ANNUAL POWER SYSTEM REVIEW

DECEMBER 2004

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Table of Contents

Disclaimer

This review is based upon information received from participants in the Territory's electricity supply industry, and agencies within government on a 'reasonable endeavours' basis. The review contains certain predictions, estimates and statements that reflect various assumptions concerning load growth forecasts including accounting for major developments which may impact on the Territory's power system over the period to 2013-14. The Commission believes that the contents are accurate within the normal tolerance of economic forecasts and that the broad analyses are correct.

The purpose of this document is to review and report to the Minister in accordance with section 45 of the Electricity Reform Act 2000. It is not intended to be relied upon or used for other purposes, such as making decisions to invest in further generation or network capacity. Any person proposing to use the information in this document for such other purposes should independently verify the accuracy, completeness, reliability and suitability of the information in this document, and the reports and other information relied upon by the Commission in preparing it. The Commission and its officers accept no liability (including liability to any person by reason of negligence) for any use of the information in this document 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 document or otherwise.

CHAPTER 1

INTRODUCTION

1.1 This is the fourth annual review of prospective trends in the capacity and reliability of the Territory's power system relative to projected load growth prepared and published by the Commission pursuant to section 45(1)(e) of the *Electricity Reform Act 2000* ("the Act").

1.2 This *Annual Power System Review* ("2004 Review") also incorporates related activities by the Commission authorised under section 45 of the Act, namely:

- developing forecasts of overall electricity load and generating capacity in consultation with participants in the electricity supply industry and reporting the forecasts to the Minister and electricity entities (sub-section (1)(a)); and
- advising the Minister on matters relating to the future capacity and reliability of the Territory's power system relative to forecast load (sub-section (1)(c)).

Consultation with interested parties

1.3 The Commission has again consulted with various parties, including participants in the Territory's electricity supply industry and agencies within Government. This report has benefited significantly from the comments received from parties consulted by the Commission, although the views expressed in the report are those of the Commission alone and are not necessarily those of the parties consulted.

Inquiries

1.4 Inquiries regarding the 2004 Review should be directed in the first instance to:

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CHAPTER 2

SUMMARY OF KEY FINDINGS

2.1 The primary focus of the 2004 Review is on whether the power system has:

- adequate generation capacity; and
- adequate fuel supplies

to keep it reliable over the next decade in all but the most extraordinary circumstances.

2.2 In addition, the Commission foreshadows broadening the scope of future reviews to include consideration of the role that the power system network plays in the delivery of reliable supply to electricity users.

Adequacy of generation capacity

2.3 The Commission's assessment of the 'adequacy' of generation capacity in the Territory's regulated power systems has involved a comparison of various electricity demand forecasts over the next decade with forecast supply including allowing an appropriate reserve margin.

2.4 In its analysis of the future supply/demand balance, the Commission has included the program of planned capacity additions and renewals submitted by the Power and Water Corporation ("Power and Water"). In doing so, the Commission has recognised that it is unrealistic to assess the adequacy of generation capacity in the light of growing demand while assuming that capacity remains static.

2.5 It must be borne in mind, however, that one consequence of taking this approach is to make the Commission's conclusions on the adequacy of generation capacity subject to the important qualification that Power and Water implements the program it has submitted as specified.

Alice Springs regulated system

2.6 As noted in last year's review, the most pressing supply situation in prospect continues to be in the Alice Springs system, with a breach of the existing 13MW reserve margin occurring in the current year. Power and Water is addressing this situation through the installation of temporary capacity later this year and the addition of new capacity in 2005-06.

2.7 Beyond this period, the supply situation in the Alice Springs system will require close monitoring. Under the Commission's higher growth demand scenario for Alice Springs, which assumes annual growth in demand averaging 3%, the supply situation is projected to remain tight for the remainder of the decade despite the program of planned capacity additions.

Darwin-Katherine regulated system

2.8 The situation in the Darwin-Katherine system continues to be adequate over the medium term, with reserve capacity in excess of projected peak demand in most years of the review period.

2.9 Nevertheless, this conclusion is contingent upon the introduction of an additional 44MW of capacity in 2008-09.

2.10 If demand follows the Commission's higher growth scenario for Darwin-Katherine, which assumes annual growth in demand averaging 3½%, supply will be tight in 2007-08, making the timing of the additional capacity critical. Under this scenario, further supply pressures are projected to arise in the later years of the review period.

Tennant Creek regulated system

2.11 Given the program of planned capacity renewals and additions, capacity is projected to remain adequate in the Tennant Creek system over the review period.

2.12 However, the small size of the system means that this outlook has the potential to change depending on the commencement of major new mining and industrial developments requiring power from the system.

Adequacy of gas supplies

2.13 Currently, the availability of adequate supplies of economically-priced gas ranks as the most significant issue for the power system over the review period.

2.14 The Territory's electricity system requires a supply of gas that is economically priced, secure and sufficiently flexible to meet an uncertain future electricity demand. The demand scenarios developed by the Commission indicate the variability in future gas requirements that need to be accommodated.

2.15 Power and Water is faced with the additional difficulty of managing the transition from reliance on a source of gas that has proven to be problematic to a more sustainable long-term arrangement.

2.16 The Commission has formed the view that during the course of the last twelve months the prospective supply situation from the Amadeus Basin has at best remained static, and possibly tightened further. In addition, the possibility that competing purchasers of the available gas will arise over the critical next few years cannot be discounted. As a consequence, the Commission considers that the prospect of a shortfall in gas supplies from the Amadeus Basin has increased, and that there is increased risk that the shortfall may be significant.

2.17 At the same time, progress has continued to be made in the development of offshore gas reserves. However, the Commission notes that since the last review was completed no firm arrangements that provide Power and Water with access to offshore gas have been disclosed.

2.18 The Commission considers that, in the short term, gas supplies are adequate.

2.19 However, until alternative longer-term arrangements are in place, it is not possible to say with reasonable confidence that sufficient gas supplies will be available *at acceptable cost* to maintain power system adequacy in the latter years of this decade.

2.20 In part this is unavoidable. Negotiations are necessarily conducted on a commercial-in-confidence basis. Moreover, the Territory is in the fortunate position of being on the threshold of a period of significant development of the extensive nearby gas reserves. This will provide opportunities for an economic and secure supply of gas to the power system in the long term, and scope for transitional arrangements in the medium term.

2.21 Nevertheless, it is of concern to the Commission that the situation is continuing to tighten with the passage of time.

Network reliability

2.22 While the scope of section 45(1) of the Act covers the Territory's power system as a whole (and so both generation and network elements of the system), this review continues to focus mainly on generation reliability. In the Commission's view, network adequacy is not as pressing an issue in the Territory, with Power and Water, as the sole network service provider, charged with responsibility for ensuring that capacity keeps pace with usage growth.

2.23 However, the Commission is concerned to ensure that the relevance of network adequacy is not overlooked. The dangers of ignoring this aspect of supply are demonstrated by the experience of other Australian States, where in recent years there have been a number of cases in which the reliability of supply has been affected by the adequacy of network capacity. Accordingly, a section discussing network adequacy is included for the first time in this review.

2.24 Measuring and managing adequacy is arguably more complex for a power system network than for generating capacity. Over the next year, the Commission will consider further the issue of network adequacy, with a view to including such an assessment in the 2005 Power System Review.

CHAPTER 3

FOCUS OF THE REVIEW

3.1 The focus of the 2004 Review is predominantly on whether the power system will be able to reliably meet the supply requirements of end-use customers over the next decade in all but the most extraordinary circumstances.

3.2 As in previous years, the reliability of supply is examined in terms of the adequacy of generation capacity and fuel supplies.

3.3 In addition, the Commission has broadened the scope of this review to include consideration of the role that the power system network plays in the delivery of a reliable supply to electricity users.

3.4 This chapter briefly outlines the main terms used in discussion of a power system's reliability and explains the Commission's particular focus.

Nature of power system 'reliability'

3.5 Two aspects of a power system's *reliability* can be distinguished:[1]

- ***adequacy***, which is the power system's ability to supply the aggregate energy requirements of end-use customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements; and
- ***security***, which is the power system's ability to withstand sudden disturbances such as electric short circuits or unanticipated loss of system elements.

3.6 Adequacy is a matter of installed generating capacity, contracted fuel supply and network infrastructure capable of delivering generated electricity to the end user's point of connection. Adequacy does not fluctuate from minute to minute. Security refers to the system's ability to withstand contingencies,[2] and system security can change from minute to minute. Immediately after a contingency, the system is much less secure.

[1] This distinction is based on the North American Electric Reliability Council's (NERC) 1996 glossary of terms, cited in Steven Stoft, *Power System Economics*, IEEE Press, New Jersey, 2002, p.135.

[2] A contingency is a possible or actual breakdown of a physical component of the power system. Typically, a generation unit becomes unavailable, leaving the system unbalanced with demand greater than supply. System frequency and voltage drop as a consequence, and the system controller may need to shed load.

3.7 A key determinant of the adequacy of power system capacity is what is termed the *planning reserves* of the power system, being the reserves required to maintain system adequacy by meeting annual demand peaks. This contrasts with *operating reserves*, which are required to maintain system security by handling short-term disturbances to the system.[3]

3.8 Although security and adequacy are distinct concepts, they are closely linked. A system with adequate capacity can maintain enough security to reduce periods of involuntary load shedding to, say, a total of 1 day in 10 years. A system that maintains security for all but one day in 10 years can be said to have adequate installed capacity. Nevertheless, the two aspects of reliability are not simply different views of the same problem. With an inappropriate policy on operating reserves, the system will have insufficient security in spite of adequate capacity.

Reasons for the Commission's focus

3.9 The focus of the Commission's annual power system reviews to date has been on the adequacy issue (and associated *planning reserves*), on the basis that adequacy is the primary economic problem.[4] Analysis of the requirements for *operating reserves* (which are intended to provide security) continues to be excluded from the 2004 Review.

3.10 This is not to suggest that a shortage of installed power system capacity (and so inadequate planning reserves) is the only cause of unreliable operation. However, the potential for market failure is greatest when it comes to planning for increments in capacity, because provision of system adequacy is relatively expensive. Security requirements are more likely to be met provided the system has adequate planning reserves, and it is relatively cheap to maintain sufficient operating reserves in an adequate system. Moreover, maintaining security is the primary responsibility of the power system controller. By contrast, the power system controller currently does not have any responsibilities when it comes to ensuring adequacy – this remains solely with service providers (and the Commission). Hence, from the Commission's external monitoring perspective, the problem of security is considered secondary to the problem of adequacy.

3.11 In the 2004 Review, the Commission has continued to reassess its evaluation of power system reliability including examining the gas supply outlook and any implications for system reliability (both adequacy and security) in the Territory.

3.12 Nevertheless, the 2004 Review remains limited in certain other respects. First, while the scope of section 45(1) of the Act covers the Territory's power system as a whole (and so both generation and network elements of the system), this review continues to focus mainly on generation reliability. In the Commission's view, network adequacy is not as pressing an issue in the Territory, with Power and Water, as the sole network service provider, charged with responsibility for ensuring that capacity keeps pace with usage growth. It is in the generation area where there is most potential for market failure when it comes to planning for increments in capacity, and where the Commission continues to give priority.

3.13 However, the Commission is concerned to ensure that the relevance of network adequacy is not overlooked. The dangers of ignoring this aspect of supply are demonstrated by the experience of other Australian States, where in recent years there have been a number of cases in which the reliability of supply has been affected by the

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[3] Operating reserves include spinning reserves.

[4] While section 45(1) of the Act refers to the future capacity and reliability of the Territory's power system, this review limits its concern to those aspects of the reliability of the system arising from supply relative to demand and reserve margins.

adequacy of network capacity. Accordingly, a section discussing network adequacy is included for the first time in this review.

3.14 Secondly, coverage of the review is limited to the customers supplied in the regulated power systems of Darwin-Katherine, Tennant Creek and Alice Springs. The load outside this network coverage (e.g., isolated systems, rural townships and remote aboriginal communities) is not included in the review.

3.15 Finally, the review has not undertaken any sophisticated modelling of power demand. Instead, the Commission has developed its own demand scenarios which are predominantly based on the growth assumptions and methodology used by Power and Water and the longer-term experience.

CHAPTER 4

OUTLOOK FOR ELECTRICITY DEMAND

4.1 This chapter develops forecasts for electricity demand in the Territory's regulated power systems for the period to 2013-14.

4.2 In developing the forecasts, the Commission has taken account of current economic projections and participants' views on future electricity demand, including views on the quantum and timing of electricity demand of prospective major developments.

4.3 Generally, the Commission has taken a cautious approach to forecasting the impact of major developments. This involves factoring-in demand increases from the earliest point they could impact the system and, at the same time, assigning a high probability to associated developments taking place.

Baseline demand forecast

4.4 Consistent with the approach taken in last year's review, demand has been forecast in a two-stage process to illustrate the load growth *likely* to occur in the Territory over the period to 2013-14. The first stage is a 'baseline' demand forecast, showing demand in the Territory based on a moderate economic growth scenario and excluding the impact of both one-off projects and possible major developments. The second stage incorporates the forecasts associated with both one-off and prospective developments, principally mining and resource-based projects. Together, these two stages provide an overall picture of prospective power demand in the Territory.

4.5 The Commission has adopted forecasts of baseline growth and major developments that are consistent with Power and Water's current views of future demand conditions.

4.6 Electricity sourced from Independent Power Producers ("IPPs") connected to the regulated network have been included in the figures. Minor centres with their own independent generating capacity have been excluded.

4.7 As an additional aid to understanding the potential range for future electricity demand in the Territory, the Commission has included a projection of demand based on average rates of growth experienced over the last 10 to 12 years. In recent years, demand growth has slowed below the longer-term average. This raises the question of whether the slow-down reflects a change in the underlying behaviour of demand, or whether it represents a short-term departure from trend that will be reversed in future years. If the latter, then longer-term projections based on recent rates of growth will underestimate future demand.

4.8 Consistent with Power and Water's current view on load growth over the period to 2013-14, the Commission's baseline demand assumptions underlying the forecasts are:

- 2% average annual growth in electricity demand in the Darwin-Katherine regulated system (compared with an average of 2.4% forecast in last year's review);
- 2% average annual growth in electricity demand in the Alice Springs regulated system (compared with 1.2% in last year's review); and
- 1% average annual growth in electricity demand in the Tennant Creek regulated system (compared with 1.1% in last year's review).

4.9 The baseline demand forecasts do not take into account the demand for the projects relating to proposed major developments ("direct demand"). The demand flow-on effects provided by these developments, such as the increase in workforce and commercial services ("indirect demand"), are also excluded from the baseline forecast. These components of demand are considered later in this chapter.

4.10 2003-04 is the base year to which the forecast rates of growth are applied. Peak demand in the Darwin-Katherine system during 2003-04 was 226.7MW, down from 233.0MW in the 2002-03 year. Peak demand in the Alice Springs system increased from 47.5MW in 2002-03 to 49.3MW in 2003-04. In the Tennant Creek system peak demand declined from 7.5MW in 2002-03 to 7.0MW in 2003-04.

4.11 The 'baseline' peak demand and energy use forecasts through to 2013-14 in each regulated system are summarised in table 4.1 below. The electricity generation is on an annual 'sent-out energy' basis. For the purposes of this review, forecast energy and peak demand growth rates are assumed to be identical.

Table 4.1 – Peak Demand and Energy
Actual and Forecast – Regulated Systems

	Darwin-Katherine		Alice Springs		Tennant Creek	
Financial Year	**Demand (MW)**	**Energy (GWh)**	**Demand (MW)**	**Energy (GWh)**	**Demand (MW)**	**Energy (GWh)**
2000-01	218	1291	44	205	6	27
2001-02	223	1357	43	210	7	31
2002-03	233	1253	48	220	8	33
2003-04	227	1241	49	223	7	30
2004-05	231	1266	50	228	7	30
2005-06	236	1292	51	232	7	30
2006-07	241	1317	52	237	7	31
2007-08	245	1344	53	242	7	31
2008-09	250	1371	54	246	7	31
2009-10	255	1398	56	251	7	32
2010-11	260	1426	57	256	8	32
2011-12	266	1455	58	261	8	32
2012-13	271	1484	59	267	8	33
2013-14	276	1513	60	272	8	33

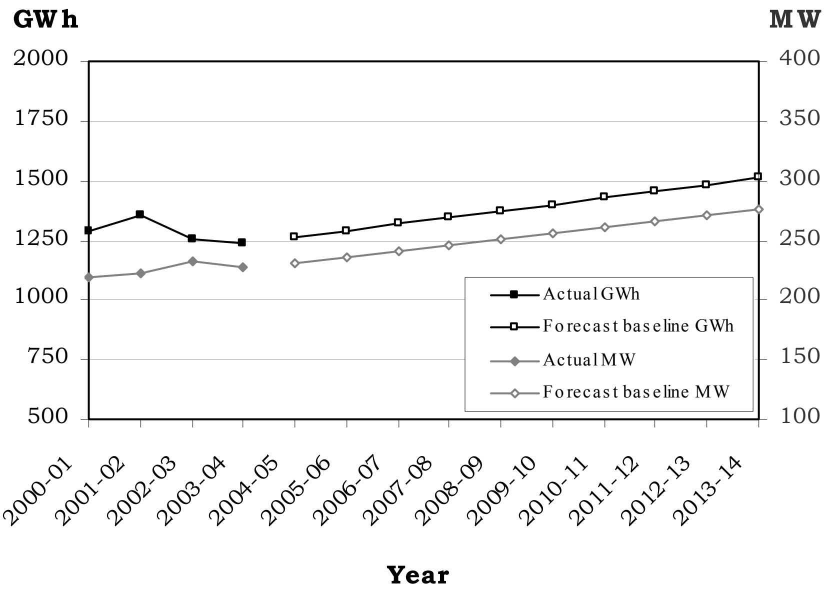
4.12 The following sections briefly detail these forecasts for each of the regulated power systems.

Darwin-Katherine regulated system

4.13 The Darwin-Katherine regulated system accounts for about 80% of all electricity demand in the Territory and is significantly influenced by mining and commercial/industrial activity as well as by weather conditions from year to year.

4.14 Chart 4.1 shows that both peak demand and energy sent out have recorded declines as well as increases in recent years. This variability is mostly attributed to changes in mining activity in the Darwin-Katherine region, and illustrates the difficulty inherent in forecasting future levels of demand, and hence capacity required, for this market. As an example, table 4.1 shows that an annual growth rate of 2% applied to peak demand recorded in 2003-04 (226.7MW) gives a peak demand of 276MW in 2013-14. However, the same growth rate when applied to the peak recorded in 2002-03 would achieve this level of demand three years earlier.

Chart 4.1 – Baseline Peak Demand and Energy Darwin-Katherine



4.15 The key question in this case is which is the more appropriate figure to use as the basis for rolling forward the forecast rates of growth in demand – the higher 2002-03 figure or the lower 2003-04 figure? Using relatively simple techniques,[5] the Commission's analysis suggests that the 2003-04 figure is closer to 'trend', and therefore more suitable for use as a base year.

4.16 In last year's review, the Commission used an average annual growth rate of 2.4%, consistent with Power and Water's approach at that time. Applying that rate of growth to the 2002-03 peak demand would produce a forecast peak demand of 304MW in 2013-14, which is 10% above the baseline forecast in this review for the same year. Variations of this magnitude hold significant implications for generating capacity, network capacity and primary fuel requirements.

4.17 This baseline scenario produces an expected peak demand of about 276MW and energy consumption of about 1,500GWh in 2013-14, an overall increase of approximately 22% from current levels.

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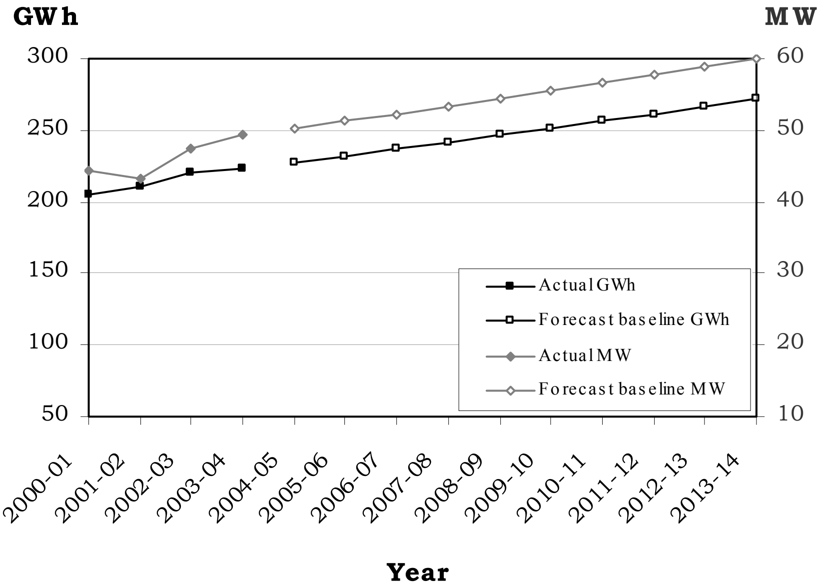
[5] A simple 3 year moving average.

Alice Springs regulated system

4.18 In 2003-04, Alice Springs experienced a 3.8% increase in peak demand and 1.5% increase in energy use, compared with a 9.7% increase in peak demand and 4.6% increase in energy use the previous year. This increase was mostly on account of construction of the Alice Springs to Darwin railway. Under the forecast baseline scenario (see chart 4.2), the Commission expects average annual growth of 2% over the 10 years to 2013-14.

Chart 4.2 – Baseline Peak Demand and Energy Alice Springs

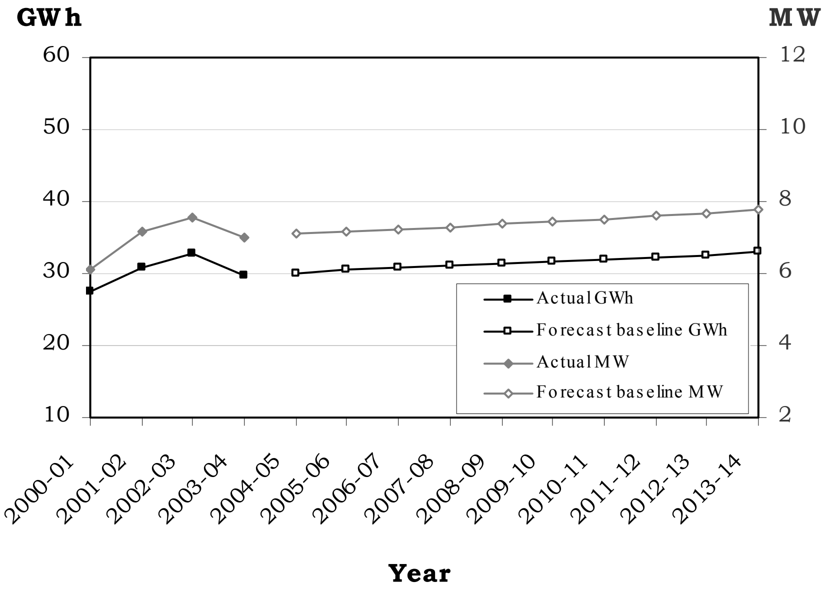


Tennant Creek regulated system

4.19 Due to its small size, the Tennant Creek system experiences greater volatility in electricity demand from year to year, and is influenced by the level of mining activities and other projects. In past reviews, the Commission reported a substantial decrease in electricity demand with the scaling down of Normandy's Warrego mine. More recently, however, the system has seen a progressive increase since 2001-02 due to increased industrial activity associated with the construction of the Alice Springs to Darwin railway. These increases were partly reversed in 2003-04 when both peak demand and energy use declined in the order of 8-9%.

4.20 The baseline forecasts for Tennant Creek (see chart 4.3) show an average annual growth of 1% over the ten years to 2013-14, in the absence of any new mining and resource-related projects.

Chart 4.3 – Baseline Peak Demand and Energy
Tennant Creek



Major developments impacting on the power system

4.21 In addition to the above baseline forecasts, also playing a role is the demand that arises from *major developments*, be they one-off projects (like the Alice Springs to Darwin railway) or developments associated with the Timor Sea gas discoveries and the construction of the Bayu-Undan gas pipeline to Darwin.[6]

4.22 In considering the range of major developments likely to impact on the Territory's power system over the next five years, it is important to note that some projects are likely to have onsite generation capacity and take advantage of relatively low cost gas to generate electricity when Timor Sea gas comes onshore (as will be the case with the ConocoPhillips LNG Plant). However, power requirements for most other projects are expected to be met by external network-sourced electricity, through power purchase agreements with a third-party generation supplier.[7]

4.23 The difficulty with adding in the demand arising from new developments on a project-by-project basis is that the demand impacts are often large and the projects themselves subject to considerable uncertainty. As a result, estimates of the expected impacts on the power system may vary considerably from year to year. Moreover, the project approach does not allow for possible future projects that are yet to be identified. The profile of incremental demand impacts therefore tends to flatten out after three to four years.

4.24 Developments at Darwin Airport, the Darwin Wharf Development and certain mining and resource developments have been identified by Power and Water as likely to have a significant impact on the power system. The list of projects is reduced from last year's review as some projects have been completed and the status of others has

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[6] A number of resource projects have been put on hold pending improved economic conditions, or are subject to further review or a feasibility study, and as such are not considered in this Review.

[7] For forecasting and comparison purposes, the projects outlined here are assumed to be connected to Power and Water's electricity networks.

altered. No projects have been identified that impact on the Alice Springs and Tennant Creek systems. The aggregate forecast electricity demand is shown in table 4.2.

Forecast demand – major developments

4.25 The demand and energy impacts of major developments are two-fold: they have a *direct* impact through the operational requirements of the projects themselves and an *indirect* impact due to residential and commercial flow-on effects.

4.26 A summary of the impacts these developments may have on the Territory's power systems is shown in table 4.2 and illustrated in chart 4.4.[8]

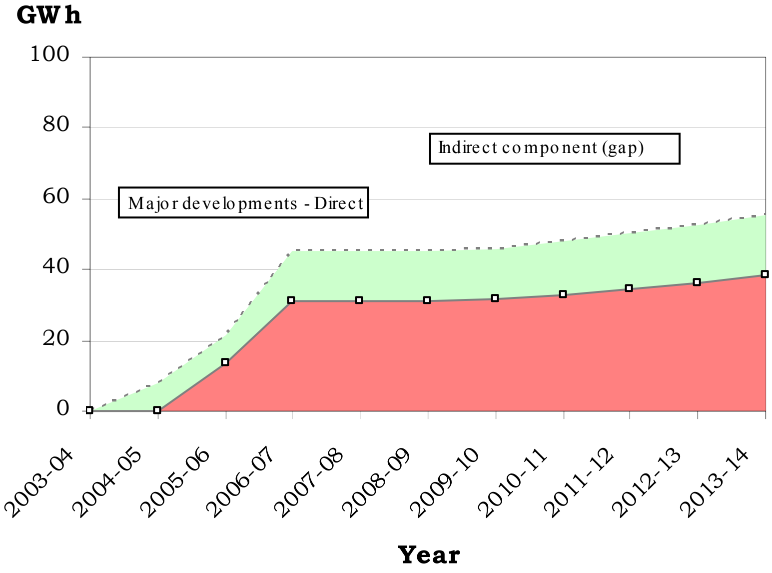
Table 4.2 – Peak Demand and Energy Forecast Major Developments

	Demand (MW)			Energy (GWh)		
Financial Year	**Direct**	**Indirect**	**Total**	**Direct**	**Indirect**	**Total**
2004-05	0	2	2	0	8	8
2005-06	4	4	8	14	8	22
2006-07	8	4	11	31	14	45
2007-08	8	4	12	31	14	45
2008-09	8	4	12	31	14	45
2009-10	8	4	12	31	14	46
2010-11	8	4	12	33	15	48
2011-12	9	4	13	35	16	50
2012-13	9	4	13	36	16	53
2013-14	10	4	14	38	17	55

4.27 The Commission's forecasts assume the indirect demand component arising from these projects will have a ripple-effect throughout the Territory – mainly in the Darwin-Katherine region where most of the projects are to be based.

[8] The forecasts are based on currently available data and are subject to change. The projections for the ConocoPhillips LNG Plant are indicative only.

Chart 4.4 – Energy Forecast
Major Developments



4.28 The forecasts indicate a progressive increase in the electricity demand for major developments, corresponding to the planned levels of construction and industrial activity. In early years, between 2004-05 and 2006-07, the indirect impacts relating to construction workforces and other commercial activities are expected to be as significant as the direct impacts of the projects themselves. Overall, identified projects could add 14MW to peak demand and 55GWh to energy use by the end of the period.

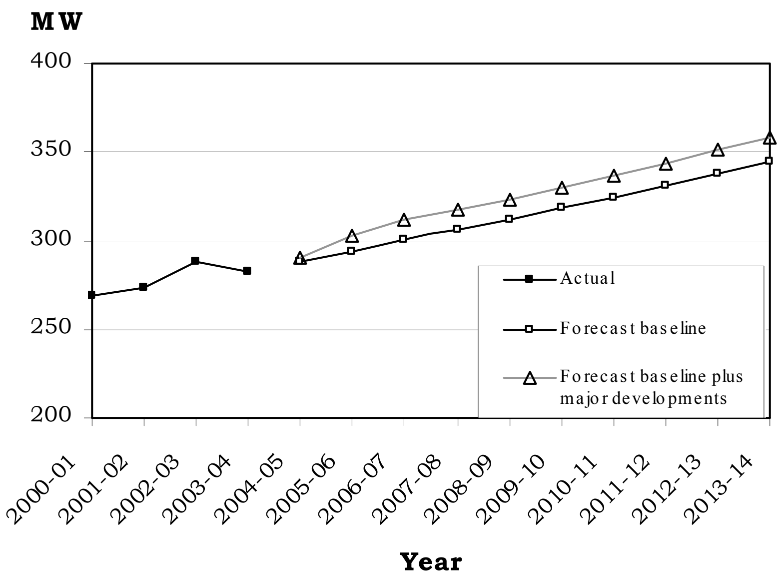
Overall demand – Territory baseline plus major developments

4.29 The Commission has consolidated the regional baseline forecasts in table 4.1 with the major developments forecasts (including the indirect component) in table 4.2 to produce combined forecasts in table 4.3 and in chart 4.5 below.

Table 4.3 – Peak Demand and Energy
Actual and Forecast – Baseline plus Developments

Financial Year	Baseline MW	Baseline and Major Devel'mts MW	Baseline GWh	Baseline and Major Devel'mts GWh
2000-01	269	269	1523	1523
2001-02	273	273	1598	1598
2002-03	288	288	1505	1505
2003-04	283	283	1494	1494
2004-05	289	291	1524	1532
2005-06	294	303	1554	1576
2006-07	300	312	1585	1630
2007-08	306	318	1616	1662
2008-09	312	324	1648	1694
2009-10	318	330	1681	1727
2010-11	325	337	1714	1762
2011-12	331	344	1748	1799
2012-13	338	351	1783	1836
2013-14	344	358	1818	1874

Chart 4.5 – Peak Demand, Actual and Forecast
Baseline, and Baseline plus Major Developments



4.30 Once account is taken of the major developments, this approach suggests that the Territory system 10 years from now could have an indicative demand of about 358MW and energy consumption of 1,874GWh, about 26% greater than that of the Territory's existing system.

4.31 Clearly, however, caution should be taken when interpreting these forecasts due to the indicative nature of the quantum and timing of electricity requirements for the projects considered, and the uncertainty regarding unidentified future projects.

Higher growth scenario

4.32 As the discussion above indicates, the development of longer-term demand forecasts is subject to considerable uncertainty. While this is true for most electricity systems, the Territory economy in particular is subject to a range of influences that can cause the demand for electricity to vary significantly over periods of several years.

4.33 The separation of demand into a baseline component and a project component is one approach to addressing the causes of this volatility. While this approach adds important information, it also has limitations.

4.34 Another approach is to look at longer-term average rates of growth. This approach is directed more at identifying longer-term trend rates of growth than year-to-year fluctuations. As such, while it can be useful in identifying the aggregate increase in capacity and primary fuel required over a period, the timing of the increments required is no more than indicative.

4.35 Because longer-term average rates of growth include the effect of major developments, there is no need to explicitly allow for these when extrapolating the trend forward. However, in the absence of a detailed analysis of the components and behaviour of demand, the extrapolation of longer-term average growth rates is limited to providing a broad indication of plausible future trend demand growth.

4.36 A broad analysis by the Commission of peak demand and energy use in the Darwin-Katherine region indicates a longer-term average annual growth rate of approximately 3.5-3.7% for both series.[9] While rates of growth later in the period have been significantly lower than the longer-term average, the Commission has used this average to develop a ***higher growth scenario***, in which peak demand and energy use increase at an annual rate of 3½%. This scenario has been used to indicate the capacity that would be required if the experience in aggregate over the last 10 or so years was to be repeated over the next 10 years.

4.37 For Alice Springs and Tennant Creek, the higher growth scenario assumes average annual growth in peak demand and energy use of 3%.

4.38 Tables 4.4 and 4.5 and chart 4.6 show that in 2013-14 the higher growth scenario produces a peak demand for the Territory of 395MW and energy use of approximately 2,100GWh. While this outcome is significantly above the level of demand and energy use produced by the current baseline plus major developments forecast, it is broadly comparable with the levels forecast in last year's review.[10]

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[9] Measured over the period 1989-90 to 2003-04 for peak demand and 1994-95 to 2003-04 for energy sent out.

[10] Due to three factors that applied to the forecasts in last year's review – the higher base year (2002-03) values, the higher baseline rate of growth assumed for Darwin-Katherine (2.4% compared with 2%) and the higher level of demand attributed to major developments.

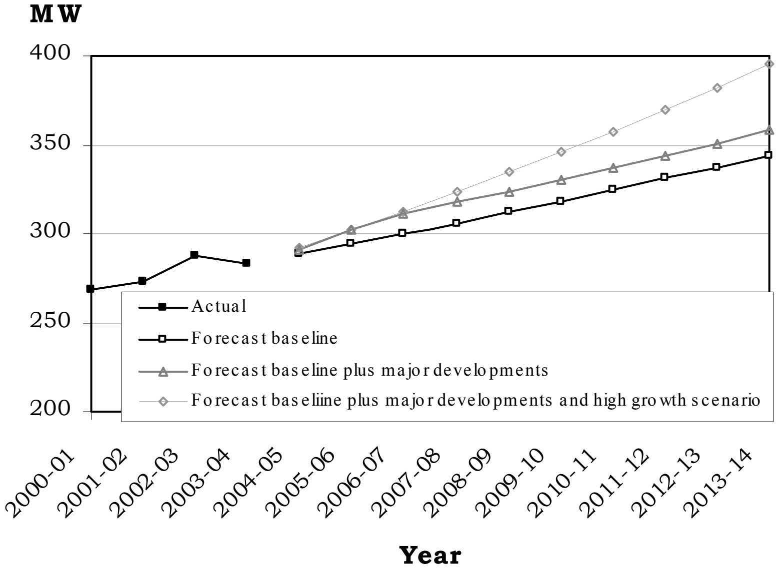
Table 4.4 – Peak Demand (MW), Actual and Forecast, Under Alternative Scenarios

Financial Year	Baseline	Baseline and Major Devel'mts	Higher Growth Scenario
2000-01	269	269	269
2001-02	273	273	273
2002-03	288	288	288
2003-04	283	283	283
2004-05	289	291	293
2005-06	294	303	303
2006-07	300	312	313
2007-08	306	318	324
2008-09	312	324	335
2009-10	318	330	346
2010-11	325	337	358
2011-12	331	344	370
2012-13	338	351	382
2013-14	344	358	395

Table 4.5 – Energy (GWh pa), Actual and Forecast, Under Alternative Scenarios

Financial Year	Baseline	Baseline and Major Devel'mts	Higher Growth Scenario
2000-01	1523	1523	1523
2001-02	1598	1598	1598
2002-03	1505	1505	1505
2003-04	1494	1494	1494
2004-05	1524	1532	1545
2005-06	1554	1576	1598
2006-07	1585	1630	1653
2007-08	1616	1662	1709
2008-09	1648	1694	1768
2009-10	1681	1727	1828
2010-11	1714	1762	1891
2011-12	1748	1799	1955
2012-13	1783	1836	2022
2013-14	1818	1874	2091

Chart 4.6 Peak Demand, Actual and Forecast, Under Alternative Scenarios



CHAPTER 5

ADEQUACY OF GENERATION CAPACITY

5.1 This chapter first outlines the generation capacity available in the Territory's regulated power systems, and briefly outlines some of the factors influencing supply-side decision making. Against the background of the demand forecasts canvassed in the previous chapter, this chapter concludes by examining the prospective supply-demand position in the Territory's power system.

Existing capacity

5.2 Supply of electricity in the Territory's regulated power systems is predominantly provided by Power and Water in all major regions. Power and Water has power purchase agreements with a number of IPPs. At the regional level, about 80% of all generation capacity in the Territory's regulated networks is installed in the Darwin-Katherine system, with the bulk of this capacity located at the Channel Island Power Station. The remaining 20% of generation capacity is installed in the Alice Springs and Tennant Creek regulated systems.

5.3 The Territory's generation facilities, consisting mainly of gas and liquid fuel driven turbines, are summarised in table 5.1. Two indicators of 'supply capacity' are provided:

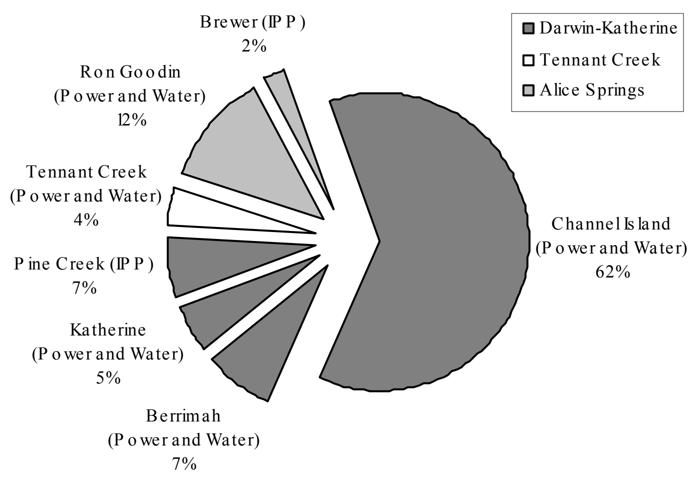
- total capacity (in MW); and
- N-1 capacity (in MW), which indicates the generation capacity excluding the largest generating set in a particular system.

Table 5.1 – Power Facilities in Regulated Systems

Region / Power station	Operator	Capacity (MW)	% of Total	Capacity at N-1
Darwin-Katherine Regulated System:				
Channel Island	P&W	253.7		
Berriah	P&W	30.0		
Katherine	P&W	21.3		
Pine Creek	IPP	26.6		
Total		**331.6**	**81%**	**287.6**
Tennant Creek Regulated System:				
Tennant Creek	P&W	16.3		
Total		**16.3**	**4%**	**14.1**
Alice Springs Regulated System:				
Ron Goodin	P&W	50.6		
Brewer	IPP	8.5		
Total		**59.1**	**15%**	**47.4**
Total Capacity in Regulated Systems		**407.0**	**100%**	

5.4 Power and Water has power purchase agreements with two IPPs which operate in regulated systems: EDL NGD (NT) Pty Ltd (Pine Creek Power) and Central Energy Power Pty Ltd (Brewer). Overall, about 35MW of capacity is currently available from these IPPs.

Chart 5.1 – Regulated Capacity per Power Station



5.5 Power and Water is additionally responsible for the provision of power services to remote indigenous communities and townships that are not connected to the regulated power system. Some of these areas include Yulara, Borroloola, Timber Creek, Daly Waters, Newcastle Waters, Elliot, Ti-Tree and Kings Canyon. The generation capacity associated with these rural areas has not been included in system supply (for the purposes of this review) and is consistent with the treatment of associated demand in chapter 4.[11]

Factors affecting supply

5.6 Broadly, the factors affecting supply in the Territory in the short to medium term are:

- the level of demand, particularly from the mining industry;
- the level of additional effective capacity introduced into the system;[12]
- the existing condition and economic life of generation assets;
- the introduction of newer technologies or environmentally friendly generating systems;
- the minimum standards of system reliability that stakeholders (i.e., consumers and generators) are willing to accept;
- the risk for capacity to 'come and go';[13] and
- existing network constraints.

Baseline supply projections

5.7 In previous reviews, the Commission has adopted a 'baseline' supply scenario incorporating only existing and committed capacity. The advantage of this approach is that it allows the requirement for new capacity to be clearly indicated.

5.8 However, it is highly likely that over a review period of 10 years new capacity will be required. In its submission to this review, Power and Water has proposed a program of planned capacity additions to meet increases in demand and to replace older capacity as it is decommissioned.

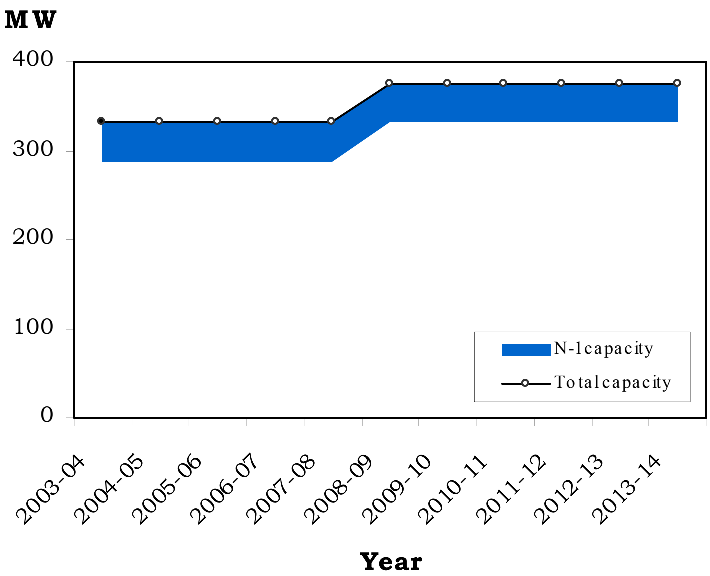
5.9 For the Darwin-Katherine system Power and Water is planning to add 44MW of generating capacity in 2008-09. No existing capacity is scheduled for decommissioning. The resulting projected level of capacity is illustrated in chart 5.2.

[11] In future reviews, the Commission may consider the supply and demand arising in areas not connected to the regulated power system.

[12] For example, additional capacity may accompany new onshore gas developments and other projects, which could significantly increase supply. The average net export (if any) into the system from these major developments would contribute to available capacity for the Territory system. This possibility is considered later in this chapter.

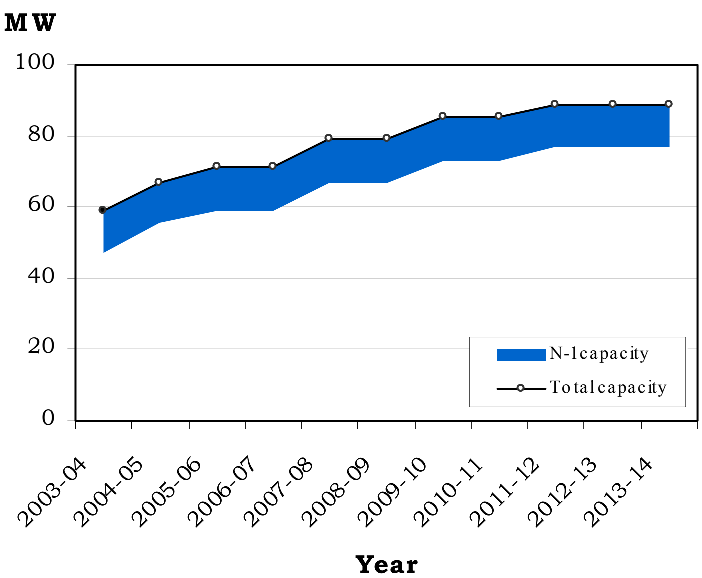
[13] This is more of a concern to the Territory than in other States due to the small number of participants and size of the Territory market.

Chart 5.2 – Baseline Supply Projection
Darwin-Katherine Regulated System



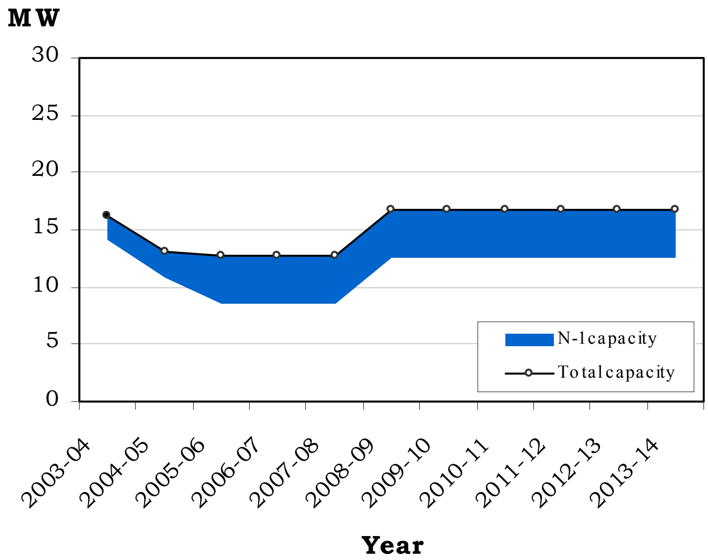
5.10 Power and Water's program for the Alice Springs system adds 8MW of temporary generating capacity in 2004-05. This is scheduled to be replaced in 2005-06 by 12MW of new capacity, followed by a further 12MW of new capacity in 2007-08, 2010-12 and 2012-13 and the progressive decommissioning of 18.2MW of existing capacity. The resulting capacity projection is illustrated in chart 5.3.

Chart 5.3 – Baseline Supply Projection
Alice Springs Regulated System



5.11 In Tennant Creek, Power and Water plans to decommission 3.2MW of existing capacity in 2004-05, followed by the decommissioning of a further 8.5MW and the addition of 8.1MW of new capacity in 2005-06 and the addition of a further 4.1MW of new capacity in 2008-09. The resulting projected level of capacity is illustrated in chart 5.4.

Chart 5.4 – Baseline Supply Projection
Tennant Creek Regulated System



5.12 The extent of this program illustrates that supply capacity in a power system is far from static. Accordingly, it is somewhat artificial to review demand-supply balance on the assumption that supply is unchanged. Indeed, one of the valuable functions of this type of review is to provide an opportunity for planned supply actions to be subject to public disclosure and independent assessment. For this reason, the Commission has decided to include Power and Water's program for capacity additions and decommissioning into its baseline supply projections.

5.13 It must be borne in mind, however, that one consequence of taking this approach is to make the Commission's conclusions on supply adequacy subject to the important qualification that Power and Water implements the supply program as specified.

Indicators of system adequacy

5.14 System adequacy depends fundamentally on the level of installed capacity measured against expected demand. The difference is known as the reserve margin, which is a margin that allows for both planned maintenance and forced outages (failures). If system adequacy is low, there is a greater chance of electricity supply interruption.

5.15 The current reserve margin for each regulated system has been provided by Power and Water, and indicates the point at which intervention in the market is required to ensure risks to supply are adequately minimised. It reflects the nature of demand and the supply capabilities in servicing that demand, in a particular system.

5.16 The Commission has undertaken its analysis for each regulated system.

Darwin-Katherine regulated system

5.17 In this section, the prospective supply-demand balance in the Darwin-Katherine regulated system is presented under the three demand scenarios described in chapter 4 – the baseline scenario, baseline demand plus major developments and the higher growth demand scenario.

5.18 In each scenario a reserve margin of 22% of peak demand has been allowed for.[14]

Baseline scenario

5.19 Table 5.2 and charts 5.5 and 5.6 indicate the reserves implied by the Commission's baseline supply and demand forecasts for the Darwin-Katherine regulated system. This scenario ignores any impact on demand arising from major developments, whether direct or indirect. The assumptions underlying the baseline demand forecasts were outlined in chapter 4.

Table 5.2 – Supply-Demand Balance Forecast
Darwin-Katherine Baseline Scenario (MW)

Financial Year	Existing Generator Capacity	IPPs	Planned New Capacity	Total Planned Capacity	Peak Demand	Supply-Demand Balance	Reserve Margin	Reserves over margin
2003-04	305	27	0	332	227	105	50	55
2004-05	305	27	0	332	231	100	51	49
2005-06	305	27	0	332	236	96	52	44
2006-07	305	27	0	332	241	91	53	38
2007-08	305	27	0	332	245	86	54	32
2008-09	305	27	44	376	250	125	55	70
2009-10	305	27	44	376	255	120	56	64
2010-11	305	27	44	376	260	115	57	58
2011-12	305	27	44	376	266	110	58	51
2012-13	305	27	44	376	271	105	60	45
2013-14	305	27	44	376	276	99	61	38

[14] In larger systems, a 10% (of peak demand) reserve capacity may be sufficient, however in the Darwin-Katherine system, the current demand levels and supply capabilities would dictate around 22% as being the reserve margin.

Chart 5.5 – Supply-Demand Balance Forecast
Darwin-Katherine Baseline Scenario

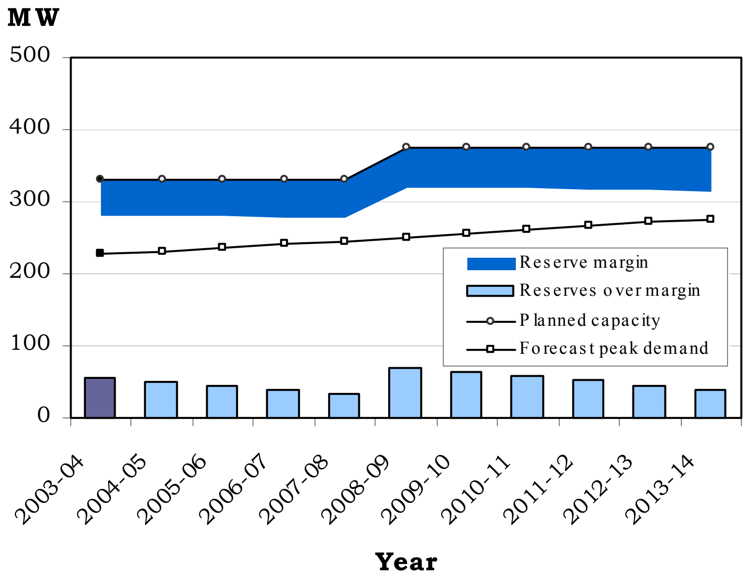
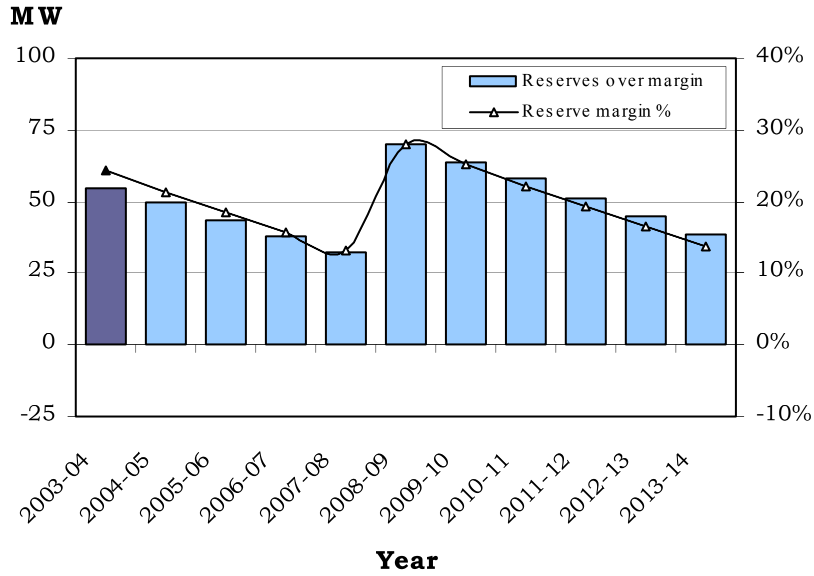


Chart 5.6 – Forecast Reserves over Margin
Darwin-Katherine Baseline Scenario



5.20 Under the Commission's baseline scenario, with annual demand growth of 2%, reserves over the margin (22% of peak demand or about 51MW) decline to 32 MW in 2007-08, prior to the installation of 44MW of new capacity in 2008-09. By 2013-14 38MW of reserves over margin are projected to be available. Accordingly, no significant adequacy issues appear likely under this scenario over the forecast horizon.

Baseline plus major developments scenario

5.21 Table 5.3 and charts 5.7 and 5.8 indicate the reserves implied by the Commission's supply and demand forecasts for the Darwin-Katherine system when the impact of projected major developments are added to the baseline demand scenario.

Table 5.3 – Supply-Demand Balance Forecast
Darwin-Katherine Baseline Plus Major Developments Scenario (MW)

Financial Year	Existing Capacity	Planned New Capacity	Total Planned Capacity	Peak Demand	Supply-Demand Balance	Reserve Margin	Reserves over margin
2003-04	332	0	332	227	105	50	55
2004-05	332	0	332	233	98	51	47
2005-06	332	0	332	244	87	54	34
2006-07	332	0	332	252	79	55	24
2007-08	332	0	332	257	75	57	18
2008-09	332	44	376	262	114	58	56
2009-10	332	44	376	267	109	59	50
2010-11	332	44	376	273	103	60	43
2011-12	332	44	376	278	97	61	36
2012-13	332	44	376	284	91	63	29
2013-14	332	44	376	290	85	64	21

Chart 5.7 – Supply-Demand Balance Forecast
Darwin-Katherine Baseline Plus Major Developments Scenario

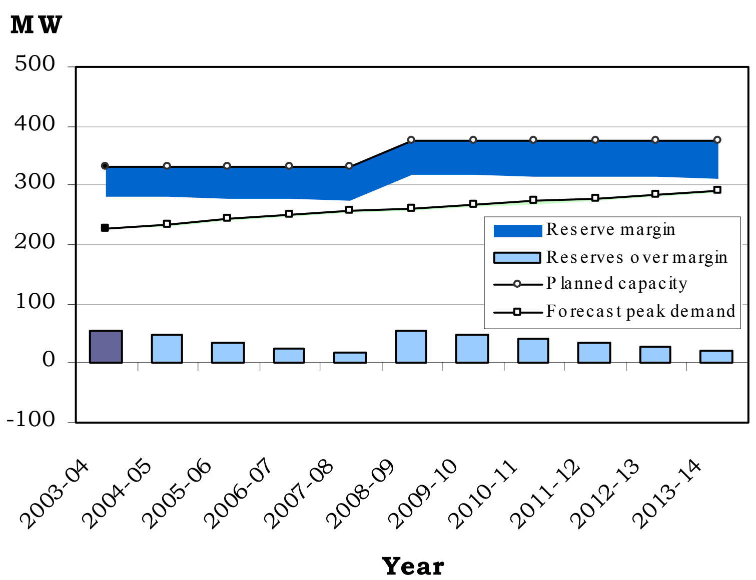
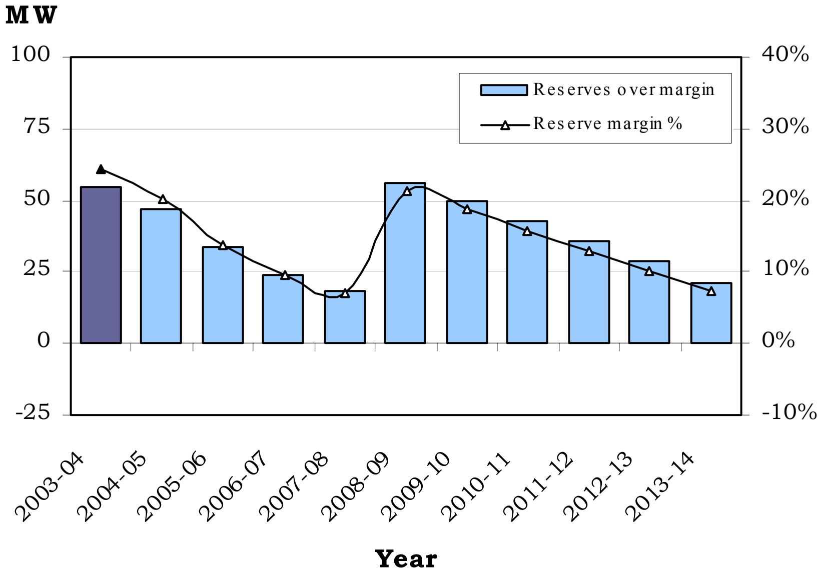


Chart 5.8 – Forecast Reserves over Margin
Darwin-Katherine Baseline Plus Major Developments Scenario



5.22 Introducing the additional direct and indirect demand attributed to the identified major developments described in chapter 4 reduces the level of reserves over margin. The impact is not sufficient, however, to erode the margin to a level where adequacy issues are raised. Once again it should be noted that this conclusion is subject to the qualification that the additional 44MW of new capacity scheduled to be operational in 2008-09 is in place on time. Without this additional capacity reserves over margin would be negative by 2010-11.

Higher growth scenario

5.23 Table 5.4 and charts 5.9 and 5.10 indicate the reserves implied by the Commission's supply and demand forecasts for the Darwin-Katherine system when demand is projected forward at an average annual rate of 3.5%, which is approximately the rate of growth recorded over the last 10 or so years.

Table 5.4 – Supply-Demand Balance Forecast
Darwin-Katherine Higher Growth Scenario (MW)

Financial Year	Planned Capacity	Peak Demand	Supply-Demand Balance	Reserve Margin	Reserves over Margin
2003-04	332	227	105	50	55
2004-05	332	235	97	52	45
2005-06	332	243	89	53	35
2006-07	332	251	80	55	25
2007-08	332	260	71	57	14
2008-09	376	269	106	59	47
2009-10	376	279	97	61	36
2010-11	376	288	87	63	24
2011-12	376	299	77	66	11
2012-13	376	309	67	68	-1
2013-14	376	320	56	70	-15

Chart 5.9 – Supply-Demand Balance Forecast
Darwin-Katherine Higher Growth Scenario

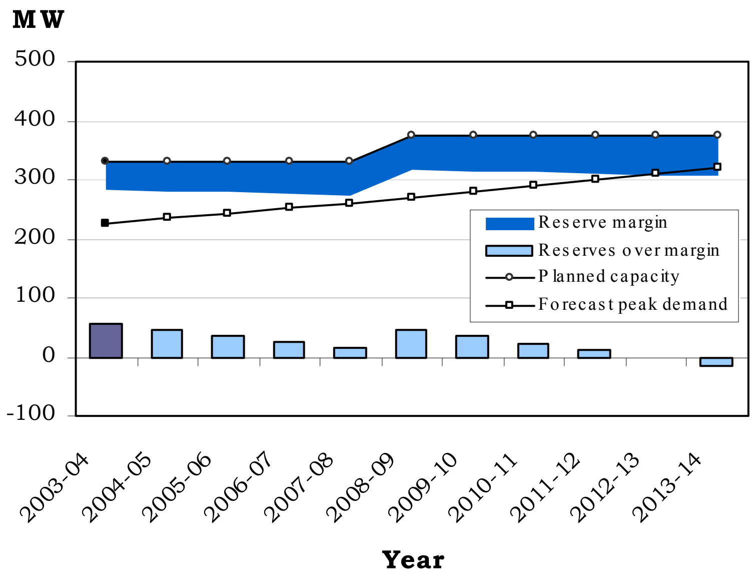
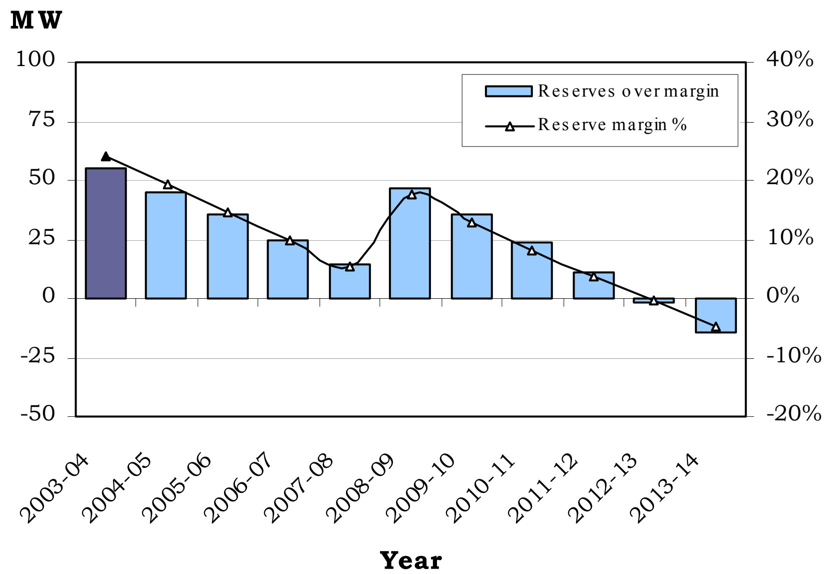


Chart 5.10 – Forecast Reserves over Margin
Darwin-Katherine Higher Growth Scenario



5.24 Under the assumptions of this scenario, the Darwin-Katherine system would be facing adequacy issues in 2007-08, the year prior to the planned introduction of additional capacity. Delaying the introduction of new capacity to 2008-09 would increase the risk of a capacity shortfall during the year.

5.25 Adequacy issues would arise again in 2011-12, and rapidly become severe without the addition of further capacity.

Alice Springs regulated system

5.26 Because no major developments have been identified that would impact on the Alice Springs system, the Commission's analysis is limited to baseline and higher growth scenarios.

Baseline demand scenario

5.27 Table 5.5 and charts 5.11 and 5.12 indicate the supply-demand balance and reserves implied by the Commission's forecasts for the Alice Springs regulated system under the baseline demand scenario.

5.28 Reflecting demand characteristics and supply capabilities in this system a reserve margin of 28% of peak demand has been allowed for in each scenario.

Table 5.5 – Supply-Demand Balance Forecast
Alice Springs Baseline Scenario (MW)

Financial Year	Existing Capacity	IPPs	Planned New Capacity	Total Planned Capacity	Peak Demand	Supply-Demand Balance	Reserve Margin	Reserves over Margin
2003-04	51	9	0	59	49	10	14	-4
2004-05	51	9	8	67	50	17	14	3
2005-06	51	9	12	71	51	20	14	5
2006-07	51	9	12	71	52	19	15	4
2007-08	47	9	24	79	53	26	15	11
2008-09	47	9	24	79	54	25	15	9
2009-10	41	9	36	85	56	30	16	14
2010-11	41	9	36	85	57	29	16	13
2011-12	32	9	48	89	58	31	16	15
2012-13	32	9	48	89	59	30	16	14
2013-14	32	9	48	89	60	29	17	12

Chart 5.11 – Supply-Demand Balance Forecast
Alice Springs Baseline Scenario

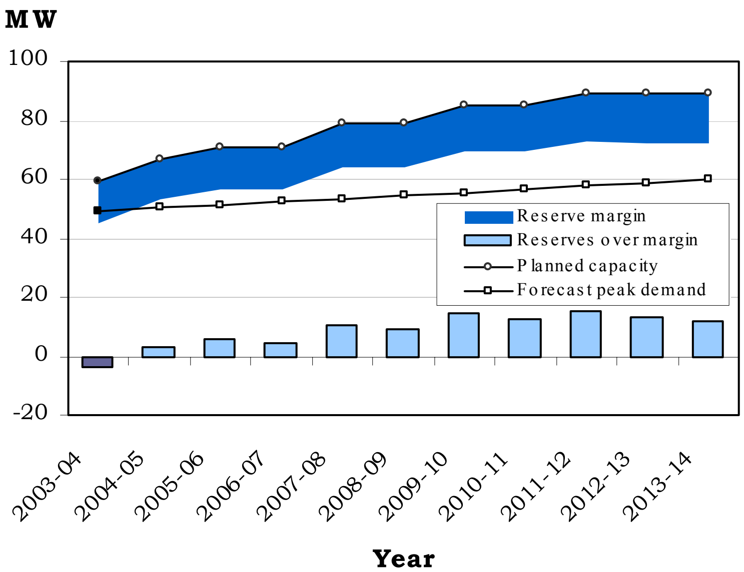
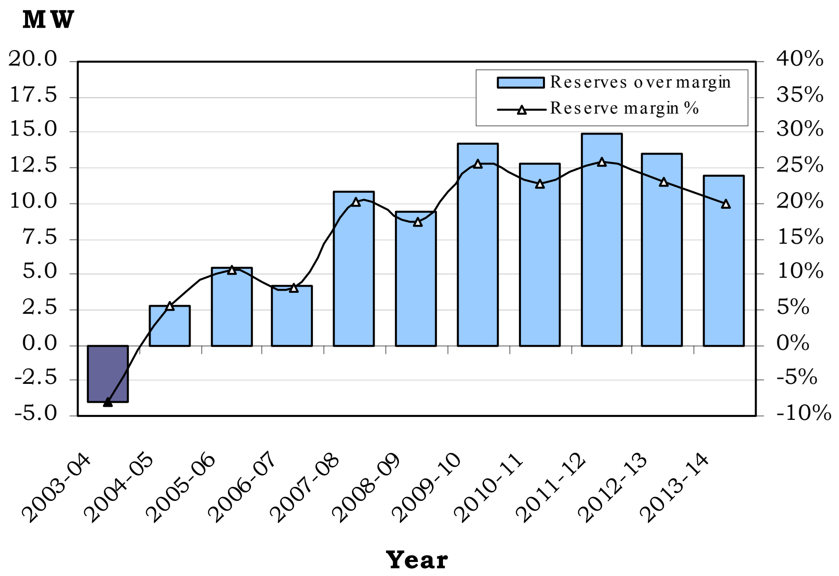


Chart 5.12 – Forecast Reserves over Margin
Alice Springs Baseline Scenario



5.29 The forecast demand and supply in the Alice Springs regulated system indicates a tight supply situation over the next few years. Under the assumption of 2% annual growth in the baseline scenario this situation will ease as new capacity is brought on line in accordance with the program proposed by Power and Water.

Higher growth scenario

5.30 The consequences of demand in the Alice Springs system following a higher annual growth path of 3% is illustrated in table 5.6 and charts 5.13 and 5.14.

Table 5.6 – Supply-Demand Balance Forecast
Alice Springs Higher Growth Scenario (MW)

Financial Year	Total Planned Capacity	Peak Demand	Supply-Demand Balance	Reserve Margin	Reserves over Margin
2003-04	59	49	10	14	-4
2004-05	67	51	16	14	2
2005-06	71	52	19	15	4
2006-07	71	54	17	15	2
2007-08	79	55	24	16	8
2008-09	79	57	22	16	6
2009-10	85	59	26	16	10
2010-11	85	61	25	17	8
2011-12	89	62	26	17	9
2012-13	89	64	25	18	7
2013-14	89	66	23	19	4

Chart 5.13 – Supply-Demand Balance Forecast
Alice Springs Higher Growth Scenario

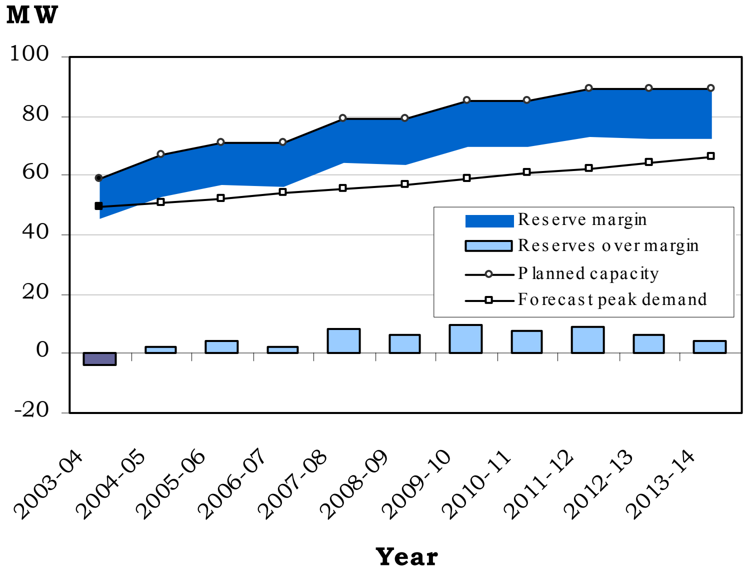
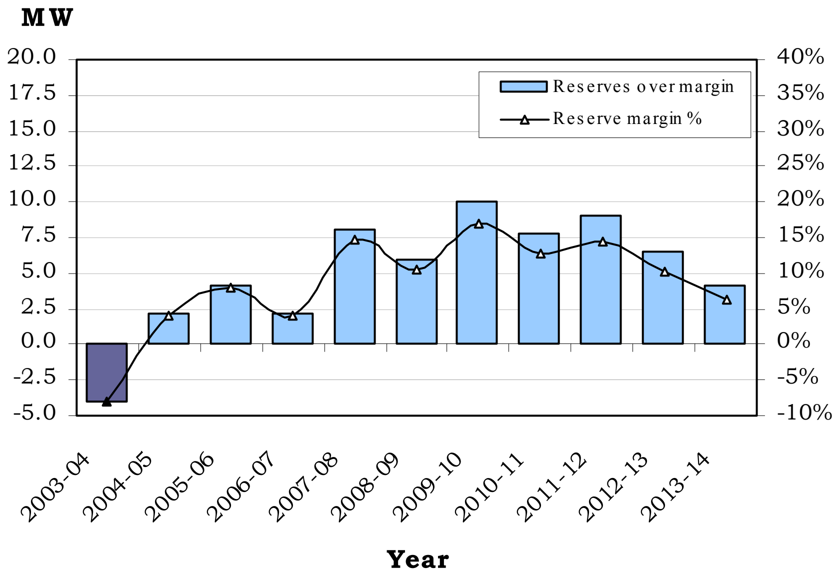


Chart 5.14 – Forecast Reserves over Margin
Alice Springs Higher Growth Scenario



5.31 While a positive margin over reserves is maintained, the effect of demand growth following a higher profile is to ensure that adequacy remains an issue in the Alice Springs system over the next 10 years, despite the program of capacity additions planned by Power and Water.

5.32 In the Commission's view, an average annual growth rate of 3% while at the higher end of the scale is within the range of plausible outcomes. On this basis, the Commission's conclusion is that the supply/demand balance in the Alice Springs system will require close continuous monitoring.

Tennant Creek regulated system

5.33 As for the Alice Springs system, supply/demand balance is considered in the context of a baseline demand scenario and higher growth demand scenario.

5.34 Because Tennant Creek is a small system exposed to potentially large impacts from demand and supply factors, reserve capacity is set at 40% of peak demand.

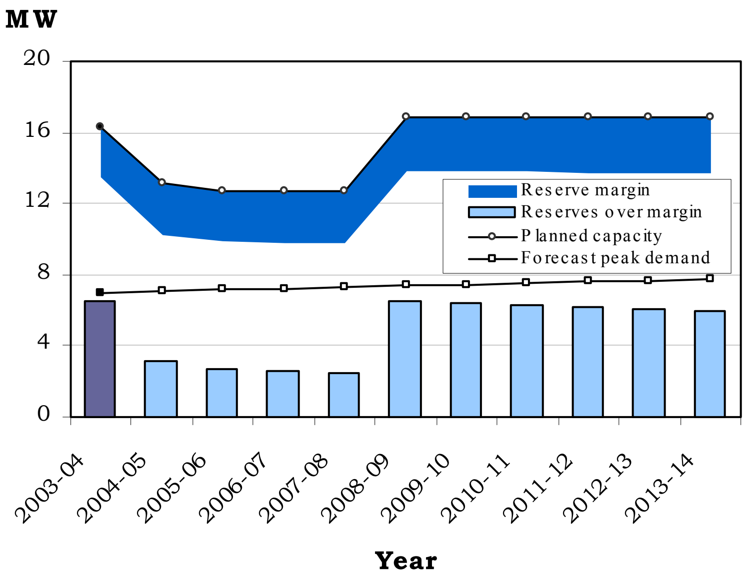
Baseline scenario

5.35 Table 5.7 and charts 5.15 and 5.16 indicate the supply-demand balance and reserves implied by the Commission's forecasts for the Tennant Creek regulated system under the baseline demand scenario, which projects annual growth at an average rate of 1%.

Table 5.7 – Supply-Demand Balance Forecast
Tennant Creek Baseline Scenario (MW)

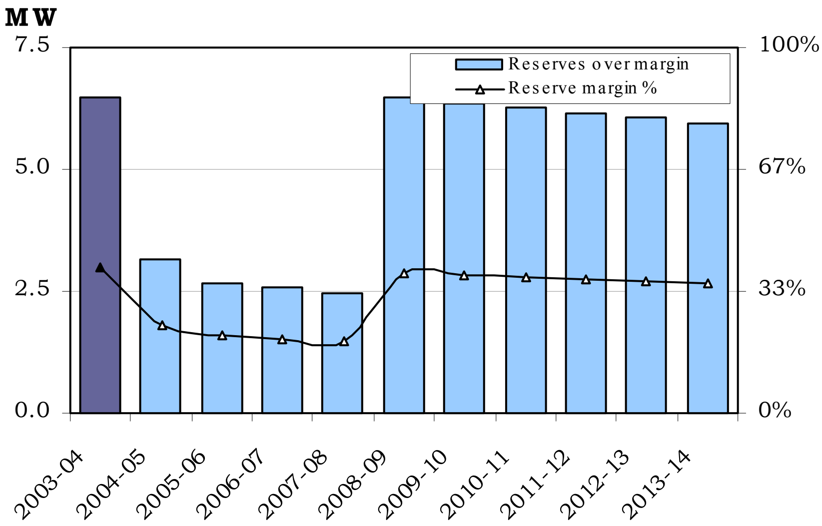
Financial Year	Existing Capacity	Planned New Capacity	Total Planned Capacity	Peak Demand	Supply-Demand Balance	Reserve Margin	Reserves over Margin
2003-04	16	0	16	7	9	3	6
2004-05	13	0	13	7	6	3	3
2005-06	5	8	13	7	6	3	3
2006-07	5	8	13	7	5	3	3
2007-08	5	8	13	7	5	3	2
2008-09	5	12	17	7	9	3	6
2009-10	5	12	17	7	9	3	6
2010-11	5	12	17	8	9	3	6
2011-12	5	12	17	8	9	3	6
2012-13	5	12	17	8	9	3	6
2013-14	5	12	17	8	9	3	6

Chart 5.15 – Supply-Demand Balance Forecast
Tennant Creek Baseline Scenario



5.36 On the assumption that the planned program of capacity renewal is implemented, current and projected generation capacity in Tennant Creek appears sufficient to comfortably accommodate the expected baseline demand over the next 10 years, including an allowance for a 40% reserve margin.

Chart 5.16 – Forecast Reserves over Margin
Tennant Creek Baseline Scenario



Higher growth scenario

5.37 The effect of increasing the projected average annual rate of demand growth to 3% is illustrated in table 5.8 and charts 5.17 and 5.18.

Table 5.8 – Supply-Demand Balance Forecast
Tennant Creek Higher Growth Scenario (MW)

Financial Year	Total Planned Capacity	Peak Demand	Supply-Demand Balance	Reserve Margin	Reserves over Margin
2003-04	16	7	9	3	6
2004-05	13	7	6	3	3
2005-06	13	7	5	3	2
2006-07	13	8	5	3	2
2007-08	13	8	5	3	2
2008-09	17	8	9	3	5
2009-10	17	8	8	3	5
2010-11	17	9	8	3	5
2011-12	17	9	8	4	4
2012-13	17	9	8	4	4
2013-14	17	9	7	4	4

Chart 5.17 – Supply-Demand Balance Forecast
Tennant Creek Higher Growth Scenario

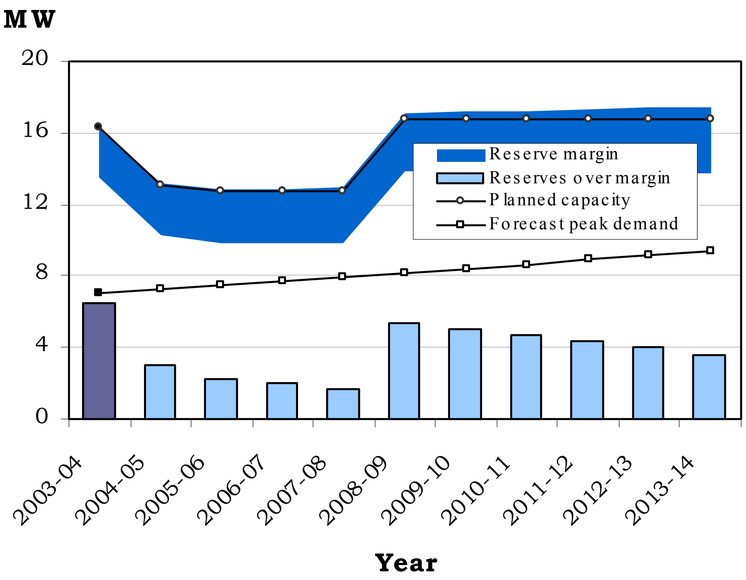
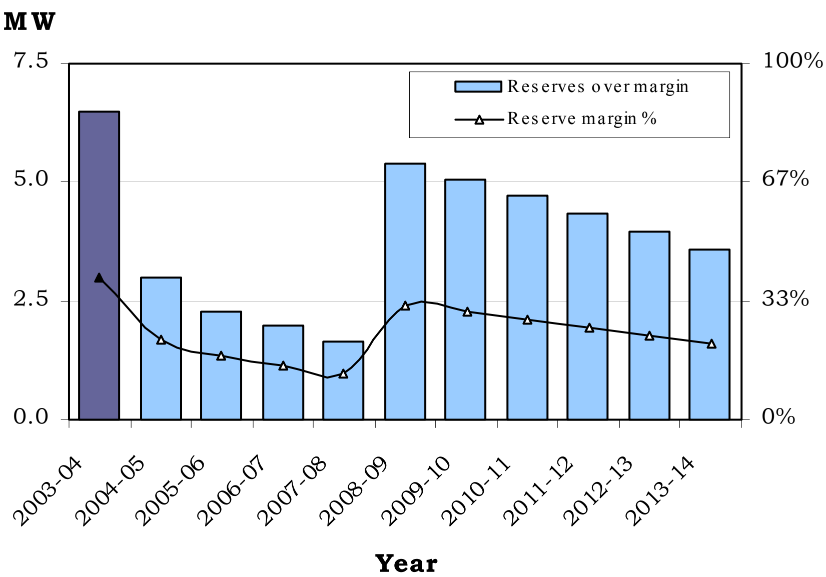


Chart 5.18 – Forecast Reserves over Margin
Tennant Creek Higher Growth Scenario



5.38 Again, on the assumption that the planned program of capacity renewal is carried out as scheduled, the level of capacity appears to adequately allow for the impact of the higher rate of demand growth represented in this scenario.

CHAPTER

6

ADEQUACY OF GAS SUPPLIES

6.1 In the Territory context, system *adequacy* concerns can also arise if declining gas reserves and production give rise to a fuel supply shortfall for electricity generation. This chapter addresses this issue.[15]

Natural gas supply

6.2 Over 99% of electricity in the Territory's regulated system is generated from natural gas-fuelled plant through direct powering of gas turbines and reciprocating engines and the production of steam through the recovery of waste heat from the gas turbines.

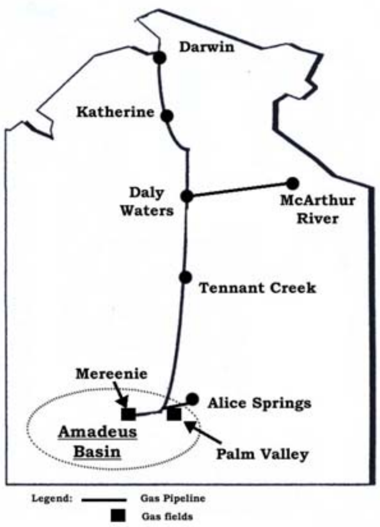
6.3 These plants are serviced by two gas fields in the Amadeus Basin: the Palm Valley field operated by Magellan Petroleum Australia Ltd and the Mereenie field operated by Santos Ltd. Each operator has significant interest in both fields. These gas fields are shown in chart 6.1.

6.4 In 1983, Power and Water entered into an agreement with the operator of the Palm Valley field to supply gas to Alice Springs primarily for electricity generation.

6.5 In 1985, the Power and Water subsidiary Gasgo contracted to purchase gas totalling 200 petajoules ("PJ") from the Palm Valley field until 2012 to fuel electricity generation in the Darwin-Katherine region. In the same year, Gasgo also entered into a gas purchase agreement with the operator of the Mereenie field for the supply of 66PJ during the period until 2012. Since that time, natural gas has been the major fuel source for electricity generation in the Territory.

[15] The 2003 Review also addressed system *security* issues associated with fuel, finding that the gas supply system and the back-up liquid fuel supplies have proven reliable over the past 15 years and electricity supply has not been interrupted through a fuel-related contingency. The Commission indicated that it was comfortable that the levels of liquid fuel storage maintained by Power and Water and the scope for pipeline line pack should together continue to allow the maintenance of electricity supply during short-term interruptions to gas production or transportation.

Chart 6.1 – Location of Amadeus Basin Gas Fields

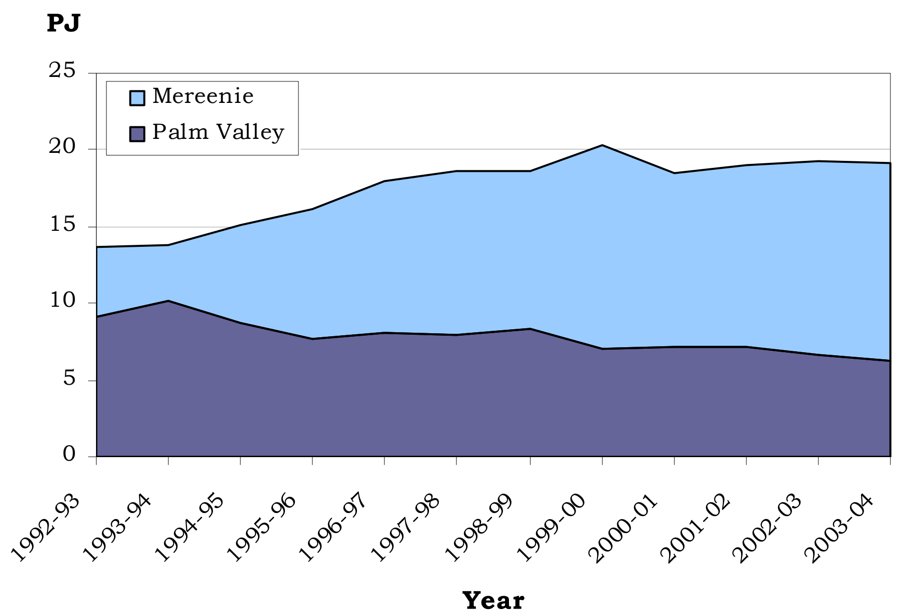


6.6 The Palm Valley field has not met original expectations and, although Gasgo has funded substantial development work as required by the gas purchase agreement, the operator has downgraded the resource (including forecast cumulative production) to approximately 50% of the original reserves figure.

6.7 The poor performance of the Palm Valley field and the greater than expected energy demand have resulted in three other gas purchase contracts totalling 113PJ being established with Mereenie.

6.8 Chart 6.2 illustrates the declining production of the Palm Valley field and the increasing reliance upon the Mereenie field over the last 10 years.

Chart 6.2 – Gas Sales
1992-93 to 2003-04



6.9 The Gasgo contracts for the supply of gas from Mereenie expire in 2009. Gas volumes permitting, the Palm Valley contract expires in 2012.

Gas supply-demand outlook

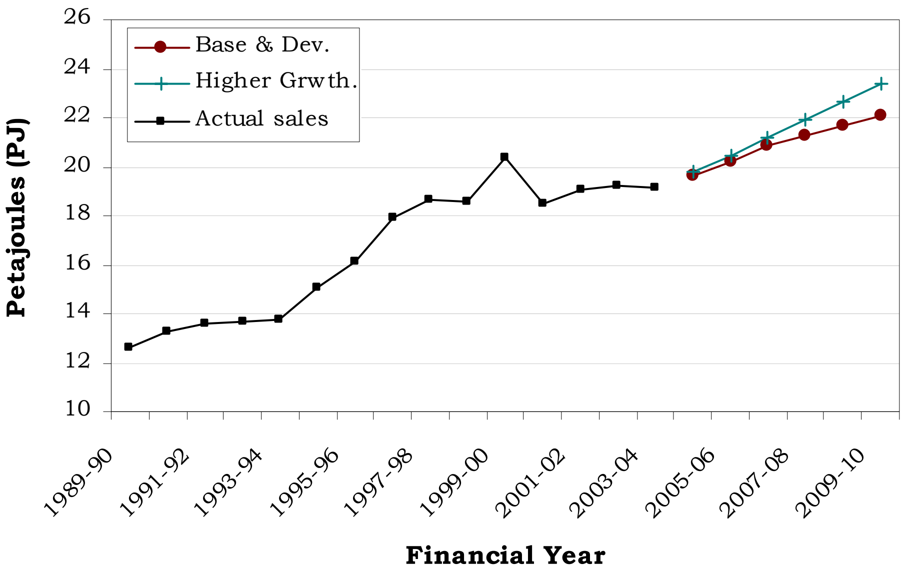
Demand projections

6.10 Power and Water's requirement for gas is directly related to its level of electricity generation. Accordingly, the Commission has projected the requirement for gas on the basis of the projected growth in electricity sent out. The Commission has projected gas requirements for the baseline plus major developments demand scenario and the higher growth demand scenario.

6.11 Under the *baseline plus major developments demand scenario*, the requirement for gas is projected to increase from the current level of approximately 19PJ a year to approximately 22PJ a year in 2009-10. Under the *higher growth demand scenario,* the annual gas requirement by 2009-10 is projected to be a little over 23PJ.

6.12 Chart 6.3 illustrates these projected future requirements in their longer-term historical context.

Chart 6.3 – Actual and Projected Gas Requirements, Under Alternative Scenarios



Gas supply issues

6.13 The availability of gas from the Amadeus Basin for use by Power and Water for electricity generation is subject to considerable uncertainty. While Palm Valley has failed to provide the levels of supply initially expected, the shortfall has to date been adequately covered by an increase in production from Mereenie.

6.14 The consensus view is for continued declines in Palm Valley production. How steep the decline will be is the subject of considerable debate. The Commission's analysis of annual gas requirements indicates that approximately 3 and possibly 4PJ of additional gas may be needed within the next six years. As production from Palm Valley continues to decline, the requirement for additional gas from Mereenie and other sources will accelerate.

6.15 The consensus view appears to be that, on a geological basis, Mereenie has the potential to continue to make up the shortfall through to 2009, and possibly beyond. However, the key questions would appear to be, first, whether Power and Water would have access to a sufficient amount of Mereenie gas to make up the shortfall and, secondly, whether the required volume of gas would be available on terms commercially acceptable to Power and Water.

6.16 The first question arises because it cannot be assumed that Power and Water would necessarily be the only prospective purchaser of additional Mereenie production. It is quite possible that other gas users with access to the pipeline that connects the Amadeus Basin to Darwin may also require additional supplies of gas in the next few years. Should this situation arise, Power and Water would encounter competition for the available supplies, which could lead to its requirements failing to be met in full.

6.17 The second question arises because the costs of increased Mereenie production are expected to be relatively high. Power and Water may be faced with a situation where sufficient additional supplies are indeed available to make up the shortfall, but at a substantially increased (and possibly uneconomic) cost.

6.18 In last year's review, the Commission undertook a scenario-based quantitative analysis of gas supplies from Palm Valley and Mereenie. This analysis indicated that the supply situation would indeed be tight. However, the Commission took comfort from the opportunities that appeared to be opening up for Power and Water to access alternative sources of gas associated with the various offshore developments then in prospect.

6.19 The Commission has formed the view that, during the course of the last 12 months, the prospective supply situation from the Amadeus Basin has at best remained static, and possibly tightened further. In addition, the possibility that competing purchasers of the available gas will arise over the critical next few years cannot be discounted. In consequence, the Commission considers that the prospect of a shortfall in gas supplies from the Amadeus Basin has increased, and that there is increased risk that the shortfall may be significant.

6.20 At the same time, progress has continued to be made in the development of offshore gas reserves. These reserves are substantial, and are discussed further in the following section. However, the Commission notes that since the last review was completed no firm arrangements that provide Power and Water with access to offshore gas have been disclosed.

Alternative sources of fuel

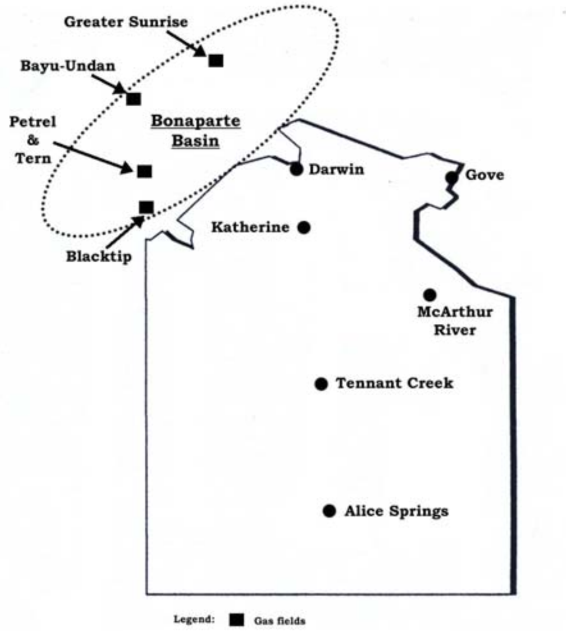
6.21 As Amadeus Basin gas production declines towards the end of the decade, Power and Water has indicated that any potential gas production shortfalls will be managed by entering into gas purchase arrangements with offshore gas producers, and has advised the Commission that discussions to that end are currently underway.

6.22 As noted in last year's review, Power and Water's existing demand for gas of around 19PJs per annum is insufficient to drive offshore developments by itself, so that future sources of gas are contingent on aggregated demand supplied via offshore projects. To develop a new gas resource, gas producers, gas purchasers and gas pipeliners need to negotiate agreements that collectively establish workable commercial arrangements for the complete supply chain from field production to gas end users. For both commercial and operational reasons, the lead times between commencement of negotiation and the physical supply of new gas can be 3-5 years.

6.23 A number of offshore fields (see chart 6.4) have the potential to supply gas for electricity generation and to potential new major industrial users as the supply from the Amadeus basin declines:

- Bayu-Undan (3.4 trillion cubic feet ("TCF"));[16]
- Greater Sunrise (7.7 TCF);
- Blacktip (1.1 TCF); and
- Petrel & Tern (1.4 TCF).

Chart 6.4 – Offshore Fields



6.24 A number of other fields also have the potential to supply gas to the Territory and exploration and appraisal work is continuing to progress.

6.25 The ConocoPhillips-operated Bayu-Undan field in the Timor Sea has a long-term export contract to supply LNG from a Darwin-based processing plant. An LNG Plant at Wickham Point is being constructed and production is expected to commence in 2005-06. Known reserves are committed to the LNG contract, however some gas may be available on a short term basis for use by other purchasers.

6.26 Woodside is the operator of the Blacktip discovery south west of Darwin in the Joseph Bonaparte Gulf. All known reserves are currently conditionally committed to supplying gas to Alcan's expansion project at Gove. Gas would be delivered via trans-Territory pipeline, which would represent a significant and complex project in it's own right.

6.27 The offshore Petrel and Tern fields 300km west of Darwin operated by Santos are other potential gas supply sources. Development of these fields seems contingent on aggregating customers with total demand of 60PJs per annum. These fields seem more likely to be developed in the immediate future now that the final development decision for the Sunrise field in the Timor Sea has been postponed until the end of the decade at the earliest.

[16] One TCF is equivalent to approximately 1,000PJ or about 50 times the existing Territory annual gas demand.

Commission's view

6.28 The Territory's electricity system requires a supply of gas that is economically priced, secure and sufficiently flexible to meet an uncertain future electricity demand. The demand scenarios developed by the Commission indicate the variability in future gas requirements that need to be accommodated.

6.29 Currently, Power and Water is faced with the additional difficulty of managing the transition from reliance on a source of gas that has proven to be problematic to a more sustainable long term arrangement.

6.30 The Commission considers that in the short-term gas supplies are adequate.

6.31 However, until alternative longer-term arrangements are in place, it is not possible to say with reasonable confidence that sufficient gas supplies will be available *at acceptable cost* to maintain power system adequacy in the latter years of this decade.

6.32 In part this is unavoidable. Negotiations are necessarily conducted on a commercial-in-confidence basis. Moreover, the Territory is in the fortunate position of being on the threshold of a period of significant development of the extensive nearby gas reserves. This will provide opportunities for an economic and secure supply of gas to the power system in the long term, and scope for transitional arrangements in the medium term.

6.33 Nevertheless, it is clear to the Commission that the situation is continuing to tighten with the passage of time.

CHAPTER 7

NETWORK ADEQUACY

7.1 Electricity that is generated at the power station cannot be supplied to customers without a properly functioning transmission and distribution network. This network is made up of fixed assets – high voltage wires, low voltage wires, distribution substations and other associated equipment – that are connected together in a complex system linking generators with electricity load (users).

7.2 Each item of network infrastructure has a rated capacity that defines the quantity of electricity that it can distribute. As the demand for electricity increases, the physical capacity of assets in the network must also be increased to allow for the transport of larger volumes of electricity and greater geographic spread.

7.3 From the customer's perspective, the relevant aspect of reliability is the reliability of delivered supply, which is affected by each component of the supply chain – the adequacy of primary fuel supplies, generation capacity and network performance. In principle, the same reliability considerations that apply to the generation sector also apply to the network – there must be sufficient capacity in the network elements to allow for expected future growth and unexpected increases in demand, and sufficient back-up to cover the failure of critical individual elements.

7.4 In practice, the management of network reliability faces a quite different set of considerations. While generators tend to be large, standalone items of equipment that produce a uniform output – bulk electricity – and that can be added in single 'lumps', the network is made up of many elements of varying sizes that supply a service to customers that varies both by volume and location. When a generating unit fails, it affects the level of supply to the total system. When a network element fails, it usually affects only those customers in the immediate locality. This makes both measuring and managing network adequacy more complex.

7.5 For these reasons (and perhaps because it is generally the case that attention is directed first at the things that are more easily measured), to date network adequacy has not received the same attention as generation adequacy. However, as the recent experience in Queensland demonstrates, network adequacy quickly becomes a central issue when customers are faced with the prospect of repeated widespread supply failures due to declining network performance.

7.6 The Independent Panel appointed by the Queensland Government to investigate the circumstances that led to widespread supply failures in January 2004 provided a succinct summary of the issue:

> *"There will always be a small number of outages as a result of matters such as motor vehicle accidents, storms, lightning or animals. While some alleviating measures can be taken to reduce or avoid outages as a result of these causes, such problems can never be totally eliminated.*
>
> *Other outages are caused by asset failure or the system being over loaded in peak times. It is possible to provide a service which will almost certainly never fail as a result of these causes. This is generally achieved by having spare assets and a degree of spare capacity in the system which allow, in the case of failure or over loading of a particular asset, the employment of either alternative assets or the automatic switching*

of load so that customers can be supplied via an alternative asset without noticeable interruption. This is the standard that should be expected for large urban and developed areas.

The difficulty is that building a network with the spare assets and capacity to be outage proof in peak times is extremely expensive. This is because the peaks only last for relatively short intervals, predominantly over the extremes of the summer and winter periods (e.g. on very hot days in summer when air conditioner use is high). In recent years, Queensland has experienced summer peaks of extended length. For the remainder of the year, the additional network assets needed to guard against outages in the case of asset failure during those short peak times remain idle or underutilised.

The likelihood of an outage being caused by asset failure during peak times in a well-maintained network operating at a level of reasonable capacity is very low. Furthermore, in the event that a failure does occur in such a network at peak times, the number of customers affected is likely to be low (e.g. less than 10,000) and the time of the outage reasonably short (e.g. an hour)." [17]

7.7 In Queensland's case, the Panel also noted that there is limited contingent capacity in key parts of the networks.

"In ENERGEX'S case, the Panel found that there is limited contingent capacity, which has resulted from two factors. The first was the adoption in 1989 of a planning methodology (Reliability Assessment Planning) designed to promote increased system utilisation and reduced spare capacity. In addition, ENERGEX was faced with peak demand growth over the past two years well in excess of its forecast.

The ENERGEX network has utilisation of around 76%. The Australian average is around 56% and the professional advice that the Panel obtained was that prudent practice dictates that utilisation should be around 60% to 65%. It is clear that, as mentioned above, some of this over utilisation came about as a result of ENERGEX not accurately predicting growth in peak demand levels in 2002/03 and 2003/04. …

It must be understood, however, that to a very significant degree the over utilisation resulted from a deliberate decision to work the assets much harder than had previously been the case. The ENERGEX management took a decision as early as 1989 to take a greater risk than had previously been the case. The risk taken was that, if there was equipment failure at the time of peak demand, there could be an outage to a part of the network until load switching took place. The assessment made by ENERGEX management was that the chances of the outage occurring and the time for which the outage would last if it did occur were small enough to justify the risk being taken in view of the financial savings made from avoiding or deferring capital expenditure.

The Board/management saw this as prudent business practice. They estimated that it reduced spending on the network by around $1 billion over a 10 to 12 year period. ENERGEX was not alone in employing this Reliability Assessment Planning (RAP) system. Other distributors also have used it but generally it has been used in conjunction with a philosophy which dictates that all major components in the system will have an "N-1" capacity. This simply means that if there is equipment failure in one of the major assets, such as a bulk supply sub-station or a zone sub–station, there will be enough spare capacity to allow alternative assets to be used or load to be switched thus avoiding an outage. Such a philosophy also allows existing assets to be operated under normal conditions at levels well within the capacity for which they are designed. …

It is the Panel's view that ENERGEX should have been monitoring the utilisation level of its network such that when it reached the prudent level of around 60% to 65% it should have set its capital expenditure programme at such a level as to maintain it at that utilisation level. The Panel believes that its failure to do this has led to capital expenditure being too low for at least the past two years and perhaps considerably longer.

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[17] *Summary Report of the Independent Panel, Electricity Distribution and Service Delivery for the 21st Century*, July 2004.

> *The primary cause of this over-utilisation was the inappropriate use of the RAP system without adequate supporting data. The unexpected growth in peak demand in 2002/03 and 2003/04 also contributed to the high utilisation. The high peak demand would not have been problematic if the system had been operating at an appropriate utilisation rate. Another element was the desire not to exceed the capital expenditure "building block" used in the QCA's determination.*
>
> *The current position with ENERGEX is that 69% of bulk supply sub-stations and 79% of zone sub-stations do not meet the "N-1" criteria. It is accepted that there is some switching capacity available. Nevertheless, the Panel lacks confidence that ENERGEX has sufficient data at its disposal to know whether it would be able to successfully switch load in the case of equipment failure in peak demand times. This follows from the overall high utilisation of the network and the lack of load data collected by ENERGEX in recent years. This data is necessary to allow ENERGEX to make an assessment of its ability to switch load.*
>
> *Approximately 10% of ENERGEX's zone sub-stations are operating in peak demand times at levels in excess of their design capacity. This means that 22 zone substations are effectively overloaded at peak demand times. …*
>
> *Based on the above discussion, the Panel's overall finding is that ENERGEX's capital expenditure has not been adequate to cater for current demand and future growth."*

7.8 Over the next year, the Commission will consider how best to assess the capacity of the NT electricity networks, with a view to including a review of network adequacy formally within the 2005 Power System Review.

APPENDIX A

GLOSSARY

Capacity – The maximum output that a generating unit can provide under specific conditions for a given time period without exceeding temperature and stress limits.

Co-Generation – Involves the capture of exhaust heat (or other useful thermal energy such as steam) from a generating facility that produces electricity, for use in industrial, commercial, heating, or cooling processes.

Demand – The amount of electricity consumed by customers at any given time or over a period of time.

Demand Side Management – The planning, implementation, and monitoring of utility activities designed to encourage consumers to modify patterns of electricity usage, including the timing and level of electricity demand. It refers only to energy and load-shape modifying activities for the purpose of reducing peak load and the need for generating capacity at such times.

Forced Outage – The shutdown of a generating unit, transmission line or other system asset for either emergency reasons or unexpected breakdown.

Gigawatt-hour (GWh) – A measure of electricity consumption in gigawatts for a one-hour continuous period. One gigawatt hour equates to one million kilowatt hours.

Interruptible Load – Load that, in accordance with contractual arrangements, can be interrupted at times of peak load. Load can be disconnected, either manually or automatically, and usually involves commercial and industrial consumers.

Kilowatt-hour (kWh) – The total amount of energy used in one hour by a device that uses one kilowatt of power for continuous operation. Electric energy is commonly sold by the kilowatt-hour, which equates to 1000 watt-hours.

Line Pack – Refers to the gas that is in the pipeline at any given point in time for the purpose of maintaining minimum pipeline operating pressure. Line pack does not increase gas supply availability, but increases short-term deliverability by moving gas from one place on the pipeline to another.

LNG – An abbreviation for liquefied natural gas. LNG consists mainly of methane – the simplest hydrocarbon.

Load – The amount of electricity required to meet demand at any given time.

Load Duration – Indicates the proportion of time that particular levels of demand (expressed as a proportion of the maximum demand for a year) are exceeded.

Load Shedding – Occurs when there is inadequate generation to meet demand resulting in disconnected load. Load shedding protocols enable the System Controller to automatically disconnect load in order to maintain frequency and voltage and prevent the possible collapse of the system.

Megawatt (MW) – One megawatt equates to one thousand kilowatts.

Megawatt-hour (MWh) – One megawatt-hour equates to one thousand kilowatt-hours. One MWh of electricity can power ten thousand 100-watt light bulbs for one hour.

Network – That part of the power system involved in the transmission and distribution of electricity from generation sources to end-use customers.

Operating Reserves – The generation arrangements required to maintain system security by handling short-term disturbances in the system.

Petajoules (PJ) – A measure of energy in petajoules. One petajoule equates to 1000 terajoules.

Planned Outage – Occurs when a network provider disconnects supply in order to undertake maintenance or capital works on a part of its network.

Planning Reserves – The generation reserves required to maintain system adequacy by meeting annual demand peaks.

Regulated Power System – A system for generating and supplying electricity that is based on an electricity network that is subject to regulation under the *Electricity Networks (Third Party Access) Act 2000*.

Reserve Margin – The reserve level associated with the point at which, given the current demand and supply capabilities of a power system, intervention in the market is required to ensure risks to supply are minimised.

Sent-out Energy – The amount of electricity measured leaving a generator at its connection point to the transmission or distribution network, and therefore does not reflect network losses.

System Adequacy – The power system's ability to supply the aggregate energy requirements of end-use customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements.

System Security – The power system's ability to withstand sudden disturbances such as electric short circuits or unanticipated loss of system elements.

TCF – A measure of the size of a resource in trillion cubic feet. One TCF equates to 930PJ.

Terajoules (TJ) – A measure of energy in terajoules.