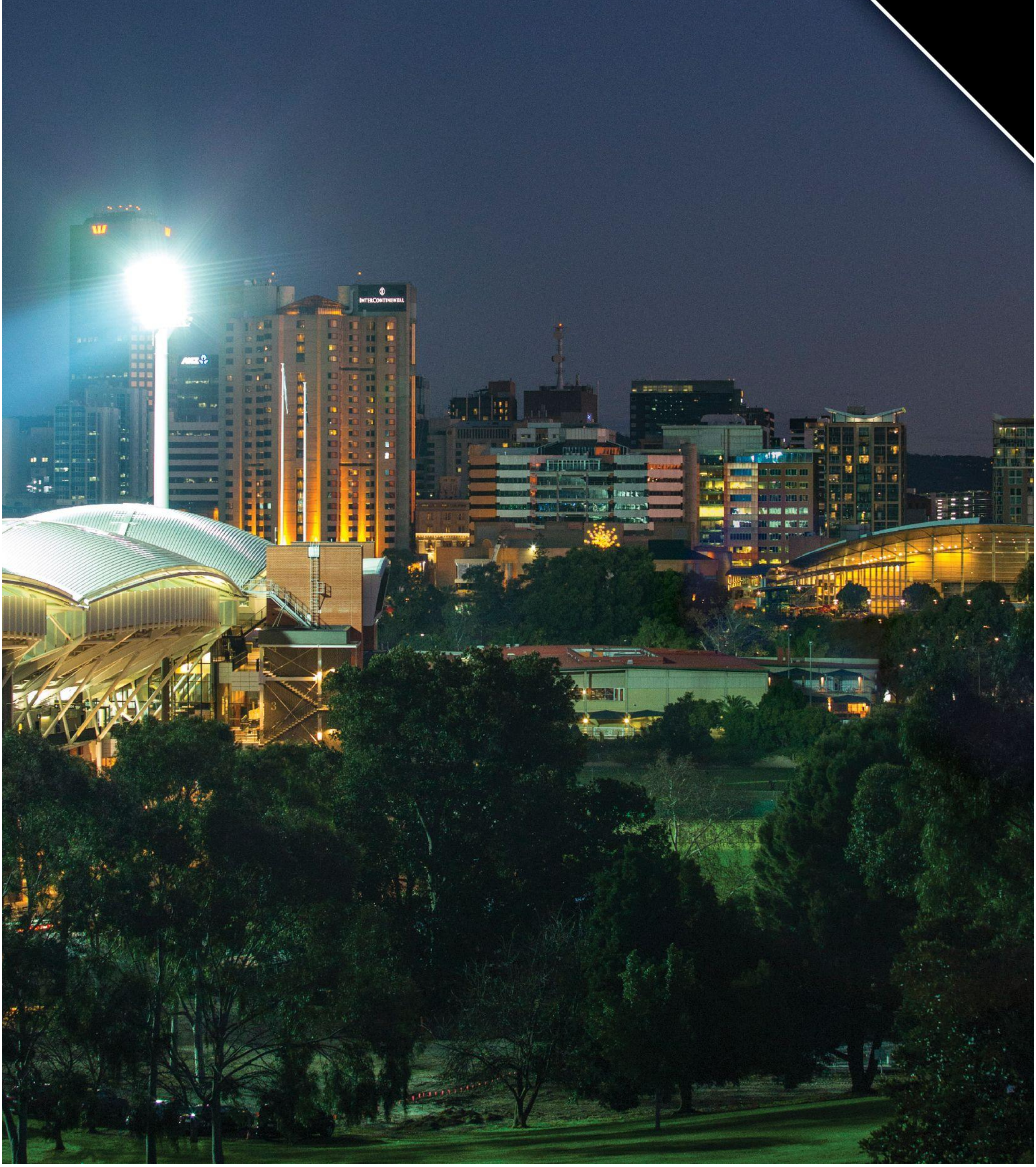
Attachment 16.2

EY:
SAPN IT Data Centre Strategy

June 2013

SA Power Networks



Data Centre Strategy

(Version 1.0)

SA Power Networks

June 2013

Ernst & Young

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Alison Kidd
SA Power Networks
1 Anzac Highway
Keswick SA 5035

28 June 2013

Private and confidential

Dear Alison

Ernst & Young has completed the project to assist SA Power Networks develop a 5-10 year Data Centre Strategy.

During the course of this engagement, we have worked closely with your team to determine your current state and to then map out a logical set of activities to meet future business requirements. These activities have been informed by a number of constraints and assumptions that have been described in the strategy.

We completed this process through extensive consultation including stakeholder interviews and workshops. We have also used a collaborative development approach to tailor this strategy to your specific needs.

If you have any questions, please feel free to contact Nick Kervin on 08 8417 6138 or Pauline Ellis on 08 8417 1750.

Yours sincerely

Mark Stewart
Partner

Contents

We believe that the statements made in this report are accurate, but no warranty of completeness, accuracy or reliability is given in relation to the statements and representations made by, and the information and documentation provided by SA Power Networks management and personnel. We have indicated within this report the sources of the information provided. We have not sought to independently verify those sources unless otherwise noted with the report. We are under no obligation in any circumstance to update this report, in either oral or written form, for events occurring after the report has been issued in final form unless specifically agreed with SA Power Networks. The findings expressed in this report have been formed on the above basis.
Third party reliance

This report is solely for the purpose set out in the Scope and Approach sections of this report and for SA Power Networks' information, and is not to be used for any other purpose or distributed to any other party without Ernst & Young's prior written consent.

1. Executive Summary

Data Centres have grown remarkably in the past decade, both in storage capacity and number. As organisations deal with increasing volumes of data, challenges are arising, particularly around location considerations, cost considerations, and not least, increased pressure to be environmentally conscious.

SA Power Networks is not dissimilar to other organisations navigating an effective way in which to manage and house its increasing array of services required to meet business objectives. To do this in an efficient, planned and effective manner is becoming increasingly important to assist in reducing risks in topology complexity. As SA Power Networks Information Technology (IT) services have grown, so too has their network topology which has become a complex and distributed environment whereby a number of facilities, with varying constraints, are being utilised to host critical infrastructure for the business.

An acknowledgement of the need to remediate the risks associated with this complex and growing environment led to the engagement of Ernst & Young in April 2013. Ernst & Young used their Data Centre Lifecycle Methodology to assist in guiding key SA Power Networks stakeholders through the process of Data Centre Strategy development with a clear requirement to address short-term and longer-term objectives.

Ernst & Young gathered detailed information in relation to the current Data Centre topology which was validated by SA Power Networks. It was found that the environment is largely representative of an organisation which has grown rapidly from a business needs perspective whilst the supporting Information Technology functions have struggled to sustain efficient operations. This has essentially led to a lack of sufficient processes, procedures and governance surrounding the arrangement of Data Centre topology to support the growing service needs.

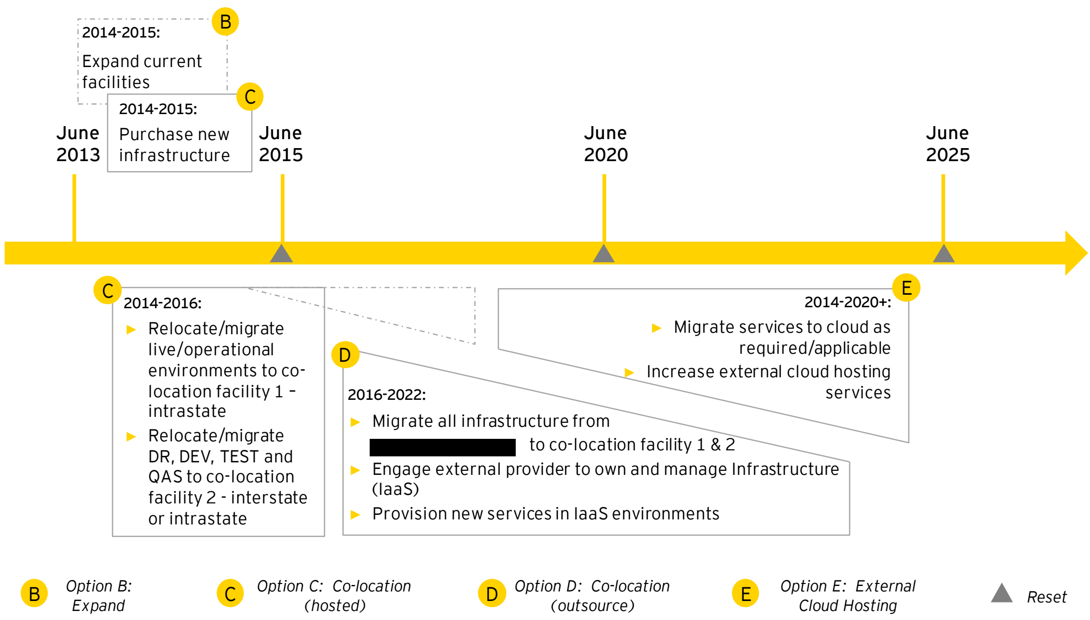
Current environment statistics demonstrate that SA Power Networks Data Centre facilities hold varying levels of risk which have the potential to impact on business critical systems. At the forefront of these risks is the fact that the Data Centres are managed by two separate business units which causes a disconnect in governance of the facilities. [redacted], the environment is certainly positioned in a reactive state according to industry standard best practice in Data Centre operations. Mitigating activities to alleviate the threats to business critical system unavailability by virtue of the current Data Centre topology are not visible, exposing the organisation to major operational and potential reputational risk.

Following consideration of the current state environment, Ernst & Young worked with SA Power Networks stakeholders to gain an appreciation of business requirements over the next ten years. SA Power Networks has significant investment planned in future years and these major initiatives will place added pressure on an already deficient architecture. Growth estimates associated with planned initiatives will result in current Data Centre capacity exceeding acceptable thresholds and resulting in constrained business operations within the next two years. Specifically,

- The [redacted] Data Centre facility will reach capacity within the next 12 months for power and within two years for storage.
- The [redacted] Data Centre facility's physical capacity has already reached its maximum and storage is expected to be exceeded within two years.

Taking into account the current constraints in the environment and the planned initiatives over the longer-term, Ernst & Young and SA Power Networks stakeholders worked through a collaborative process to define and agree on preferred options and scenarios that would collectively comprise the future Data Centre Strategy.

Scenarios and options were assessed against agreed organisational guiding principles and the result is a recommended combination of options set out in chronological sequence to align to both regulatory and organisational requirements. The recommended roadmap to reach the end state is illustrated below and it is important to note that the current capital expenditure model plays a significant part in the approach:



The preferred roadmap for an effective Data Centre Strategy will see a significant decrease in the use of SA Power Networks owned and managed Data Centre facilities and an eventual shift towards comprehensive Data Centre as a Service (DaaS).

The high level advantages of moving towards such a model are significant in nature and include:

- A topology which is highly elastic and flexible in nature.
- A significant reduction in risks associated with loss of Data Centre availability given the accessibility of 'Active' characteristics.
- An enhanced physical environment where redundant power, cooling, high-speed connectivity and density planning are continuously available and maintained and managed at superior levels.
- Significant cash flow savings whereby the costs associated with replacing obsolete equipment are no longer the responsibility of the owner. Rather than periodic spikes in equipment purchases, SA Power Networks would simply pay a steady monthly fee and fluctuations will occur only when increases or decreases in Data Centre services are required.
- Server reliability and administration are no longer the responsibility of the owner, allowing the organisation to repurpose positions and costs to higher value technology activities.

Notwithstanding the benefits associated with moving towards a significantly more resilient environment, the path to reach this all encompassing end-state is likely to take several years with many milestones in between. Consideration for SA Power Networks mandatory expenditure model during regulatory periods will play a significant part in determining the pace at which the organisation can reach the end-state, as will its operational readiness.

2. Introduction

2.1 Background

Over a number of years, the SA Power Networks Information Technology (IT) group has commissioned new services to meet the organisations growing business requirements. IT services have continued to meet SA Power Networks availability requirements and are currently within the scope of control. However, due to large growth and informal procedures for commissioning new infrastructure, the network has become a complex and distributed environment whereby a number of facilities are being utilised to host critical infrastructure, posing risk to business operations.

Overall, SA Power Networks utilise four sites, all connected by an optic fibre network. The majority of SA Power Networks systems and infrastructure for IT, Telecommunications (TEL) and some third party carrier management equipment are located [redacted] at 1 Anzac Highway in converted office space.

A second Data Centre is located in [redacted] This facility is owned by the Networks Group with facilities management being provided by the Property Group. The [redacted] site itself is the primary Business Continuity (BC) site which IT will relocate to, in the event of a disaster. Since its creation, the Data Centre use has since expanded to include the provision of disaster recovery (DR) for a number of critical SA Power Networks systems and services, and acts as a secondary site for the Operations Management System (OMS) and Interactive Voice Response (IVR) system for high availability purposes.

SA Power Networks also lease floor space at [redacted] Data Centres in South Australia, which effectively deliver hosted data centre models. The [redacted] Data Centre is primarily used to host SAP production environments and wide area network (WAN) components to provide connectivity to the SA Power Networks WAN ring.

[redacted] Data Centre located at [redacted] in South Australia is used as a fourth facility, exclusively to host infrastructure for the Advanced Distribution Management System (ADMS) Project. SA Power Networks have provisioned diverse fibre feeds to the Adam Internet facility to connect it to the SA Power Networks WAN ring and will provide the [redacted] Internet facility with redundant connectivity to multiple SA Power Networks sites in the event that communications are interrupted.

There are other facilities (such as Depots) that contain SA Power Networks infrastructure, however they are not deemed as critical and are primarily used to provide connectivity or specific services to specific users.

The culmination of all of the abovementioned facilities has resulted in a disparate resilience model whereby there is currently a mixture of critical and non-critical systems with little, to no formal planning or strategic direction and which will increase risk to business operations in future years. Consequently, SA Power Networks acknowledge they require a short-term and long-term strategy to remedy the current complexities and risks associated with meeting current capacity issues and future needs of the organisation.

2.2 Document Purpose

The purpose of this document is to detail the current state of Data Centres within SA Power Networks, the immediate and long term organisational initiatives that may impact these environments and a roadmap for the future in terms of SA Power Networks' Data Centre architecture and investment.

2.3 Scope and Approach

Ernst & Young were engaged to develop a strategy to meet SA Power Networks' future Data Centre and IT Infrastructure requirements. The Ernst & Young Data Centre Lifecycle Methodology was used as the basis for our approach in developing this Data Centre Strategy. The five phased approach along with key activities is summarised below with detailed information delivered by the phases set out over the following pages:

2.3.1 Phase 1: Initiate

During this initial phase, we confirmed the program of work and scope of the engagement. Roles and responsibilities were confirmed and key workshops and meetings were scheduled. Additionally, current state information and data was requested from relevant stakeholders.

2.3.2 Phase 2: Current state confirmation

Despite holding much of the current state information we required for the engagement, via previous engagements and our knowledge of your environment, we promptly confirmed the SA Power Networks facility and infrastructure topology. In parallel we reviewed related and/or interdependent strategies that may have impacted on the Data Centre Strategy development whilst also identifying and confirming current risks and constraints within the environment.

2.3.3 Phase 3: Requirements gathering

During workshops and meetings with the relevant stakeholders in SA Power Networks, we developed future requirements across key domains such as capacity, financial, applications, infrastructure, resilience, service levels and cloud and prioritised them, keeping in mind and identifying your future constraints.

2.3.4 Phase 4: Options development

The development of options to build your Strategy was a collaborative and iterative process which was socialised and continually reviewed with key stakeholders.

2.3.5 Phase 5: Strategy & roadmap development

On general agreement of the Strategy, we developed a high level roadmap which identifies the key activities and milestones to reach your desired future state.

3. Current State

3.1 Current Data Centre Topology

The current Data Centre Topology is based on a three site design connected by WAN ring architecture. These three sites are:

- [redacted] - the primary Data Centre for all systems excluding SAP.
- [redacted] – the DR site for all critical applications excluding SAP.
- [redacted] – a vendor owned and managed co-location facility which hosts the SAP production system.

Additional sites house small amounts of communications equipment or file servers specifically for the use of Depot personnel in communications rooms rather than dedicated Data Centre facilities. It is important to note that these facilities will remain in place and are not included within the scope of the Data Centre Strategy.

SA Power Networks also utilise or interface with a number of systems hosted by other organisations, including Powercor Australia, Electranet and Australian Meter Reading Services (AMRS). These systems are hosted in facilities which are not managed by SA Power Networks, however SA Power Networks maintains connectivity to these facilities directly, and in some cases houses networking infrastructure within them to facilitate this connectivity.

A number of business systems (e.g. OMS, IVR and several databases) are configured to be highly available or load balanced across the [redacted] and [redacted] Data Centres. These systems are designed to automatically (or with little manual intervention) fail over from the [redacted] site to the [redacted] site if the former is lost. The remainder of systems for which DR is in place are required to be manually failed over to the [redacted] site in this scenario.

The TEL group[1] currently house their infrastructure within facilities shared with IT in many cases, however both groups manage and maintain their equipment independently.

The diagram on the following page describes the current SA Power Networks Data Centre Topology at a high level and includes a summary of the services provided from each site, along with the size of the site in terms of infrastructure housed there. Please refer to Appendix A for a detailed description of the various technology environments at SA Power Networks including the Oracle Database, Storage and Server environments.

[1] TEL racks and equipment have been acknowledged within this report where possible, however it is noted that the roadmap and strategy outlined in this document is intended to describe the strategy for housing only IT infrastructure primarily, and assumes that TEL infrastructure can be relocated if required.

Figure 1 - Current State Data Centre Topology

[redacted]

3.2 Current Data Centre Services

SA Power Networks' Data Centre services are provided by the IT Operations, TEL and Facilities groups. While the division of these services is largely informal, the generally accepted division of services across these groups is outlined below:

IT Operations

- Cabling within the data centre facilities.
- Small-scale inter-floor cabling to or from the data centre to other IT equipment.
- Racking and de-racking of IT equipment.
- Maintenance of all racks containing IT equipment within the data centre facility.
- Understanding impacts of additional power requirements.

TEL

- Management and provision of all cabling within SA Power Networks buildings including major intra and inter floor cabling.
- Maintenance of TEL infrastructure and racks.

Facilities

- Provision and management of maintenance of Uninterrupted Power Supply (UPS), air conditioners and generators.
- Monitoring of ambient temperatures in facilities.
- Responding to incidents affecting the failure of UPS, air-conditioning or generators.
- Provision of power to buildings and to data centre rooms.
- Management of all building security including swipe card access to data centres.

3.3 Current Data Centre Overview

3.3.1 [redacted]

The [redacted] Data Centre hosts the majority of SA Power Networks systems and infrastructure, and houses IT, TEL and a small amount of third party carrier managed equipment.

The Data Centre facility itself is located on the [redacted] access to the Data Centre is restricted through a swipe card reader at the door.

The infrastructure within the [redacted] Data Centre is largely virtualised, with the exclusion of hosting infrastructure and a number of physical servers pending migration to virtual infrastructure which is planned for the 2014/2015 financial year. There are currently four storage area network (SAN) environments at the [redacted]

The [redacted] facility hosts all applications defined as critical within SA Power Networks (with the exception of SAP) including the Citrix Web Desktop, Microsoft Exchange and Network Operations Centre (NOC) systems environments. SA Power Networks users and IT are therefore highly reliant on the availability of the [redacted]

3.3.1.1 [redacted] Data Centre [redacted]

The following table displays the current power capacity and consumption of the [redacted] Data Centre in terms of IT load.

Category	Units
Mains incoming total	144Kw
IT equipment consumption (as read from UPS)	51.98kW
TEL equipment power consumption (as read from UPS)	10.1kW
Chiller and air conditioner power consumption	27.12kW
Chiller water consumption (to cool entire [redacted] building)	45kL/day

Source: SA Power Networks Facilities Management

3.3.1.2 [redacted] Data Centre –Rack Space

The following table displays the high level rack utilisation and current average power consumption per rack. These results indicate that there is some opportunity to consolidate the IT equipment and create additional rack space in the Data Centre if required, however more detailed evaluation of the current racking would need to be performed to determine which infrastructure could be consolidated in this manner.

Category	Value
Utilised Rack Units (RU)	697 RU
Racks currently utilised	21 Racks
Percentage of rack space utilised	79%
Estimated average kilowatt (kW) per rack	2.48kW
100% Utilised racks required	16.5 Racks

Source: SA Power Networks Facilities Management

3.3.1.3 [redacted] Data Centre – Resilience

- **Power**
  Dual feeds have been provisioned to the [redacted] building through separate transformers, however it is noted that both of these feeds are provided from a single substation.

  The building itself has two generators; a 1000 kilovolt-amps (kVA) generator which is more than capable of providing generation capacity for both the IT and building load if required, with a secondary generator of 250kVA capable of providing enough load to power the Data Centre in the event of a loss of mains and primary generator power.

  UPS units with a total of 1445A capacity are provisioned to support Data Centre equipment of which an 80Kva unit and 40Kva unit are dedicated to IT equipment. Separate UPS units are provisioned to support the air conditioners, including both the refrigerated and chilled air conditioner units.

- **Fire Suppression**
  A VESDA (Very Early Smoke Detection Apparatus) system is in place within the [redacted] Data Centre, as are temperature monitors for the ambient temperature of the room; however no fire suppression system is in place within the Data Centre.

- **Air Conditioning**
  Three units are commissioned within the [redacted] Data Centre; Two chilled water and one refrigerated unit. Due to the layout of the Data Centre, two units are required to cool the room at once and as a result, the remaining unit does not provide full N+1 redundancy for air-conditioning.

  The air conditioning to the room is provided by chillers that service the building – however in the absence of these chillers, the room's air conditioners are able to cool the room adequately to support the operation of IT equipment with some manual intervention by the facilities team.

3.3.1.4 [redacted] Data Centre - Past Incidents

The following significant incidents have occurred within the last five years impacting the availability of the [redacted] Data Centre facility:

- Loss of street water, 2012 – a burst water main on [redacted] led to the loss of water supply to the [redacted] building. This resulted in warm water being used to supply the chillers, and warm air being circulated within the data centre – creating a risk of overheating of the IT infrastructure located there. IT management team considered whether to invoke DR or install a temporary solution at the time of the incident. It was elected that temporary air conditioning units be installed to mitigate this risk on the day, however in the future, Facilities have determined a workaround using existing air conditioning units by circumventing the use of the chillers.

- UPS failure, 2012 – while a vendor technician was performing maintenance on one of the data centre UPS units, power was switched over to the secondary/backup unit. This backup unit carried a fault which essentially caused the UPS to fail, resulting in a loss of power to a SAN storage draw. IT and Facilities have noted that this incident could have been of significantly higher impact had one of the more utilised UPS' presented this fault.

- Generator failure, 2008 – power failure to the [redacted] building resulted in the generator being required, however the generator failed to start due to a flat starter battery. This resulted in a lack of power to the [redacted] building. A secondary battery has since been installed to mitigate this risk.

3.3.1.5 [redacted] Data Centre - Constraints and Risks

- The [redacted] Data Centre is governed by various Change Boards and despite the rigour that these separate Boards apply to changes within the Data Centre, it is not clear whether they consistently liaise with each other to inform and assess impacts effectively. Historically this has caused issues with implementations within the Data Centre; however, more recently, collaboration between the groups is increasing. A residual risk may still remain and could be mitigated with the establishment of an over-arching Data Centre Change Board.

- Despite IT Operations having recabled the Data Centre within the last twelve months to more effectively balance UPS load, the units are now balanced as much as is possible. An increase in the power density of any given rack may now run the risk of overloading a UPS unit.

- No fire suppression system exists within the [redacted] Data Centre facility. While a VESDA system exists, if a fire were to occur, the risk of infrastructure experiencing significant damage as a result is deemed as high.

- There are no formal policies or procedures supporting the security or occupational health and safety for the Data Centre.

3.3.1.6 [redacted] *Data Centre - Current Estimated Operating Costs*

The following costs have been sourced and estimated by SA Power Networks Facilities Management, IT Management Office (ITMO) Commercial, members of the IT Management Team and Ernst & Young to help quantify the relative cost to operate the [redacted] Data Centre facility on a per annum basis.

Category	Cost per annum (AUD)
Power to IT equipment[1]	$173,031
Power to TEL equipment[1]	$33,621
Power to cooling[3]	$19,628
Out of hours air-conditioner chilling[2]	$52,662
Facility Management[4]	$80,000
VESDA System[5]	$1,392
UPS - Maintenance and testing[6]	$43,056
Generator - Maintenance and testing[7]	$60,204
Air Conditioning - Maintenance[8]	$8,832
Estimated Operating Costs	**$472,426**

The following assumptions were made when calculating these costs:

1. Electricity costs quoted as 19c per kWh and calculated at a Power Usage Effectiveness (PUE) of 2.0.
2. Chillers to support air conditioning could be operated only 50% of the time if the Data Centre did not require chilled air on a 24/7 basis (87Amp recorded at night, 415 volt chiller for 14 hours A/H).
3. Cooling includes the cost to cool all infrastructure located in the Data Centre including TEL equipment and chillers to level 3 as a percentage of the total cost of running whole-of-building chiller plants (10 hours per day).
4. Total Facilities Management effort is estimated at 1 Fulltime Equivalent (FTE) (which equates to $80,000 per annum) split as follows:
    a. ¼ FTE for IT Technical Operations support.
    b. ¼ FTE for TEL support.
    c. ¼ FTE for Facilities Management.
    d. ¼ FTE for Security.

5. Heating, Ventilation and Air-conditioning (HVAC) full function fire test (SA76) annual cost $1,392 (*source: Spotless planned services 2013 document*).

6. UPS – Maintenance and testing monthly cost $3,588 * 12 = $43,056 *(source: Spotless planned services 2013 document).*

7. Generator – Maintenance and testing monthly cost $5,017 * 12 = $60,204 *(source: Spotless planned services 2013 document).*

8. Air Conditioning – Maintenance monthly cost $736 * 12 = $8,832 *(source: Spotless planned services 2013 document).*

3.3.1.7 [redacted]k Data Centre - TEL Infrastructure

The following TEL infrastructure currently resides within the [redacted] facility:

- Nine TEL rack spaces.
- Two Nextgen carrier rack spaces, and
- One Supervisory Control and Data Acquisition (SCADA) system rack space.

Each of these rack spaces consists of up to two non-standard racks which when placed back to back form approximately one standard rack space. These racks have been established in a separate row from IT infrastructure. Cooling for TEL equipment is shared with IT infrastructure, however only two of the racks are powered by the IT UPS, while the remainder are directly fed with Data Centre power from a Data Centre cabinet in the basement of the building.

3.3.2 [redacted] Data Centre

The [redacted] Data Centre is located [redacted], immediately adjacent to the warehouse and access to the Data Centre is restricted through a swipe card reader at both entrances.

This Data Centre contains space for approximately eighteen total racks and was purpose-built to house DR infrastructure for the NOC system and The Network Operations Centre (TNOC) groups. Its use has since expanded to provision DR for a number of other critical SA Power Networks systems and services. The [redacted] site itself is the primary BC site which IT will relocate to in the event of a disaster.

Infrastructure within the [redacted] Data Centre is almost entirely virtualised aside from the hosting infrastructure itself. Racks are dedicated to support the SCADA and DMS systems and a DR SAN and DR Demilitarised Zone (DMZ) SAN reside at the site to support DR systems.

The [redacted] facility hosts all non-SAP DR system environments, including supporting services such as Active Directory (AD) and Citrix. Various technologies are used to replicate systems to this site.

3.3.2.1 [redacted] - Power

Building Management Systems had not been connected to the UPS infrastructure at [redacted] at the time of developing this strategy, therefore the only power consumption directly available was the draw of the entire [redacted] Data Centre facility including all IT, TEL and SCADA equipment at [redacted]

Category	Units
IT equipment consumption	14kW
TEL and SCADA equipment consumption[1]	10kW
Cooling power consumption[2]	36kW

Source: SA Power Networks Facilities Management

The following assumptions have been made in producing the figures above:

1. TEL and SCADA power consumption is 10kW – the amount consumed at the [redacted] site for this equipment.

2. Cooling power consumption figures are expressed for the entire Data Centre room due to limited availability of cooling data for individual racks or floor areas.

3.3.2.2 [redacted] – Rack Space

The following table displays the high level rack utilisation and current average power consumption per rack based on utilisation. These figures include only IT, SCADA and Demand Management System (DMS) racks, and do not include TEL racks in-scope:

Category	Value
Utilised Rack Units (RU)	217 RU
Racks currently utilised	9 Racks
Percentage of rack space utilised	57%
Estimated average kW per rack	1.55kW
100% Utilised racks required	5.2 Racks

Source: SA Power Networks Facilities Management

3.3.2.3 [redacted] - Resilience

- **Power**
  A single power feed has been provisioned into the [redacted] site, and a single generator provides backup power to the [redacted] Data Centre. The generator at [redacted] is capable of providing 605kW of generation capacity.

  Three UPS units are provisioned at the [redacted] facility, with two providing power and the third acting as a standby UPS. These UPS have a total of 900A of capacity. Dedicated separate UPS units are in place to support the air conditioning units.

- **Fire Suppression**
  A gas-based fire suppression system is in place in the [redacted] facility, however testing of the system has shown that the room is not adequately sealed to prevent the leakage of this gas in the event that it is required, so the system is not currently active.

- **Air Conditioning**
  The [redacted] Data Centre currently has no redundant air conditioning units in place.

3.3.2.4 [redacted] - Constraints and Risks

- As no redundant air conditioning is in place at the site, a failure of the air conditioning units are likely to result in an outage to systems hosted within the site.

- No processes are currently in place surrounding change control for infrastructure in the Data Centre. This essentially means that infrastructure can be installed without consideration being given to which UPS infrastructure it is connected to, the power loading of racks into which it is installed or the floor loading impacts of the installation.

- A single power feed to the site exists, which could result in a failure of equipment housed there in the event of a substation or transformer failure. It is noted however that a generator with significant overcapacity to power the site has been installed at the site as a compensating control.

- As two separate groups govern the Data Centre with two separate Change Boards it is unclear if changes are consistently reviewed for impacts to the site.

3.3.2.5 [redacted] - Current Operating Costs

The following costs have been estimated to quantify the relative cost to SA Power Networks to operate the [redacted] facility:

Category	Cost per annum
Power to IT and DMS equipment[1]	$46,600
TEL and SCADA equipment consumption[1]	$33,288
Power to cooling[2]	$59,920
Facility Management[3]	$40,000
Gas-based Fire Suppression - Maintenance[4]	$12,816
UPS - Maintenance and testing[5]	$10,764
Generator - Maintenance and testing[6]	$36,444
Air Conditioning - Maintenance[7]	$19,860
Estimated Operating Costs	**$259,692**

Source: SA Power Networks Facilities Management

The following assumptions were made when calculating these costs:

1. Electricity costs quoted as 19c per kWh and calculated at a PUE of 2.0.

2. The cooling cost represents the cooling cost of the entire Data Centre room including TEL equipment rather than the cost to cool IT equipment only, as this data was not available.

3. Total Facility Management effort is estimated at ½ an Fulltime Equivalent (FTE) (which equates to $40,000 per annum) and includes a blend of:

    a. ¼ FTE for IT Technical Operations support.

    b. TEL support

    c. Facilities Management support (including Security).

4. ¼ FTE for SecurityGas-based Fire Suppression – maintenance monthly cost $1068 * 12 = $12,816 *(source: Spotless planned services 2013 document).*

5. UPS – Maintenance and testing monthly cost $897 * 12 = $10,764 *(source: Spotless planned services 2013 document).*

6. Generator – Maintenance and testing monthly cost $3,037 * 12 = $36,444 *(source: Spotless planned services 2013 document).*

7. Air Conditioning – Maintenance monthly cost $1,655 * 12 = $19,860 *(source: Spotless planned services 2013 document).*

3.3.2.6 [redacted] - TEL Infrastructure

Six TEL rack spaces and one Telstra carrier rack space of infrastructure currently reside in the [redacted] facility. Each of these rack spaces consists of up to two non-standard racks which, when placed back to back form approximately one standard rack space. These racks are physically separated from the IT racks within the facility; however they share cooling with the IT infrastructure. Two of the TEL racks are connected to the IT UPS, while the remainder are directly fed with Data Centre power from a dedicated Data Centre unit in one of the TEL racks. This Data Centre cabinet is connected to the generator used to power the facility.

3.3.3 [redacted] Data Centre

The [redacted] Data Centre is a [redacted] in South Australia, essentially providing hosted services to SA Power Networks. SA Power Networks lease floor space in this facility and have done so since its inception.

The Data Centre restricts access through the use of swipe cards and business hours manned security into the building, and requires that all staff be escorted to and from the co-location facility and sign in before entering.

The Data Centre is structured in data hall architecture with hot and cold rows, and SA Power Networks racks are located within the first row of racks upon entering the co-location facility.

The [redacted] facility hosts SAP production environments and WAN components to provide connectivity to the SA Power Networks WAN ring. Some Demand Management System infrastructure and now unutilised servers, historically used to support spatial systems also reside at the site.

3.3.3.1 [redacted] - Power

The SA Power Networks IT equipment consumption documented below was the consumption reported for the month of April 2013 and which is deemed to accurately reflect typical consumption for infrastructure hosted at this facility:

Category	Units
IT equipment consumption[1]	14.81kW

Source: SA Power Networks Facilities Management

3.3.3.2 [redacted] – *Rack Space*

The following table displays the high level rack utilisation and current average power consumption per rack at the [redacted] site.

Category	Value
Utilised Rack Units (RU)	178 RU
Racks currently utilised	5 Racks
Percentage of rack space utilised	85%
Estimated average kW per rack	2.96kW
100% Utilised racks required	4.2 Racks

Source: SA Power Networks Facilities Management

3.3.3.3 [redacted] - *Resilience*

- **Power**
  Dual feeds to the [redacted] site exist from separate substations, and power distribution units (PDU's) for each rack have dual power supplies. Three UPS' are provisioned at the site, each capable of powering the site for at least 25 minutes while being recharged by generators.

  A 1.8mW generator is available on-site and can power the facility for one day using its internal fuel supply. Two underground tanks are provisioned on the site which contains capacity for seven weeks of fuel. A second generator is being installed in 2013 to provide redundancy for the generator currently on site.

- **Fire Suppression**
  A VESDA system is in place for fire detection, and an FM200 fire suppression system has been implemented throughout the co-location facility.

- **Air Conditioning**
  Redundant air-conditioning, cooling and humidification units are in place at the facility.

3.3.3.4 [redacted] *Constraints and Risks*

- Capacity within the Hostworks facility is limited and as such, capacity to allow for rack growth is at risk.

3.3.3.5 [redacted] - *Current Operating Costs*

The following costs have been taken from the April 2013 [redacted] invoice to quantify the annual cost of [redacted] services to SA Power Networks. It should be noted that power consumption costs are not explicitly stated in the [redacted] invoice or contract.

Category	Cost per annum
Annual cost of [redacted] services and power consumption	$123,636

Source: SA Power Networks Facilities Management

3.3.4 [redacted] Data Centre

The [redacted] Data Centre is a [redacted] in South Australia and provides a hosted facility model for SA Power Networks. SA Power Networks lease floor space in this facility at this stage exclusively to host infrastructure for the ADMS Project.

SA Power Networks have recently completed the laying of fibre to the [redacted] facility to connect it to the SA Power Networks WAN ring. This will provide the [redacted] facility with redundant connectivity to multiple SA Power Networks sites in the event that communications are interrupted.

The Data Centre restricts access through the use of swipe cards, biometric readers and Personal Identification Numbers (PIN) entry devices and manned security on a 24/7 basis.

The Data Centre is designed in data hall architecture with hot and cold rows, and SA Power Networks have sourced space in the DC2 wing of the facility, the second build phase of the facility, which completed construction in early 2013.

3.3.4.1 [redacted] - Power and Rack Space

At this time, no equipment has been commissioned at the [redacted] site, therefore power readings and rack unit allocations cannot be quantified, however SA Power Networks currently secure four racks within the facility:

Category	Value
Rack spaces consumed	4 Racks

Source: SA Power Networks Facilities Management

3.3.4.2 [redacted] - Resilience

- **Power**
  Dual feeds to the [redacted] site are in place; however both are fed from the same substation as the [redacted] facility. All racks within the facility have dual power supplies and feeds. 2N UPS redundancy is also in place across both the DC1 and DC2 data halls.

  A generator is available on-site and a second generator has been provisioned for redundancy.

- **Fire Suppression**
  A VESDA system is in place for fire detection, and an FM200 fire suppression system has been implemented throughout the co-location facility.

- **Air Conditioning**
  Redundant air-conditioning is in place within the facility.

3.3.4.3 [redacted] - Constraints and Risks

- The [redacted] site poses a significant risk to business operations due to its lack of power redundancy.

3.3.4.4 [redacted] - Current Operating Costs

The following costs have been estimated to quantify the relative cost to SA Power Networks to operate the [redacted] facility:

Category	Cost per annum
Annual cost of [redacted] services	$79,740
Annual power estimate[1]	$36,135
Estimated Operating Costs	**$115,875**

Source: SA Power Networks Facilities Management

The following assumptions were made in producing the figures above:

1. Power consumption at this facility is estimated at 6kW per rack.

3.3.5 Other Facilities

Other facilities are used by SA Power Networks to provide connectivity or specific services to users; however they do not host significant amounts of SA Power Networks IT infrastructure and are therefore not considered Data Centre facilities for the purposes of this Strategy.

It should be noted that a number of other SA Power Networks sites exist from which users access IT services, including Greenhill Road, Station Place, depots and remote sites. These sites do not act as core facilities supporting the SA Power Networks WAN ring and do not specifically host any IT infrastructure providing an IT service to users, and have therefore been excluded from the scope of this Strategy.

These facilities include:

- SA Power Networks owned sites:
  - [redacted] – a business site used to host an Oracle DataGuard observer server and WAN infrastructure to allow [redacted] to connect to the SA Power Networks WAN ring.
  - [redacted] – a business site used to host WAN infrastructure to allow Kilburn to connect to the SA Power Networks WAN ring.
  - [redacted] – a TEL managed site which houses an SA Power Networks radio tower and a facility hosting TEL infrastructure. This infrastructure provides TEL connectivity to remote and regional sites, and is required to operate in an emergency or bushfire scenario. Approximately twenty racks of infrastructure are located at this site, which operate on 48 volt DC power. Site resilience is provided by a dedicated Data Centre battery room which is capable of powering the facility for several days, as well as an on-site generator.

- [redacted] Limited owned sites:
  - [redacted] – a Computer Sciences Corporation (CSC) managed co- location facility used by [redacted] as their primary Data Centre facility. SA Power Networks firewall and routing infrastructure is hosted here to allow SA Power Networks to connect to [redacted] to access the IVR and CIS Open Vision (CIS/OV) systems. Until 2009, SA Power Networks outsourced management of components of their environment to CSC, and hosted their SAP, Enterprise Resource Planning (ERP) and Business Warehouse (BW) systems at the Clayton site. Under this arrangement, SA Power Networks shared rack and chassis infrastructure with [redacted] When the contract with CSC ended, SA Power Networks relocated SAP infrastructure to the [redacted] site.
  - [redacted], Victoria – a Data Centre facility located in [redacted] This Data Centre acts as the [redacted] DR facility for critical systems, and hosts SA Power Networks firewall and routing infrastructure to allow SA Power Networks to connect to [redacted] to access the IVR and CIS/OV systems. This connectivity also allows the Bendigo Contact Centre to utilise the SA Power Networks Citrix and OMS TCE applications.
- [redacted] – Service Stream at [redacted] provides meter reading services to SA Power Networks, and utilise the SA Power Networks Multi Vendor Reading System (MVRS) system to record meter data for customers. SA Power Networks maintains connectivity to this site and workstations located there to allow meter data to be uploaded through the WAN network to the CIS/OV system.
- [redacted] South Australia – a Data Centre located in [redacted]. A small group of SA Power Networks users access the [redacted] Citrix environment through direct connectivity to the [redacted] Data Centre. Similarly, some [redacted] users require access to the SA Power Networks SAP and Citrix environments.

3.4 Cloud Services

3.4.1 Public Cloud

Public cloud services are being used within SA Power Networks at present, with a small number of Software as a Service (SaaS) platforms utilised by groups within the business.

Street Light Out (SLO) is an example of the organisation's utilisation of public cloud offerings. Built using Google Maps and linkages to the company's in-house SAP infrastructure, Street Light Out allows customers to view street lights and report faults by clicking on the relevant asset. Any lights that have already been reported as malfunctioning will be represented on the map by a red icon. The SLO system utilises Microsoft's Azure cloud platform offering.

Other cloud services currently being used or considered include:

- Power @ My Place
- Online Outage Reporting
- Online Forms

Cloud services with the use of SaaS being considered or currently utilised include:

- Figtree – Figtree is currently being hosted in-house however a proposal has been provided by the vendor to provide it under a SaaS model.
- Learning Management Systems (LMS) including Cura LMS, E3 Learning and ARIS.
- PageUp People Recruitment

3.4.2 Private Cloud

SA Power Networks do not currently utilise a private cloud service.

4. Market trends and insights

4.1 Key Data Centre trends

The continuing issue for many organisations is whether they should build a new Data Centre or transform their existing centre, because they are close to or have already run out of space. A major focus for most organisations is planning what their Data Centre should look like for the next 10-20 years. Following are several key trends that are influencing the planning for Data Centres, both in Australia and Globally.

- **Convergence –** Spending on Data Centre hardware in Australia is projected to reach almost $2.09 billion in 2013, up 11% from 2012, according to Gartner forecasts. This growth is largely being driven by a shift towards integrated systems, or converged infrastructure – servers, storage and networking converged into a single environment. This is having an impact on the sort of Data Centres organisations are building, how they power and cool them, how they segment the infrastructure within the Data Centre, and so on.

- **Consolidation** – A large number of organisations globally consolidated or are in the process of consolidating their Data Centres (on an average ratio of 10:1) into a more-efficient and more-effective modern Data Centre. The continued focus on consolidation and centralisation of Data Centres has been driven by the need to reduce the total cost of ownership (TCO) and gain benefits of high availability, economies of scale, and operational efficiencies.

- **Multi-sourcing** – Global resilient and self sufficient Data Centre strategies are being implemented with a combination of in-source and collocation facility with a view towards emerging cloud service offerings.

- **BC/DR emphasis** – Business continuity and disaster recovery (BC/DR) preparedness continues to be a critical business priority. The centralised approach for a DR facility lends itself more suitably to site integrity, recovery efficiency/control, and lowers overall DR TCO.

- **WAN optimisation** – Many organisations are coupling a centralised Data Centre strategy with WAN optimisation solutions and content distribution to mitigate application latency and performance issues. This accelerates applications, enables IT consolidation, and provides enterprise-wide network and application visibility – all while eliminating the need to increased bandwidth.

- **Mobility** – Organisations are trying to manage the impact of mobility and the proliferation of mobile devices on the Data Centre. The expectation is to allow anytime, any device access to corporate information, assets and accounts, while managing workload and security.

4.2 Technology trends in the Utilities sector

Survey data produced by Gartner in 2013 revealed the top trends in technology in the Utilities industry. It suggested that the demand for business agility is pushing organisations toward Data Centre solutions that have greater flexibility, enabling them to expand or contract their Data Centres according to business needs. It predicted that most enterprises will use multiple Data Centre models to meet different kinds of business needs.

Some other key technology trends in the Utilities sector are listed below:

Trend	Alignment to SA Power Networks Major Projects
▶ Significant increase in the prevalence of Big Data - 30% of IT organisations are experiencing 20% Big Data growth year on year (source: IDC's Big Data Survey, March 2013)	▶ ADMS ▶ CAD Vault ▶ Lidar ▶ SmartGrid ▶ Smart Metering
▶ Mobile and Location Aware technologies to become more common.	▶ Lidar ▶ SmartGrid ▶ Smart Metering
▶ Cloud computing and SaaS - the Utilities sector trails in this area, however solutions are emerging in areas such as smart meter, big data analytics, demand response coordination and Geographic Information Systems (GIS).	▶ SmartGrid ▶ Smart Metering ▶ Increased GIS usage
▶ In-memory computing	▶ CAD Vault ▶ Smart Metering

4.3 Key recovery trends

With continually increasing dependency on business systems, the business costs of downtime have escalated across all industries. Recovery is therefore an important consideration in Data Centre operations. Following are some key trends for consideration:

- Recovery time objectives (RTOs) and recovery point objectives (RPOs) have dropped significantly following the escalation in downtime costs of business critical systems;
- Many organisations cannot afford a "one size fits all" recovery strategy and are opting for a layered strategy for tiered recovery to contain costs and match the quality of service to the criticality of the IT service;
- Increasingly, enterprises are implementing a more granular application or business system recovery approach, as opposed to complete site failover;
- The implementation of recovery service level agreements (SLAs) or targets is driving more systematic analysis and implementation of an architecture that matches appropriate recovery solutions to the criticality of business systems;
- The time required to recover data from tape is often 24 hours or more, and does not meet escalating business requirements for business system availability. Tape is being used for recovery of last resort and for long-term retention (archiving).

4.4 Data centre tiers

The Uptime Institute has established four levels of fault tolerance for Data Centres with Tier 1 representing the lowest level and Tier 4 the highest. The Uptime Institute cautions that a level of availability cannot be assured by design specification alone as most service interruptions occur due to human error. Details are provided as follows:

Design Components	Tier I	Tier II	Tier III	Tier IV
Active capacity components to support IT load	N	N + 1	N + 1	N After any Failure
Distribution paths	1	1	1 Active and 1 Alternate	2 Simultaneously Active
Concurrently maintainable	No	No	Yes	Yes
Fault tolerance	No	No	Yes	Yes
Compartmentalisation	No	No	Yes	Yes
Continuous cooling	Load Density Dependent	Load Density Dependent	Load Density Dependent	Class A
Availability & Other	Single path for power and cooling distribution, no redundant components – Less than 28.8 hours downtime/year (99.6% uptime).	Single path for power and cooling distribution, redundant components – Less than 22.0 hours downtime/year (99.75% uptime).	Multiple power and cooling distribution paths, but only one path active, redundant components, concurrently maintainable – Less than 1.6 hours downtime/year (99.98% uptime).	Multiple active power and cooling distribution paths, redundant components fault tolerant – Less than 0.4 hours downtime/year (99.995% uptime).

4.5 Resilience - Facility roles

For the purpose of hosting business applications, the role of a hosting facility can be a primary site or a secondary site. There are different kinds of secondary sites, as illustrated in the diagram below.

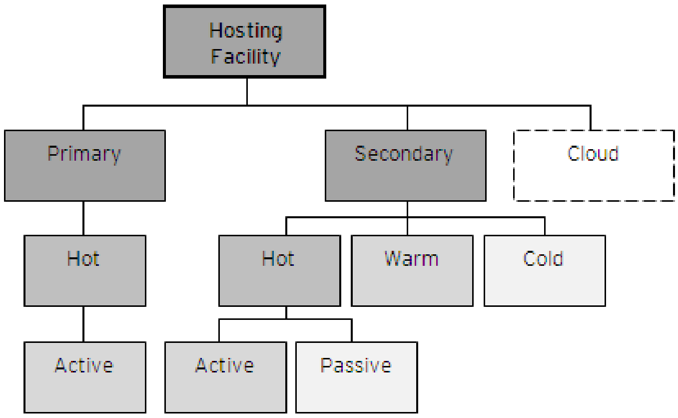


Figure 2: Hosting facility classification

The roles and functions of the different types of hosting facilities above are defined in the following table:

Types of hosting sites	Definition
Primary	An active facility utilised for hosting the infrastructure and other equipment supporting the business applications.
Secondary	A facility expected to be utilised during an event that leads to a disaster recovery scenario. A secondary site can be one of hot, warm, or cold.
Hot	A fully equipped mirror of an existing hosting facility. Includes all infrastructures to go live during or immediately after a disaster. A hot site should support continuous synchronisation with existing hosting facility providing little to no data loss.
Active	A hot site that is accessed on a daily or regular basis. An example of an active facility is one utilised for continuous load balancing.
Passive	A hot site that is accessed only during disaster recovery or regular maintenance scenarios where the primary is unavailable.
Warm	A warm site provides the required ancillary services and infrastructure in addition to pre-built ICT equipment ready for immediate connectivity. Backup equipment is also available as is periodic data replication.
Cold	A cold facility provides minimal facilities in the event of a disaster. The site would include the required ancillary services and infrastructure but no actual IT equipment or data measures for data recovery or replication.

4.6 Adelaide Data Centre – Market Scan

The table below represents information gathered from a recent market scan of Data Centre capability across Adelaide. It is attached for information purposes only:

Facility	Specifications	Rack capacity	Rack layout	Power availability	Facility access	Migration Services
Adam Internet	Built to Tier 3 specification however has not been formally accredited PUE of 1.63.	150+ with no min. spend	Continuous row of up to 12 racks	3Kw for low density racks. 8Kw for high density racks	24/7 access following induction. Multifactor security required.	HP used by Adam Internet. Clients able to use own integrator if required, whom will need to be escorted within the facility.
Colocity (new)	Tier 2 aligned with a PUE of 1.5	30 racks and close to capacity	Continuous row of 8-10 racks	Unconfirmed	24/7 access with no security on site currently	Have provided migration services for clients themselves for individual RUs or small no. of racks.
Hostworks	Tier 2 aligned with a PUE of 1.3	Current capacity is 20 racks (near capacity)	Continuous row of 8 racks	No rack level restrictions however any rack over 8Kw will require approval	24/7 access with pre-arranged escort requirement. If dedicated area assigned, no escort required	Alliance SI is used to carry out migration services, however clients can utilise their own integrator whom must be inducted and escorted at all times.
Internode	Aligned to Tier 3 meeting availability standards of 99.741% with a PUE of between 1.5 and 2.	Capacity exists to accommodate more than 20 racks with no minimum spend	Internode will attempt to keep all racks together but will create cross-connects if needed	2-4Kw for low density racks. 12Kw for high density racks (generally located in a separate area). Additional power can be negotiated.	24/7 access with biometric scan, swipe card & pin code. No escort required.	Internode has a relationship with a number of integrators including Subnet, Iocane & Vectra.
Intervolve	Tier 2 accredited facility with a PUE of 2.2 in summer & 1.7 in winter.	Current capacities of 9 racks with a secondary facility build imminent at the same site.	n/a	2.4Kw for low density racks. 6Kw for high density racks. Additional power can be negotiated.	24/7 access.	Use of their own subcontractor is suggested however are open to clients using their own integrator.
Metronode	Currently at capacity with the build of a new facility imminent.					
Nextgen Networks	Currently at capacity however negotiating an agreement with Tier 5 to resell data centre space.					
Tier 5	Tier 3 rating with PUE of 1.3	Available capacity for any number of racks given facility size. No minimum spend	Continuous rack layout	No power restrictions – can provide up to 20Kw per rack if reqd.	24/7 access with swipe card and no specific escort requirements	Subcontract integration to CSG

5. Future Requirements

Ernst & Young have worked collaboratively with SA Power Networks through an iterative process to gain a detailed understanding of the future requirements. Over the following pages we describe SA Power Networks' future initiatives and how they may impact on the requirements for Data Centre capability and capacity.

5.1 Planned Future Initiatives

Over a number of years SA Power Networks Information Technology Group will commission new services to meet organisational needs. Known initiatives[2] are listed in the following table with likely impacts outlined over the page:

	Confirmed	Likely
IT Initiatives	▶ Service Oriented Architecture (SOA) implementation ▶ Implementation of additional SAP instances ▶ IPv6 Rollout ▶ Spanned data centres ▶ Increase in Oracle DR requirements (2 racks)	▶ Data warehousing implementation ▶ Implementation of DR capability for all applications ▶ Information security systems – Intrusion Detection System (IDS) and Intrusion Prevention System (IPS).
Major Projects	▶ ADMS: A set of management and decision support tools used to operate and control the electricity distribution network. Also provides the NOC with an integrated set of functions available through a consistent user interface ▶ CAD Vault: Document management for CAD drawings ▶ Demand Management System: Provides a comprehensive set of application to manage major project distributions including Smart Grid and Smart Metering ▶ Lidar: Remote sensing technology that can be used for vegetation management ▶ Smart Grid: Extending telecommunications to intelligent devices throughout the electricity distribution network to allow adjustment and control of devices from a central location providing a more effective way to manage peaks in demand, realise long term reductions in capital and operating costs, and improve network reliability ▶ Smart Metering: Electrical metering used to record consumption of a utility for remote monitoring and reporting for billing purposes	▶ Increased GIS usage and data requirements ▶ Implementation of a Customer Information System ▶ Asset Management System ▶ Consolidation of CAD systems

[2] Detailed department future initiatives that have the potential to impact infrastructure requirements can be found in *Appendix B*

The table below displays the expected impact of some of the major future initiatives and projects listed above on storage, rack space, power and compute requirements. These expectations are based on what is currently known about the future projects and initiatives at the time of developing this report and are not absolute:

Major Projects	Storage	Compute	Rack Space	Power
ADMS	High	High	High	High
CAD Vault	Moderate	Moderate	Minor	Minor
Demand Management	High	High	High	High
Lidar	Very High	Very High	High	High
Smart Grid	High	High	High	High
SoA (ITSP)	Minor	Minor	Minor	Minor
IPv6	Minor	Minor	Minor	Minor
Data Warehouse	Moderate	Moderate	Moderate	Minor

Despite having liaised with an extensive stakeholder group to determine the impacts that these projects and initiatives will likely have on Data Centre capability and capacity going forward, it is important to note that much of the information regarding storage requirements and overall footprint for the majority of the projects and initiatives was not available. For the most part, the future major projects are only in the preliminary stages of conception and therefore have not been included in many of the projected calculations.

5.2 SA Power Networks Capacity Projections

5.2.1 SA Power Networks Storage Capacity

An increase in SA Power Networks storage requirements to meet the needs of future major projects and initiatives will essentially result in additional requirements for rack space, power and cooling in the Data Centre facilities.

In terms of general storage growth, SA Power Networks has witnessed rapid growth in its R Drive (which is the network drive where all unstructured data is stored by employees), which (as was agreed with key stakeholders) is a good indicator of the overall organic growth rate for storage at SA Power Networks.

The R Drive, after increasing by approximately 13% and 25% in the years 2011 and 2012 respectively, increased almost 3 times in 2013 to nearly 8.9 terabytes (TB). This significant increase in storage can be attributed to the initiation of asset image data capture and is ongoing. Discussion with SA Power Networks stakeholders indicates that the continued projected organic growth is estimated at 25%-30% year on year and the illustrated storage growth in the graph below is based on these estimates:

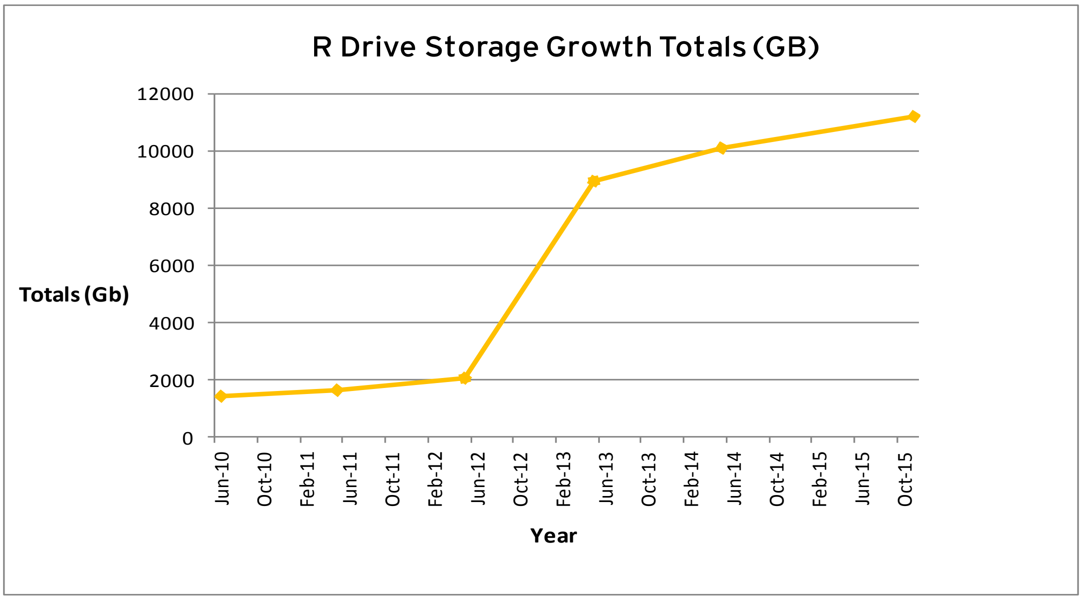


Figure 3: R drive growth

5.2.1.1 [redacted] Data Centre – Storage Capacity Projections

The following table lists the characteristics of the storage environment at the [redacted] Data Centre:

SAN	Environments Supported	Capacity Consumed (TB)	Total Capacity (TB)	Warranty Expiry
IBM Branded NetApp N6040	Oracle production environments	21.96	67.8	Rolling maintenance
NetApp 3210	E2E, B2B and Internet DMZ environments	4.2	5.76	28/02/2015
NetApp 3270	production, DEV and QAS for Wintel	72.7	128.1	28/02/2015
Hitachi USP-VM	SAP ERP and BW Dev, Test and QAS environments	27.58	30.08	Rolling maintenance
Terabytes (TB)		126.44	231.74	

Given the historical and projected growth in the R Drive and the current projects and initiatives across SA Power Networks, it is estimated that storage requirements at the [redacted] Data Centre will grow at approximately 25%-30% annually. However, it is important to note that storage projections for future major projects (with the exception of Smart Metering) are not included in the illustrated projections as these estimates are not known at the time of developing this document.

Consequently, based on organic growth, current projects in progress, expected refresh of SAN infrastructure, and the Smart Metering Project, [redacted] storage capacity is expected to be breached by the year 2015:

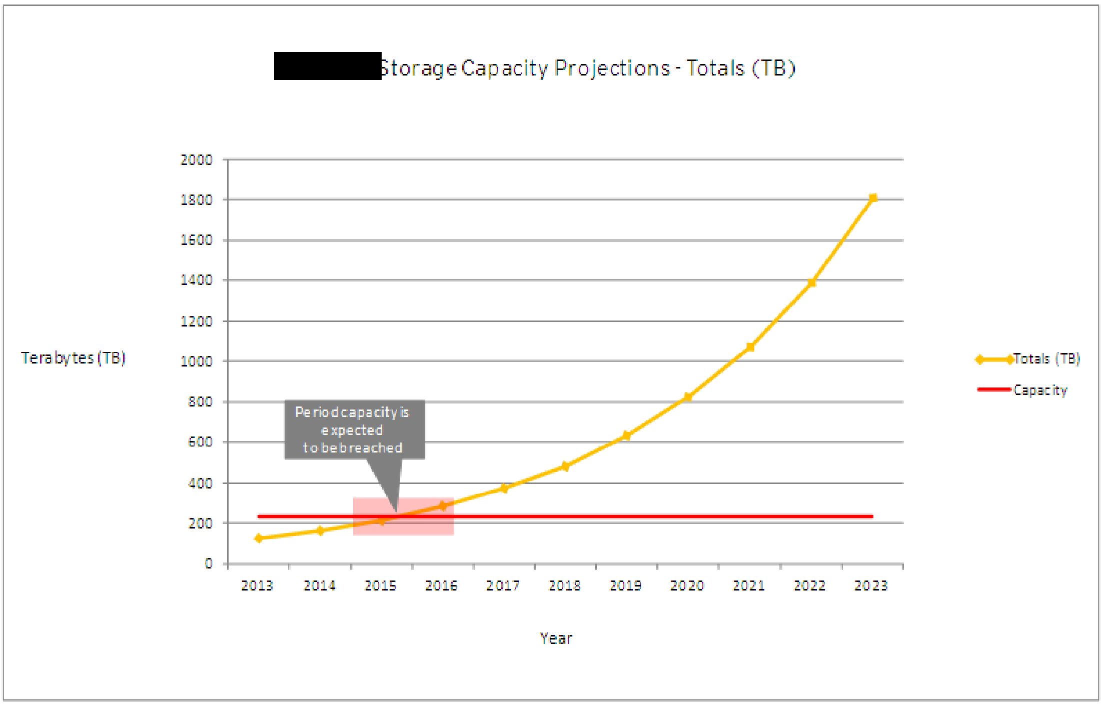


Figure 4: [redacted] **storage capacity projections**

5.2.1.2 [redacted] Data Centre – Storage Capacity Projections

The following table lists the characteristics of the storage environment at the [redacted] Data Centre:

SAN	Environments Supported	Capacity Consumed (TB)	Total Capacity (TB)	Warranty Expiry
IBM Branded NetApp N6040	Oracle and Wintel DR environments	37	45.6	Rolling maintenance
NetApp 3210	DMS environment components	1.52	5.52	30/06/2014
IBM DS1760	DMS environment components	Unknown - DMS managed		
NetApp 3210	B2B and Internet DMZ environments	3.52	5.52	30/06/2014
NetApp 3250	N series replacement SAN – currently being installed	61	159	30/04/2018
Terabytes (TB)		103.04	215.64	

Similarly to the [redacted] Data Centre, given the historical and projected growth in the R Drive and the current projects and initiatives across SA Power Networks, it is estimated that storage requirements at the [redacted] Data Centre will grow at approximately 25%-30% annually. However, again, it is important to note that storage projections for future major projects (with the exception of Smart Metering and the Single Online Backup Projects) are not included in the illustrated projections. Conversely, estimates do take into account, expected refresh of SAN infrastructure.

As indicated, the [redacted] storage capacity will be reached by 2016 based on current projections:

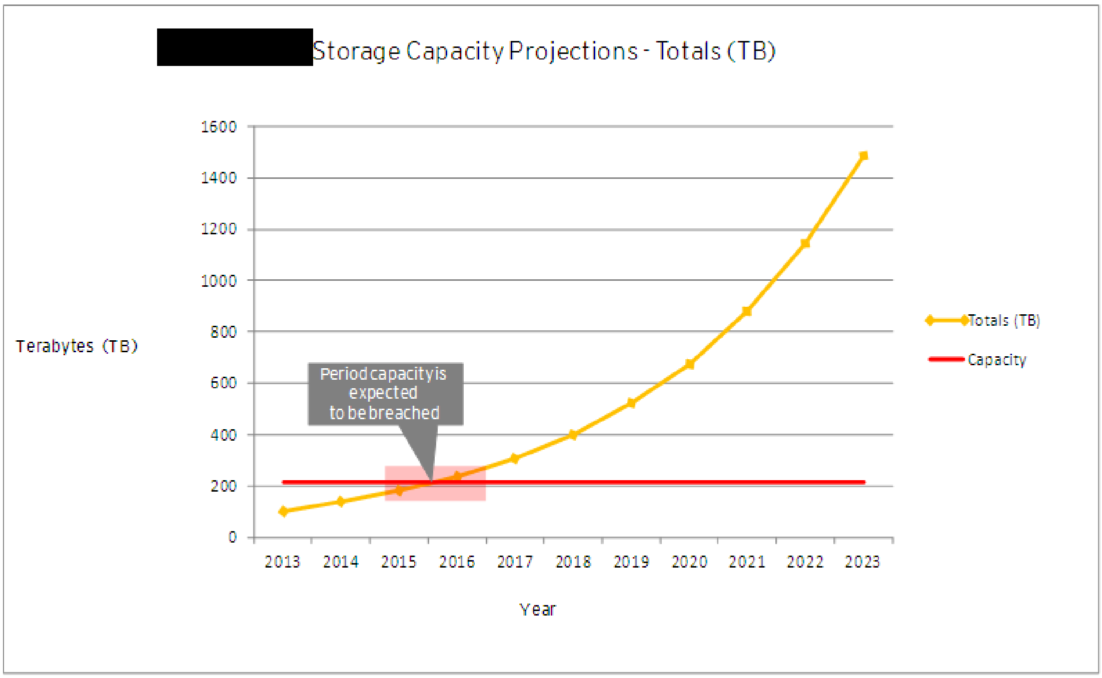


Figure 5: [redacted] storage capacity projections

5.2.2 SA Power Networks Power and Physical Capacity Projections

5.2.2.1 [redacted] Centre – Power Capacity Projections

Based on current consumption, Data Centre trends, additional storage requirements and the implementation of current and future projects, it is predicted that the [redacted] Data Centre will utilise approximately 80% more power in the next three years. This estimate is also cognisant of the significant power consumption increase that is attributed to newer computer hardware.

In determining the power projections for the [redacted] Data Centre facility, we have based calculations on the following assumptions, constraints and inputs:

- We have assumed an average rack power consumption of 4.6kW.
- We have not included the impact of a Server refresh.
- ADMS is not included in the statistics as project increases to capacity are expected to be added to the [redacted] Data Centre.
- All other major projects and IT initiatives (excluding ADMS) have been added to the [redacted] Data Centre statistics.
- [redacted] capacity is at 64.8kW based on information provided by SA Power Networks key stakeholders.

Based on the above requirements, inputs, assumptions and constraints, a breach of the power capacity at the [redacted] Data Centre is imminent as illustrated below:

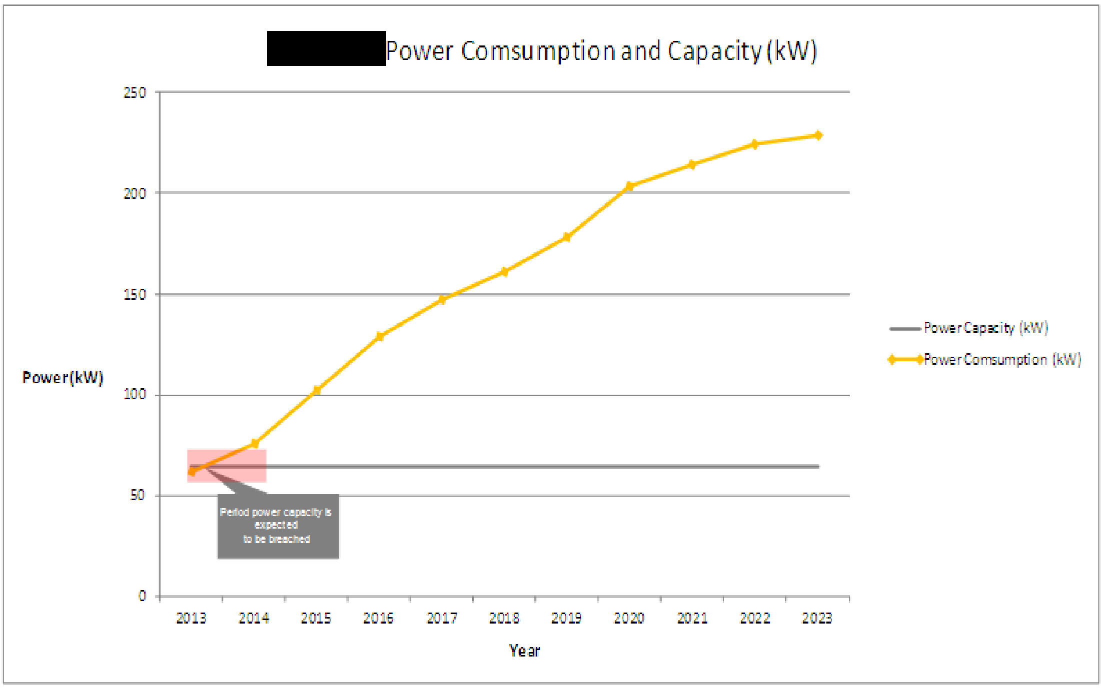


Figure 6: [redacted] data centre capacity projections

5.2.2.2 [redacted] Data Centre – Physical Capacity Projections

Floor space within the [redacted] Data Centre Facility, although close to capacity, is not likely to be reached in the foreseeable future, largely due to more efficient ways of implementing infrastructure (e.g. virtualisation of systems which increases density) and improved technologies.

In determining the calculations for the graph below we have taken into consideration statistics derived from market analysis and Gartner as follows:

- Density will increase by 5.5% per year based on industry projections and SA Power Networks' future requirements.
- Although Ernst & Young were advised by SA Power Networks Facilities Management that current floor space available within [redacted] Data Centre is approximately 100 square metres, we have applied a 35% reduction based on recommended 'white space' requirements which reduces the available space to 65%.
- We have applied a physical space requirement per rack of 2.8 square metres. When this figure is applied to current utilisation and remaining physical space within the Data Centre, SA Power Networks has approximately 7% remaining available floor space.
- All future projects are included in the projections; however it is important to note we have assumed that the majority of infrastructure will be virtualised and all obsolete infrastructure will be decommissioned and removed from the facility.

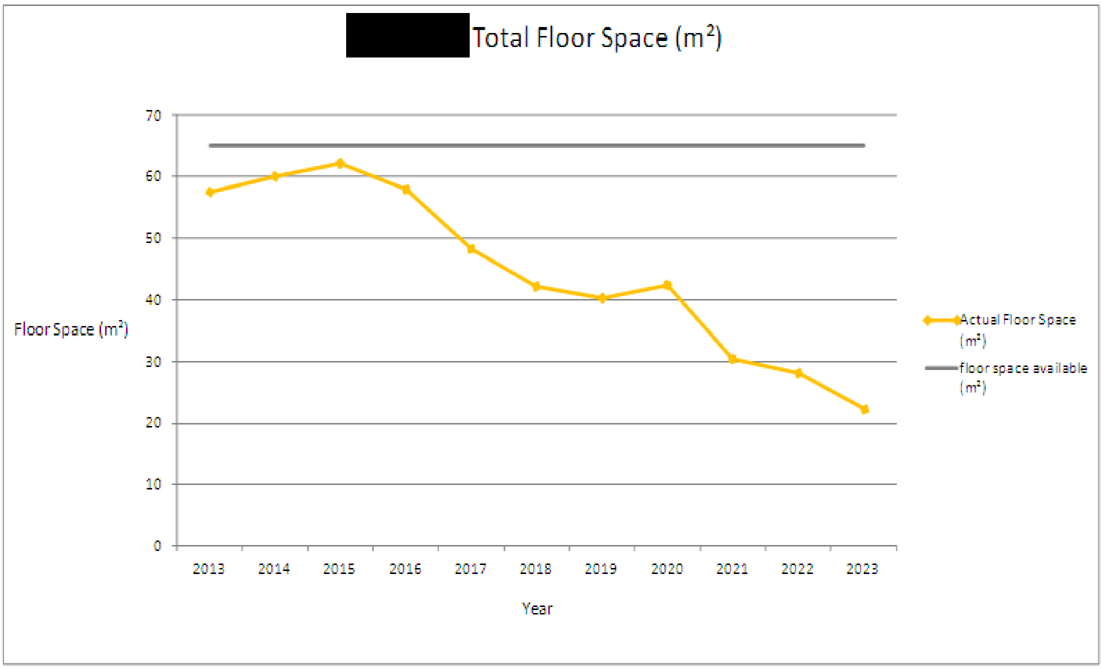


Figure 7: [redacted] data centre capacity projections

5.2.2.3 [redacted] *Data Centre – Power Capacity Projections*

It is predicted that the [redacted] Data Centre power requirements will increase exponentially over the next 10 years. However, the power capacity of 600kW is not expected to be breached in the next 10 years.

Conversely, the facility faces immediate space crunch throughout. Of the eighteen racks in use at the Data Centre at the moment, nine are used by IT and nine by TEL. Though there is scope for increasing the rack density within the nine racks available to IT, additional swing space will be required to do so.

Power consumption growth and rack density increase expectations have been calculated based on Data Centre trends and future requirements and we have based our calculations on the following assumptions, constraints and inputs:

- Density will increase by 3.1% per year based on industry projections and SA Power Networks' future requirements.
- We have assumed an average rack power consumption of 4.6kW.
- We have been advised that within the next ten years it is likely there will be an increase in additional DR capability for all SA Power Networks applications that do not currently have DR capability. We have therefore factored additional infrastructure requirements at [redacted] as a percentage of additional growth of infrastructure implemented into the [redacted] Data Centre. DR infrastructure at [redacted] is approximately 36% of the [redacted] infrastructure environment.
- We have not included the impact of Server refresh.
- ADMS is not included in the statistics as project increases to capacity are expected to be added to the [redacted] Data Centre.

Based on the above requirements, assumptions and constraints, power capacity at the [redacted] Data Centre will not be reached within the next 10 years as illustrated in the graph below:

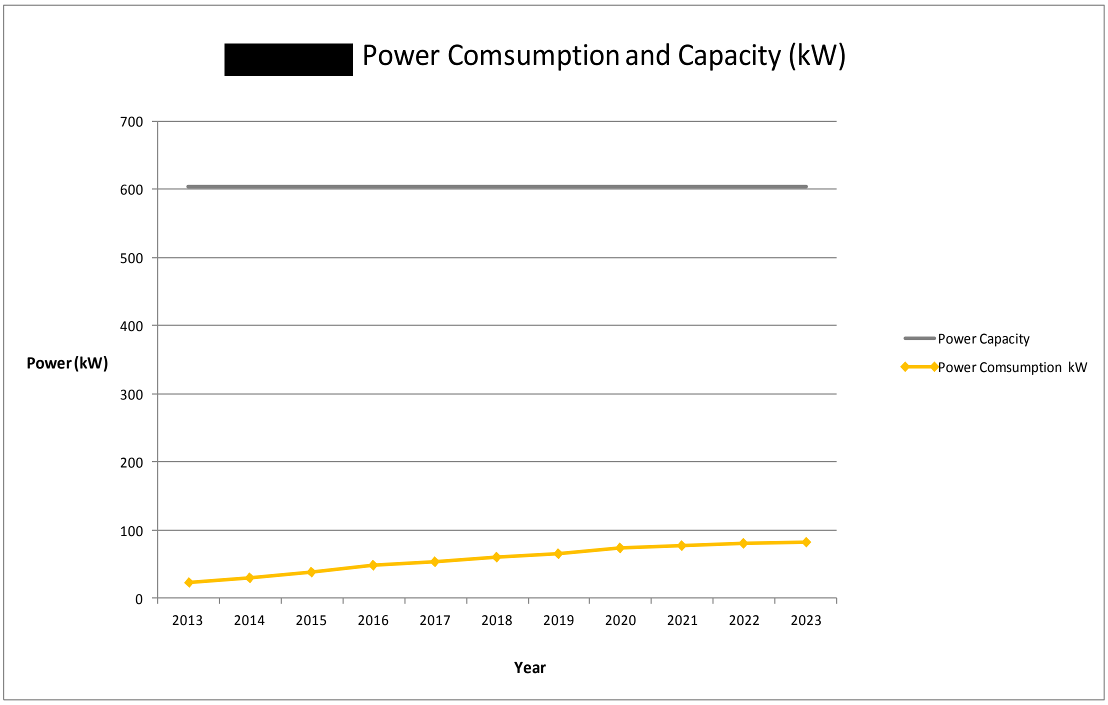


Figure 8: [redacted] **data centre capacity projections**

5.2.2.4 [redacted] Data Centre – Physical Capacity Projections

We have applied the same calculation inputs as described in section 5.2.2.2 above to derive [redacted] Data Centre physical capacity projections.

By applying these assumptions and inputs, the graph illustrates that a physical capacity breach at the [redacted] site is imminent with no mitigating factors applied.

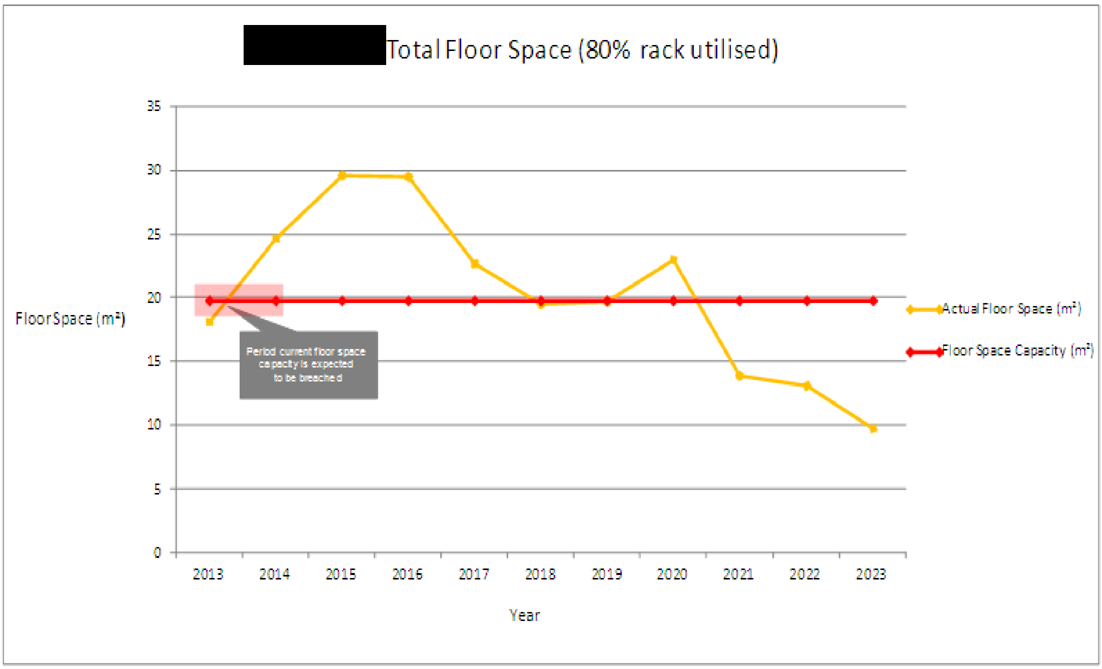


Figure 9: [redacted] data centre capacity projections

5.3 Cloud Services

5.3.1 Private Cloud

Despite the use of minor private cloud services to house production use cases for small software platforms, SA Power Networks require substantial cloud readiness initiatives to be performed in preparation for significant cloud use.

SA Power Networks have identified a roadmap that provides for activities in preparedness for cloud readiness as follows:

- Clearly define the organisation's cloud strategy.
- Define cloud types and their associated security models and use cases.
- Align Infrastructure roadmaps.
- Create cloud provider / services use matrix identifying risk management and tolerance.
- Define cloud principles, standards, operations, and governance processes & artefacts.

By 2014, SA Power Networks have identified they desire a complete private cloud solution which provides for elasticity and flexibility. The Cloud dependencies roadmap, as defined by SA Power Networks, is detailed on the following page.

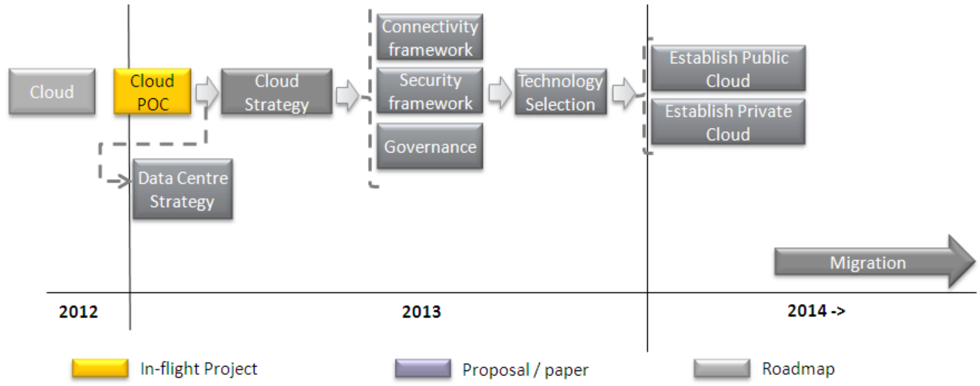


Figure 10: SA Power Networks Cloud Roadmap

On implementation of the Cloud roadmap, the desired state is to have the following capabilities within SA Power Networks:

- Clear guidance on when to use cloud services, and for what to use what cloud type or cloud provider.
- Standardised infrastructure and security framework for Cloud providers.
- Security framework based on information classification.
- Reduced internally delivered resource and infrastructure requirements.
- Agile and efficient service delivery.
- Tighter alignment of technology with business priorities.
- Tight and secure data integration.
- Elastic compute and storage resources.

The end-state Data Centre Strategy has a key dependency on the implementation of the Cloud roadmap and its associated initiatives to enable full-scale implementation of services such as IaaS and SaaS to be realised.

5.4 Resilience Requirements

SA Power Networks do not currently have a Disaster Recovery Strategy; however there is a current DR Program being driven by SA Power Networks IT that outlines certain systems that do not currently meet Business Continuity Plan (BCP) requirements and require additional effort. It is noted that the Cloud readiness roadmap detailed above is not interlinked to the current business case for future disaster recovery projects.

Similarly, a full business impact assessment (BIA) focused on business processes, has not been performed across the business. Therefore for input into this Strategy, the focus has been on system outage impacts.

Due to the proposed 24 hour RTO requirements of the majority of applications and services identified in the SA Power Networks BCP there is a requirement for a primary and a secondary Data Centre to ensure failover capabilities can be reached within required timeframes.

To assist in determining what the resilience requirements are for the future Data Centre Strategy and roadmap, we refer to a number of IT systems that were identified across SA Power Networks departmental business continuity plans as being required within one day of each BCP being enacted.

Recovery requirements for core SA Power Networks systems and supporting services are referenced in the SA Power Networks Business Continuity Plan.

6. Data Centre Strategy - Options and Roadmap

6.1 Guiding principles

Guiding principles are an articulation of shared organisational value that will underline this Data Centre Strategy. They are listed below:

- SA Power Networks are not in the business of operating purpose built Data Centres.
- The Data Centre Strategy must fit into SA Power Networks' Operational/Capital Expenditure (Opex/Capex) Model.
- Reduce complexity and increase service delivery across the environment that meets business needs.
- Reduce capacity and operational risks currently acknowledged.
- Allow for improved capability of inter-data centre networks to support future requirements.
- Facilitate the physical or logical separation of primary and secondary environments (in line with the imminent Network Separation Strategy).
- Increase flexibility and agility to take advantage of future technologies.
- Build an appropriate roadmap that caters for different application classifications.
- Reduce cost to run Data Centres, and understand the cost to operate existing facilities.

6.2 Constraints

Several short term and long term constraints have been identified, that have had a bearing on the proposed Data Centre Strategy. These constraints include:

- Current database infrastructure is between five and six years old and is due for refresh.
- The production cluster at [redacted] is currently near capacity.
- [redacted] is a single node cluster. If this cluster were to fail, all databases at [redacted] would be unavailable.
- The Data Centre Strategy must fit into SA Power Networks' Opex/Capex model.

6.3 Assumptions

The following assumptions have been identified and factored into the Data Centre Strategy analysis. These include:

- With significant consolidation, the number of racks to migrate to co-location facility and or an IaaS Cloud environment is approximately nineteen from [redacted] and [redacted] Data Centres.
- Applications have been constructed in tiers and may not be separable.
- Priority is to reduce risks associated with the facilities at [redacted] and [redacted] Data Centres.
- There is significant space to be saved by consolidating equipment into denser racks.

6.4 Data centre strategy

The Data Centre Strategy has been defined at a high level through intensive collaboration between Ernst & Young and SA Power Networks stakeholders. The process has been iterative in nature and agreed at the Strategy level.

6.4.1 Nomenclature

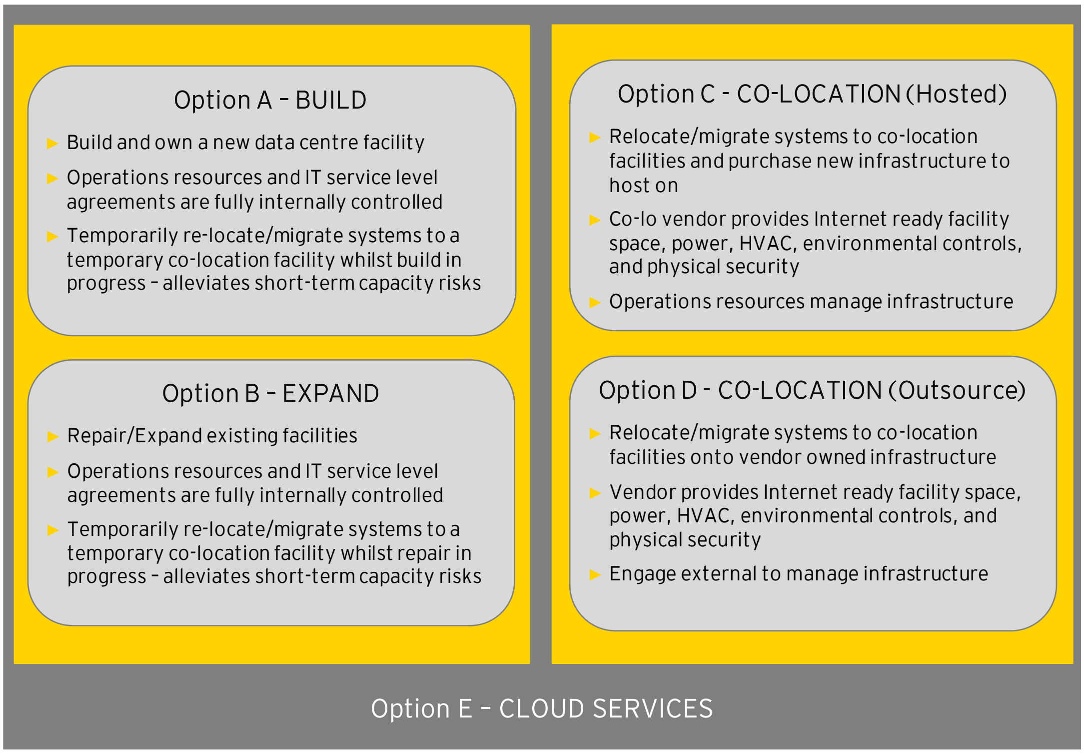
- Four high-level mutually exclusive Data Centre options have been defined. These four options are supplemented by a supporting ‘cloud’ option.
- Eleven potential scenarios were developed using one or more of the above defined options.
- The eleven scenarios were then assessed against SA Power Networks’ Guiding Principles to help select the preferred scenario.
- The recommended preferred scenario is cohesion of options and has been adopted for the Data Centre Strategy roadmap at section 6.5 – Data Centre Strategy Roadmap. This result has largely been driven by the capital vs. operating expenditure model that SA Power Networks is currently governed by.

6.4.2 Data centre strategy options

Four high-level options have been evaluated and discussed with SA Power Networks stakeholders. Two of these options (Option A: Build, and Option B: Expand) are Capex intensive while the other two largely support an Opex expenditure model (Option C: Co-location (hosted), and Option D: Co-location (outsource)).

It is envisaged that the supporting 'Cloud' option will supplement one or more of the four-preferred option categories and will likely grow over time.

The four high-level options are illustrated in the diagram below:



The above options have been assessed against the Guiding Principles to facilitate selection of the preferred option(s). The table on the following page highlights the differences between the different option categories, when evaluated against the Guiding Principles.

	Option A: Build	Option B: Expand	Option C: Co-location (Hosted)	Option D: Co-location (Outsource)	Supporting Option E: Increasing external cloud hosting
Approx time to implement	▶ 24 – 30 months ▶ Long and complex execution time	▶ 12 – 24 months ▶ Long and complex execution time	▶ 12 – 24 months	▶ 12 – 24 months	▶ 6 – 24 months
Total cost of ownership	▶ Highest CAPEX ▶ TCO lower over extended period	▶ High CAPEX ▶ TCO lower over extended period ▶ Co-location facility overhead during repair period	▶ Can be more economical in both OPEX and CAPEX spending ▶ OPEX varies based on SLA and DR requirements	▶ Highest OPEX ▶ OPEX varies based on SLA and DR requirements	▶ Further decrease in both OPEX and CAPEX because of ability to align supply and demand
Estimated High level cost range	▶ $5M - $10M per 1MW for Tier 3 *(based on estimates derived from Uptime Institute)*	▶ $500K-$2M capital cost to expand existing facilities *(based on power upgrade of 100Kw @[redacted] and base build expansion @[redacted])*	▶ $1M - $2M per annum *(based on 500 servers in a Tier 3 facility @ $25K per rack per annum)*	▶ $4M - $6M per annum *(based on 500 mixed servers (i.e. wintel, unix, storage) with 24x7 availability in a Tier 3 facility)*	▶ $5M - $6M per annum *(based on 500 servers in the cloud – each server with 4CPU, 4GB RAM, 2.5TB High Performance Storage)*
Cost transparency	▶ Normally low cost transparency as not all internal IT costs are transferred to the business	▶ Normally low cost transparency as not all internal IT costs are transferred to the business	▶ Better than options A and B as the hosting costs are relatively more transparent	▶ High cost transparency as the vendor charges all costs as agreed contractually	▶ High cost transparency as the vendor charges all costs as agreed contractually
Operational resources	▶ Incremental, no knowledge transfer	▶ Incremental, no knowledge transfer	▶ Incremental, no knowledge transfer ▶ Remote location requirements	▶ Complex handoff to vendor including knowledge transfer and training	▶ No additional resources required
Risk management and control	▶ More control over regulatory compliance/ security requirements	▶ More control over regulatory compliance/security requirements	▶ Relatively less control compared to options A and B but increasingly mature managed hosting market	▶ Relatively less control compared to options A and B but increasingly mature managed hosting market	▶ Perceived less control over regulatory compliance/security requirements
SLA maturity	▶ Relies on internal operation maturity	▶ Relies on internal operation maturity	▶ Offers well defined SLAs	▶ Offers well defined SLAs	▶ Relatively less mature but emerging
Agility	▶ Limited or constrained agility ▶ Built in future constraints and requires well forecasted growth	▶ Limited or constrained agility ▶ Built in future constraints and requires well forecasted growth	▶ Limitation per location, lease contract and vendor capacity	▶ Limitations defined per managed service contract and vendor capacity	▶ Highly agile and flexible ▶ Offers rapid capacity on demand
Market trend	▶ Dominated the market direction in the last decade ▶ Increasingly less popular now	▶ Same as “A. Build”	▶ Upward trend with significant increases in recent years	▶ Upward trend with significant increases in recent years	▶ Upward trend with good adoption in recent years

6.4.3 Data centre strategy scenarios

Multiple strategy scenarios were assessed by conducting multiple workshops with key SA Power Networks stakeholders. The scenarios were mapped to the options discussed above and assessed against the guiding principles as defined by the IT management team.

The following table maps the strategy scenarios to the option categories and assesses the combination on SA Power Networks' guiding principles.

Scenario #	Option category (combination)	Scenarios 2014- 2015	2016 +	Objectives									
				SA Power Networks is not in the business of operating purpose built data centres	Fit into SA Power Networks opex / capex model	Reduce complexity and simplify service delivery across the environment to meet business needs	Reduce capacity and operational risks currently acknowledged	Allow for improved capability of inter-data centre networks to support future requirements	Facilitate the physical or logical separation of the Primary and Secondary environments	Increased agility and flexibility to take advantage of future technologies	Improved capacity management capabilities and timeliness of service delivery	Build appropriate roadmap that caters for different application classifications	Reducing cost to run data centres, and understand the cost to operate existing facilities
1	Option categories C, D and E	▶ Relocate/migrate live/operational environments to co-location facility 1 – intrastate ▶ Relocate/migrate DR, DEV, TEST and QAS to co-location facility 2 - interstate or intrastate ▶ Migrate services to cloud as required/applicable	▶ Migrate infrastructure from [redacted] co-location facility 1 and 2 ▶ Provision all new services in IaaS environments	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	Option categories C and D	▶ Relocate/migrate production systems to co-location facility 1 ▶ Relocate/migrate DR to co-location facility 2 ▶ Relocate/migrate DEV, TEST and QAS to co-location facility 3		✓	❶	✓	✓	✓	✓	✓	✓	✓	×

Scenario #	Option category (combination)	Scenarios 2014- 2015	2016 +	Objectives									
				SA Power Networks is not in the business of operating purpose built data centres	Fit into SA Power Networks opex / capex model	Reduce complexity and simplify service delivery across the environment to meet business needs	Reduce capacity and operational risks currently acknowledged	Allow for improved capability of inter-data centre networks to support future requirements	Facilitate the physical or logical separation of the Primary and Secondary environments	Increased agility and flexibility to take advantage of future technologies	Improved capacity management capabilities and timeliness of service delivery	Build appropriate roadmap that caters for different application classifications	Reducing cost to run data centres, and understand the cost to operate existing facilities
3	Option categories B and C	▶ Relocate/migrate production systems to co-location facility 1 ▶ Consolidate DR, DEV, TEST and QAS into [redacted] - managed by a third party		×	✓	✓	×	×	✓	✓	✓	✓	❶
4	Option category E	▶ Provision new DEV, Test, QAS and DR into Cloud IaaS ▶ Gradually migrate required DEV TEST QAS DR into Cloud IaaS ▶ Relocate/migrate production systems to Cloud IaaS	▶ Relocate/migrate production systems to Cloud IaaS	✓	✓	❶	✓	❶	✓	❶	❶	×	✓
5	Option categories C/D and E	▶ Provision new DEV, Test, QAS and DR into Cloud IaaS ▶ Gradually migrate required DEV TEST QAS DR into Cloud IaaS ▶ Relocate/migrate production systems to co-location facility 1	▶ Relocate/migrate production systems to co-location facility 1 ▶ As required, migrate Production systems to Cloud IaaS	✓	✓	✓	✓	❶	✓	✓	❶	✓	✓
6	Option categories C/D and E	▶ Relocate/migrate production systems to a co-location facility 1 ▶ Relocate/migrate DR to co-location facility 2		✓	✓	✓	✓	✓	✓	✓	❶	✓	✓

Scenario #	Option category (combination)	Scenarios 2014- 2015	2016 +	Objectives									
				SA Power Networks is not in the business of operating purpose built data centres	Fit into SA Power Networks opex / capex model	Reduce complexity and simplify service delivery across the environment to meet business needs	Reduce capacity and operational risks currently acknowledged	Allow for improved capability of inter-data centre networks to support future requirements	Facilitate the physical or logical separation of the Primary and Secondary environments	Increased agility and flexibility to take advantage of future technologies	Improved capacity management capabilities and timeliness of service delivery	Build appropriate roadmap that caters for different application classifications	Reducing cost to run data centres, and understand the cost to operate existing facilities
		▶ Relocate/migrate all DEV, TEST, QAS to Cloud IaaS											
7	Option categories B, C/D, and E	▶ Relocate/migrate production systems to a co-location facility 1 ▶ Relocate/migrate DR to [redacted] ▶ Relocate/migrate all DEV, TEST, QAS to Cloud IaaS		×	✓	✓	×	✓	✓	✓	❶	✓	×
8	Option categories B and C/D	▶ Relocate/migrate production systems to a co-location facility 1 ▶ Engage third party to manage [redacted]k and [redacted] sites containing DR, DEV, TEST, QAS infrastructure		×	✓	✓	×	✓	✓	❶	❶	✓	×
9	Option category C/D	▶ Enter any of the above co-location options with a business partner		✓	✓	❶	✓	✓	✓	❶	❶	✓	✓

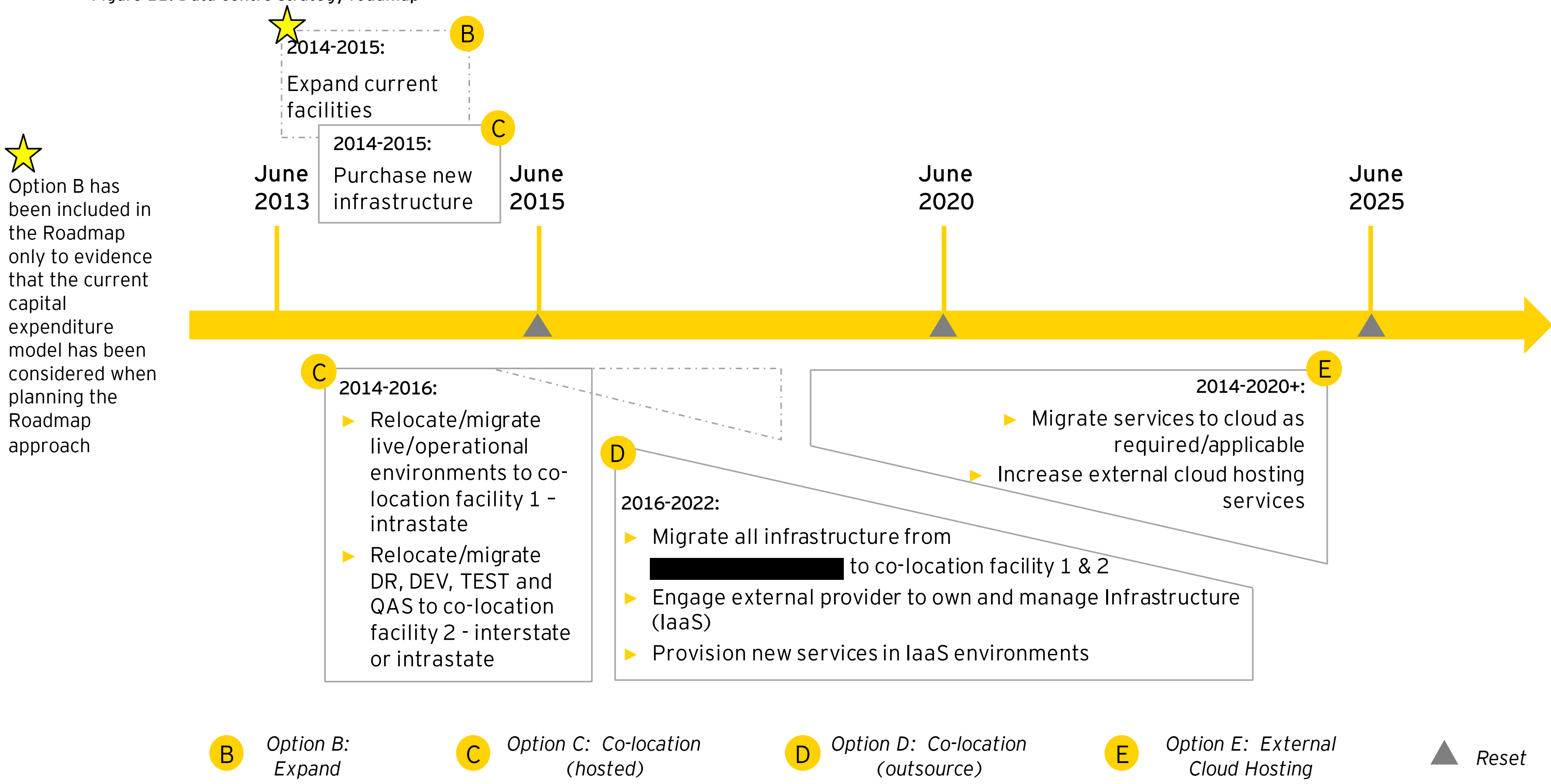
Scenario #	Option category (combination)	Scenarios 2014- 2015	2016 +	Objectives									
				SA Power Networks is not in the business of operating purpose built data centres	Fit into SA Power Networks opex / capex model	Reduce complexity and simplify service delivery across the environment to meet business needs	Reduce capacity and operational risks currently acknowledged	Allow for improved capability of inter-data centre networks to support future requirements	Facilitate the physical or logical separation of the Primary and Secondary environments	Increased agility and flexibility to take advantage of future technologies	Improved capacity management capabilities and timeliness of service delivery	Build appropriate roadmap that caters for different application classifications	Reducing cost to run data centres, and understand the cost to operate existing facilities
10	Option categories A, B, C/D and E	▶ Initiate commission of new facility ▶ Temporarily house all new infrastructure services at a co-location facility or enter Cloud ▶ Build modular solution at [redacted] to house additional DR, Dev, Test, QAS infrastructure	▶ Relocate/migrate Prod, Dev, Test, QAS to newly built facility and leave DR in Co-location or Cloud ▶ Relocate/migrate the remainder of infrastructure to newly built facility	×	✓	✓	✓	✓	×	✓	✓	✓	×
11	Option category A	▶ Build modular solution at [redacted] to house additional DR, Dev, Test, Qas infrastructure		×	✓	✓	×	✓	✓	✓	❶	✓	×

❶ Partially meets objective

6.5 Data Centre Strategy Roadmap

Following analysis of the identified scenarios and options and taking into consideration the SA Power Networks guiding principles, the proposed strategy is to chronologically adopt Options C and D whilst increasing Cloud services (Option E) throughout and as needed. However, in the immediate short-term, Option B will weigh heavily due to the current capital expenditure model which prevails until 2015. The following diagram is a high-level illustration of the proposed Strategy and Roadmap.

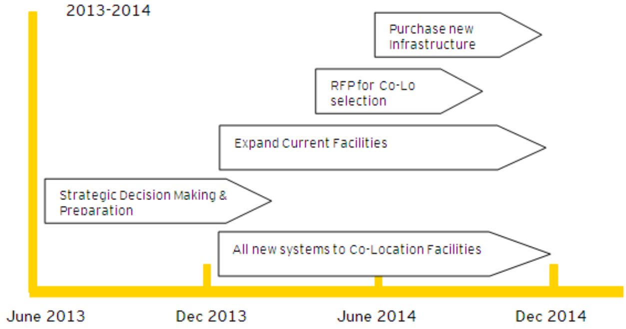
Figure 11: Data centre strategy roadmap



6.5.1 High Level Roadmap Activities

2013 – 2014 (Planning):

The focus of this period will be to simultaneously make strategic decisions to commence the strategic roadmap journey whilst stabilising the current environment by mitigating the current risks to the existing facilities. In parallel SA Power Networks should commence preparations for relocation to co-location facilities.



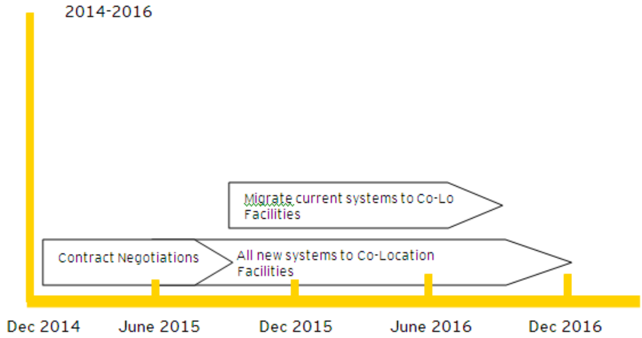
Activities in this period will include:

- Strategic decision making in regards to expansion needs of current facilities, co-location requirements, new infrastructure requirements, cloud services, and operational readiness requirements.
- Expansion of the current facilities to mitigate the current risks.
- Prepare for Co-location selection and issue Request for Information (RFI) and/or Requestion for Proposal (RFP).
- Purchase new infrastructure to house in Co-location facilities.

*All new systems will be housed in temporary co-location facility to ensure no further impact on current facility capacity issues.

2014 – 2016:

The focus of this period will be to relocate to the identified co-location facilities. In the proposed arrangement, the co-location vendor will provide internet ready facility space, power, HVAC, environmental controls, and physical security while SA Power Networks' operations resources manage infrastructure.

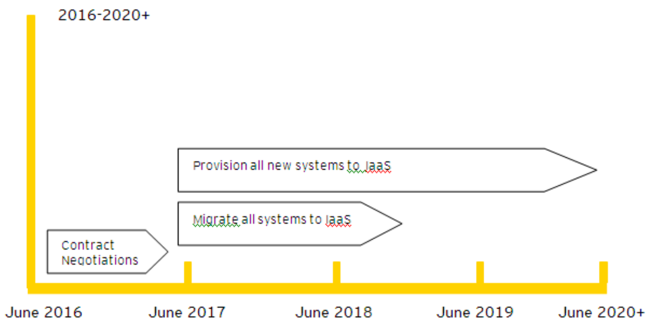


Activities in this period will include:

- Selection of co-location services provider(s) after RFP response evaluation and negotiations.
- Consolidate into a primary/secondary dual data centre model that includes:
  - A primary data centre - Relocate/migrate live/operational environments to co-location facility 1 – intrastate
  - Secondary data centres that support DR - Relocate/migrate DR, DEV, TEST and QAS to co-location facility 2 - interstate or intrastate
  - High availability and redundancy in pairs
  - Highly interconnected transmission mesh linking data centres
  - Carrier and route diversity of telecommunications linking the data centres.
  - Expand cloud services as required (on demand).

2016 – 2022:

The focus of this period will be to extend the services of an external provider to both own and manage the infrastructure for SA Power Networks. In the proposed arrangement, the co-location vendor will provide internet ready facility space, power, HVAC, environmental controls, and physical security along with managing the infrastructure.



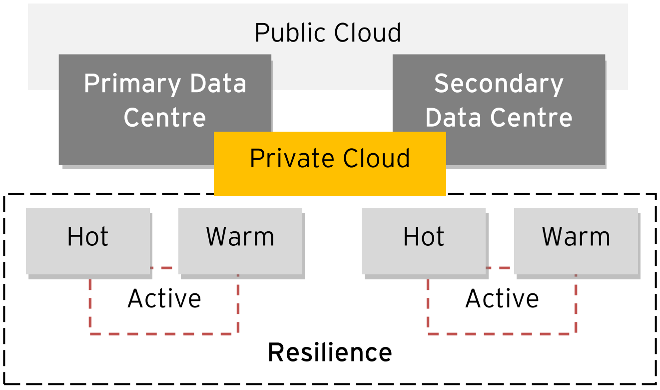
Activities in this period will include:

- Enter into contract negotiations to extend the current co-location hosting providers services to provision Infrastructure as a Service (IaaS).
- Migrate all remaining infrastructure from [redacted] to co-location facilities 1 and 2 and current hosted systems to IaaS.
- Provision of all new systems to IaaS at co-location facilities 1 and 2.

*It should be noted that the provision of services obtained from the cloud provider will increase as SA Power Networks increase in maturity. The cloud vendor will provide facilities, network, storage and on-demand, multi-tenant "Elastic" computing capacity, which can be either dedicated or virtualised (e.g. Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and SaaS).

6.5.2 Data Centre Strategy Future Vision

The culmination of the roadmaps illustrated above will result in a highly elastic, flexible and resilient topology which will increase IT service delivery to the business whilst eliminating many of the risks and issues currently being experienced.

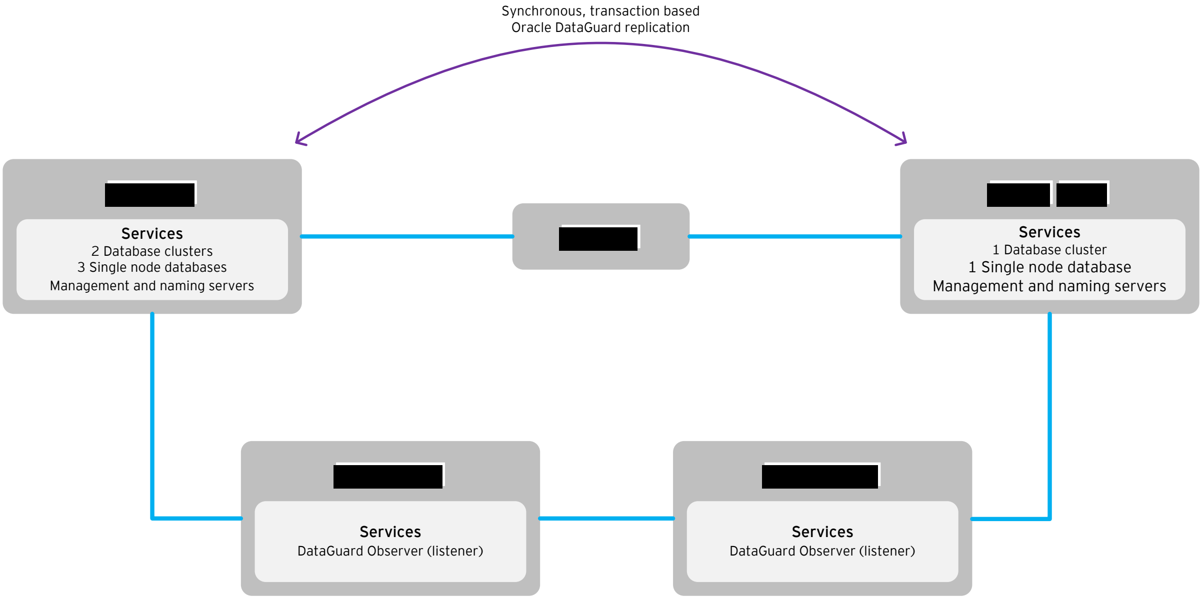


Essentially this will create a Data Centre as a Service (DaaS) model, allowing SA Power Networks to concentrate on its primary business of power distribution to South Australia.

Appendix A - Detailed Current State Information

The appendix sections that follow outline the current state environment information provided to Ernst & Young during information gathering and are current as at 3 May 2013.

A.1 Oracle Database Environment



The Oracle environment is provisioned on blade chassis and storage infrastructure shared with general server infrastructure in the internal domain. No DMZ database environments currently exist. Support for Oracle database environments is provided by the Oracle DBA team within the IT Technical Operations Group.

Generally speaking, Oracle databases at the [redacted] site hold data for production systems, while those at the [redacted] site exist as DataGuard replicas of these primary databases.

Service Providers:

- Blue Crystal provides ad-hoc support services to the Oracle DBA team.
- Datacom provide UNIX system administration services for the SA Power Networks Oracle environments.

Constraints:

- Current database infrastructure is between 5 and 6 years old and is due for refresh.
- The production cluster at [redacted] is currently near capacity.
- [redacted] is a single node cluster. If this cluster were to fail, all databases at [redacted] would be unavailable.
- Requests for establishment of new databases tend to come in at short notice, or detailed designs used do not account for database impacts at all – resulting in databases being implemented as remediation activities rather than as a planned implementation activity.

A.2 Storage Environment

The SA Power Networks storage environment consists of the following SAN devices across sites:

Site	SAN	Environments Supported	Capacity Consumed	Total Capacity	Warranty Expiry
[redacted]	IBM NSeries Branded NetApp N6040	Oracle production environments	21.96TB	67.8TB	Rolling maintenance
	NetApp 3210	E2E, B2B and Internet DMZ environments	4.2TB	5.76TB	28/2/2015
	NetApp 3270	production, DEV and QAS for Wintel	72.7TB	128.1TB	28/2/2015
	Hitachi USP-VM	SAP ERP and BW Dev, Test and QAS environments	27.58TB	30.08	Rolling maintenance
[redacted]	IBM Branded NetApp N6040	Oracle and Wintel DR environments	37TB	45.6TB	Rolling maintenance
	NetApp 3210	DMS environment components	1.52TB	5.52TB	30/6/2014
	IBM DS1760	DMS environment components	Unknown – DMS managed		
	NetApp 3210	B2B and Internet DMZ environments	3.52TB	5.52TB	30/6/2014
	NetApp 3250	N series replacement SAN – currently being installed	N/A	159TB	30/4/2018
[redacted]	NetApp 3210	DMS environment components	1.51TB	5.52TB	30/6/2014
	IBM DS1760	DMS environment components	Unknown – DMS managed		
	Hitachi USP-VM	SAP ERP and BW production environments	10.33TB	4.2TB	Rolling maintenance

Support for storage environments is provided by the:

- Server team for NetApp SAN's including IBM branded NetApp SAN's.
- UNIX and SAP Basis teams for Hitachi SAN's.
- DMS project for IBM DMS SAN's.

The [redacted] IBM N series SAN is currently being replaced with a NetApp 3250 due to it no longer meeting operational requirements and having reached the end of its warranty period. Similarly, the N series SAN at [redacted] is to be decommissioned in 2013, with its data migrated to other production SAN's at [redacted]

A.3 Server Environment

The server environment is composed primarily of Windows Servers, with a small number of UNIX servers operating to support the Oracle database and SAP environments. Servers are largely virtualised, with approximately 50% of physical infrastructure supporting virtual environments. Windows based server environments are supported by the Server team within the IT Operations group. UNIX environments are supported either by the internal UNIX support team in the case of SAP, or by Datacom in the case of Oracle Unix environments.

The server team are currently in the process of compiling an asset inventory including end of life equipment, however indications from IBM suggest the following equipment end of life dates:

Period	Number of IBM Devices Reaching End of Warranty
2015	11
2014	48
2013	51

The server team anticipate that if the current physical server infrastructure were refreshed, the current compute capacity of servers could be replicated with approximately a 30% reduction in rack space consumed.

A.4 Managed Services

A.4.1 Cloud Services

Cloud services are used sparingly within SA Power Networks at present, with a small number of Software as a Service (SaaS) platforms being utilised by groups within the business. At present, cloud services are used to support:

- ARIS – a process modelling tool provided by a vendor through an Amazon private cloud environment.
- ESRI – an asset capture and inspection tool provided as a service from the vendor to toughbooks and handheld devices.
- Geomatic – a system provided as a service from the vendor which may replace ESRI. It is also used for asset capture and inspection on toughbooks and handheld devices.
- A number of Customer Related Programs (CRP). These are provided through the Microsoft Azure platform and were developed in-house by the .NET development team. 3rd level support is provided by SMS Technology who assisted in the development of these applications, which include:
  - Power @ My Place
  - Street Light Out
  - Online Outage Reporting
  - Online Forms
- Figtree – Figtree is currently being hosted in-house however a proposal has been provided by the vendor to provide it under a SaaS model.
- Learning Management Systems (LMS) – the organisation also accesses several LMS' including Cura LMS and E3 Learning's LMS.

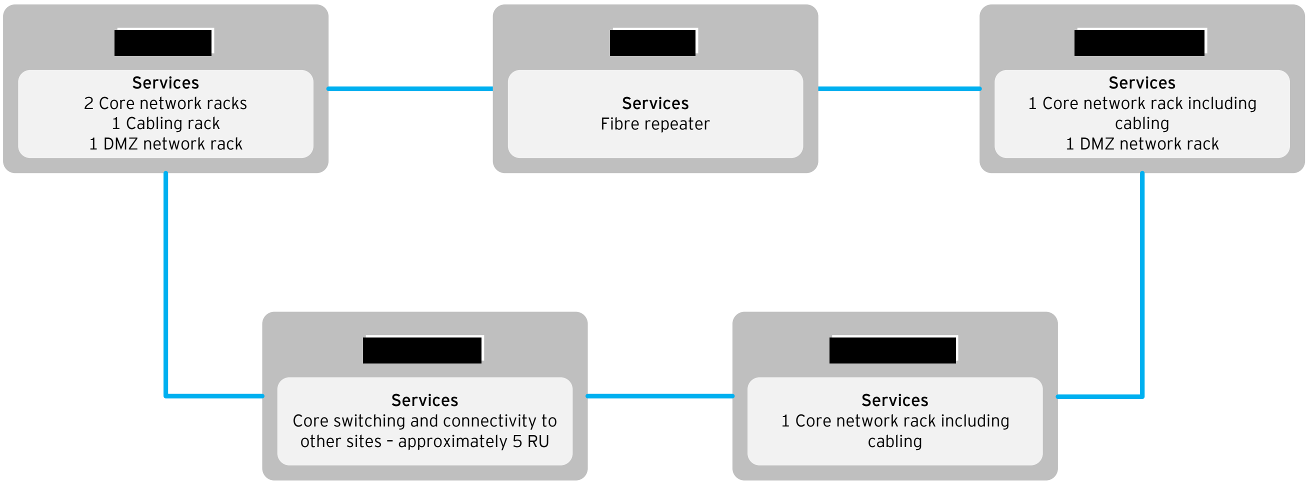
A.4.2 Other Managed/Provided Services

- Phase Alternating Line (PAL) Connectivity – connectivity between PAL and SA Power Networks is maintained through routing and firewall infrastructure located at the [redacted] SA Power Networks sites and the [redacted] and [redacted] PAL sites. This connectivity provides the foundation for a number of critical services between the two organisations including:
    - IVR – the IVR used by the SA Power Networks customer facing contact centre is hosted by [redacted] in Victoria. This system accesses outage information held within the OMS system at the [redacted] sites and relies on this information to provide accurate outage information to customers. This system is considered a critical service which relies on the connectivity maintained between SA Power Networks and PAL.
    - CIS/OV – the customer information system used by SA Power Networks to record customer details and bill customers is provided as a service to SA Power Networks by PAL, and is hosted from their [redacted] data centre in Victoria. SA Power Networks CIS/OV users access this application via their Citrix clients, and a number of systems including SAP and the metering system MVRS, interface with CIS/OV across the [redacted] PAL link.
- [redacted] Connectivity – direct connectivity to [redacted] site has been established from the [redacted] site and relies on SA Power Networks routing infrastructure housed both at [redacted]. [redacted] users access the SA Power Networks site to utilise the SAP application, and SA Power Networks users utilise [redacted] Citrix environment to access their SAP application to support various business processes.
- MVRS – [redacted] provide meter reading services to SA Power Networks and upload their meter data to the MVRS application on dedicated workstations provided by SA Power Networks at the [redacted] site. Dedicated connectivity between these workstations and a dedicated domain controller and server infrastructure at [redacted] then allow this information to be uploaded to MVRS and ultimately CIS/OV to support customer billing.
- [redacted] – a small group of SA Power Networks users access the [redacted] Citrix environment through direct connectivity to the [redacted] data centre. Similarly, some [redacted] users require access to the SA Power Networks SAP and Citrix environments. This connectivity is provided through dedicated SA Power Networks firewall and routing infrastructure located at the [redacted] sites.

A.4 Network Environment

The WAN environment at SA Power Networks spans all local and remote sites, and currently consists of layer 3 switching infrastructure. The WAN team are currently working to implement layer 2 connectivity across the major data centres to allow a consolidated logical view of SA Power Networks data centres from a WAN perspective.

The diagram below outlines the high level WAN infrastructure and topology that comprises the SA Power Networks WAN ring, which excludes depots and remote sites. All other sites connect directly to one of the sites listed in the diagram, and while redundant connectivity may exist between them and other SA Power Networks sites, they do not form a component of the WAN ring topology.



Constraints:

- 40GB of bandwidth is currently provisioned between VLAN's which acts as a constraint for data passing across VLAN's. This is planned to be upgraded in the future, however no timeframe has been set for this project.
- The [redacted] facility is currently approaching capacity for data centre server ports. This is a known limitation and is planned for remediation; however no timeframe has been set for this project.

A.5 Alerts and Escalations

A.5.1 [redacted] data centre alerts and escalations summary

Alerts and Escalations	Responsible Contractor / BU	Generated Alert	SLA	Response time from alert identified	Documented policy & procedure
Electrical	Property Services	None	Yes	3 hours	Documentation part of Security procedures
Generators	Property Services	Security/ Property/IT	Yes	3 hours	
Chiller	Property Services	Security/ Property/IT	Yes	3 hours	
Air Conditioning	Property Services	Security/ Property/IT	Yes	3 hours	
Environmental alerts	Property Services	Security/ Property/IT	Yes	3 hours	
Security Access	IT/Tel/Property	Na	na	Na	na
Building Security Alarm	Property Services	Security	Yes	Immediate	
Fire	Property Services	Security	Yes	3 hours	
UPS	Property Services	Security/ Property/IT	Yes	3 hours	
Security Cameras	None	Na	Na	Na	na

A.5.2 [redacted] data centre alerts and escalations summary

Alerts and Escalations	Responsible Contractor / BU	Generated Alert	SLA	Response time	Documented policy & procedure
Electrical	Property Services	None	Yes	3 hours	Documentation part of Security procedures
Generators	Property Services	None	Yes	3 hours	
Chiller	NA	NA	None	NA	
Air Conditioning	Property Services	Security/Proper ty/IT	Yes	3 hours	
Environmental alerts	Property Services	Security/Proper ty/IT	Yes	3 hours	
Security Access	IT/Tel/Property	Security	Na	3 Hours	na
Building Security Alarm	Property Services	Security	Yes	3 Hours	
Fire	Property Services	Local	Yes		
UPS	Property Services	Security/Proper ty/IT	Yes	3 hours	
Security Cameras	None	Na	Na	na	na

Appendix B - Detailed Future Requirements

B.1 Department Future Requirements

B.1.1 Applications Team

Department initiatives that have the potential to impact infrastructure requirements.

It is noted that the below initiatives are outside the major projects discussed in *section 4.2.1*.

- Click upgrade will have an effect on the [redacted] footprint. There will be increased by a few blade servers.
- The use of GIS is likely to increase in the long term as the new system implemented provides more user capabilities.
- Data Warehousing will be implemented in the future, however timeframe and infrastructure requirements are unknown.
- Mobility upgrades will be implemented in the future, however timeframe and infrastructure requirements are unknown.
- Local warehouse for CIS/OV data – likely implemented in 2014 or 2015 pre-CIS replacement, however infrastructure requirement are unknown.
- Service Stream Brompton will move to another office however this will not increase infrastructure requirements.
- Additional IT tools are likely to be implemented including:
    - Knowledge management.
    - Increased SCOM usage.
    - Increased CMDB usage.
- Portfolio management and project server will be implemented in the future; however timeframe and infrastructure requirements are unknown.

B.1.2 Database Team

Department initiatives that have the potential to impact infrastructure requirements.

It is noted that the below initiatives are outside the major projects discussed in *section 4.2.1*.

- Currently a project is underway to refresh the Oracle environments in FY13-FY14. Currently options are being presented for a full or partial refresh. In addition, vendor options are being sought for available infrastructure solutions.

- Currently the Oracle and SAP Oracle database environments are distinct from one another. Future plans in place to amalgamate the database environments into a single oracle cluster and decoupled from applications. It is likely that Oracle Exadata or Vblock will be used for the new architecture. However, despite the increase in requirements there should be no impact on the infrastructure footprint (approximately 4 racks). This is due to increased processing power and consolidation of hardware/software. It is noted that as a component of this clustering amalgamation, it is likely 1-2 new racks at [redacted] would be required for SAP DR purposes. It is also expected that Dev, Test, QAS environments would be implemented for non-SAP Oracle databases. The refresh is unlikely to occur until 2016 when the hardware is refreshed.

- SoA implementation would require additional database environments be established in 2014.

- There is a possibility that a new a Customer Information System (CIS) will be implemented which will be required to run on an Oracle database; however timeframe and infrastructure requirements are unknown.

- Tape libraries will potentially expand with service and rack requirements expansion; this will result in approximately an additional rack of storage located at a nonproduction site.

- Implementation of additional SAP instances and databases (SAP Site Recovery Manager (SRM) – 3-4 instances to be implemented on existing infrastructure).

- Four new SAP instances will be required for change management requiring additional RU space in existing racks. It is noted that this will not result in a significant infrastructure expansion.

- 0.5 racks of SUN 6130's at [redacted] will be decommissioned.

- Oracle management instances are likely to be expanded to 1 full rack from the current partial use of a rack.

B.1.3 SAP Team

Department initiatives that have the potential to impact infrastructure requirements.

It is noted that the below initiatives are outside the major projects discussed in *section 4.2.1*.

- SAP SRM to be implemented in December 2013.
- SAP CRM potentially implemented as a CIS/OV replacement.
- Additional storage requirements due increased photos of assets and document management (attached to larger projects discussed above).
- Implementation of SAP gateway or another mobility platform to cater for future mobility initiatives.
- Business intelligence (BI) strategy and the requirement for an implementation of a data warehouse (to be considered).
- Additional training modules and material to be implemented within SAP requiring an increase in servers and potentially RU space.
- Potential implementation of SAP ITSM.
- It is likely that SAP geo-enabling will be integrated with GIS in FY14-15. This will likely create additional storage and rack requirements as further development/projects occur to utilise the geo data.
- Implementation of Success Factors which is a SaaS solution to integrate with SAP for workforce planning initiatives.
- Portals have the potential to be migrated to a cloud provided solution in the longer term.
- SAP High-Availability planned for the future.
- SAP HANA – essentially consists of very fast SAP databases stored entirely in random access memory (RAM). Possibility of being implemented in the future and would require dedicated certified infrastructure to operate.
- SAP content server implementation planned for the future.
- Multi Resource Scheduling (MRS) which is an add-on to ERP has the potential to be implemented in the future.

Additional information: It was noted that [redacted] storage has grown from 70TB to 500TB from the implementation of their smart meter program which has resulted in a 30% increase in backup storage requirements. If SA Power Networks implement smart metering the SAP storage architecture is likely to the storage requirements will likely to in SAPN, this requirement would likely fall onto the SAP storage architecture.

B.1.4 Server and Storage Team

Department initiatives that have the potential to impact infrastructure requirements.

It is noted that the below initiatives are outside the major projects discussed in *section 4.2.1*.

- R drive will continue to grow at larger rates in the next five years at a larger rate than the previous five due to increased project storage requirements.
- Implementation of additional DR capability for all other applications is likely within a 10 year period.
- Creation of separated Test, QAS and Dev environments for server and storage components as there is currently no separate environments for any storage or back-end wintel environments, virtualisation will reduce the impact of increase infrastructure.
- Transition from unstructured to structured data, primarily the R drive space.
- Large growth is predicted in the number and size of photos and videos stored on shared drives, in addition to assets and metadata to be uploaded centrally due to asset management initiatives.
- There will be an increase in E-learning and corporate communications by moving to video and delivery of DVD video over WAN accessible channels.
- Introduction of solid state storage as it becomes more cost effective.
- Archiving of data to lower tiers of storage with data compression to reduce disk requirements. As a result there may be a reduction in backup requirements.
- Possible consolidation of SAP and Wintel storage platforms and environments which will reduce rack space requirements.
- Introduction of new NetApp clustering architecture, likely to be implemented where storage is more easily expanded once capacity is reached.
- Gradual movement of software from locally deployed field devices to virtualised client server model.
- Currently there are 1,200 concurrent users connected at maximum, likely to introduce up to 200-300 additional users over time and increase storage requirements accordingly.
- Policies to be implemented to prevent the use of local storage will move a significant amount of storage to R drive/servers.

Additional information: It was noted that over the past five years the rack footprint has halved, primarily due to increased virtualisation.

B.1.5 Network Team (WAN)

Department initiatives that have the potential to impact infrastructure requirements.

It is noted that the below initiatives are outside the major projects discussed in *section 4.2.1*.

- Security – IDS and IPS is likely to be implemented, however timeframe and unknown.
- Convergence of TEL and WAN group infrastructure using multiprotocol label switching (MPLS) is unconfirmed and no timeframe are unknown.
- Point of Presence (PoP) deployment of nexus switch infrastructure to all SA Power Networks sites to allow 10 GB connectivity between all sites. The current fibre is capable of supporting up to 40gbps, however in order to upgrade to 100 GB, there is an additional infrastructure requirement. It is anticipated that this upgrade would be required within a five year timeframe due to big data requirements and other business initiatives.
- IPV6 rollout is required internally and is planned within the next five years.
- Network virtualisation/convergence will likely occur within a 10 year timeframe, incorporating processing and storage into the network layer.
- Intelligent networks are likely to be implemented within 10 years, allowing self healing and intelligent quality of service across networks.

Appendix C - Table of Acronyms

Acronym	Meaning
IT	Information Technology
DC	Data Centre
DaaS	Data Centre as a Service
IaaS	Infrastructure as a Service
SaaS	Software as a Service
PaaS	Platform as a Service
TEL	Telecommunications
BC	Business Continuity
BCP	Business Continuity Plan
DR	Disaster Recovery
BIA	Business Impact Assessment
OMS	Operations Management System
IVR	Interactive Voice Response
WAN	Wide Area Network
LAN	Local Area Network
ADMS	Advanced Distribution Management System
DMS	Demand Management System
AMRS	Australian Meter Reading Services
UPS	Uninterrupted Power Supply
SAN	Storage Area Network
NOC	Network Operations Centre
TNOC	The Network Operations Centre
RU	Rack Unit
kW	Kilowatt
kVA	Kilovolt-amps
VESDA	Very Early Smoke Detection Apparatus
ITMO	IT Management Office
PUE	Power Usage Effectiveness
FTE	Fulltime Equivalent
HVAC	Heating, Ventilation and Air-conditioning
SRM	Site Recovery Manager
ITSM	IT Service Management
RAM	Random Access Memory
MRS	Multi Resource Scheduling
MPLS	Multi-protocol Label Switching
SCADA	Supervisory Control and Data Acquisition
DMZ	Demilitarised Zone
AD	Active Directory
PDU	Power Distribution Unit
PIN	Personal Identification Number
CSC	Computer Sciences Corporation
CIS/OV	Customer Information System / Open Vision
ERP	Enterprise Resource Planning
BW	Business Warehouse
MVRS	Multi Vendor Reading System
SLO	Street Light Out
LMS	Learning Management System
TCO	Total Cost of Ownership
GIS	Geographic Information System
RTO	Response Time Objective
RPO	Response Point Objective
SLA	Service Level Agreement
SOA	Service Orientated Architecture
IDS	Intrusion Detection System
IPS	Intrusion Prevention System
PAL	Phase Alternating Line
PoP	Point of Presence

Appendix D - References

References:

Emerson Network Power 2009, The Four Trends Driving the Future of Data Centre Infrastructure Design and Management, *viewed 14th September 2011*, http://www.emersonnetworkpower.com/en-US/Solutions/ByApplication/DataCenterNetworking/DCIM/Documents/WhitePapers/M06252_EWC_WP_v3.5hi.pdf

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Appendix E - Stakeholders

The following stakeholders were interviewed during the fieldwork to produce this report and we thank them for their input during the Strategy development process.

[redacted]