



REPORT FOR THE DOMGAS ALLIANCE

**NATURAL GAS DEMAND OUTLOOK FOR WESTERN
AUSTRALIA AND ECONOMIC IMPACT**

October 2008

COMMERCIAL AND ECONOMIC REPORT FOR THE DOMGAS ALLIANCE

This Publication

This report has been prepared for the DomGas Alliance to assist in review of the impact of natural gas supply issues in Western Australia.

This report aims to provide an assessment of the economic impact of potential shortages in natural gas availability.

This report is based on information verified by Economics Consulting Services where possible. Only broad details are included in this report and no investment decisions should be made based on the information included.

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Key Points

This report has been prepared by Economics Consulting Services for the DomGas Alliance. The Alliance is a group of Western Australian based companies that transport natural gas, or are users or potential users of natural gas.

Natural gas first flowed into the Western Australian market with the completion of a pipeline to Perth in 1971 and supplemented with a second pipeline in 1984.

Western Australian natural gas consumption averaged an estimated 1,194 TJ/day in 2006-07 – seven times the volume used in 1983 prior to deliveries from the North West Shelf¹. The average rate of increase over the 23 years from 1984 was 8.5% per annum.

Future consumption will depend on demand and availability. Recent supply constraints and uncertainties over future carbon emission prices make forecasting challenging. Forecasts by ABARE and the Department of Industry and Resources offer different scenarios and this study attempts to take a project approach to reconcile these.

The ABARE and DOIR forecasts suggest an increase over 2007-08 levels of at least 40% by 2014-15 or about 400 TJ/day. This is additional gas above current levels.

This study estimates there is potential new demand of 1,125 TJ/day by 2014-15 including gas for new projects and replacement gas needed to cover contracts that will expire in the intervening years. The new projects included in this study are generally in feasibility study stages and are reasonable prospects to proceed subject to acceptable market conditions and relevant regulatory approvals. The actual level of demand will depend on gas availability and price. The forecast assumes gas at similar prices to current levels.

The projects with new gas demand would deliver huge benefits to the State:

- Construction capital investment - \$36 billion
- Construction workforce – 24,750 people
- Operating workforce – 13,250 jobs
- Economic output - \$19 billion per annum when fully operational

This estimate based on **expansions** and **new** projects does not take into account the broader costs to the economy should replacement gas not be available for current consumers. Natural gas is important in the generation of electricity in the State and has significant environmental advantages over most alternatives. In a carbon constrained business climate, gas will play a more important role than in the past.

The cost to the State in the absence of gas supplies will depend on the cost of alternative energy sources should they be acceptable and the costs associated with converting existing facilities to operate on a new energy source.

¹ ABARE: Natural gas consumption by State, 2008

Chapter

1

1. Background

1.1 Introduction

This report has been prepared by Economics Consulting Services for the DomGas Alliance. The Alliance is a group of Western Australian based companies that transport natural gas, or are users or potential users of natural gas. The group was formed to work with State and Federal governments, regulators and gas producers to ensure a long-term supply of competitive gas for Western Australia.

This report has been prepared with assistance from Alliance members, gas producers and consumers. Much of the information provided was commercially sensitive, and Economics Consulting Services appreciates the willingness of the companies to discuss the issues as part of the important task of natural gas policy development.

The content of this report has been carefully constructed to avoid the release of commercially sensitive information. Whilst the report might present less underlying information than might otherwise be optimal, the authors believe it does not disqualify the key conclusions and findings reached by the report which remain factually based.

The report begins with a brief snapshot of past production and the structure of gas consumption in the State. This provides context for the forecast and explains why a project analysis approach provides a valid form of forecasting.

1.2 Natural Gas Production History

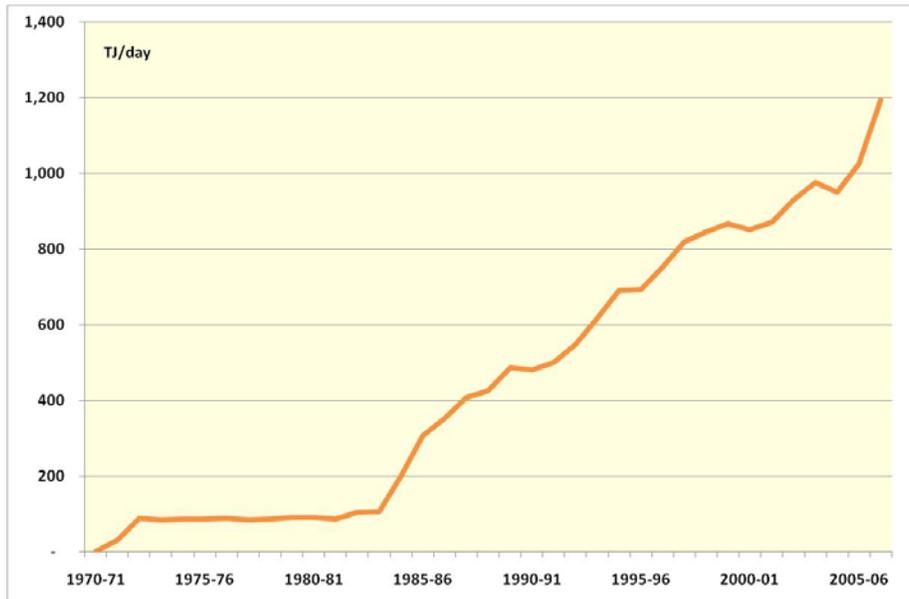
Natural gas first flowed into markets in Western Australia with the completion of a pipeline from the Dongara gas fields to Perth in 1971. This Western Australian Natural Gas Pipeline (WANG) supplied the only gas to industry and residential consumers until completion of the Dampier to Bunbury Natural Gas pipeline from the North West Shelf project in 1984.

The huge gas resources located in the offshore North West Shelf area accessed by the Dampier to Bunbury Natural Gas pipeline has allowed a dramatic increase in gas consumption since construction (Figure 1). The gas has come from the North West Shelf Joint Venture project at the Burrup Peninsula, the Varanus Island processing hub and a number of other projects in the offshore Carnarvon Basin.

Western Australian natural gas consumption in 2006-07 averaged 1,194 TJ/day – 11 times the volume used prior to deliveries from the North West Shelf. The average rate

of increase over the 24 years from 1982-83 has been 10.5% per annum due to the low starting level but the rate of increase since 2000-01 has still been 5.75%².

Figure 1: Domestic Gas Production, 1970-01 to 2006-07 (TJ/day)



Source: ABARE

The estimate for 2006-07 appears to be around 100 TJ/day higher than Western Australian government estimates for that period. This is less than a 10% discrepancy and reflects differences in estimate timing.

1.3 Natural Gas Use

Mineral processing consumes around 40% of natural gas with most used to produce alumina from bauxite with nickel and mineral sand processing also important. Alumina, produced in four refineries owned by two companies, is the largest single use of natural gas in the State.

Electricity generation is the second largest sector accounting for about 30% of total domestic consumption. Base load power generation has historically been dominated by coal-fired plants with gas used in mid-merit and peak electricity power stations. In the last ten years, gas use has grown rapidly both in combined cycle plants and in cogeneration plants. Cogeneration plants have been built where there is a demand for heating (steam) such as alumina refineries, oil refineries, hospitals and large hotels.

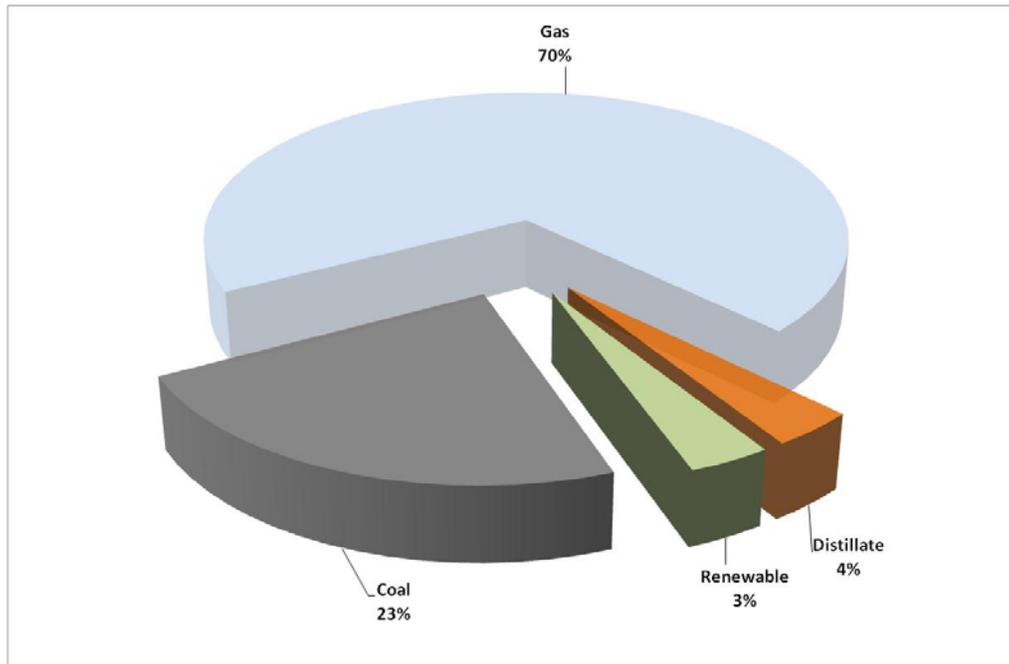
Use of gas for electricity generation has grown rapidly over the last few decades and plants that can use natural gas now make up 70% of the electricity generating capacity in the State, compared to 23% of capacity in coal-fired plants (Figure 2).

The mining sector is a large consumer of natural gas for electricity generation with some mineral extraction processing. Annual consumption has risen steadily over the last two decades and now accounts for around 25% of the total.

² ABARE Australian Energy 07.24

In summary, mineral processing, mining and electricity generation account for over 90% of natural gas use in Western Australia. Use in the commercial and residential sectors is a small proportion of the total, although this rises significantly if gas demand to fuel electricity supply to commercial and residential users is taken into account. While most households in the State access a reticulated gas supply, the milder climate means a relatively low heating requirement with most gas used to provide hot water.

Figure 2: Power station capacity by fuel type in Western Australia



Source: Office of Energy: Energy and Resources Infrastructure 2006

2. Project Forecast

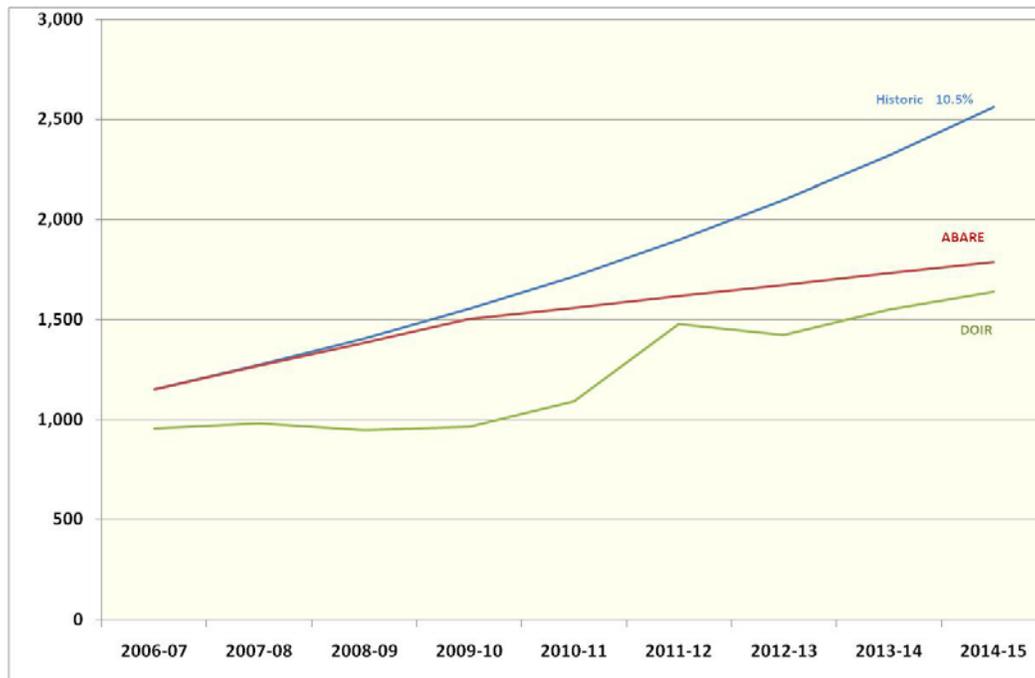
2.1 Introduction

This report looks at potential gas demand from a project perspective and compares this with forecasts based on past consumption patterns.

2.2 Trend Analysis

Gas consumption in the Western Australian domestic market has grown on average by 10.5% per annum since 1983-4 since the first supplies of North West Shelf gas reached the south west of the State via the Dampier to Bunbury Natural Gas Pipeline. A continuation of this trend would see consumption reach 2,500 TJ/day in 2014-15 (Figure 3).

Figure 3: Natural Gas Consumption Forecast (TJ/day)



ABARE has forecast 1,790 TJ/day in that year suggesting a slowdown in the rate of growth while the Western Australian Department of Industry and Resources has factored in expected supply constraints to derive a forecast reaching 1,640 TJ/day in the same period.

There is a difference in the starting point for the projections (2006-07) with DOIR below the ABARE estimate. This is explained by the timing of the forecasts with the DOIR forecast a recent revision and the ABARE forecast made in 2006-07.

These trend forecasts implicitly assume a continuation of the circumstances that prevailed during the past growth period. Hence they assume a similar level of new gas availability and prices that lead to commercial sales. Availability assumes new gas field production and expanded pipeline delivery capability.

All forecasts represent a substantial increase in gas consumption from current levels. The smallest increase of the three is the ABARE estimate which has consumption in 2014-15 at 40% higher than the estimate for 2007-08. The DOIR forecast is for a 67% increase and the trend line implies a 100% rise.

This study suggests a cautious outlook given the concerns with supply and the potential uncertainties over carbon emission price penalties. An increase of 40% is thus proposed as the base case.

Nearly all gas sold in Western Australia is by way of bilateral contract between a small number of gas producers and a larger number of buyers. Traditionally, these contracts were long term contracts and included detailed specifications on gas quality, the reliability of delivery, gas volumes and prices. A reduction in the availability of new supplies for sale in Western Australia since around mid 2006 has seen the producing companies less willing to offer long term contracts.

Future gas requirements are thus made up from gas that is needed to replace existing contract volumes when the current contracts expire; gas for expansion in electricity generation; and new projects that require gas for processing or electricity production. New gas is also required as energy for the transmission and distribution of gas through the pipeline system.

2.3 Project Analysis

2.3.1 Total Demand

Forecast gas demand includes gas to replace existing contract volumes; gas for expansion in electricity generation; and new projects that require gas for processing or electricity production. The total forecast estimate of new or replacement gas by 2015 is 1,125 TJ/day made up of:

- Replacement gas: 274 TJ/day;
- Resource project grid connected electricity: 68 TJ/day; and
- New mineral and petroleum processing projects: 783 TJ/day.

The following sections provide more detail on each of these demand sectors.

2.3.2 Replacement Gas

Replacement gas includes all gas currently used in the State such as electricity generation, industrial processing and gas used in manufacturing processes.

Public information on gas contracts was last published by the Office of Energy in 2003 and some of the contracts have expired and been renegotiated. Industry sources suggest there are large contracts that require replacement between 2010 and 2013. There is no certainty that gas will be available to meet these replacement contracts. Contracts may be tied to fields that are declining and with producers that have no replacement fields in the required timetable.

The estimate of replacement gas by 2013 is 274 TJ/day. The companies involved have limited options for alternative energy sources.

2.3.3 Electricity Generation

Energy sources for electricity generation primarily depend on the location of the power station and the purpose for which it is intended. In the interconnected grid servicing the south west of the State (SWIS), coal and natural gas have been the dominant fuel sources. In the Pilbara grid, natural gas and prior to that, fuel oil, were the only sources. Regional towns not connected to either grid have traditionally been diesel fired. Gas (in the form of LNG) is now being used as an alternative in a number of Kimberly power stations and two remote gold mines while renewable sources supplement supplies in some remote towns. Mine sites were traditionally diesel fired with gas emerging as a major fuel source following the construction of the Goldfields Gas Transmission pipeline in 1996.

There are no statistics available on individual power station fuel use but an examination of capacity provides some guidance of the relative importance of fuel types. The Office of Energy lists power stations with more than 10 MW of capacity and those supplying electricity into the SWIS.

The SWIS includes government owned power stations (Verve) and private stations mostly associated with mineral processing projects that supply surplus electricity into the grid. This system accounts for over 70% of the installed capacity in the State.

There are also power stations within the grid area that provide stand alone power to resource projects but are not connected into the SWIS. These stations are included in the "other" category. The "other" category includes stand alone power stations for smaller regional towns and stations on mines or mineral processing facilities.

For the State as a whole, gas fired power stations dominate with 73% of installed capacity, coal with 24% and diesel and renewable sources with 3% (Table 1).

Coal and fuel oil were the dominant sources of energy in SWIS until gas arrived in large volumes with the Dampier to Bunbury Natural Gas Pipeline. Coal remained the preferred option for base load generation with gas use in peak electricity generation plants for many years. Over time, relative price changes allowed some mid-merit electricity generation plant to operate profitably on gas and the proportion of installed capacity able to operate on gas gradually increased.

Table 1: Installed electricity generation capacity (MW)

Location	Capacity	Coal	Gas	Diesel	Renewable
South West Grid	5,133	1,578	3,493	62	
Pilbara	684		684		
Other	1,362	120	1,043	199	264
Total	7,179	1,698	5,220	261	264

Source: Office of Energy, 2008 (includes new stations under construction)

South West Interconnected System

The current capacity (including plants under construction) includes 30% coal and 68% gas. Stations include government owned and private stations connected to the grid.

Statistics on fuel used are not available but the government owned generator, Verve, used 69% coal in 2007 and 30% gas (both rounded).

The power station mix in the SWIS is constantly changing as old plants are rehabilitated or closed and new stations opened.

Five power stations are under construction or committed:

- Bluewaters 1 – private coal station at Collie with 240 MW capacity due for completion
- Bluewaters 2 – private coal stations at Collie each with 240 MW capacity due for completion
- Kwinana Newgen – private gas fired mid-merit plant with 320 MW capacity due for completion late 2008
- Neerabup – private gas fired peaking plant with 330 MW capacity due for completion 2010
- Kwinana Perth Energy – private gas fired peaking plant with 120 MW capacity due for completion

The Neerabup and Perth Energy projects are gas peaking plants and will use quite small volumes of gas over a year as they are designed to operate for only a few weeks a year. The Kwinana Newgen plant is a mid-merit power station with a much longer operating regime. Industry observers believe that the plant may be the last of this type for a while as it was able to secure a long term gas contract at what is now seen as “low” prices. It has secured a gas supply for some years and is not included in the additional gas needed for this study.

The government Independent Market Operator has forecast additional generation demand in the SWIS as follows:

- 2009-10 – 225 MW
- 2010-11 - 353 MW

The IMO forecast that electricity consumption will grow at 2.2% per annum on average over the period 2007/08 to 2016/17, while maximum demand is forecast to grow at 3.3% over this period.

The main energy retail organization, Synergy, is currently seeking an additional 400 MW of electricity capacity as part of this demand expectation and it appears highly likely that this can only be met by a new coal fired power station.

In the last decade, cogeneration plants associated with industrial processes have emerged as an electricity source for the interconnected grid. Two of these are located at Alcoa's Pinjarra alumina refinery; one at BHP Billiton's Worsley alumina refinery; and one at the BP oil refinery. Three new gas fired cogeneration plants associated with alumina production have received environmental approval. Two units are coming on line in an open cycle configuration and were planned to convert to cogeneration with electricity available to sale in the south west of the State around 2009-2010. Two other cogeneration plants were under consideration but one company has moved to coal as the preferred energy source given the lack of gas supplies. A significant potential gas demand arises from the construction of cogeneration plants.

This study assumes that the existing gas fired power stations operated by Verve have gas contracts for the forecast period. Hence, no new gas demand from power generation in the SWIS is included up to 2014-15. The new generation will need to come from coal with a small amount from renewable sources.

Some new electricity generation is included for resource projects connected into the SWIS and 68 TJ/day has been included in this category.

Pilbara

All of the listed power stations in the Pilbara are gas fired with many capable of operating on diesel as well. A few smaller power stations associated with small mining projects and remote communities are diesel fired also but are not included.

Future demand for larger facilities will remain gas focused. The gas demand for this area will primarily come from mining and mineral processing projects and is included in that section.

Other locations

This category includes power stations outside the Pilbara and a small number in the South West area that are not grid connected.

There are 28 facilities with a capacity in excess of 10 MW, 18 of them are gas fired, 9 are diesel and 1 is coal. Gas accounts for 76% of the total installed capacity in the "other" locations.

A total of 83% of the installed capacity is associated with mining projects and the expansion of this sector will primarily determine future energy demand. Gas turbines make up 80% of the mining capacity which means that across the State, gas power generation on mining and mineral processing plants makes up 67 % of the capacity installed in off-grid locations. Coal fuels one large power station (9%) and diesel capacity accounts for 7% of the total.

Given the dominance of the mineral and mineral processing sector, gas demand estimates are covered in the next section.

2.3.4 New Mineral and Petroleum Processing Projects

There are a large number of resource projects under consideration for Western Australia over the next five or so years. Horizon Power has prepared a potential scenario for the Pilbara region involving total gas demand by 2015 of 600 TJ/day. This compares with current use in the area of around 65 TJ/day. Horizon use expansions in the three current large iron ore producers and add six new mining projects in the region. The gas demand implies an increase of 535 TJ/day by 2015.

Outside the Pilbara, at least five iron ore projects are under consideration in the Mid West region along with associated port and rail infrastructure. Expansions to two large gold mines are planned in the Goldfields along with eight potential new gold mines and four nickel projects.

A potential list of projects is included here to illustrate the demand (Table 2). Not all of these projects will proceed and a number that have not been listed are also possible. This is illustrative only. A more detailed list with an estimated electricity demand range is included as Attachment 1 to this report.

Many projects have not been included for a range of reasons. Some projects will turn to coal due to lack of a competitively priced gas. Some Mid-West iron ore producers have already committed to other fuel sources. Other projects which might use gas if available are difficult to forecast at this stage.

The supply of LNG to two Eastern Goldfields mines has opened up new possibilities for gas producers. Wesfarmers LNG plant at Kwinana points the way to new gas supply options in that region.

The total forecast demand from this sector is 818 TJ/day with most demand coming from the Pilbara region.

Table 2: Potential Projects with significant gas demand

Pilbara
BHP Billiton iron ore expansion
Rio Tinto iron ore expansion
FMG expansion
Citic Pacific Cape Preston
Moly Mines molybdenum
Atlas Pardoo and Ridley
Aurox Balla Balla vanadium
CBH Sulphur Springs
Brockman Resources
Australasian Resources Balmoral South
Cape Lambert Iron Ore
Mid West
Murchison Metals Jack Hills
Asia Iron Extension Hill
Ferrowest Yalgoo pig iron
Gindalbie Karara
Midwest Weld Range
Windimurra vanadium
Oakajee port
Goldfields
Jaguar Metals Leonora
Lion Ore Bulong nickel
Newmont Super pit contract
Newmont Jundee pit
Barrick Gold Darlot
Anglo Gold Sunrise
Anglo Gold Tropicana
Duketon gold
Paddington gold
South Laverton gold (Saracen Gold)
Wiluna gold
Diggers South nickel concentrate
Honeymoon Well nickel metal
Sinclair nickel concentrate
Aldiss/Randalls gold
Leonora gold
Norseman Gold
Mt Windarra nickel concentrate
Other
DBNGP pipeline expansion
CSBP ammonium nitrate

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3. Economic Impacts

3.1 Introduction

Natural gas underpins electricity generation, mining and mineral processing in Western Australia. Consumers have moved to this energy source in response to a range of factors including convenience of use, technical advantages, price, and environmental advantages. Each industry has options for alternative energy sources except those that are based on gas conversion or chemical processing using the gas. The suitability of the alternatives will vary with industry and project location. For example, electricity generation can be based on coal in the south west of the State or diesel in areas remote from an electricity grid.

For some industries, the conversion to other energy sources will be relatively inexpensive while for others, the alternatives may prevent the project proceeding. For example, iron ore projects based on magnetite with pellet production require substantial energy inputs and may not be viable in the Pilbara where the only alternative to natural gas appears to be imported coal or imported fuel oil. Magnetite production may be profitable in the Mid West region where there are coal resources.

The recent Varanus Island processing hub outage underlined the price sensitivity of many industries to alternative fuel supply and their dependence on competitively priced gas.

A comprehensive analysis of the potential impact of a lack of natural gas on the Western Australian economy would examine each industry sector and potential project; review the alternative energy sources and the potential for that project to operate profitably under a range of commodity price scenarios. Such a comprehensive approach would be difficult to undertake and would rely on many assumptions about future relative prices and industry technical options. It is beyond the scope of this study.

An alternative approach is to assume that a lack of gas prevents the projects from proceeding at this time. The best case would be simply a deferral until gas became available while the worst outcome would be the loss of that development completely. Implicit in the first assumption is that commodity prices will continue at levels that enable profitable development when gas becomes available. The second outcome implies that the supply to international markets is met by a competitor outside Western Australia and is not recovered or that the current “price bubble” is not repeated for the foreseeable future. There are commodity forecasters that hold both views.

3.2 Potential Economic Benefits

The projects with **new** gas demand have the potential to deliver significant economic benefits to the State:

- Construction capital investment - \$36.5 billion
- Construction workforce – 24,750 people
- Operating workforce – 13,250 jobs
- Economic output - \$19 billion per annum when all new projects operational

Economic output has been conservatively estimated using long term prices rather than the current record high levels. No value has been ascribed to the increased gas use in the DBNGP or the replacement gas that continues current economic activity.

The economic output of \$19 billion a year appears high at first consideration. For comparison, the State Department of Treasury and Finance has estimated a loss over six months for the State economy of \$2 billion from the Varanus Island gas disruption. This outage involved a net gas loss of around 250 TJ/day for two months with some gas made up from other projects to cover the full loss of 350 TJ/day. The new project demand forecast here of 851 TJ/day for a year is 20 times the Varanus Island loss. The implication is that the \$19 billion does not appear to be overstating the potential economic output.

In addition to the potential benefits forgone if adequate gas supplies are not available, existing consumers will also be adversely affected. Some users will be able to convert to electricity or other fossil fuels at relatively low cost while others will face significant conversion and operational disadvantages. While relatively small overall gas consumers, residential dwellings illustrate the options. Houses have water and home heating options that include wood, liquid fossil fuels (heating oil), town gas (from coal) and electricity from a range of energy sources. Houses have, and continue to use, most of these sources and while natural gas has become a preferred option in most urban houses; it would be possible to convert to other sources of heat albeit with inconvenience, cost and environmental consequences.

The replacement gas included in this study (due for replacement in the next six years) includes large resource companies and the full range of small to medium sized consumers. It is not possible to determine the value of the economic output without disclosing the identity of these companies.

Attachment 1: Potential New Resource Projects in Western Australia

Project	Company	Expected Start	Commodity	MW	Location
BHP Billiton expansion	BHP Billiton	Expanding	Iron ore	>400	Port Hedland BHP grid
Cape Preston	Citic Pacific	2010	Magnetite	>400	Cape Preston
Rio expansion	Rio Tinto	Expanding	Iron ore	200-400	Dampier Rio Grid
Wagerup 3 expansion	Alcoa	na	Alumina	200-401	Wagerup site
Balmoral South	Australian Resources	2010	Magnetite	200-402	Cape Preston
Worsley expansion	Worseley Alumina	2009	Alumina	100-200	Collie
Cape Lambert	Cape Lambert	2010	Magnetite	100-200	Cape Lambert
Balla Balla	Aurox	2010		100-200	Karratha-Whim Creek
Extension Hill	Asia Iron	2012	Iron cons	100-200	Morawa
Gindalbie Karara	Gindalbie	2010	Iron cons	100-200	Morawa
FMG expansion	FMG	Expanding	Iron ore	50-100	Central and West Pilbara
Super Pit	KCGM	2009	Gold	50-100	Kalgoorlie
Honeymoon Well	Noriisk	2012	Nickel metal	50-100	Wiluna
Wingellina	Metals X Ltd	2012	Nickel conc	50-100	Wingellina WA border
Barrambie	Reed Resources	2011	Ferrovandium	10-20	Sandstone
Nickel Laterite Heap Leach	GME Resources	2011	Nickel conc	10-20	Leonora
Paddington	Norton Gold Fields	2009	Gold	10-20	Kanowna north of Kalgoorlie
Yilgarn	Polaris	2010	Iron ore	10-20	Meekatharra
South Laverton	Saracen Mineral	na	Gold	10-20	Laverton
Wiluna	Apex Minerals	2008	Gold	10-20	Wiluna
Tropicana	AngloGold Ashanti	2011	Gold	10-20	Leonora
Murchison Metals Jack Hills 2	Murchison	2011	Iron ore	5-10	Jack Hills, Murchison
Cosmos	Jubilee Mines	2008	Nickel conc	5-10	Leinster
Aldiss/Randalls	Integra Mining	2010	Gold	5-10	Kalgoorlie
Diggers South/New Morning	Western Areas	2009	Nickel conc	5-10	Southern Cross
Wodgina/Lalla Rookh		2010	Iron ore	5-10	Port Hedland inland
Moly Mines Spinifex Ridge	Moly Mines	2010	Molybdenum	5-10	Nullagine
Midwest Weld Ranges	Midwest	2009	Iron ore	5-10	Weld Ranges, Murchison
Wiluna	Golden West	2010	Iron ore	5-10	Wiluna
Marillana	Brockman Resources	2009	Iron ore	1-5	Newman
West Pilbara	Aquila	2010	Iron ore	1-5	Pannawonica
Pardoo	Atlas Iron	2008	Iron ore	1-5	Port Hedland inland
Abydos		2009	Iron ore	1-5	Port Hedland inland
Robertson Range	Fer Aus	2009	Iron ore	1-5	Newman
Mount Gibson	Mt Gibson Iron	2010	Iron ore	1-5	Morawa
Gindalbie Mungada	Gindalbie	2009	Iron ore	1-5	Morawa
Coburn	Gunson Resources	2010	Mineral sands	1-5	Shark Bay
Gullewa copper gold	ATW Mining	2009	Gold	1-5	Yalgoo
Dongara	Tiwest	2010	Mineral sands	1-5	Dongara
CBH Panorama Springs	CBH	2010	Zinc/Copper	<1	Nullagine
Phil's Creek	Iron Ore Holdings	2009	Iron ore	<1	Newman
Nullagine moly/gold	Millenium Minerals	2010	Molybdenum	<1	Nullagine