ANNUAL POWER SYSTEM REVIEW

DECEMBER 2002

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CHAPTER 1

INTRODUCTION

Legislative requirements

1.1 The purpose of this report is to review and report to the Minister on the matters required under section 45 of the *Electricity Reform Act 2000* ("the Act"). In particular, section 45(1)(e) of the Act requires the Commission to prepare and publish an annual review of prospective trends in the capacity and reliability of the Territory's power system relative to projected load growth.

1.2 Under section 45 of the Act, the Commission is also authorised to:

- develop forecasts of overall electricity load and generating capacity in consultation with participants in the electricity supply industry and report the forecasts to the Minister and electricity entities (sub-section (1)(a)); and
- advise 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)).

The Commission has also incorporated its activities in these respects in this its second *Annual Power System Review* ("2002 Review").

Nature of power system 'reliability'

1.3 Two aspects of 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.

1.4 Adequacy is a matter of installed generating capacity and 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, and before operating reserves have been replenished, the system is much less secure.

1.5 Correspondingly, two types of power system 'reserves' can be contrasted:

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[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.

- ***operating reserves***, which are required to maintain system security by handling short-term disturbances to the system;[3] and
- ***planning reserves***, which are required to maintain system adequacy by meeting annual demand peaks.

These two types of reserves are considered the basic inputs to the generation side of system reliability.

1.6 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.

Focus of review

1.7 In the Commission's first *Annual Power System Review* published in October 2001 ("2001 Review"), the focus was predominantly on the adequacy issue (and associated planning reserves) through to 2009-10, and hence whether the power system has sufficient generation to keep it secure in all but the most extraordinary circumstances.

1.8 While the 2001 Review focused on adequacy, it was recognised that a shortage of installed generating capacity (and so inadequate planning reserves) is not the only cause of unreliable operation.[4] Requirements for operating reserves (which are intended to provide security) were overlooked in the 2001 Review on the basis that adequacy is the primary economic problem. Because system adequacy is relatively expensive to provide for, there is potential for market failure when it comes to planning for increments in capacity. Security requirements are more likely to be met provided the system has adequate planing reserves, and it is relatively cheap to maintain sufficient operating reserves in an adequate system. Hence, while complex, the problem of security can be considered secondary to the problem of adequacy – at least from an external monitoring perspective.

1.9 For the 2002 Review, the Commission has chosen to build on its evaluation of power system reliability by also examining the gas supply outlook and any implications for system reliability (both adequacy and security) in the Territory.

1.10 Nevertheless, the 2002 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, with the Power and Water Corporation ("PowerWater") charged (as the sole network service provider) with responsibility for ensuring that capacity keeps pace with usage growth. It is in the generation area where there is potential for market failure when it comes to planning for increments in capacity, and where the Commission has chosen to give initial priority.

1.11 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

[3] Operating reserves include spinning reserves.

[4] In terms of power system reliability and its evaluation by the Commission in the 2001 Review it was stated: "while section 45(1) of the Act refers to the future capacity and reliability of the Territory's power system, the review limited its concern to those aspects of the reliability of the system arising from supply relative to demand and reserve margins."

load outside this network coverage (e.g., rural townships and remote aboriginal communities) is not included in the review.

1.12 Finally, the review has not undertaken any sophisticated modelling of power demand. Such modelling will be justified only when the supply-demand position becomes more finely balanced and the impacts of major developments become more apparent. Instead, the Commission has developed its own forecasts based in the main on growth assumptions and methodology used by generators.

Consultation with interested parties

1.13 In developing the 2002 Review, the Commission has consulted with various parties, including participants in the Territory's electricity supply industry and agencies within Government. The parties providing information to the Commission were provided with drafts of this report. The final report has benefited significantly from the comments received on the earlier drafts, although the views expressed in this final report are those of the Commission alone and are not necessarily those of the parties consulted by the Commission.

Disclaimer

1.14 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 2011-12. The Commission believes that the contents are accurate within the normal tolerance of economic forecasts and that the broad analyses are correct.

1.15 The purpose of this document is to review and report to the Minister in accordance with section 45 of the Act. 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.

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CHAPTER 2

SUMMARY OF KEY FINDINGS

Generation adequacy

2.1 The Commission has undertaken an assessment of the 'adequacy' of generation capacity in the Territory's regulated power systems, that is the extent to which these systems have sufficient generation to keep them secure in all but the most extraordinary circumstances.

2.2 The Commission's assessment in this regard has involved a comparison of various electricity demand forecasts over the next decade with existing supply including an appropriate reserve margin.

2.3 A supply-demand imbalance appears imminent only for the Alice Springs system, with electricity demand likely to encroach on a prudent reserve margin between 2004 and 2006.

2.4 As to the Darwin-Katherine system, the generation capacity currently in place appears sufficient for the time being, even after taking account of the impact of possible onshore gas related and mining developments over the forecast period. While the net electricity import/export requirements of major developments are subject to some uncertainty, the Commission's modelling indicates that additional generation capacity would be necessary towards the end of this decade only were the new developments to exhibit in excess of a 20% net draw on offsite generation. Current indications are that the net draw of projects on the drawing board is not this high.

2.5 Existing generation capacity in the Tennant Creek system appears sufficient over the forecast period to 2011-12.

Fuel supply outlook

2.6 The Territory's reliance on the supply of natural gas for electricity generation in the regulated power systems can also give rise to 'adequacy' issues. The Commission has undertaken its assessments in this area by comparing potential gas production with forecast demand for gas used in electricity generation over the coming decade.

2.7 The Commission has found that production from the Palm Valley field is likely to decline substantially over the next few years. As a result, the combined volumes available under existing contracts from the Palm Valley and Mereenie fields may then not be sufficient to supply all the regulated power systems' requirements after 2006.

2.8 Moreover, while a number of large offshore gas reserves could supply future electricity generation gas requirements as production from existing gas fields declines, the lead times for the development of alternative gas supplies mean that new gas supply arrangements may need to be established in the next year or two to meet the potential requirements after 2006.

2.9 However, this potential inadequacy in gas supply does not give rise to concerns regarding electricity supply reliability in the immediate and medium term. The availability of liquid fuel alternatives will ensure continuity of supply until new gas sources come on stream. The main problem is likely to be the extra cost of liquid-fuelled electricity generation to end-users of electricity in the Territory.

CHAPTER 3

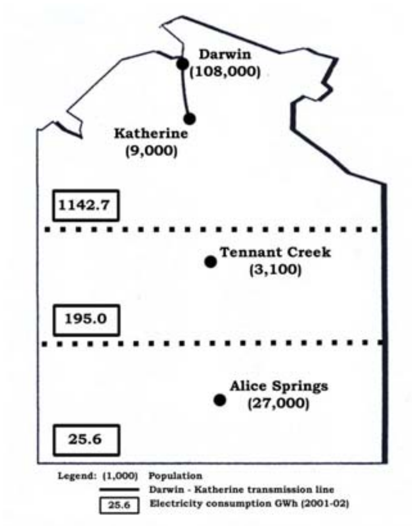
KEY FEATURES OF THE TERRITORY'S POWER SYSTEM

Introduction

3.1 The 'power system' essentially involves two key processes: producing electricity (generation) and transporting electricity (networks). Those involved with these activities are integral to the supply of electricity to end-use customers, and the decisions they make in respect of generation and network operation can have widespread effects on the continued supply of electricity.

3.2 For the purposes of this review, the Territory's power system consists of three distinctly separate systems/regions of Darwin-Katherine, Tennant Creek and Alice Springs, with the Darwin and Katherine distribution networks being connected by a 132kV transmission line. The review is focused on the regulated aspects of these systems. Chart 3.1 depicts these three systems, indicating the electricity consumption in each regulated network and the population of major centres.

Chart 3.1 – Territory's Regulated Regions



Unique aspects of the Territory's electricity supply industry

3.3 The Territory's power system, unlike those of the south-eastern States, is not interconnected with the National Electricity Market ("NEM"). Technical and economic limitations, due to the great distances from other major centres in Australia, mean that the Territory's systems operate in isolation from other markets.

3.4 Furthermore, the small size of the Territory market means that it is not possible to operate a wholesale pool like that operating in the NEM. Instead, end-use customers and third-party retailers are obliged to have supply agreements in place directly with generators (termed ‘bilateral contracting’).

3.5 The dispatch and system control functions are essential to ensure that the power system as a whole (generators and networks together) produces and delivers the quantity of power required by all customers. PowerWater currently undertakes the role of power system controller in the interests of all participants in the market, in accordance with section 38 of the Act.

Generation

3.6 Until September 2002, NT Power Generation Pty Ltd (“NT Power”) was licensed to generate electricity from its Mt Todd power station. At that time, NT Power withdrew from the Territory’s electricity market due to difficulties experienced in securing gas supply.

3.7 During 2001-02, the Commission brought independent power producers (“IPPs”) under the licensing regime. Each of these IPPs is currently contracted with PowerWater to supply electricity into various systems. IPPs operating in the regulated system include Pine Creek Power Pty Ltd, Cosmo Power Pty Ltd, and Central Energy Power Pty Ltd.

3.8 PowerWater remains the single largest generator of electricity throughout the major regions of the Territory. Over 80% of all generation capacity in regulated power systems are installed in the Darwin-Katherine region with the remainder in the southern regions of Tennant Creek and Alice Springs.

3.9 The Territory’s generation market remains open to competition.

Fuel supply

3.10 Generation plant in the Territory consists mainly of gas and liquid fuel driven turbines. The gas produced from the Palm Valley and Mereenie fields in the Amadeus Basin in Central Australia is currently the primary source of fuel. Timor Sea gas supplies are eventually expected to replace the Central Australia gas supply for most generators.

3.11 Gas from the Amadeus Basin is transported within the Territory by a single gas pipeline, which has capacity constraints due to its size and length, connected to two gas fields, each of which have production capacity limits. To manage the risk of interruption to this supply, PowerWater has installed and operates dual fuel generators in most sites as a safety net and commitment to ensure reliability of supply to customers.

3.12 Fuel supply issues are examined in more detail in chapter 9 below.

Networks

3.13 PowerWater is the sole owner of the regulated networks in the Territory, and is responsible for operating and maintaining power transmission and distribution in most cities, suburbs and townships. In carrying out its responsibilities, PowerWater is responsible for ensuring that network capacity keeps pace with usage growth, while working within existing transmission and network constraints.

Retailers

3.14 Following NT Power's withdrawal from the market in September 2002, PowerWater is the sole licensed retailer operating in contestable segments of the Territory's electricity market. These segments of the Territory's electricity market remain open to competition. PowerWater is also the licensed retailer for supplying non-contestable customers.

CHAPTER 4

KEY FEATURES OF THE TERRITORY'S ECONOMY AND ENVIRONMENT

Introduction

4.1 The nature of demand in the Territory's power system is essentially determined by economic and environmental factors. This chapter briefly describes these factors.

Climate

4.2 Weather conditions throughout the Territory are the main variable contributing to the daily and seasonal fluctuations in electricity demand.

4.3 The Territory has two distinct climate regions:

- the Top End and the Gulf District – which is distinctly monsoonal; and
- Central Australia (or Alice Springs District) – located in the south of the Territory and characterised as arid.

4.4 The Top End has two distinct seasons, the Wet (November to April) and Dry (May to October). Throughout the year, temperatures are similar to Cairns, Bali and Singapore. The average temperature of Darwin changes little throughout the year, with average daily maximums between 30-32°C, and minimums between 19-25°C. The Top End is also one of the most lightning prone areas in the world.

4.5 The amount and reliability of rainfall decreases considerably from north to south, with Darwin on the northern coast receiving approximately 1500mm per annum (mostly from December to March), while the average annual rainfall is about 150mm per annum at the South Australian border.

4.6 South of Tennant Creek, the environment becomes semi-arid to arid, with the Alice Springs District being generally hot and dry. Rainfall is also generally low and erratic throughout the year. Temperatures are high throughout the year, but with a large diurnal (day-night) range. The average daily maximum in January is 37°C, and minimum 22°C, but in July the averages drop with a daily maximum of around 19°C and minimum of 5°C.

Population

4.7 As at 30 June 2001, the Territory population was 200,019 persons. The Territory is sparsely populated, with a density of 0.1 persons per square kilometre, lower than any other State or Territory in Australia and well below the national average of 2.5 persons per square kilometre. Despite this, over three-quarters of the population live in urban areas.

4.8 As at 30 June 2001, the Darwin region (comprising of Darwin, Palmerston and Litchfield areas) accounted for 54% of the Territory's population. Alice Springs accounted for a further 14%, while other major centres accounted for around 9%. Table 4.1 below provides the population distribution in the Territory.

Table 4.1 – Territory Population – June 2001

Region	Population	Proportion of Persons
Darwin	69,698	34.8
Palmerston	22,753	11.4
Litchfield	15,740	7.9
Darwin Region	**108,191**	**54.1**
Jabiru	1,161	0.6
Katherine	8,965	4.5
Nhulunbuy	3,918	2.0
Tennant Creek	3,065	1.5
Alice Springs	26,990	13.5
Rest of Territory	47,729	23.9
Other NT	**91,828**	**45.9**
Total	**200,019**	**100.0**

Source: Territory Budget Paper No. 5, 2002-03 p.26; ABS Cat 3218.

4.9 Over the five years to June 2001, the Territory's population grew at an annual average rate of 1.9%, and was the highest of all jurisdictions.[5] Since June 2001, however, population growth has slowed significantly with little growth estimated to have occurred in the year to June 2002, considerably lower than the national average. Population growth is expected to pick up in 2002-03.[6]

4.10 Further out, a return to stronger population growth is expected to be driven by large construction workforces over a number of years, relating to onshore gas expansions and projects, as well as defence force expansion and other building infrastructure works.

Economy and industry

4.11 In terms of output, the mining and energy industry remains the most important industry in the Territory, accounting for 22.2% of Gross State Product ("GSP") in 2001-02. In that year, the total value of mineral and energy production in the Territory was $4.4 billion, the result of offshore oil production from Laminaria-Corallina oil fields coupled with onshore minerals production. The outlook for energy developments in the Territory is positive. Oil production will dominate in the short term, while gas extraction and gas-based manufacturing are expected to dominate in the medium to long term.

4.12 Territory economic growth of 3.7% is forecast for 2002-03 as the upswing in the economy continues due primarily to growth in private consumption and non-residential construction. Over the next 5 years to 2006-07, average annual growth of 5% is forecast.[7] In the medium term, Territory economic growth prospects have significant upside.

[5] Budget Paper No.5, 2002-03, *Northern Territory Economy,* p.28.

[6] Budget Paper No.5, 2002-03, *Northern Territory Economy,* p.25.

[7] Budget Paper No.5, 2002-03, *Northern Territory Economy,* p.17.

CHAPTER 5

DEMAND

Introduction

5.1 This chapter develops forecast electricity demand in the Territory's regulated power systems for the period to 2011-12. In the main, data provided by PowerWater and NT Power have been combined to give an overall picture of demand in the Territory's power system.[8]

5.2 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.

5.3 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.

Composition of demand

5.4 Demand patterns depend upon those associated with the two main types of consumers: residential consumers and commercial/industrial consumers. Residential consumers include those in individual homes and apartments and are the biggest class of consumers in terms of numbers. Commercial/industrial consumers are the largest users of electricity, and include both private businesses and government service providers.

5.5 Table 5.1 shows the extent of these two categories in each regulated system, in terms of energy usage (gigawatt-hours (GWh) per annum) and number of customers.

5.6 As shown in Table 5.1, commercial and industrial customers, while fewer in number, accounted for about 68% of total energy consumption in 2001-02. Typically, electricity demand in the Territory is marginally more dependent on commercial and industrial customers than is the case in other jurisdictions around Australia.[9]

[8] Some revisions have been made to historical data provided by industry participants. As a consequence, some of the data published in the 2001 Review has been revised.

[9] Electricity Supply Association of Australia (ESAA), *Electricity Australia 2002*, p.47.

Table 5.1 – Regulated Electricity Market – 30 June 2002

	Energy Sales (GWh)	Energy Sales (%)	No. of Customer Sites
Darwin-Katherine:			
Residential	360	31%	43,396
Commercial/Industrial:	783	69%	8,435
<750 MWh	*292*		*8,256*
>750 MWh	*491*		*179*
Total	**1,143**	**100%**	**51,831**
Tennant Creek:			
Residential	7	27%	1,432
Commercial/Industrial	19	73%	409
<750 MWh	*12*		*402*
>750 MWh	*7*		*7*
Total	**26**	**100%**	**1,841**
Alice Springs:			
Residential	71	36%	9,719
Commercial/Industrial	124	64%	1,884
<750 MWh	*62*		*1,851*
>750 MWh	*62*		*33*
Total	**195**	**100%**	**11,603**
Total:			
Residential	438	32%	54,547
Commercial/Industrial	926	68%	10,728
<750 MWh	*366*		*10,509*
>750 MWh	*560*		*219*
Grand Total	**1,364**	**100%**	**65,275**

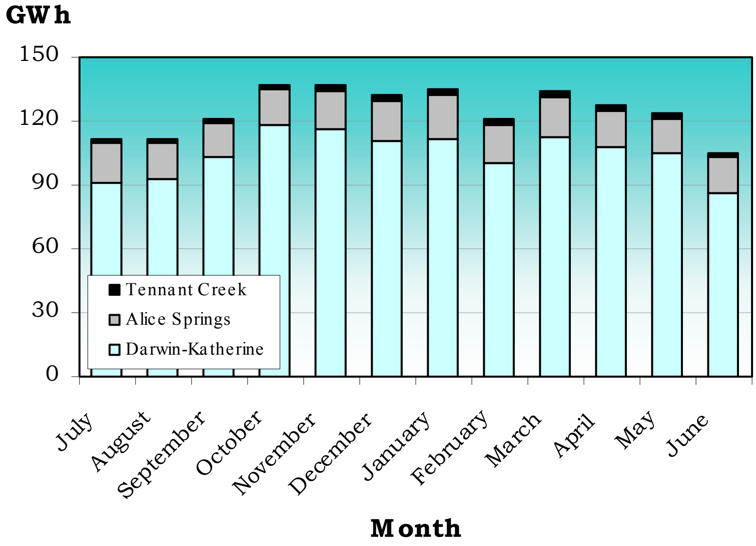
Demand profile

5.7 The Territory exhibits a unique demand profile, which is a result of numerous demand drivers related to seasonal, population and economic characteristics. The Territory's current demand profile is illustrated and briefly described below.

5.8 The electricity demand shown is measured in two ways: as demand in megawatts (MW) at a particular point in time (i.e., the generation required to meet the estimated likely load conditions), and as a consumption rate measured in GWh per annum (i.e., the amount of electricity consumers use on average over a 12 month period).

5.9 Chart 5.1 shows the sent-out energy for each regulated system in 2001-02. Sent-out energy is energy measured leaving the generator and therefore does not reflect network losses.

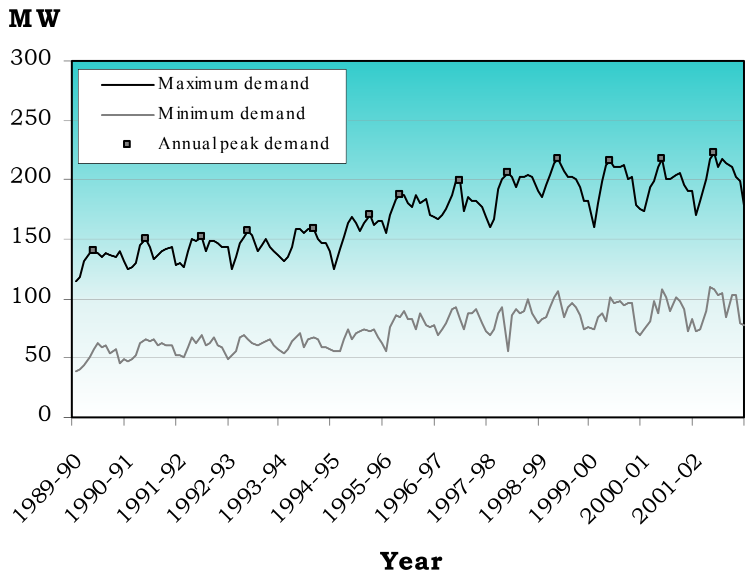
Chart 5.1 – Monthly Energy Regulated Systems 2001-02



5.10 The chart clearly shows the Darwin-Katherine system is the largest accounting for about 85% of overall energy sent-out in 2001-02. There is some evidence of seasonal variations in the Darwin-Katherine system with the period from October to January (known as the 'build-up') usually having the highest electricity consumption.

5.11 Since the 132kV Darwin-Katherine transmission line ("DKTL") was constructed in 1989-90, demand in the Darwin-Katherine system has grown at an average annual rate of about 4%. Chart 5.2 shows the historical monthly maximum and minimum demand in the Darwin-Katherine system.

Chart 5.2 – Historical Demand Darwin-Katherine Regulated System 1989-90 to 2001-02



5.12 The seasonal variations in the Darwin-Katherine and Alice Springs regulated systems are illustrated below.

Chart 5.3 – Daily Demand
Darwin-Katherine Regulated System 2001-02

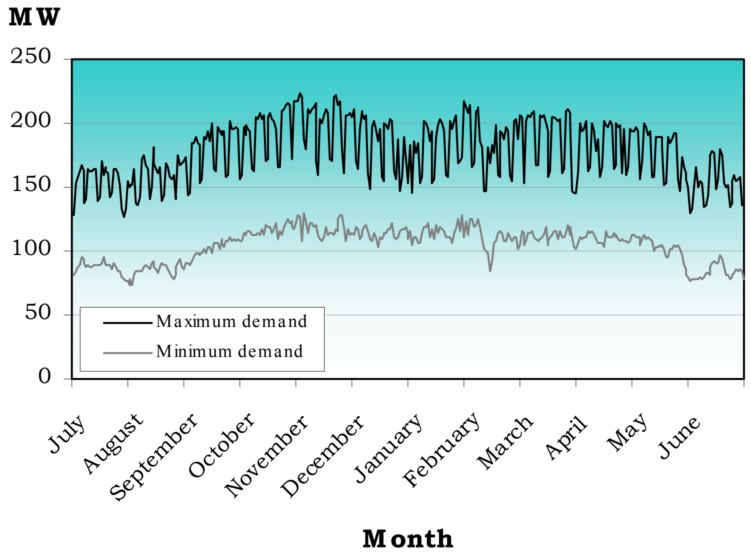
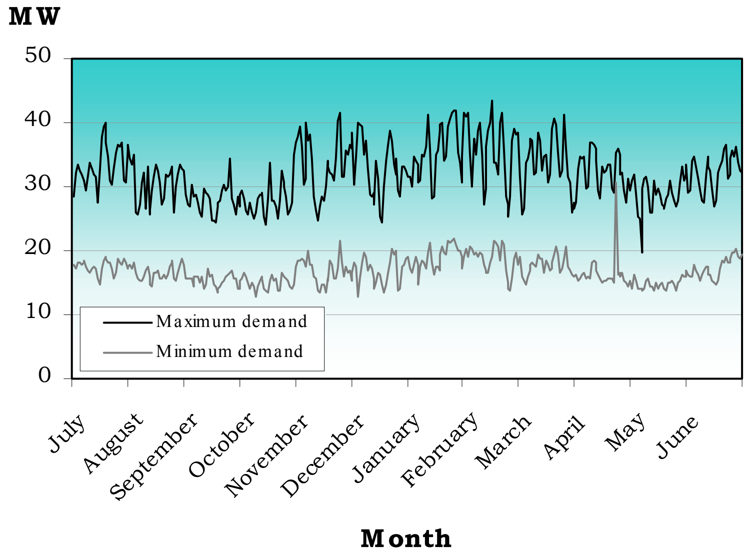


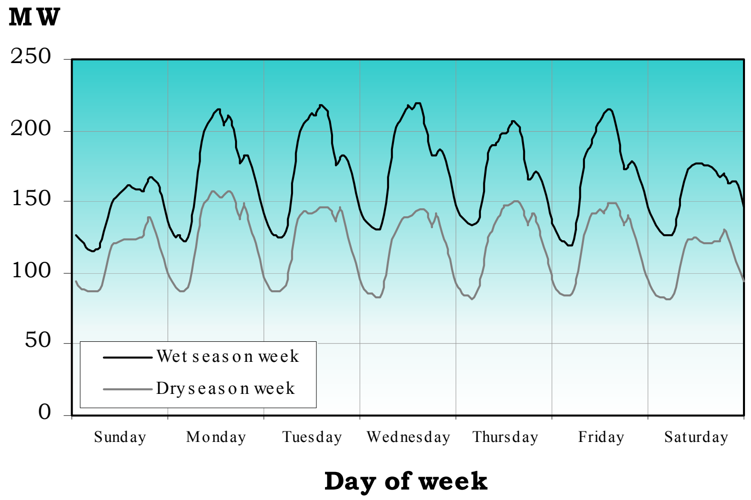
Chart 5.4 – Daily Demand
Alice Springs Regulated System 2001-02



5.13 Charts 5.3 and 5.4 above show the daily maximum and minimum demand experienced over 2001-02. The Darwin-Katherine system exhibits some consistency throughout the year in terms of its relative daily variations, although the Wet and Dry seasonal influence is also apparent. The Alice Springs system differs somewhat in that the period between January and April typically exhibits higher volatility in maximum demand than any other period throughout the year. The Alice Springs system also shows signs of a four-seasonal influence as defined by its unique waveform.

5.14 The weekly demand profile of the Darwin-Katherine system is shown in Chart 5.5.

Chart 5.5 – Hourly Demand – Darwin-Katherine Regulated System
Typical Seasonal Weeks



5.15 Chart 5.5 shows the hourly demand for the typical Wet season week of 19-25 November 2000, and the typical Dry season week of 11-17 July 1999, in the Darwin-Katherine system. The hourly demand profile is typically consistent throughout the working week with peaks usually experienced between 12-3pm, and a noticeable 'kink' in demand between 6-8pm reflecting 'close of trading' and 'end of day' residential activities. Maximum weekly demand is usually experienced mid-week, though in the Dry season we find that Mondays have weekly maximum demand points, however this can vary from time to time. The typical Dry season week is broadly similar to the Wet season, though demand is obviously lower and additionally less 'peaky'. During a typical weekend, demand is less volatile and less 'peaky' and mostly corresponds with daily weather patterns and residential activities than with commercial activities.

5.16 The Darwin-Katherine and Alice Springs load duration curves are shown in Charts 5.6 and 5.7 below. A load duration curve is a plot of the demand in each hour of the year, arranged by the level of demand. The horizontal axis indicates the percentage of time that the load is above a certain MW level as indicated by the vertical axis.

Chart 5.6 – Darwin-Katherine Regulated System
Load Duration Curves

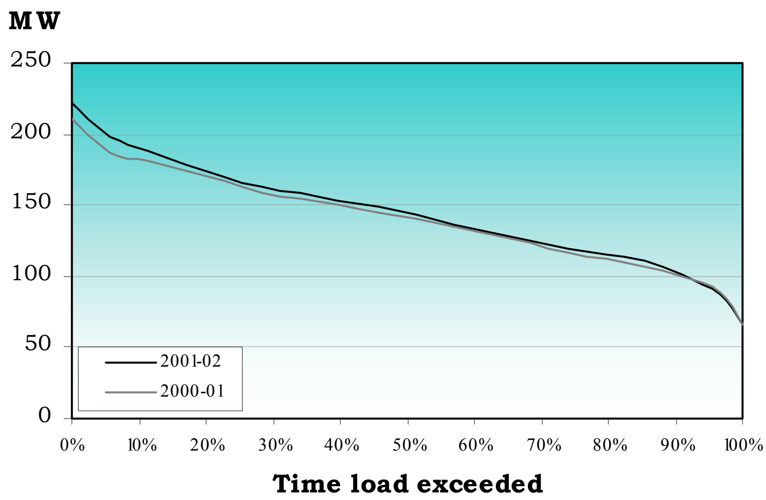
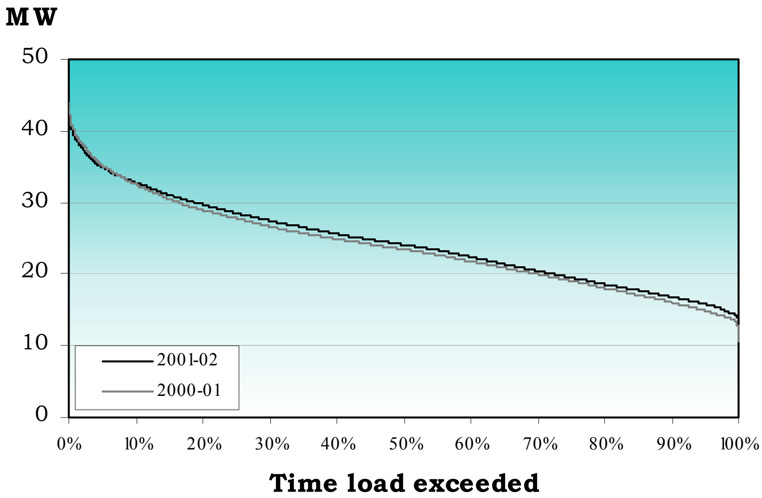


Chart 5.7 – Alice Springs Regulated System Load Duration Curves



5.17 The Territory experiences relatively longer duration peaking loads, as compared to southern jurisdictions (such as South Australia and Victoria) which have considerably shorter peak load periods. This difference is due mostly to contrasting climate conditions between the Territory and southern States.

5.18 Another feature of the load duration is its general slope. A flatter curve essentially indicates higher customer load factors, and is usually exhibited by large systems with the potential for greater diversity in demand profiles. The Territory's load duration curve is steeper than that exhibited by other jurisdiction and is due mostly to this size-effect.

5.19 Another load characteristic not so apparent in load duration curves is the ratio of peak demand to average demand. The Darwin-Katherine system has a peak to average demand ratio of about 1.3:1. In Tennant Creek the ratio is about 1.6:1 and in Alice Springs ranges from 1.5:1 in summer to 1.9:1 in winter. The ratio is useful in illustrating the current efficiency in the use of capacity. For example, shorter periods of peak demand would see the ratio move higher, and therefore require capacity to be available for shorter periods, which is economically inefficient. The ratio is a reflection of the demand and supply realities facing a particular system.

Baseline demand forecast

5.20 The overall demand forecasts have been undertaken in a two-stage process to illustrate the load growth *likely* to occur in the Territory over the period to 2011-12. The first stage is a 'baseline' demand forecast, showing the demand in the Territory based on a moderate economic growth scenario and excluding the impact of both one-off projects (in this review only the Alice Springs-Darwin railway) and possible major developments. The second stage incorporates the forecasts associated with both one-off and prospective developments, some of which are associated with the Timor Sea gas discoveries and the construction of the Bayu-Undan gas pipeline to Darwin. Together, these two stages provide an overall picture of prospective power demand in the Territory.

5.21 Electricity sourced from IPPs connected to the regulated network which are contracted with PowerWater has been included in the figures. Minor centres with their own independent generating capacity have been excluded.

5.22 Broadly consistent with the participants' views on load growth over the period to 2011-12, the Commission's baseline demand assumptions underlying the forecasts are: [10]

- approximately 2.5% average annual growth in electricity demand in the Darwin-Katherine regulated system; and
- approximately 2% average annual growth in electricity demand in both the Alice Springs and Tennant Creek regulated systems.

The forecasts also take account of low economic growth expected in the current financial year (2002-03), with the Territory resuming moderate growth patterns from 2004.

5.23 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.

5.24 The peak demand forecasts in the Darwin-Katherine system are based on the 2001-02 year, where a maximum of 223MW occurred on 1 November 2001. For the purposes of this review, forecast energy and peak demand growth rates are identical.

5.25 The 'baseline' peak demand and consumption forecasts through to 2011-12 in each regulated system are summarised in Table 5.2 below. The electricity generation is on an annual 'sent-out energy' basis.

Table 5.2 – 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)**
1999-00	215	1313	43	207	7	30
2000-01	218	1291	44	205	6	27
2001-02	223	1357	43	210	7	31
2002-03	225	1370	44	213	7	31
2003-04	231	1404	45	218	7	32
2004-05	237	1440	46	221	7	32
2005-06	243	1476	46	225	8	33
2006-07	249	1512	47	229	8	33
2007-08	255	1550	48	234	8	34
2008-09	261	1589	49	238	8	35
2009-10	268	1629	50	243	8	36
2010-11	274	1669	51	248	9	37
2011-12	281	1711	52	253	9	38

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

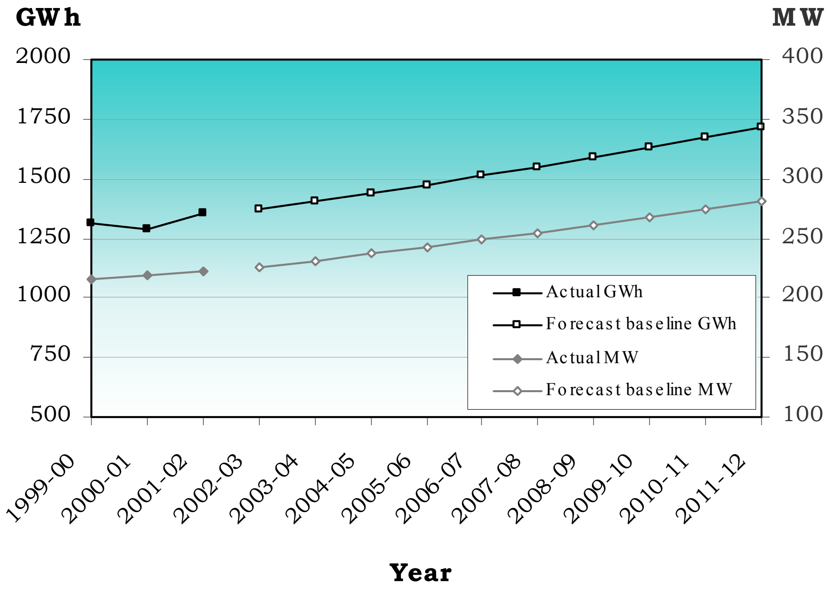
[10] These demand assumptions are predominantly based on population growth projections, however consideration has been given to technological trends in the take up of smart appliances as well as income elasticity of demand. Population growth assumptions have been sourced from the Australian Bureau of Statistics and the Northern Territory Treasury.

Darwin-Katherine regulated system

5.27 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 varying from year to year.

5.28 Chart 5.8 shows that, over the three years to 2001-02, peak demand and energy have increased marginally. In the past, variations in demand have been mostly attributed to changes in mining activity in the Territory (e.g., Mount Todd mine ceased operating in July 2000). Historically, over the last 10 years, peak demand in the Darwin-Katherine system grew at an average annual rate of about 4.0%, due mainly to various mining developments as well as the build up of defence forces in the Top End.

Chart 5.8 – Peak Demand and Energy Darwin-Katherine

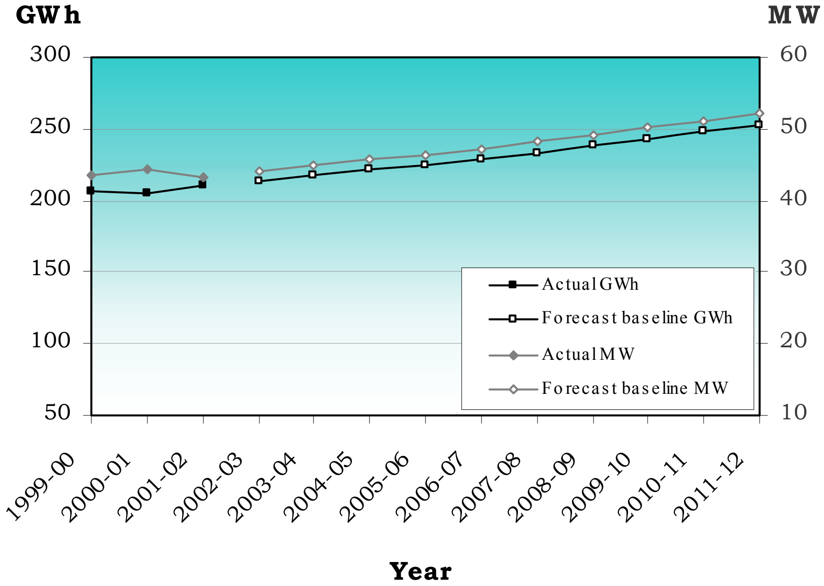


5.29 The peak demand and electricity consumption forecast for the Darwin-Katherine regulated system under the baseline scenario indicates an average annual growth of 2.3% over the period to 2011-12. This forecast demand is based on a moderate economic growth scenario, although the Commission has taken account of lower than average economic activity over the period to 2004. This baseline scenario produces an expected peak demand of about 280MW and energy consumption of about 1,700GWh in 2011-12, an overall increase of approximately 26% from current levels.

Alice Springs regulated system

5.30 In 2001-02, Alice Springs experienced a 2.3% increase in energy consumption, compared with the slight decline experienced in the previous year. Under the forecast baseline scenario (see Chart 5.9), the Commission expects average annual growth of approximately 1.9% accounting for current economic trends/projections including technological take-up rates. The growth over the forecast horizon also assumes population growth rates will be moderate to high in Alice Springs. This baseline scenario excludes any additional demand arising on account of the Alice Springs to Darwin railway.

Chart 5.9 – Peak Demand and Energy
Alice Springs

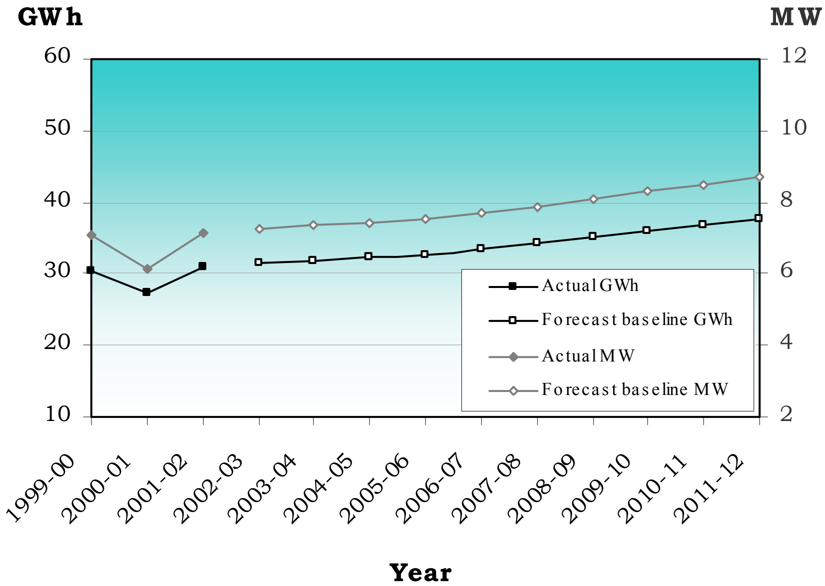


Tennant Creek regulated system

5.31 Since 1998, Tennant Creek saw about 40% decrease in peak demand and energy consumption, which is mainly a result of the progressive scaling down of Normandy's Warrego mine over this period. In 2001-02, a pick up in demand was evident with peak demand of about 7.15MW, due to increased industrial activity associated with the construction of the Alice Springs to Darwin railway.

5.32 The baseline forecasts for Tennant Creek (see Chart 5.10) show an average annual growth rate of about 2% over the ten years to 2011-12. The baseline forecast ignores the direct impact on account of the railway.

Chart 5.10 – Peak Demand and Energy
Tennant Creek



Gas-related resource and industrial projects

5.33 In addition to the above baseline forecasts, also playing a role is both the demand that arises from major one-off projects (here only the Alice Springs to Darwin railway) and the demand that could arise from major developments associated with the Timor Sea gas discoveries and the construction of the Bayu-Undan gas pipeline to Darwin.

5.34 Construction of the Alice Springs to Darwin railway is well underway with track work already completed in the Katherine and Tennant Creek regions. The project is due for completion in early 2004.

5.35 The remainder of this section outlines electricity demand that might arise from major developments, including those relating to Timor Sea gas discoveries which may commence in the next three years.[11] Some projects will have onsite generation facilities and take advantage of relatively low cost gas to generate electricity when Timor Sea gas comes onshore. Power requirements for other projects may be met by external network-sourced electricity, through power purchase agreements with a third-party generation supplier.[12]

5.36 Since the 2001 Review, ConocoPhillips has received NT Government approval of plans to construct a liquefied natural gas ("LNG") plant at Wickham Point in Darwin Harbour, which will be supplied with gas by pipeline from the Bayu-Undan field in the Timor Sea. Indications are that this gas has been contracted to Tokyo Electric Power Company and Tokyo Gas Company and will not be available for the domestic markets.

5.37 Gas from the Greater Sunrise field (three times the size of the Bayu-Undan field) also has the potential to supply domestic markets. The joint principals, Shell, Woodside and Phillips, have considered two development concepts, the floating LNG plant and domestic market option where gas is to be transported to Darwin by subsea pipeline. Recent reports indicate that these options are currently not viable in the short to medium term.

5.38 In light of these current events, the Commission has chosen to illustrate the effects of gas-related resources, and other industrial projects, in a range from certainty to those with lower probability. Brief descriptions of these major developments follow.

ConocoPhillips – LNG Plant

5.39 As part of development of the Bayu-Undan gas resources in the Timor Sea, ConocoPhillips has proposed to build a LNG plant at Wickham Point in Darwin Harbour. This review assumes that outstanding matters such as Timor Sea Treaty ratification will be resolved in the near future. On this basis, construction of the LNG plant could commence during 2003 with full commercial production expected as early as 2004-05.

Compass Resources NL – Browns Polymetallic Project

5.40 The Browns Polymetallic Project is about 80 kilometres south of Darwin and 7km north of Batchelor. Compass Resources NL hold mineral leases over the Browns prospect in the surrounding Mount Fitch project area. The prospect is rated as a world's largest undeveloped polymetallic resource consisting of lead, cobalt, copper, and nickel. First production is planned to commence in the fourth quarter of 2004. It is estimated

[11] As some projects have not reached the detailed design stage, their electricity requirements and impact on the power system are based upon initial concepts.

[12] For forecasting and comparison purposes, the projects outlined here are assumed to be connected to the Darwin-Katherine power system, which would require additional infrastructure to augment the existing network.

that approximately 40MW peak generating capacity will be required. This translates to a 2 petajoules ("PJ") per year gas demand.

Mt Grace Resources Ltd – Batchelor Magnesium Project

5.41 Mt Grace Resources Ltd had proposed a staged development of their Batchelor Project to construct an opencut mine and processing plant to produce magnesium metal 85 kilometres south of Darwin. However, recent reports indicate that their project will be moved to Malaysia due to uncertainty surrounding the availability of competitively priced gas in the Darwin region. Mt Grace has indicated that it requires an assurance that additional gas will become available in Darwin within 2 to 3 years before they can commit to development.[13]

5.42 At this time, the project has been deferred indefinitely and therefore has a low probability of proceeding in the short to medium term. This may change over the forecast period if there is a firm commitment to bring additional competitively priced natural gas to the Darwin region. Given this, the Commission has excluded the Batchelor Magnesium Project from forecast demand over the period to 2011-12.

Forecast demand – major developments

5.43 The forecasts presented in this section are based upon currently available data on electricity demand and consumption of the major one-off projects and prospective developments described above. Other major proposals are not included, since they are still in the conceptual phase. Future reviews undertaken by the Commission will update the forecasts as more information comes to light.

5.44 The demand and energy impacts of major developments are two-fold: they can have a *direct* impact through the operational requirements of the projects themselves and an *indirect* impact due to residential and commercial flow-on effects. The Commission's forecasts assume the indirect demand component arising from major one-off projects and prospective developments will have a ripple-effect throughout the Territory – mainly in the Darwin-Katherine system.

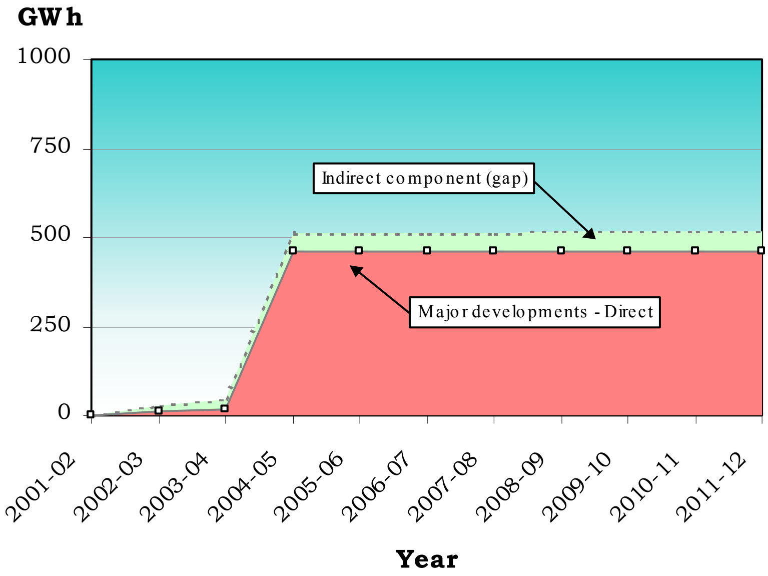
5.45 A summary of these impacts for the Territory as a whole is provided below in Table 5.3 and illustrated in Chart 5.11.

Table 5.3 – Peak Demand and Energy Forecast
Major Developments

	Demand (MW)			Energy (GWh)		
Financial Year	**Direct**	**Indirect**	**Total**	**Direct**	**Indirect**	**Total**
2002-03	8	3	11	10	16	26
2003-04	9	5	15	15	32	47
2004-05	59	10	69	460	58	518
2005-06	59	10	69	460	59	519
2006-07	59	10	69	460	60	520
2007-08	59	11	70	460	62	522
2008-09	59	11	70	460	63	523
2009-10	59	11	70	460	65	525
2010-11	59	11	70	460	67	527
2011-12	59	12	71	460	68	528

[13] Mt Grace Resources Limited, *MGD Monthly Bulletin*, September 2002, p.2.

Chart 5.11 – Energy Forecast
Major Developments



5.46 The forecasts indicate a staged increase in the electricity demand for major developments corresponding to the planned levels of construction and industrial activity, including forecast mining production. In early years, between 2003 and 2004, the construction of the Phillips LNG plant and activity associated with Alice Springs to Darwin railway is expected to impact on the power system. As projects move into their initial production stages and reach optimal capacity in the middle of the decade, electricity consumption in the Territory is expected to increase significantly. The total indirect component is expected to represent about 2.6% (on average) of total Territory baseline energy over the forecast period.

Overall demand – Territory baseline plus developments

5.47 The Commission has consolidated the regional baseline forecasts in Table 5.2 with the major developments forecasts (including the indirect component) in Table 5.3 to produce combined forecasts in Table 5.4 and in Chart 5.12 below.

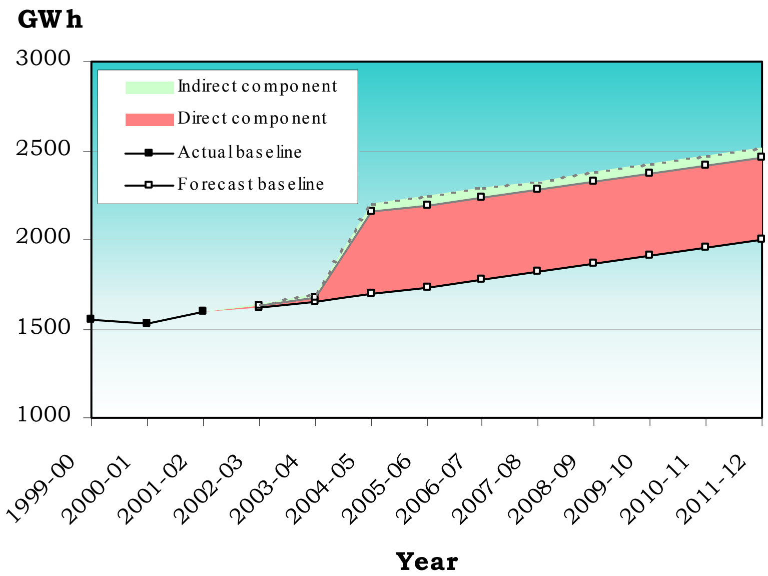
5.48 Once account is taken of the major developments, the potential is for a significant increase in peak demand and energy over the period to 2011-12. The forecasts show that the overall Territory system 10 years from now could have an indicative demand of about 400MW and energy consumption of 2,500GWh, about 60% greater than that of the Territory's existing system.

5.49 While these forecasts could be on the high side, they illustrate the scenario to be catered for if system adequacy is not to be jeopardised. Nevertheless, caution should be taken when interpreting these forecasts due to the uncertainty surrounding both the quantum and timing of electricity requirements for the projects considered as well as the uncertainty surrounding some of the projects themselves.

Table 5.4 – Peak Demand and Energy
Actual and Forecast – Baseline plus Developments

	Territory baseline		Major developments		Total	
Financial Year	Demand (MW)	Energy (GWh)	Demand (MW)	Energy (GWh)	Demand (MW)	Energy (GWh)
1999-00	266	1550			266	1550
2000-01	269	1523			269	1523
2001-02	273	1598			273	1598
2002-03	276	1615	11	26	288	1641
2003-04	283	1654	15	47	298	1701
2004-05	290	1693	69	518	357	2203
2005-06	296	1733	69	519	364	2243
2006-07	304	1775	69	520	371	2287
2007-08	311	1818	70	522	379	2331
2008-09	318	1862	70	523	387	2377
2009-10	326	1908	70	525	395	2423
2010-11	334	1954	70	527	403	2471
2011-12	342	2002	71	528	411	2520

Chart 5.12 – Energy Actual and Forecast
Baseline plus Developments



CHAPTER 6

SUPPLY

Introduction

6.1 This chapter outlines the generation capacity available in the Territory's regulated power systems, and briefly outlines some of the factors influencing supply-side decision making. The comparison of supply and demand forecasts is left to chapter 7.

6.2 Supply of electricity in the Territory's regulated power systems is predominantly provided by PowerWater in all major regions. PowerWater 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.

Existing capacity

6.3 The Territory's generation facilities, consisting mainly of gas and liquid fuel driven turbines, are summarised in Table 6.1. Two indicators of 'supply capacity' are provided:

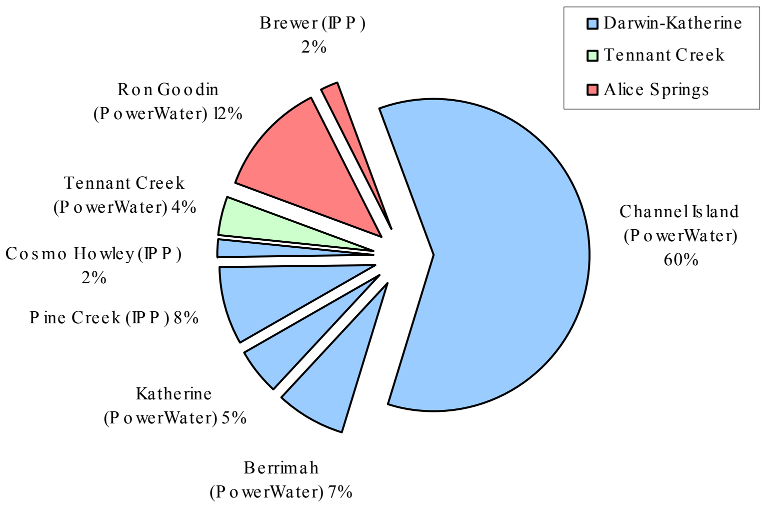
- total capacity (in MW); and
- N-1 capacity (in MW), which indicates the generation capacity excluding the largest generating set in a particular system.

Table 6.1 – Power Facilities in Regulated Systems

Power Station/Region	Capacity (MW)	% of Total	Capacity at N-1
Darwin-Katherine regulated system:			
Channel Island (PowerWater)	254.5		
Berrimah (PowerWater)	30.0		
Katherine (PowerWater)	20.4		
Pine Creek (IPP)	34.1		
Cosmo Howley (IPP)	7.5		
Total	**346.5**	**82%**	**302.5**
Tennant Creek regulated system:			
Tennant Creek (PowerWater)	16.3		
Total	**16.3**	**4%**	**14.1**
Alice Springs regulated system:			
Ron Goodin (PowerWater)	50.6		
Brewer (IPP)	8.5		
Total	**59.1**	**14%**	**47.4**
Total Capacity	**421.9**	**100%**	

6.4 PowerWater has power purchase agreements with three IPPs in the regulated systems: Pine Creek Power, Cosmo Power, and Central Energy Power. Overall, about 50MW of capacity are currently available from these IPPs.

Chart 6.1 – Regulated Capacity per Power Station



6.5 PowerWater is additionally responsible for the provision of power services to 85 remote aboriginal communities and townships that are not connected to the 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 5.[14]

Factors affecting supply

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

- the level of additional effective capacity introduced into the system;[15]
- 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', which 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; and
- existing network constraints.

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

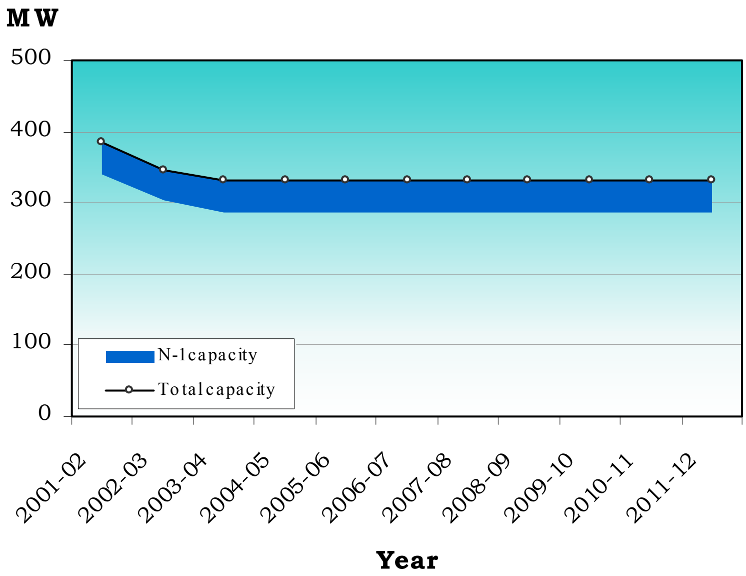
[15] For example, additional capacity may accompany new onshore gas developments and other projects, which could significantly increase supply. The average net export (if any) into the system from these major developments would contribute to available capacity for the Territory system. This possibility is considered in chapter 7.

6.7 For the purposes of this review, the Commission has adopted a 'baseline' supply scenario incorporating only known developments. Supply additional to this baseline depends upon the supply characteristics of the various major development scenarios.

Baseline supply projections

6.8 The Commission has been advised that a reduction of about 15-16MW is expected in 2003 in PowerWater's contracted IPP capacity in the Darwin-Katherine regulated system. The baseline supply projections for Darwin-Katherine are therefore based on a capacity of 330.5MW from 2003-04. The resultant baseline supply projection is illustrated in Chart 6.1.

Chart 6.2 – Baseline Supply Projection
Darwin-Katherine Regulated System



6.9 The reduction in supply during 2001-02 shown in Chart 6.1 reflects the closure of the NT Power's Mt Todd power station. This resulted in removal of 37MW in capacity in the Darwin-Katherine system.

6.10 'Baseline' supply in the Alice Springs and Tennant Creek regulated systems is projected on the basis that system capacity remains unchanged from existing capacity outlined in Table 6.1 of 59.1MW and 16.3MW respectively.

CHAPTER 7

SUPPLY-DEMAND BALANCE

Introduction

7.1 Against the background of the demand and supply forecasts canvassed in the previous two chapters, this chapter examines the prospective supply-demand position in the Territory's power system.

Indicators of system adequacy

7.2 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.

7.3 In the 2001 Review, the Commission chose to focus on the "N-1 reserve margin", being the generating capacity maintained above the peak demand for electricity after accounting for the unavailability of the largest generating plant (the so-called "N-1" rule). For the 2002 Review, PowerWater has provided the Commission with current system "reserve trigger levels". This approach broadly corresponds to the N-1 rule, but additionally factors-in the current technical realities and constraints in the system. The reserve trigger level indicates the point at which intervention in the market is required to ensure risks to supply are minimised.

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

Darwin-Katherine regulated system

7.5 In this section, the prospective supply-demand balance in the Darwin-Katherine regulated system is presented under a number of scenarios over the forecasting horizon. First, the baseline scenario is shown, then the likely impacts of major developments are shown in alternative scenarios. The following four scenarios are examined:

- a baseline scenario, where no account is made for the demand (or supply) associated with major developments;
- a no direct impact scenario by major developments (i.e., all direct demand arising from major developments is assumed to be met in its entirety by onsite generating capacity provided by major developments);
- a 20% net draw on offsite generation capacity by major developments; and
- a 20% net addition to generation capacity by major developments.

Baseline scenario

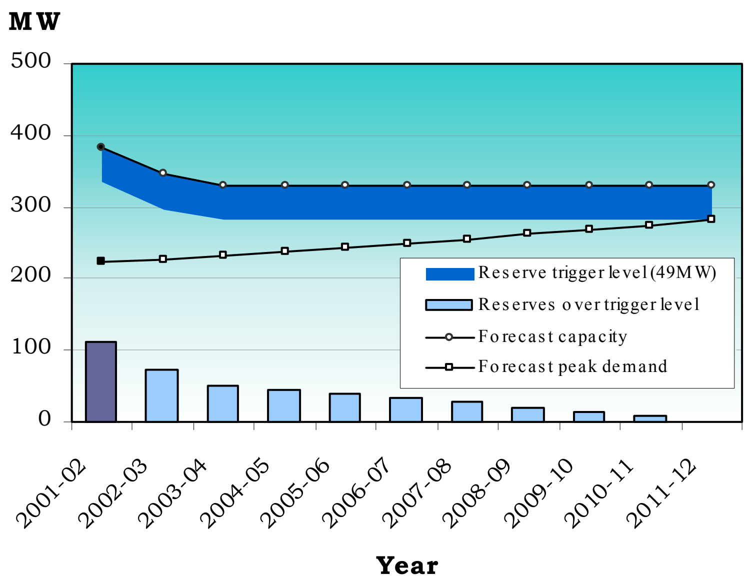
7.6 Table 7.1 and Charts 7.1 and 7.2 indicate the reserves implied by the Commission's baseline supply and demand forecasts for the Darwin-Katherine regulated system. This scenario ignores any impact on demand arising from major developments, whether direct or indirect.

7.7 The assumptions underlying the baseline forecasts were outlined in chapter 5 and chapter 6. Also assumed over the forecast period is the absolute reserve trigger level of 49MW which is based on 22% of current peak demand.[16]

Table 7.1 – Supply-Demand Balance Forecast
Darwin-Katherine Baseline (MW)

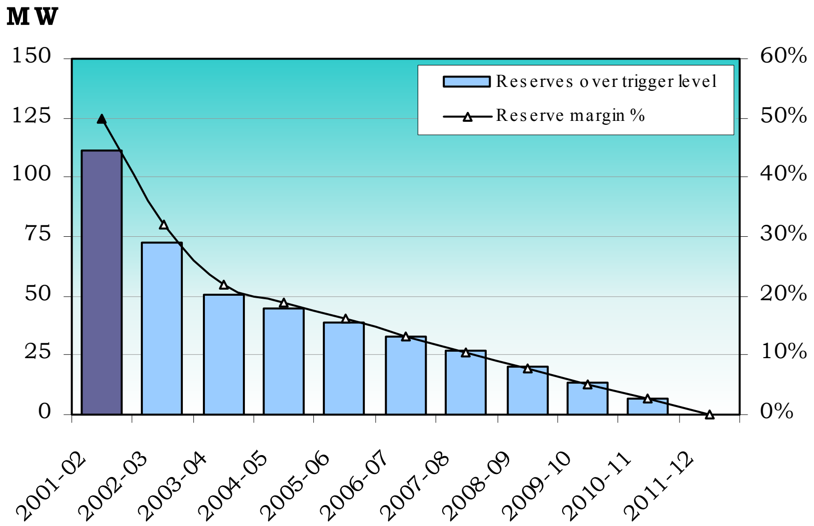
Financial Year	Generator Capacity	IPPs	Forecast Capacity	Peak Demand	Supply-Demand Balance	Reserve Trigger Level	Reserves over Trigger
2001-02	342	42	384	223	161	49	111
2002-03	305	42	347	225	121	49	72
2003-04	305	26	331	231	100	49	51
2004-05	305	26	331	237	94	49	45
2005-06	305	26	331	243	88	49	39
2006-07	305	26	331	249	82	49	33
2007-08	305	26	331	255	76	49	27
2008-09	305	26	331	261	69	49	20
2009-10	305	26	331	268	63	49	14
2010-11	305	26	331	274	56	49	7
2011-12	305	26	331	281	49	49	0

Chart 7.1 – Supply-Demand Balance Forecast
Darwin-Katherine Baseline



[16] 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 a trigger level.

Chart 7.2 – Forecast Reserves over Trigger Level
Darwin-Katherine Baseline



7.8 Under the Commission's baseline scenario, with annual demand growth of about 2.3%, all reserves over the trigger level (49MW) are exhausted in 2011-12. This represents about 110MW decrease in reserves from those levels existing in 2001-02. Even so, no significant issues appear likely under this scenario over the forecast horizon. However, an evaluation of the system reliability will determine whether the system has deteriorated, in which case additional capacity will be required towards the end of the forecast period, to ensure reliability requirements are satisfactorily met.

Major developments equilibrium scenario

7.9 Table 7.2 and Charts 7.3 and 7.4 indicate the reserves implied by the Commission's supply and demand forecasts for the Darwin-Katherine system, based on the assumption that the demand arising on account of the major developments is met in its entirety by onsite generation capacity provided as part of these developments.

7.10 The technical assumptions underlying this scenario are:

- the % of MW drawn from the power system is the same across all major developments and is set to zero under this scenario to illustrate the overall effect on supply and demand by major developments as a whole;
- the % of MW drawn from the system is the same across all years from the time the projects commence to the end of the forecast horizon; and
- the absolute reserve trigger level remains at 49MW over the forecast horizon.

Table 7.2 – Supply-Demand Balance Forecast
Major Developments Equilibrium (MW)

Financial Year	Forecast Capacity	Major Dev'ts Supply	Total Forecast Capacity	Peak Demand	Supply-Demand Balance	Reserve Trigger Level	Reserves over Trigger
2001-02	384	0	384	223	161	49	111
2002-03	347	7	354	235	119	49	70
2003-04	331	8	339	244	95	49	46
2004-05	331	59	390	303	87	49	38
2005-06	331	59	390	309	81	49	32
2006-07	331	59	390	315	75	49	25
2007-08	331	59	390	321	68	49	19
2008-09	331	59	390	328	62	49	12
2009-10	331	59	390	335	55	49	6
2010-11	331	59	390	342	48	49	-1
2011-12	331	59	390	349	41	49	-8

Chart 7.3 – Supply-Demand Balance Forecast
Major Developments Equilibrium

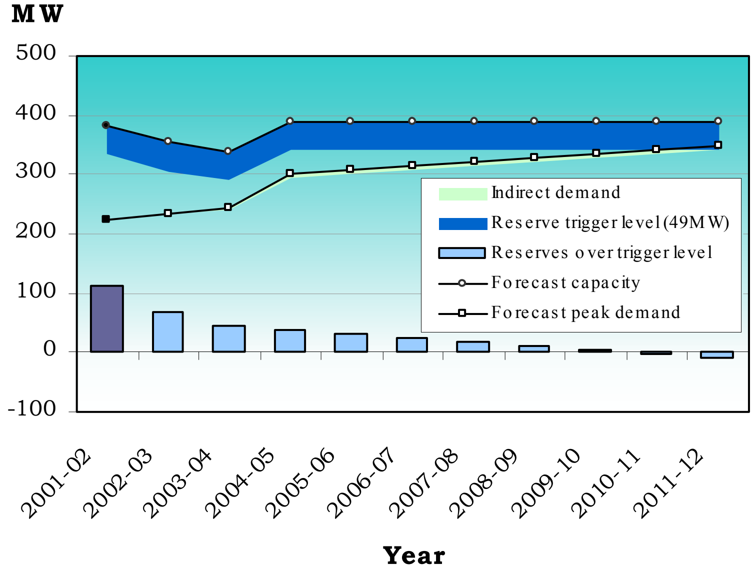
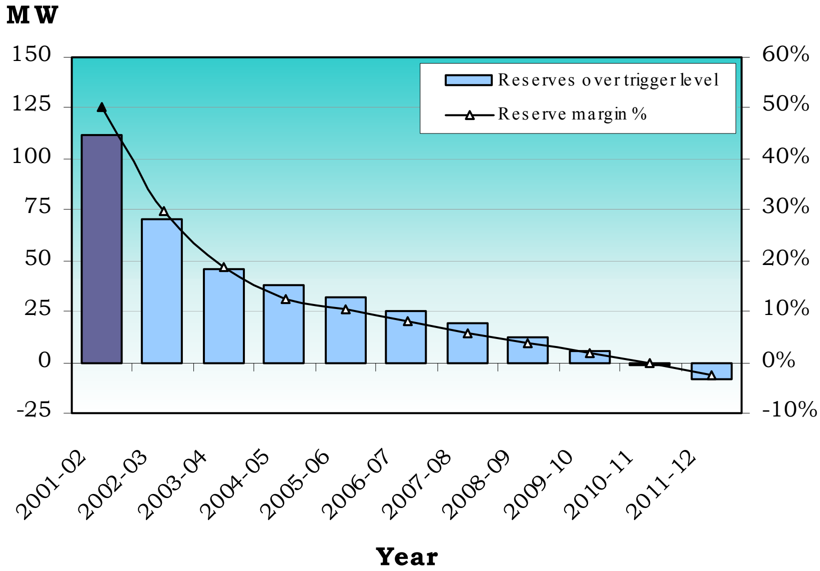


Chart 7.4 – Forecast Reserves over Trigger Level
Major Developments Equilibrium



7.11 Once major developments proceed, the Commission recognises that not only will there be a direct demand impact arising from the projects themselves, but also indirect demand associated with the flow-on effects throughout the Darwin-Katherine region. This has been shown in the demand projection in Chart 7.3 above.

7.12 Introducing the equilibrium supply-demand scenario of major developments into the Darwin-Katherine system sees the potential for a breach of the reserve trigger level near the end of the forecast period, reflecting an overall decrease of 120MW in reserves from 2001-02 levels. This additional decrease in reserves over the baseline scenario is a result of the potential indirect demand associated with the projects. Under this scenario, peak demand in the Darwin-Katherine regulated system is forecast to increase by about 60% to 350MW over the forecast period, representing about 4.6% average annual growth. Additionally, reflecting the additional supply capacity meeting the demand associated with the developments themselves, the forecast shows that supply may potentially increase to 390MW in 2011-12.

7.13 This scenario indicates that, provided all additional demand arising on account of the major developments were met by onsite generation capacity provided as part of these developments, the Darwin-Katherine system would have sufficient capacity to meet expected growth in demand, including any additional indirect demand, over most – but not all – of the forecast horizon. Prospects for a supply-demand mismatch may only emerge towards the end of the forecasting period.

Impact of offsite power requirements by major developments

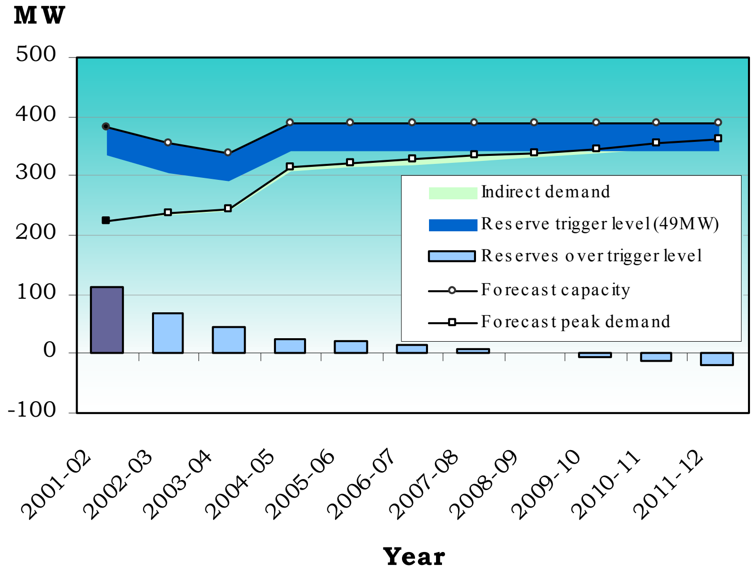
7.14 The above assessment is dependent upon the assumption made that the additional direct electricity demand arising from all major developments is met entirely from onsite generation.

7.15 To illustrate the effect were the major developments to draw energy from the remaining power system in order to meet their energy requirements, Table 7.3 and Charts 7.5 and 7.6 illustrate the effect of a 20% net draw on offsite generation capacity. The 20% figure is chosen because it is around the level that would see the need for increased generation capacity well before the end of the forecasting period.

Table 7.3 – Supply-Demand Balance Forecast
Major Developments as Net Users (MW)

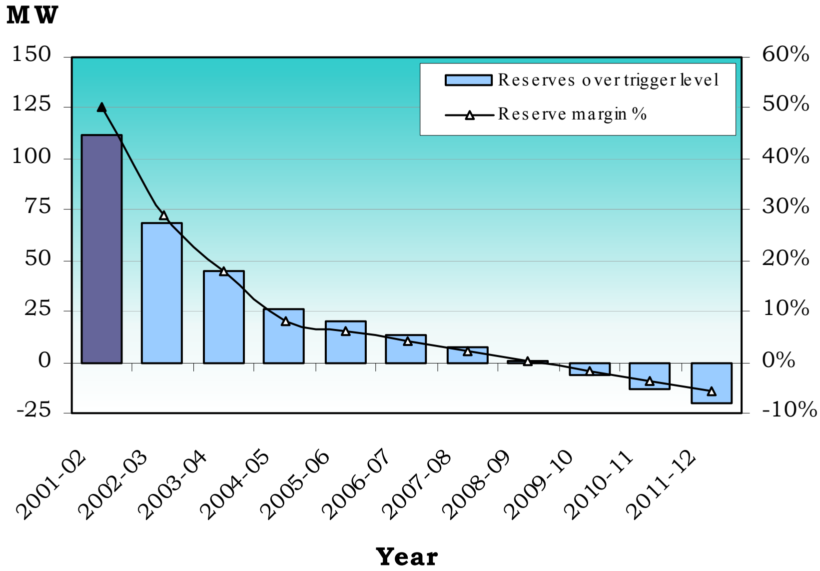
Financial Year	Forecast Capacity	Peak Demand	Supply-Demand Balance	Reserve Trigger Level	Reserves over Trigger
2001-02	384	223	161	49	111
2002-03	354	236	118	49	69
2003-04	339	245	93	49	44
2004-05	390	314	75	49	26
2005-06	390	321	69	49	20
2006-07	390	327	63	49	14
2007-08	390	333	56	49	7
2008-09	390	340	50	49	1
2009-10	390	346	43	49	-6
2010-11	390	353	36	49	-13
2011-12	390	360	29	49	-20

Chart 7.5 – Supply-Demand Balance Forecast
Major Developments as Net Users



7.16 The Darwin-Katherine system capacity would likely need to be extended well before the end of the forecast period were at least 20% of the expected external demand from major developments to be met by offsite generation. Without additional capacity, under this scenario demand will breach the reserve trigger level by 2009-10.

Chart 7.6 – Forecast Reserves over Trigger Level
Major Developments as Net Users



Impact of a net addition to generation capacity by major developments

7.17 An alternative possibility is that onsite generation capacity associated with the major developments generates in excess of their own power requirements, which is being exported into the power system.

7.18 Table 7.4 and Charts 7.7 and 7.8 illustrate the effect of a 20% increase in supply from major developments on the power system. The 20% figure is chosen because it is sufficient to postpone any need to introduce additional external generating capacity (other than that expected to be provided by major developments) beyond the end of the forecasting period.

Table 7.4 – Supply-Demand Balance Forecast
Major Developments as Net Generators (MW)

Financial Year	Forecast Capacity	Peak Demand	Supply-Demand Balance	Reserve Trigger Level	Reserves over Trigger
2001-02	384	223	161	49	111
2002-03	355	235	120	49	71
2003-04	340	244	97	49	48
2004-05	401	303	99	49	50
2005-06	401	309	93	49	43
2006-07	401	315	86	49	37
2007-08	401	321	80	49	31
2008-09	401	328	73	49	24
2009-10	401	335	67	49	18
2010-11	401	342	60	49	11
2011-12	401	349	53	49	4

Chart 7.7 – Supply-Demand Balance Forecast
Major Developments as Net Generators

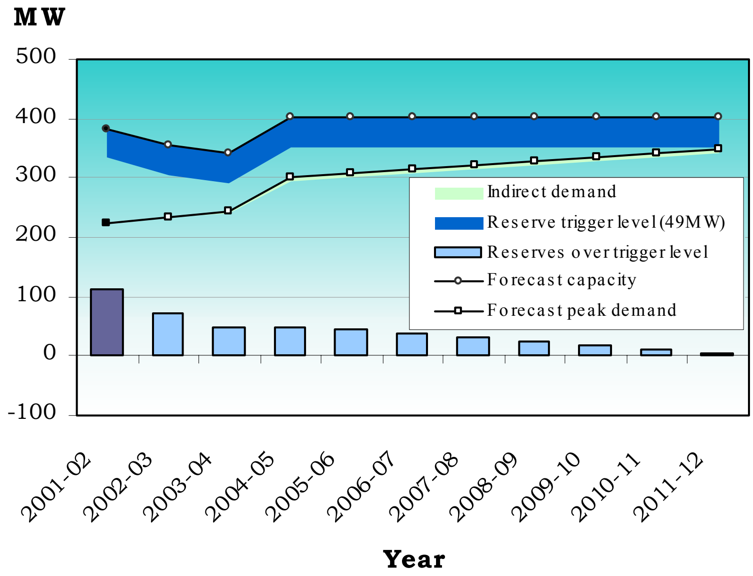
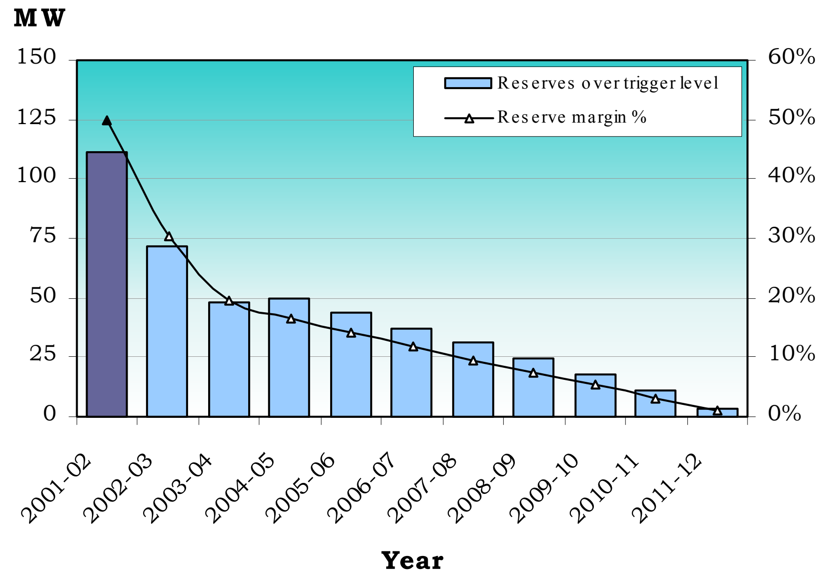


Chart 7.8 – Forecast Reserves over Trigger Level
Major Developments as Net Generators



7.19 With an increase in supply of 20% from major developments, the Darwin-Katherine system could be well placed to satisfy forecast demand through to at least 2011-12.

7.20 The decline in reserves over the forecast period is comparable to that indicated by the baseline scenario, with about 108MW decrease in reserves from those levels existing in 2001-02.

Summary

7.21 The future supply-demand balance situation in the Darwin-Katherine regulated system may fall somewhere between the major development scenarios presented above. For example, in initial years (including during construction), additional power may be drawn from the system to satisfy the demand of major developments and, in later years, major developments could build up spare additional capacity and export into the system.

Alice Springs regulated system

7.22 The Commission has not undertaken alternative scenarios for the regions outside the Darwin-Katherine region.

7.23 Table 7.5 and Charts 7.9 and 7.10 indicate the supply-demand balance and reserves implied by the Commission's forecasts for the Alice Springs regulated system. This includes some additional indirect demand associated with the flow-on effects arising from the impact of major developments including the Alice Springs to Darwin railway.

Table 7.5 – Supply-Demand Balance Forecast Alice Springs (MW)

Financial Year	Generator Capacity	IPPs	Total Existing Supply	Peak Demand	Supply-Demand Balance	Reserve Trigger Level	Reserves over Trigger
2001-02	51	8	59	43	16	12	4
2002-03	51	8	59	44	15	12	3
2003-04	51	8	59	45	13	12	1
2004-05	51	8	59	46	12	12	0
2005-06	51	8	59	46	11	12	-1
2006-07	51	8	59	47	10	12	-2
2007-08	51	8	59	48	9	12	-3
2008-09	51	8	59	49	8	12	-4
2009-10	51	8	59	50	7	12	-5
2010-11	51	8	59	51	6	12	-6
2011-12	51	8	59	52	5	12	-7

Chart 7.9 – Supply-Demand Balance Forecast Alice Springs

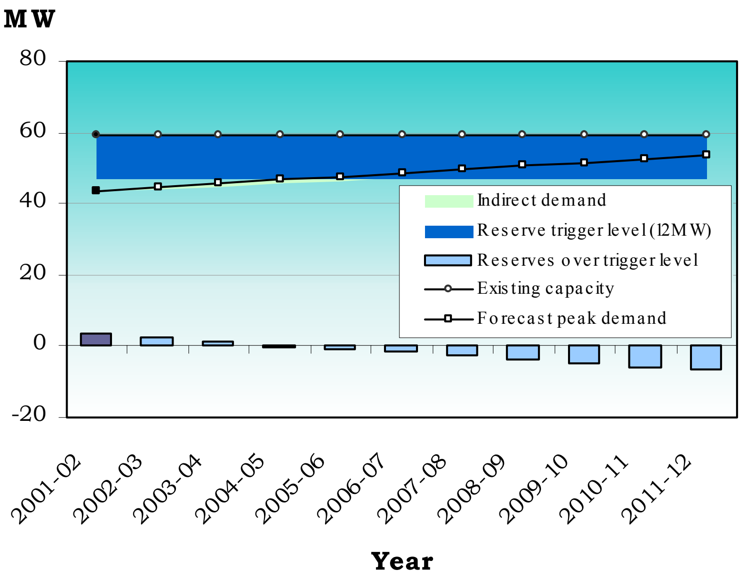
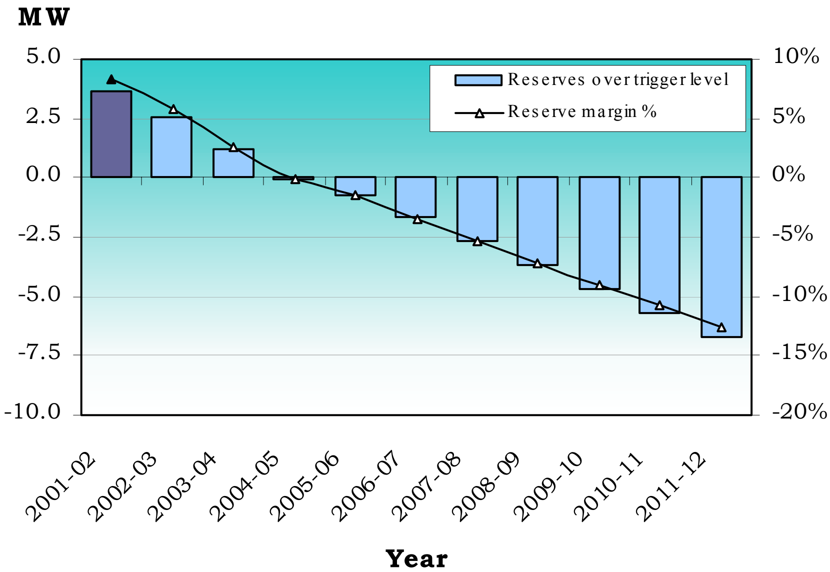


Chart 7.10 – Forecast Reserves over Trigger Level
Alice Springs



7.24 The forecast demand and supply in the Alice Springs regulated system clearly indicates a tight supply situation approaching 2004-05. At this time, reserves over the trigger level are expected to be completely exhausted, indicating some intervention is required to reduce supply risks. The need for additional generating capacity and/or implementation of demand management programs is imminent.

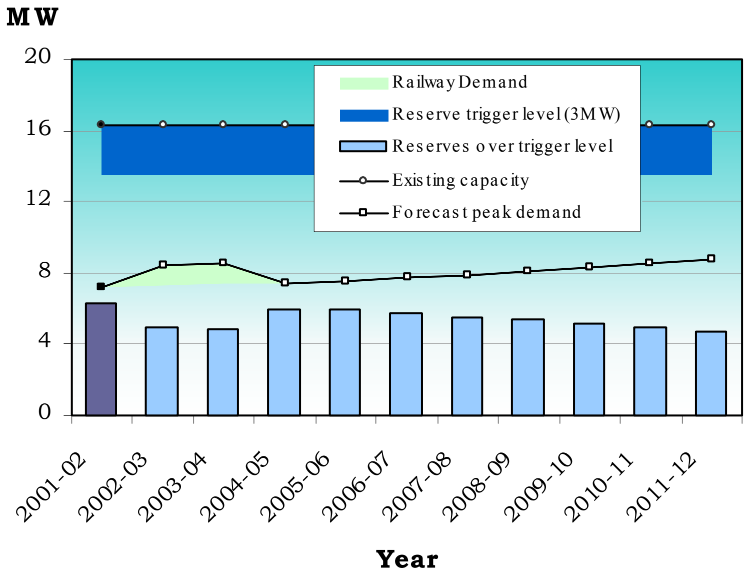
Tennant Creek regulated system

7.25 Table 7.6 and Charts 7.11 and 7.12 indicate the supply-demand balance and reserves implied by the Commission's forecasts for the Tennant Creek regulated system.

Table 7.6 – Supply-Demand Balance Forecast
Tennant Creek (MW)

Financial Year	Total Existing Supply	Baseline Demand	Railway Demand	Total Demand	Supply-Demand Balance	Reserve Trigger Level	Reserves over Trigger
2001-02	16	7	0	7	9	3	6
2002-03	16	7	1	8	8	3	5
2003-04	16	7	1	9	8	3	5
2004-05	16	7	0	7	9	3	6
2005-06	16	8	0	8	9	3	6
2006-07	16	8	0	8	9	3	6
2007-08	16	8	0	8	8	3	6
2008-09	16	8	0	8	8	3	5
2009-10	16	8	0	8	8	3	5
2010-11	16	9	0	9	8	3	5
2011-12	16	9	0	9	8	3	5

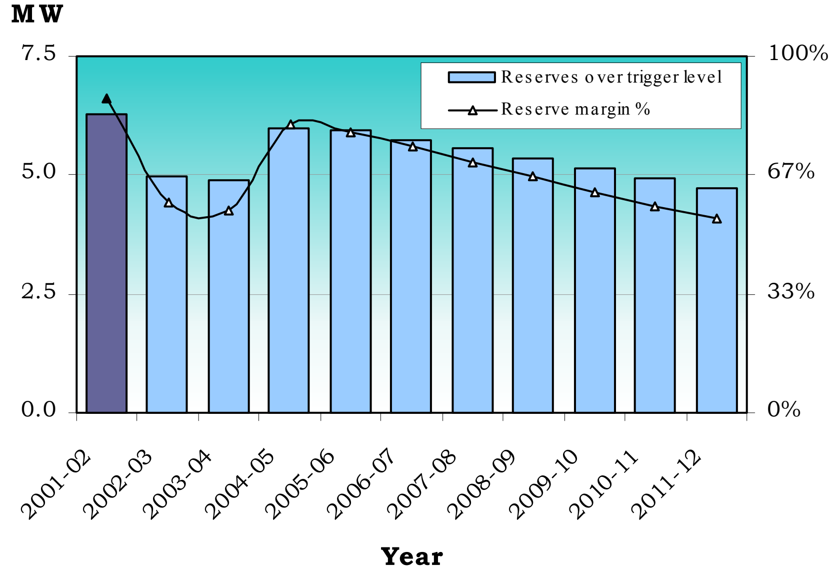
Chart 7.11 – Supply-Demand Balance Forecast Tennant Creek



7.26 Current generation capacity in Tennant Creek of 16 MW appears sufficient to accommodate the expected demand over the next 10 years, even after taking into account the reserve trigger level of 3 MW. This is the case notwithstanding additional pressure on the system expected between 2002-03 and 2003-04 as a result of expected increased industrial activity associated with the Alice Springs to Darwin railway.

7.27 With railway work expected to be completed in 2004 and no further major activity on the horizon, Tennant Creek is expected to experience baseline growth of about 2% per annum.

Chart 7.12 – Forecast Reserves over Trigger Level Tennant Creek



CHAPTER 8

ADDRESSING SUPPLY-DEMAND IMBALANCES

Introduction

8.1 This chapter canvasses options available to the Government to counteract any projected 'adequacy' problems in the Territory's regulated power systems over the forecast period to 2011-12.

General assessment

Alice Springs regulated system

8.2 The most pressing supply situation in prospect is in the Alice Springs system, with a possible breach of the existing 12MW reserve margin being forecast to occur between 2004 and 2006, depending on the extent of demand growth in the region. Further out to 2011-12, the supply-demand balance could be as little as 5MW, which means that not all existing capacity (59MW) is expected to be exhausted at that time. In any case, the Alice Springs currently calls for a 28% reserve margin in order to remain adequate. This reserve level should continue to be observed in the short to medium, while taking into account the associated risks.

Darwin-Katherine regulated system

8.3 The situation in the Darwin-Katherine system appears adequate for the moment, with reserve capacity in excess of projected peak demand in most of the scenarios presented over the forecast period (see chapter 7). According to the Commission's projections, a net additional 20% of the electricity demanded by major developments (i.e., its impact on offsite power requirements) would see a breach of system's existing reserve margin of 49MW in 2009-10.

8.4 Nevertheless, the Darwin-Katherine supply-demand balance needs to be kept under watch as gas-related resource and industrial developments firm up and a clearer picture of their impact is evident.

Tennant Creek regulated system

8.5 The Tennant Creek system with capacity of 16MW appears manageable, even with projected increases in demand associated with industrial work on the Alice Springs to Darwin railway. Consideration will need to be given to other risk factors, particularly the age of existing generation plant and performance.

8.6 Supply deficiencies would only be in prospect in the Tennant Creek system with the commencement of major new mining and industrial developments requiring power from the system. No such developments are in prospect at the moment.

Options

8.7 Generally, there are two options available to address supply-demand imbalances in a power system: increasing generating capacity and/or implementing demand-side response initiatives. The options available for the Alice Springs system are canvassed below, but also apply in principle to other regulated systems in the Territory where appropriate.

Demand-side responses

8.8 Demand-side management refers to initiatives that focus on influencing the demand for electricity, with the objective of reducing peak load and the need for additional generating capacity at such times.

Interruptible contracts

8.9 Retailers could be encouraged, for example, to negotiate *interruptible contracts* with large customers where appropriate. Contracts such as these allow the retailer to initiate a price driven load response in the market.

Ice storage air-conditioning

8.10 By encouraging the investment of ice-storage in businesses air-conditioning plants, electrical energy can be produced more cheaply at night and used to produce ice. The ice is slowly melted during the next day to provide cooling in air-conditioning systems, which in turn lessens the electricity demand of businesses during the day. In Alice Springs, there has been no successful ice storage implementation to date. However, this is under periodic review and the take-up rate could be enhanced by appropriate tariff structures and levels.

Production scheduling

8.11 Some major customers may be able to operate in a cooperative mode with the power supplier in order to relieve tight periods of maximum demand. Adjusting working hours and/or using their standby plant could achieve this.

Load control

8.12 Similar to production scheduling, this is aimed at households who can operate pool pumps and electric hot water systems during low demand periods.

Supply responses

Refurbishment of existing generation plants

8.13 The refurbishment or life extension of existing generation plant can provide for the more efficient generation of electricity and defer retirement. The Commission understands that a decision is expected by 2005-06 on the refurbishment of the 11.7MW gas turbine at the Ron Goodin Power Station.

Co-generation

8.14 Co-generation involves the capture of exhaust heat from an engine and using it for heating purposes (such as required by absorption chillers in air-conditioning plants). Customers with high steam, heating and cooling requirements (e.g., hospitals) may find co-generation an attractive alternative to grid supply within the Alice Springs market. A 1MW co-generation at the hospital has been mentioned as one possibility.

Alternative energy solutions

8.15 Alice Springs has an abundant supply of solar energy, which is rarely disturbed by cloud. The installation of solar hot water systems could play a role in moderating the demand for electricity. Grid connected photovoltaics by individual customers to supply into the grid could also be possible.

Installation of additional generation capacity

8.16 Ultimately, the Government may need to facilitate investment in additional generation capacity in Alice Springs.

CHAPTER 9

FUEL SUPPLY

Role of fuel in power system reliability

9.1 Over 99% of the Territory's regulated system electricity 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.

9.2 Most of the generating units in the system can also be fuelled by distillate or kerosene and PowerWater maintains substantial liquid fuel holdings for emergency use.

9.3 The impact of fuel supply on the reliability of electricity supply can be considered at two levels:

- the ability to maintain electricity supply in the event of a sudden interruption to gas production or a pipeline failure (hereafter 'security issues'); and
- the ability to maintain electricity supply in the event that declining gas reserves and production result in a natural gas shortfall as a fuel for electricity generation (hereafter 'adequacy issues').

Security issues

Gas pipelines

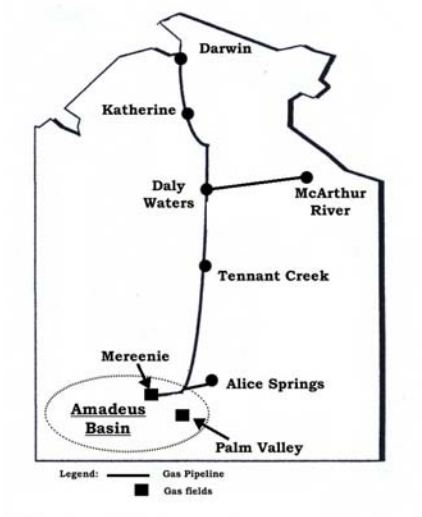
9.4 Natural gas has been the major fuel source for electricity generation in the Territory since the development of the Amadeus Basin gas fields and the construction of the gas pipeline to Darwin in 1986. [17]

9.5 There are two gas fields in the Amadeus Basin: the Palm Valley field operated by Magellan and the Mereenie field operated by Santos.

9.6 The gas pipelines currently servicing the Northern Territory are shown in Chart 9.1. The 164km Palm Valley to Alice Springs pipeline, operated by Origin Energy Asset Management Pty Ltd, was constructed in 1983 and the 1,513km Amadeus Basin to Darwin pipeline, operated by NT Gas Pty Ltd, was constructed in 1985-86. The spur line to the McArthur River mine was constructed in 1996-1998, and is also operated by NT Gas.

[17] 99.7% of the natural gas transported by the Amadeus Basin to Darwin pipeline is used for power generation. ACCC, *Draft Decision – Access Arrangement proposed by NT Gas Pty Ltd for Amadeus Basin to Darwin Pipeline*, May 2001, p.5.

Chart 9.1 – Amadeus Basin to Darwin Pipeline



9.7 NT Gas is on the public record as indicating that the Amadeus Basin to Darwin pipeline is fully contracted and has a maximum delivery capability of 44 terajoules per day ("TJ/day") under free flow conditions and 54TJ/day with compression.[18] NT Gas has also stated that actual pipeline peak day loads have generally been higher than user forecasts and that the peak demand in 1999 of 57TJ/day exceeded the nominal pipeline capacity. The forecast growth in electricity demand will mean that the expected peak gas demand will frequently exceed pipeline capacity and that line pack will increasingly be used to manage the shortfall. However, this practice is only sustainable for a few days, before pipeline operating pressures fall below acceptable levels required to maintain supply. The addition of further compression to the pipeline may be necessary in the medium term to increase its maximum capacity. In the short run, it is generally more cost effective to use liquid fuels to meet peak electricity demands.

Liquid fuel

9.8 The key PowerWater generating units at Darwin, Katherine, Tennant Creek and Alice Springs are capable of operating on liquid fuel if gas supply is not available.

9.9 PowerWater maintains onsite liquid fuel storage equivalent to at least three days supply at each of these centres, and can draw upon further supplies from local fuel suppliers. PowerWater advises that, in an emergency, further fuel could be sourced from interstate or Singapore within seven days.

Commission's view

9.10 The Amadeus Basin to Darwin pipeline has proven to be reliable. Over 15 years, there have been several brief supply interruptions to gas supply to Darwin due to excessive dust in the pipeline. As PowerWater was able to use liquid fuel, electricity supply was not interrupted. Also, just after the pipeline was commissioned, it suffered major earthquake damage at Tennant Creek in January 1987. The line pack available at that time allowed a 100-metre section of buckled pipeline to be replaced without loss of gas supply to Darwin.

9.11 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 is comfortable that the levels of liquid fuel

[18] ACCC, *NT Gas – Access Arrangement Information for the Amadeus Basin to Darwin Pipeline*, June 1999, p.39.

storage maintained by PowerWater and the scope for pipeline line pack together should continue to allow the maintenance of electricity supply during short-term interruptions to gas production or transportation.

Adequacy issues

Natural gas supply

9.12 In 1983, PowerWater entered into an agreement with the Magellan-operated Palm Valley field to supply gas to Alice Springs primarily for electricity generation.

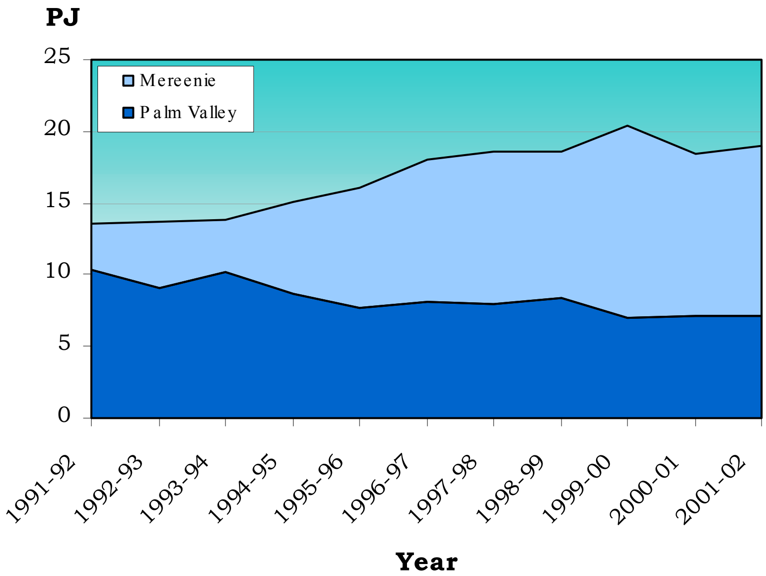
9.13 In 1985, the PowerWater subsidiary Gasgo contracted to purchase gas totalling 200PJ from the Palm Valley field until 2012 to fuel electricity generation in the Darwin-Katherine region. In the same year, Gasgo also entered into a gas purchase agreement with the operator of the Mereenie field for the supply of 66PJ during the period until 2012.

9.14 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.

9.15 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.

9.16 Chart 9.2 illustrates the declining production of the Palm Valley field and the increasing reliance upon the Mereenie field over the last 10 years.

Chart 9.2 – Annual Gas Sales in the Northern Territory 1991-92 to 2001-02



9.17 The Gasgo contracts for the supply of gas are expected to expire in 2009. Palm Valley has been unable to meet contract requirements since 1996, and gas production could be reduced to very low levels as early as 2007. Mereenie contract volumes are expected to be met through to 2009. Indications are that, after 2009, Mereenie will have gas available although the production rates may fall short of current output.

9.18 Gasgo is managing supply under the existing contracts to ensure maximum flexibility in future supply management.

Commission's view

9.19 The Commission has undertaken an analysis of potential gas production relative to forecast demand for gas used in electricity generation over the period to 2008-09. Although the Commission has had access to Gasgo's forecasts on a commercial-in-confidence basis, the Commission's own analysis is based on publicly available information and its judgment on the range of possible outcomes for gas supply and demand.

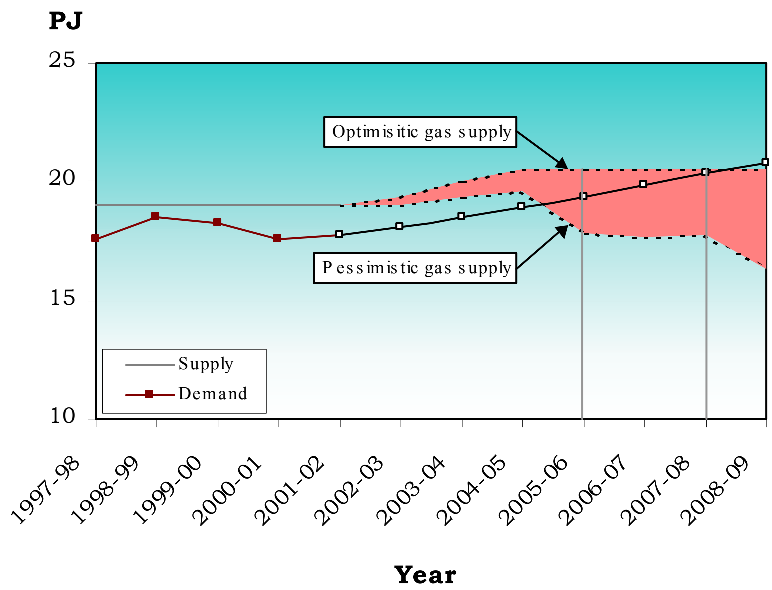
9.20 The following assumptions and limitations underlie the Commission's analysis:

- the outlook for gas '***supply***' is based on likely production by existing gas fields only – Mereenie and Palm Valley in Central Australia – with future gas from the Bonaparte/Timor Sea region and other fields within the Territory not being considered; and
- the outlook for gas '***demand***' growth is based on growth rates in electricity consumption discussed elsewhere in this report – with no account being taken of technological advances that may increase plant efficiency.

9.21 The gas outlook under alternate scenarios is illustrated in Chart 9.3, where:

- the 'optimistic' scenario involves Palm Valley continuing to produce at current levels and Mereenie meeting its contractual commitments through to the maximum level under current contracts and thereafter additional gas purchases are made to maintain production at this maximum level through to 2009; and
- the 'pessimistic' scenario involves production from the Palm Valley field continuing to decline over the next few years at the same rate as evident over the last 3-5 years and Mereenie only meeting its current contractual commitments.

Chart 9.3 – Gas Supply and Demand Projections



9.22 Chart 9.3 indicates that demand for gas for electricity generation is expected to grow at a 2.3% annual average to 2008-09. Overlaying the Commission's optimistic and pessimistic supply views, and just considering the existing sources of gas (the Mereenie and Palm Valley fields), it is possible that:

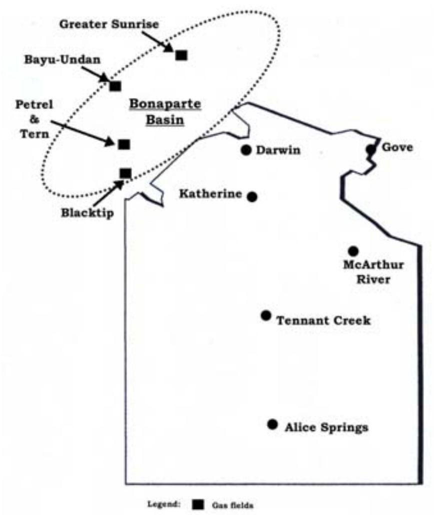
- there could be a gas fuel supply shortfall as early as 2006 under a pessimistic scenario; and
- such a shortfall could be in prospect as late as 2009 under an optimistic scenario.

Longer-term response

9.23 A number of offshore fields (see Chart 9.4) 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”));[19]
- Greater Sunrise (8 TCF);
- Blacktip (1 TCF); and
- Petrel & Tern (1+ TCF).

Chart 9.4 – Offshore Fields



9.24 The Phillips-operated Bayu-Undan field has a long-term export contract to supply LNG from a Darwin-based processing plant. Production could commence as early as 2004-05. Indications are that the reserves are committed to the LNG contract.

9.25 Woodside is the operator of the Blacktip discovery south west of Darwin in the Joseph Bonaparte Gulf. The development of the reserves could be achieved through piping the gas ashore and then overland to intersect the pipeline at Mataranka.

9.26 The offshore Petrel and Tern fields 300km west of Darwin operated by Santos are other potential gas supply sources. These fields and Blacktip seem more likely to be developed in the immediate future now that the floating LNG plant for Sunrise gas as well as the domestic gas case are reported as being no longer viable.

9.27 The Commission is not aware of any electricity generator or market participant establishing contractual arrangements for the supply of gas from any new sources.

9.28 To develop a new gas resource such as Blacktip, 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

[19] One TCF is equivalent to 930PJ or approximately 50 times the existing Territory annual gas demand.

to gas end users. For both commercial and operational reasons, the lead times between commencement of negotiation and the physical supply of new gas could be up to four years or more.

Short to medium-term response

9.29 As the Palm Valley field production declines, the combined daily output from the two fields may be less than the gas demand on peak days. PowerWater can be expected to manage this potential gas production shortfall in several different ways, including by:

- using the stored gas available as line pack in the Amadeus Basin to Darwin pipeline – although line pack is a limited storage resource and multiple consecutive high demand days may result in a gas supply shortfall for generation; and
- accelerating gas volumes under the current Mereenie gas supply contracts.

9.30 Until new gas becomes available (either in the short-term or longer-term), there may be a need for an increased use of liquid fuels to maintain electricity supply. While an increased use of liquid fuels will maintain electricity supply, another set of supply chain logistics, reliability issues and risks are introduced. Additionally, there is likely to be a substantial extra cost impost on industry participants and end users.

Commission's view

9.31 The reliance on the supply of natural gas for electricity generation in the Territory gives rise to potential 'adequacy' issues. In summary, the Commission considers that:

- the production from the Palm Valley field is likely to decline substantially over the next few years and the combined volumes available under existing contracts from the Palm Valley and Mereenie fields may then not be sufficient to supply all the Darwin-Katherine requirements after 2006;
- the peak capacity of the Amadeus Basin to Darwin pipeline is currently fully utilised and further pipeline compression or increased liquid fuel usage may be required in the future to maintain electricity supply during peak demand periods; and
- while a number of large offshore gas reserves could supply future electricity generation gas requirements as production from existing gas fields declines, the lead times for the development of alternative gas supplies mean that new gas supply arrangements may have to be established in the next year or two to meet the potential requirements post 2006.

9.32 However, the availability of liquid fuel alternatives means that this potential inadequacy in gas supply does not give rise to concerns regarding electricity supply reliability in the immediate and medium term. Rather, the issue is likely to be more one of the extra cost of liquid fuelled electricity generation to be borne by end-users of electricity in the Territory as a consequence.

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-user 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 Trigger Level – 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.