of investments. The Panel made a number of recommendations to reduce the degree of prescription of network standards, place a greater focus on outcomes rather than inputs and take greater account of customer expectations in terms of reliability of supply and affordability.

In 2013, the Government accepted IRP recommendation 3.2.1. Specifically, replace prescriptive security and reliability standards that drive network over-investment with a more economically derived, outcomes-based approach that better reflects customer expectations.

Energex's analysis indicated that outcome based standards using the value of customer reliability can lead to high network utilisation levels, and the key challenge would be to manage a range of risks linked to increasing network utilisation. In particular, high network utilisations will lead to degrading reliability, network operability issues and network access difficulties for maintenance, refurbishment and augmentation.

It is proposed a safety net approach be adopted to protect customers from high impact - low probability events as a policy obligation. This safety net, when combined with the MSS targets and worst performing feeder programs, will underpin prudent capital and operating costs to deliver the appropriate level of service outcomes to customers.

6 2015-20 Program Initiatives

In order to improve the reliability of the worst performing feeders, a capital program of work has been developed for the next regulatory period. This Program of Work consists solely of 11 kV feeder reliability projects, and these have been evenly spread for commissioning over a seven year period.

The program of work has been developed by analysing the reliability of Energex's 2013/14 worst performing feeders. The worst performing feeders are defined based on the impact on customers of both planned and unplanned interruptions at all voltage levels. However, it is unplanned faults on the 11 kV which tend to be the highest contributor to the performance of worst performing feeders. By ranking the worst performing feeders by their SAIDI contribution from unplanned 11 kV events, the feeders which would benefit most from capital expenditure to improve reliability can be identified.

For strategic planning purposes, two "styles" of reliability projects will be utilised: Rural High (RH), and Urban High (UH). These styles consist of a typical scope of works which may be implemented on 11 kV feeders in order to improve reliability. The scope of works included in each style is shown in the following table.

Table 6.1 – Reliability Project Style Components

Style	ACR	Sect	Remote LBS	MDOs	CFIs	LFIs	CCT (m)	Recond. (m)	ABS	OH Tie (m)	Wildlife Proofing
Rural HIGH	2	3	1	5	-	-	1000	500	5	500	10
Urban HIGH	-	-	4	-	5	4	500	500	-	-	10

These styles are then applied to those worst performing feeders selected. This process has resulted in the proposed reliability program of work for the period 2015/16 to 2021/22, outlined in Table 6.2. Note that this program of work only includes new initiatives, and doesn't include projects already identified and included in the program from earlier years.

Definitions of the reliability components outlined in the project styles in Table 6.1 can be found in Appendix 2.

Table 6.2 – Proposed Reliability Program of Work

Year	Rural High Projects	Urban High Projects
2015/16	18	4
2016/17	18	4
2017/18	18	4
2018/19	18	4
2019/20	18	4
2020/21	18	4
2021/22	18	4
TOTAL	**126**	**28**

Based on the 2013/14 worst performing feeders list, this proposed reliability Program of Work will address 29% of rural worst performing feeders and 6% of urban worst performing feeders in any given year. The program is biased towards rural feeders as the overall magnitude of feeder SAIDI on the rural worst performing feeders is typically higher than that for urban worst performing feeders, especially that component of SAIDI which is caused by unplanned faults on the 11 kV network.

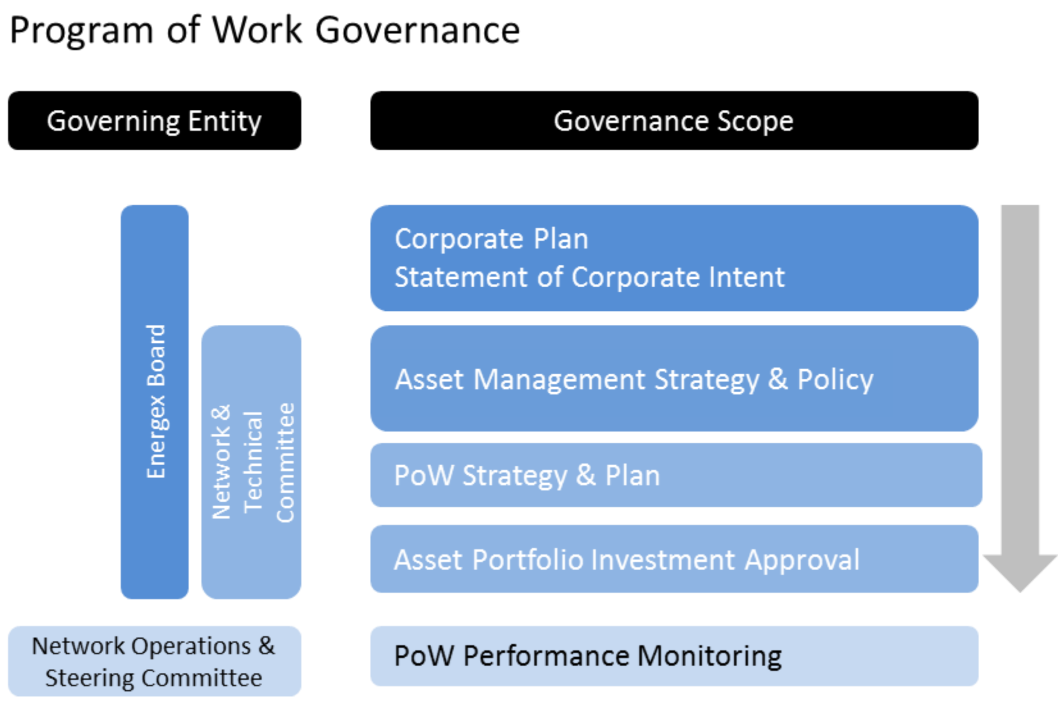
7 Governance

7.1 Ownership

This strategy is owned by Group Manager Network Maintenance and Performance within the Asset Management Division.

7.2 Governance

Energex Program of Work Governance ensures strategy & policy development and resulting portfolio investment approvals align to achieve the strategic objectives of the business. Monitoring and review of the program of work performance against annual targets and performance standards is undertaken by the Network Operations & Steering Committee.



7.3 Performance Monitoring and Reporting

Monitoring of performance achieved compared to the approved program investment is to be presented on a quarterly basis to the Network Operations and Steering Committee or earlier if requested.

Reporting about this strategy/program is facilitated through the following form/methods:

- Distribution Annual Planning Report

Reporting occurs at annual intervals and is produced by the Reliability & Power Quality department.

7.4 Review

This Strategic Plan is to be reviewed annually as part of Energex's annual business planning process. Review details can be referenced in the Version Control section at the start of this document.

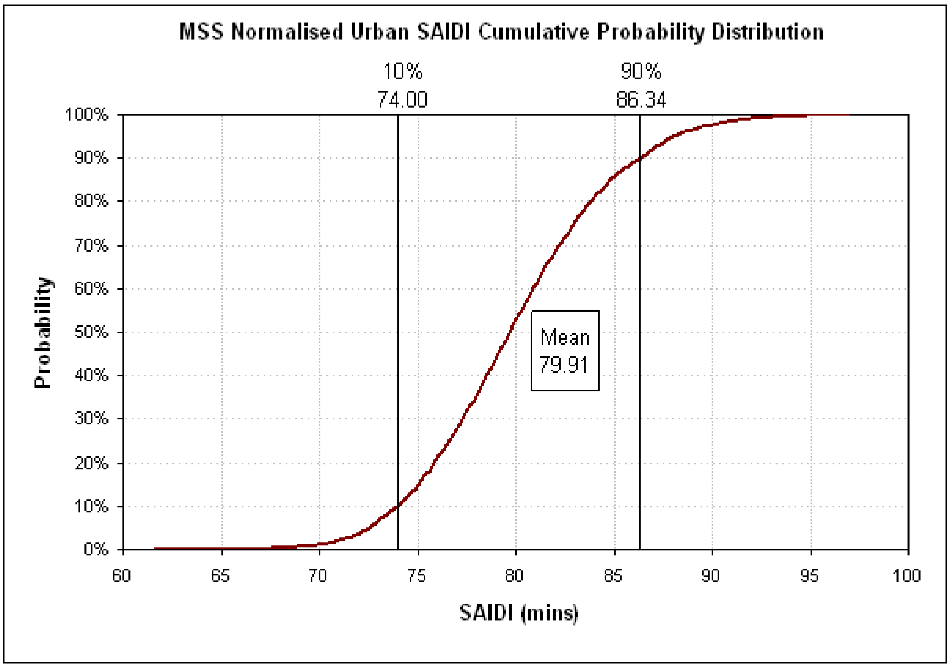
7.5 Publication

The current version of this Strategic Plan is available on the Energex Intranet and can be accessed via the *Reliability & Power Quality* Intranet page. All other electronic and printed versions of this document are to be deemed as non-current and uncontrolled unless specifically authorised by the owning Group Manager.

APPENDIX 1

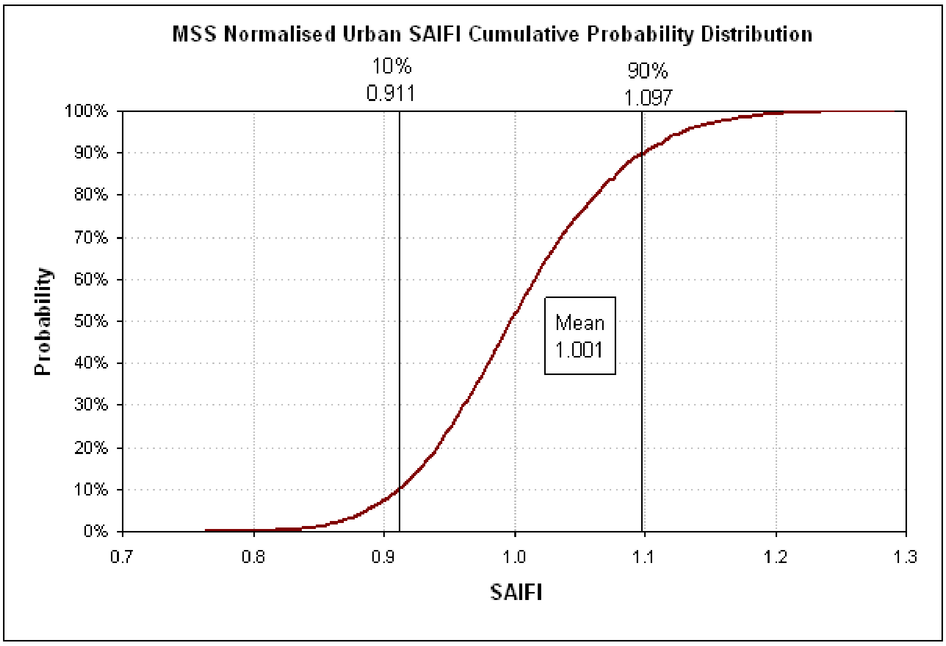
MSS Cumulative Probability Distributions

Urban SAIDI



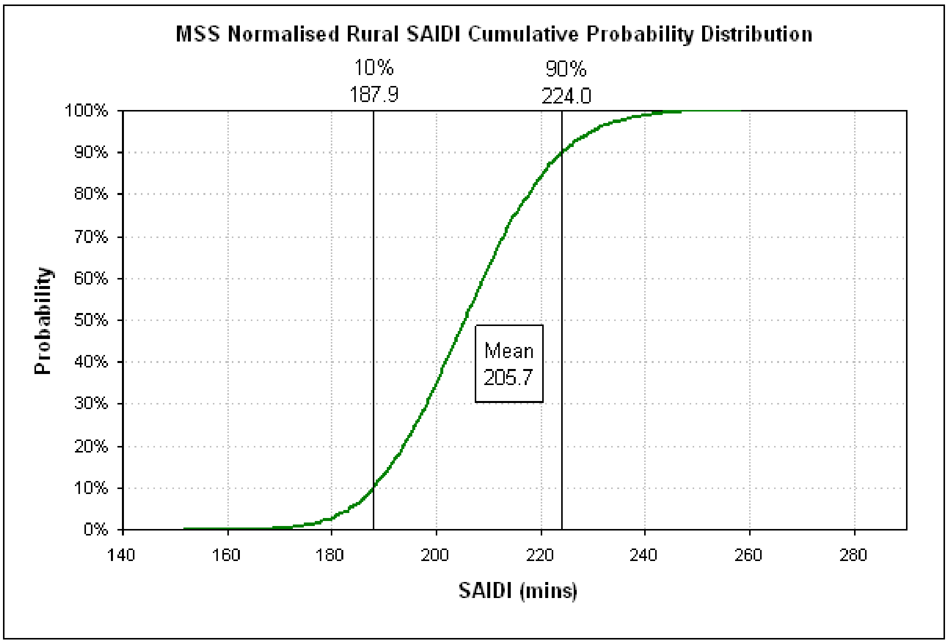
MSS Normalised Urban SAIDI Probability Distribution	
Mean	79.91
Min.	61.50
Median	79.69
Max.	97.12
Std. Dev.	4.74
Skewness	0.23
10%	74.00
90%	86.35
95%	88.10
Ratio (90^{th} / 50^{th} percentile)	1.08
Ratio (95^{th} / 50^{th} percentile)	1.11

Urban SAIFI



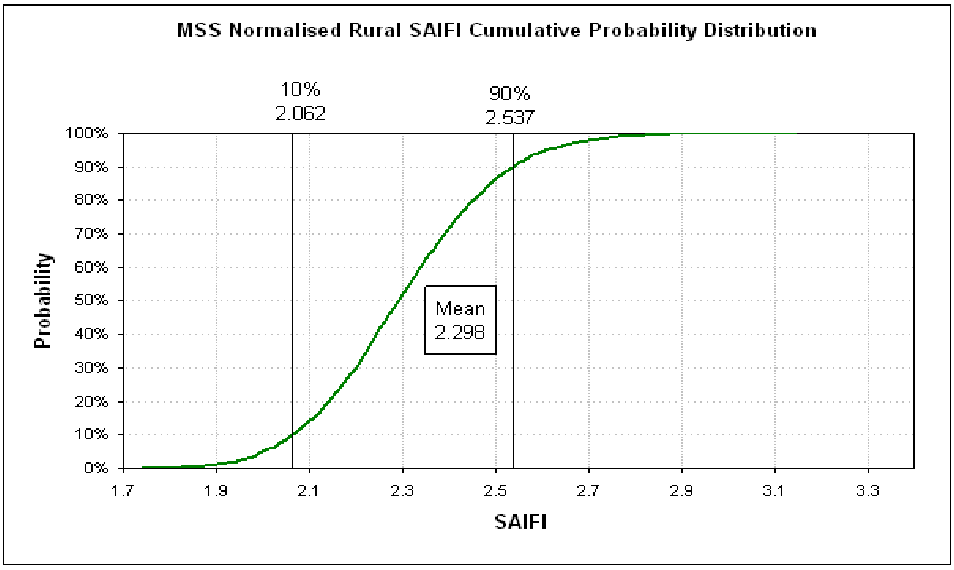
MSS Normalised Urban SAIFI Probability Distribution	
Mean	1.00
Min.	0.76
Median	1.00
Max.	1.29
Std. Dev.	0.07
Skewness	0.28
10%	0.91
90%	1.10
95%	1.13
Ratio (90^{th} / 50^{th} percentile)	1.10
Ratio (95^{th} / 50^{th} percentile)	1.13

Rural SAIDI



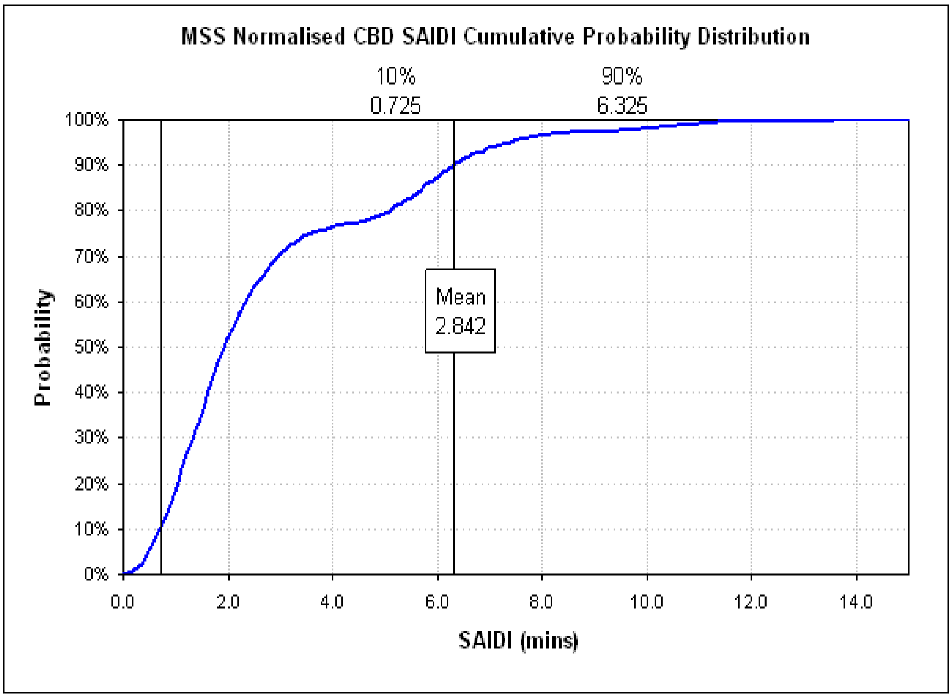
MSS Normalised Rural SAIDI Probability Distribution	
Mean	205.77
Min.	151.42
Median	205.35
Max.	258.71
Std. Dev.	14.07
Skewness	0.15
10%	187.90
90%	224.09
95%	29.72
Ratio (90th / 50th percentile)	1.12
Ratio (95th / 50th percentile)	1.09

Rural SAIFI



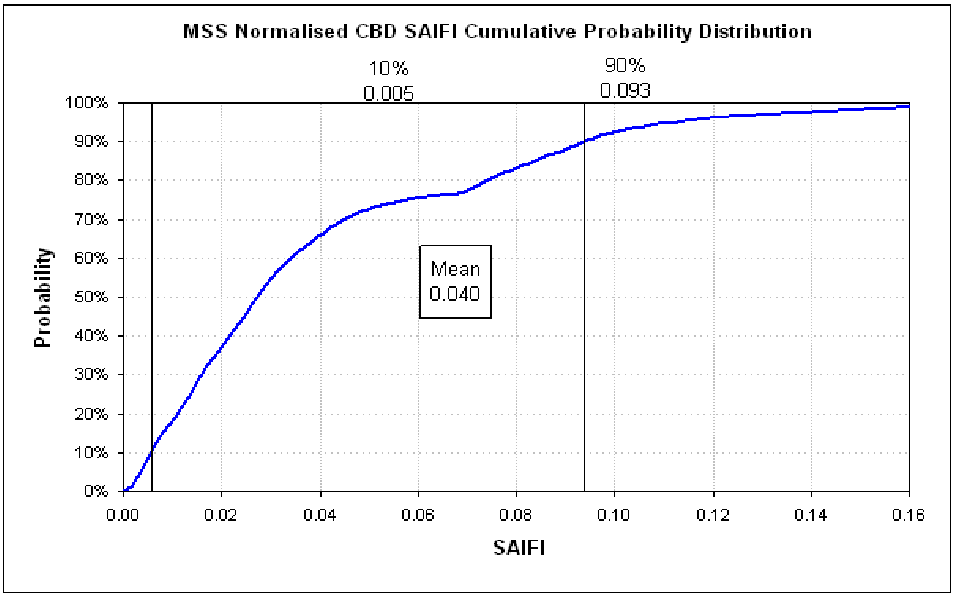
MSS Normalised Rural SAIFI Probability Distribution	
Mean	2.30
Min.	1.74
Median	2.29
Max.	3.15
Std. Dev.	0.19
Skewness	0.23
10%	2.06
90%	2.54
95%	2.61
Ratio (90th / 50th percentile)	1.11
Ratio (95th / 50th percentile)	1.14

CBD SAIDI



MSS Normalised CBD SAIDI Probability Distribution	
Mean	2.84
Min.	0.00
Median	1.98
Max.	19.73
Std. Dev.	2.40
Skewness	1.65
10%	0.73
90%	6.33
Ratio (90th / 50th percentile)	3.19

CBD SAIFI



MSS Normalised CBD SAIFI Probability Distribution	
Mean	3.23
Min.	0.00
Median	2.37
Max.	19.65
Std. Dev.	2.57
Skewness	1.38
10%	0.74
90%	6.77
Ratio (90^{th} / 50^{th} percentile)	2.86

APPENDIX 2

Reliability Project Styles

Section 6 of the Reliability Strategic Plan refers to a number of reliability components which are included in each of the "styles" of reliability projects. The following table includes further explanation of these components.

Abbreviation	Description	Purpose
ACR	Automatic Circuit Recloser	Pole mounted circuit breaker which automatically trips for a fault, maintaining supply to customers "upstream" of the recloser.
Sect	Sectionaliser	Pole mounted switch which is used in conjunction with an ACR to automatically open during a fault, maintaining supply to customers "upstream" of the sectionaliser, apart from an initial momentary interruption.
Remote LBS	Remote Controlled Load Break Switch	Pole mounted switch which can be opened and closed remotely via SCADA by a Network Controller.
MDOs	Master Drop Out fuse	Pole mounted fuse which automatically blows for a fault, maintaining supply to customers "upstream" of the fuse.
CFIs	Cable Fault Indicator	Device installed on an 11kV underground network which provides a visual cue (eg a flashing light) to indicate that a fault has occurred beyond the device. Used by field crews to assist with fault location and isolation.
LFIs	Line Fault Indicator	Device installed on an 11kV overhead network which provides a visual cue (eg a flashing light) to indicate that a fault has occurred beyond the device. Used by field crews to assist with fault location and

Abbreviation	Description	Purpose
		isolation.
CCT	Covered Conductor	Insulated conductor which is installed to replace bare overhead mains. The insulation helps prevents faults due to tree branches or wildlife contacting the mains.
Recond	Reconductoring	Replacement of existing overhead conductor with new conductor.
ABS	Air Break Switch	Pole mounted switch which can be open or closed manually.
OH Tie	Overhead Tie	Installation of new overhead mains to connect two existing networks. May be used as an alternate supply point during an interruption.
Wildlife Proofing		Insulation of certain exposed parts of the network (eg underground terminations) to prevent wildlife from causing a fault.