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Institute for Energy Economics and Financial Analysis

Technical Appendix:

Browse gas

Cost Assumptions

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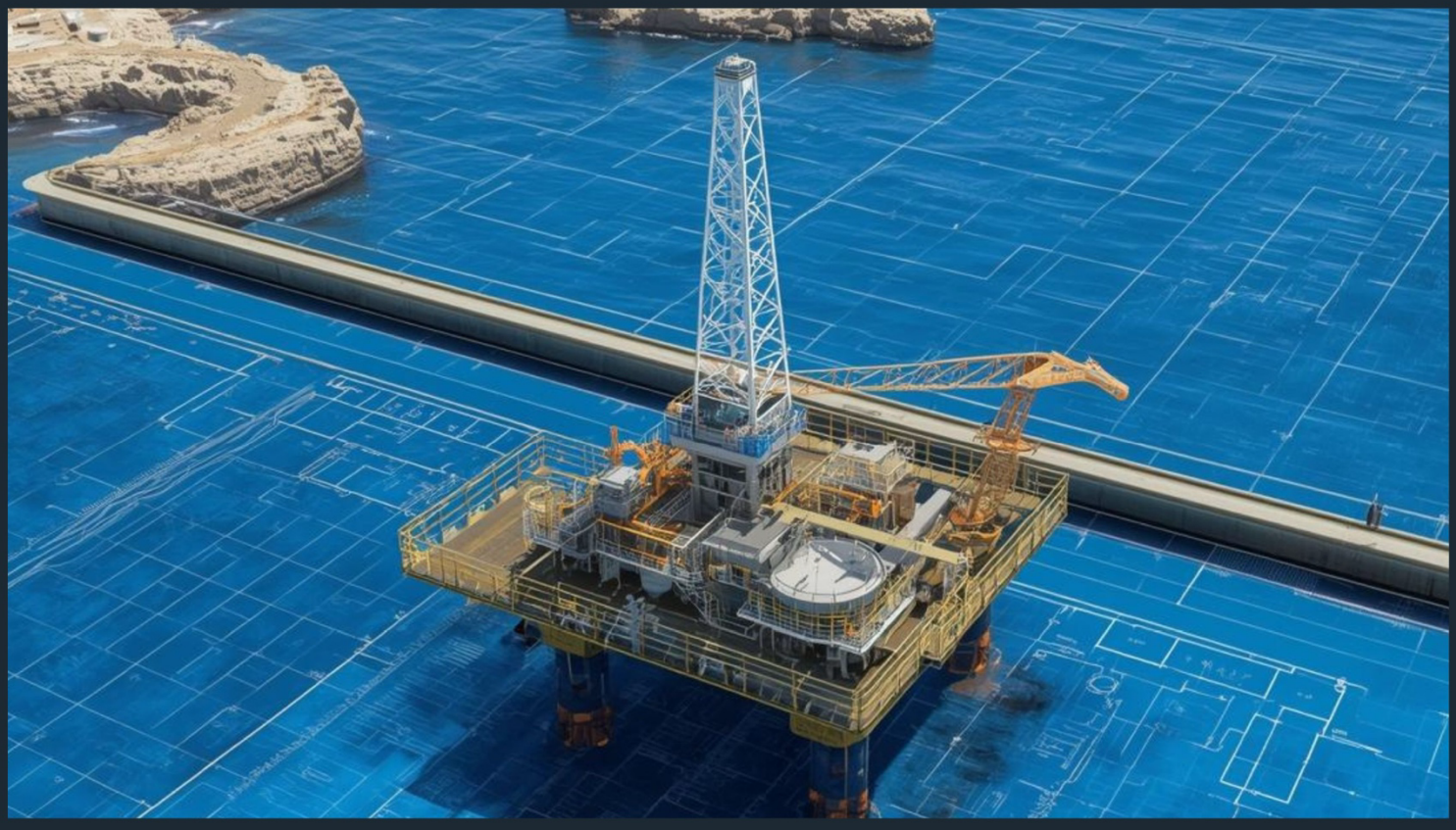


Introduction

The breakeven prices for feedgas and LNG from the Browse field were calculated using a Discounted Cash Flow method, using parameters detailed in this appendix.

The two key sources were:

- Acil Allen's Economic Impact Assessment (EIA) for the Browse and North West Shelf Extension, published in June 2019, based on data supplied by Woodside.
- KPMG's Independent Expert Report (IER) for the proposed merger between Woodside and BHP's petroleum business, published in April 2022.

All costs are expressed in real 2025 AU$.

This appendix shows cost assumptions for:

- The Browse project
- The North-West Shelf (NWS) extension
- The carbon capture and storage (CCS) facility planned for the Browse project
- Carbon offset costs associated with Browse reservoir emissions

Breakeven prices were then calculated for each component, in order to get a zero dollar net present value (NPV).

The feedgas cost (used to estimate the cost of domestic gas from Browse) was calculated as the breakeven price to cover the costs of the Browse project, the CCS project and the carbon offset costs.

The LNG cost was calculated as the feedgas cost plus the breakeven price to cover the cost of the NWS extension. It was assumed that previous costs associated with the NWS project were covered through its operations to date.

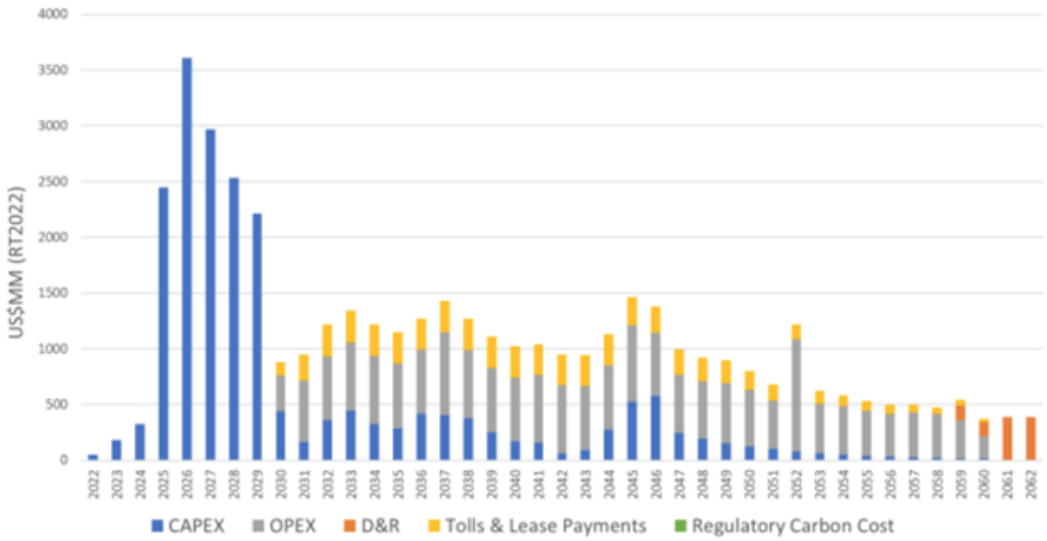
Browse project

Table 1: Key cost assumptions for the Browse project

Metric	Low	High	Source/rationale
Capex, AU$bn	33.2	42.4	**Total capex, low case:** • Budgeted capex (real 2018): 27.3 (EIA). • Escalation to 2025: 28% increase, based on the Australian Bureau of Statistics (ABS) Producer Price Index (PPI) for construction, "Other heavy and civil engineering construction Australia". • Cost overruns – Low case: 0%. • Development/operational capex profile: taken from the IER (Figure 1) for the development/operational period, adjusted to compress the development period from 2022-2029 to 2026-2029. First gas in 2030. • Decommissioning/rehabilitation capex: 5% of total capex, spread over five years from 2060. **Total capex, high case:** • Budgeted capex (real 2018): 27.3 (EIA). • Escalation to 2025: 28% increase, based on the ABS construction PPI for "Other heavy and civil engineering construction Australia". • Cost overruns – High case: 25%. This is a conservative assumption based on cost overruns from a number of recent LNG projects, including: 25% for US Golden Pass LNG, 30% for Plaquemines LNG, 35% on average during Australia's first LNG wave, 50% for Papua LNG, 73% for Canada's Woodfibre LNG. • Development/operational period capex profile: taken from the IER (Figure 1) for the development/operational period, shifting the development period to 2026-2031 and combining costs for 2022-2023 into 2026. First gas in 2032, representing a two-year delay compared with current timelines, but a slightly shorter development period than estimated in 2022. • Decommissioning/rehabilitation: 3% of total capex, spread over three years from 2062.
Average opex, AU$m per year	431	713	**Average annual opex, low case:** • Budgeted opex (real 2018): 375 (EIA) – taken as a pro-rata share of the total annual opex for Browse and NWS extension (493). • Escalation to 2025: 15% increase, based on the ABS Western Australian gas producers PPI. • Operational period from 2030 to 2060. **Average annual opex, high case:** • Opex estimate (real 2022 US$): 535 (IER). • Exchange rate: 1.33 AU$/US$ (IER). • No escalation. • Operational period from 2032 to 2062. **Opex profile:** • Ratio of opex in a given year/average opex calculated from IER (Figure 1).
Production, MMBoe	2770	2770	• Budgeted production: 2773 (EIA). • Production profile per year taken from IER (Figure 2) for low case, and delayed by two years for high case.

Weighted average cost of capital (WACC), %	12.2%	13.2%	• Calculated using the IER methodology (p. 247).
			• Equity beta, equity market risk premium, country risk/project specific risk factor and proportion of debt/equity in the capital mix from IER.
			• Updated risk free rate of return (based on IER methodology) to 4.53% based on the spot yield on US 20 year Treasury bonds at 28 October 2025.
			• Updated cost of debt to:
			  ○ Low case: 4%, based on a 3% cash rate and a 100 basis point credit spread.
			  ○ High case: 5.6%, based on a 3.6% cash rate (at 28 October 2025) and a 200 basis point credit spread.

Figure 1: Browse asset cost profile, US$m (real, 2022)



Source: KPMG, Independent Expert Report (2022)

Figure 2: Browse asset production profile, MMBoe

Source: KPMG, Independent Expert Report (2022)

NWS extension

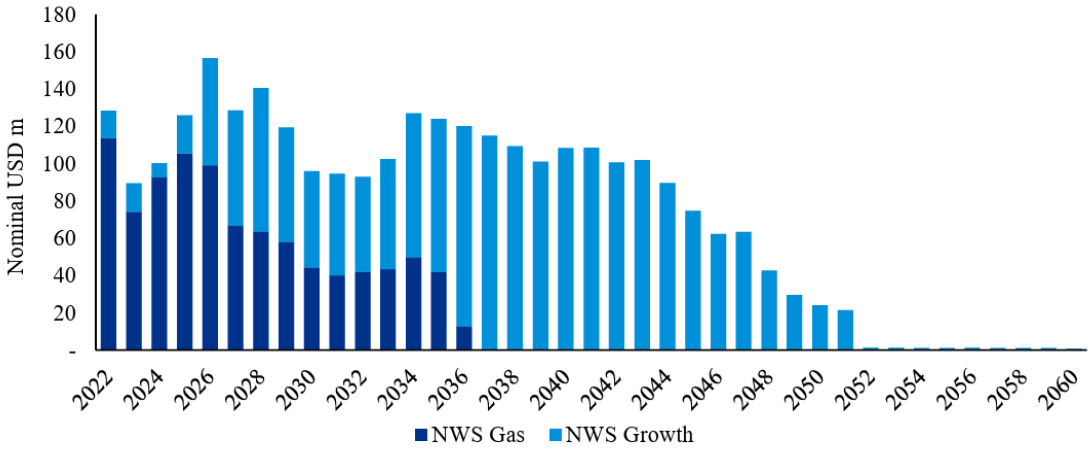
Table 2: Key cost assumptions for the North West Shelf extension

Metric	Low	High	Source/rationale
Capex, AU$bn	11.0	13.8	**Total capex, low case:** • Budgeted capex (real 2018): 8.6 (EIA). • Escalation to 2025: 28% increase, based on the ABS construction PPI for "Other heavy and civil engineering construction Australia". • Cost overruns – Low case: 0%. • Development/operational capex profile: taken from the IER (Figure 3) – computed by taking 100% of NWS growth capex, 25% of NWS gas capex between 2026-2030 and 50% of NWS gas capex after 2030. Adjusted to compress the development period from 2022-2029 to 2026-2029 (evenly spread). **Total capex, high case:** • Budgeted capex (real 2018): 8.6 (EIA). • Escalation to 2025: 28% increase, based on the ABS construction PPI for "Other heavy and civil engineering construction Australia". • Cost overruns – High case: 25%. This is a conservative assumption based on cost overruns from a number of recent LNG projects, including: 25% for US Golden Pass LNG, 30% for Plaquemines LNG, 35% on average during Australia's first LNG wave, 50% for Papua LNG, 73% for Canada Woodfibre LNG. • Development/operational capex profile: taken from the IER (Figure 3) – computed by taking 100% of NWS growth capex, 25% of NWS gas capex between 2026-2030 and 50% of NWS gas capex after 2030. Adjusted to compress capex from 2022-2025 over 2026-2027 (evenly spread), and shift capex from 2026-2030 to 2028-2032. **Decommissioning/rehabilitation:** • Assumes no cost for decommissioning and rehabilitation, with all costs covered through the initial NWS project.
Average opex, AU$m per year	136	272	**Average annual opex, low case:** • Budgeted opex (real 2018): 118 (EIA) – taken as a pro-rata share of the total annual opex for Browse and NWS extension (493). • Escalation to 2025: 15% increase, based on the ABS Western Australian gas producers PPI. **Average annual opex, high case:** • Double compared with low case data. • This is about half of the estimated total opex for the NWS project associated with the Browse project, according to IER, which would be 539 (real 2022 US$) – this was computed by taking 100% of NWS growth opex and 50% of NWS gas opex from 2030, and with a Woodside interest share of 16.67% in 2022 (Figure 4). **Opex profile:** • Ratio of opex in a given year/average opex calculated from IER (Figure 4) – computed by taking 100% of NWS growth opex and 50% of NWS gas opex from 2030.

LNG production, MMBoe	2021	2021	**Low case:** • Budgeted production: 2021 (EIA) • LNG production profile per year taken from IER, assumed to match total Browse production (Figure 2) **High case:** • Low case production, curtailed to reflect a 45% reduction in NWS capacity following the closure of Trains 1, 2, and 3 due to environmental requirements • Maximum annual production: 483 million MMBtu • Maximum annual production curtailment: 66 million MMBtu / 70 PJ • Total production curtailed: 699 million MMBtu (8% of total production) • Note: we have not reflected any impact on the Browse project production, assuming that the excess gas could instead be sold on the domestic market

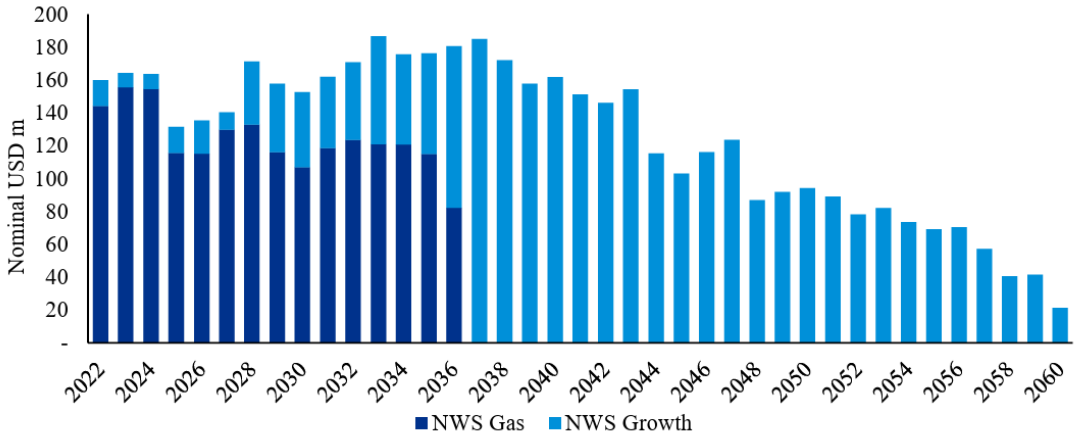
WACC, %	9.4%	10.8%	• Calculated using the IER methodology (p. 247)
			• Equity beta, equity market risk premium, country risk/project specific risk factor and proportion of debt/equity in the capital mix from IER.
			• Updated risk-free rate of return (based on IER methodology) to 4.53% based on the spot yield on US 20 year Treasury bonds at 28 October 2025.
			• Updated cost of debt to:
			  ○ Low case: 4%, based on a 3% cash rate and a 100 basis point credit spread.
			  ○ High case: 5.6%, based on a 3.6% cash rate (at 28 October 2025) and a 200 basis point credit spread.

Figure 3: NWS project forecast capital costs (Woodside interest)



Source: KPMG, Independent Expert Report (2022)

Figure 4: NWS project forecast operating costs (Woodside interest)



Source: KPMG, Independent Expert Report (2022)

CCS project

Table 3: Key cost assumptions for the CCS project

Metric	Low	High	Source/rationale
Capex, AU$bn	2.5	4.8	**Total capex, low case:** • Reference capex: 2.5, based on the initial capex for the Gorgon CCS project (spent by FY2019-20), approximated to be in 2018 real dollars and for a capacity of 4MtCO₂ a year. • Scale ratio: 75%, assuming the Browse CCS project would have a capacity of 3MtCO₂ a year and a similar complexity to the Gorgon CCS project. • Escalation to 2025: 28% increase, based on the ABS construction PPI for "Other heavy and civil engineering construction Australia". • Capex spread evenly between 2026 and 2029. • Rehabilitation/decommissioning: Additional 5% in capex, spread over five years from 2060. **Total capex, high case:** • Reference capex: 3.2, based on the total capex to date for the Gorgon CCS project, approximated to be in 2018 real dollars and for a capacity of 4MtCO₂ a year. • Scale ratio: 100%, assuming the Browse CCS project would have an equivalent capacity to the Gorgon project or additional complexity given its more remote location. • Escalation to 2025: 28% increase, based on the ABS construction PPI for "Other heavy and civil engineering construction Australia". • 80% capex spread evenly between 2026 and 2031. • 20% capex spread over subsequent eight years: 5% in 2032, 3% in 2033, 2% over 2034-2039. • Rehabilitation/decommissioning: Additional 15% in capex, spread over three years from 2062.

Average opex, AU$m per year	23	31	**Average annual opex, low case:** • Reference opex: 25.6 spent by the Gorgon CCS project in FY2020-21. • Escalation to 2025: 22% increase, based on the ABS Western Australian gas producers PPI. • Scale ratio: 75% as per above. **Average annual opex, high case:** • Reference opex: 25.6 spent by the Gorgon CCS project in financial year FY2020-21. • Escalation to 2025: 22% increase, based on the ABS Western Australian gas producers PPI. • Scale ratio: 100% as per above. **Opex profile:** • Same as Browse opex.
WACC, %	12.2 %	13.2 %	Same as Browse WACC.

Carbon offsets

The financial model only includes the cost of carbon offsets related to reservoir emissions, given the uncertainty on the emissions reduction requirements on other emissions sources and on the approach the project will take to meeting those requirements.

Table 4: Key cost assumptions for carbon offsets

Metric	Low	High	Source/rationale
Average annual emissions to be offset, $MtCO_2$	0.6	1.7	**Low case:** • Reservoir CO_2 emissions: 2.3, based on Woodside estimates (Table 7-5). • Reservoir CO_2 emissions captured by CCS: 74% of reservoir emissions, based on Woodside estimates of emissions with CCS (Table 10-1). **High case:** • Reservoir CO_2 emissions: 2.6, based on Woodside estimates (Table 7-5). • Reservoir CO_2 emissions captured by CCS: 33% of reservoir emissions, based on recent performance levels of the Gorgon CCS project. **Emissions profile:** • Assume emissions vary in line with production levels
Carbon price in 2030, $/$tCO_2$	40	99	• Low case: 40, similar to ACCU prices in recent years. • High case: 99, based on the estimated price of the cost containment measure in 2030.
Carbon price increase, % per annum (above inflation)	1%	3%	• Reference increase: 2% a year above the consumer price index for the government's cost containment measure. • Spread of 1% around the reference increase for the low and high cases.
WACC, %	12.2%	13.2%	Same as Browse WACC.

Resulting break-even prices

Metric	Low	Central	High
Domestic gas, AU$/GJ			
Browse project	5.5	6.9	8.2
CCS project	0.5	0.7	0.9
Carbon offsets	0.0	0.2	0.4
Total	6.1	7.8	9.5
LNG exports, US$/MMBtu			
Browse project	3.8	4.7	5.6
CCS project	0.3	0.5	0.6
Carbon offsets	0.0	0.2	0.3
NWS extension	1.1	1.5	1.8
Total	5.3	6.8	8.3

Shipping costs

Approximate shipping costs to North Asia are estimated based on relative shipping distances compared to a reference cost for the Gladstone-to-Tokyo route (medium-term average).

Route	Cost, US$/MMBtu	Distance, nautical miles
Reference cost: Gladstone to Japan (Tokyo)	1.14	3,860
Browse (Dampier) to Japan (Tokyo)	1.09	3,679
Browse (Dampier) to China (Shanghai)	0.98	3,306
Browse to North Asia	1.0	
Qatar to Japan (Tokyo)	1.92	6,512
Qatar to China (Shanghai)	1.73	5,845
Qatar to North Asia	1.8	