POWER SYSTEM REVIEW

2008-09

March 2010

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Disclaimer

The Power System Review is prepared by the Utilities Commission as a report to the Minister, participants in the electricity supply industry and the community in accordance with section 45 of the *Electricity Reform Act*.

The Review also reports on performance against standards of service under the Electricity Standards of Service Code, and on performance of the power system under the System Control Technical Code.

The Review is prepared using information sourced from participants in the electricity supply industry, Northern Territory Government agencies and relevant publicly available data. The Commission understands this information to be current as at December 2009.

The Review contains predictions, estimates and statements that are based on the Commission's interpretation of data provided by electricity industry participants, and assumptions about the power system, including load growth forecasts and the affect of potential major developments in particular power systems. The Commission considers that the Review is an accurate report within the normal tolerance of economic forecasts.

Any person using the information in the Review should independently verify the accuracy, completeness, reliability and suitability of the information and source data. The Commission accepts no liability (including liability to any person by reason of negligence) for any use of the information in this Review or for any loss, damage, cost or expense incurred or arising by reason of any error, negligent act, omission or misrepresentation in the information in this Review or otherwise.

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CHAPTER 1

Key Findings

1.1 The Power System Review is an annual document prepared by the Utilities Commission to advise the Minister, participants in the electricity supply industry (including potential participants) and the community on power system performance and capacity.

1.2 The 2008-09 Review provides an overview of the generation capacity, forecast electricity load and generation, network and customer service performance of the Northern Territory's three main power systems, Darwin-Katherine, Tennant Creek and Alice Springs for the period 2008-09 to 2018-19.

1.3 The Commission has decided to expand the scope of the 2008-09 Review to consolidate the system performance data available to the Commission in a single document. The 2008-09 Review includes information which in previous years was separately reported in the Northern Territory Electricity Market Information statement and the Standards of Service performance report.

1.4 The scope of the Power System Review is an evolving project, and the Commission anticipates further changes to the approach and content of subsequent reviews in response to the findings of the series of reviews being undertaken by the Commission during 2010 for the Treasurer. In particular, the Commission anticipates future Power System Reviews will provide more detailed data and analysis of power system performance, reliability and security.

Major events in 2008-09

1.5 Equipment failures in and around the Casuarina zone substation in the northern suburbs of Darwin during September and October 2008 led to extended power outages to a large number of customers, with the most significant outage causing more than 11 000 customers to lose power for up to 14 hours. The Territory Government commissioned the Independent Enquiry into Casuarina Substation Events and Substation Maintenance Across Darwin (the Davies Enquiry), which exposed deficiencies in electricity networks maintenance practices and asset management by the service provider, the Power and Water Corporation (PWC).

1.6 The PWC response to the Davies Enquiry included establishing the Remedial Asset Management Program (RAMP) to ensure safe access to substations, carry out remedial works and replace failed equipment at Casuarina zone substation. PWC also continued efforts to improve asset management systems and capability, and implemented an action plan to improve asset management operations in the long term.

1.7 Energy infrastructure projects underway or completed in 2008-09 included the completion of works on Weddell power station stage two, adding up to 44 megawatt of capacity to the Darwin-Katherine system, or about 9 per cent of system capacity.

1.8 Additional sources of gas for electricity generation became available with the completion of a pipeline connecting the Darwin liquefied natural gas (DLNG) plant to the Darwin city gate gas hub in July 2009, and the first supply of gas from the Eni Australia B.V. (Eni) owned and operated Blacktip gas field in the Bonaparte Gulf in October 2009. From the December quarter 2009, gas for electricity generation in the Darwin-Katherine, Tennant Creek and Alice Springs systems was available in varying quantities and quality from the Amadeus Basin fields, Blacktip field and the DLNG plant.

Generation adequacy

1.9 Generation peak demand in the Darwin-Katherine system increased by 22.5 per cent between 1999-00 and 2008-09, an average of 2.1 per cent per year. Generation peak demand increased by 2.4 per cent between 2007-08 and 2008-09. The rate of peak demand growth over the period has been influenced by periods of major industrial development; for example the 2005-06 and 2006-07 period, when the DLNG plant was under construction, saw an increase in peak demand of 8.4 per cent.

1.10 The increase in generation peak demand in the Alice Springs system between 2007-08 and 2008-09 was about 0.1 per cent. The average annual rate of peak demand growth between 2001-02 and 2008-09 was about 2.7 per cent.

1.11 Generation peak demand increased by 5.7 per cent in the Tennant Creek system between 2007-08 and 2008-09. The average annual rate of peak demand growth between 2001-02 and 2008-09 was 2.5 per cent.

1.12 To assess the adequacy of generation infrastructure to meet forecast generation peak demand in the period 2009-10 to 2018-19, the Commission has tested the sensitivity of ten year forecasts provided by electricity industry participants.

1.13 For the Darwin-Katherine system, the Commission has used a high growth scenario of 4 per cent per year, a baseline growth scenario of 2.4 per cent a year, and a low growth scenario of 1 per cent a year. For the Alice Springs and Tenant Creek systems, the Commission has used a high growth scenario of 2.5 per cent per year, a baseline growth scenario of 1.0 per cent a year, and a low growth scenario of 0.1 per cent a year.

1.14 Under the low, baseline and high growth scenarios, projected generation capacity in each system using current security of supply criteria (N-2, or the loss of two largest units of generation capacity) appears adequate to meet forecast peak demand in the medium term to 2011-12 and long term to 2018-19, with the exception of:

- the Darwin-Katherine system, where projected generation capacity is adequate until 2012-13 under the high peak demand growth scenario, and until 2014-15 under the baseline peak demand growth scenario; and
- the Alice Springs system, where projected generation capacity is adequate until 2016-17 under the high peak demand growth scenario.

1.15 The projected adequacy of generation capacity in the Darwin-Katherine and Alice Springs systems is subject to the planned installation of additional capacity in the period to 2011-12. Alteration to plans to add or retire capacity will affect the projected adequacy of capacity to meet forecast demand.

1.16 The Commission was advised in November 2009 that, between 2009-10 and 2011-12, 12.1 MW of capacity is to be added at the Katherine power station in 2010-11, 30 MW of capacity is to be added at the Weddell power station in 2011-12, and the 30 MW of capacity at the Berrimah power station is to be retired from service by 2011-12.

1.17 For the Alice Springs system, between 2009-10 and 2011-12, 32.1 MW of capacity is to be added at the Owen Springs power station in 2010-11, and 14 MW of capacity at the Ron Goodin Power station is to be retired or relocated in 2010-11.

1.18 The Commission notes that this assessment of the adequacy of generation infrastructure to meet forecast peak demand is based on an assumption of all generation infrastructure being in good working condition and generally available for dispatch. Without additional information about scheduled extended outages, the condition of generation assets and availability of plant, the Commission cannot ascertain whether there is adequate reserve capacity to meet forecast peak demand, particularly in the short to medium term.

1.19 The Commission considers that additional information is necessary to effectively assess generation adequacy. In future reviews, key data to be required of generators is expected to include: the operating capacity of plant under varying circumstances, the condition of the assets, and the potential for planned and unplanned outages to reduce available generation capacity.

Networks adequacy

1.20 The Commission began examining planning and reliability of electricity networks in the 2004-05 Review. The power outages caused by problems with the Casuarina zone substation in late 2008 highlighted the risks associated with inadequate oversight of the performance and capacity of the entire power system, including electricity networks.

1.21 PWC is forecasting an increase in average network peak demand of 2.5 per cent a year across the Territory, with higher network peak demand growth forecast in areas such as the Darwin central business district, Palmerston and East Arm peninsula.

1.22 PWC provided the Commission with capacity, forecast peak demand and reserve margin data for substations in the Darwin-Katherine, Tennant Creek and Alice Springs systems. The Commission has not independently tested the network peak demand forecasts provided by PWC, and has not assessed the capacity of network assets relative to forecast network peak demand. In particular, the Commission does not have sufficient data on the condition of network assets, and the associated capability of these assets to meet demand and maintain security of supply to provide a full assessment.

1.23 PWC advised the Commission that about $287 million is to be spent between 2009-10 and 2013-14 augmenting and maintaining existing network assets, and constructing new network assets.

1.24 The Commission is aware that PWC is putting significant effort into improving network planning and asset management practices. The Commission will also be examining network planning and reliability during 2010 under a System Planning, Monitoring and Reporting review in response to terms of reference from the Treasurer. The Commission expects to provide more comprehensive assessment of these matters in future Reviews.

Adequacy of fuel supplies

1.25 Natural gas is the primary fuel for electricity generation in the Darwin-Katherine, Tennant Creek and Alice Springs systems.

1.26 The primary gas supply for electricity generation was in transition during 2008-09, from the Amadeus basin fields in central Australia to the Eni Blacktip field in the Bonaparte Gulf.

1.27 Supply of gas from the Blacktip field was delayed beyond the contract date of 1 January 2009 due to difficulties experienced by Eni sourcing components on time, and extreme weather conditions. Blacktip gas was used for electricity generation from October 2009, although this gas was not processed to the required specification. The Commission understands that full specification gas was supplied from mid January 2010 at volumes sufficient to meet requirements for electricity generation.

1.28 PWC was able to mitigate the risk of a potential shortfall in fuel for electricity generation during 2008-09 due to the delay in availability of Blacktip gas by using about 1.1 petajoules of liquid fuels. In the second half of 2009 PWC purchased gas from the DLNG plant. The Commission expects that the use of liquid fuels will reduce significantly from the second half of 2009-10 as Blacktip gas takes over as the main fuel source.

1.29 The supply of gas into generation facilities has been very reliable, with only four occasions since 1987 when gas has not been supplied to a power station in the Darwin-Katherine system in May 1999, December 2004 and in November and December 2009.

1.30 The Commission understands that the gas supply-demand balance in the period to 2010-11 to 2018-09 is adequate, with gas supply contract volumes from the Amadeus Basin fields, Blacktip and from the DLNG plant able to supply sufficient fuel to meet forecast electricity generation requirements without resorting to obtaining additional gas or using liquid fuels.

System performance – generation and networks

1.31 The Electricity Standards of Service Code requires PWC to report on performance against defined reliability indicators for electricity generation and networks.

Duration of power outages

1.32 The average duration of generation and network related power outages in the Katherine, Tennant Creek and Alice Springs regions in 2008-09 was better than the combined standard for generation and network outages. However, the average duration of power outages in the Darwin region, where the majority of electricity customers in the four regions reside, was worse than the combined standard for generation and network outages.

1.33 The Commission notes that the Electricity Standards of Service Code allows network related performance indicators to be adjusted to exclude major event days. The three major event days recorded in 2008-09 were:

- Darwin on 2 October 2008 following a failure at the Casuarina zone substation. SAIDI was adjusted downwards by 75 minutes;

- Katherine region on 12 May 2009 due to an outage caused by a flashover on the 22 kV distribution board. This affected about 1 400 customers for 125 minutes, and SAIDI was adjusted by 53 minutes; and
- Alice Springs on 22 September 2008 when strong wind and flying debris caused by a severe storm caused power outages on a number of feeders. SAIDI was adjusted downwards by 439 minutes.

1.34 Electricity customers in the Darwin region experienced an average of 344.4 minutes off supply in 2008-09 from generation and networks outages, compared to the combined standard of 262.7 minutes, due to an (adjusted) average loss of supply of 311 minutes, 91 minutes more than the standard of 220 minutes off supply from network related outages.

1.35 The (adjusted) average minutes off supply from network related power outages in the Alice Springs region was 154 minutes, compared to the standard of 108 minutes. However, the overall average duration of power outages was 157.6 minutes, below the combined standard of 230.5 minutes.

1.36 More detail on the average duration of generation and network related power outages for 2008-09, is provided in table 1.1.

Table 1.1: Average minutes off supply (SAIDI), generation, network (adjusted) and combined results, 2008-09

Region	Generation Result	Generation Standard	Network Result	Network Standard	Combined Result	Combined Standard
Darwin	33.4	42.7	311	220	344.4	262.7
Katherine	24.1	25.7	182	401	206.1	426.7
Tennant Creek	49.6	125	245	411	294.6	536
Alice Springs	3.6	122.5	154	108	157.6	230.5

Frequency of power outages

1.37 The average frequency of generation and network related power outages in 2008-09 was better than the combined standard for frequency of generation and network outages for the Katherine, Tennant Creek and Alice Springs regions, but worse than the standard for the Darwin region.

1.38 The average frequency of network related outages is also adjusted to exclude major event days. Network SAIFI was adjusted downwards by 0.1 interruptions for Darwin, 0.5 interruptions for Katherine and 0.6 interruptions for Alice Springs.

1.39 The increased frequency of network related power outages in the Darwin region is attributed by PWC to the problems with the Casuarina zone substation in late 2008, and outages associated with the subsequent repairs and maintenance, with customers experiencing an adjusted average of 6.1 network related outages, compared to the standard of 4.2 outages. Overall, customers in the Darwin region experienced an average of 9.1 generation and network outages in 2008-09, compared to the combined standard of 8.1 outages.

1.40 More detail on the average frequency of generation and network related power outages for 2008-09 is provided in table 1.2.

Table 1.2: Average number of interruptions (SAIFI), generation, network (adjusted) and combined results, 2008-09

Region	Generation Result	Generation Standard	Network Result	Network Standard	Combined Result	Combined Standard
Darwin	3.0	3.9	6.1	4.2	9.1	8.1
Katherine	1.5	1.1	4.7	9.6	6.2	10.7
Tennant Creek	1.7	12.5	4.2	9.8	5.9	22.3
Alice Springs	0.5	3.6	3.1	2.9	3.6	6.5

Customer service indicators

1.41 The Electricity Standards of Service Code requires PWC to report against defined customer service indicators for electricity networks and retail.

1.42 Customer service indicators for electricity network and retail service performance include the time taken to connect a property to the network, the time taken for telephone calls to be answered by an operator, and the number of customer complaints (about network and retail services).

1.43 In 2008-09, PWC Networks connected 99.2 per cent of existing properties to the network within 24 hours, and 91.3 per cent of properties in new subdivisions within 5 working days. This is better than the agreed standard of 98 per cent and 90 per cent, respectively.

1.44 However, PWC Networks did not meet the standard for connecting properties in new subdivisions where minor extensions or augmentation is required, with 66.5 per cent of connections taking more than 10 weeks, compared to the agreed standard of 35 per cent of connections. PWC attributes this result to the diversion of resources to the RAMP program.

1.45 PWC reported that 62 per cent of telephone calls were answered by a human operator within 20 seconds. All calls to PWC concerning electricity are recorded, so this measure includes retail and network inquiries, e.g. billing or supply problems. The standard is for 63 per cent of telephone calls to be answered within 20 seconds of a customer choosing to speak to a person.

1.46 PWC recorded 2 235 complaints from customers in 2008-09 about electricity retail and network performance. The most common matters for complaint were billing, level of service and pension concession. The number of complaints as a percentage of customers in 2008-09 was 3.2 per cent.

1.47 More detail on the type of customer complaints received in 2008-09 is provided in table 1.3.

Table 1.3: Customer complaint types

Complaint type	2008-09
Billing	1 106
Level of service	341
Pension concession	299
High bill	120
Other	369
Total	2 235

CHAPTER 2

Introduction

2.1 The Power System Review is an annual report prepared by the Utilities Commission to advise the Minister, participants in the electricity supply industry and the community on power system performance and capacity.

2.2 The purpose of the Review is to provide information and analysis on the historical and forecast power system performance, focusing on the previous financial year, and on the next 10 years. The Review is prepared in accordance with the *Electricity Reform Act* [s45], which requires the Commission to monitor and advise on the Northern Territory power systems by:

- reporting forecasts of electricity load and generating capacity;
- reviewing and reporting on the performance of the Territory's power systems;
- advising on matters relating to the future capacity and reliability of the Territory's power systems relative to forecast load;
- advising on other electricity supply industry and market policy matters; and
- reviewing the prospective trends in the capacity and reliability of the Territory's power systems relative to projected load growth.

2.3 This 2008-09 Review focuses on system performance in 2008-09, and on forecast system performance in the period 2009-10 to 2018-19.

2.4 In a change from the approach taken in previous years, the 2008-09 Review also reports the performance by the Power and Water Corporation (PWC) against electricity generation, network and customer standards of service indicators specified in the Electricity Standards of Service Code, and on the technical performance of the Darwin-Katherine power system for the period January to June 2009.

2.5 The information and analysis in this Review is considered current up to the end of December 2009, and only relates to the Darwin-Katherine, Alice Springs and Tennant Creek power systems (referred to as the market systems).[1]

2.6 The Commission prepares the Review with the assistance and advice of participants in the electricity supply industry and other electricity industry stakeholders. The Commission appreciates the effort and input of all those who have contributed to the Review, but notes that the views expressed in the Review are those of the Commission, and may not necessarily reflect those of the parties consulted.

1 The activities of electricity industry participants and customers in the market systems are regulated under the *Electricity Reform Act*, *Electricity Networks (Third Party Access) Act and Code* and associated legislation. At present, only the Darwin-Katherine, Alice Springs and Tennant Creek systems meet this criteria.

Overview of 2008-09 Review

Expanded scope of Review

2.7 The Commission has decided to expand the scope of the 2008-09 Review to consolidate the system performance data available to the Commission in a single document.

2.8 Previous Reviews have reported on forecasts of electricity demand, the adequacy of generation capacity and gas supplies, system planning arrangements and network reliability. However, the Commission has also separately collected and reported information on system capacity and performance in the:

- Northern Territory Electricity Market Information statement, an annual report on electricity usage, generation capacity and network length. This information is provided as part of annual licence returns by licensed participants retailers, and is published by the Commission to provide key statistics for the electricity supply industry; and
- Standards of Service Performance report, an annual report on the standard of electricity generation, network and retail service performance. The Electricity Standards of Service Code requires PWC to report annual performance against specified standards of service indicators.

2.9 Additionally, the Commission intends reporting system performance data provided biannually by the System Controller from January 2010.[2] The System Control Technical Code [s7.4] requires the System Controller to report to the Commission on the performance and major incidents of the power system on or before 31 January and 31 July each year.

2.10 Regular and comprehensive public reporting on power system performance is a feature of the electricity supply industry elsewhere in Australia. The Australian Energy Regulator (AER) publishes an annual State of the Energy Market report to provide a high level overview of energy market activity in Australia, and supplement the AER's extensive technical reporting on the energy sector. The Australian Energy Market Operator (AEMO) publishes detailed reports on the operation of energy markets, notably the National Transmission Statement and Electricity Statement of Opportunities.

2.11 The Commission considers that collating and analysing all data relevant to system capacity and performance in a single document will assist participants in the electricity supply industry, and the community, make an informed view about the performance and prospective trends for the Territory's power systems. The expanded scope of the Review should make system reporting in the Territory more consistent with practice elsewhere in Australia.

[2] The *Electricity Reform Act* [s38] gives the System Controller the functions of monitoring and controlling the operation of the power system to ensure the system operates reliably, safely and securely in accordance with the System Control Technical Code. The System Control function is currently held by the PWC System Control unit, according to the System Control licence granted by the Commission.

2.12 The expanded scope of the Power System Review is an evolving project, and the Commission expects that future reviews will provide more detailed data and analysis on power system performance and capacity. The Commission welcomes feedback on the 2008-09 Review so that the scope and content of future Reviews provide an accurate and relevant source of information on system performance and capacity to the Minister, participants in the electricity supply industry and the community.

Electricity Standards of Service Code

2.13 The Electricity Standards of Service Code requires PWC to report annually to the Commission on performance against defined standards for electricity generation, networks and customer service.[3]

2.14 The Code establishes 47 indicators, and defines a standard of performance for 46 of these indicators. The current standards specified in the Code apply until 30 June 2011, at which time they may be revised by the Commission. The Commission notes that electricity standards of service are to be considered through a Review of Electricity Standards of Service to be conducted during 2010 by the Commission under terms of reference approved by the Treasurer.

2.15 The Commission has previously released PWC's annual report on standards of service, and a brief overview of the report.[4] The Commission considers the standards of service indicators are relevant to the capacity and reliability of the power systems, and there is merit in their being reported along with other system performance data.

Half year Power system performance reports

2.16 PWC System Control is required to provide the Commission with half yearly reports setting out the performance and major incidents of the Darwin-Katherine, Alice Springs and Tennant Creek power systems. The half yearly reports are to include information on system security problems and relevant technical or operational details.

2.17 The Commission received the half yearly report for the Darwin-Katherine system for January to June 2009 in July 2009, and expects to receive further half yearly reports by 31 January and 31 July each year for the Darwin-Katherine, Alice Springs and Tennant Creek systems. The Commission intends reporting data contained in the half yearly reports on a regular basis, and providing more comprehensive analysis of the performance data in future Reviews.

Structure of Review

2.18 The 2008-09 Review is structured as follows:

- Chapter 1 provides an overview of the findings in the 2008-09 Review;
- Chapter 2 is the introduction;

3 Utilities Commission website, www.utilicom.nt.gov.au, Electricity Standards of Service Code.

4 Utilities Commission website, www.utilicom.nt.gov.au, 2007-08 Standards of Service Report.

- Chapter 3 provides an overview of the Darwin-Katherine, Alice Springs and Tennant Creek systems, significant power system events and some key performance and forecast data;
- Chapter 4 provides performance and capacity data, and forecasts of demand and capacity for the electricity generation sector, and an assessment of the adequacy of the supply of fuel for electricity generation;
- Chapter 5 provides performance and forecast data for the electricity network sector, and analysis of network planning and reliability; and
- Chapter 6 provides performance against customer service indicators specified in the Electricity Standards of Service Code for PWC Retail and PWC Networks.

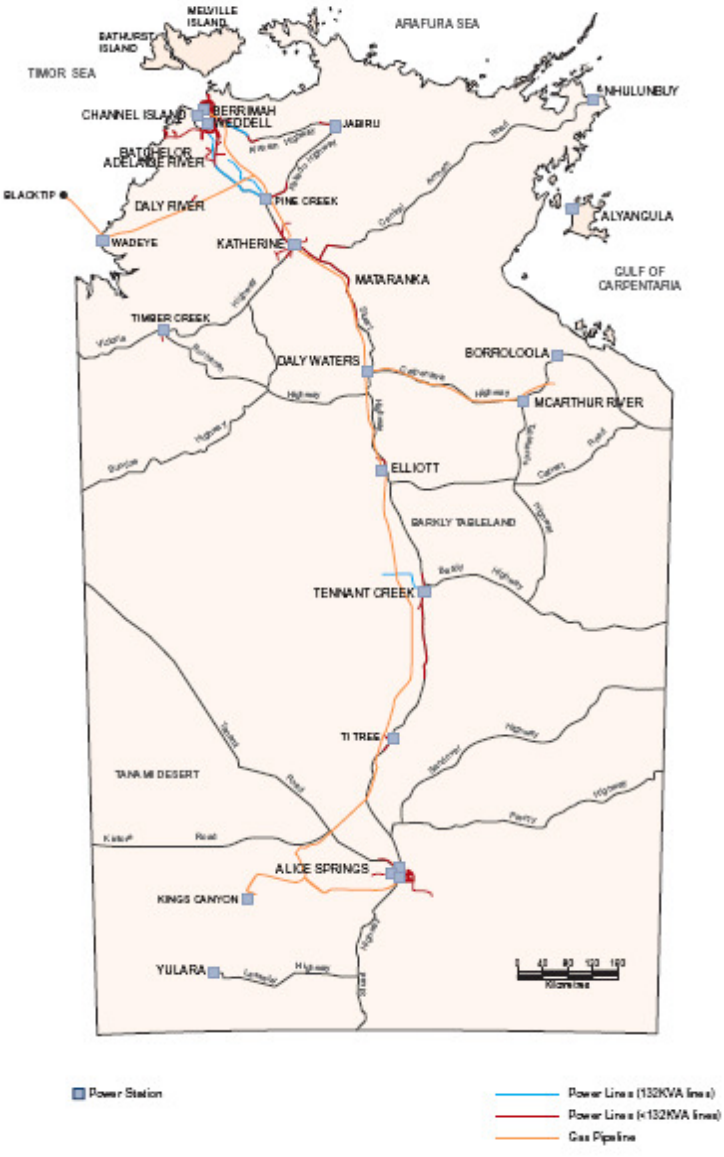
CHAPTER 3

Power System Overview

3.1 This chapter provides an overview of Darwin-Katherine, Alice Springs and Tennant Creek systems. The chapter also discusses significant power system events in 2008-09 year and the six months to December 2009.

3.2 Chart 3.1 shows the location of energy supply infrastructure in the Darwin-Katherine, Alice Springs and Tennant Creek systems, and in some of the regional and remote areas of the Territory.

Chart 3.1: Northern Territory power system infrastructure



Source: Utilities Commission, Northern Territory Treasury and Power and Water Corporation.

Power system information

3.3 Table 3.1 provides an overview of the Darwin-Katherine, Alice Springs and Tennant Creek systems for 2008-09.

Table 3.1: Power system data for 2008-09 (at 30 June 2009)

	Darwin-Katherine	Alice Springs	Tennant Creek
Connections (customer numbers)	58 319	12 109	1 709
Generation (rated) capacity (megawatts)	370	63	17
Peak demand (megawatts)	267	54.4	7.3
Electricity sent out (gigawatt hours for 2008-09)	1 341	216	26
Network line length (kilometres)	4 773	603	373
Licencees			
Generation	PWC Generation NGD (NT) P/L Cosmo Power P/L LMS Generation P/L	PWC Generation Central Energy Power	PWC Generation
Network	PWC Network	PWC Network	PWC Network
Retail	PWC Retail	PWC Retail	PWC Retail

Source: Electricity industry participants; and Utilities Commission licence register. The table only relates to the market systems.

3.4 PWC is the primary industry participant in the market systems, generating the majority of electricity, operating the network and supplying retail services to all customers.

3.5 PWC is a vertically integrated electricity supplier which also provides water supply and sewerage services. PWC's generation, network and retail units operate as separate businesses with internal transactions between units subject to oversight and regulation by the Commission. PWC is owned by the Territory Government and is also subject to oversight by a shareholding Minister under the *Government Owned Corporations Act*.

3.6 The other industry participants are the three licensees generating electricity in the Darwin-Katherine system, and a further licensee generating electricity in the Alice Springs system. These four licensees have historically generated electricity under power purchase agreements with PWC. This remained the case in 2008-09. However, the Commission understands that the agreement with Cosmo Power Pty Ltd ended in 2008-09, but that the 7.5 MW of capacity remains available to supply electricity into the Darwin-Katherine system, at this time.

3.7 Additional information on these four licensees is provided in Chapter Four.

Significant power system events

3.8 The Commission identified the following events that occurred during 2008-09 and in the period to December 2009 that influenced power system performance:

- Casuarina zone substation failures in September and October 2008;
- announcement of a Remedial Asset Management Program (RAMP) by PWC Networks in early 2009;
- availability of new capacity in the Darwin-Katherine system from Weddell power station stage two in early 2009 and the start of construction of Owen Springs power station in the Alice Springs system; and
- energy infrastructure projects that diversified the sources of fuel for electricity generation in the market systems.

Casuarina zone substation failures

3.9 The northern suburbs of Darwin experienced six power outages in September and October 2008 following equipment failures in and around Casuarina zone substation. About 15 000 customers were affected, many more than once, with the most significant outage causing more than 11 000 customers to lose power for up to 14 hours.

3.10 In response to the community disruption and concern about the performance of PWC's electricity network assets, the Territory Government commissioned Mervyn Davies, a former senior executive of Energy Australia and a member of the Board of Western Power, to undertake the Independent Enquiry into Casuarina Substation Events and Substation Maintenance Across Darwin (the Davies Enquiry). A Preliminary Report was released in November 2008, and the Final Report in February 2009.[5]

3.11 The Davies Enquiry found serious deficiencies in PWC's procedures for monitoring and reporting the condition of assets, and maintenance practices were assessed as below the standard for good industry practice. The Davies Enquiry made 11 major recommendations about PWC's electricity networks and assets, focusing on maintenance effectiveness, asset management, leadership and supervision and personnel development.[6]

Remedial asset management program

3.12 The Territory Government and PWC accepted all the recommendations of the Davies Enquiry. PWC's immediate response was to establish the RAMP to ensure safe access to substations, carry out remedial works and replace the failed equipment at the Casuarina zone substation. PWC also continued efforts to improve asset management systems and capability, and initiated a long term action plan to improve PWC's maintenance and asset management operations for the long term.

3.13 RAMP involves a significant investment by PWC in maintenance and remediation of network assets to meet acceptable standards of reliability and safety. The investment

[5] Refer Power and Water Corporation website, www.powerwater.com.au for these reports.

[6] Refer statement from Minister for Essential Services on 5 February 2009: Announcement of Release of Davies Enquiry Final Report.

is additional to the capital expenditure program of over $1 billion announced by PWC in 2007-08 to augment and upgrade electricity, water and sewerage assets.

Weddell power station and Owen Springs power station

3.14 The Weddell power station stage one was completed in February 2008 with the commissioning of a GE LM6000 PD gas fuelled combustion turbine. Weddell power station stage two was completed in November 2008 with the commissioning of a second GE LM6000 PD gas fuelled combustion turbine. PWC advised the Commission in November 2009 that the sustainable installed capacity of these two sets is 86 MW, representing about 17.7 per cent of capacity in the Darwin-Katherine system. The Weddell power station is the largest electricity generation project undertaken in the market systems in 20 years and is intended to meet increasing base load and peak demand in the Darwin-Katherine system.

3.15 The Commission notes that both Weddell sets appear to have experienced initial operating problems that led to a number of unplanned shutdowns in 2009. The effect of this on overall system reliability appears to have been exacerbated by the unplanned shutdown of generation sets at the Channel Island power station in the same period.

3.16 The Owen Springs power station was under construction in 2008-09. The power station is intended to meet increasing peak demand and will eventually replace the ageing Ron Goodin power station as the major power station in the Alice Springs system. Following complaints from nearby residents of excessive noise, PWC announced that it would relocate two new sets from the Ron Goodin power station to Owen Springs power station.

New sources of fuel for electricity generation

3.17 Natural gas from the Amadeus Basin gas fields in central Australia has been the primary fuel for electricity generation in the Darwin-Katherine, Alice Springs and Tennant Creek systems since the mid-1980's. However, the production of gas from these fields has been declining since the late 1990's, and alternative fuel sources are required to meet electricity demand.

3.18 In June 2006, Eni Australia B.V. (Eni) agreed to supply PWC with 740 petajoules (PJ) of gas over 25 years from the Blacktip field in the Bonaparte Gulf. Under this agreement, gas from the Blacktip field was to replace gas from the Amadeus Basin fields as the primary fuel for electricity generation in the Territory's power systems from 1 January 2009. However, supply was delayed until late 2009, with delays being mainly attributed by Eni to difficulties sourcing components on time and extreme weather conditions. The Commission understands that full specification gas was supplied in sufficient volumes to meet PWC's from mid January 2010.

3.19 PWC was able to reduce the risk of a potential shortfall in gas for electricity generation caused by the delay in availability of Blacktip gas by purchasing gas from the Darwin liquefied natural gas (DLNG) plant. This gas was available from July 2009 after construction of a pipeline connecting the DLNG plant to the Darwin city gate gas hub. In addition, PWC reached agreements with Eni and the pipeline companies involved in transporting gas from the Eni gas processing plant at Wadeye to PWC's power stations to allow some Blacktip gas to be used from October 2009, despite the gas not being fully processed to specifications agreed by PWC and Eni. This reduced PWC's requirement for more costly diesel fuel.

3.20 During 2008-09, PWC used about 1.1 petajoules of diesel to augment constricted gas supplies, with diesel accounting for about 5.4 per cent of total fuel used for electricity generation. The balance of the fuel requirement was met by gas from the Amadeus basin fields. The use of diesel enabled PWC to generate sufficient power to meet demand, but at a significantly higher cost.

3.21 The Commission considers that the projects completed or commenced in 2008-09 will significantly improve security of fuel supply across the Territory by increasing the number of fuel sources. From the December quarter 2009, fuel for electricity generation was available, in varying quantities and quality, from the previous sources of the Amadeus Basin fields and liquid fuels, and the new sources of the Blacktip field and the DLNG plant.

CHAPTER 4

Electricity Generation

4.1 This chapter examines the capacity and performance of electricity generation in the Darwin-Katherine, Alice Springs and Tennant Creek systems.

4.2 In addition to the historical and forecast electricity supply-demand data included in previous Reviews to meet the requirements of the *Electricity Reform Act*, this chapter also reports electricity generation performance data submitted by PWC under the Standards of Service Code. This chapter is structured as follows:

- historical electricity usage, demand and generation capacity (supply);
- forecast supply-demand balance for 2009-10 to 2018-19;
- generation standards of service performance data; and
- adequacy of the supply of fuel for electricity generation.

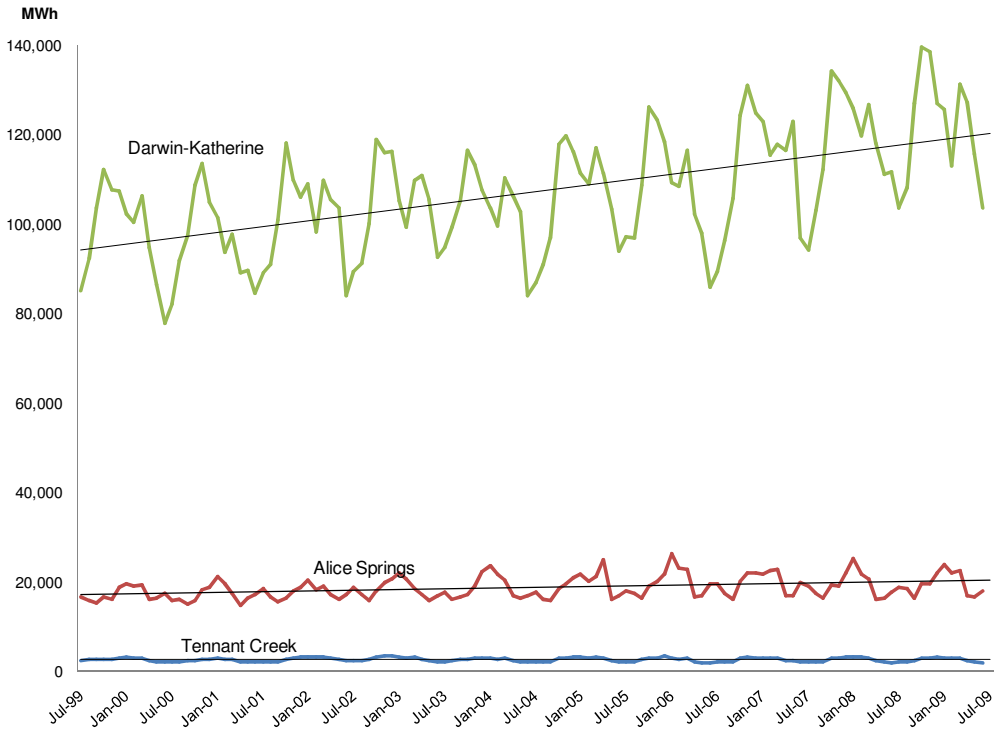
Historical electricity usage

4.3 The Commission is using electricity sent out to represent electricity usage in the market systems.[7] Chart 4.1 provides monthly electricity usage in the Darwin-Katherine, Alice Springs and Tennant Creek systems between July 1999 and June 2009.

4.4 The chart shows the relative size of the Darwin-Katherine, Alice Springs and Tennant Creek systems. The Darwin-Katherine system accounted for 84.7 per cent of total electricity usage in the market systems in 2008-09, with the Alice Springs and Tennant Creek systems accounting for 13.6 per cent and 1.7 per cent respectively.

[7] Electricity sent out is defined as electricity generated, less electricity used in the power station. Electricity demand can also be measured as electricity generated (by the generating sets) and electricity used (by the customer), which is electricity sent out, less system losses.

Chart 4.1: Electricity sent out from July 1999 to June 2009 (monthly)



Source: Electricity industry participants. A linear trend line is overlaid on the data to better show the change in consumption over time.

4.5 Electricity use in 2008-09 in the Darwin-Katherine system increased by 3.0 per cent from 2007-08. Average electricity use has increased by 2.0 per cent per year since 1999-00, and by 4.2 per cent per year since 2006-07. The highest recorded total monthly use in the Darwin-Katherine system since June 1999 was 139 485 megawatt hours (MWh) in October 2008. Notably, total monthly use has not fallen below 100 000 MWh since August 2007.

4.6 Electricity use in the Alice Springs system in 2008-09 increased by 1.8 per cent from 2007-08. Average electricity use has increased by 1.2 per cent per year in the Alice Springs system since 1999-00, but has declined by an average 0.9 per cent per year since 2006-07.

4.7 Although not obvious in Chart 4.1 due to the chart scale, electricity use in the Tennant Creek system has varied significantly since 1999-00. Electricity use increased by 0.8 per cent in 2008-09 from the previous year, going against the average annual decline of 0.2 per cent per year since 2001-02. Electricity use has been increasing since 2007-08.

4.8 Electricity use in the market systems in 2008-09 was 21.7 per cent higher than in 1999-00, with electricity use 24.2 per cent higher in the Darwin-Katherine system, and 11.7 per cent higher in the Alice Springs system. Electricity use in the Tennant Creek system was 1.3 per cent lower.

4.9 The increase in use in the past 10 years is attributed to rapid population and economic growth in the Territory, and particularly the high levels of resource, engineering and

construction activity in the Darwin region. For example, the population of the greater Darwin and Katherine regions increased by about 12.7 per cent between 2001 and 2008, from 115 803 to 130 564.[8] The Commission recognises that increased system losses may occur as a result of the growth in electricity use, this will be investigated and reported in future Reviews.

4.10 Electricity use in the Tennant Creek system is likely to be closely linked to global commodity prices and the associated fortune of a number of small mines around the town. Population growth has been about 16.3 per cent between 2001 and 2008, but this is from a small base of 3 002 to 3 494. However, stop start industrial and mining activity in the region has kept average electricity use at a relatively constant level.

Residential and business usage

4.11 Average residential electricity use for each jurisdiction is compared in Chart 4.2 below. The national average residential electricity use is 7 159 kilowatt hours (KWh) per annum. Residential electricity customers in Tasmania have the highest average use of jurisdictions, with 9 059 KWh per annum, while the average use of 8 859 KWh per annum in the Territory is the second highest.

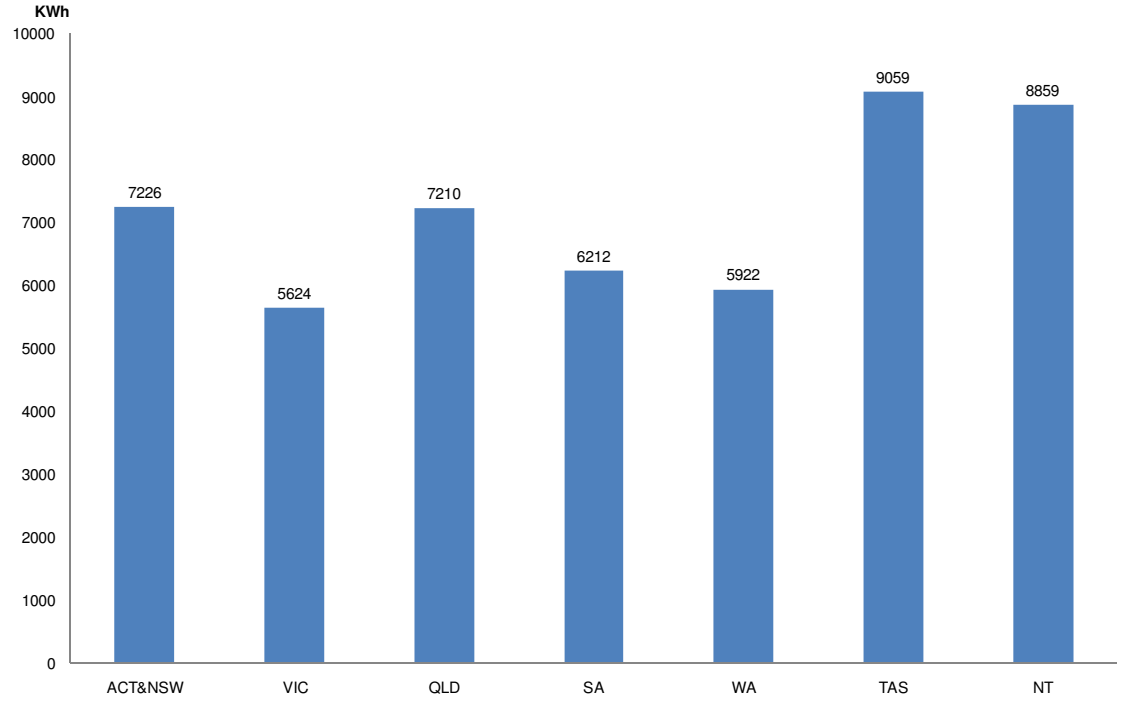
4.12 The high use in the Territory can probably be attributed to the use of air-conditioning. For example, Darwin has the highest penetration of air-conditioner usage in Australia of Australian capital cities, estimated at 92 per cent in 2005.[9]

4.13 Average residential electricity use for Australian jurisdictions is compared in Chart 4.2.

[8] Northern Territory Treasury, 2009-10 Budget, Northern Territory Economy, page 31; and Australian Bureau of Statistics (ABS) Catalogue 3218.0.

[9] Ministerial Council on Energy, Cost Benefit Analysis of Smart Metering and Direct Load Control, page 125.

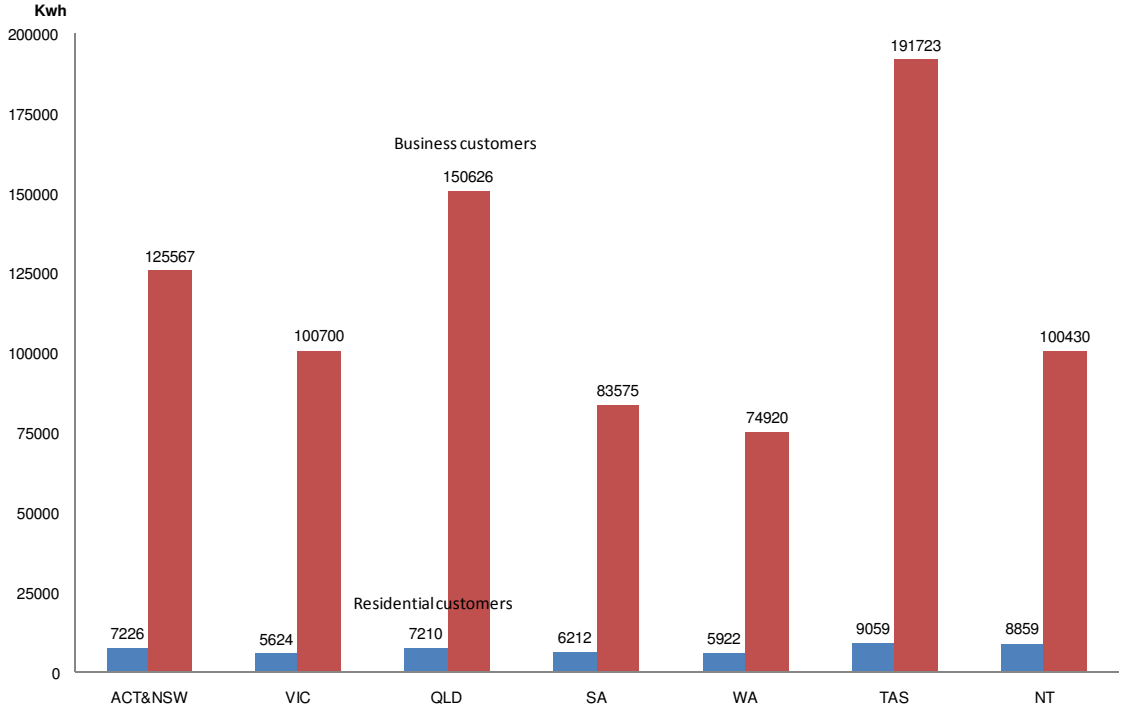
Chart 4.2: Average residential electricity use for 2007-08



Source: ESAA, Electricity Gas Australia 2009, page 27, tables 3.2 and 3.3. The most recent comprehensive data set available is for 2007-08.

4.14 Average residential and business electricity use for Australian jurisdictions is compared in Chart 4.3 below.

Chart 4.3: Average residential and business electricity use for 2007-08



Source: ESAA, Electricity Gas Australia 2009, page 27, tables 3.2 and 3.3. The most recent comprehensive data set available is for 2007-08.

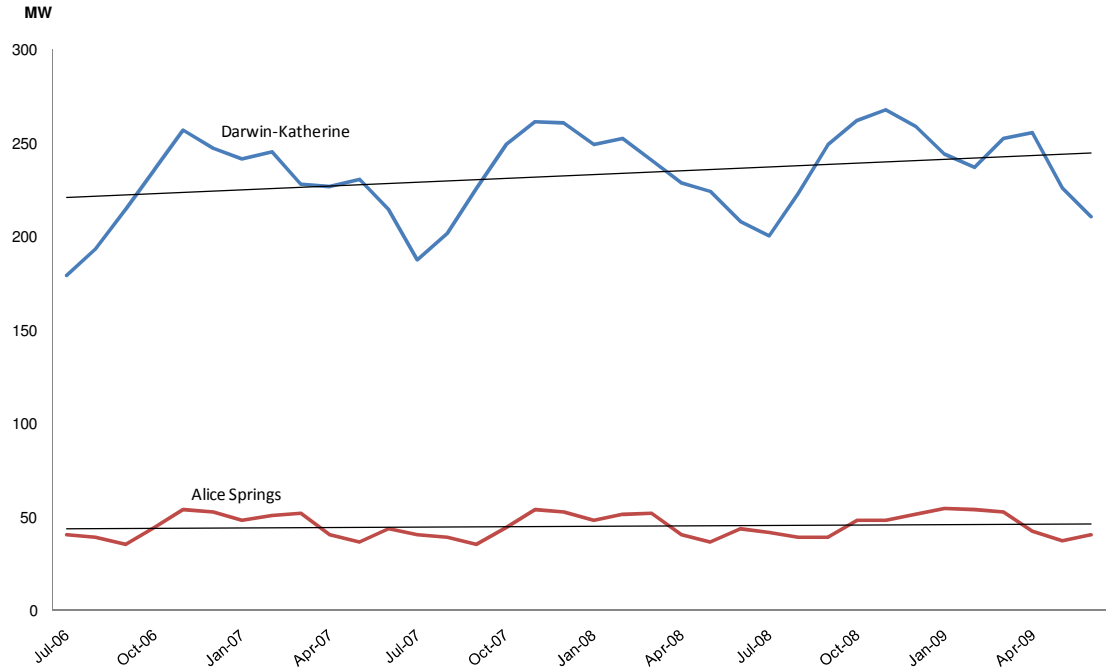
4.15 Business electricity use comprises over 60 per cent of total residential and business use in each jurisdiction. More recent data for 2008-09 is available for the Territory, with business accounting for about 64 per cent of electricity use in 2008-09.

4.16 Average electricity use by businesses is likely to be affected by the range of usage profiles, from very large industrial users to small shops. However, Chart 4.3 does highlight the relative significance of residential and business electricity use across jurisdictions.

Historical electricity demand

4.17 The maximum monthly peak electricity demand in the Darwin-Katherine and Alice Springs systems for July 2006 to June 2009 is shown in Chart 4.4 below.

Chart 4.4: Electricity maximum monthly peak demand for Darwin-Katherine and Alice Springs systems for 2006-07 to 2008-09



Source: Electricity industry participants. A linear trend line is overlaid on the data to better show the change in maximum monthly demand over time.

4.18 Generation peak demand in the Darwin-Katherine system increased by 2.4 per cent between 2007-08 and 2008-09. Peak demand has increased by 22.5 per cent between 1999-00 and 2008-09, at an average of 2.1 per cent per year.

4.19 The increase in peak demand in the Alice Springs system between 2007-08 and 2008-09 was about 0.1 per cent. The average annual rate of peak demand growth between 2001-02 and 2008-09 is about 2.7 per cent.

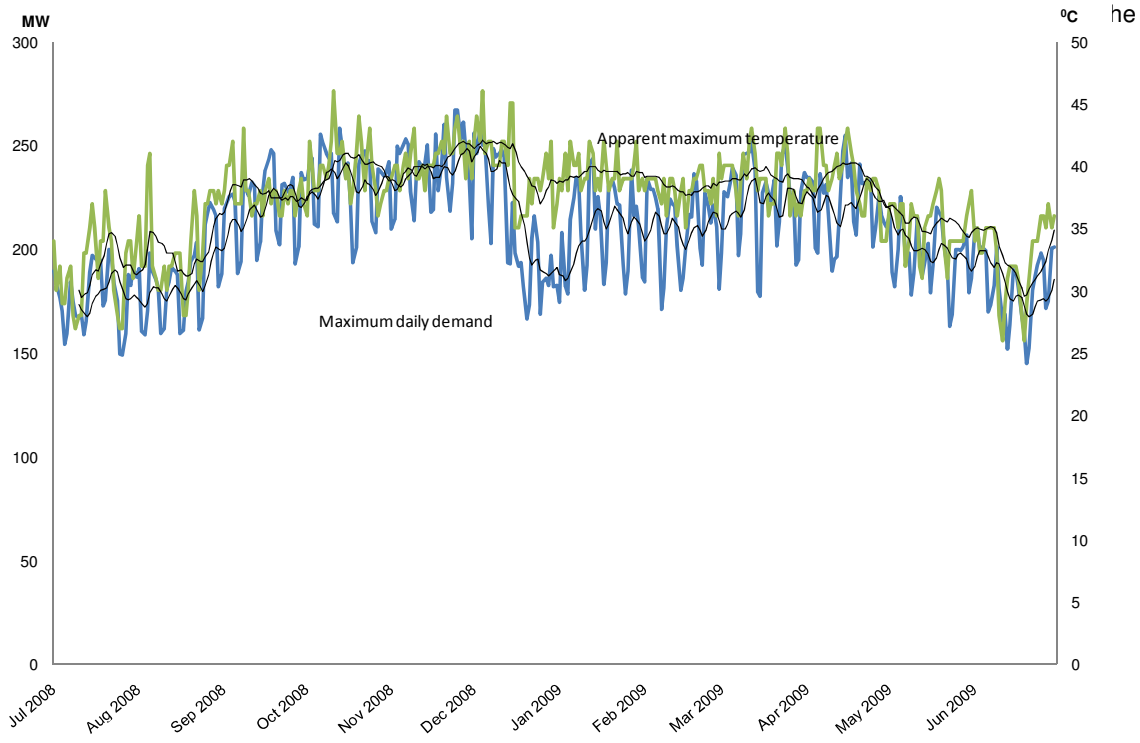
4.20 Peak demand increased by 5.7 per cent in the Tennant Creek system between 2007-08 and 2008-09. The average annual rate of peak demand growth between 2001-02 and 2008-09 is 2.5 per cent.

Seasonal variation in peak demand

4.21 The Darwin-Katherine and Alice Springs systems experience a significant seasonal variation in peak demand. Chart 4.5 highlights the significant rise and fall in electricity demand in the Darwin-Katherine system between the wet and dry seasons for 2008-09. The average percentage seasonal change over 2006-07 to 2008-09 is 24.5 per cent.[10] The Alice Springs system also experiences large variation in seasonal electricity demand, with the average percentage change in the same period being 27.6 per cent.

4.22 Chart 4.5 also illustrates the relationship between apparent temperature for Darwin and daily peak electricity demand in the Darwin-Katherine system for 2008-09.[11] Average apparent temperature is preferred over the recorded daily temperature because this takes into account the similar (if not greater) debilitating effect on a persons comfort of the high humidity experienced in Darwin in the wet season compared to the often higher summer time maximum daily temperatures in other capital cities in Australia.

Chart 4.5: Daily peak demand and apparent maximum temperature for Darwin in 2008-09



4.23 Bureau of Meteorology records indicate that Darwin has the highest minimum and lowest maximum temperatures of all Australian capital cities. The relatively high and relatively constant temperatures (typical of the sub-tropical monsoonal climate) influence household electricity use, in particular through high use of air-conditioning.

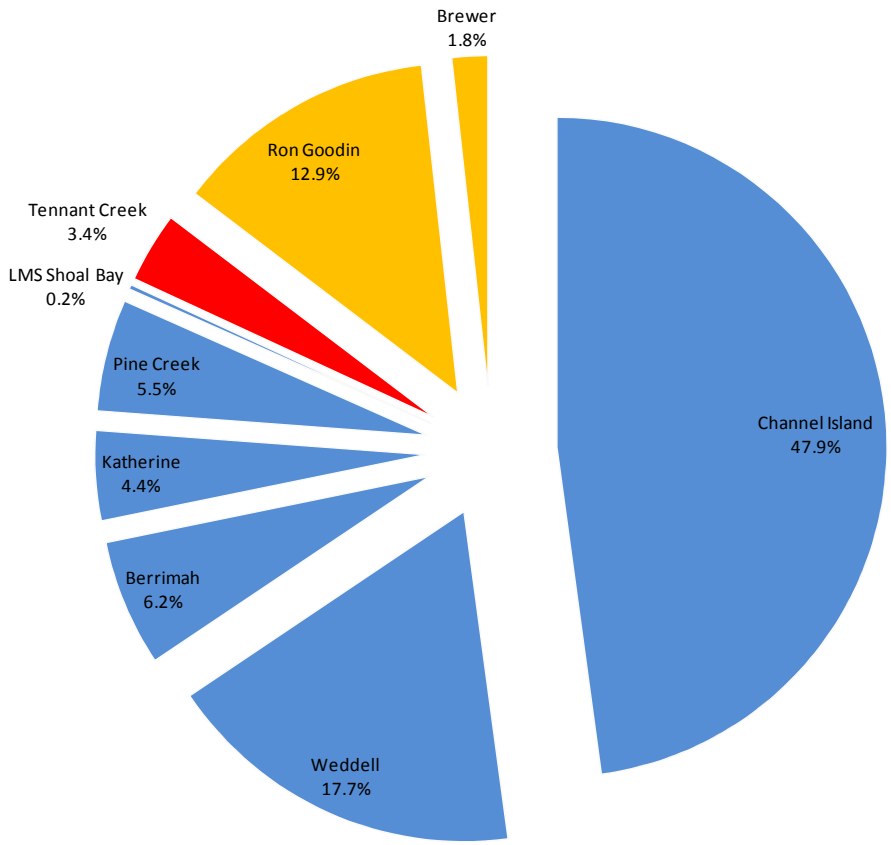
[10] Calculated as the average percentage change between July ("the dry") and January ("the wet") of the relevant years.

[11] The apparent temperature is calculated by comparing the mean daily maximum temperature and the mean 3pm relative humidity (Steadman Apparent Temperature Index). Refer Bureau of Meteorology website, www.bom.gov.au for methodology.

Generation capacity

4.24 Electricity supplied in the Darwin-Katherine, Alice Springs and Tennant Creek systems is generated by PWC Generation and four other licensed generation suppliers with agreements to supply PWC. Chart 4.6 shows the percentage of total registered generation capacity at each power station operating in the Territory electricity market.

Chart 4.6: Power station capacity as percentage of registered capacity (MW), at 30 June 2009



Source: Utilities Commission licence register and electricity supply industry participants. Note: chart reports capacity data for regulated systems only.

4.25 About 82 per cent of total generation capacity in the market systems is located in the Darwin-Katherine system, with about 48 per cent at the Channel Island power station. The next most significant power station in the market systems is the Weddell power station (also in the Darwin-Katherine system), with almost 18 per cent of capacity. About 15 per cent of total generation capacity is located in the Alice Springs system and 3 per cent in the Tennant Creek system.

4.26 More detail for each power station is given in table 4.1 below.

Table 4.1: Power stations in the market systems at 30 June 2009

Region and power station	Operator	Capacity (MW)	Fuel
Darwin Katherine			
Channel Island	PWC	232	Natural gas or liquid fuel
Weddell	PWC	86	Natural gas or liquid fuel
Berrimah	PWC	30	Natural gas or liquid fuel
Katherine	PWC	21	Natural gas or liquid fuel
Pine Creek	NGD(NT) Cosmo Power	35	Natural gas or liquid fuel
LMS Shoal Bay	LMS Generation	1	Waste Methanisation
Total		**405**	
Alice Springs			
Ron Goodin	PWC	63	Natural gas or liquid fuel
Brewer	Central Energy Power	9	Natural gas or liquid fuel
Total		**72**	
Tennant Creek			
Tennant Creek	PWC	**17**	Natural gas or liquid fuel
Total Capacity		**494**	

Source: Electricity industry participants. Note: Capacity figures include currently non-contracted capacity available from Cosmo Power Pty Ltd. Figures have been rounded upwards to the nearest whole number.

4.27 The sustainable installed capacity of the Channel Island power station, as reported by PWC to the Commission in November 2009 is 232 MW, comprising five GE Frame 6 gas or diesel fuelled combustion turbines (sets 1-5) with a capacity of 31.6 MW each, one GE LM6000 PC gas fuelled combustion turbine (set 7) with a capacity of 42 MW, and one Mitsubishi steam turbine (set 6) with a capacity of 32 MW. The steam turbine uses waste heat from two of the GE Frame 6 turbines (sets 4 and 5).

4.28 Each of the sets at Channel Island represents at least 7 per cent of capacity in the Darwin-Katherine system. However, two of the GE Frame 6 turbines (sets 4 and 5) and the steam turbine (set 6) can operate as a 95 MW block, representing about 23 per cent of capacity in the system. A shutdown of set 4 or 5 apparently reduces the capacity of the block to about 45 MW, as the remaining combustion turbine producing only enough heat for the steam turbine to generate about 15 MW.

4.29 The Commission understands that set 5 has been shut down for much of 2009 for maintenance, reducing total system capacity by about 45 MW, or 11 per cent, and effectively taking the equivalent of the largest unit of capacity out of service.

4.30 PWC reports that the Weddell power station has a sustainable installed capacity of 86 MW, comprising two GE LM6000 PD gas fuelled combustion turbines of 42 MW (set 1) and 44 MW (set 2). These sets are the largest individual units of capacity in the system, with each representing about 10 per cent of total capacity in the

Darwin-Katherine system. In this context, the loss of just one set has significant implications for system security and reliability.

4.31 PWC has power purchase agreements with NGN (NT) Pty Ltd, Cosmo Power Pty Ltd (subsidiaries of Energy Developments Ltd), Central Energy Power Pty Ltd and LMS Generation Pty Ltd. These four firms currently operate generation equipment with capacity of about 44 MW, or potentially about 9 per cent of total generation capacity of the market systems. The Commission understands that not all this capacity is currently in use, with the contract with Cosmo Power Pty Ltd ending in 2008-09 reducing the notional generation capacity by 7.5 MW. However, the Commission understands that PWC has the ability to use this capacity, at this time.

4.32 PWC supplies the natural gas used by the first three firms listed as fuel for electricity generation, and takes all their production, subject to the terms of power purchase agreements. LMS Generation uses methane released at the Darwin City Council Shoal Bay rubbish dump as a fuel for electricity generation.

4.33 The Ron Goodin power station in Alice Springs had a sustainable installed capacity of 63 MW as at 30 June 2009, comprising three reciprocating diesel engines (sets 1, 2 and J) with a combined capacity of 4 MW, six reciprocating dual fuel (gas and diesel) engines (sets 3-8) with a combined capacity of 29 MW, four combustion turbines (sets 9, 10, F and G) with a combined capacity of 26 MW and a 4 MW Taurus combustion turbine, which PWC advises has since been relocated to the Owen Springs power station.

4.34 The sustainable installed capacity of the Tennant Creek power station is 17 MW which comprises seven reciprocating diesel engines (sets 1-5, 16 and 17) with a combined capacity of 8 MW, five reciprocating spark fired gas engines (sets 10-14) with a combined capacity of 5 MW and a dual fuel (gas and diesel) combustion turbine (set 15) with a capacity of 4 MW.

Changes to capacity in 2008-09

4.35 Based on advice from PWC in November 2009, the most significant change to generation capacity in the market systems in 2008-09 was the commissioning of the 44 MW GE LM6000 PD turbine (set 2) at the Weddell power station in November 2008.

4.36 The Weddell power station is the largest electricity generation project undertaken by PWC in 20 years and is intended to meet increasing base load and peak demand in the Darwin-Katherine system. The Commission has been advised of plans by PWC for further expansion of the station, with the addition of a further generation set in the short to medium term. The Commission has been advised that PWC has started procurement of equipment and other requirements for this expansion, with completion expected in 2011.

4.37 Other changes to capacity in the Darwin-Katherine system in 2008-09 compared to 2007-08 were:

- the capacity of the Channel Island power station was increased by 6 MW to 232 MW after PWC exchanged the engine on the GE LM6000 PC (set 7);
- PWC did not de-commission the 15 MW set 1 at Berrimah power station in 2008-09 as was foreshadowed in the 2007-08 Review. PWC advised in November 2009 that this set will be de-commissioned in 2009-10; and

- the power purchase agreement with Energy Developments Pty Ltd for electricity from Pine Creek B power station (operated by Cosmo Power Pty Ltd) ended in 2008-09, removing a notional 7.5 MW from the Darwin-Katherine system. This capacity can be made available for system use when required. The Commission understands that PWC agreed to a short term supply arrangement with Energy Developments for December 2009.

4.38 In the Alice Springs system, the Owen Springs power station (to be owned and operated by PWC) was under construction in 2008-09. The station is intended to meet increasing peak demand and will eventually replace the ageing Ron Goodin power station as the major power station in the Alice Springs system. A 3.9 MW Solar Taurus 60 gas or diesel combustion turbine was relocated from Ron Goodin to Owen Springs in June 2009. The Commission has been advised that the Owen Springs power station will be commissioned and operating in 2010-11.

4.39 In the Tennant Creek system, the capacity of the power station increased marginally to 16.7 MW after engine modifications to two of the 11 diesel and gas fuelled reciprocating diesel/reciprocating spark fired engines at the Tennant Creek power station.

Baseline capacity projections

4.40 Tables 4.2 to 4.4 outline the proposed changes to capacity the Commission has been advised by PWC will occur in 2009-10 to 2011-12 in the Darwin-Katherine, Alice Springs and Tennant Creek systems.

4.41 The baseline capacity projections take into account planned new capacity and retirements for a system, to project the total capacity, and N-1 and N-2 capacity. N-1 and N-2 are indicators of the available capacity following the loss of the largest and largest two units of capacity in a system, respectively.

4.42 The Commission cautions that the timing of the retirement and addition of capacity can vary in response to commercial priorities of electricity industry participants and changing electricity peak demand forecasts. For example, the Commission notes that PWC postponed the de-commissioning of 15 MW of capacity at the Berrimah power station by a year. Other proposed changes to capacity advised to the Commission for preparation of the 2007-08 Review do not appear to be proceeding as planned (e.g. the augmentation of Katherine power station planned for 2009-10 appears now scheduled for 2010-11).[12]

4.43 Due to the uncertainty about the timing, and also the location and size, of proposed changes to generation capacity, the Commission has chosen not to list any retirements or augmentation advised by electricity industry participants after 2011-12 in the baseline capacity projections.

4.44 Baseline capacity projections for the Darwin-Katherine, Alice Springs and Tennant Creek systems for 2009-10 to 2011-12 are provided in the tables below.

[12] Refer Utilities Commission, 2007-08 Power System Review, March 2009, pages 27-29, tables 5.2, 5.3 and 5.4.

Table 4.2: Darwin-Katherine baseline capacity projection (MW), 2009-10 to 2011-12

Financial Year	Retirements	New Capacity	Total Capacity	N-1	N-2
2009-10	15		382	334.4	286.8
2010-11		12.1	394.1	346.5	298.9
2011-12	15	30	409.1	361.5	313.9

Source: Electricity industry participants.

4.45 The capacity projection for the Darwin-Katherine system for 2009-10 to 2011-12 takes into account advice to the Commission from PWC in November 2009 that capacity will be added at the Katherine and Weddell power stations in 2010-11 and 2011-12, respectively, and that the two units at Berrimah power station will be retired from service by 2011-12. There is a net increase of 27.1 MW between 2010-11 and 2011-12.

Table 4.3: Alice Springs baseline capacity projection (MW), 2009-10 to 2011-12

Financial Year	Retirements	New Capacity	Total Capacity	N-1	N-2
2009-10			71	59.3	49.2
2010-11	14	32.1	89	77.3	66.6
2011-12			89	77.3	66.6

Source: Electricity industry participants.

4.46 The capacity projection for the Alice Springs system takes into account advice to the Commission from PWC that 32.1 MW will be added with the commissioning of the Owen Springs power station in 2010-11, and that 14 MW at the Ron Goodin power station will be relocated or retired in the same year. There is a net increase of 18 MW by the end of 2010-11. The Commission is advised that a 10 MW turbine from Ron Goodin is to be relocated to the Katherine power station in 2010-11.

Table 4.4: Tennant Creek baseline capacity projection (MW), 2009-10 to 2011-12

Financial Year	Retirements	New Capacity	Total Capacity	N-1	N-2
2009-10			16.7	12.8	11.3
2010-11			16.7	12.8	11.3
2011-12			16.7	12.8	11.3

Source: Electricity industry participants.

4.47 PWC has advised the Commission that there are no changes to capacity in the Tennant Creek system planned for the period 2009-10 to 2011-12.

4.48 The Commission is not aware of any other committed projects that will change generation capacity in the market systems capacity in the period 2009-10 to 2011-12.

Indicators of system capacity

4.49 In previous Reviews, the Commission has compared three indicators of generation capacity against forecast electricity peak demand to estimate the future supply-demand balance for the market systems. These indicators are:

- total capacity in MW, which is the capacity of all units of generation in the power system;
- N-1 capacity in MW, which excludes the largest unit of generation in the system from the total capacity; and
- N-2 capacity in MW, which excludes the largest two units of generation in the system from the total capacity.

4.50 The Commission considers that the N-1 and N-2 standard for assessing the appropriate reserve capacity that should be maintained in a system is a basic indicator of the potential risks to system security. An N-2 standard means that peak demand can be met even if the largest two generators are not in service. However, scheduled maintenance outages and network outages reduce the ability of the system to meet peak load in the event of unscheduled loss of generation. Environmental factors such as prolonged high temperatures may also reduce the available generation capacity, as increased temperatures adversely affect a generator's production.

4.51 Additionally, an informed assessment of the adequacy of system capacity should take account of the maintenance history and condition of generating plant, the potential for major equipment failure with extended replacement times, the duration and timing of planned overhauls and maintenance, the frequency of unplanned outages and the level of redundancy in supporting systems.

4.52 For example, the Commission notes system performance data provided by the System Controller indicating reliability problems at the Weddell and Channel Island power stations that resulted in a number of unplanned outages during 2009, and particularly with the onset of the wet season. The Commission understands that initial operating problems at Weddell led to a number of unplanned outages, and that the effect of these problems on overall system reliability appears to have been exacerbated by the unplanned shutdowns (with the exact cause or extent of any potential problems not yet known to the Commission) at Channel Island.

4.53 The Commission understands that unplanned maintenance was occurring at Channel Island during 2009 that may have extended the time needed to bring reserve capacity into service to meet demand when there was an unplanned outage. This suggests that during a period of peak seasonal demand the Darwin-Katherine system was operating at significantly lower levels of reserve capacity than would be considered desirable.

4.54 The Commission notes that there is no statutory definition of security of supply or the methodology for determining the reserve capacity needed to maintain an acceptable level of security of supply, or any obligation for the Commission to use the N-1 and N-2 standard.

4.55 PWC's Statement of Corporate Intent (SCI), which is a contract between the shareholding Minister and PWC about technical and financial performance, has been developed using the N-2 criterion for generation. As such, there is a case for accepting that the N-2 standard is a reasonable measure. However, the Commission will be assessing the suitability of the standard as part of the upcoming System Planning Monitoring and Reporting Review to be conducted under terms of reference from the

Treasurer. As part of this review, the Commission will assess the feasibility of aligning security and reliability of supply standards used in the Territory with National Electricity Market (NEM) equivalents, which will assist with cross jurisdictional comparisons.

4.56 The Commission also notes that high system loads occur over long periods, with the implication that load may be at risk for long periods when generation is not available.

4.57 The Commission intends examining the type and detail of information that should be available from, and for, electricity industry participants and others during 2010. For example, the Commission notes that detailed information on the planned augmentation and retirement of generation capacity is reported in the annual Statement of Opportunities released by the AEMO.[13] The Commission will be examining this issue in 2010, and expects to provide a more comprehensive analysis of baseline capacity projections and the appropriate reserve capacity that should be maintained for each power system in future Reviews.

Demand forecasts

4.58 The 2008-09 Review examines prospects for electricity demand in the market systems for the 10 years to 2018-19, focusing on demand forecasts for the medium term, for the four years 2009-10 to 2012-13, and for the long term, for the period 2013-14 to 2018-19.

4.59 In a break with the approach in previous Reviews, the Commission has not independently tested the accuracy of the demand forecasts, opting instead to develop forecasts by testing the sensitivity of forecasts by electricity industry participants. In future years, the Commission will revert to adopting its own forecasts, based on forecasts of economic activity and other indicators. The nature of generation in the Territory is such that additional capacity can be procured relatively quickly should high growth emerge. The Commission will also test in future Reviews electricity industry participant's preparation, by way of environmental and other approvals, for augmentation.

Methodology and assumptions for demand forecasts

4.60 To assist the Commission in preparing the 2008-09 Review, PWC provided the Commission with information on methodology and assumptions used to forecast demand. Based on this data, the Commission understands that PWC used a baseline generation peak demand growth rate of 2.4 per cent per year for the Darwin-Katherine system, and one per cent per year for the Alice Springs and Tennant Creek systems.[14] PWC has advised that these growth rates are consistent with the forecast growth in electricity sales used in the 2009-10 SCI prepared by PWC for the shareholding

[13] Refer Australian Energy Market Operator website, www.aemo.com.au for this report.

[14] Data response provided to the Commission by the Power and Water Corporation on 23 November 2009.

Minister.[15] PWC also appears to assume an equivalent growth rate for electricity use and generation peak demand.[16]

4.61 PWC has advised the Commission that the main assumptions being used to prepare the demand forecasts for developing the 2010-11 SCI are:

- customer number and consumption data is that reported for 2008-09;
- the customer growth rate is consistent with Australian Bureau of Statistics projections of population growth; and
- energy consumption growth rates are based on a 'medium' growth rate scenario that is supported by historical trend analysis. The average annual consumption growth rate is 1.99 per cent for Darwin-Katherine, 0.97 per cent for Alice Springs and 0.65 per cent for Tennant Creek.

4.62 The relatively small size of market systems means that major industrial or mining projects can have a significant effect on electricity demand. As such, demand forecasts must take into account the likelihood and timing of major projects. For the 2008-09 Review, PWC has advised that although a number of major projects are mooted, the respective proponents have not provided sufficiently firm demand projections or otherwise signaled a firm timeframe for requiring an electricity supply. On this basis, PWC has not considered demand from any major projects in forecasting demand and generation capacity requirements.

Baseline demand forecast

4.63 The Commission is adopting the PWC forecast for baseline demand growth of 2.4 per cent per year for the Darwin-Katherine system, and 1 per cent per year for the Alice Springs and Tennant Creek systems.

4.64 These baseline demand growth rates are used to provide medium and long term baseline demand growth scenarios for each system.

High and low demand growth scenarios

4.65 In addition to the baseline forecast, the Commission is adopting the average annual demand growth rates in table 4.5 to provide high and low demand growth scenarios.

4.66 These scenarios are used to assess the possible effect on demand of stronger and weaker demand growth, which could reflect different economic or population growth rates. For example, the high growth demand scenario represents the assumed affect on the supply demand balance of major projects, such as the proposed construction of an LNG plant at Blaydin Point on Darwin harbour or the construction of a significant residential development.

[15] The SCI is a public document tabled in the Assembly and represents in effect a performance agreement between the shareholding Minister and PWC.

[16] Demand growth is the important indicator to consider for generator capacity. Energy production is an important further consideration for adequacy of fuel supply.

Table 4.5: Long term peak demand growth rates, 2013-14 to 2018-19 (average annual percentage change)

System	Baseline growth scenario	Low growth scenario	High growth scenario
Darwin-Katherine	2.4	1.0	4.0
Alice Springs	1.0	0.1	2.5
Tennant Creek	1.0	0.1	2.5

Source: Utilities Commission.

4.67 The high and low growth rates have been derived to test the sensitivity of the supply-demand balance to varying demand conditions. A broad analysis of consumption in the Darwin-Katherine system undertaken by the Commission for previous Reviews indicates an average annual growth rate of approximately 3 per cent over the period from 1990-91 to 2007-08. The Commission has used this average to inform the high and low demand growth scenarios for the Darwin-Katherine system.

4.68 The 2007-08 Review discussed the assumed additional demand associated with construction of the proposed LNG plant at Blaydin Point. The proponent had then indicated that about 10 to 15 MW of capacity would be required during construction, representing between 3.6 and 5.5 per cent of total capacity in 2009-10. The Commission estimated the following demand profile for the life of the project:

- 7.5 MW in year one;
- 15 MW in years two to five; and
- 7.5 MW in year six.

4.69 In addition to these local loads, the strong economic activity which would be stimulated by such a major project could add to underlying demand. In the 2007-08 Review, the Commission adopted an assumption of demand growth of 3.3 per cent per year for 2008-09 to 2011-12, including the indirect impact of the Blaydin Point LNG project. Taking account of the direct effect, the Commission estimated an average compound growth rate of 4.6 per cent per year.

4.70 After construction, the Commission understands that the LNG plant would most likely generate its own electricity and not be a source of electricity demand or supply into the Darwin-Katherine system.

Forecast supply-demand balance

4.71 The adequacy of generation capacity relative to forecast demand is assessed by comparing the baseline capacity projection with medium term and long term demand forecast scenarios.

4.72 The following sections outline the forecast-supply demand balance for the Darwin-Katherine, Alice Springs and Tennant Creek systems in the medium term (2009-10 to 2012-13) and long term (2013-14 to 2018-19).

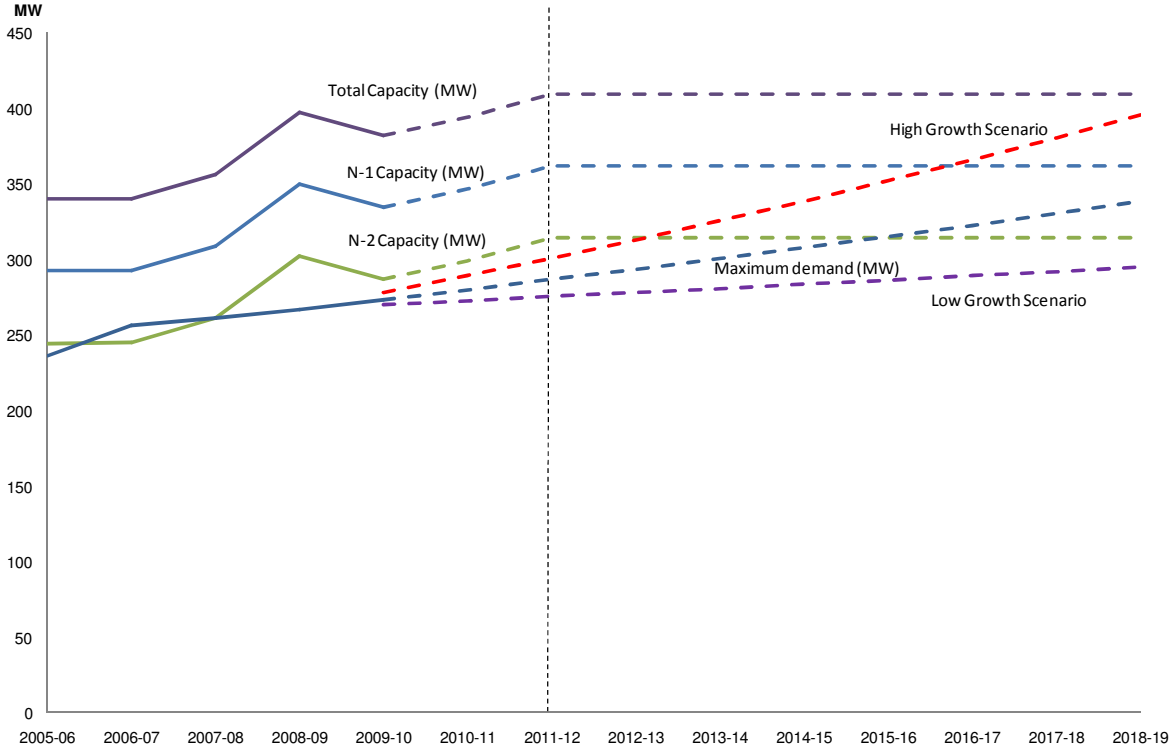
4.73 The Commission has assumed demand growth for the baseline, high and low growth scenarios for 2009-10 to 2018-19 are the demand growth scenarios specified in table 4.5 above.

4.74 As noted above, the Commission has chosen not to include capacity additions or retirements advised to occur after 2011-12. However, this does not mean that a capacity shortfall is to be expected, or will occur. Rather, the Commission considers that this approach effectively represents the prospective trend for capacity by demonstrating when available and committed capacity could prove insufficient to meet forecast maximum demand with adequate reserves, and highlights the size and timing of opportunities to invest in the generation sector.

Supply demand balance – Darwin-Katherine system

4.75 Chart 4.7 provides a summary of the historical and forecast supply-demand balance for the Darwin-Katherine system. Further detail on the supply-demand balance for each year from 2009-10 is available in tables below.

Chart 4.7 Supply demand balance with baseline, high and low demand growth scenarios, Darwin-Katherine, 2005-06 to 2018-19



Source: Electricity industry participants. Note: Dotted vertical line represents cessation of capacity adjustments.

4.76 Overall, based on the assumed demand growth rates, projected capacity in the Darwin-Katherine system is adequate at the more conservative N-2 standard until 2014-15, under the baseline demand scenario, and until 2012-13 under the high demand scenario. Projected capacity is adequate at the N-1 standard until 2015-16 under the high demand scenario.

4.77 The capacity projection for the Darwin-Katherine system for 2009-10 to 2011-12 takes into account the addition of 12.1 MW of capacity to the Katherine power station in 2010-11, the addition of 30 MW to the Weddell power station in 2011-12, and the retirement of the 30 MW Berrimah power station by 2011-12 (15 MW in 2009-10 and 15 MW in 2011-12).

Table 4.6: Supply demand balance, baseline demand growth scenario, Darwin-Katherine, 2009-10 to 2018-19

Financial Year	Total Capacity	N-1	N-2	Peak Demand	Reserve Margin over N-1	Reserve Margin over N-2
2009-10	382	334.4	286.8	273.4	61	13.4
2010-11	394.1	346.5	298.9	280	66.5	18.9
2011-12	409.1	361.5	313.9	286.7	74.8	27.2
2012-13	409.1	361.5	313.9	293.6	67.9	20.3
2013-14	409.1	361.5	313.9	300.6	60.9	13.3
2014-15	409.1	361.5	313.9	307.8	53.7	6.1
2015-16	409.1	361.5	313.9	315.2	46.3	-1.3
2016-17	409.1	361.5	313.9	322.8	38.7	-8.9
2017-18	409.1	361.5	313.9	330.5	31.0	-16.6
2018-19	409.1	361.5	313.9	338.5	23.0	-24.6

4.78 For the Darwin-Katherine system, demand is met for the medium term at the N-1 and N-2 standard, with a reserve margin of at least 61 MW over N-1 and at least 13.4 MW over N-2 in the period to 2012-13. The reserve margin over N-1 and N-2 in the period 2009-10 to 2012-13 is subject to the planned addition of new capacity at Katherine and Weddell power stations.

4.79 At the N-2 standard, reserve conditions are adequate through to 2014-15. Based on the baseline demand forecasts provided by PWC, additional capacity is required before 2015-16 to satisfy the N-2 reserve standard. Proposed capacity additions or retirements beyond 2011-12 are not factored into the projected assessment of system adequacy.

Table 4.7: Supply demand balance, low growth demand scenario, Darwin-Katherine, 2009-10 to 2018-19

Financial Year	Total Capacity	N-1	N-2	Peak Demand	Reserve Margin over N-1	Reserve Margin over N-2
2009-10	382	334.4	286.8	269.7	64.7	17.1
2010-11	394.1	346.5	298.9	272.4	74.1	26.5
2011-12	409.1	361.5	313.9	275.1	86.4	38.8
2012-13	409.1	361.5	313.9	277.8	83.7	36.1
2013-14	409.1	361.5	313.9	280.6	80.9	33.3
2014-15	409.1	361.5	313.9	283.4	78.1	30.5
2015-16	409.1	361.5	313.9	286.3	75.2	27.6
2016-17	409.1	361.5	313.9	289.1	72.4	24.8
2017-18	409.1	361.5	313.9	292	69.5	21.9
2018-19	409.1	361.5	313.9	294.9	66.6	19

4.80 Assuming the low growth scenario for the Darwin-Katherine system, capacity remains adequate at both the N-1 and N-2 reserve standards over the medium term to 2012-13 if planned additional capacity is installed. N-1 and N-2 standards are met in the longer term to 2018-19.

Table 4.8: Supply demand balance, high growth demand scenario, Darwin-Katherine, 2009-10 to 2018-19

Financial Year	Total Capacity	N-1	N-2	Peak Demand	Reserve Margin over N-1	Reserve Margin over N-2
2009-10	382	334.4	286.8	277.7	56.7	9.1
2010-11	394.1	346.5	298.9	288.8	57.7	10.1
2011-12	409.1	361.5	313.9	300.3	61.2	13.6
2012-13	409.1	361.5	313.9	312.4	49.1	1.5
2013-14	409.1	361.5	313.9	324.8	36.7	-10.9
2014-15	409.1	361.5	313.9	337.8	23.7	-23.9
2015-16	409.1	361.5	313.9	351.4	10.1	-37.5
2016-17	409.1	361.5	313.9	365.4	-3.9	-51.5
2017-18	409.1	361.5	313.9	380	-18.5	-66.1
2018-19	409.1	361.5	313.9	395.2	-33.7	-81.3

4.81 The reserve margin over N-1 and N-2 in the period to 2012-13 is adequate in the medium term to 2012-13 if planned additional capacity is installed at Katherine and Weddell power stations.

4.82 The effect of a high growth scenario (4 per cent per year) from 2009-10 is illustrated in Table 4.8 and Chart 4.7 above. It shows that anticipation of high rates of growth, which

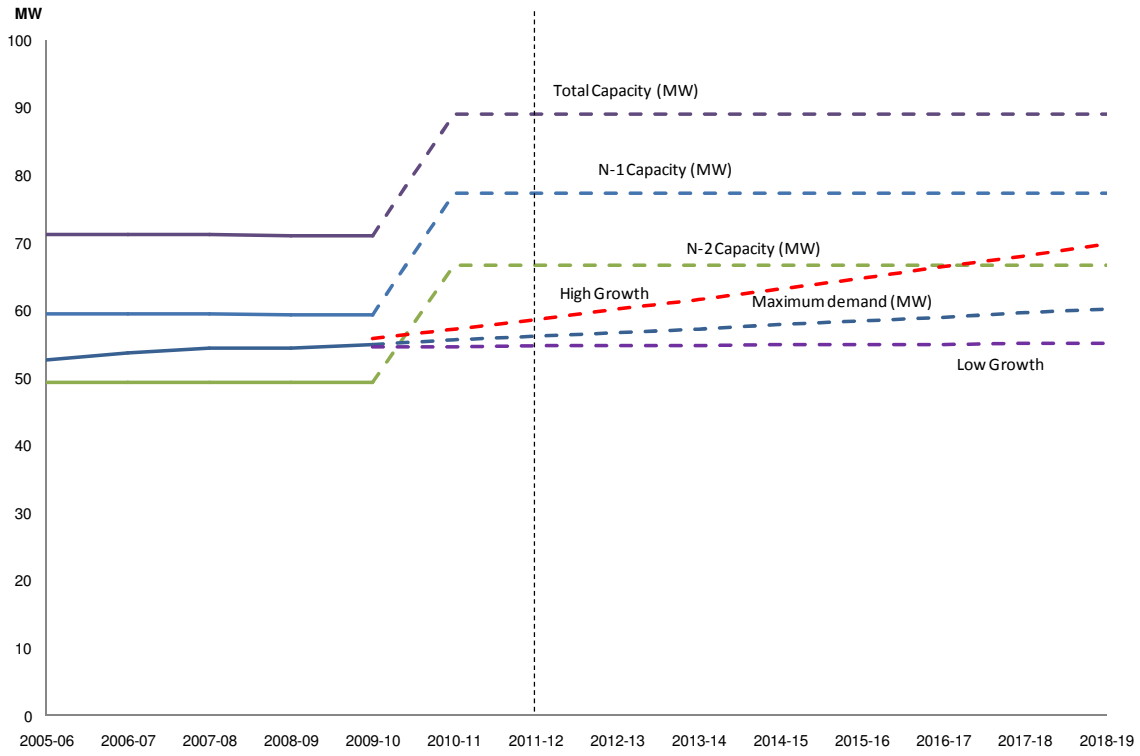
could arise from strong economic recovery and from discrete addition to industrial load, could bring forward the need for augmentation to meet the N-2 criteria to before 2013-14.

4.83 At the N-1 standard reserve conditions are adequate through to 2015-16. Based on the high growth demand scenario, additional capacity is required before 2016-17 to satisfy the N-1 reserve standard. Proposed capacity additions or retirements beyond 2011-12 are not factored into the projected assessment of system adequacy.

Supply demand balance – Alice Springs

4.84 Chart 4.8 provides a summary of the historical and forecast supply-demand balance for the Alice Springs system. Further detail on the supply-demand balance for each year from 2009-10 is available in tables below.

Chart 4.8: Supply demand balance with baseline, high and low demand growth scenarios Alice Springs, 2005-06 to 2018-19



Source: Electricity industry participants. Note: Dotted vertical line represents cessation of capacity adjustments.

4.85 For the Alice Springs system, projected generation capacity is adequate at the N-1 standard for the period 2009-10 to 2018-19 under the low, baseline and high demand growth scenarios. The capacity projection for the Alice Springs system for 2009-10 to 2011-12 takes into account the addition of 32.1 MW of capacity to the Owen Springs power station, and the retirement or relocation of 14 MW at the Ron Goodin power station in 2010-11 (10.1 MW is to be moved to Katherine power station).

4.86 At N-2, projected capacity is below the reserve standard in 2009-10, but is adequate until 2018-19 under the baseline and low demand growth scenarios, and until 2016-17 under the high demand growth scenario. Proposed capacity additions or retirements beyond 2011-12 are not factored into the projected assessment of system adequacy.

Table 4.9: Supply demand balance, baseline demand growth scenario, Alice Springs, 2009-10 to 2018-19

Financial Year	Total Capacity	N-1	N-2	Peak Demand	Reserve Margin over N-1	Reserve Margin over N-2
2009-10	71	59.3	49.2	54.9	4.4	-5.7
2010-11	89	77.3	66.6	55.5	21.8	11.1
2011-12	89	77.3	66.6	56	21.3	10.6
2012-13	89	77.3	66.6	56.6	20.7	10
2013-14	89	77.3	66.6	57.2	20.1	9.4
2014-15	89	77.3	66.6	57.7	19.6	8.9
2015-16	89	77.3	66.6	58.3	19	8.3
2016-17	89	77.3	66.6	58.9	18.4	7.7
2017-18	89	77.3	66.6	59.5	17.8	7.1
2018-19	89	77.3	66.6	60.1	17.2	6.5

4.87 Under the baseline demand growth scenario of 1 per cent per year, reserve conditions are adequate at the N-1 for the period 2009-10 to 2018-19, and at the N-2 standard after 2009-10. An additional 18 MW of capacity is to be added to the Alice Springs system when the Owen Springs power station begins operating in 2010-11.

Table 4.10: Supply demand balance, low growth demand scenario, Alice Springs, 2009-10 to 2018-19

Financial Year	Total Capacity	N-1	N-2	Peak Demand	Reserve Margin over N-1	Reserve Margin over N-2
2009-10	71	59.3	49.2	54.5	4.8	-5.3
2010-11	89	77.3	66.6	54.5	22.8	12.1
2011-12	89	77.3	66.6	54.6	22.7	12
2012-13	89	77.3	66.6	54.6	22.7	12
2013-14	89	77.3	66.6	54.7	22.6	11.9
2014-15	89	77.3	66.6	54.7	22.6	11.9
2015-16	89	77.3	66.6	54.8	22.5	11.8
2016-17	89	77.3	66.6	54.8	22.5	11.8
2017-18	89	77.3	66.6	54.9	22.4	11.7
2018-19	89	77.3	66.6	54.9	22.4	11.7

4.88 If demand increased by an average rate of 0.1 per cent per year over 2009-10 to 2018-19, capacity will be adequate at both the N-1 and the N-2 standard after 2009-10. The reserve margin over N-2 is not sufficient to meet forecast demand in 2009-10, but is adequate thereafter with the planned addition of new capacity at the Owen Springs power station.

Table 4.11: Supply demand balance, high growth demand scenario, Alice Springs, 2009-10 to 2018-19

Financial Year	Total Capacity	N-1	N-2	Peak Demand	Reserve Margin over N-1	Reserve Margin over N-2
2009-10	71	59.3	49.2	55.8	3.5	-6.6
2010-11	89	77.3	66.6	57.2	20.1	9.4
2011-12	89	77.3	66.6	58.6	18.7	8
2012-13	89	77.3	66.6	60	17.3	6.6
2013-14	89	77.3	66.6	61.5	15.8	5.1
2014-15	89	77.3	66.6	63.1	14.2	3.5
2015-16	89	77.3	66.6	64.7	12.6	1.9
2016-17	89	77.3	66.6	66.3	11	0.3
2017-18	89	77.3	66.6	67.9	9.4	-1.3
2018-19	89	77.3	66.6	69.6	7.7	-3.0

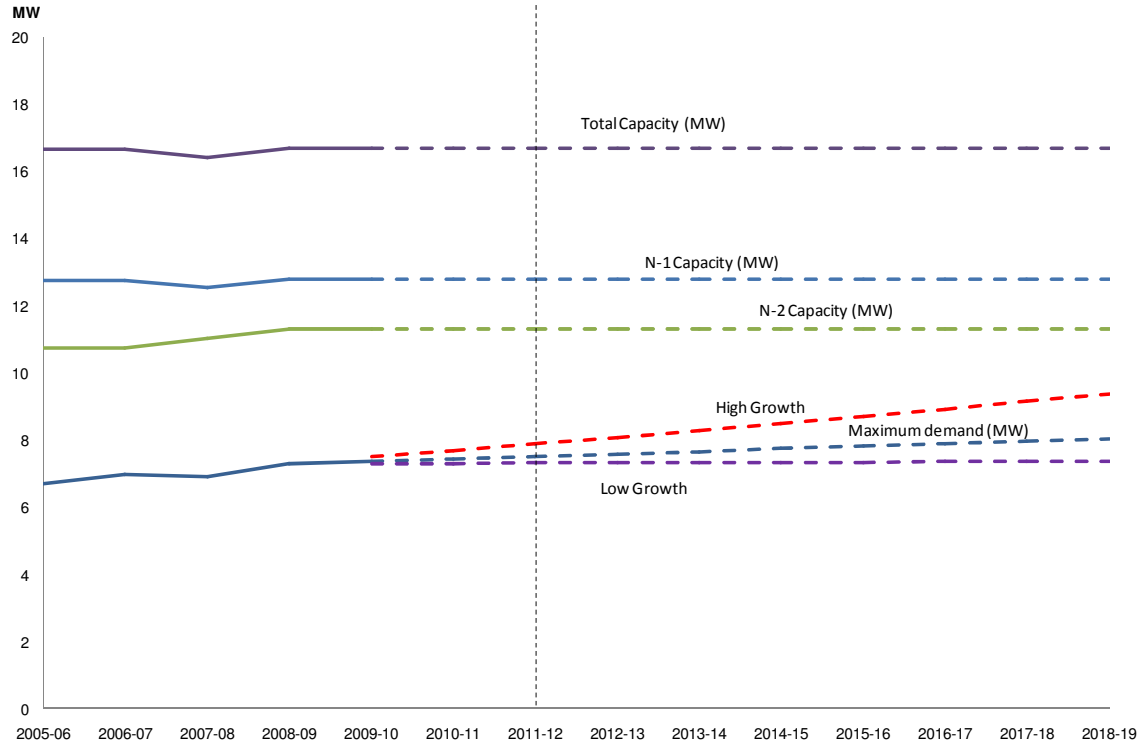
4.89 As indicated by Table 4.11, if demand growth averages 2.5 per cent per year, projected generation capacity is adequate at the N-1 standard for the period 2009-10 to 2018-19. However, additional capacity will be needed by 2016-17, as the reserve margin over N-2 is not sufficient to meet forecast demand by 2017-18.

Supply demand balance – Tennant Creek

4.90 Chart 4.9 provides a summary of the historical and forecast supply-demand balance for the Tennant Creek system. Further detail on the supply-demand balance for each year from 2009-10 is available in tables below.

4.91 No additional capacity, or capacity retirements, are planned for the Tennant Creek system for the period 2009-10 to 2011-12.

Chart 4.9: Supply demand balance with baseline, high and low demand growth scenarios, Tennant Creek, 2005-06 to 2018-19



Source: Electricity industry participants. Note: Dotted vertical line represents cessation of capacity adjustments.

4.92 The reserve margin in the Tennant Creek system appears adequate to meet the expected future maximum demand under all demand growth forecast scenarios.

Table 4.12: Supply demand balance, baseline demand growth scenario, Tennant Creek, 2009-10 to 2018-19

Financial Year	Total Capacity	N-1	N-2	Peak Demand	Reserve Margin over N-1	Reserve Margin over N-2
2009-10	16.7	12.8	11.3	7.4	5.4	3.9
2010-11	16.7	12.8	11.3	7.4	5.4	3.9
2011-12	16.7	12.8	11.3	7.5	5.3	3.8
2012-13	16.7	12.8	11.3	7.6	5.2	3.7
2013-14	16.7	12.8	11.3	7.7	5.1	3.6
2014-15	16.7	12.8	11.3	7.7	5.1	3.6
2015-16	16.7	12.8	11.3	7.8	5.0	3.5
2016-17	16.7	12.8	11.3	7.9	4.9	3.4
2017-18	16.7	12.8	11.3	8	4.8	3.3
2018-19	16.7	12.8	11.3	8.1	4.7	3.2

4.93 At both the N-1 and the N-2 reserve standards, projected capacity in Tennant Creek remains adequate over the medium to 2012-13 and long term to 2018-19 under the baseline demand growth scenario of 1 per cent per year.

Table 4.13: Supply demand balance, low demand growth scenario, Tennant Creek, 2009-10 to 2018-19

Financial Year	Total Capacity	N-1	N-2	Peak Demand	Reserve Margin over N-1	Reserve Margin over N-2
2009-10	16.7	12.8	11.3	7.3	5.5	4
2010-11	16.7	12.8	11.3	7.3	5.5	4
2011-12	16.7	12.8	11.3	7.3	5.5	4
2012-13	16.7	12.8	11.3	7.3	5.5	4
2013-14	16.7	12.8	11.3	7.3	5.5	4
2014-15	16.7	12.8	11.3	7.3	5.5	4
2015-16	16.7	12.8	11.3	7.4	5.4	3.9
2016-17	16.7	12.8	11.3	7.4	5.4	3.9
2017-18	16.7	12.8	11.3	7.4	5.4	3.9
2018-19	16.7	12.8	11.3	7.4	5.4	3.9

4.94 Under the low demand growth scenario of 0.1 per cent per year, the projected capacity is sufficient to meet both the N-1 and N-2 reserve standards for the period 2009-10 to 2018-19.

Table 4.14: Supply demand balance, high demand growth scenario, Tennant Creek, 2009-10 to 2018-19

Financial Year	Total Capacity	N-1	N-2	Peak Demand	Reserve Margin over N-1	Reserve Margin over N-2
2009-10	16.7	12.8	11.3	7.5	5.3	3.8
2010-11	16.7	12.8	11.3	7.7	5.1	3.6
2011-12	16.7	12.8	11.3	7.9	4.9	3.4
2012-13	16.7	12.8	11.3	8.1	4.7	3.2
2013-14	16.7	12.8	11.3	8.3	4.5	3
2014-15	16.7	12.8	11.3	8.5	4.3	2.8
2015-16	16.7	12.8	11.3	8.7	4.1	2.6
2016-17	16.7	12.8	11.3	8.9	3.9	2.4
2017-18	16.7	12.8	11.3	9.1	3.7	2.2
2018-19	16.7	12.8	11.3	9.3	3.5	2

4.95 Under the high growth demand scenario of 2.5 per cent per year, projected capacity is adequate at both the N-1 and N-2 reserve standards for the period 2009-10 to 2018-19.

Electricity generation performance

4.96 This section reports on generation performance in the Darwin-Katherine, Alice Springs and Tennant Creek systems in 2008-09 against the indicators specified in the Electricity Standards of Service Code, and compares this to historical results and the relevant standard.

4.97 The Electricity Standards of Service Code requires PWC to report annually on actual generation performance against the defined standards. The performance indicators for generation are:

- system average interruption duration index (SAIDI), which is the average minutes of off supply per customer;
- system average interruption frequency index (SAIFI), which is the average number of interruptions per customer; and
- customer average interruption duration index (CAIDI), which is the average interruption duration per customer.

4.98 According to the information reported by PWC for 2008-09, PWC's generation performance breached three of the agreed standards in 2008-09. Additionally, PWC reported that these were consecutive breaches of the standard. The breaches were for:

- Darwin Generation CAIDI. The standard of an average interruption duration per customer of 10.9 minutes was exceeded in 2008-09 (11.3 minutes) and 2007-08 (17.7 minutes);
- Katherine Generation SAIFI. The standard of an average 1.1 interruptions per customer was exceeded in 2008-09 (1.5 interruptions) and 2007-08 (4.3 interruptions); and
- Tennant Creek Generation CAIDI. The standard of an average interruption duration per customer of 10 minutes was exceeded in 2008-09 (28.5 minutes) and every year since 1999-00.

4.99 Table 4.15 sets out the major generation related incidents in the Darwin-Katherine system for January to June 2009, as reported by the System Controller.

Table 4.15: Major generation power system incidents, Darwin-Katherine, January to June 2009

Date	Power Station	Description
15 January	Channel Island	Generator trip and loadshed
25 January	Channel Island	Generator trip and loadshed
23 March	Pine Creek	Generator trip and loadshed
1 April	Channel Island	Manual loadshed, partial voltage collapse around CIPS
20 April	Channel Island	Generator trip and loadshed
21 April	Weddell	Generator trip and loadshed
30 April	Channel Island	Generator trip and loadshed
22 May	Channel Island	Generator trip and loadshed
8 June	Channel Island	Generator trip and loadshed

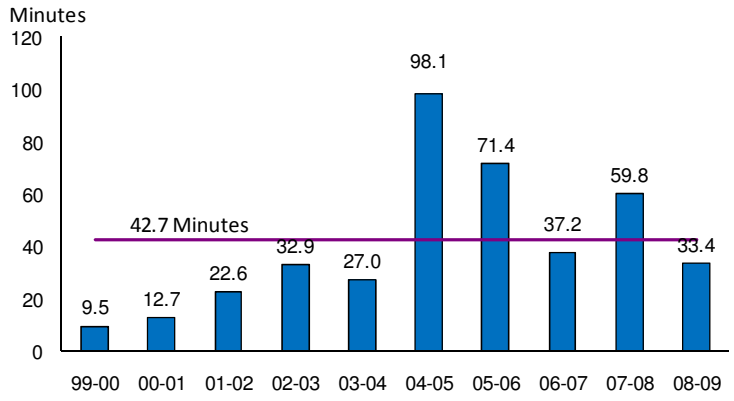
Source: Power and Water Corporation, System Controller Half Year Report, January to June 2009.

4.100 PWC System Control will be providing the Commission with information on major power system incidents, including the date, location and a brief description of each event, such as cause, duration and action taken. Future Reviews will provide more comprehensive reporting and analysis of power system incidents for the Darwin-Katherine, Alice Springs and Tennant Creek systems for the year under review.

Darwin region generation performance

4.101 This section reports performance against the SAIDI, SAIFI and CAIDI indicators for the Darwin region for 1999-00 to 2008-09. Although they are part of the same system, performance is reported separately for the Darwin region and Katherine.

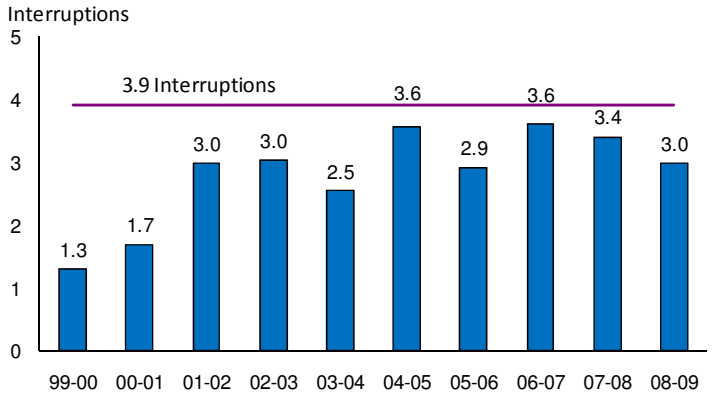
Chart 4.10: SAIDI, Darwin, 1999-2000 to 2008-09



4.102 The agreed standard for SAIDI in the Darwin region is 42.7 minutes. This standard has been breached in three of the past five years. However, SAIDI performance for 2008-09 of 33.4 minutes is better than the agreed standard, and better the average for the past decade of 40.5 minutes.

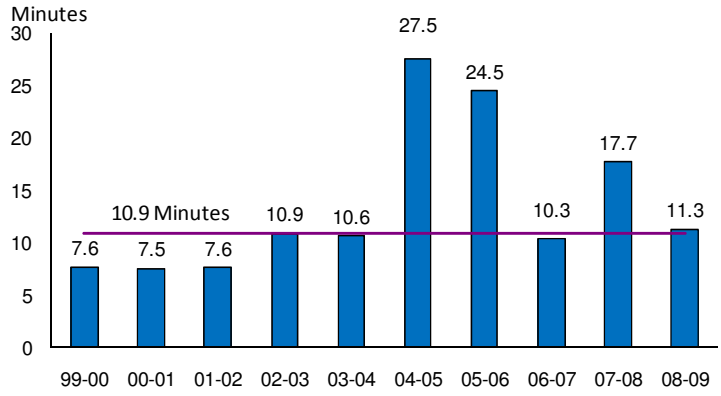
4.103 PWC advises that the breach of the standard in 2007-08 was due to initial operating problems with the commissioning of the Weddell power station. Further load shedding occurred in the second quarter of 2008 as a result of work at Weddell power station.

Chart 4.11: SAIFI, Darwin, 1999-2000 to 2008-09



4.104 The Darwin region SAIFI has never breached the agreed standard of an average 3.9 interruptions per customer. Although the average number of interruptions has declined from the decade high of 3.6 in 2006-07 to 3.0 in 2008-09, performance is above the average for the decade of 2.8 interruptions.

Chart 4.12: CAIDI, Darwin, 1999-2000 to 2008-09

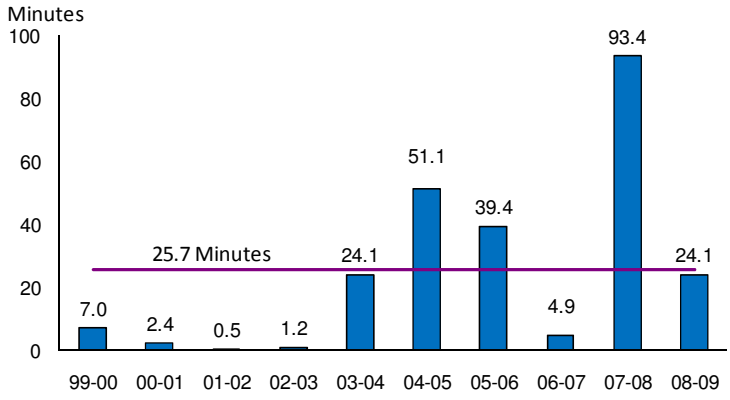


4.105 The Darwin region CAIDI of 11.3 minutes for 2008-09 was above the agreed standard of an average 10.9 minutes per customer. PWC advises that this is most likely a result of generation disruptions towards the end of 2008. The Darwin region CAIDI has been above the agreed standard in four of the past five years.

Katherine region generation performance

4.106 This section reports performance against the SAIDI, SAIFI and CAIDI indicators for the Katherine region for 1999-00 to 2008-09.

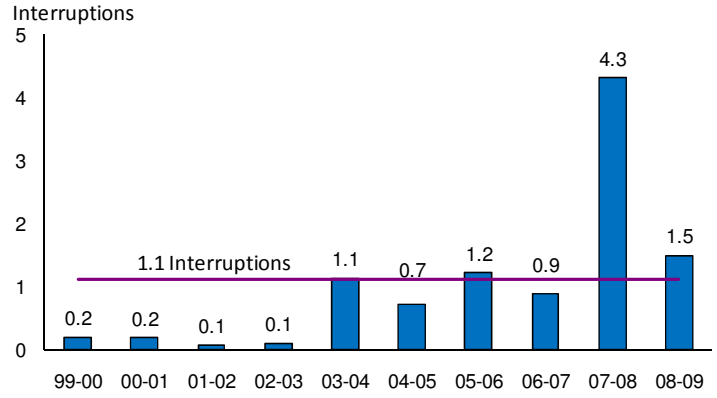
Chart 4.13: SAIDI, Katherine, 1999-2000 to 2008-09



4.107 The agreed standard for SAIDI in the Katherine region is 25.7 minutes. SAIDI performance for 2008-09 of 24.1 minutes is better than the agreed standard, and a significant improvement on the 93.4 minutes reported for 2007-08. The average for the past decade is 24.8 minutes, although this includes the outlier of 2007-08.

4.108 PWC attributed the poor performance in 2007-08 to several power system incidents in the Darwin region which had a flow on effect to the Katherine system.

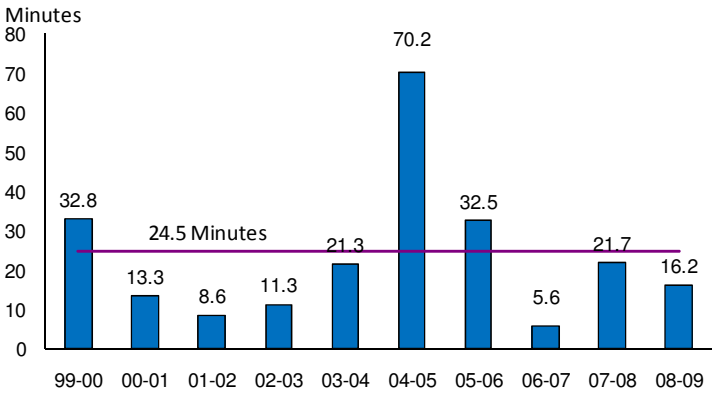
Chart 4.14: SAIFI, Katherine, 1999-2000 to 2008-09



4.109 The Katherine region SAIFI exceeded the agreed standard of an average 1.1 interruptions per customer in 2007-08 and 2008-09, recording an average 4.3 and 1.5 interruptions respectively. PWC attributes the 2008-09 outcome to bushfires affecting the Manton-Pine Creek 132 kV line and causing a subsequent loss of generation at the Pine Creek power station.

4.110 The average number of interruptions has declined from the decade high of 4.3 in 2007-08, but remains above the average for the decade of 1.0 interruptions.

Chart 4.15: CAIDI, Katherine, 1999-2000 to 2008-09

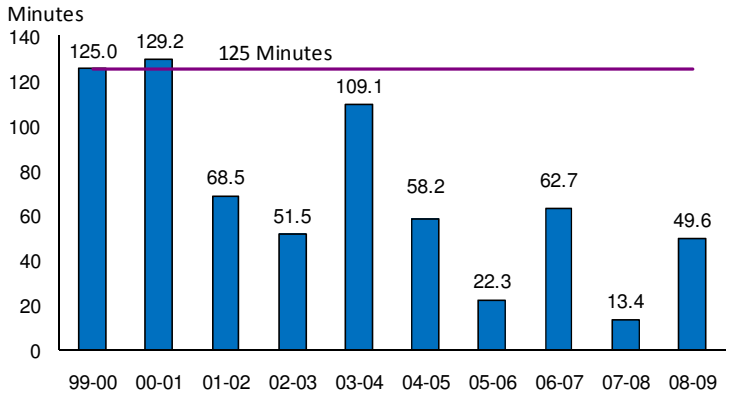


4.111 The Katherine region CAIDI of 16.2 minutes in 2008-09 was better than the agreed standard of 24.5 minutes. The average CAIDI for the decade is 23.4 minutes.

Tennant Creek generation performance

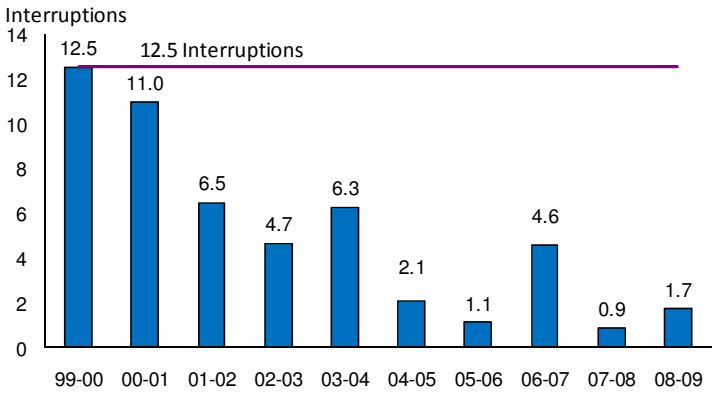
4.112 This section reports performance against the SAIDI, SAIFI and CAIDI indicators for the Tennant Creek system for 1999-00 to 2008-09.

Chart 4.16: SAIDI, Tennant Creek, 1999-2000 to 2008-09



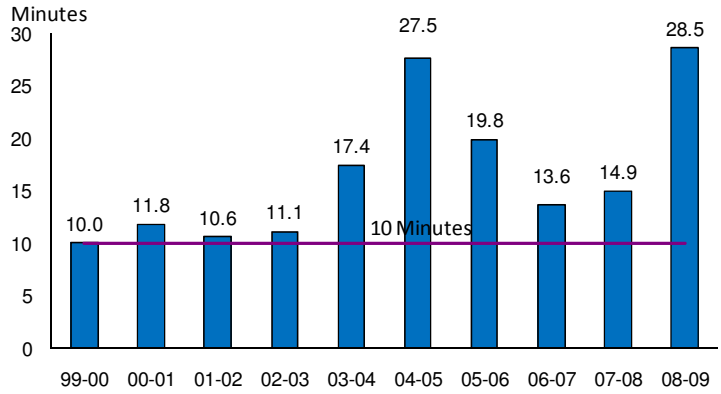
4.113 The agreed standard for SAIDI in the Tennant Creek system is 125 minutes, compared to SAIDI performance in 2008-09 of 49.6 minutes. The average for the past decade is 68.9 minutes. However, performance in the past five years has been much improved relative to earlier in the decade, with an average for the past five years of 41.2 minutes.

Chart 4.17: SAIFI, Tennant Creek, 1999-2000 to 2008-09



4.114 The Tennant Creek SAIFI has not exceeded the agreed standard of an average 12.5 interruptions per customer in the past decade. Performance in 2008-09 of 1.7 interruptions is below the average for the past decade of 5.1 interruptions, but the average for the past five years is 2.1 interruptions.

Chart 4.18: CAIDI, Tennant Creek, 1999-2000 to 2008-09



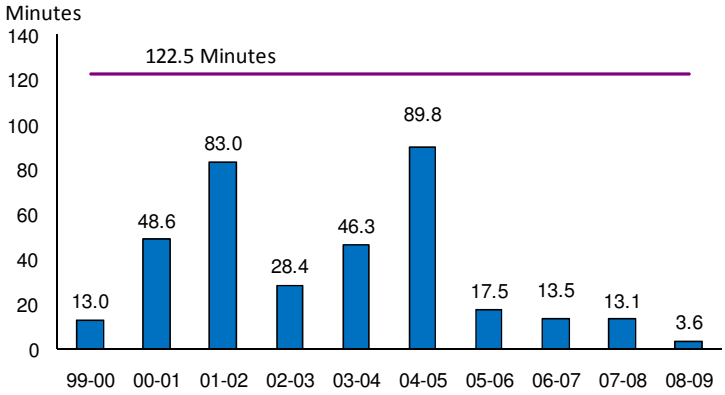
4.115 The Tennant Creek CAIDI in 2008-09 of 28.5 minutes was above the agreed standard of 10 minutes, and the highest recorded outcome in the past decade. PWC attributes the performance in 2008-09 to an increase in the duration of interruptions, as the frequency of interruptions has remained relatively constant.

4.116 The Tennant Creek CAIDI has exceeded the agreed standard in every year since 2000-01, and the average performance for the decade is 16.5 minutes.

Alice Springs system generation performance

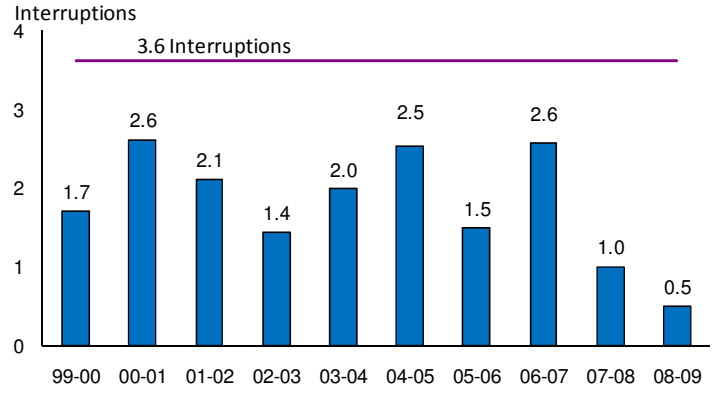
4.117 This section reports performance against the SAIDI, SAIFI and CAIDI indicators for the Alice Springs system for 1999-00 to 2008-09.

Chart 4.19: SAIDI, Alice Springs, 1999-2000 to 2008-09



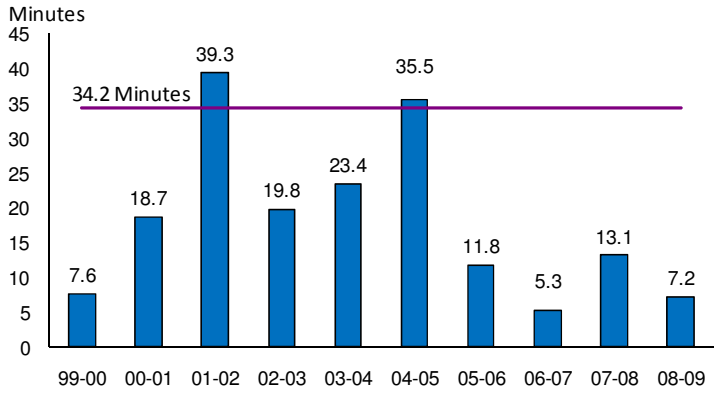
4.118 The agreed standard for SAIDI in the Alice Springs system is 122.5 minutes, compared to SAIDI performance of 3.6 minutes in 2008-09. Average SAIDI in the past decade is 35.7 minutes.

Chart 4.20: SAIFI, Alice Springs, 1999-2000 to 2008-09



4.119 The Alice Springs system SAIFI has not exceeded the agreed standard of an average of 3.6 interruptions per customer in the past decade. Performance in 2008-09 was 0.5 interruptions, and the average performance for the decade is 1.8 interruptions per customer.

Chart 4.21: CAIDI, Alice Springs, 1999-2000 to 2008-09



4.120 The Alice Springs CAIDI in 2008-09 of an average interruption duration of 7.2 minutes a customer is below the agreed standard of 34.2 minutes. Average performance in the past five years is 14.6 minutes.

Adequacy of fuel supplies

4.121 Natural gas is the main fuel for electricity generation in the Darwin-Katherine, Alice Springs and Tennant Creek systems. With the exception of the LMS Shoal Bay power station and peaking/standby generation at Berrimah, almost all electricity in these systems is generated by burning gas in gas turbines and reciprocating engines, or by the production of steam through the recovery of waste heat from the gas turbines. However, most power stations can use liquid fuels (i.e. diesel) as an alternative fuel source if required.

4.122 The supply of gas in the Territory to generators has been very reliable, with only four occasions since 1987 when gas has not been supplied to a power station in the Darwin-Katherine system, with:

- a failed pressure transmitter at Channel Island on 16 May 1999;
- a lightning strike on the Channel Island meter station on 17 December 2004;

- gas supply issues to Channel Island power station on 10 December 2009; and
- gas supply issues to Weddell power station on 23 November 2009.

4.123 An earthquake in the Tennant Creek region in January 1988 led to a need to interrupt supply to the Tennant Creek power station so that pipeline repairs could be made, but there was no interruption to the gas supply in the Darwin-Katherine system.

Amadeus Basin gas fields

4.124 Gas from the Palm Valley and Mereenie fields in the Amadeus Basin in central Australia has been used for electricity generation in Alice Springs since 1983, and in Darwin-Katherine and Tennant Creek systems since 1987. The Amadeus Basin to Darwin gas pipeline (ABDP) was commissioned in December 1986 to transport gas from central Australia to Darwin, with the first gas supplied in January 1987.

4.125 The Palm Valley field is operated by Magellan Petroleum Australia Ltd and the Mereenie field by Santos Ltd. Both operators have a significant interest in each field.

4.126 In 1985, Gasgo Pty Ltd contracted to purchase 200 petajoules (PJ) of gas in the period to 2012 from the Palm Valley field, and 66 PJ of gas in the period to 2009 from the Mereenie field.[17] However, the Palm Valley field did not meet expected gas volumes, despite further field development to arrest the decline in gas production.

4.127 The lower than expected gas volumes from Palm Valley, and greater than expected energy demand resulted in supplementary contracts to purchase 113 PJ in the period to 2009 from the Mereenie field. A fourth supplementary contract to supply a minimum of 5.2 PJ from March 2006 to December 2008, and additional gas from January 2008 to December 2010 was agreed in 2005-06. However, the additional gas supplied was on a reasonable endeavours basis, as the Mereenie field was also experiencing declining production.

Blacktip gas field

4.128 In response to the declining gas reserves in the Amadeus Basin fields, in 2006 PWC entered agreements for the supply and transport of 740 PJ of gas until 2034. The Commission understands that the field has estimated reserves of 1.1 trillion cubic feet, and there could be additional gas available.

4.129 The Blacktip field is located in the Bonaparte Gulf about 100 km west of Wadeye, and is operated by Eni. The gas comes onshore to a processing plant near Wadeye, and is transported by the 286 km Bonaparte gas pipeline to join the ABDP near Ban Ban Springs.

4.130 Gas from the Blacktip field was to replace gas from the Amadeus Basin fields as the primary fuel for electricity generation in the Territory's power systems from 1 January 2009. However, supply was delayed, apparently due to difficulties experienced by Eni sourcing components on time and extreme weather conditions.

4.131 Gas for electricity generation was supplied from the Blacktip field from October 2009, after PWC reached agreements with Eni and the pipeline companies involved in

[17] Gasgo Pty Ltd is a subsidiary of PWC.

transporting Blacktip gas to supply gas, despite the gas not being fully processed to specifications agreed between Eni and PWC.

4.132 The Commission understands that full specification gas was being supplied from mid January 2010 at volumes sufficient to meet electricity generation requirements.

Alternate fuel sources

4.133 The declining volumes of gas supplied from the Palm Valley and Mereenie fields and rising energy demand has required PWC to use distillate as an alternate fuel source for electricity generation since 2006-07. PWC advises that about 0.05 PJ of diesel was used in 2006-07, 0.8 PJ in 2007-08 and 1.1 PJ in 2008-09. The Commission expects that the use of distillate will reduce significantly from the second half of 2009-10 as Blacktip gas is now available.

4.134 PWC was able to mitigate the risk of a potential shortfall in fuel for electricity generation during 2008-09 due to the delay in availability of Blacktip gas by using about 1.1 petajoules of liquid fuels. In the second half of 2009 PWC purchased gas from the DLNG plant. This gas was available from July 2009 after construction of a pipeline connecting DLNG plant to the Darwin city gate gas hub.

4.135 The Commission considers that security of fuel supply improved during 2008-09. From the December quarter 2009, fuel for electricity generation, at varying quantities, quality and cost, was available from the Amadeus Basin fields (the Commission understands these fields may have remaining reserves of about 100 PJ of gas); the DLNG plant; the Blacktip field and liquid fuels.

Fuel supply-demand in the medium term

4.136 The Commission understands that the gas supply-demand balance in the medium term to 2012-13 is adequate, although with some potential for a shortfall in contracted gas supply relative to forecast gas demand in the first half of 2009-10 due to the delays in the supply of full specification gas from the Blacktip field.

4.137 PWC has advised the Commission that contracts for gas supply from the Palm Valley, Mereenie and Blacktip fields, and from the DLNG plant are adequate to meet forecast gas demand in 2009-10.

4.138 The data available to the Commission suggests that any increase in energy demand over PWC's forecasts over the next five years or more is unlikely to require PWC to acquire gas in addition to contract, or to use liquid fuels. However, the Commission intends to examine the robustness of the underlying gas demand forecasts during 2010 to better understand the adequacy of the long term gas supply volumes relative to energy demand.

Fuel supply-demand in the longer term

4.139 Based on the data available to the Commission, projected gas requirements for 2013-14 to 2018-19 are met under existing gas contracts. Nonetheless, as noted above, the Commission will examine the robustness of the underlying gas demand forecasts during 2010 to better understand the adequacy of the long term gas supply volumes relative to energy demand.

4.140 The Commission notes that gas reserves in the Blacktip field mean gas in excess of contract quantities is likely to be available. Additionally, the Commission notes that the

gas supply-demand balance could change as more modern and efficient generation equipment is installed in the Darwin-Katherine and Alice Springs systems.

4.141 The Commission also considers that the diversification of fuel sources through contingency supply arrangements (e.g. the contract with DLNG to supply supplementary gas and its diesel fuel stocks) improves the security of fuel supplies in the medium and long terms.

CHAPTER 5

Electricity Networks

5.1 This chapter examines the capacity and performance of electricity networks in the Darwin-Katherine, Alice Springs and Tennant Creek systems.

5.2 In the 2004-05 Review, the Commission undertook a broad assessment of the arrangements used to manage power system planning and reliability, including for electricity transmission and distribution networks. Previous Reviews had mainly focused on capacity and reliability of the electricity generation sector. At the time, the Commission noted there were deficiencies in the approach to power system planning and that this meant the Commission was unable to provide an assessment of the prospective capacity and reliability of the power system as a whole, including electricity transmission and distribution networks.[18]

5.3 The equipment failures in and around Casuarina zone substation in late 2008 highlighted the risks associated with inadequate oversight of the reliability of the whole power system, including electricity network assets.

5.4 In response to concerns raised first in the 2004-05 Review, the Commission asked PWC Networks to respond to a supplementary data request on network planning and reliability, for inclusion in the 2007-08 Review. The request was based on requirements in other Australian jurisdictions, where electricity network operators are subject to statutory obligations to report on network planning methods and asset capacity. No similar obligation exists in the Territory.

5.5 The Commission replicated the network planning and reliability report information request to PWC Networks in preparing the 2008-09 Review. Additionally, the 2008-09 Review includes network performance data that PWC is obliged to report by the Electricity Standards of Service Code and System Control Technical Code.

5.6 In this context, this chapter includes the following sections:

- overview of the Darwin-Katherine, Alice Springs and Tennant Creek electricity networks;
- network planning arrangements and criteria;
- forecast electricity demand and network capacity-demand balance; and
- network performance against the indicators specified in the Electricity Standards of Service Code.

[18] Utilities Commission, December 2005, Annual Power System Review, page 5.

Electricity networks overview

5.7 The electricity industry reforms introduced by the Territory Government in April 2000 established a third party access regime for the Darwin-Katherine, Alice Springs and Tennant Creek electricity networks. Access charges and conditions are regulated by the Commission, with the most recent determination made in March 2009 for the period 1 July 2009 to 30 June 2014.[19]

5.8 The Darwin-Katherine, Alice Springs and Tennant Creek networks are stand alone networks for what were the main population centres of the Territory at the turn of the millennium.[20]

5.9 Chart 3.1 (page 11) shows the location of the three main networks, and also some of the electricity networks in regional and remote areas of the Territory.[21] The map highlights the substantial distance between the networks that makes interconnection an unlikely prospect in the foreseeable future.

Electricity network assets

5.10 Electricity networks comprise the poles, underground pipes and wires that carry electricity from the generator to the customer, as well as the substations, transformers, switching equipment, and monitoring and signaling equipment.

5.11 Table 5.1 provides relevant electricity network information for 2008-09. The Commission intends to provide additional detail in future Reviews, including a more detailed description of line capacity and function in each network, and substation capacity.

Table 5.1: Electricity network asset information 2008-09

	Darwin Katherine	Alice Springs	Tennant Creek
Connections (customer numbers)	58 319	12 109	1 709
Electricity use (gigawatt hours)	1 341	216	26
Network line length (circuit kilometres)	4 773	603	373
Substations	26	3	1

Source: Power and Water Corporation 2008-09 Retail Licence compliance return; and Power and Water Corporation Network Planning and Reliability Report, November 2009.

5.12 Elsewhere in Australia, there is a distinction between the transmission and distribution sections of an electricity network. Transmission networks carry electricity at high

[19] Utilities Commission, March 2009, Final Determination Networks Pricing: 2009 Regulatory Reset.

[20] However, there are now a number of towns with a population size similar to that of Tennant Creek, for example, Wadeye.

[21] Regional and remote networks comprise the electricity networks used to supply electricity to 72 communities and about 600 outstations (operated under the Territory Government Indigenous Essential Services program), three mining towns and nine remote towns. These networks are not subject to the institutional and regulatory framework established by the *Electricity Reform Act*, *Electricity Networks (Third Party Access) Act* and Code and associated instruments.

voltage from the generator to the distribution network, where electricity is converted to a lower voltage and taken to customers.

5.13 A transmission network overlay exists in the Darwin area to transport electricity produced at three power station locations (Channel Island; Weddell and Berrimah) to primary load centres via two 132 kV transmission lines and seven 66 kV zone substations. This network is also connected with power stations and loads at Katherine and Pine Creek via a single 132 kV line from Channel Island.

5.14 The design of this transmission network is largely radial, from power stations to load centres, with only a limited number of alternative flow paths. The Commission anticipates that future reviews will examine plans for the development of this transmission overlay to align practices with those of other jurisdictions. Relevant practices might include plans for alternative flow paths and arrangements to minimise the risk of network collapse and maximise the ability of the network to manage major incidents without the collapse of the network.

5.15 The Commission considers that effective monitoring of power system performance requires reporting on the performance of those network assets that have the transmission like characteristic of linking generation and zone substations. The Commission will examine the information that could be reported as part of the Review of Electricity System Planning, Monitoring and Reporting.

Network planning and reliability

5.16 The Commission has reported on electricity network planning arrangements and reliability since the 2004-05 Review, focusing on the effectiveness of arrangements determining network performance standards and reliability.

5.17 At the time, the Commission noted:

For all practical purposes, power system planning and reliability (including that for transmission and distribution networks) continues to be managed…as an internal matter by Power and Water.

This is inconsistent with generally accepted industry practice. Among a number of disadvantages, it blurs the distinction between commercial interests and the public interest, makes the planning and investment process opaque and increases the risk that investment decisions may be sub-optimal from a power system perspective.

While acknowledging that Power and Water may have achieved relatively good system reliability outcomes to date in a harsh environment (as evidenced in the most recent industry statistics), the Commission is not in a position to provide an assessment of the prospective capacity and reliability of the power system as a whole in the Territory (including that for transmission and distribution networks) while differences with industry practice in other jurisdictions continue.[22]

[22] Utilities Commission, December 2005, Annual Power System Review, page 5.

5.18 In the 2007-08 Review, the Commission noted that the management of power system reliability had been given specific focus by the supply interruptions customers experienced in September and October 2008 as a result of events at the Casuarina zone substation, and the subsequent findings and conclusions of the Davies Enquiry. In particular, the Commission noted that the Davies Enquiry found that procedures for monitoring and reporting the condition of key assets were deficient and the resulting level of equipment maintenance was assessed as below the standard required to meet good industry practice.[23]

5.19 For the 2007-08 Review, the Commission requested that PWC Networks provide information on network planning methods and network asset capacity. This information request was similar to that reported by network operators elsewhere in Australia to meet regulatory reporting obligations. PWC Networks provided the Commission with a Network Planning and Reliability Report that was released along with the 2007-08 Review, but was not subject to analysis or comment by the Commission.

5.20 The Commission requested that PWC Networks update the Network Planning and Reliability Report for this Review. The Commission has undertaken some analysis of the data, but notes that more comprehensive assessment is planned for future Reviews.

5.21 Some of the key points of the November 2009 Network Planning and Reliability Report are:

- PWC Networks is investing $287 million over the period 2009-10 to 2013-14 (2009-10 SCI) to improve reliability and meet projected demand growth;
- the Network Planning Criteria, established under the Electricity Networks (Third Party Access) Code, are being reviewed with the intention of ensuring the associated arrangements are robust, prescriptive and more closely aligned with the planning criteria used in the NEM; and
- PWC Networks is working toward extending measurement of network reliability from the feeder level to an asset class level to better identify the source of electricity interruptions and target maintenance programs accordingly.[24]

5.22 The Commission is aware that PWC is putting significant effort into improving planning and asset management practices, including through the RAMP and the Asset Management Capability project. The Commission will also examine network planning and reliability during 2010 in response to a request by the Treasurer to review and report on:

- the adequacy of current system performance monitoring and reporting arrangements under the *Electricity Reform Act*, and appropriate network and generation reliability standards for performance monitoring; and
- the efficiency of system planning and market operation arrangements, including the role and structure of the PWC system control unit.

5.23 PWC Networks assesses the adequacy of network assets by comparing forecast peak demand with the firm capacity of the network, which is set using the N-1 standard. The

[23] Utilities Commission, March 2009, Annual Power System Review, page 12.

[24] Power and Water Corporation, November 2009, Power Networks Network Planning and Reliability Report.

N-1 planning standard means that supply should be maintained to all customers following the loss of any single item of plant such as transmission line, zone substation transformer or feeder circuit breaker. If forecast demand (MVA) is greater than the minimum firm capacity (MVA), there is a risk of loss of load, and augmentation of the network may be required. However, PWC Networks notes that the N-1 standard cannot be met in some situations, such as rural areas that are supplied by a single radial distribution line.

5.24 PWC Networks notes in the November 2009 Network Planning and Reliability Report that there is not a consistent methodology applied by network operators for measuring load at risk and asks the Commission for guidance on a preferred methodology. The Commission is likely to consider this issue as part of the Review of Electricity System Planning, Monitoring and Reporting during 2010.

5.25 In light of the anticipated changes to network planning and reliability criteria due to work planned for 2010, the Commission does not consider a detailed overview of existing arrangements is necessary as part of the 2008-09 Review. The Commission expects that future Reviews (or other Commission papers) will report more comprehensive information on network planning and reliability outcomes.

Forecast electricity demand and network capacity-demand balance

5.26 The Network Planning and Reliability Report indicated that PWC Networks is forecasting peak demand growth of 2.5 per cent per year on average across the Territory, with higher than average load growth forecast in areas such as the Darwin central business district, Palmerston and East Arm peninsula. The specific demand growth rates for these areas and underlying assumptions are not provided.

5.27 The Network Planning and Reliability Report included details of the historical (2005-06 to 2008-09) and forecast (2009-10 to 2013-14) demand from, and capacity of the 30 zone substations in the Darwin-Katherine, Alice Springs and Tennant Creek systems. This data is provided in full in Appendix A.

5.28 The Commission has not independently tested the PWC Networks peak demand forecasts, and cannot assess the capacity of network assets relative to forecast demand. In particular, the Commission does not have sufficient data on the condition of network assets, and the associated capability of these assets to maintain security of supply. The Commission will review local load forecasts and the implications for the capital and operating program as part of the next network pricing determination process.

5.29 Table 5.2 below provides a summary of the data in Appendix A, focusing on the 8 zone substations where peak demand is forecast to be greater than the minimum firm capacity using the N-1 standard in the period 2008-09 to 2013-14.

Table 5.2: Selected zone substation reserve margin at N-1 capacity (MW), 2008-09 to 2013-14

Substation	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Palmerston 11/22 kV	-5.3	-5.6	-6.0	-6.3	-6.7	-7.0
Weddell 66/22 kV	1.1	-4.7	-4.9	-5.2	-5.4	-5.7
Mary River 66/22 kV	-1.3	-1.3	-1.4	-1.4	-1.4	-1.5
Manton 132/22 kV	-3.3	-3.3	-3.4	-3.4	-3.4	-3.5
Batchelor 132/22 kV	-11.3	-11.6	-11.8	-12.1	-12.4	-12.6
Katherine 132/22 kV	-1.2	-1.9	-2.6	-3.4	-4.1	-4.6
Frances Bay 66/11 kV	0.0	-17.2	-18.1	-19.0	-20.0	-20.4
Union Reef 66/11 kV	-5.4	-5.5	-5.7	-5.8	-5.9	-6.0

Source: Power and Water Corporation, November 2009, Power Networks Network Planning and Reliability Report

5.30 Using the minimum firm capacity based on the ratings of the substation transformers, the reserve margin of these 8 substations could be insufficient at times of forecast peak demand. As these substations have one transformer, N-1 is effectively zero, and the loss of the transformer, at times of high demand, would result in some load shedding, unless load can be shared between substations through the network. The Commission expects to examine the planning criteria and decision making processes for determining adequate reserve margin during 2010.

Response to forecast demand growth

5.31 PWC Networks has advised that the Archer zone substation is currently being constructed at a forecast cost of $29.8 million between 2009-10 and 2010-11. This substation will provide an alternative power supply to the Palmerston zone substation at 11 kV, and will act as a reserve power supply to the Palmerston area in the event of a failure at the Palmerston zone substation.

5.32 The Weddell-Archer-Hudson Creek 66 kV line began construction in 2008-09 and is expected to cost $13.5 million between 2008-09 and 2010-11. The construction of the 66 kV overhead line between the Weddell 66 kV Switching Station, the Archer zone substation and the Hudson Creek Terminal Station was considered the only effective way to ensure full output from Weddell power station is maintained at N-1 capacity.

5.33 PWC Networks has advised that installation of a second zone transformer and 66 kV lines to the Frances Bay zone substation will commence in 2011-12 at a forecast cost of $13.7 million. The project has been commissioned to improve the security of power supply for both the zone substation and the CBD area.

5.34 PWC has not provided any information to the Commission outlining its plans to meet the expected supply shortfalls for the Mary River, Manton, Batchelor, Katherine or Union Reef substations. The Commission will investigate this further and findings will be reported in future reviews. The Commission notes that conventional industry

practice means the N-1 security criteria is not met in all circumstances, particularly in those locations where the loss of load is not critical and where the cost of providing redundant capacity is relatively high.

5.35 PWC has developed a masterplan for the implementation of new zone substations to meet Darwin-Katherine and Alice Springs system requirements.[25] The following considerations are taken into account in determining the timing and location of new substations:

- the need to maintain a secure and reliable electricity supply;
- national and international economic conditions;
- likely connection of significant new customers;
- increase in load from existing customers; and
- prospective new large commercial, industrial and residential developments.

5.36 PWC Networks indicates that the response to forecast demand growth will involve a combination of network and non-network solutions:

- the PWC Networks demand management strategy is in a formative stage, and is to be developed over the coming years. Key areas identified for demand management include energy conservation, tariff structure, power factor correction, load shifting and embedded generation;
- PWC Networks will consider embedded generation as part of the broader demand management strategy, and notes that the power purchase agreements with Pine Creek, Shoal Bay and Brewer Estate power stations provide additional capacity. PWC continues to investigate if there is other capacity that might be available from commercial customers with standby generation in the Darwin-Katherine system. The Commission understands that PWC can make arrangements for the Department of Defence to self generate if necessary; and
- PWC Networks is spending an estimated $287 million from 2009-10 to 2013-14 augmenting and maintaining existing assets, and constructing new network assets.[26]

[25] Power and Water Corporation, Energy and Demand Forecasting and Planning Framework, Assumptions and Methodology.

[26] Power and Water Corporation, November 2009, Power Networks Network Planning and Reliability Report, page 6-7.

Network performance

5.37 This section reports on network performance for the Darwin-Katherine, Alice Springs and Tennant Creek systems in 2008-09 against the indicators specified in the Electricity Standards of Service Code, and compares this to historical results and the relevant standard.

5.38 This section also includes network related incidents reported by the System Controller for January to June 2009.

5.39 The Electricity Standards of Service Code requires PWC to report annually on actual network performance against the defined standards. The performance indicators for electricity networks are:

- system average interruption duration index (SAIDI), which is the average minutes of off supply per customer;
- system average interruption frequency index (SAIFI), which is the average number of interruptions per customer;
- customer average interruption duration index (CAIDI), which is the average interruption duration per customer;
- number of and percentage of customers on feeders on interconnected networks that experience more than 15 interruptions a year, and the percentage of customers affected;
- number of feeders on interconnected networks that experience more than 1500 minutes of interruptions a year;
- number of and percentage of customers on feeders on radial networks that experience more than 27 interruptions a year, and the percentage of customers affected; and
- number of feeders on radial networks that experience more than 2500 minutes of interruptions a year.

5.40 PWC reports that the agreed standard was breached for the following indicators in 2008-09:

- Darwin network SAIDI;
- Darwin network SAIFI;
- Tennant Creek network CAIDI;
- Alice Springs network SAIDI;
- Alice Springs network SAIFI;
- Alice Springs network CAIDI;

5.41 According to the information reported by PWC for 2008-09, PWC's network performance recorded one consecutive breach (based on adjusted data). The breach was for Alice Springs Network CAIDI. The standard average interruption duration per customer of 37 minutes was exceeded in 2008-09 (50 minutes) and in 2007-08 (47 minutes).

5.42 Overall, the majority of customers in the Territory experienced worse network performance in 2008-09 compared to 2007-08, mainly due to events at Casuarina zone substation in September and October 2008 and a severe storm in Alice Springs in September 2008. Although the reporting may conceal pockets of very poor

performance, the reliability of the worst performing feeders, in each region has improved in recent years (between 2006-07 and 2008-09) compared with previous years.

Network incidents

5.43 To provide some context to the network performance in the Darwin-Katherine system during 2008-09, table 5.3 briefly describes the major network related incidents in the Darwin-Katherine system reported by the System Controller for January to June 2009.[27]

Table 5.3: Major network power system incidents, January to June 2009

Date	Description
1 January	Manton zone substation outage due to CB Fail protection
17 January	HC-CZ 66 kV Feeder trip and reclose
25 February	WD-MM 66 kV Feeder trip *2
13 March	BE-CA 66 kV Feeder trip and reclose
2 April	11 kV Bus outage at Berrimah zone substation
27 April	11 kV Bus outage at Casuarina zone substation
11 June	Trip of City Zone Transformer 1 and bus outage of 11 kV Bus

Source: Power and Water Corporation, System Controller Half Year Report, January to June 2009.

5.44 As discussed in the Generation chapter, the Commission will be seeking further information related to power system incidents, including the date, location and cause of each event. This information will be provided in future reviews.

Excluded events

5.45 The Electricity Standards of Service Code allows PWC to adjust network performance data to exclude days where there is a major interruption to reliability. The intention is to remove events that are beyond the control of the network operator. Specifically:

The Regulated Electricity Entity may remove the effect of severe interruptions to supply on its key reliability indicators, based on the "2.5 Beta method"[28], in order to determine the underlying network-related reliability performance. Such severe interruptions are referred to as "network exclusion events". When an interruption meets the definition of a network exclusion event, the Regulated Electricity Entity must state the date the event occurred and provide a satisfactory description of the reasons for the excluded

[27] Power and Water Corporation: Half Year Report (January to June 2009). Page 4

[28] The "2.5 Beta method" excludes natural events which are more than 2.5 standard deviations greater than the mean of the log normal distribution of five regulatory years. On average, 3 to 4 days would be expected to be excluded each year.

event. The values of the relevant system-wide reliability indicators must nevertheless be reported in both unadjusted and adjusted terms.[29]

5.46 The 2.5 beta method is an objective statistics based methodology for identifying outlying performance. Instances may arise where an event may not be a statistical outlier, but is still an event that a network service provider cannot reasonably be expected to prevent or avoid. Because of this, some regulators take the approach of specifying a comprehensive list of events.[30]

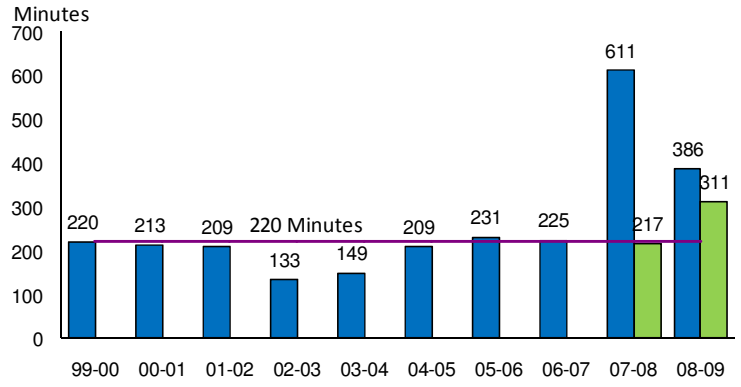
5.47 Charts 5.1 to 5.16 show adjusted and unadjusted data. Where the information has been provided, the Commission has noted the event that has been excluded.

Darwin region network performance

5.48 This section reports performance against the SAIDI, SAIFI and CAIDI indicators, as well as feeder results for the Darwin region for 1999-00 to 2008-09. Although they are part of the same system, network performance is reported separately for the Darwin region and Katherine.

5.49 A major event day was recorded for Darwin on 2 October 2008 following a failure at the Casuarina zone substation. SAIDI was adjusted downwards by 75 minutes.

Chart 5.1: SAIDI, Darwin, 1999-2000 to 2008-09



Source: Power and Water Corporation, Standards of Service, 2008-09

5.50 The agreed standard for the Darwin SAIDI is 220 minutes. This standard was breached by the adjusted result in 2008-09 by 91 minutes.

5.51 In 2007-08 network reliability in the Darwin region was affected by Cyclone Helen, which passed close by Darwin on 4 January 2008. PWC has indicated that this accounted for 394 SAIDI minutes being added to the 2007-08 result.

5.52 PWC has advised that average minutes off supply (SAIDI) was greater than the standard in 2008-09 primarily due to equipment failure in and around the Casuarina 66/11 kv zone substation in September and October 2008.

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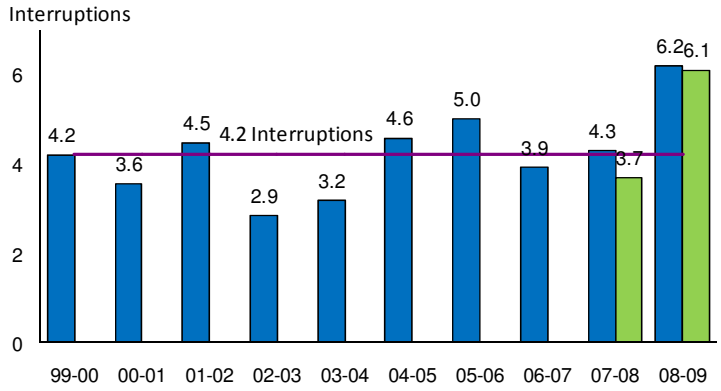
[29] Electricity Standards of Service Code, Schedule 1, clause 1.6.

[30] Refer Institute of Electrical and Electronic Engineers, Working Group on System Design, January 2003, Classification of Major Event Days.

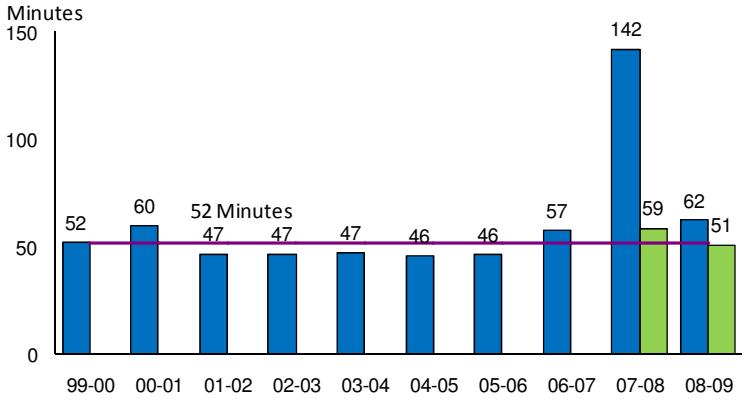
Chart 5.2: SAIFI, Darwin, 1999-2000 to 2008-09



Source: Power and Water Corporation, Standards of Service, 2008-09

5.53 The Darwin region average frequency of interruptions (SAIFI) of 6.2 interruptions breached the agreed standard of an average of 4.2 interruptions in 2008-09. The Darwin network SAIFI was adjusted downwards by 0.1 interruptions due to the major event day on 2 October 2008. The adjusted 2008-09 result of 6.1 interruptions is the highest in the decade, and is 45 per cent higher than the decade average of 4.2 interruptions. PWC attributes the high frequency of interruptions to the power outages associated with problems at the Casuarina zone substation, and subsequent outages to allow maintenance.

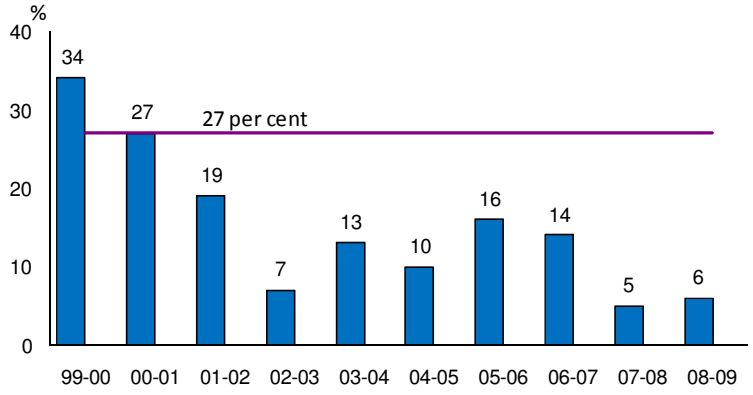
Chart 5.3: CAIDI, Darwin, 1999-2000 to 2008-09



Source: Power and Water Corporation, Standards of Service, 2008-09

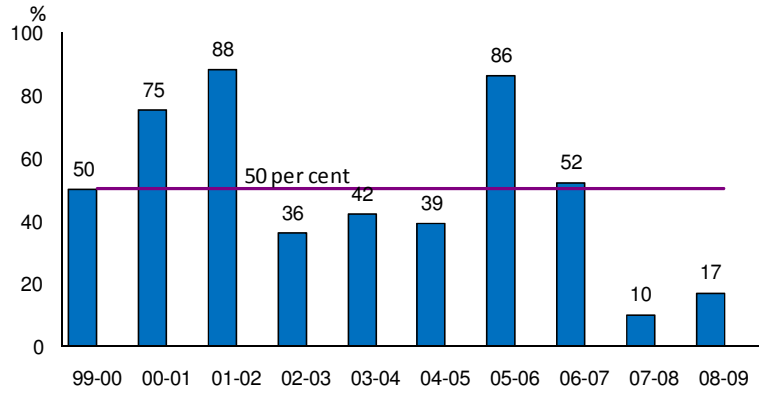
5.54 The Darwin region CAIDI of 51 minutes in 2008-09 was 1 minute below the agreed standard of 52 minutes. The average CAIDI for the decade was 51 minutes.

Chart 5.4: Percentage of consumers supplied by feeders that experience more than 15 interruptions per year, Darwin Urban, 1999-2000 to 2008-09



5.55 The percentage of consumers in the Darwin urban region supplied by feeders that experience more than 15 interruptions per year was 6 per cent in 2008-09, which is better than the agreed standard of 27 per cent, as well as the decade average of 15 per cent.

Chart 5.5: Percentage of consumers supplied by feeders that experience more than 27 interruptions per year, Darwin Rural, 1999-2000 to 2008-09



Source: Power and Water Corporation, Standards of Service, 2008-09

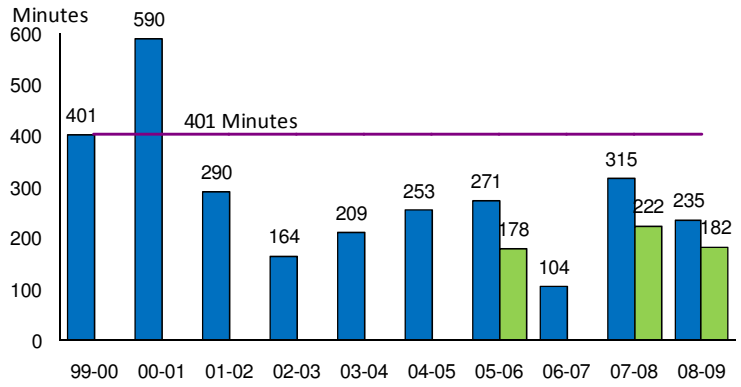
5.56 The percentage of consumers in the Darwin rural region supplied by feeders that experience more than 27 interruptions per year was 17 per cent in 2008-09. The average for the decade was 50 per cent.

Katherine region network performance

5.57 This section reports performance against the SAIDI, SAIFI and CAIDI indicators, as well as feeder results for the Katherine region for 1999-00 to 2008-09.

5.58 A major event day was recorded for the Katherine region on 12 May 2009 due to an outage caused by a flashover on the 22 kV distribution board. This affected about 1 400 customers for 125 minutes, and SAIDI was adjusted by 53 minutes.

Chart 5.6: SAIDI, Katherine, 1999-2000 to 2008-09

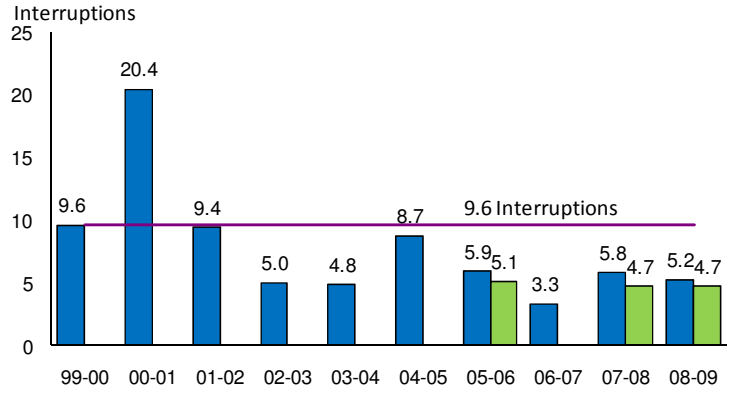


Source: Power and Water Corporation, Standards of Service, 2008-09

5.59 The agreed standard for SAIDI performance in Katherine is 401 minutes. The SAIDI performance in 2008-09 of 182 minutes is better than the agreed standard and an improvement on the 222 minutes reported in 2007-08. The average SAIDI result for the decade is 259 minutes.

5.60 PWC has indicated that a significant percentage of the feeder outages in the Katherine region can be attributed to local bat colonies clustering on the poles. PWC has responded by continuing the insulation of feeders in at risk areas. The Commission will be monitoring the progress of this task and will report findings in future reviews.

Chart 5.7: SAIFI, Katherine, 1999-2000 to 2008-09

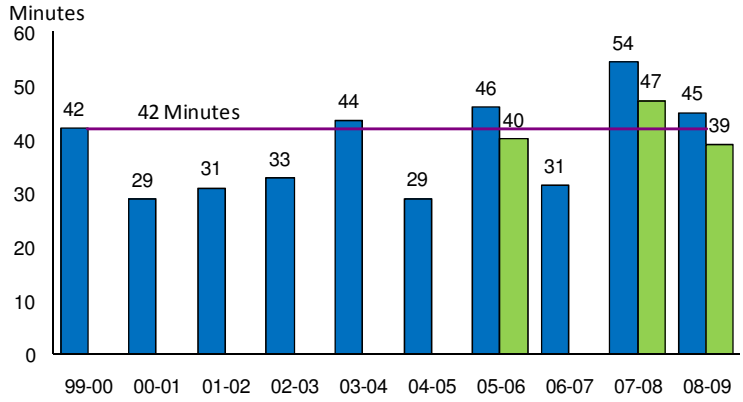


Source: Power and Water Corporation, Standards of Service, 2008-09

5.61 The agreed standard for the Katherine SAIFI is an average of 9.6 interruptions per customer. The 2008-09 adjusted result of 4.7 interruptions was better than the agreed standard and the decade average of 7.6 interruptions. Katherine network SAIFI was adjusted downwards by 0.5 interruptions due to the major event day on 12 May 2009.

5.62 PWC has reported that ongoing network upgrades and continuation of maintenance programs in the Katherine region have contributed to the decrease in the number of interruptions.

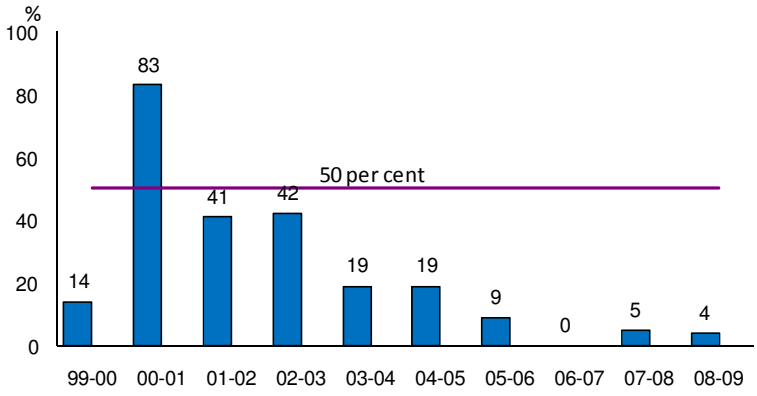
Chart 5.8: CAIDI, Katherine, 1999-2000 to 2008-09



Source: Power and Water Corporation, Standards of Service, 2008-09

5.63 The Katherine region CAIDI of 39 minutes in 2008-09 was better than the agreed standard of 42 minutes, however was worse than the average CAIDI for the decade of 37 minutes.

Chart 5.9: Percentage of consumers supplied by feeders that experience more than 27 interruptions per year, Katherine, 1999-2000 to 2008-09



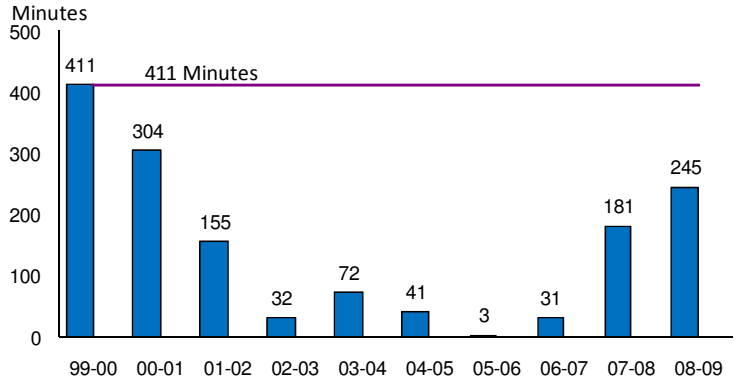
Source: Power and Water Corporation, Standards of Service, 2008-09

5.64 The percentage of consumers in the Katherine region supplied by feeders that experience more than 27 interruptions per year was 4 per cent in 2008-09, which is better than the minimum agreed standard of 50 per cent, as well as the decade average of 24 per cent, which includes the outlier in 2000-01.

Tennant Creek network performance

5.65 This section reports performance against the SAIDI, SAIFI and CAIDI indicators for Tennant Creek for 1999-00 to 2008-09.

Chart 5.10: SAIDI, Tennant Creek, 1999-2000 to 2008-09

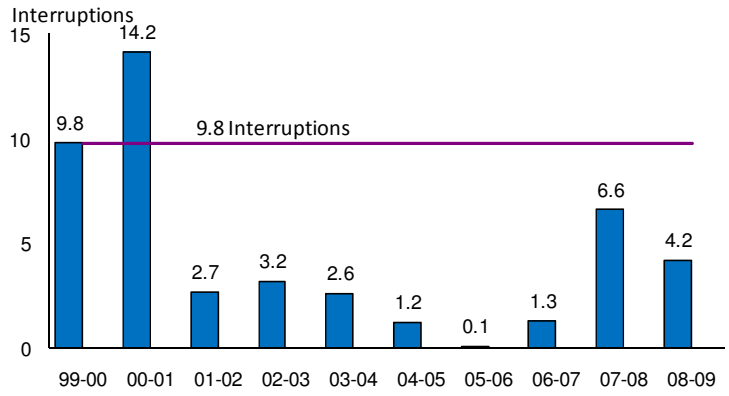


Source: Power and Water Corporation, Standards of Service, 2008-09

5.66 The minimum agreed standard for SAIDI in Tennant Creek is 411 minutes. The SAIDI performance in 2008-09 of 245 minutes is better than the agreed standard, however was worse than the decade average of 148 minutes.

5.67 PWC has indicated that the standard for Tennant Creek may no longer reflect the operating environment of the region.

Chart 5.11: SAIFI, Tennant Creek, 1999-2000 to 2008-09

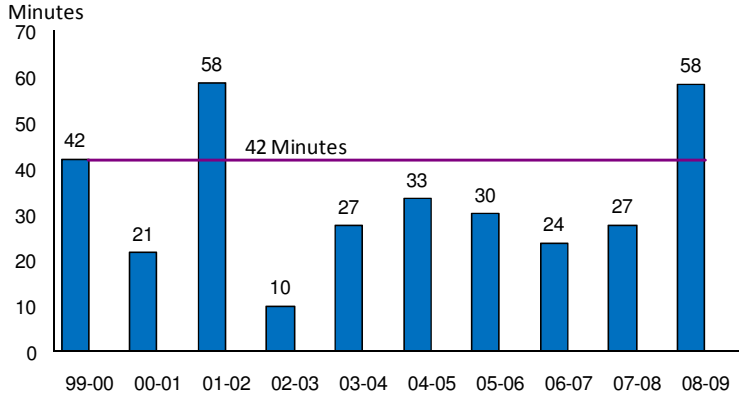


Source: Power and Water Corporation, Standards of Service, 2008-09

5.68 The agreed standard for the Tennant Creek SAIFI is an average of 9.8 interruptions per customer. The 2008-09 result of 4.2 interruptions is better than the agreed standard, as well as the decade average of 4.6 interruptions.

5.69 PWC advise that ongoing network upgrades and the continuation of maintenance programs in Tennant Creek have contributed to the decrease in the number of interruptions.

Chart 5.12: CAIDI, Tennant Creek, 1999-2000 to 2008-09



Source: Power and Water Corporation, Standards of Service, 2008-09

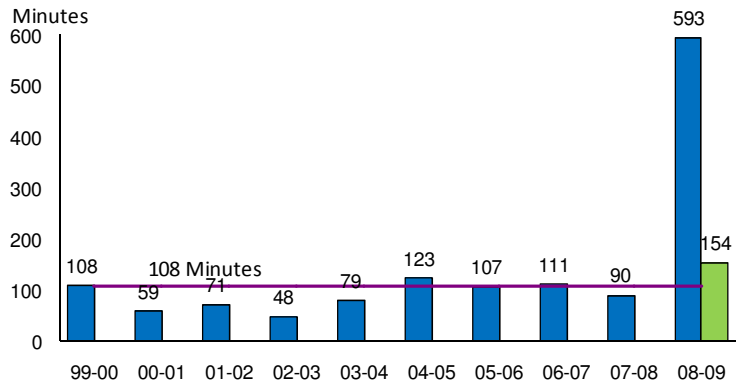
5.70 The Tennant Creek CAIDI in 2008-09 of 58 minutes was worse than the agreed standard of 41.8 minutes, as well as the decade average of 33 minutes.

Alice Springs network performance

5.71 This section reports performance against the SAIDI, SAIFI and CAIDI indicators, as well as feeder results for Alice Springs for 1999-00 to 2008-09

5.72 A major event day was recorded for Alice Springs on 22 September 2008 when strong wind and flying debris caused by a severe storm caused power outages on a number of feeders. SAIDI was adjusted downwards by 439 minutes.

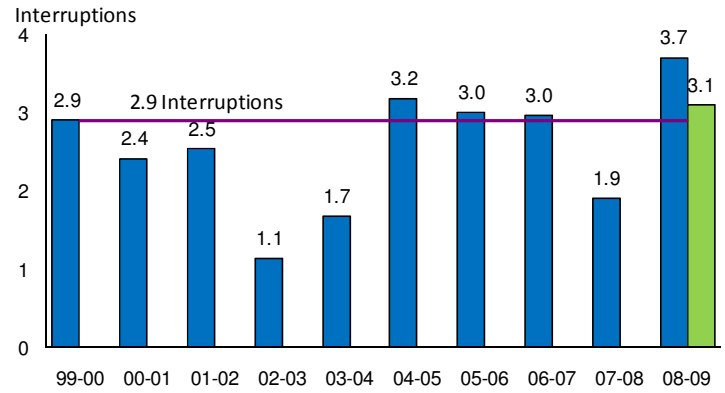
Chart 5.13: SAIDI, Alice Springs, 1999-2000 to 2008-09



Source: Power and Water Corporation, Standards of Service, 2008-09

5.73 The agreed standard for the Alice Springs SAIDI is an average of 108 minutes per customer. The 2008-09 result of 154 minutes is worse than the agreed standard, as well as the decade average of 95 minutes.

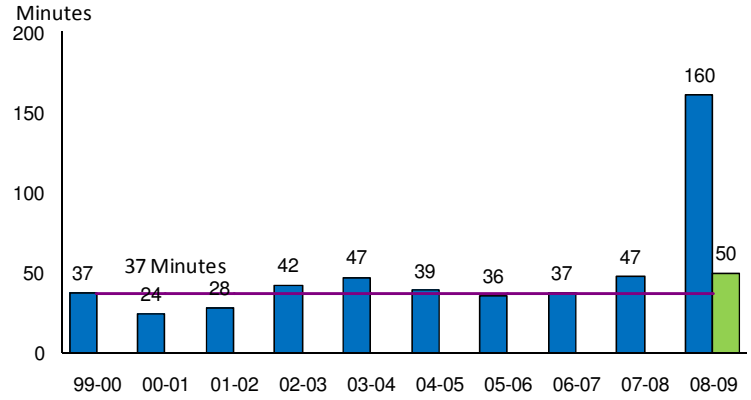
Chart 5.14: SAIFI, Alice Springs, 1999-2000 to 2008-09



Source: Power and Water Corporation, Standards of Service, 2008-09

5.74 The Alice Springs SAIFI exceeded the agreed minimum standard of an average 2.9 interruptions per customer in 2008-09, recording an average of 3.1 interruptions. The 2008-09 result was also higher than the decade average of 2.5 interruptions. The major event day on 22 September 2008 meant that Alice Springs network SAIFI was adjusted downwards by 0.6 interruptions.

Chart 5.15: CAIDI, Alice Springs, 1999-2000 to 2008-09

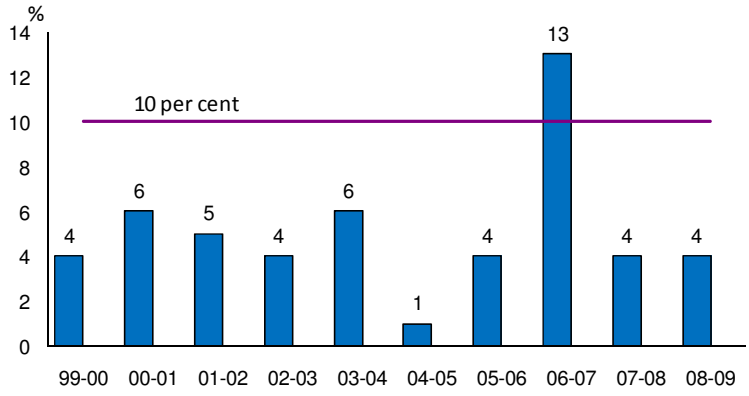


Source: Power and Water Corporation, Standards of Service, 2008-09

5.75 The Alice Springs CAIDI in 2008-09 of 50 minutes was above the agreed standard of 37.2 minutes, and the highest recorded performance of the past decade.

5.76 The Alice Springs CAIDI has exceeded the agreed standard in five of the past seven years, with the average performance for the decade being 39 minutes.

Chart 5.16: Percentage of consumers supplied by feeders that experience more than 15 interruptions per year, Alice Springs, 1999-2000 to 2008-09



Source: Power and Water Corporation, Standards of Service, 2008-09

5.77 The percentage of consumers in Alice Springs supplied by feeders that experience more than 15 interruptions per year was 4 per cent in 2008-09, which is better than the agreed standard of 10 per cent, as well as the decade average of 5 per cent.

CHAPTER 6

Customer Service Indicators

6.1 This chapter reports on customer service performance for the Darwin-Katherine, Alice Springs and Tennant Creek systems in 2008-09, and reviews this against the agreed standards specified in the Electricity Standards of Service Code.

Table 6.1: New connections not provided to existing supply properties within 24 hours

NT wide (%)	Agreed Standard	2005-06	2006-07	2007-08	2008-09
All Customers	2	0	1	1	0.8

Source: Power and Water Corporation, Standards of Service, 2008-09

6.2 The agreed standard for the percentage of new connections not provided to existing supply properties within 24 hours is 2 per cent. In 2008-09 there were 5 166 new connections, of which 40 were not made within the required timeframe, this equates to 0.77 per cent, which is better than the agreed standard.

Table 6.2: New connections not provided to new subdivisions in urban areas within 5 working days

NT wide (%)	Agreed Standard	2005-06	2006-07	2007-08	2008-09
All Customers	10	7	19.3	16	8.7

Source: Power and Water Corporation, Standards of Service, 2008-09

6.3 In 2008-09 the percentage of new connections not provided to new subdivisions in urban areas within five working days was 8.7 per cent, which is better than the agreed standard of 10 per cent, as well as the reporting period average of 12.8 per cent. In 2008-09 there were a total of 1 828 new connections to new subdivisions, of which 159 were not completed within the specified timeframe.

6.4 During the 2006-07 and 2007-08 reporting periods the agreed standard for the number of new subdivision connections was breached, with PWC attributing this to a significant increase in the total number of new connections required.

Table 6.3: New connections not provided to new subdivisions where minor extensions or augmentation is required in urban areas within 10 weeks

NT wide (%)	Agreed Standard	2005-06	2006-07	2007-08	2008-09
All Customers	35	30	32	32	66.5

Source: Power and Water Corporation, Standards of Service, 2008-09

6.5 The agreed standard for new connections not provided to new subdivisions where minor extensions or augmentation is required in urban areas within 10 weeks is 35 per cent. In 2008-09, 66.5 per cent of new connections took more than 10 weeks to provide where minor extension or augmentation was required. In 2008-09 there were a total of 158 new connections, with 105 of these connections not completed within the specified 10 week period.

6.6 PWC has indicated that failure to meet the agreed standard for 2008-09 breach is due to maintenance commitments within RAMP and the associated resource shortages.

Table 6.4: The number and percentage of telephone calls responded to within 20 seconds from when the customer selects to speak to a human operator

NT wide (%)	Agreed Standard	2005-06	2006-07	2007-08	2008-09
All Customers	58 679	NA	96 562	78 453	87 013
All Customers	63	76	69	58	62

Source: Power and Water Corporation, Standards of Service, 2008-09

6.7 In 2008-09 the percentage of telephone calls responded to within 20 seconds from when the customer selects to speak to a human operator was 62 per cent, which is slightly worse than the agreed standard which requires 63 percent of calls to be answered within the specified time limit.

6.8 All calls to PWC concerning electricity are recorded, including retail enquiries about accounts and other matters, as well as network related calls, e.g. regarding connections and interruptions to supply.

6.9 PWC advises that the failure to meet the agreed standard in 2008-09 was due to system and resource constraints as well as an increase in total volume of telephone calls received. The Commission is advised that several process changes were implemented by PWC in the second half of 2008-09 to address this standard, including software upgrades, staff relocation and expanded training for new staff.

Table 6.5: Total customer complaints

NT Wide	Agreed Standard	2005-06	2006-07	2007-08	2008-09
Darwin				1 778	1 718
Katherine				121	160
Tennant Creek				42	39
Alice Springs				391	318
All Customers	5 146	3 000	1 917	2 332	2 235

Source: Power and Water Corporation, Standards of Service, 2008-09

6.10 The agreed standard for the number of customer complaints received by PWC is 5 146. In 2008-09 a total of 2 235 complaints were received which was below the agreed standard and the reporting period average of 2 371.

6.11 The most common complaint types received by PWC in 2008-09 were about billing, level of service and pension concession. Table 6.6 provides a breakdown of the main complaints by type. 'Other' includes complaints on matters such as streetlight faults, meter reads and change of ownership.

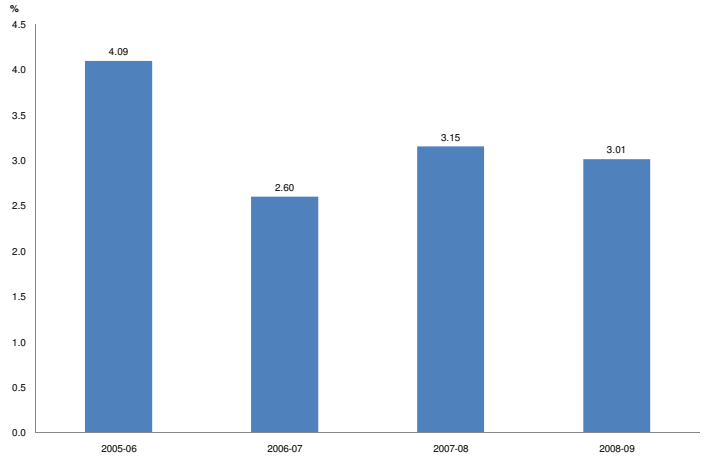
Table 6.6: Customer complaint types

Complaint type	2008-09
Billing	1 106
Level of service	341
Pension concession	299
High bill	120
Other	369
Total	2 235

Source: Power and Water Corporation, Standards of Service, 2008-09.

6.12 Chart 6.1 shows the total number of customer complaints as a percentage of retail customers. The average percentage of complaints recorded by PWC during this period was 3 per cent.

Chart 6.1: The number of customer complaints as a percentage of total customers



Source: Power and Water Corporation, Standards of Service, 2005-06 to 2008-09 and PWC 2009 Annual Report.

6.13 To provide a comparison with elsewhere in Australia, the Commission has undertaken a basic estimate of electricity retail related complaints received by PWC, and considers about 2.2 per cent of complaints in 2008-09 to be retail related. In contrast, the number

of customer complaints received by retailers in the NEM in 2008-09 as a percentage of customers was less than one percent.[31]

[31] Australian Energy Regulator, State of the Energy Market 2008, page 194

Appendix A: Substation capacity 2008-09

						Actual				*Forecast*				
Zone Substations - Northern & Southern Regions	**Number of Transformers**	**Max. Capacity MVA[1]**	**Min. Capacity MVA[1]**	**Max. Firm Capacity MVA[2]**	**Min. Firm Capacity MVA[2]**	**2006 Demand MVA**	**2007 Demand MVA**	**2008 Demand MVA**	**2009 Demand MVA**	**2010 Demand MVA**	**2011 Demand MVA**	**2012 Demand MVA**	**2013 Demand MVA**	**2014 Demand MVA**
Palmerston 11/22kV	1	7.5	7.5	0.0	0.0	4.5	4.7	5.0	5.3	5.6	6.0	6.3	6.7	7.0
McMinns 66/22kV	3	40.5	30.0	27.0	20.0	16.3	16.7	17.2	17.7	18.1	18.6	19.1	19.6	20.1
Weddell 66/22kV	2	10.0	10.0	5.0	5.0	3.6	3.7	3.8	3.9	9.7	9.9	10.2	10.4	10.7
Humpty Doo 66/22kV	3	7.5	7.5	5.0	5.0	1.4	1.5	1.5	1.5	1.6	1.6	1.7	1.7	1.7
Mary River 66/22kV	1	5.0	5.0	0.0	0.0	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.4	1.5
Marrakai 66/22kV	2	5.0	5.0	2.5	2.5	-	-	-	-	1.0	1.5	1.5	1.6	1.6
Manton 132/22kV	1	27.0	20.0	0.0	0.0	3.2	3.2	3.3	3.3	3.3	3.4	3.4	3.4	3.5
Batchelor 132/22kV	1	27.0	20.0	0.0	0.0	10.5	10.7	11.0	11.3	11.6	11.8	12.1	12.4	12.6
Pine Creek 11/66kV	2	40.0	40.0	20.0	20.0	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3
Katherine 132/22kV	2	54.0	40.0	27.0	20.0	26.2	26.8	27.5	28.2	28.9	29.6	30.4	31.1	31.6
Berrimah 66/11kV	2	76.0	50.0	38.0	25.0	30.3	30.9	31.6	32.2	32.9	33.4	23.3	15.0	16.0
Leanyer 66/11kV3	2	54.0	40.0	27.0	20.0	-	-	-	-	-	-	10.1	10.3	10.5
Casuarina 66/11kV	3	114.0	75.0	76.0	50.0	37.4	38.0	38.6	39.2	44.8	45.6	26.0	26.7	27.1
Snell Street 66/11kV	4	47.0	40.0	35.0	30.0	31.0	31.5	31.9	32.4	32.9	33.4	33.9	34.4	34.9
East Arm 66/11kV3	2	54.0	40.0	27.0	20.0	-	-	-	-	-	-	-	11.3	11.5
City Zone 66/11kV	3	120.0	90.0	80.0	60.0	49.4	51.9	54.4	56.1	43.6	45.8	42.0	43.0	44.0
Frances Bay 66/11kV3	1	40.0	30.0	0.0	0.0	-	-	-	-	17.2	18.1	19.0	20.0	20.4
66/11kV tx 2 (2012)	2	80.0	60.0	40.0	30.0	-	-	-	-	-	-	25.0	26.0	27.0
Centre Yard 66/11kV	2	1.0	1.0	0.5	0.5	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Radio Australia 66/11kV	2	9.0	7.0	4.5	3.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Palmerston 66/11kV	2	80.0	60.0	40.0	30.0	31.3	33.2	35.1	37.2	22.5	23.8	25.2	26.7	27.8
Archer 66/11kV3	2	54.0	40.0	27.0	20.0	-	-	-	-	16.9	17.9	18.9	20.1	20.9
Pine Creek 11/22kV	4	10.0	10.0	7.5	7.5	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8
Union Reef 66/11kV	1	12.5	10.0	0.0	0.0	5.0	5.1	5.3	5.4	5.5	5.7	5.8	5.9	6.0
Brocks Creek 66/11kV	2	7.0	7.0	3.5	3.5	1.5	1.5	1.6	1.6	1.7	1.7	1.7	1.8	1.8
Cosmo Howley 66/11kV	2	15.0	15.0	7.5	7.5	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
Alice Springs - Lovegrove 22/11kV	3	35.0	25.0	20.0	15.0	14.6	14.9	15.1	15.1	15.5	15.9	16.3	16.7	17.1
Alice Springs - Sadadeen 22/11kV4	2	38.0	30.0	19.0	15.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Alice Springs - Ron Goodin4	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Tennant Creek4	2	15.0	15.0	7.5	7.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Network - Substation Totals	**61**	**1085.0**	**830.0**	**546.5**	**417.5**	**272.8**	**281.2**	**289.8**	**297.5**	**320.7**	**331.2**	**339.7**	**352.9**	**361.8**

Notes:

1. Maximum and minimum capacity are based on the ratings of the substation transformers.
2. Based on N-1 contingency criteria (i.e. the loss of one transformer). Example: Pine Creek Zone Substation consists of 2 transformers rated at 20 MVA; if one transformer fails the minimum firm capacity is 20 MVA.
3. Actual and forecast demand commences from completion of construction of the zone substation.
4. Sadadeen, Ron Goodin and Tennant Creek are stations with generators. Loading on the transformers depends on the generators dispatched.