

Domestic Onshore Option for Timor Sea Gas: Analysis of Implications for Australia

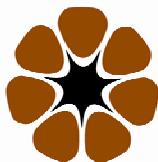
A Report to the Northern Territory Government

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Prepared by



ACN 058 284 521



Northern Territory Government

CANBERRA OFFICE

ACIL House
103-105 Northbourne Avenue
Canberra ACT 2601

telephone +61 2 6249 8055
facsimile +61 2 6257 4170

SYDNEY OFFICE

Level 2
181 Miller Street
North Sydney NSW 2060

telephone +61 2 9957 6363
facsimile +61 2 9957 1805

BRISBANE OFFICE

Level 15
127 Creek Street
Brisbane QLD 4000

telephone +61 7 3236 3966
facsimile +61 7 3236 3499

MELBOURNE OFFICE

Level 6
224-236 Queen Street
Melbourne VIC 3000

telephone +61 3 9600 3144
facsimile +61 3 9600 3155

PERTH OFFICE

Level 29
221 St Georges Terrace
Perth WA 6000

telephone +61 8 9480 3762
facsimile +61 8 9481 3177

Economics • Policy • Strategy

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Summary and key findings

This report has been prepared by ACIL Consulting for the Northern Territory Government to assist in the assessment of development options for natural gas from the Sunrise and Bayu-Undan projects in the Timor Sea. The domestic option in this report is based on data provided by Phillips Petroleum at the request of the NT Government, and is supplementary to an earlier ACIL report of March 2002 exploring other development options. The FLNG option is based on revised data provided by Woodside Energy Limited to the Northern Territory Government.

ACIL has used its *GasMark* model to assess the implications for eastern states gas markets of new gas supply from the Timor Sea. Further, the Centre for International Economics (CIE) has applied its integrated model of the Northern Territory and rest of Australia economies to assess macroeconomic impacts of investment and of new gas supply to eastern states markets.

Two basic scenarios are assessed:

- Revised Scenario A, including the latest capital cost data
- Scenario C

The scenario assumptions are detailed in Attachment A-1.

For the purposes of analysing the impacts of Timor Sea gas on the Eastern Australian gas market, Scenario C has been assessed assuming PNG gas is delivered to Australia from 2006.

Revised Scenario A involves:

- Bayu-Undan gas piped ashore to the Darwin area by 2006; and
- Sunrise gas to an offshore floating liquefied natural gas (FLNG) plant by mid-2007.

Scenario C, which is based on information provided by Phillips Petroleum, involves:

- Bayu-Undan gas piped ashore to the Darwin area by 2006; and
- Sunrise gas piped ashore to the Darwin area by mid-2007.

ACIL *GasMark* model results

GasMark is a gas market simulation model developed by ACIL Consulting and designed to assist in analysing gas markets and understanding market dynamics. The model allows testing of differing assumptions regarding availability and pricing of gas production from different fields, transmission pipelines, network developments and market demand. From a consumer's point of view the model seeks to satisfy

demand at minimum price, while from a gas producer's perspective it seeks to allocate available supply so as to maximise netback margins after transportation costs, taking into account competitive alternatives.

The modelling shows that both Revised Scenario A and Scenario C deliver significant benefits (in terms of expansion of the Australian gas market and improved price outcomes) when compared with a No Timor Sea Gas Case¹.

However, the benefits achieved under Scenario C are significantly greater than for Revised Scenario A. Moreover, bringing both Bayu-Undan and Sunrise gas onshore stimulates markets not only in the Northern Territory but also throughout the whole of Eastern Australia. Scenario C sees higher gas volumes than Revised Scenario A delivered into both the Northern Territory and interstate markets. This creates a more competitive supply situation resulting in lower prices to industrial, commercial and residential consumers.

Scenario C, which includes PNG gas delivered to Australia shows that, while PNG gas wins significant market volumes particularly in Eastern Queensland, it does so without adversely impacting on the market penetration of Timor Sea gas. Thus the modelling indicates that the two projects would be complementary, rather than mutually exclusive.

A further key finding is that bringing Sunrise gas onshore is essential to creating the benefits of Scenario C. The Bayu-Undan project would be capable of supplying an LNG project with a demand of 165 PJ/annum. However, the reserves base available to Bayu-Undan alone could not support production at the levels necessary to underpin significant new industrial development in Darwin, nor justify the pipeline infrastructure needed to access interstate markets.

CIE macroeconomic results

CIE estimated the contribution of the Revised Scenario A and C development packages² and each of their components to the Northern Territory and Australian economies using an economy-wide integrated model of the Northern Territory and the rest of Australia. The model describes the composition of production and sales in the Northern Territory and rest of Australia economies, the links at the sector level between the two economies through trade and the links through exports and imports to the rest of the world.

As shown in Table 1, the annual economic benefits to the Northern Territory from Scenario C are expected to be substantially greater than those from Revised Scenario A. Similarly, Table 2 shows the additional

¹ The No Timor Sea Gas Results are reported in ACIL's March 2002 report.

² The macroeconomic modelling of the scenarios does not include the investment impacts from PNG gas.

national benefits, including for the Northern Territory, from Scenario C over Revised Scenario A.

Table 1: Additional economic benefits to the Northern Territory delivered by Scenario C over Revised Scenario A

Economic indicator	Construction phase		Operations phase annual benefits
	2002-04 ^(a)	2005-07 ^(a)	
Gross State Product, including	(\$35m)	\$375m	\$995m
Real investment	(\$115m)	\$2,493m	\$68m
Household consumption	(\$17m)	\$150m	\$184m
Net exports (imports) to other States	(\$105m)	(\$792m)	(\$225m)
Net exports (imports) overseas	(\$5m)	(\$1,420m)	\$986m
Employment (full-time equivalents)	(1,057)	5,781	3,701
NT Government revenue	\$5m	\$16m	\$17m

Source: CIE

(a) Annual average over the three-year period

Table 2: Additional National benefits (including NT) delivered by Scenario C over Revised Scenario A

Economic indicator	Construction phase		Operations phase annual benefits
	2002-04 ^(a)	2005-07 ^(a)	
Gross Domestic Product, including	(\$91m)	\$860m	\$1,070m
Real investment	(\$115m)	\$2,493m	\$22m
Household consumption	(\$29m)	\$347m	\$373m
Net exports (imports) overseas	\$55m	(\$1,931m)	\$660m
Employment (full-time equivalents)	(2,596)	13,053	4,891
Government revenue	(\$18m)	\$308m	\$127m

Source: CIE

(a) Annual average over the three-year period

1. **GasMark modelling**

GasMark is a gas market simulation model developed by ACIL Consulting and designed to assist in analysing and understanding the dynamics of the Eastern Australian gas market. The model allows testing of different assumptions regarding availability and pricing of gas production from different fields, transmission pipelines, network developments and market demand. From a consumer's point of view the model seeks to satisfy demand at minimum price, while from a gas producer's perspective it seeks to allocate available supply so as to maximise netback margins after allowing for transportation costs and taking into account competitive alternatives.

Two scenarios have been examined in this report using *GasMark*³:

- A scenario in which Sunrise gas is produced solely for processing in an offshore floating liquefied natural gas (FLNG) plant, while Bayu-Undan gas is landed in Darwin for supply to an onshore LNG facility and for local power generation (Revised Scenario A); and
- A scenario in which both Sunrise and Bayu-Undan gas are piped to shore at Darwin, for use in a range of industrial applications in the Northern Territory. Transmission pipeline connections to Mount Isa and Moomba provide access to markets throughout Eastern Australia, with up to 170PJ/annum of Sunrise gas sold in these markets (Scenario C).

Details of the Revised Scenario A and C assumptions are provided in Attachment A-1.

1.1 **Revised Scenario A**

1.1.1 **Introduction**

Revised Scenario A reflects the FLNG option for Sunrise Gas.

In this scenario it is assumed that 300 PJ/year of gas from Sunrise is dedicated to an FLNG plant, commencing in mid-2007. Up to 165 PJ/year of gas from Bayu-Undan is available for delivery to an onshore LNG plant, with a further 30 PJ/year available for consumption within the Northern Territory — principally for power generation.

Gove remains unconnected, nor is there any pipeline linkage to interstate markets. This is because the reserves available in Bayu-Undan alone are

³ See ACIL's earlier report of March 2002 where scenarios of No Timor Sea gas, and scenarios involving less gas available for sale into domestic markets (Scenario B) are reported.

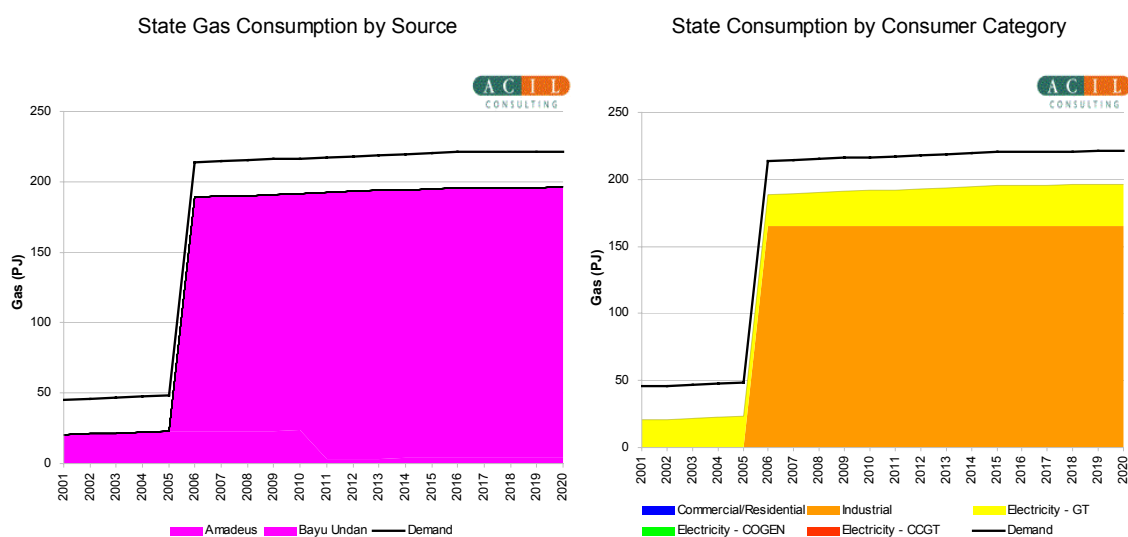
insufficient to support both the Darwin-based developments and interstate exports at viable levels.

The modelling shows that production from the Amadeus Basin declines significantly by 2011 to around 4 PJ/year, after which it supplies only small power generation loads in remote areas of the Territory. Most of the Territory's power generation demand is then met by Bayu-Undan gas. Consumption in the power generation sector rises from 20 PJ/year in 2001 to 31 PJ/year in 2020.

There is a gap between supply and potential demand due mainly to unmet demand of 25 PJ/year at the existing Gove alumina refinery.

Figure 1 shows NT gas consumption by source for Revised Scenario A.

Figure 1: NT gas consumption by source for Revised Scenario A



1.1.2 Volumes of gas sold – Revised Scenario A

Figure 2 shows the volumes of gas sold into state and territory markets under this scenario, while Figure 3 shows the incremental gas sales volumes (compared to the No Timor Sea Gas Scenario modelled in ACIL's March 2002 report).

Figure 2: Total gas sales volumes, by State/Territory — Revised Scenario A

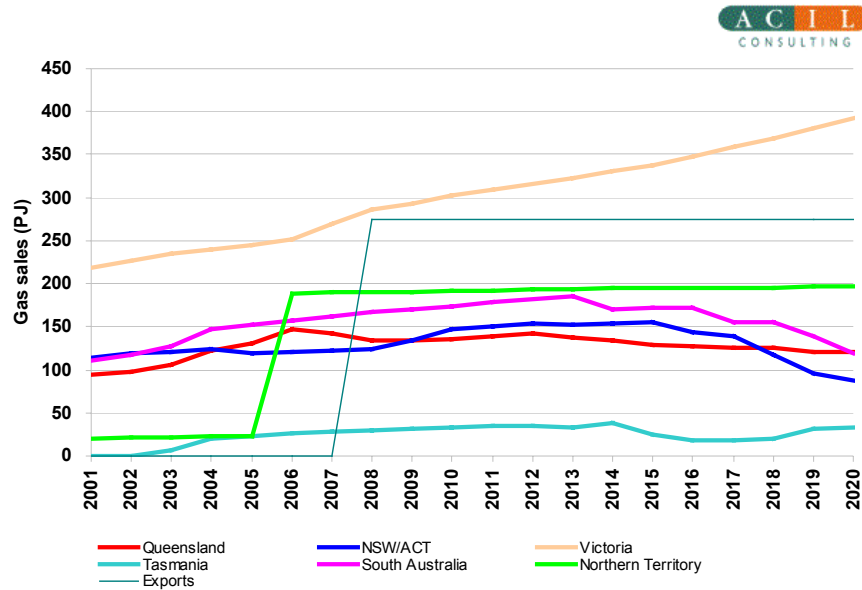
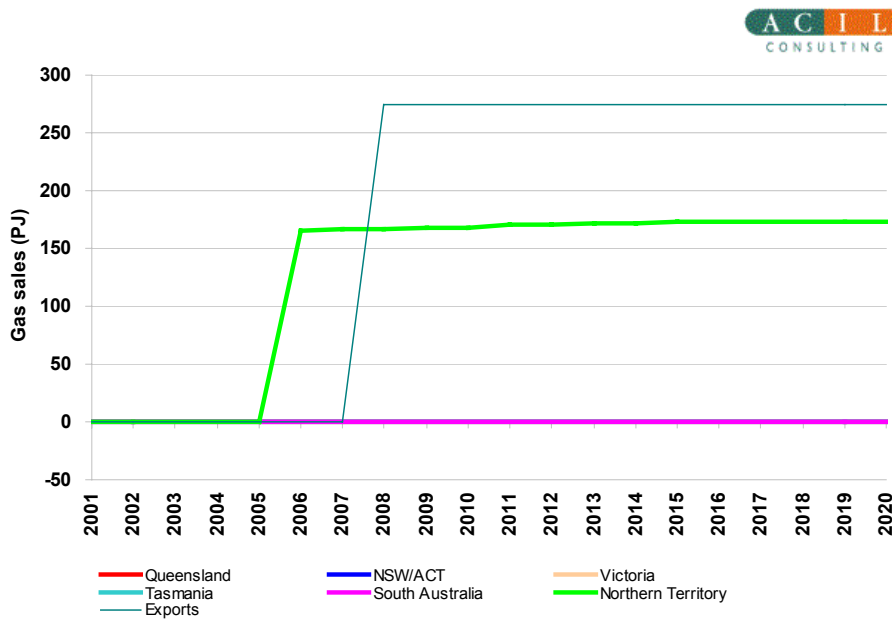


Figure 3: Incremental gas sales volumes, by State/Territory — Revised Scenario A



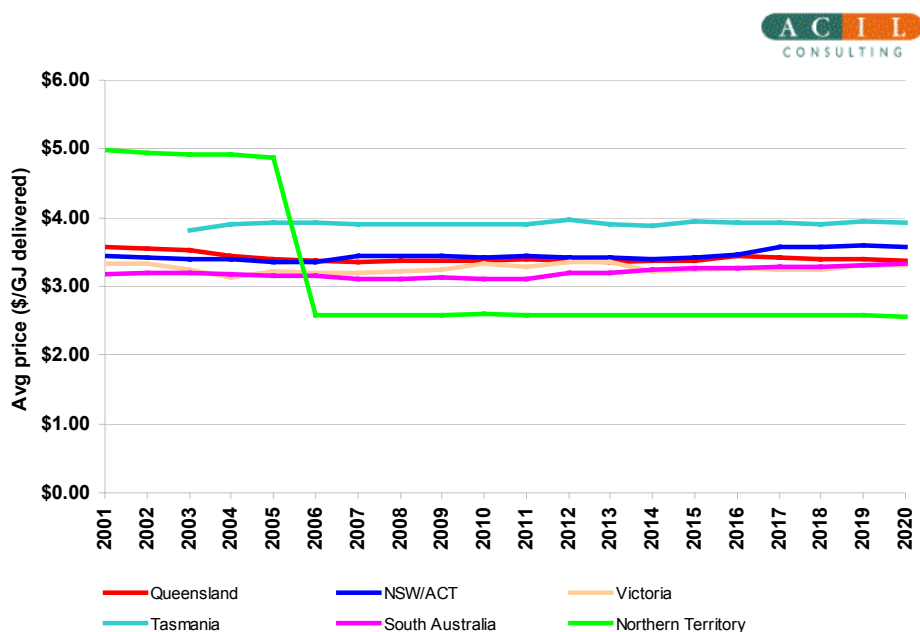
As expected, in view of the lack of pipeline interconnection to southern states, Revised Scenario A does not result in any change to outcomes in markets other than Northern Territory and exports of LNG.

1.1.3 Average Delivered Gas Price – Revised Scenario A

Figure 4 shows the impact on average delivered prices for Revised Scenario A. Connection of Bayu-Undan gas to Darwin has a dramatic

effect on gas prices in the Northern Territory, with the average delivered gas price falling to around half current levels. This scenario impacts no other State market.

Figure 4: Average real delivered gas prices for Revised Scenario A



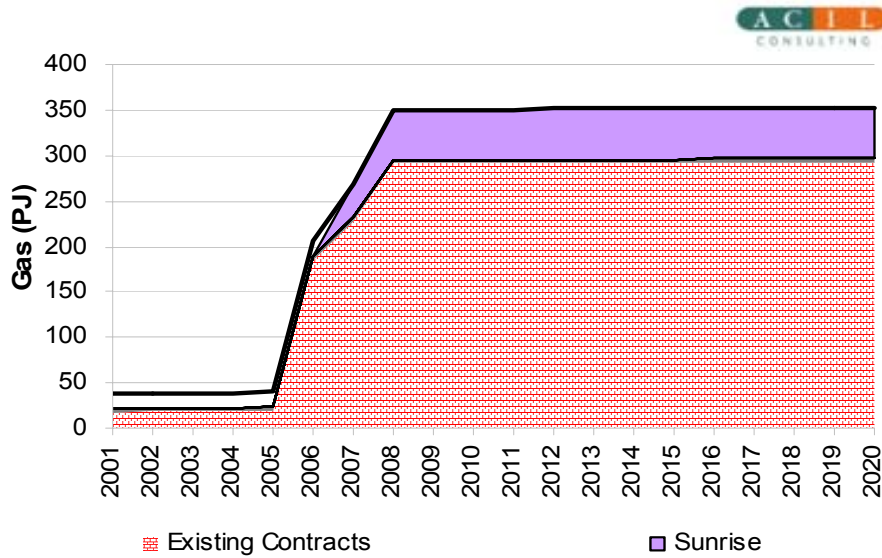
1.2 Scenario C with PNG

1.2.1 Introduction

This scenario is a case where all gas production from Sunrise and Bayu-Undan is piped ashore to Darwin. The modelling assumptions are that Bayu-Undan gas is dedicated to LNG export, and Sunrise gas is dedicated to industrial loads in Darwin and up to 170PJ/annum for marketing in Queensland, South Australia and NSW. The PNG gas project is assumed to proceed with gas deliveries commencing in 2006.

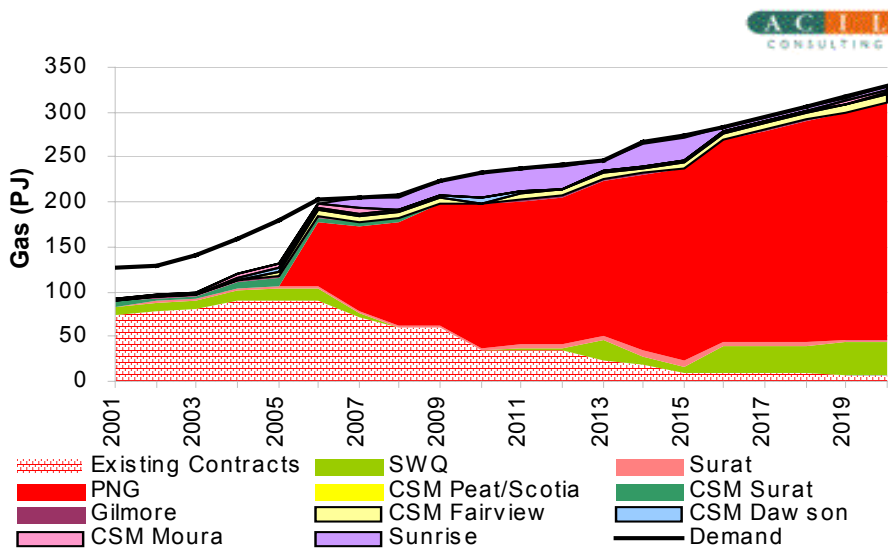
Under this scenario all Northern Territory demand is satisfied once Timor Sea gas becomes available from Bayu Undan in 2006 and Sunrise in mid-2007 (Figure 5). For the purposes of the model, in Figure 5 contracts for Pechiney (aluminium smelting) and the Bayu-Undan LNG plant are treated as “existing contracts”. The bulk of remaining demand is principally for Nabalco at Gove and the Power and Water Authority.

Figure 5: Northern Territory demand and supply for Scenario C with PNG gas.



With regard to supply in other States, the outcomes for Scenario C in Queensland are that the introduction of PNG gas provides a major boost to overall supply such that all of the identified potential demand in Queensland is satisfied (Figure 6). Timor Sea gas is supplied into the Mt Isa market, however, Timor Sea gas is unable to reach consumers in Eastern Queensland at prices likely to be sustainable in the market. Hence the modelling indicates that the Timor Sea gas does not displace PNG project. Instead, the two projects are found to serve essentially different markets – PNG in coastal Queensland and Timor Sea in northwest Queensland and the southern States.

Figure 6: Queensland demand and supply for Scenario C with PNG Gas



1.2.2 Volumes of gas sold – Scenario C with PNG

Figure 7 shows the aggregate volumes of gas sold into State and Territory markets under Scenario C with PNG gas, while Figure 8 shows the incremental gas sales volumes (compared to a No Timor Sea Gas Scenario). Both the Northern Territory and Queensland markets show major increases in gas sales volumes. In the case of South Australia and NSW markets, Timor Sea gas is modelled to capture market share at the expense of Moomba and Gippsland gas, respectively.

Figure 7: Total gas sales volumes, by State/Territory — Scenario C with PNG gas

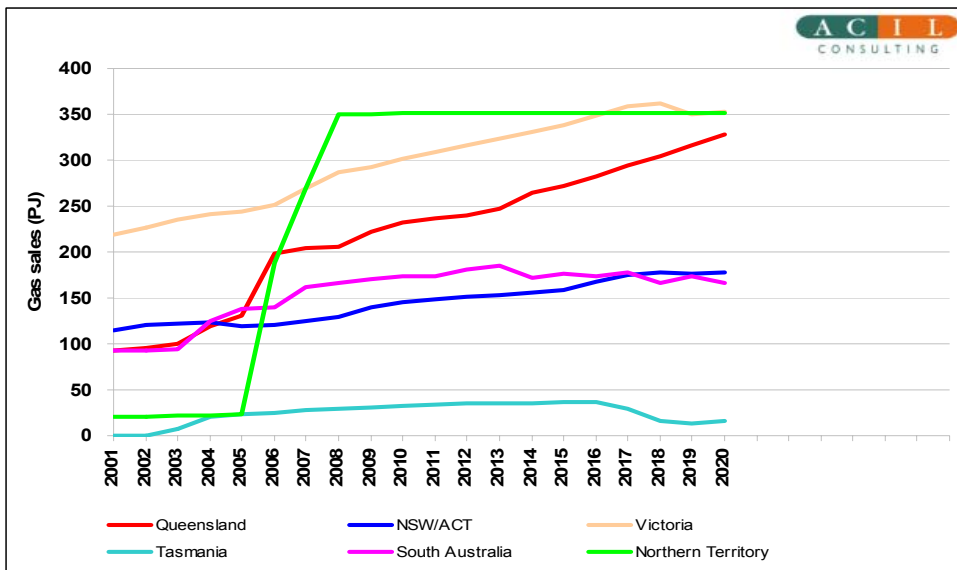
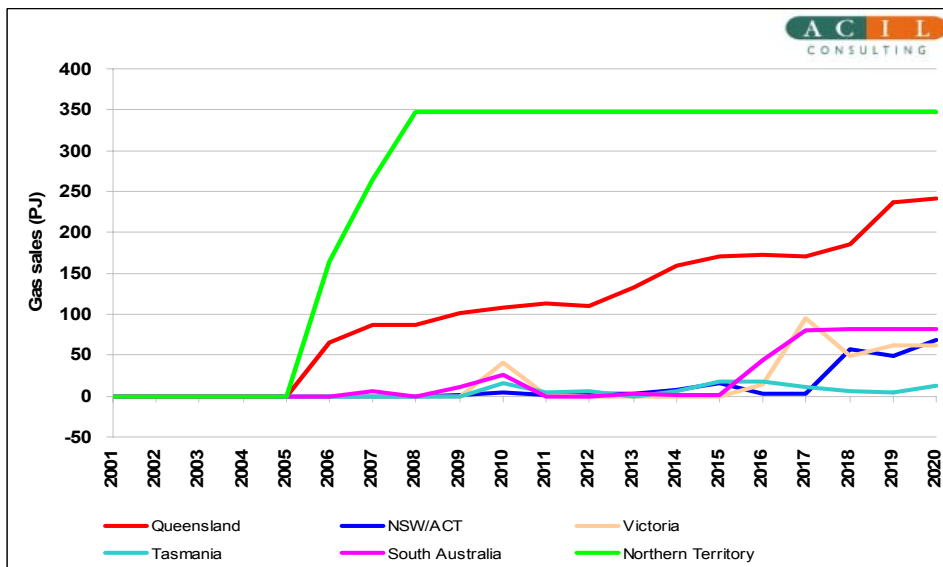


Figure 8: Differential gas sales volumes, by State/Territory — Scenario C with PNG gas



1.2.3 Average Delivered Price of Gas – Scenario C with PNG

The impact of availability of Timor Sea gas on average real delivered gas prices in the various State and Territory markets under Scenario C is shown in Figures 9 to 13.

The NT and Queensland are the major beneficiaries of lower gas prices in this scenario, the later principally because of PNG gas. In NSW/ACT, average prices decline by around \$0.01-\$0.20/GJ over the period to 2020. In South Australia, average prices decline by up to \$0.35/GJ by 2020 (although there is an increase of around \$0.05/GJ in 2010). Prices in Victoria vary across the period.

Figure 9: Average real delivered gas prices and price differential in Northern Territory — Scenario C with PNG gas

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Figure 10: Average real delivered gas prices and price differential in Queensland — Scenario C with PNG gas

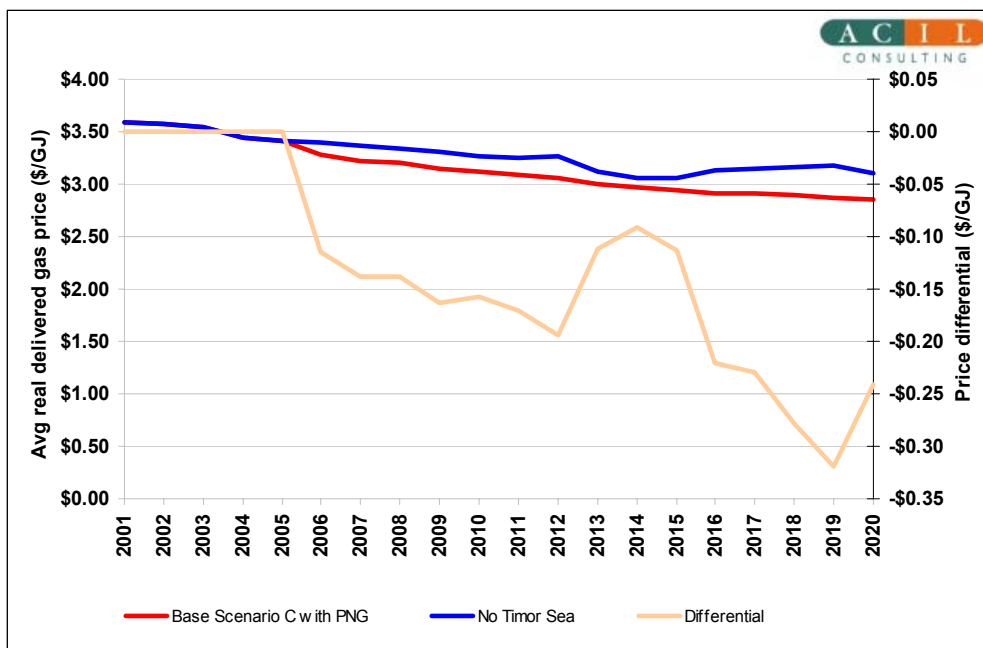


Figure 11: Average real delivered gas prices and price differential in NSW/ACT — Scenario C with PNG gas

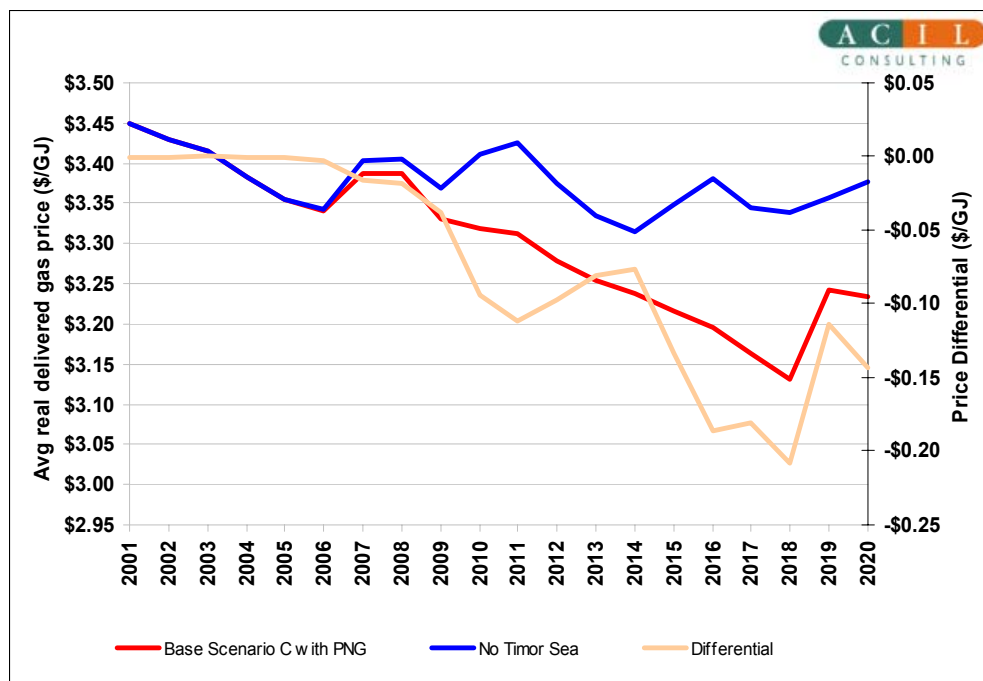


Figure 12: Average real delivered gas prices and price differential in Victoria — Scenario C with PNG gas

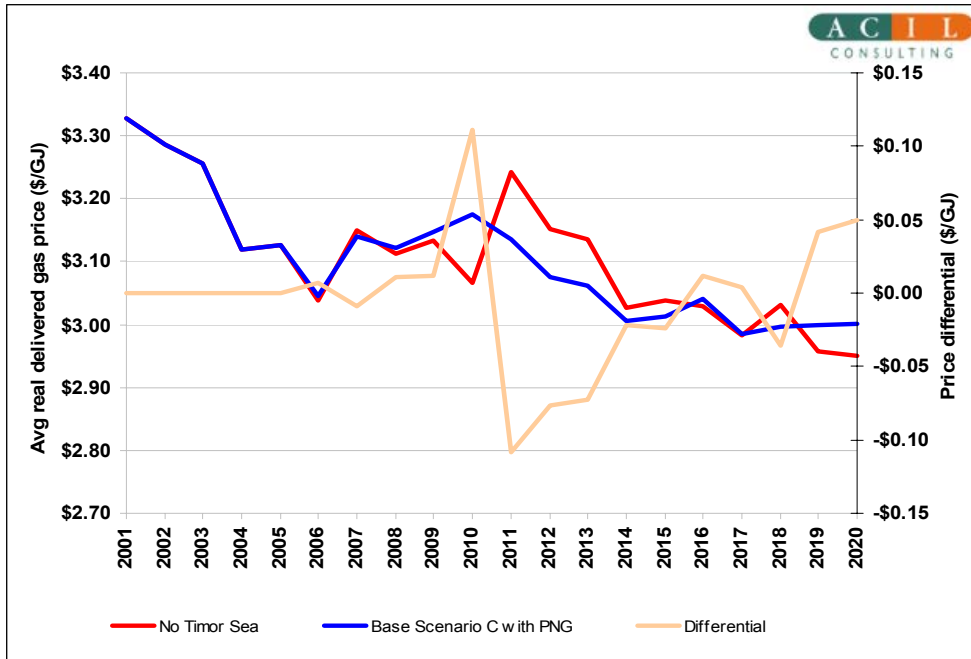
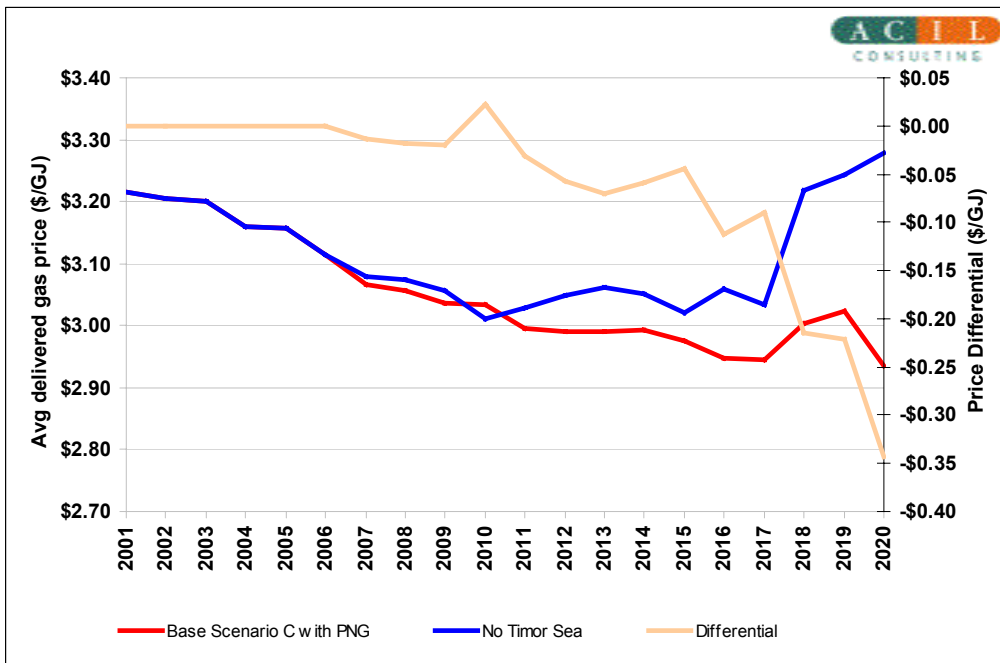


Figure 13: Average real delivered gas prices and price differential in South Australia— Scenario C with PNG gas



2. CIE macroeconomic modelling

The Centre for International Economics was commissioned to estimate the contribution that Revised Scenario A and Scenario C would make to the Northern Territory and Australian economies. CIE has used its integrated model of the Northern Territory and rest of Australia economies.

The CIE model distinguishes 60 sectors of production in each economy (Northern Territory and rest of Australia), including oil and gas production, methanol production, the aluminium industry, gas pipeline transmission activities, electricity generation and the various upstream and downstream industries providing capital and current inputs to production of goods and services to meet the needs of consumers. It accounts for all sectors of production in the Northern Territory and hence Northern Territory net income, which is referred to as gross state product (GSP), and all sectors in the rest of Australia, and hence Australia's national income (GDP).

Each sector in the Northern Territory and rest of Australia economies can source its inputs from suppliers in the Northern Territory, suppliers in the rest of Australia and from overseas (imports). Similarly, each sector's products can be sold to industries and households in the Northern Territory, the rest of Australia and to export markets.

As well as identifying the cost and sales structures of each industry, the model accounts for the various taxes and charges the Northern Territory and Commonwealth governments levy throughout the economy to raise revenue.

By including, at a detailed level, representations of the interactions between sectors, the model is able to assess the direct and flow on effects of the scenarios and their components on the performance of industries, employment opportunities, government revenue, macroeconomic performance and living standards. It accounts for how much of the benefits remain in the Northern Territory and how much flow to the rest of Australia and overseas.

CIE use the Northern Territory – rest of Australia model to analyse the impact of the construction and operations phases of the scenarios and their components. Two periods of the construction phase are modelled — 2002/04 and 2005/07. The operations phase is modelled at 2008. The modelling outcomes are estimated by imposing the new investment associated with the scenarios as a “shock” to the Northern Territory and rest of Australia economies.

The CIE analysis focuses on a selection of economic variables likely to be of relevance to decision makers in coming to grips with the economic effects of the scenarios. Key variables of interest are:

- value added (which is GSP for the Northern Territory and GDP for the rest of Australia and Australia as a whole);
- living standards (measured in terms of increase in real consumption expenditure) of Northern Territory and Australian households;
- labour market performance;
- trade between the Northern Territory and rest of Australia, and between Australia and overseas; and
- government revenue (Northern Territory, Australia).

2.1 Revised Scenario A

The development assumptions under Revised Scenario A are as set out in Attachment A-1.

Table 3 shows the macroeconomic impacts of the Revised Scenario A development on the Northern Territory and the Australian economies.

The operations phase from 2008 is estimated to contribute **annually**:

- an increase of 42% to NT GSP and, for the whole of Australia, a \$3.4 billion increase in GDP;
- an increase in real investment in the NT economy of \$115 million;
- net overseas exports from the NT of over \$3 billion;
- a permanent employment boost of over 4,500 persons in the NT and a further 2,400 persons elsewhere in Australia; and
- increased NT Government revenues of \$23.8 million and Commonwealth revenues of over \$140 million.

Table 3: Revised Scenario A construction and operations impacts on the economy

			Construction Phase		Operations Phase
			2002-04a	2005-07a	2008
Gross domestic product (a)	NT	%	2.92	3.75	41.57
		\$m 2000	224	287	3186
	ROA	%	0.05	0.06	0.03
		\$m 2000	289.4	352.6	199.0
	Australia	%	0.09	0.11	0.57
		\$m 2000	513.5	640.1	3385.4
Real investment	NT	%	85.26	81.97	5.39
		\$m 2000	1824.6	1754.1	115.3
	ROA	%	0.00	0.00	0.05
		\$m 2000	0.0	0.0	62.6
	Australia	%	1.3	1.3	0.1
		\$m 2000	1824.6	1754.1	177.9
Household consumption	NT	%	2.77	3.92	8.70
		\$m 2000	95.4	135.0	299.8
	ROA	%	0.03	0.03	0.02
		\$m 2000	88.9	120.6	83.0
	Australia	%	0.05	0.07	0.11
		\$m 2000	184.3	255.6	382.8
Exports interstate	NT	%	0.35	0.41	-0.13
		\$m 2000	3.6	4.1	-1.3
	ROA	%	17.73	18.48	8.83
		\$m 2000	645.5	672.9	321.3
Exports overseas	NT	%	-0.29	-0.30	101.23
		\$m 2000	-9.2	-9.4	3205.3
	ROA	%	-0.29	-0.29	-0.17
		\$m 2000	-330.7	-330.5	-201.3
	Australia	%	-0.3	-0.3	2.5
		\$m 2000	-339.8	-339.9	3004.0
Imports interstate	NT	%	17.73	18.48	8.83
		\$m 2000	645.5	672.9	321.3
	ROA	%	0.35	0.41	-0.13
		\$m 2000	3.6	4.1	-1.3
Imports overseas	NT	%	115.93	102.33	14.69
		\$m 2000	994.3	877.6	126.0
	ROA	%	0.09	0.09	0.05
		\$m 2000	108.1	105.1	63.2
	Australia	%	0.89	0.80	0.15
		\$m 2000	1102.4	982.7	189.2

Persons	NT	%	4.29	5.20	5.35
		Persons	3647	4424	4556
	ROA	%	0.07	0.08	0.03
		Persons	5514	6525	2427
	Australia	%	0.11	0.13	0.08
		Persons	9161	10949	6983
Consumer price index	NT	%	1.67	2.14	0.02
	ROA	%	0.05	0.06	0.03
Government revenues (d)	NT	%	0.60	0.88	1.31
		\$m 2000	10.9	16.0	23.8
	ROA	%	0.06	0.08	0.07
		\$m 2000	126.5	153.1	140.8
	Australia	%	0.07	0.08	0.08
		\$m 2000	137.3	169.1	164.7

Source: CIE NT-Australia model and CIE calculations. (a) Three year annual average.

2.2 Scenario C

The development assumptions for Scenario C are set out in Attachment A-1.

Table 4 shows the macroeconomic impacts of the Scenario C development on the Northern Territory and the Australian economies. The operations phase from 2008 is estimated to contribute **annually**:

- an increase of 55% to NT GSP and, for the whole of Australia, an increase of over \$4.4 billion in GDP;
- an increase in real investment in the NT economy of \$180 million;
- net overseas exports from the NT of over \$4 billion;
- a permanent employment boost of over 8,200 in the NT and 3,600 for the rest of Australia; and
- increased NT Government revenues of \$40 million and Commonwealth revenues of \$250 million.

Table 4: Scenario C construction and operations impacts on the economy

			Construction Phase		Operations Phase
			2002-04a	2005-07a	2008
Gross domestic product (a)	NT	%	2.46	8.65	54.55
		\$m 2000	189	663	4182
	ROA	%	0.04	0.14	0.05
		\$m 2000	234.3	837.5	273.8
	Australia	%	0.07	0.25	0.75
		\$m 2000	423.0	1500.2	4455.6
Real investment	NT	%	79.89	198.45	8.57
		\$m 2000	1709.5	4246.7	183.3
	ROA	%	0.00	0.00	0.01
		\$m 2000	0.0	0.0	16.4
	Australia	%	1.2	3.0	0.1
		\$m 2000	1709.5	4246.7	199.7
Household consumption	NT	%	2.28	8.28	14.05
		\$m 2000	78.6	285.3	483.8
	ROA	%	0.02	0.09	0.08
		\$m 2000	76.4	317.8	271.5
	Australia	%	0.04	0.17	0.21
		\$m 2000	155.0	603.0	755.3
Exports interstate	NT	%	0.27	0.81	49.77
		\$m 2000	2.8	8.2	503.7
	ROA	%	14.87	40.36	28.89
		\$m 2000	541.5	1469.2	1051.6
Exports overseas	NT	%	-0.22	-0.67	136.97
		\$m 2000	-6.9	-21.3	4337.1
	ROA	%	-0.25	-0.59	-0.47
		\$m 2000	-283.4	-677.5	-538.2
	Australia	%	-0.2	-0.6	3.2
		\$m 2000	-290.4	-698.8	3798.8
Imports interstate	NT	%	14.87	40.36	28.89
		\$m 2000	541.5	1469.2	1051.6
	ROA	%	0.27	0.81	49.77
		\$m 2000	2.8	8.2	503.7
Imports overseas	NT	%	116.78	266.59	31.71
		\$m 2000	1001.6	2286.5	271.9
	ROA	%	0.08	0.22	0.04
		\$m 2000	94.6	268.6	51.9
	Australia	%	0.89	2.07	0.26
		\$m 2000	1096.2	2555.1	323.9

Persons	NT	%	3.04	11.99	9.70
		Persons	2589	10205	8257
	ROA	%	0.05	0.17	0.04
		Persons	3976	13797	3616
	Australia	%	0.08	0.29	0.14
		Persons	6565	24002	11874
Consumer price index	NT	%	1.35	4.50	0.16
	ROA	%	0.04	0.13	0.03
Government revenues (d)	NT	%	0.88	1.31	2.22
		\$m 2000	16.0	32.3	40.5
	ROA	%	0.05	0.22	0.13
		\$m 2000	103.0	444.8	251.4
	Australia	%	0.06	0.24	0.15
		\$m 2000	119.0	477.0	291.9

Source: CIE NT-Australia model and CIE calculations. (a) Three year annual average.

Attachment A1. Development options for Timor Sea Gas

A1.1 FLNG development option

Table 5 sets out the products and capital investment arising from a FLNG development of Sunrise gas, the preferred Shell and Woodside option.

The following corresponds to Revised Scenario A in the gas market and macroeconomic modelling.

Table 5: FLNG development option — Revised Scenario A

Project Development	Gas PJ/annum	Total Liquids in Field mmbbls	Investment A\$Million	Product
PRODUCTION				
Bayu-Undan - gas field	195	0	2,700	Natural gas to shore
Bayu-Undan - condensate	0	400		Condensate/LPG for export
Sunrise - gas field	300		2,200	Natural gas offshore
Sunrise - condensate		320		Condensate/LPG for export
Pipeline to shore (B-U only)			1,200	26"
CONSUMPTION				
Floating LNG (Sunrise gas)	-300		2,900	Export of gas (5mtpa)
Onshore LNG (Bayu-Undan gas)	-165		2,000	Export of gas (3mtpa)
NT grid (Bayu-Undan gas)	-30		0	Electricity (substitution)
<i>Balance</i>	<i>0</i>	<i>720</i>	<i>11,000</i>	

A1.2 Phillips Petroleum development option

Table 6 sets out the products and capital investment arising from the Phillips Petroleum development option for Timor Sea gas.

The following corresponds to Scenario C in the gas market and macroeconomic modelling.

Table 6: Integrated development option — Scenario C

Project Development	Gas PJ/annum	Total Liquids in Field mmbbls	Investment A\$Million	Product
PRODUCTION (2008)				
Sunrise - gas field	352		3,600	Natural gas to shore
Sunrise - condensate		320		Condensate/LPG for export
Bayu-Undan - gas field	165		2,700	Natural gas to shore
Bayu-Undan - condensate	0	400		Condensate/LPG for export
Pipeline to shore (Networked)			2,000	B-U 26", Sunrise 36", Shared 36"
CONSUMPTION				
Bayu-Undan - onshore LNG	-165		2,000	Export of gas (3mtpa)
Aluminium smelter and power	-127		5,400	Aluminium (0.9mtpa)
NT grid	-20		0	Electricity (substitution)
Gas to Gove	-35		1,500	Electricity (substitution)
Interstate Pipeline			1,300	
Interstate gas sales	-170			Sales gas to Mt Isa and Moomba
<i>Balance</i>	<i>0</i>	<i>720</i>	<i>18,500</i>	