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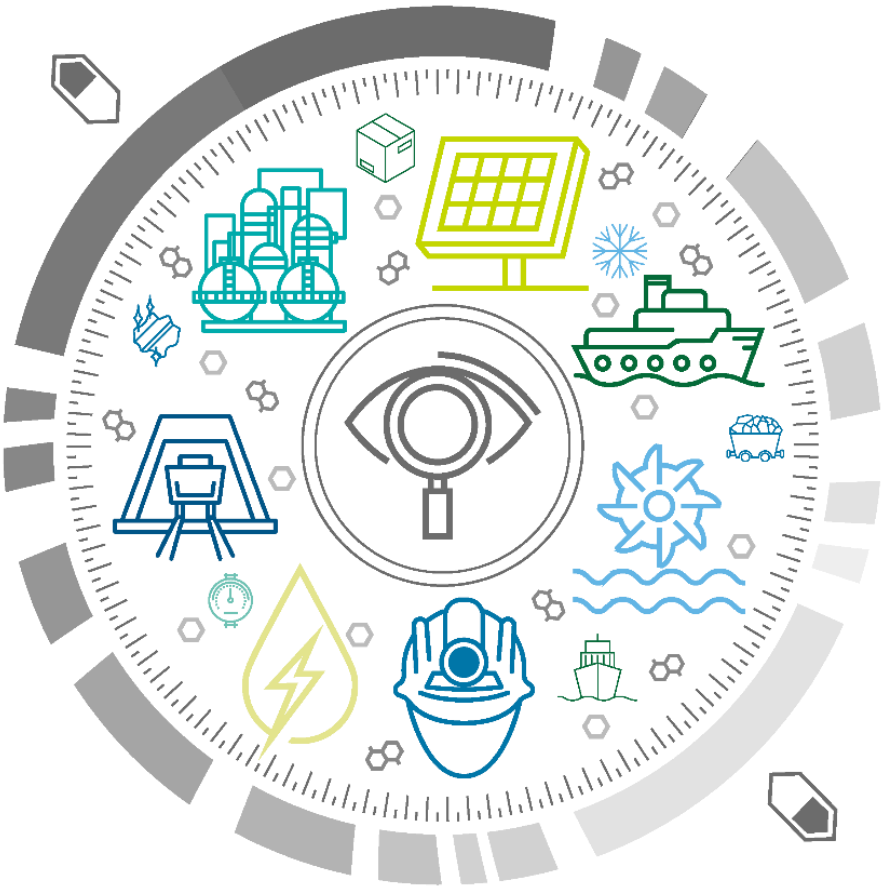

Report on the Development of the Beetaloo Sub-basin

For the Commonwealth Department of Industry, Science, Energy and Resources
November 2020

Partnering with:

CORE ENERGY & RESOURCES

EPC Technologies
Smarter Energy

Contents

Table of Figures

Table of Tables

Glossary

Abbreviations and Acronyms

ACCC	Australian Competition and Consumer Commission
ACCU	Australian Carbon Credit Units
ADGSM	Australian Domestic Gas Security Mechanism
AEMO	Australian Energy Market Operator
APLNG	Australia Pacific LNG
Bbl	Barrel of oil
BoE	Barrel of oil Equivalent
CAPEX	Capital Expenditure
CGE	Computable General Equilibrium
C&I	Commercial and Industrial
Contingent Resource	Quantities of petroleum which are estimated, on a given date, to be potentially recoverable from known accumulations, but which are not currently considered to be commercially recoverable
CORE	Core Energy & Resources
COVID-19	Coronavirus disease 2019
CSG	Coal Seam Gas
DLNG	Darwin LNG
East Coast	A region which includes NSW, VIC, QLD, SA, TAS and ACT
EPCT	EPC Technologies Pty Ltd
ERA	Environmental Risk Assessment
ERF	Emissions Reduction Fund
ESOO	Electricity Statement of Opportunities
EUR	Estimated Ultimate Recoverable (gas or oil resource)
FID	Final Investment Decision
Frac, Fracking, Fracture Stimulation	A well completion technique which involves injecting substances into a rock formation to create fractures which facilitate increased flow of hydrocarbons
GBA	Geological and Bioregional Assessment
GJ	Gigajoule
GLNG	Gladstone LNG
GMRG	Gas Market Reform Group

GPG	Gas Powered Generation
LGC	Large Scale Generation certificate
LNG	Liquified Natural Gas
LPG	Liquified Petroleum Gas
LRET	Large Scale Renewable Energy Target
MmBbl	Millions of Barrels of oil
MmBTU	One million British Thermal Units
MTPA	Million Tonnes per Annum
MW	Megawatts
NAIF	Northern Australia Infrastructure Fund
NGL	Non-Gas Liquid
NT	Northern Territory
NSW	New South Wales
PJ	Petajoule
PRMS	Petroleum Resource Management System
Prospective Resource	Quantities of petroleum which are estimated, on a given date, to be potentially recoverable from undiscovered accumulations
QCLNG	Queensland Curtis LNG
QLD	Queensland
QNI	Queensland- New South Wales Interconnector
Reserve	Quantities of petroleum which are anticipated to be commercially recovered from known accumulations from a given date forward
SA	South Australia
SIA	Social Impact Assessment
SREBA	Strategic Regional Environmental and Baseline Assessment
TAS	Tasmania
TJ	Terajoule
USE	Unserved energy
UOM	Unit of Measurement
VNI	Victoria- New South Wales Interconnector
VIC	Victoria
WA	Western Australia

1 Introduction and Executive Summary

1.1 Scope of report

Deloitte was engaged to provide the Commonwealth and Northern Territory Governments with an understanding of the steps needed to develop the Northern Territory's Beetaloo Sub-basin gas resources. The scope of this study was to analyse how the development of the Beetaloo Sub-basin can be accelerated, including identifying:

- the key steps that would need to be taken to develop Beetaloo Sub-basin gas resources most efficiently, including likely development pathways and critical paths (building on pre-existing analysis conducted for the NT government in 2019)
- general risks and constraints to development that would need to be overcome or mitigated in order for the development to occur, and specific risks and constraints to supplying gas from the Beetaloo Sub-basin to the East Coast domestic market;
- opportunities to proactively overcome these constraints, and other opportunities to accelerate, facilitate and/or influence development for domestic supply, including for a potential Northern Territory gas intensive manufacturing hub in Darwin;
- the economic, strategic and financial impact of gas development scenarios
- opportunities for governments, gas producers, industry, businesses and the community to realise the economic and non-economic benefits that the Beetaloo Sub-basin gas supply can deliver
- all relevant constraints, risks and opportunities including industry and investment, infrastructure, policy and planning, regulatory, information community, environment, transport and future demand (global and domestic)

Analysis of the prospectivity of the resource was outside of the scope of this project. Further, this report was focussed by the scope on methane opportunities in the relevant gas markets (and not on assessing opportunities in the liquids market).

The Commonwealth partnered with the Northern Territory Government for this project, as part of the MOU signed between the two governments in 2018 aimed at supporting the development of the NT onshore and offshore gas industry and gas-leveraged industries.

1.2 Summary of analysis and findings

The resource

Gas from the Beetaloo Sub-basin may provide an important source of supply for a Northern Territory manufacturing hub and the East Coast gas market which is facing a shortfall from 2024 onwards.[1] There is still a large degree of uncertainty as to the volumes and consistency of the gas and liquids in the basin, which is not likely to be settled until 2021 - 22. Initial results are promising; however the resource has a number of stages to progress through prior to commercial or investment decisions being taken. There is still a risk that the resource will not prove viable. To ensure success for the Beetaloo Sub-basin, the resource must be proven to a higher level of certainty as soon as safely possible, so that investment decisions can be made, and supply can meet the forecast window of demand.

East Coast gas market

The East Coast gas market continues to be exposed to LNG export markets, which directly impacts large commercial and industrial (C&I) customers for a number of reasons. As the ACCC has noted on numerous occasions, a high gas price is a significant issue for C&I consumers, and many have already explored options

[1] ACCC Gas Inquiry 2017 – 2025, January 2020 report, and AEMO GSOO, March 2020. The 'East Coast gas market' referenced in this report includes Queensland, South Australia, New South Wales, the Australian Capital Territory, Victoria and Tasmania. This is considered to be a separate market to the Northern Territory gas market, however the Northern Gas Pipeline does now provide a connection between the two. The Western Australian gas market is separate from the North and East Coast markets and is referred to as the West Coast gas market.

such as reducing gas demand or contracting directly with producers (instead of via a retailer) to reduce costs. An inability to secure contracts with appropriate price and non-price terms and conditions has contributed to the recent closure of chemical and manufacturing plants on the East Coast, and is a key factor for international manufacturers when deciding whether or not to invest on the East Coast or the NT.[2]

The recent fall in spot-gas prices could benefit C&I customers if they have the ability to engage in the spot market and ramp up production, or use lower prices as leverage in contract negotiations. However the ACCC Gas Inquiry report[3] highlights that many manufacturers or large users do not have the ability to utilise short-term low cost spot-gas. Spot-gas prices have fallen further in 2020, ranging between $4 - $6 on the East Coast.[4] Gas users interviewed in April 2020 indicated they were still not getting access to those prices on longer term contracts. This may change in coming months if the downward trend in spot prices continues or prices stay at this lower level for a longer period.

The Beetaloo Sub-Basin could serve as a long-term, secure source of supply to the constrained East Coast if: it can be developed in time, the price is competitive, and infrastructure and regulatory constraints can be overcome by industry with support from the NT and Commonwealth governments. This forms the basis of the recommendations below.

Gas scenarios and realisable market

This report has been informed by scenarios developed by KPMG, RISC and GHD in a report to the NT Government. The price and volume scenarios were modelled into the domestic and international gas market. The scenarios analysed are High, Medium and Low dry gas scenarios, and a Liquids scenario which involves both dry gas scenario, and a scenario where gas liquids are found with the dry gas. These are referred to as the 'dry gas' and 'liquids' scenarios.

In a mature production phase, the dry gas scenarios have been estimated to produce as follows:

- Low – 159 TJ/day or 58 PJ p/a
- Mid – 1,562 TJ/d or 569 PJ p/a
- High – 3,300 TJ/d or 1,200 PJ p/a

In a mature production phase, the liquids scenarios will produce as follows:

- Low – 192 TJ/day or 70 PJ p.a.
- Mid – 877 TJ/d or 320 PJ p.a.
- High –1663 TJ/d or 606 PJ p.a.

The findings indicate that:

- If Beetaloo gas is below AU$5/GJ ex field processing plant, it is highly probable that it will be a competitive source of supply into a market of greater than 10,000 PJ, over 20 years from 2030 – 2032 onwards;
- If the cost is above AU$6/GJ ex field processing plant, there is a risk that the realisable market would be below 5,000 PJ over 20 years; and
- If the cost is at or above AU$7/GJ ex field processing plant, it is unlikely that it will be a competitive source of supply without some form of government subsidy or incentive.

A liquids scenario could see ethane and liquids content support the overall economics of the development, where the cost of producing the liquids is a marginal cost additional to the cost of producing gas. The additional revenue stream from liquids production means that the cost of methane production could, in effect fall below AU$3-4 / GJ. This scenario would make Beetaloo gas the lowest cost in Australia and one of the lowest cost gas sources in the country and very competitive globally. In addition, the Beetaloo Sub-basin development could also help in reducing Australia's dependency on petroleum product imports.

[2] Including Remapak and Claypave in 2019, Kimberley-Clark closure of its western Sydney plant, and Norske Skog announcing the sale and closure of the Albury Mill (ACCC Gas Inquiry Report, and discussions with prospective investors via stakeholder engaement).
[3] This is also noted in the January 2020 ACCC Gas Inquiry report.
[4] AEMO Bulletin Board data (Brisbane, Sydney, Victoria, Adelaide, Wallumbilla).

If mostly dry gas is developed, it may be difficult for Beetaloo gas to compete with East Coast gas, and every effort will need to be made to reduce production costs. This could occur through the development of shared infrastructure and assessment of the best pipeline route to market in the High gas scenario. If liquids are also present and brought to market, the economics appear stronger, however actions will need to be taken by governments and industry in order to avoid inefficiencies in infrastructure development.

A number of high priority 'Tier 1', Short term infrastructure recommendations have been made for government, including a wastewater treatment plant, an assessment of a centralised common user gas processing hub, medical and health services assessment and facilitation or support for upgrades to relevant pipelines through the appraisal phase. The 'Tier 2' recommendations for the Medium term relate to rezoning key sites in surrounding towns to support new infrastructure, developing a shared user aerodrome upgrade and development of new landfill and waste stations.

Recent change in international and domestic gas price dynamics may affect availability of capital for Beetaloo developers

From March through to July 2020, oil and gas producers across Australia made announcements delaying investment in new onshore and offshore gas resources, indicating that these delays are due to the fall in gas price and COVID-19 pressures on availability of funding. In June and July 2020, three major global oil and gas producers announced impairments to their oil and gas producing and exploration assets, due to the crash in energy prices and the current economic climate.[5] On 15 July 2020, Origin Energy announced a write-down of the value of its business, due to lower oil and gas prices, and the progressive transition to a lower-carbon economy.[6] Santos announced that while production was up 4 per cent, sales revenue was down due to the realised oil price falling by 34% and 14% for LNG.[7] The September quarterly results for both companies included further revenue falls.[8]

On 9 October Origin Energy re-started Beetaloo exploration activities with commencing activities to drill the Kyalla well. Santos and Empire Energy also recommenced drilling activities at the Tanumbrini-1 and Carpentaria-1 wells in the Velkerri shale area.[9]

Building shared value and community

In order to develop shared value and secure the economic and non-economic benefits for the NT local community from the potentially huge expenditure associated with the development, it is important that developers:

- understand the local context and consider, inform and communicate with local stakeholders potentially impacted by the development;
- act to build legitimacy, credibility, trust and long term investment in people; and

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[5] BP highlight the propect of the pandemic having an enduring impact on the global economy, with potential for weaker energy demand for a sustained period, and a higher likelihood of acceleration of transition to lower carbon economies. The forecast for Brent futures redcced 27% and Henry Hub gas prices down 31% compared to reporting at the end of 2019 - https://www.bp.com/en/global/corporate/news-and-insights/press-releases/bp-revises-long-term-price-assumptions.html
Shell announced post-tax impairment charges in the range of $15 - $22 billion for Q2 2020, due to the impact of the coronavirus pandemic and the 'ongoing challenging commodity price environment'. Integrated gas assets were attributed with $8-9 billion of those impairments - https://www.shell.com/media/news-and-media-releases/2020/shell-second-quarter-2020-update-note.html
Woodside Petroleum announced a $4.37 billion post-tax impairment losses and provisions, with 80% of the oil and gas properties impairment losses due to the significant and immediate in oil and natural gas prices assumed to 2025. https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/071420-australias-woodside-takes-437-billion-impairment-loss-on-low-oil-and-gas-prices

[6] Origin Energy announcement of $1.2 billion downgrade, 15 July 2020, https://www.originenergy.com.au/about/investors-media/media-centre/origin_expects_to_recognise_non_cash_charges_in_fy2020.html

[7] Santos Half Yearly results, 20 August 2020 – at https://www.santos.com/news/2020-santos-half-year-results/

[8] For Origin Energy, in the integrated gas portfolio, revenue fell 39% during this quarter, driven by lower realised prices. Volumes declined by 4% with lower purchases and less volume taken from non-operated gas production due to lower overall demand. The September quarter realised gas price was A$6.52/ GJ which was down from $10.21/GJ in the prior quarter. The average contracted and spot LNG price was A$7.73/GJ and average domestic price of A$3.30/GJ (see https://www.originenergy.com.au/about/investors-media/reports-and-results/quarterly_report_september_2020.html). For Santos, revenue dropped nearly 23% due to declining gas prices, but production volumes were up 22% (see https://www.santos.com/news/2020-third-quarter-activities-report-2/)

[9] See ASX report, 26 October 2020 – at https://empireenergygroup.net/wp-content/uploads/20.10.26-Carpentaria-1-Drilling-Update-Drilling-Campaign-Complete.pdf

- consider broader socio economic factors when taking these actions.

Consistent with the Scientific Inquiry into Hydraulic Fracturing in the Northern Territory (NT Fracking Inquiry) report we have recommended that these factors should be considered through the strategic regional environmental baseline assessment (SREBA). This assessment will establish a baseline dataset and framework through which communities can gain confidence in the management of potentially significant social, economic and environmental implications.

The workforce and social engagement seen through the commissioning and construction of Jemena's Northern Gas Pipeline is a model for building capacity, skills and engagement in regional and remote communities.

Economic impacts

This report has utilised Computable General Equilibrium (CGE) modelling to assess the impacts of the development in the three dry gas scenarios and the Mid-liquids scenario. Of the three dry gas scenarios, at 2040 under the high scenario, there is projected to be an increase in Australia of around 6,000 FTE positions cumulatively, as compared to the base case (which is a no-development scenario). For the NT, the increase in Gross Regional Product is between $3.4 - 7 billion higher in the Medium and High gas scenarios, as compared to no development.

Summary - Development pathway requirements in the Short, Medium and Long Term

In the findings and recommendations overleaf, Short term, Medium term and Long term timeframes and activities are as follows:

Short term activities (2020 -2022)

- Further exploration and appraisal well data and evaluate results
- Seismic data and exploration well results to inform appraisal program
- Planning and approvals for infrastructure – including pipeline corridor feasibility study by NT government
- Operators will use existing infrastructure through this phase while assessing what may be required and sounding out prospective providers.

Medium term activities (2023 – 2025)

- Planning, approvals, engineering, procurement, drilling and completions, construction of facilities
- 20 – 40 wells per annum – appraisal and early production testing (pilot) wells
- 12 months flow data will confirm deliverability of resource.

Long term activities (2025 – 2040)

- Planning, approvals, engineering, procurement, drilling and completions, construction of facilities
- Drill 200 – 300 wells per year in ramp up phase (2025 – late 2020s)
- Plateau of production post ramp phase (late 2020s / early 2030s)
- 2040 onwards - 30 – 50 new wells per annum

Findings and recommendations

The key findings and recommendations are set out on the following pages, set over the short, medium and longer term.

Findings are highlighted in the report in an orange box.

Recommendations are given a corresponding letter (A, B, C…), and outlined in a blue box.

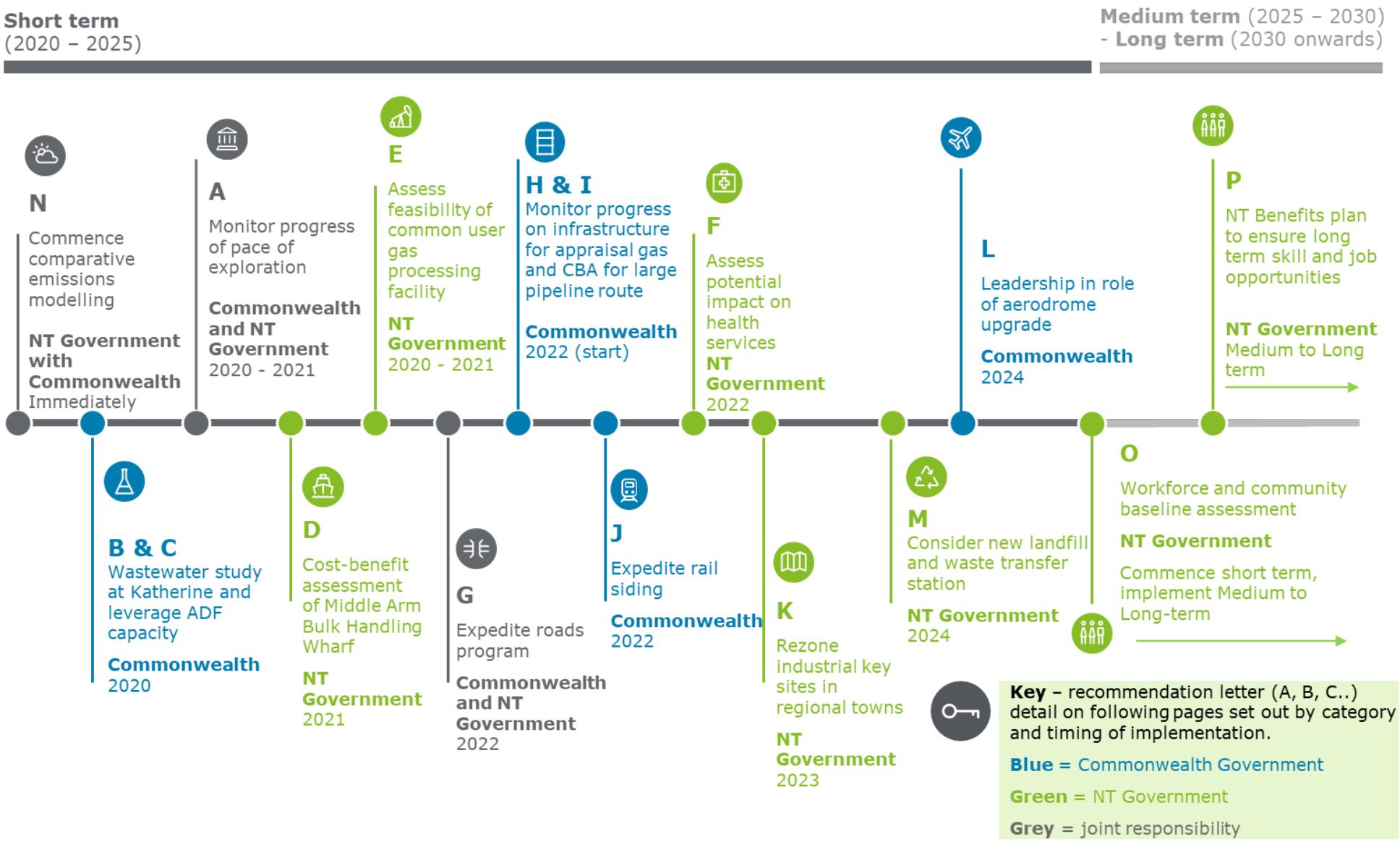
Since the commencement of this project in late February 2020, the world and oil and gas markets have changed dramatically due to the global pandemic and many producers have paused further resource development. These conditions have been considered through this report, but it should be noted that some of the data drawn from sources such as AEMO's March Gas Statement of Opportunities was pre-COVID-19.

Core Energy & Resources Pty Ltd (CORE) provided the gas market modelling to support this report, assessing future gas markets available for the supply of gas from the Beetaloo Sub-basin, assuming a commercial reserve is delineated, in accordance with estimates derived by RISC. EPC Technologies (EPCT) provided the various enabling, industry and service sector requirements for the effective development of the basin based on industry growth and development scenarios. We thank Paul Taliangis from CORE, and Martin Hay and Greg Denton from EPCT for their significant contribution to this report.

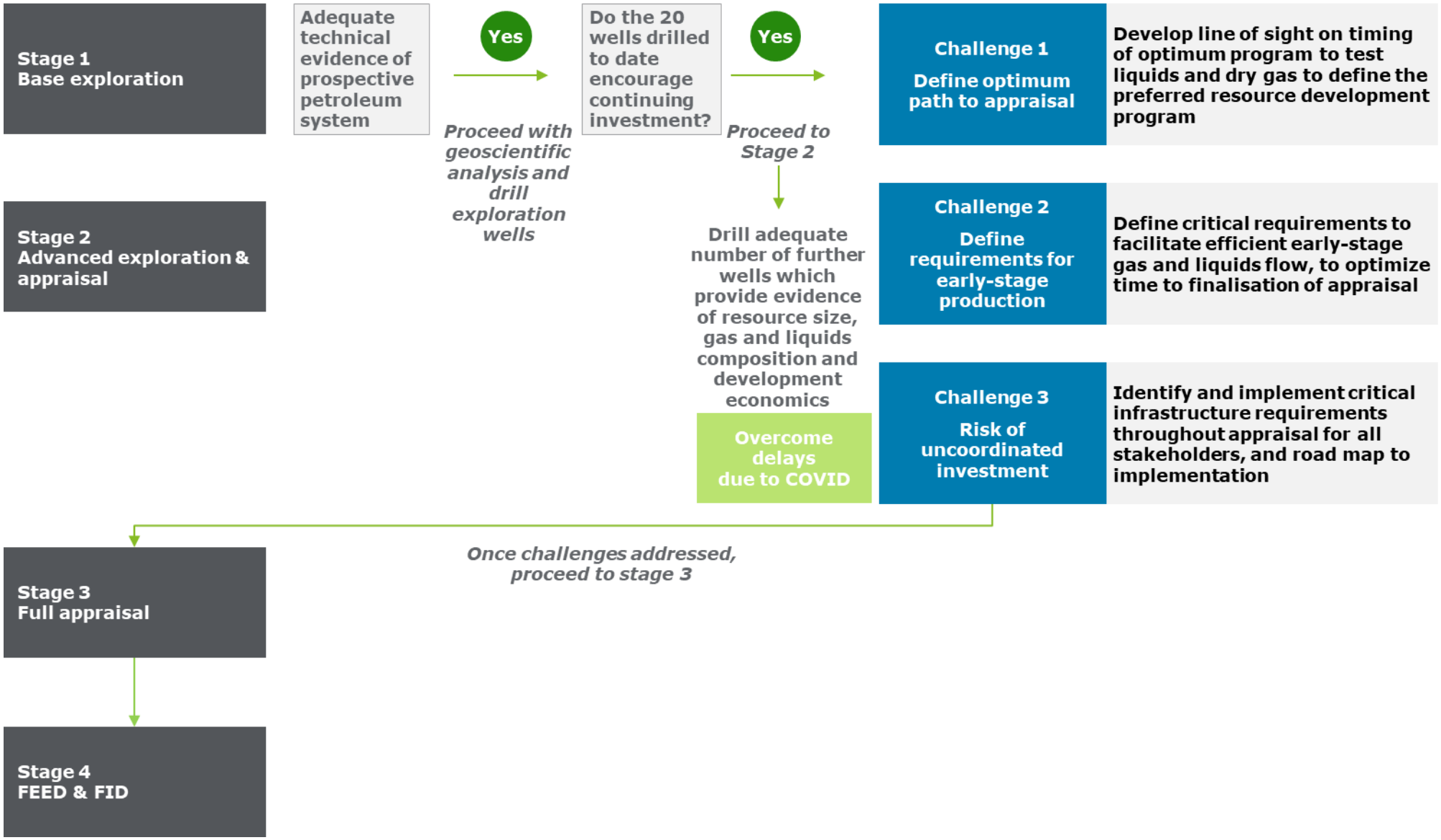
We also wish to thank the Commonwealth Department of Industry, Science, Energy and Resources Gas Policy team, as well as the Northern Territory government officials for their very valuable input and guidance through the project.

November 2020

Summary of recommendations – chronological, category and responsibility for implementation



Decision tree and path to FEED/ FID



Gas market – findings and recommendations

Findings:

There is still uncertainty relating to the Beetaloo Sub-Basin's gas resource type, volume and cost of production. This uncertainty needs to be resolved as soon as possible if the resource is to meet the demand windows, and this will occur via further exploration and appraisal drilling. A small variation in cost of production or processing may make the difference between the resource being competitive or not:

- If the Beetaloo cost, as derived via a breakeven gas cost, is below AU$5/GJ ex field processing plant, it is highly probable that it will be a competitive source of supply into a market of >10,000 PJ, over 20 years, commencing delivery from 2030-2032+.
- If the Beetaloo breakeven cost is above AU$6/GJ ex field processing plant, there is a risk that the realisable market will shrink to below 5,000 PJ over 20 years.
- If the Beetaloo breakeven cost is above AU$7/GJ, it is unlikely that it will be a competitive source of supply without government subsidy.
- A wet gas scenario could see ethane and liquids content in the production stream 'subsidise' gas in which case this could see methane prices fall below AU$3-4/ GJ – this needs extensive further drilling data and analysis.

As is set out in Chapter 4 (Resource development scenarios), there are potential competing sources of gas supply to Beetaloo Sub-basin gas. To meet the larger windows of gas demand at the right time and volumes, which is required given the likely gas volumes from the resource, the Beetaloo Sub-basin gas needs to be developed as quickly as possible. We have seen the two larger proponents announce delays on exploration drilling earlier in 2020, however activity did re-commence in late September - October 2020.

Recommendation:

Policy/regulation area	Recommendation	Responsible entity	Timeframe	Reference
Government support if further delays materialise	A. The Commonwealth and NT governments should continue to monitor progress of exploration activities, and if there appears to be material delays in exploration and appraisal activities, consider whether intervention or support may be warranted.	Commonwealth and NT Government	2020 - 2021	4.6

Infrastructure – findings and recommendations

Findings:

In Chapter 5, we set out the specific infrastructure needs over the Short, Medium and Long term. Ultimately, without intervention, even if the Beetaloo Sub-basin proves to be economic, the related infrastructure is at risk of being fragmented. This could lead to additional capital expenditures, yielding higher delivered gas prices. For example if a common shared gas processing infrastructure is not coordinated, but rather numerous facilities are built, it may increase costs in excess of AU$2 billion, and hence tariffs by approximately AU$0.50/GJ. This could be significant in a market which we have ascertained is very sensitive to price differences of $1/GJ.

We also set out the obstacles to infrastructure development which could be addressed by government involvement and identify where further data and analysis is required. The table below reference the findings and recommendations to the specific parts of the report.

Recommendations

Area	Recommendation	Responsible entity	When	Capital cost est ($M)[10]	Ref
Priority 1 Infrastructure					
Wastewater	B. Undertake a wastewater characterisation study (treatment selection) for a wastewater treatment facility to be located at Katherine. C. The Commonwealth should continue to leverage existing local ADF activity beyond wastewater to provide a continuous baseload of work to local trades.	Commonwealth (ADF)	2020	28	5.6.2.1
Ports	D. The NT Government should undertake a cost benefit assessment of the proposed Middle Arm Bulk Handling Wharf (2021).	NT Government	2021	0.5	5.6.1.2
Gas processing facility	E. NT Government to assess feasibility of a single, shared common user gas processing facility within the Beetaloo Sub-basin, to lower processed gas price.	NT Government	2021	0.5	5.5.1
Medical and Health	F. Ensure impact on local health services are assessed in Social Impact Assessment (SIA) Process and public private partnership (PPP) health clinics should be launched to support any increase in local population.	NT Government	2022	-	5.6.2.5
Roads	G. The Commonwealth and NT Governments should jointly expedite delivery of the proposed roads program (Stuart Hwy, Carpentaria Hwy, Western Creek Rd, Buchanan Hwy, Gorrie Dry Creek Rd). This includes the upgrade of highways and rural roads during the 2022-2026 period. These could be	Commonwealth and NT Government	2022 start	427	5.6.1.1

[10] Estimated total capital cost (public and private).

	funded through the existing Infrastructure Investment Programs including the Roads of Strategic Importance program, and that road user charges remain applicable.				
Oil and Gas Pipelines	H. The Commonwealth should monitor progress on the required upgrades to the AGP, NGP and CGP to evacuate **appraisal gas** to the East Coast market in the Medium term. I. The Commonwealth should undertake detailed comparative cost benefit analysis of the Beetaloo-Moomba/Ballera, and Beetaloo-Wallumbilla Gas Pipeline routes, if NAIF is approached to support a new gas pipeline in the Long term.	Commonwealth	2022 (start)	150	5.5.2.2
Priority 2 Infrastructure					
Rail	J. The Commonwealth should consider expediting the development of Daly Waters Rail Siding in collaboration with One Rail and NAIF.	Commonwealth	2022	0.3	5.6.1.3
Land	K. Rezone key sites in Daly Waters, Larrimah and Elliott.	NT Government	2023	2	5.7.2
Aerodrome	L. The Commonwealth should take a leadership role in the development of a shared user aerodrome upgrade to accept larger aircraft.	Commonwealth	2024	38	5.6.1.4
Waste Management	M. The NT Government should consider development of new landfill and waste transfer stations at Elliott, Daly Waters and Mataranka, and prepare landfill capacity assessments for listed waste at Katherine and Shoal Bay landfill sites.	NT Government	2024	4	5.6.2.2

Environment, community and social – findings and recommendations

Findings:

Chapter 7 examines some of the key climate, energy and environmental policy and regulation. Policy or regulation that inhibits or adds uncertainty to the development of the Beetaloo Sub-basin will limit the exploration and appraisal activity developers are willing to undertake. Regulatory approval processes at the Territory or Commonwealth level do add to the costs and timeframes of project development, with the aim of ensuring the project is safe and environmentally responsible. Feedback from stakeholders indicated that total well costs have increased in the order of millions already, with the partial implementation of the requirements of the NT Fracking Inquiry. The net-zero emissions recommendation was highlighted by many market participants and government stakeholders as requiring particular attention.

The development of the Beetaloo Sub-basin would have direct impacts on communities in the NT such as changes to demographics and social structures, environmental outcomes, changing infrastructure and service use and demands, and associated flow-on effects. In addition to local community impacts, broader social impacts are likely to occur across the NT, and will be dependent on the approach taken to develop the Beetaloo Sub-basin including the location of the workforce. The need for health services should be ascertained in the Short term, and medical infrastructure planned for and developed, to meet demand in the Medium to Long term.

Recommendations

Policy/regulation area	Recommendation	Responsible entity	Timeframe	Reference
Climate	N. Deloitte recommends that the NT Government undertake comparative emissions modelling for Scope 1 and 2 emissions from the Beetaloo Sub-basin. This may assist to comply with the NT Fracking Inquiry recommendation 9.8 regarding no net increase in life cycle GHG emissions. This study could be run in partnership with the Commonwealth Government.	NT Government, in partnership with the and Commonwealth Government	Immediately	7.2
Community Impacts	O. Commence workforce and community impacts baseline assessment. The potential impact of the development on local health services should be assessed through the Social Impact Assessment Process in order to inform demand for health clinics during the ramp and production phases.	NT Government	Short term	8
Community Impacts	P. As part of the NT Benefits Policy Plan for developers, ensure that skill development for local people that would support longer term job opportunities are included.	NT Government	Long term	8

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2 Background

2.1 Background to the commissioning of the report

This report was commissioned to provide the Commonwealth and Northern Territory (NT) Governments with an understanding of the steps that would need to be taken to develop the Beetaloo Sub-basin gas resources most efficiently, and the opportunities for and challenges to development and the domestic use of the gas.

The Beetaloo Sub-basin is located in a remote area of Australia, approximately 500 kilometres south of Darwin. The boundaries of the Sub-basin incorporate both the Katherine-Daly and Barkly Regions of the Northern Territory, close to a number of small towns with low residential populations, major highways and sites of cultural or conservational significance. The two regional centres of Katherine and Tennant Creek offer the closest locations with suitable infrastructure and service capabilities to support gas development activities such as rail, road and air transport; medical and education services; and a residential workforce and enabling economic capability.

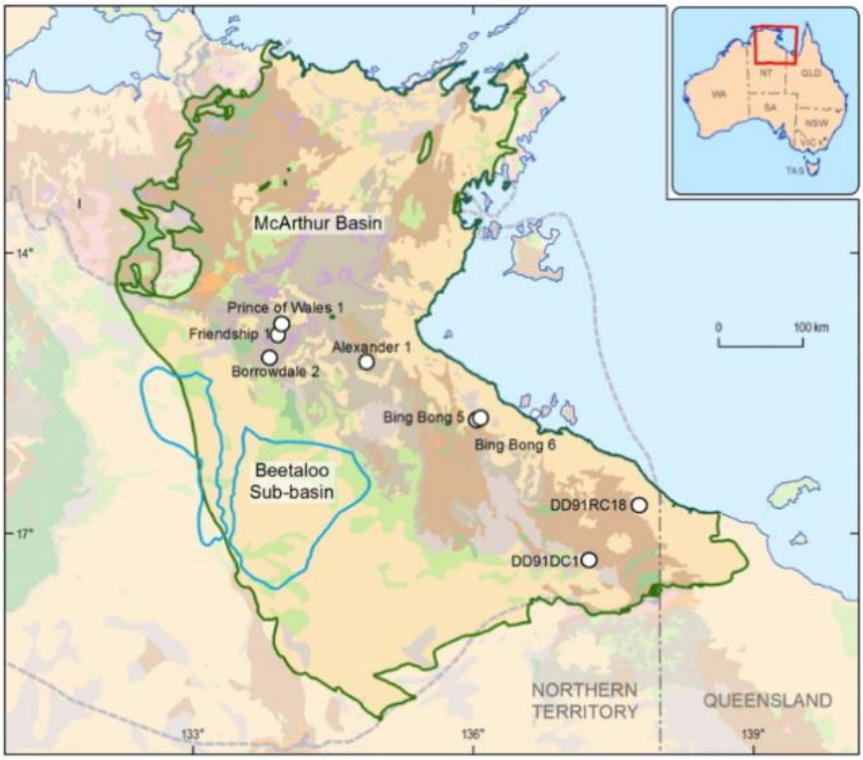
The Beetaloo Sub-basin lies within the larger McArthur Basin and spans approximately 30,000 square kilometres (estimated to be larger than any of the North West Shelf conventional gas resources and comparable with several of the major US shale gas basins). Due to its size, the Beetaloo Sub-basin has gained significant interest both politically and commercially. It is estimated that the Beetaloo Sub-basin contains approximately 70 per cent of the Territory's prospective shale gas resources and has been responsible for around 50 per cent of the total AU$505 million of exploration investment in the NT since 2010.[11]

Exploration for hydrocarbons in the greater McArthur Basin began in the 1960s, with the Beetaloo Sub-basin becoming the focus of exploration during the mid-2000s. To date significant exploration activity is underway with Santos, Origin Energy, Falcon Oil and Gas and Pangaea Resources all investigating key unconventional targets in the Beetaloo.[12] Initial results indicate the Beetaloo Sub-basin is prospective for petroleum and is estimated to contain significant technically recoverable gas and liquids resources, particularly from shale gas plays.[13] As a result of COVID-19 Origin Energy and Santos deferred some drilling activities in the Beetaloo Sub-basin in the first half of 2020, but recommenced in September 2020.

The development of the Beetaloo Sub-basin aligns with the Commonwealth Government's focus of delivering affordable, reliable gas to Australian households and businesses.[14] Additionally, it aligns with the NT Government's aspiration to develop its oil and gas sectors.

[11] *Scientific Inquiry into Hydraulic Fracturing in the Northern Territory* (Final Report, March 2018) < https://frackinginquiry.nt.gov.au/inquiry-reports?a=494286> ('*NT Fracking Inquiry*').
[12] Geological and environmental baseline assessment for the Beetaloo GBA region, Technical appendix – Petroleum prospectivity, 2020.
[13] Ibid.
[14] Josh Frydenberg MP and Angus Taylor MP, 'Government acts to deliver affordable, reliable gas' (Press Release, 2018) <https://www.minister.industry.gov.au/ministers/canavan/media-releases/government-acts-deliver-affordable-reliable-gas>.

Figure 1 - Location of the Beetaloo Sub-basin



Source: Northern Territory Geological Survey (2017)

Considering the size of the shale gas resource, there has been particular policy focus and heavy scrutiny in recent years on the sustainable development of this resource via hydraulic fracking techniques. Prior inquiries into hydraulic fracturing and relevant regulation in the NT happened in 2012 (Hunter Report) and 2014 (Hawke Report). These assessments were aimed at understanding the legislative and regulatory changes required to safely permit hydraulic fracturing practices forward. A key recommendation from the Hunter Report was that the NT government should prioritise the development and implementation of regulations under the *Petroleum Act 1984* (NT) (Petroleum Act) to ensure the protection of the environment.[15] The Hawke Report found that "…the environmental risks associated with hydraulic fracturing can be managed effectively subject to the creation of a robust regulatory system".[16] Figure 2 demonstrates major developments that have impacted the status of hydraulic fracking in the Northern Territory.

Figure 2 – The recent status of hydraulic fracking in the Northern Territory

Moratorium on Hydraulic Fracking (2016)

In September 2016, the Northern Territory Government implemented a moratorium on hydraulic fracturing of unconventional gas reservoirs.

The moratorium was set to remain in place at least until a comprehensive independent scientific inquiry into the impacts of hydraulic fracturing was completed.

The Scientific Inquiry into Hydraulic Fracking (2018)

In March 2018, the Scientific Inquiry into Hydraulic Fracturing final report was handed to the government and released to the public. This was a broad ranging inquiry involving significant community consultation.

The final report made no recommendation as to the retaining or lifting of the moratorium, as that was considered a matter for government. The Inquiry Panel made recommendations to mitigate to acceptable levels the identified risks associated with onshore shale gas development in the Northern Territory.

Lifting the Moratorium on Hydraulic Fracking (2018)

In April 2018, the Northern Territory Government announced it would support all 135 recommendations in the Scientific Inquiry into Hydraulic Fracking.

Additionally, it was announced the moratorium on hydraulic fracturing of onshore unconventional shale gas resources would be lifted.

[15] Hunter Report, Recommendation 16.
[16] Hawke Report

The Northern Territory Gas Strategy 2019 further outlines a vision that 'By 2030, the Territory is a world class gas production, manufacturing and services hub'. The strategy includes a five-point plan to achieve this vision.

Table 1 - Northern Territory Gas Strategy 2019 'five point plan'

1. Expand the world-scale Darwin LNG export hub	• Gas to expand the LNG hub could be sourced from offshore reserves, onshore gas developments, or both. • Land is secured for five additional trains – one at Darwin LNG and four at Ichthys LNG.
2. Grow the Northern Territory's service and supply industry	• The Territory Government has invested in dedicated infrastructure at the East Arm Logistics Precinct to support offshore projects. • Opportunities to support the offshore gas industry, including the operations of Darwin LNG, Ichthys LNG and Prelude FLNG. • Opportunities to support the development of the onshore industry, particularly shale gas. • The Territory Government is partnering with operators and the Industry Capability Network Northern Territory to identify opportunities to grow the local service and supply industry.
3. Establish gas-based processing and manufacturing	• Opportunities exist for methane-based products, energy intensive industries, condensate refining and production of ethane-based products. • Early opportunities from offshore gas fields lend themselves to methane-based products. • Future opportunities from onshore gas fields may expand opportunities to include ethane-based petrochemicals. • Land is available for gas-based manufacturing industries near existing LNG facilities.
4. Grow local research, innovation and training capacity	• Opportunities for strategic engagement and partnerships with Charles Darwin University, including through the North Australian Centre for Oil and Gas, the Advanced Manufacturing Alliance, and vocational education and training.
5. Contribute to Australia's energy security	• Proven large-scale offshore gas reserves and highly promising onshore resources of global significance can contribute to national energy security, and supply gas to Australia's east coast markets.

Source: Department of Trade, Business and Innovation

Additionally, the Northern Territory Economic Development Framework has identified the energy and minerals sector as one of the NT's five key economic growth sectors. With up to 500 trillion cubic feet (TCF) of prospective resources located in the NT, there is significant potential to develop the Beetaloo Sub-basin in line with these policy priorities. This is equivalent to over 527,000 PJ - 1,000 times the current annual domestic consumption in Australia or the amount of energy required to drive a car 483 million kilometres.

2.2 Approach and Chapters

This study includes several different work streams, with the major streams summarised below:

- Gas market background, Beetaloo Sub-basin context and lessons learnt from international and national jurisdictions. This work stream provides necessary context on the Australian gas and global LNG markets to understand the scale of opportunity available in the Beetaloo Sub-basin. Additionally, lessons learnt from other jurisdictions have influenced the recommendations put forward in this report. (Chapters 1 – 3 and Appendix C)
- Resource development scenarios and gas market outcomes. This work stream, informed by analysis from experts CORE, includes an independent assessment of future gas markets available for the supply of gas from the Beetaloo Sub-basin, assuming a commercial reserve is delineated, in accordance with estimates derived by resource experts RISC for a separate report to the NT Government. (Chapter 4)
  - The findings from this work stream have been utilised in the infrastructure requirements analysis and Computable General Equilibrium (CGE) modelling.
- Infrastructure requirements including regulatory impediments and further costings. This work details the infrastructure required and the associated costings to support the growth and development of the prospective gas fields in the Beetaloo Sub-basin. EPC Technologies led this work stream (Chapter 5).
- CGE modelling - This work stream used the Deloitte Access Economics' large scale, dynamic, multi-region, multi-commodity computable general equilibrium model to examine the impact the development of the Beetaloo Sub-basin would have on the broader economy (Chapter 6).
- Policy considerations are addressed in two chapters
  - Climate, energy and environment in Chapter 7 and
  - Local community and social policy considerations in Chapter 8 – this involved interviews and consultation with over 15 indigenous and community groups, as well as local councils and NT Government, and a desktop review of local, NT and Commonwealth Government policy.
- Stakeholder Engagement (All). This work stream gathered input via 1 hour verbal interviews from over 40 key market participants (market bodies, community, producers, pipeline owners, retailers and industrial customers) on the key issues affecting the Australian gas market, expected demand for Beetaloo Sub-basin gas, alternatives to the Beetaloo Sub-basin, potential barriers to development and potential benefits. The findings from the stakeholder engagement process have been utilised in all work streams listed above. (Appendix A)
- Appendix B includes the Methodology and CGE assumptions.
- Appendix C covers observations from international jurisdictions.
- A separate standalone chapter relating to Northern Territory opportunities is set out at Appendix D, (noting there is some duplication with other chapters).

2.3 Summary of previous analysis on the Beetaloo Sub-basin

This report aims to build on previous work and scenario analysis related to the development of the Beetaloo Sub-basin. The following table summarises other recent studies (completed and underway) related to the Beetaloo Sub-basin to provide additional context to this report.

Table 2 – Selection of previous analysis on Beetaloo Sub-basin

Report/analysis	Author(s)	Background	Related Deloitte report Chapter
Analysis of infrastructure and logistics requirements for the development of Onshore Oil and Gas Industry in the Northern Territory ('Infrastructure	KPMG, GHD, RISC	The NT Department of Trade, Business and Innovation commissioned a this study on the planning, infrastructure, logistics, workforce and service requirements for the development of an onshore oil and gas industry in the Beetaloo Sub-basin from exploration to production. The report found the feasibility of developing the Beetaloo Sub-basin is dependent on the presence of gas in sufficient amounts to be commercially attractive. This study showed that a per well recovery rate of 3-4 Bcf (liquids rich) and 5-6 Bcf (dry gas) is required for a viable development, whilst a breakeven gas price at Darwin of less than US$4.80/Mmbtu is anticipated to be required. This study also identified a number of recommendations relevant to common	The Infrastructure and Logistics Study provided input data into Chapter 5.

and Logistics Study') (2019)[17]		user infrastructure requirements for the development Beetaloo Sub-basin.	
Scientific Inquiry into Hydraulic Fracturing in the Northern Territory ('NT Fracking Inquiry') (2018)[18]	Inquiry Panel chaired by Hon. Justice Rachel Pepper	Presented to the NT Government in March 2018, the final report for the NT Fracking Inquiry evaluated a number of identified risks associated with any onshore shale gas development in the NT including but not limited to water, greenhouse gas emissions, public, social impacts, economic and aboriginal people and their culture. Based on this 135 recommendations were identified to mitigate to acceptable levels the identified risks associated with any onshore shale gas development in the Northern Territory, if the Government lifted the moratorium.	The NT Fracking Inquiry recommendations informed the emissions and offsets discussed in Chapter 7, as well as many parts of this report.
West - East Pipeline Pre-Feasibility Study (2018)[19]	ACIL Allen, GHD	This study considered the technical feasibility of a West-East Pipeline for increasing gas supply to East Coast from Western Australia. This report gave consideration of the Beetaloo, as a potential competing source of supply. A number of commercial and market risks associated with the proposed pipeline were identified. Overall this study showed that whilst a pipeline connecting Western Australian gas to the east coast is a technically feasible option it was not currently the best or most economical option.	The study provided background for Chapter 5.
North – South Pipeline Pre-Feasibility Study (2017)[20]	Port Jackson Partners	The purpose of this report was to advise the Commonwealth on the commercial and/or national interest case for investing in additional gas pipeline infrastructure connecting the NT's gas resources to Moomba in South Australia via a Southern NT Gas Pipeline (SNP). This study found that, even under the most optimistic scenarios, the SNP was unable to deliver competitive transmission costs to Moomba relative to alternative routes until the NT can ship at least 200TJ/day. The study also found that, considering these large volumes, there are alternative paths available to bring onshore NT gas to the East Coast, including expansion of the NGP.	The study provided background for Chapter 5
The Beetaloo Geological and Bioregional Assessment Stage 2 (Beetaloo GBA Stage 2) (2020)[21]	Bioregional Assessments	Stage 2 of the Beetaloo Geological and Bioregional Assessment (GBA) was released by the Australian Government Department of Agriculture, Water and the Environment on 15 May 2020. The purpose of these GBA's is to provide transparent scientific information to better understand the potential impacts of shale and tight gas development on water and the environment. Stage 2 investigated baseline data related to the Beetaloo Sub-basin. Stage 3 will include more detailed data and analysis of the actual impacts of gas exploration on the area and will therefore present a more complete picture of potential impacts on the Beetaloo region.	The Beetaloo GBA provides necessary background information for environmental considerations in section 7.4.

[17] KPMG, GHD, RISC, *Analysis of Infrastructure and Logistics Requirements for the Development of an Onshore Oil and Gas Industry in the Northern Territory* (Final Report, 2019) (*'Infrastructure and Logistics Study'*)
[18] *NT Fracking Inquiry* (above n 1).
[19] ACIL Allen, 'West-East Pipeline Pre- Feasibility Study' (Report, 2018) <https://www.energy.gov.au/sites/default/files/west-east_gas_pipeline_pre-feasibility_study_pdf_6805kb.pdf>.
[20] Port Jackson Partners, 'Investigating the case for a second gas pipeline between the NT and East Coast (Report, 2017) <https://www.energy.gov.au/sites/default/files/north-south_gas_pipeline_pre-feasibility_study_pdf_485kb.pdf>.
[21] Bioregional Assessments, *'Geological and environmental baseline assessment for the Beetaloo GBA region: Stage 2'* (Government Report, May 2020) <https://www.bioregionalassessments.gov.au/geological-and-bioregional-assessment-program> (*'Beetaloo GBA Stage 2 Report'*).

3 Australia's gas markets, COVID-19 impacts and the Beetaloo Sub-basin development

3.1 The current state of Australia's gas markets

Australia has three key gas markets: the East Coast domestic market, West Coast domestic market and the NT domestic market. These are generally considered to be separate markets, although the NT and East Coast domestic markets now have one connection via the Northern Gas Pipeline (NGP). These markets each have unique supply/demand dynamics and challenges which contribute to driving development of the Beetaloo Sub-basin.

Uncertainty facing Australia's gas markets was an issue raised by multiple stakeholders in the drafting of this report. Factors contributing to the uncertainty are the potential impact of import terminals, the unknowns surrounding the lifting of Victoria's moratorium on oil and gas exploration, and potential regulatory changes across all jurisdictions. The impact of COVID-19 is an additional factor contributing to the uncertainty around the future of all Australian gas markets.

3.1.1 East Coast domestic market

The East Coast domestic gas market has attracted the most attention from governments, industry and consumers in recent years with tightened supply leading to higher gas prices for households and businesses. Wholesale domestic gas prices increased threefold in nine years from approximately AU$3/GJ in 2011 to AU$9- $12/GJ in 2019.[22] Toward the end of 2019 and through 2020, spot-gas prices have trended downwards to around AU$4 - $6 in February to July 2020.

Commercial and industrial (C&I) customers were significantly affected at the peak of this 'gas crisis' in 2017 with quoted prices reaching as much as AU$22/GJ.[23] Although gas prices have decreased, the most recent ACCC Gas Inquiry interim report highlighted that C&I users continue to report difficult economic circumstances, with concerns chiefly revolving around gas prices, lack of supply and competition.[24]

Pre-COVID-19 there were a number of factors which have led to a tight supply and demand balance in the Australian domestic gas market, and significantly higher gas prices for some market participants on the East Coast compared to historical prices.

The key issues have been well documented:

- The recent supply crunch since 2017 has put upward pressure on energy prices.
- The cost of gas production on the East Coast has edged higher as cheaper supply sources, such as in the Gippsland Basin, are declining.
- Domestic gas prices are linked to international prices through the LNG export market (as most Australian LNG export contracts have oil-linked pricing). As oil prices rise, prices for Australian-produced contract and spot LNG also rises.
- There has historically been a lack of transparency around pricing and other non-price terms for both gas supply agreements and gas transport contracts.
- The market has been observed to be illiquid, limiting trades between participants.
- Pipeline operators have been observed by the ACCC exercising market power in their negotiations with gas shippers, in circumstances where there has been less capacity available.

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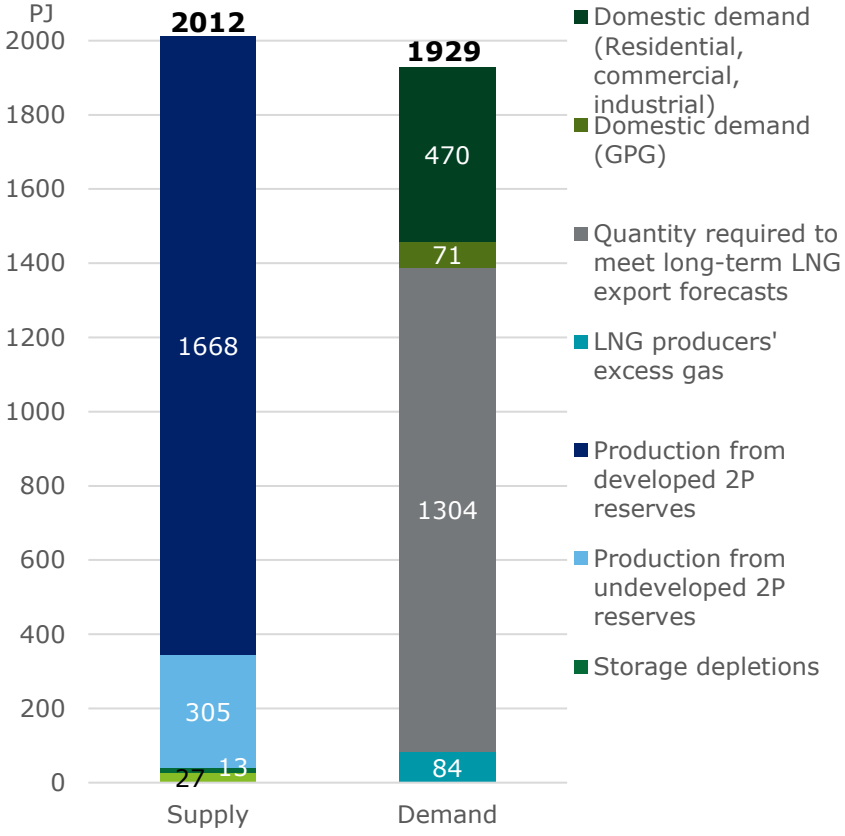
[22] Australian Competition & Consumer Commission, '*Gas Inquiry 2017 – 2025 Interim Report*' (Report, January 2020) 47<https://www.accc.gov.au/system/files/Gas per cent20inquiry per cent20- per cent20January per cent202020 per cent20interim per cent20report.pdf> ('*ACCC Interim Gas Report January 2020*').
[23] Ibid
[24] Ibid and ACCC Interim Gas Inquiry Report July 2020.

- The earlier than expected closure of the Hazelwood coal-fired generator leading to increased demand for gas-powered generation (GPG) in the NEM in 2017.[25]

These factors are relevant for why the Beetaloo Sub-basin can play a significant role in supplying the East Coast. The size of the gas resource is attractive given the current tight supply/demand balance on the East Coast, and also its potential to utilise liquids recovery to support the underlying economics of the development.

COVID-19 as well as geopolitical tensions has impacted the LNG market dramatically in the first half of 2020, leading to oversupply of LNG and very low prices. The most recent ACCC Gas Inquiry interim report was released in July 2020 and forecast that gas supply will meet forecast demand in the East Coast market throughout 2021. However, the demand assumptions were based on AEMO's March GSOO which included data that was largely pre-COVID-19. Actual gas supply and demand may be quite different, depending on how the pandemic plays out in 2021.

Table 3 - Forecast supply-demand balance in the East Coast Gas Market (including supply from the Northern Territory) for 2021



Source: ACCC Gas inquiry 2017-2025, July 2020 Interim report[26]

The ACCC considers that the longer-term supply outlook (2021-2031) for the East Coast market is still at risk of undersupply or shortfall unless:[27]

- More exploration and development occurs in the south to firm up 2P reserves
- Infrastructure (including pipelines) is built or augmented to allow greater flows of gas from Queensland and the NT to the south
- One or more liquefied natural gas (LNG) import terminals are developed.

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[25] Australian Competition & Consumer Commission, '*Gas Inquiry 2017 – 2025 Interim Report*' (Report, July 2018) < https://www.accc.gov.au/system/files/Gas%20inquiry%20July%202018%20interim%20report.pdf> ('*ACCC Interim Gas Report July 2018')*.

[26] Note – ACCC analysis of data obtained from gas producers as at May 2020 and of the domestic demand forecast (central scenario) from AEMO's March 2020 GSOO.

[27] '*ACCC Interim Gas Report*' (above n 9) <https://www.accc.gov.au/system/files/Gas per cent20inquiry per cent20January per cent202020 per cent20interim per cent20report.pdf>.

The majority of reserves and resources continue to be located in Queensland and held by LNG producers, which means the issue of sufficient pipeline capacity for gas to be transported south is very important, as described in the next section.

3.1.2 Gas network capacity constraints on the East Coast

The investment in gas pipelines over recent decades has resulted in an increasingly connected network across the East Coast and NT. Investments have included new pipelines, the expansion of existing pipelines and the conversion of existing pipelines into bi-directional pipelines. However, due to southern gas field production declining, the AEMO is forecasting that existing north-south gas pipelines will become constrained as more gas is needed to be sourced from Queensland from 2024.[28]

In order to address gas network capacity constraints between the north and south, APA has advised AEMO that if required, several pipelines could be upgraded:

- The South West Queensland Pipeline (SWQP) could provide an additional 130 TJ a day of capacity in both directions
- The Moomba-Sydney Pipeline (MSP) could provide an additional 230 TJ a day towards Sydney.
- The Victoria – New South Wales Interconnector could provide 125 TJ a day additional capacity towards Victoria.[29]

The increased capacity of SWQP to deliver gas to the south is partially driven by the introduction of the Northern Gas Pipeline (NGP) a 90TJ a day pipeline from Tennant Creek to Mt Isa which began commercial operation in 2019.[30] The ACCC has flagged the possibility that the capacity of the NGP will be expanded, to up to 256PJ p.a.[31] This would depend on the outcome of exploration results in the Beetaloo Sub-basin as currently the quantity of gas expected to flow into the East Coast Gas Market from the NT from 2021-2031 is lower than the capacity of the NGP.[32]

A potential solution to overcome gas network capacity constraints is the establishment of LNG import terminals. Currently, LNG import terminals in Australia are at various stages of development and serve as an alternative source of supply to future gas field developments such as the Beetaloo Sub-basin.

3.1.3 West Coast domestic market

In the West Coast gas market, industry and domestic users have experienced relatively lower prices for residential and industrial gas compared to the East Coast. Industrial gas prices in WA were significantly higher than other jurisdictions in 2009, but have since dropped to become lowest in Australia.[33]

WA has a Domestic Gas Reservation Policy aimed at achieving long-term supplies of natural gas for WA consumers. The policy seeks commitments for the equivalent of 15 per cent of gas available from new offshore gas developments for domestic use, as well as ensuring LNG projects develop and obtain access to the necessary infrastructure to meet their domestic commitments.[34] WA has a more stable supply of gas than the East Coast - in the latest Western Australia Gas Statement of Opportunities, AEMO forecasts that supply will exceed domestic demand over the outlook period.[35]

The WA example demonstrates the important role of new gas into an otherwise constrained market. The extra supply 'wedges' of approximately 10 – 20 per cent of market share has had a significant impact on the supply and demand balance and gas pricing in the domestic market, and has resulted in wholesale gas prices in WA at

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[28] Department of Industry, Science, Energy and Resources, '*ADGSM review*' (Government Policy Document, 2019) <https://www.industry.gov.au/sites/default/files/2020-01/review-of-the-australian-domestic-gas-security-mechanism-2019.pdf>.
[29] Australian Energy Market Operator, '*GSOO 2020*' (Report, March 2020) <https://www.aemo.com.au/-/media/files/gas/national_planning_and_forecasting/gsoo/2020/2020-gas-statement-of-opportunities.pdf?la=en>.
[30] Ibid.
[31] '*ACCC Interim Gas Report*' (above n 9).
[32] Ibid.
[33] Oakley Greenwood, '*Gas Price Trends Review*' (Report, 2017).
[34] Western Australia State Government, '*WA Domestic Gas Policy*' (Website) <https://www.jtsi.wa.gov.au/economic-development/economy/domestic-gas-policy>.
[35] Australian Energy Market Operator, '2019 Western Australia Gas Statement of Opportunities' (Report, December 2019) < https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/wa_gsoo/2019/wa-gas-statement-of-opportunities---december-2019.pdf?la=en>.

sitting around AU$5/GJ for the past four years.[36] Spot-gas has traded between AU$3 and $5 from 2015 – 2019.[37] The extra supply was coupled with the fact that the requirement to bring the extra domestic gas wedges into the market were relatively minor against the size of the new projects main scope and focus which was LNG export, chasing international prices. Liquids recovery was also an aid to underpin the economics of the overall development.

3.1.4 Northern Territory domestic market

In the NT, where the Beetaloo Sub-basin is located, domestic demand is relatively low at around 25 PJ/year, owing to the NT's population size. Industrial prices in the NT are supplied by Power and Water Corporation via the AGP to the government-owned generators, Territory Generation (T-Gen) its generation facilities in the major load centres. A proportion of gas produced in the NT is transported to East and South-east Australia for consumption in other jurisdictions or exports. Darwin port also has 12.6 Mtpa of LNG export capacity through two projects and three LNG trains.

In terms of current NT supply to the East Coast, the Northern Gas Pipeline began delivering gas to Queensland in 2019, and has announced plans to increase the capacity eight-fold. Jemena is evaluating a 1000 km extension to supply Ergon Energy's gas powered Barcaldine power station near Longreach in Queensland. In the fourth quarter of 2019, pipeline deliveries to the eastern market averaged around 72 TJ/day.[38]

3.1.5 Gas moratoria, bans and incentive programs in the States and Territories

Around Australia, there are several bans on exploration and development of both conventional and unconventional gas which has impacted new gas supply, especially in the southern states. New South Wales,[39] Victoria,[40] Tasmania[41] and South Australia[42] and WA[43] have all implemented either bans of gas exploration and/or approvals of new exploration licences for all types of unconventional onshore gas developments 2014. Victoria's moratoria on conventional onshore conventional gas exploration and development is due to lift from July 2021.

The Northern Territory Government's four–year (2018-2022) "Resourcing the Territory" initiative includes a range of pre-competitive geoscience, investment attraction and exploration stimulus programs designed to support resources exploration, including for gas and liquids. It has included major geoscience programs to define the nature and hydrocarbon potential of the Beetaloo Sub-basin and other northern Australian basins with high shale gas potential. It follows the $23.8 million Creating Opportunities for Resource Exploration (CORE) initiative (2014-2018) which included $2 million per year to assess shale gas potential in the Northern Territory.

Western Australia has a gas reservation policy which dictates that 15 per cent of gas volumes intended for export must be made available for Western Australian domestic consumers. Queensland also has a reservation policy, although it operates differently from Western Australia. In Queensland, a portion of new acreage is released on the condition that the gas will be supplied to domestic users. Permits are bid for on this understanding, rather than a post-fact or retrospective application. Where producers hold such permits, the gas developed from that plot of land must not supply gas produced from it to the export market. These requirements are known as "Australian Market Supply Conditions" and were introduced in 2011,[44] although land with this condition was only released in 2017. 11 areas are currently active, totalling more than 8,500 km^2 of land.[45]

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[36] Oakley Greenwood Gas Price Trends Review, 2018, and WA GSOO 2019, page 62.
[37] WA GSOO, page 61.
[38] AER State of the Energy Market, 2020, page 209.
[39] New South Wales State Government, '*NSW Gas Plan*' (Government Policy Document, 2015) < https://www.resourcesandenergy.nsw.gov.au/__data/assets/pdf_file/0005/534830/NSW-Gas-Plan.pdf>.
[40] Victorian State Government, '*Onshore Gas – Community Information*' (Government Policy Document, 2017) <http://onshoregas.vic.gov.au/#>.
[41] Tasmanian State Government, '*Tasmanian Government Policy on Hydraulic Fracturing*' (Government Policy Document, 2014) <http://www.mrt.tas.gov.au/portal/tasmanian-government-policy-statement-on-hydraulic-fracturing-fracking-2018>.
[42] South Australian State Government, '*10 Year Moratorium on Fracture Stimulation in the Limestone Coast Region of South Australia*' (Government Policy Document, 2018) <http://energymining.sa.gov.au/petroleum/latest_updates/10_year_moratorium_on_fracture_stimulation_in_limestone_coast_region_sa>.
[43] Western Australian government announcement - https://www.mediastatements.wa.gov.au/Pages/McGowan/2019/09/Hydraulic-fracturing-remains-banned-on-98-per-cent-of-WA.aspx
[44] Greig J, '*Reserving gas for domestic markets – Queensland's next step*' (Article, 2018).
[45] Queensland Department of Natural Resources, Mines and Energy, '*Review of domestic gas pilot program*' (Government Policy Review, 2018).

South Australia implemented the Plan for Accelerating Exploration (PACE) Initiative, with a $10.2 million expansion to the $30.9 million already included in the 2004 initiative.[46] The initiative aims to advance resource exploration and mining developments in South Australia. In 2017, South Australia handed out $24 million for five gas exploration grants under the PACE initiative and the view of the market is that this has been very effective in unlocking marginal development activity within SA.[47]

3.1.6 The rise of LNG exports in Australia

Since LNG exports from WA commenced in 1989 and from Darwin in 2006, and the Queensland Liquefied Natural Gas (LNG) export industry began in December 2014 (QCLNG), Australia has become one of the most influential LNG exporters in the world. In 2019, Australia moved to the top position in world LNG exporters on an annual basis, overtaking Qatar to ship 77.5 million tonnes with an export value of $49 billion.[48]

Although exposure to international markets has led to significant growth in export earnings it has dramatically changed the supply and demand balance in the domestic market. According to AEMO, export demand for LNG from the East Coast will continue to dominate annual gas consumption out to 2038, representing approximately 70 per cent of the total, as highlighted in the table below:

Table 4 - Percentage split of gas consumption by sector – East Coast and NT

Region	Residential /commercial	Industrial	Gas-powered electricity generation	LNG export	Gas consumption
Queensland	<1 per cent	7 per cent	2 per cent	90 per cent	1,380 PJ
New South Wales	42 per cent	48 per cent	10 per cent	0	116 PJ
Northern Territory	<1 per cent	<1 per cent	3 per cent	97 per cent	704 PJ
South Australia	12 per cent	27 per cent	62 per cent	0 per cent	93 PJ
Tasmania	8 per cent	51 per cent	41 per cent	0 per cent	10 PJ
Victoria	58 per cent	31 per cent	11 per cent	0 per cent	212 PJ
Total	**10 per cent**	**14 per cent**	**7 per cent**	**68 per cent**	**1,811 PJ**

Source: AEMO GSOO 2019

For reference, WA has the highest natural gas consumption of all Australian states, consuming 644 PJ of gas in 2017-18. Gas consumption is recorded by AEMO slightly differently in WA, but there is quite an even split between GPG (44 per cent), Mining (28 per cent) and the Industrial and minerals processing sector (25 per cent) with residential and commercial using two per cent.[49]

The Northern Territory currently uses approximately 24 PJ of gas, almost 100 per cent of which is used for electricity generation. Existing Darwin-based LNG export totals approximately 680 PJ/ per annum:

- 500 PJ Ichthys
- 180 PJ DLNG

Increasing LNG exports has had an impact upon the cost of gas for residential, commercial & industrial (C&I) and gas-powered electricity generation on the East Coast by changing the market dynamics. The large quantities of gas being exported means the domestic price of gas is now linked to and influenced by the international

[46] DEM, 'PACT 2020', *DEM.*

[47] Australian Energy Council, ' Review of South Australia's Energy Plans' (February 2018) < https://www.energycouncil.com.au/media/11669/20180206-sa-energy-plan-review-final.pdf >

[48] Office of the Chief Economist, '*Resources and Energy Quarterly*' (Report, December 2019).

[49] AEMO WA GSOO, page 17.

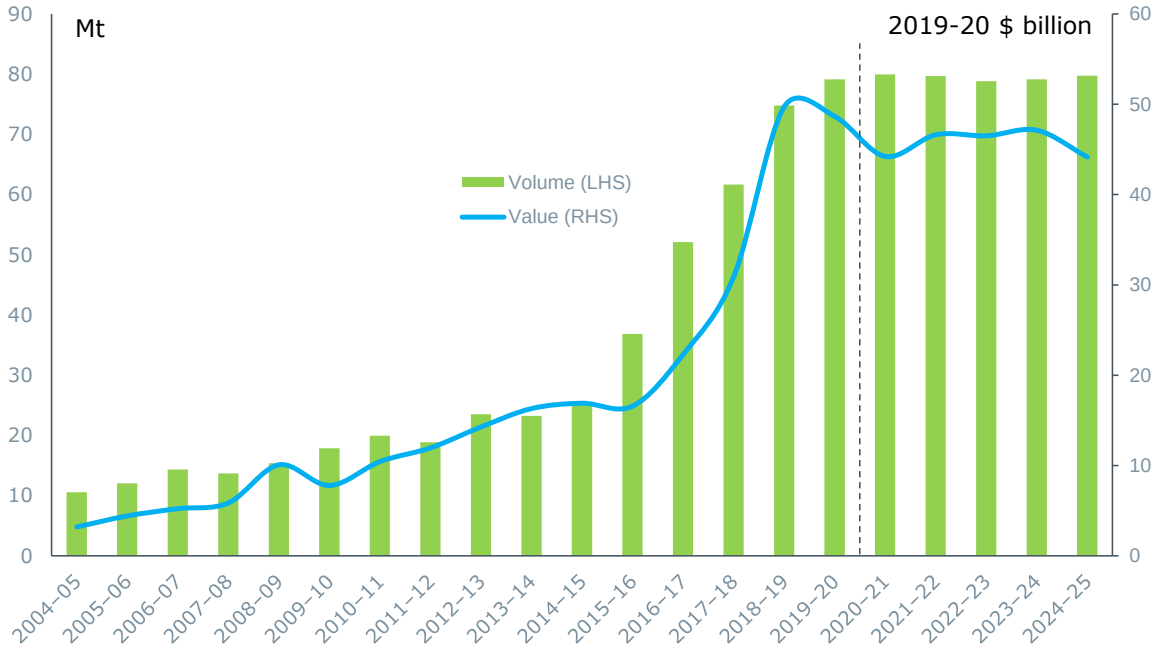
commodity market price. Of the gas sold to the LNG export market, around 75 – 80 per cent is sold on long term contracts, linked to the oil price, with the remainder sold on the international spot market.

In March 2020, as the COVID-19 situation was unfolding, the federal Office of the Chief Economist (OCE) of the Department of Industry, Science, Energy and Resources provided a view that Australian LNG export prices would be expected to decline in 2020, before a later rise and small drop in 2024-25, correlating to forecast oil prices. In the June 2020 outlook these forecasts were downgraded further – shown on the graphs below.

As noted above, some producers have downgraded their gas assets over June, July and August 2020, due to lower oil and gas price forecasts for 2020 – 2024.

Total Australian LNG export volumes (i.e. via East Coast, West Coast and Northern Territory) were forecast to rise from 75 million tonnes in 2018-19 to 81 million tonnes in 2020-21 as the Prelude and Ichthys projects ramp up. OCE forecasts a step down to 80 million tonnes by 2024 – 25.

Table 5 - Australia's LNG exports



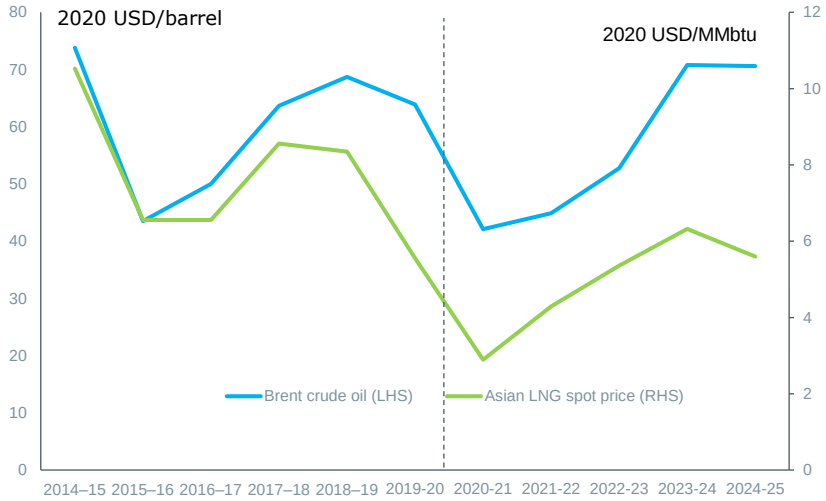
Source: Office of the Chief Economist, Resources and Energy Outlook, June 2020

The OCE's view of the Beetaloo Sub-basin was that given exploration is just commencing, it remains uncertain what proportion of the resource will be technologically and economically viable to extract, and we agree with this view.[50]

As explained further in Chapter 4, due to the low LNG spot price and for those low oil linked contract prices, prospective Beetaloo producers may be facing financial pressures and constraints on planned or future exploration and appraisal investment.

[50] Ibid.

Table 6 – Asian LNG spot price and Brent crude oil prices (2014 – forecast to 2024)



Source: Office of the Chief Economist, Resources and Energy Outlook, June 2020

Note: Forecasts for 2022-23 onwards are from the March publication as the June publication did not include these two years.

3.1.7 Lessons from the Australian LNG Experience

Australia has achieved significant LNG development over the last decade. The scale of this build out has identified leading practises and opportunities for improvement that can be used to ensure efficiency in future LNG developments. The following represent key 'lessons learnt' that should be considered in the development of the Beetaloo Sub-basin:

- ***Managing uncertainty/disruption:*** The LNG market is a dynamic landscape with competitors both domestically and internationally constantly evolving. For example, the USA quickly went from being an identified LNG customer to a major competitor for Australia.
- ***Collaborate to cut costs****:* Collaboration at the outset of many Australian LNG export projects was minimal. This was in part due to the fact that different projects were formulating early program development plans and collaborating at an early stage is challenging. Nevertheless, an outcome of this was a duplication or triplication of infrastructure including pipelines and liquefaction plant. The consequences of several independent projects prosecuting a similar resource in parallel and a failure to collaborate in some instances led to a constrained environment creating competition for scarce resources (infrastructure, suppliers and skilled employees) which significantly increased costs. Developers in Australia could have shared more infrastructure, thus minimising costs and better positioning themselves to compete more effectively with the rest of the world.
- ***Address concerns****:* Need to address health, safety and environmental concerns as early as possible and where possible over and above government standards. Historically, in Australia successful environmental campaigns have 'locked the gate' on many unconventional resources and made it more difficult to access reserves required to meet contract demand.
- ***Ensuring security of supply and surety of demand:*** World-first unconventional-to-LNG projects were based on uncertain resources which have proven costly and more difficult to access than previously thought.
- ***Fostering Innovation*****:** Industry-leading innovations in infrastructure design, process improvement, and water stewardship, among others, have paved the way for further development around the world.
- ***Adopt a long term, collaborative approach to working with local communities****:* The industry could have reduced regulatory burden, accelerated project delivery, and minimised non-recoverable costs by taking a longer-term, collaborative approach to working with local communities. For the development of the Beetaloo Sub-basin, it is essential the Indigenous population is consulted and engaged as much as possible in key decision making.
- ***Manage contractors more effectively****:* a high degree of rigour is required in defining the project scope tightly, processing change requests quickly, and resolving discrepancies earlier before costs become extreme and the schedule drags out so long. If they are to control costs, LNG developers must have active managerial teams, sufficient administrative staff, and remediation processes in place to manage contractors with a high degree of diligence.

The legacy of these developments, particularly with the Queensland unconventional onshore to LNG export projects, is that Australia now holds recent mega project experience. Learnings from execution of these major projects should be deep seated across both major project operators (which includes the large operators in the Beetaloo Sub-basin), key suppliers and service companies.

3.2 Linkage of the Australian market to international LNG markets and the impact of COVID-19

International LNG trade reached record levels in 2019, as major exporting markets such as the USA, Australia and Russia continued to add significant capacity whilst Europe greatly increased imports.[51] Australia took the position as the largest exporter in 2019, closely followed by Qatar. However, in 2020 International LNG markets have entered unprecedented territory due to COVID-19 and global oil price shocks. The pandemic curtailed demand for natural gas, furthering the observed supply glut (including a large amount of LNG which was held in floating storage).

3.2.1 Recent impact of COVID-19 on demand for Australian gas - domestically and internationally

Australia has not faced a health or economic crisis of the magnitude of COVID-19 for generations. To date, the global pandemic has resulted in the enforcement of lockdowns of varying degrees for the population. Although the outlook is subject to substantially wide bounds, the economic implications are predicted to be severe.

There remains uncertainty surrounding how quickly the Australian economy and global economies will be able to return to business as usual. This study commenced in February 2020 and the domestic and international gas market have changed dramatically in the intervening months. The short and longer policy and economic impacts on the development of the Beetaloo Sub-basin are not yet clear, but could be significant.

3.2.2 COVID-19 related drilling delays

Preliminary announcements regarding suspension of exploration activities in the Northern Territory include:

- On 26 March, Origin Energy placed its Beetaloo drilling and exploration activities on hold until at least the second half of the 2020 calendar year[52]
- On 3 April, Santos announced at its AGM that that it was delaying plans to drill two unconventional exploration wells in the NT until beyond 2020 due to spending reductions. Santos also announced that testing of the existing Tanumbirini-1 well in Beetaloo has been halted and the well shut to protect the region from a potential COVID-19 outbreak.[53]

The decision to pause operations due to the potential health risk to local NT residents posed by COVID-19 and workers travelling to the site from other parts of Australia was understandable. For the purpose of the outlook of the Beetaloo Sub-basin development, delays to exploration activities push back the timeframes for later production, and therefore present a risk to the window of success for the project. As is described below, timing is of the essence for the Beetaloo Sub-basin development and if supply does not meet the demand windows, other potential competing sources of supply may push Beetaloo gas out of the market. In our stakeholder engagement, some Beetaloo producers indicated that they thought the health risk related delays, as well as the potential impacts from COVID-19 on availability of finance would lead to a delay of between 1-2 years, as compared to the view at the end of 2019.

Following the suspension announcements of Origin and Santos, Empire Energy who have Kyalla and Velkerrie shales towards Borroloola, indicated they would continue exploration program as scheduled in second half 2020 – subject to ongoing COVID-related risk assessments. This activity has now recommenced, meaning that there is a reduced risk of delay to the overall development, as compared to the first half of 2020.

3.2.3 Recent gas price or finance-related exploration delays in Australia

The outbreak of COVID-19 has had a significant impact on the broader Australian domestic and international economic outlook. Impacts in the gas market can be seen with the announcement by ExxonMobil on 15 April 2020 that it has halted planned offshore drilling in the Bass Strait for the remainder of 2020 as a result of COVID-19. On the same day, Woodside cancelled part of a seismic survey offshore Western Australia which aimed to

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[51] International Gas Union, '*2020 World LNG Report*' (Report, 2020) <https://www.igu.org/sites/default/files/node-document-field_file/2020%20World%20LNG%20Report.pdf>.
[52] Origin, '*Beetaloo Exploration Program update*' (Company Announcement, 26 March 2020) <https://www.originenergy.com.au/about/investors-media/media-centre/beetaloo_exploration_program_update1.html>.
[53] Santos, *2020 First Quarter Activities Report*' (Company Announcement, 23 April 2020) <https://www.santos.com/wp-content/uploads/2020/04/2020_First_Quarter_Activities_Report-FINAL.pdf>.

provide data for new gas field developments, with further developments expected. Santos announced it has deferred final investment decision (FID) on the $7 billion Barossa offshore development project with no revised time estimate due to COVID-19 and the associated oil price reduction.[54]

On 15 July 2020, Origin Energy announced a write-down of the value of its business, of a hit of up to $1.2 billion due to lower oil and gas prices, and the 'progressive transition to a lower-carbon economy'.[55] No mention was made in relation to activities in the Beetaloo Sub-basin. Santos also faced significant write downs - while production was up 4 per cent, sales revenue was down due to the realised oil price falling by 34% and 14% for LNG,[56] but also did not make a further announcement on re-commencement of exploration activities. In September and October 2020 these activities were re-commenced.

In addition to the health-related concerns causing suspension of activities, the fall in oil price and tightening of expenditure may have also exacerbated the need to take the decisions to delay exploration. To the extent this is the case, it highlights the importance of a robust price and price signal – if this is absent, the exploration and development will move at a slower pace.

While drilling has recommenced, we anticipate that there is still a risk that activities may be slower than previously planned, due to potential constraints on available finance.

If there are new drilling delays, or planned activities are slower than initially planned, this will delay the opportunity for the Beetaloo Sub-basin producers to demonstrate to the market the level of definition, size and development probability**.**

COVID-19 and the current low oil and gas prices may have two potential impacts in the next 5 years:

- **Impact on competing sources of supply** - if other planned gas resources on the East coast are not developed in the shorter to medium term, there may be higher demand for Beetaloo Sub-basin gas due to scarcity, in circumstances where AEMO has forecast a gas shortfall from 2024 on the East coast. To meet this shortfall window would rely on Beetaloo Sub-basin gas being available at the right time, at a competitive price, and meeting other terms and conditions of buyers.
- However, on the potential downside, Beetaloo Sub-basin producers and infrastructure providers may have a short-to medium term **decreased ability to invest** - the ability of producers to secure investors and dedicate required capex funding may be more difficult in the current economic climate for two key reasons:
    - First, if Beetaloo Sub-Basin producers are currently receiving much lower prices for natural gas for domestic use or their LNG exports from their other fields, the available capital to hand will also be much lower than in a pre-COVID19 and higher oil price scenario. This may impact next steps in investment timing due to availability of capital within the company or from investors; and
    - Second, if the medium to long-term oil and gas price forecast are downgraded (i.e. post 2025), this will affect the economics of investing in the Beetaloo Sub-basin, as potential profits may be lower where the cost of production remains the same.

It is currently unclear as to which driver will result in a greater impact on the likelihood of the development of the Beetaloo Sub-basin. We consider that the decreased ability to invest in exploration and appraisal presents a near-term downside risk (1 – 2 years), whereas the potential increased demand upside may arise around 2023-24 (based on current announcements regarding delay on broader project investments in Australia).

Depending on the length and severity of the COVID-19 outbreak and the associated economic downturn globally, this may lead to a reduction in the medium to longer term forecast revenue and profitability of Beetaloo if oil and gas prices do not trend back upwards. As explained below, LNG export contracts from Australia, which may be needed to underpin the Beetaloo Sub-basin development, are linked to the international oil price.

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[54] Ibid.
[55] Origin Energy announcement, 15 July 2020, https://www.originenergy.com.au/about/investors-media/media-centre/origin_expects_to_recognise_non_cash_charges_in_fy2020.html
[56] Santos Half Yearly results, 20 August 2020 – at https://www.santos.com/news/2020-santos-half-year-results/

3.3 Fuel security considerations

Australia, like all countries, has minimum reserves for liquid fuels which can be sourced from domestic sources or internationally. Considering the importance of petroleum based products, such as liquids rich gas, for the continued operation of the Australian economy, liquids rich gas from the Beetaloo Sub-basin may be an important source of future domestic supply.

3.3.1 Historical fuel security considerations

Australia's economy is reliant on liquid fuel and will be for some time to come. Australia's liquid fuel sector comprises crude oil and condensate, refined products such as petrol, diesel and jet fuels, ethanol and biodiesel.[57] Liquids rich gases, such as those listed above are vital components of key liquid fuels, such as ethane and propane which is LPG or bottled gas, butane which is used as fuel in lighters, or condensate. On average, each Australian uses nearly three times more energy from liquid fuel than they do electricity.[58] This is unsurprising, considering the relative size of Australia and the country's reliance on fuel-intensive transport options. The transport sector makes up 75 per cent of Australia's total liquid fuel demand. It includes road (passenger and freight), rail, shipping and air transport. Mining, agriculture and manufacturing (including petrochemicals) make up the most significant industry demand for liquid fuel. Both mining and agriculture are over 90 per cent reliant on diesel, and this partly drives the growth in demand for diesel. Under normal circumstances, use by the Australian Defence Force equates to 3 per cent of national demand for jet fuel and about 0.5 per cent of national demand for diesel. Ultimately, Australia spends $57 billion on liquid fuels each year—more than electricity, at $38 billion; and gas, at $37 billion.[59]

Imports supply the majority of liquid fuels in Australia (see Figure 3 below). In 2017–18, Australia imported the equivalent of 90 per cent of refined and consumed petroleum products. This number is made up of 60 per cent of refined product imported directly, including petrol, jet fuel and diesel. The remaining refined product was produced by the four refineries in Australia, with these refineries importing around 80 per cent of the crude oil feedstock they needed from overseas. Australia currently exports the majority of domestically produced oil, but, if all crude oil produced in Australia were refined onshore, this would still only meet 24 per cent total refined product demand.[60] That means that imports are essential to meet the growing demand for liquid fuels.

Australia has previously relied on market mechanisms and flexible international supply chains to manage fuel security risks.

Although Australia is geographically close to its largest sources of crude oil (i.e. Malaysia, the UAE and Indonesia) and refined petroleum products (i.e. South Korea, Japan and Malaysia), these countries are in turn heavily reliant on supply from the Middle East. Of the six countries in Asia that Australia receives 90 per cent of its refined petroleum products, five countries (including Japan, Singapore and South Korea) are all net importers of crude oil themselves.[61] This represents an inherent risk to Australia's fuel security, as it is likely that these countries would prioritise security of their own fuel supply during an international shortage. This perceived weakness in Australia's liquid fuel supply chain has been exacerbated by the impact on global oil and gas prices by the simultaneous Russia-SAUi Arabia oil price war and the COVID-19 outbreak. The Commonwealth Government has responded with a purchase of crude oil and development of a stockholding obligation on the industry, as announced on 14 September 2020.[62]

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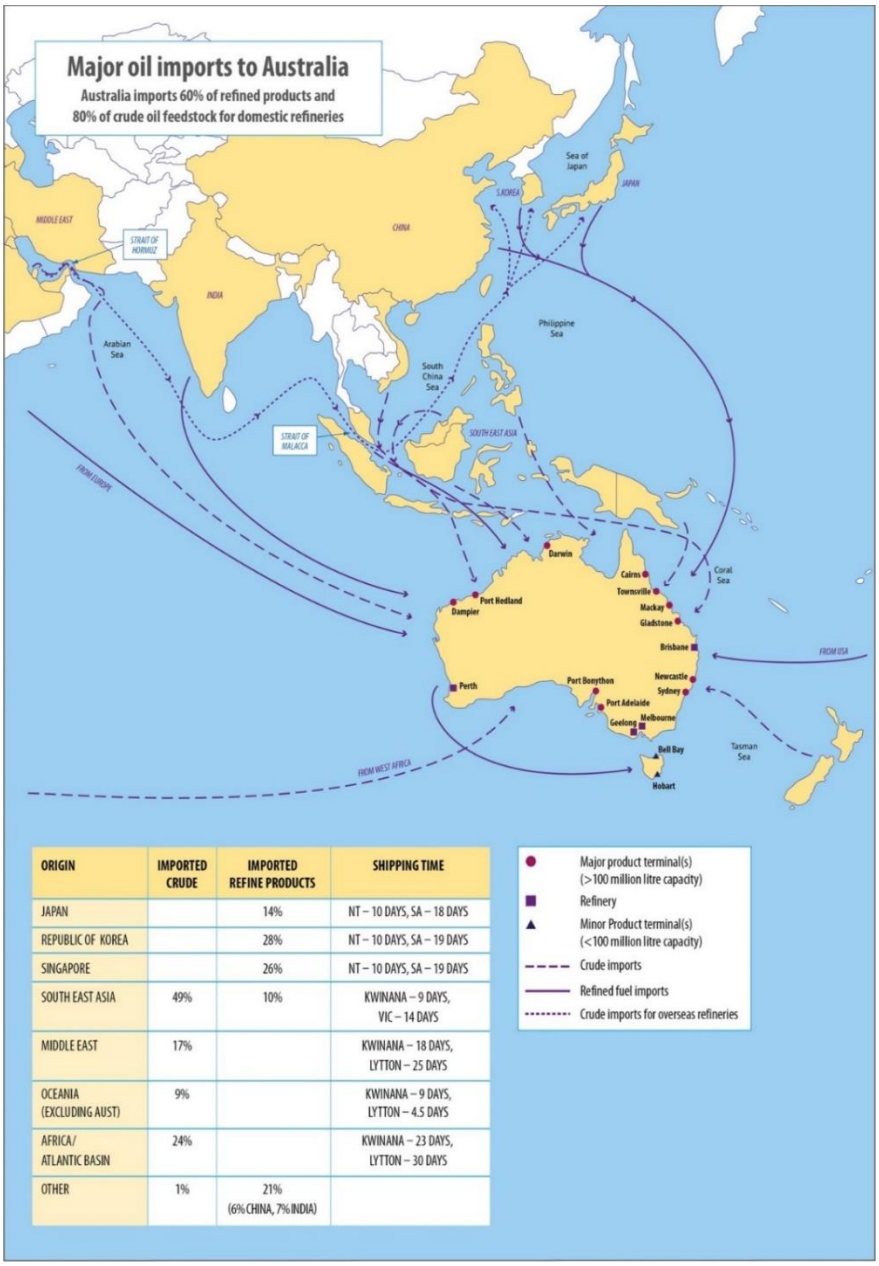
[57] Commonwealth Government, '*Liquid Fuel Security Review*' (Interim Report, April 2019) 11 <https://www.environment.gov.au/system/files/consultations/7cf6f8e2-fef0-479e-b2dd-3c1d87efb637/files/liquid-fuel-security-review-interim-report.pdf>.
[58] Ibid.
[59] Ibid.
[60] Most of the domestically produced oil is condensate, which is a by-product of natural gas production. Condensate is less suited to domestic refining but could be used to supplement supply in an extreme disruption scenario.
[61] Ibid 24.
[62] See https://www.minister.industry.gov.au/ministers/taylor/media-releases/boosting-australias-fuel-security

Figure 3 - Major oil import routes to Australia



ORIGIN	IMPORTED CRUDE	IMPORTED REFINE PRODUCTS	SHIPPING TIME
JAPAN		14%	NT – 10 DAYS, SA – 18 DAYS
REPUBLIC OF KOREA		28%	NT – 10 DAYS, SA – 19 DAYS
SINGAPORE		26%	NT – 10 DAYS, SA – 19 DAYS
SOUTH EAST ASIA	49%	10%	KWINANA – 9 DAYS, VIC – 14 DAYS
MIDDLE EAST	17%		KWINANA – 18 DAYS, LYTTON – 25 DAYS
OCEANIA (EXCLUDING AUST)	9%		KWINANA – 9 DAYS, LYTTON – 4.5 DAYS
AFRICA/ ATLANTIC BASIN	24%		KWINANA – 23 DAYS, LYTTON – 30 DAYS
OTHER	1%	21% (6% CHINA, 7% INDIA)	

Source: Liquid Fuel Security Review – Interim Report (April 2019)

3.3.2 Implications for Beetaloo liquids rich gas

The development of liquids rich gas for the domestic market in the Beetaloo Sub-basin would be a welcome source of domestic supply and a further step towards greater liquid fuel security. As previously discussed, ongoing disruption in global oil and gas markets represent a risk to stable supply into the Australian market for liquid fuels. This may be a factor in increasing demand for Beetaloo Sub-basin gas and liquids for domestic use or via liquids export such as LPG to Asia.

4 Resource development scenarios and gas market outcomes

Core Energy & Resources (CORE) has provided an assessment of future gas markets available for the supply of gas from the Beetaloo Sub-basin of the McArthur Basin in the NT, assuming a commercial reserve is delineated, in accordance with the estimates derived from KPMG, RISC and GHD for the NT Department of Trade, Business and Innovation (2019).

This Chapter includes:

- Analysis of existing and new contestable gas markets available to Beetaloo Sub-basin gas supply – both domestic and LNG export, within Northern Territory and the East Coast region. Under three scenarios (High, Mid, Low)
- Analysis of the estimated cost of Beetaloo Sub-basin gas delivered to major demand nodes, relative to competing gas supply sources
- Analysis of gas supply scenarios with regard to the estimated future market prices and cost of delivering gas to defined demand centres/delivery points.

Throughout this Chapter the following assumptions have been used:

- Markets for a potential 'methane' sales gas stream have been addressed in detail, however the specific local and export markets open to ethane and gas liquids – condensate, LPG (propane and butane) under the Liquids-rich scenarios have not been addressed in detail
- The analysis has not considered potential nitrogen, CO_2 and other gas elements of any future production stream in terms of implications for new infrastructure and related cost
- The analysis has not considered potential import of WA gas as this was excluded from scope
- The analysis has not sought expert advice from a reservoir engineer in relation to assumed shape of 'ramp' gas, ahead of mature/plateau production.

4.1 Summary

Based on the analysis completed, the CORE market modelling informed the following findings:

Finding	Detail
1.	If the Beetaloo Sub-basin gas cost is below AU$5/GJ ex field processing plant, it highly probable that it will be a competitive source of supply into a market of >10,000 PJ over 20 years, commencing delivery from 2030-2032+.
2.	If the Beetaloo Sub-basin gas cost is above AU$6/GJ ex field processing plant, there is a risk that the realisable market will shrink to below 5,000 PJ over 20 years due to: • Risk that LNG import will be seen as the preferred, short term option in the east due to low spot LNG prices and lack of confidence in alternatives. • Risk that Petrel Tern economics will be more favourable. • Risk of it being uncompetitive as a source of supply into LNG markets, particularly at higher exchange rates and LNG price range. • Risk that it will be difficult to compete against even lower quality CSG in Queensland, due to marginal costing advantages against fixed capital, advanced knowledge of coal system, and advances in capital and operating cost optimisation – based on a longer period of operating history.
3.	If the Beetaloo Sub-basin breakeven cost is above AU$7/GJ, it unlikely that it will be a competitive source of supply without government intervention or other subsidy.
4.	A liquids scenario could see ethane and liquids content in the production stream 'subsidise' gas. In this scenario, methane prices could fall below AU$3-4 per GJ – but this needs extensive further data and analysis. As an illustration, RISC estimated that the breakeven gas price under a High Liquids scenario is $6.30 per GJ at a liquids price of $48/barrel. For each $6 increase in liquids price/barrel the breakeven gas price would fall by $1/GJ (based on 6 GJ/barrel of oil equivalent). Therefore a liquids price of $66/barrel would see the breakeven cost fall between AU$3-4/GJ.

A number of strategic issues relate to the resource assessment, demand, supply-side competition, price and cost, and are summarised as follows:

- There is evidence of a petroleum resource which deserves significant attention to fully evaluate its potential;
- There is potential for a high liquids production scenario as presented by RISC – up to and potentially over 500 million barrels of liquids which would potentially act to 'subsidise' the gas to AU$3-4/GJ;
- There is adequate evidence of a contestable market to accommodate a large-scale development of the Beetaloo Sub-basin from 2030;
- There is evidence of sufficient supply-side competition which, if it proceeded, will make it improbable that Beetaloo Sub-basin will secure a large scale market before 2040 (with commitment required as early as 2025-6);
- There is substantial national and international evidence that petroleum systems can be subject to transformational improvements in productivity under the pressure of changing markets and competition and general learning. This suggests there may be an opportunity to optimise cost of Beetaloo Sub-basin gas supply to move it ahead of competitive supply sources; and
- There is clear evidence of material movement in domestic sales gas, ethane, LNG and gas liquids prices over time for varying durations which have and continue to impact assessment of project and 'play' economics.

A detailed explanation of the strategic issues can be found in section 4.6.

The key recommendation resulting from this analysis is as follows:

Policy/regulation area	Recommendation	Responsible entity	Timeframe	Reference
Government support if further delays materialise	A. The Commonwealth and NT governments should continue to monitor progress and if there appears to be a material delay in exploration and appraisal activities, consider whether intervention or support may be warranted.	Commonwealth and NT governments	2020 - 2021	4.6

4.2 Gas Supply

This section summarises the Beetaloo Sub-basin development potential. It is important to understand that the Beetaloo Sub-basin is at an early stage of appraisal and it is too early to determine, with confidence, the scale of and composition of any economically recoverable resource either dry or liquids rich gas.

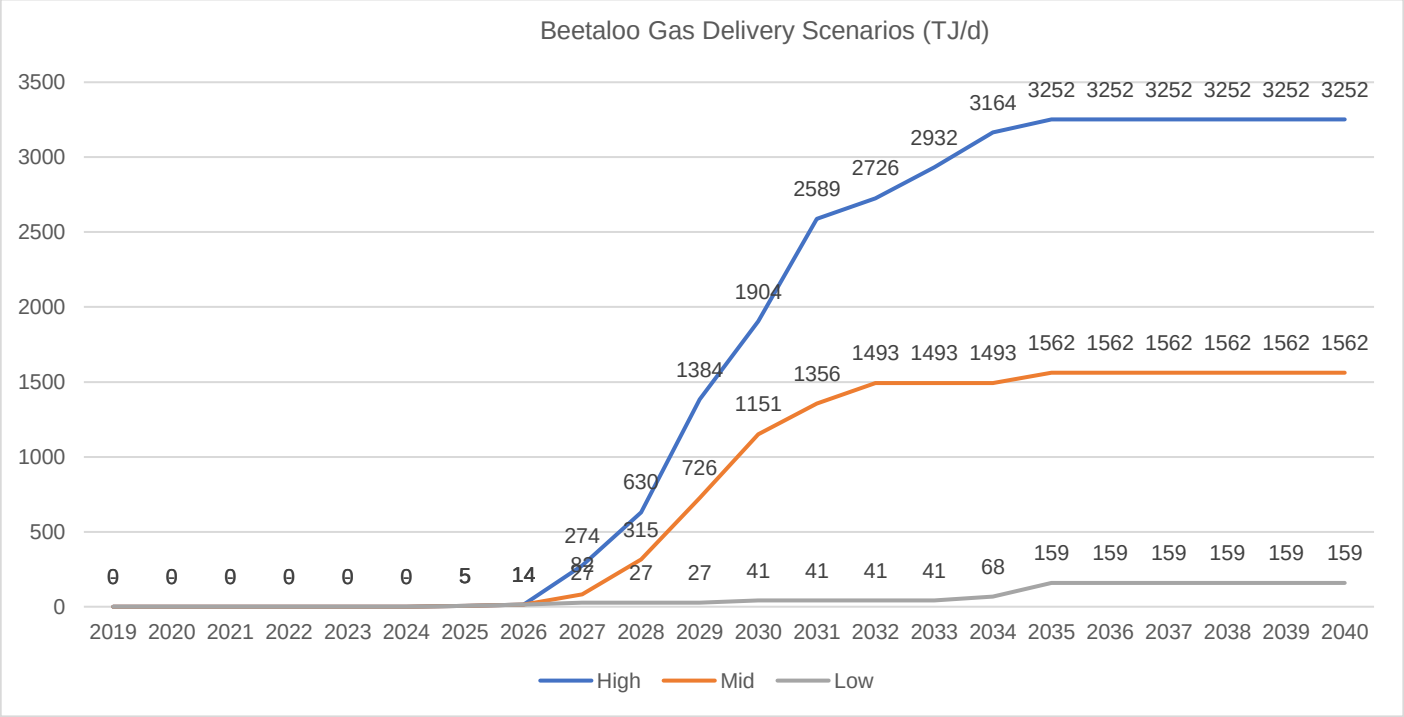
4.2.1 Dry Gas

Three scenarios of future gas supply, as requested, based on the KPMG, GHD and RISC report to the Department of Trade, Business and Innovation (2019), Low, Mid and High Dry Gas scenario, and a Liquids scenario. The methane market segments that could be supplied under each scenario are described.

In a mature production phase, the dry gas scenarios will produce as follows, as shown in Figure 4

- Low – 159 TJ/day / 58 PJ p/a
- Mid – 1,562 TJ/d or 569 PJ p/a.
- High – 3,300 TJ/d or 1,200 PJ p/a

Figure 4 - Beetaloo Sub-basin dry gas scenarios



Source: CORE Analysis

Commercialisation options for consideration of associated infrastructure requirements may involve a combination of the following:

Northern Territory

- 30-75 TJ/day – NT new industrial
- Replace Blacktip fully or partially post 2034 to address existing generator fuel requirements – 40-60 TJ/day

East Coast

- Queensland export – NGP 70-80 TJ/day
- DLNG and Ichthys – 700-1200 TJ/day
- Gladstone LNG – 1200 TJ/day
- New East (e.g. Moomba) – 500 TJ/day

As described in the stakeholder engagement Appendix A, producers estimate that first production (early 2020s) from some of the horizontal wells will be 10 TJ/day, ramping up to 100 TJ/day around the mid-2020s before reaching full-scale production of 1,000-2,500 TJ/day by 2030. Another producer's base case is for first gas in the mid-2020s with a scale up to full production in the late-2020s.

4.2.2 Liquids rich

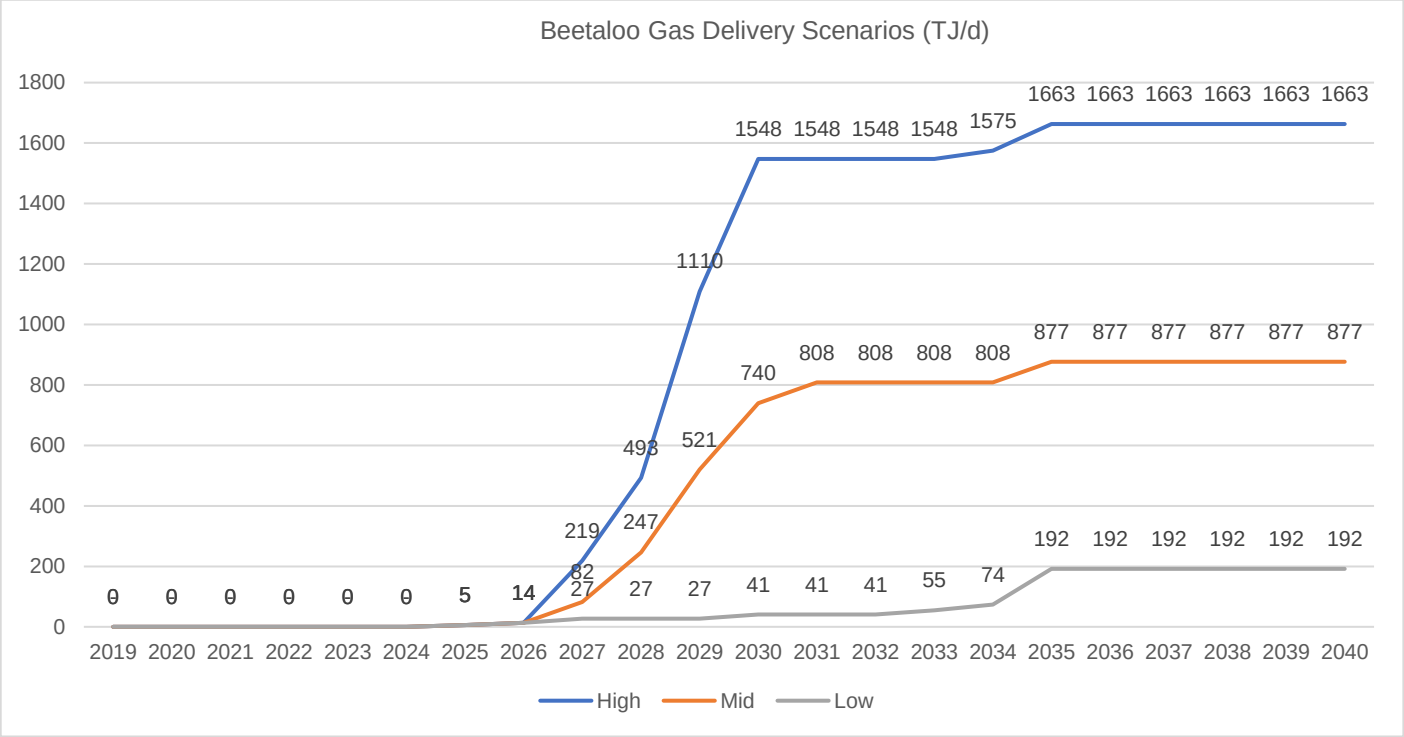
CORE has derived three scenarios of future gas supply, based on the Department of Trade, Business and Innovation (2019) Liquids Rich Gas analysis (High, Mid, Low).

In a mature production phase, the scenarios will produce as follows:

- Low – 192 TJ/day or 70 PJ p.a.
- Mid – 877 TJ/d or 320 PJ p.a.
- High –1663 TJ/d or 606 PJ p.a.

As described in the stakeholder engagement appendix and the CGE modelling results, the liquids rich scenario will be the more lucrative play in the Beetaloo Sub-basin, and a way to more economically ramp up to full gas production (as the revenue from liquids sales could effectively help fund the infrastructure required to ramp up to full production).

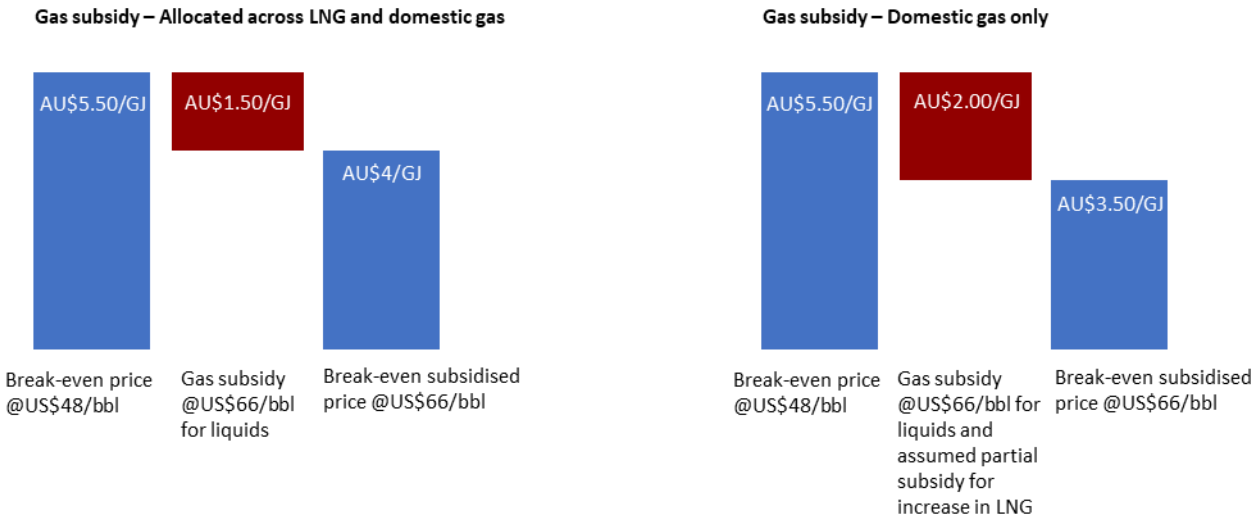
Figure 5 - Liquids Scenarios (TJ/ day)



Source: CORE Analysis

As an illustration, RISC estimated that the break-even gas price under a High Liquids scenario is $6.30 per GJ at a liquids price of $48/barrel. For each $6 increase in liquids price/barrel the breakeven gas price would fall by $1/GJ (based on 6 GJ/barrel of oil equivalent). Therefore a liquids price of $66/barrel would see the breakeven cost fall to between AU$3-4/GJ, shown in Figure 6 below.

Figure 6 - Liquids impacts on methane cost of production



Source: CORE Analysis based on RISC data

4.3 Gas Demand

The potential markets that have been identified as sources of demand for gas sourced from the Beetaloo Sub-basin include:

1. NT Domestic Gas Market
2. EA Domestic Gas Market
3. Asia LNG Export Market (Darwin (DLNG, Ichthys) and Gladstone (APLNG, GLNG, QCLNG))

4.3.1 NT Domestic Gas Market

NT existing domestic gas demand is approximately 52 PJ (142 TJ/d) which comprises two segments:

- 24 PJ local (66 TJ/d)
- 28 PJ export to Queensland (77 TJ/d)

Accounting for new industrial activity into the future, three demand scenarios for 2031-40 are highlighted below:

- Best Estimate – net growth of +15 PJ
- Low – net growth of -7 PJ
- High - net growth of +32 PJ

The analysis assumes that the existing Blacktip contract will be adequate, together with modest Amadeus production, to meet reference demand to 2034, with potential for Beetaloo Sub-basin to supply the NT domestic market thereafter.

Table 7 - Key variables influencing NT Domestic Gas Consumption between 2020-40

Variable	Description	Low	Best Estimate	High
Existing				
Reduction in GPG gas use	• NT total domestic market is estimated at 24 PJ p.a. (excluding NGP pipeline export to EA of approximately 28 PJ) • NT's major domestic use of gas is for power generation. Gas represents 90 per cent of electricity generation. • The NT Government has stated that it has a commitment to 50 per cent renewable generation by 2030. • These scenarios address the feasible range of future gas consumption by the electricity generation segment.	50 per cent reduction in GPG by 2030 due to substitution in favour of lower emission technologies, in line with government policy – reduction of 12 PJ p.a.	40 per cent reduction in GPG by 2030 due to substitution in favour of lower emission technologies, in line with government policy – reduction of 9 PJ p.a.	25 per cent reduction in GPG by 2030 due to substitution in favour of lower emission technologies, in line with government policy – reduction of 6 PJ p.a.
New				
Growth in gas-intensive industry	It is assumed that growth in competitively priced gas in NT will provide a significant incentive to invest in new, gas-intensive industry, candidates include methanol and petrochemical operations.	Growth of 5 PJ p.a. of gas consumption by 2025	Growth of 10 PJ p.a. of gas consumption by 2025 and a further 10 PJ by 2030	Growth of 10 PJ p.a. of gas consumption by 2025 and a further 20 PJ by 2030

Source: CORE Analysis

4.3.2 Eastern Australia Domestic Gas Market

Three scenarios of future EA Domestic gas consumption were developed based upon AEMO's GSOO scenarios including the following.

Throughout the 2020 to 2040 timeframe, eastern Australia's gas demand is expected to fall within the range of 400-600 PJ p.a. (up to 1,600 TJ), with the range of uncertainty attributable to:

- The role of gas-powered generation in the energy mix which targets stepped reduction in GHG/carbon intensity
- The sustainability of gas-intensive industry – including Ammonia/Urea and Aluminium
- Any developments in future state and federal energy policy.

The full set of variables are set out in section B1 of Annexure B below. The AEMO GSOO 2020 Central supply and demand scenarios, indicates that existing developed and undeveloped reserves and currently anticipated developments will be insufficient to meet EA demand beyond 2024-5.

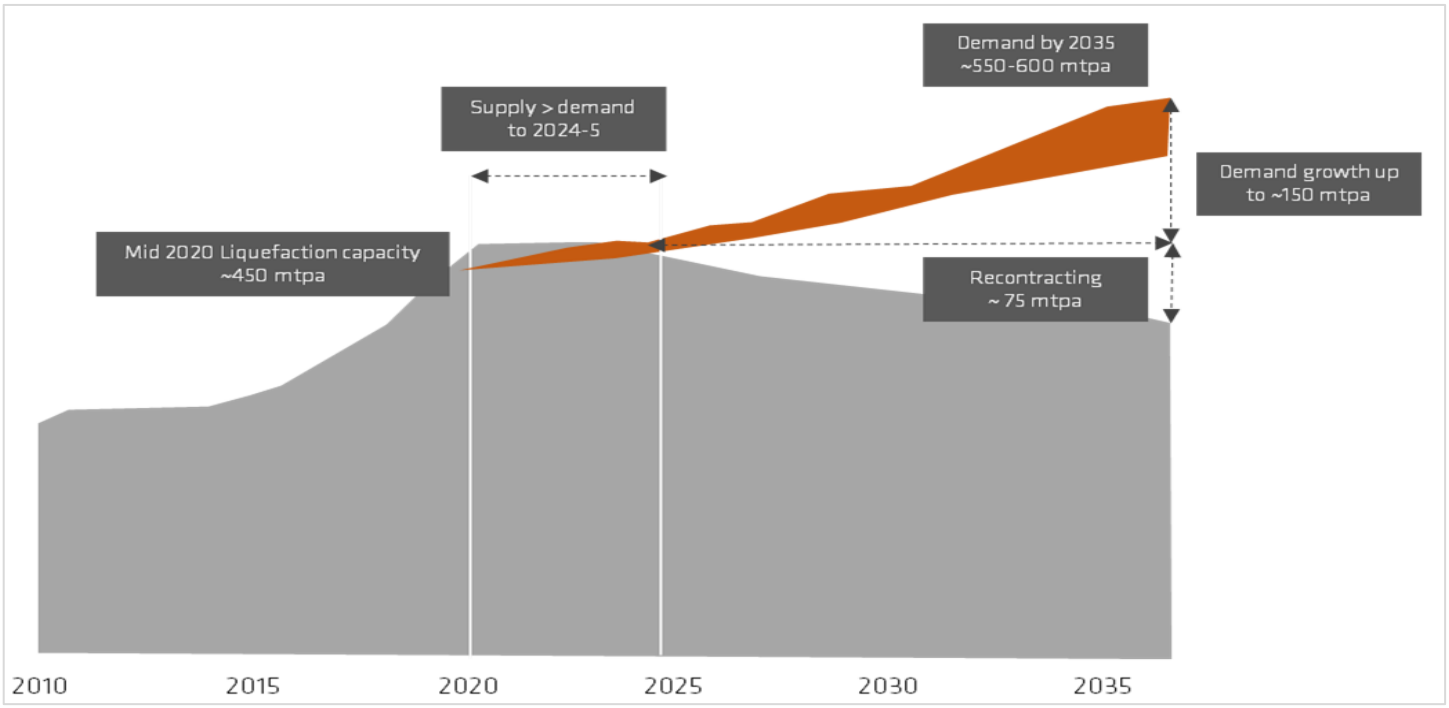
4.3.3 Asia LNG Export Market

Global growth in LNG demand is likely to give rise to an additional 150 mtpa of new supply requirement by 2035, a contestable market which is open to Beetaloo Sub-basin fed LNG projects (in the NT or Eastern Australia). The success of this will depend on competitive cost/price of Beetaloo-supplied LNG versus other competitive supply options.

Key assumptions are as follows:

- Global liquefaction capacity is estimated to be 450 mtpa by mid 2020s
- Net new demand is expected to be 150 mtpa after assumed recontracting
  The 150 mtpa of new demand faces strong supply side competition as outlined in Figure 7

Figure 7 – LNG export demand and supply

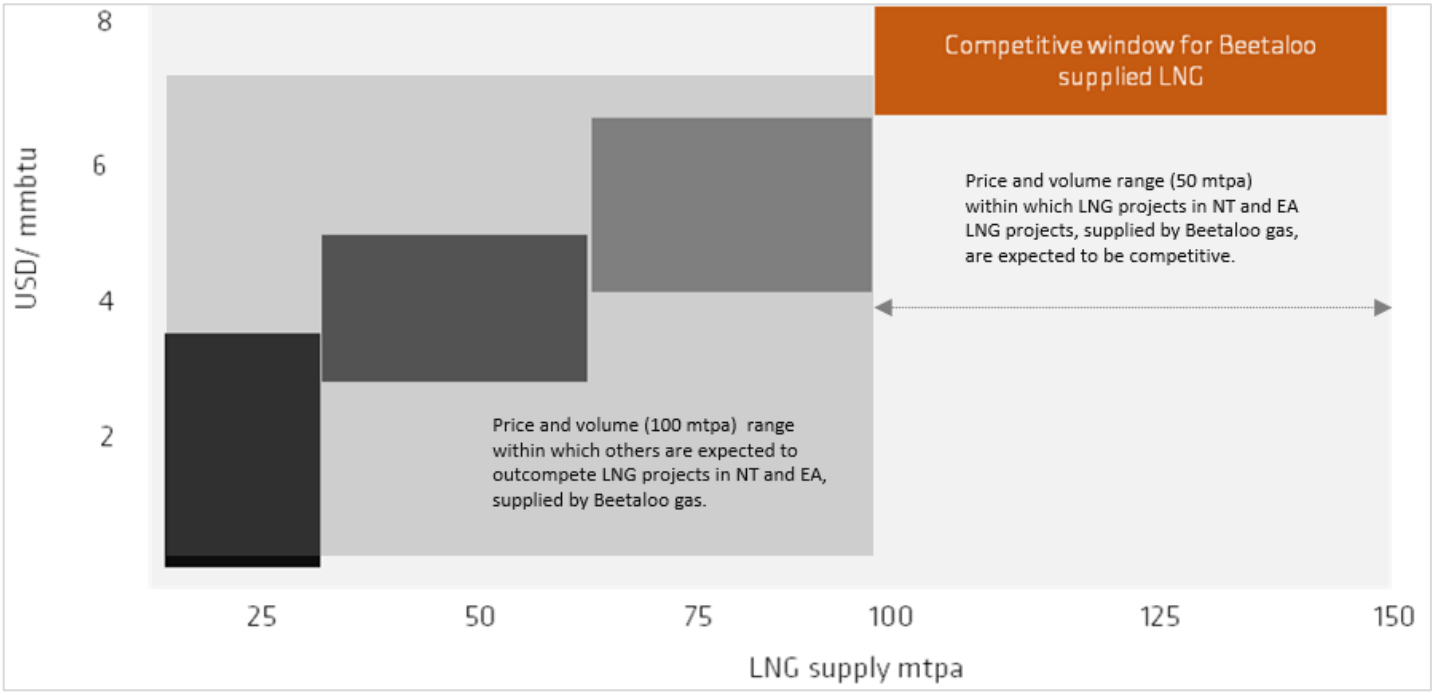


Source: CORE Analysis

However, further analysis indicates that competing sources of supply from Qatar, Mozambique and other locations are likely to reduce the contestable window open to Beetaloo Sub-basin gas fed LNG to a 50 mtpa tranche of future global LNG supply. To meet unfulfilled demand between 2025 and 2035 (e.g. projected demand which is not yet contracted, based on full or partial supply from the Beetaloo Sub-basin).

This opportunity is subject to the Beetaloo Sub-basin gas cost at the field (ex-processing plant) not exceeding AU$6/GJ or US$4.20/MmBTU. This is assuming a competitive delivered price range for LNG into Northeast Asia of US$7.00-US$8.00/MmBTU.

Figure 8 – Competitive window for Beetaloo Sub-basin supplied Australian LNG exports



Source: CORE Analysis

4.3.3.1 LNG Demand – North

Darwin-based existing LNG is approximately 680 PJ p.a (~1,900 TJ/d)

- 500 PJ Ichthys
- 189 PJ DLNG.

Future demand scenarios include expansion of these projects based on assumption of competitiveness of new upstream supply, including, potentially from the Beetaloo Sub-basin.

The three scenarios addressed are:

- Medium or best estimate – growth of 180 PJ - double current DLNG (490 TJ/d growth)
- Low – no expansion
- High - growth of 680 PJ – double both Ichthys and DLNG (~1,900 PJ).

4.3.3.2 LNG Demand – East

Gladstone-based existing LNG is approximately 1,400 PJ p.a (3,800 TJ/d)

- 531 PJ APLNG
- 474 PJ QCLNG
- 419 PJ GLNG.

Future demand scenarios include moderate expansion and contraction of these projects based on competitiveness into spot markets.

Table 8 - key variables influencing LNG Demand-East between 2020-40

Variable	Description	Low	Reference	High
Existing				
GLNG	• Potential challenge with reserves – volume and economics mid to longer term • Contract and capacity – (see below)	419 PJ p.a. average to 2034, falling to 335 PJ thereafter	419 PJ p.a. average to 2040	419 PJ p.a. average to 2040 then increase to 467 p.a. average by 2025 – new supply and debottlenecking
QCLNG	• Potential challenge with reserves – volume and economics mid to longer term • Arrow acreage development timing and scale is key	474 PJ p.a. average to 2040	474 PJ p.a. average to 2040	474 PJ p.a. average to 2040 then increase to 509 p.a. average by 2025 – debottlenecking
APLNG	• Potentially surplus reserves if Beetaloo successful • Economics of lower quality CSG is key risk	532 PJ average p.a. dropping to 515 PJ to 2025	532 PJ p.a. average to 2040	532 PJ p.a. average to 2040 then increase to 539 p.a. average by 2025 - debottlenecking

Source: CORE Analysis

4.3.4 Delivery pathways to available gas demand centres

For Beetaloo Sub-basin gas to be supplied to the markets referred to above, field processing facilities and other infrastructure must be developed, including gas transmission pipelines as the mature daily rate (TJ/d) of estimated potential production exceeds the capacity of existing transmission systems. Optimising use of existing infrastructure will be critical as any development moves though the initial ramp up phase.

CORE considered the following pathways (but has not undertaken cost estimates of any required system augmentation, consistent with its scope of work) (see Figure 9):

1. A transmission line (1) to enable higher rate flow (of on-spec sales gas) to Darwin (utilising or along same route as existing AGP) to facilitate supply to existing consumers, new industrial consumers and the Darwin LNG hub.
2. Additional transmission capacity to supply higher rates and larger volumes to eastern Australia. Two routes have been considered:
    i. A new pipeline (2) to Moomba.
    ii. Augmented/new pipeline connecting with Qld (3).
        i. An expanded pipeline to Queensland via the existing NGP route to Mt Isa and with bidirectional flow on Mt Isa line (CGP) allow approximately 200TJ/d of gas flow south. This may be optimum pathway for the appraisal and early gas production phase.
        ii. A new pipeline connection with a pipeline proposed by Jemena, which would facilitate flow to Gladstone.

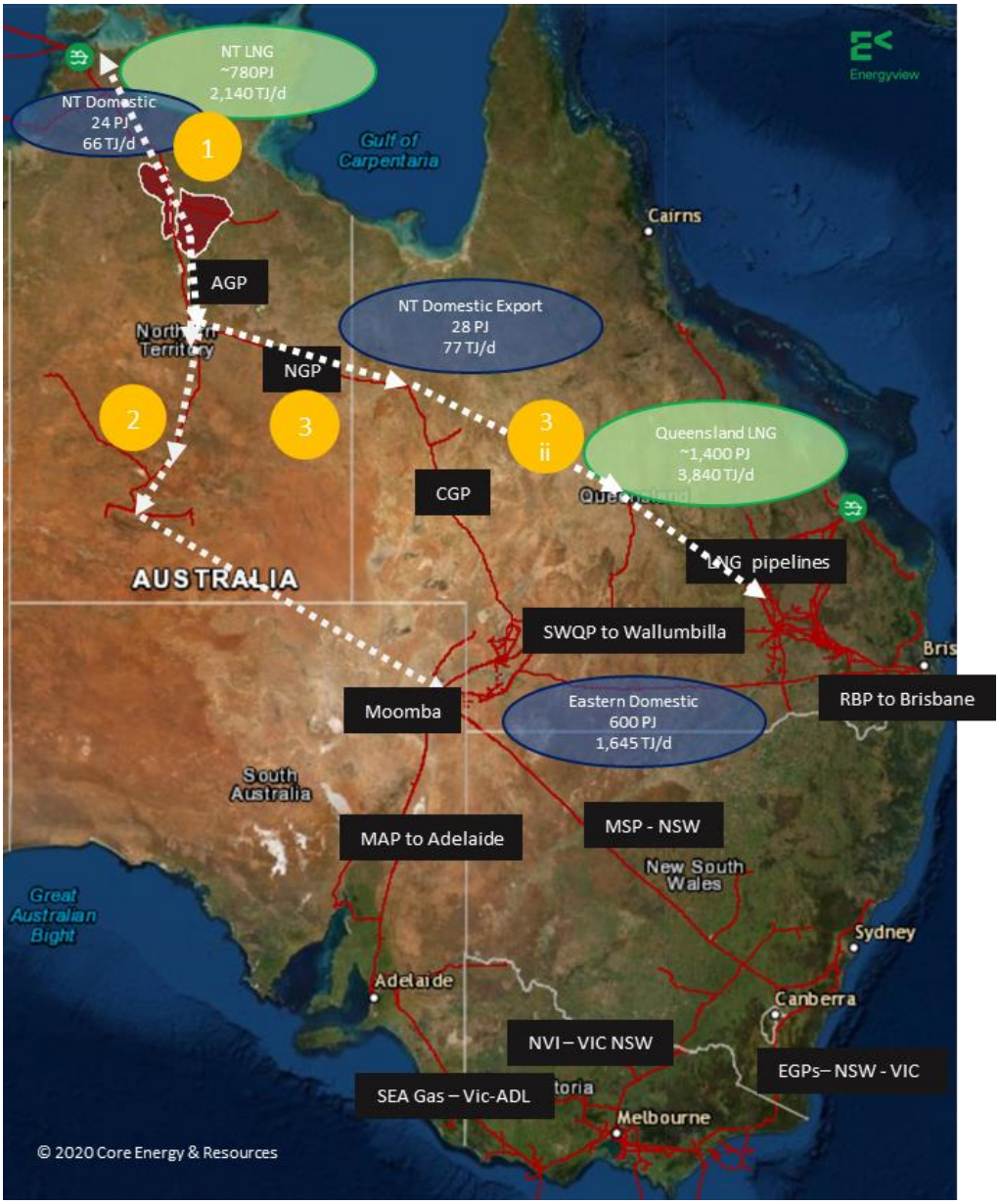
These options must also be considered in terms of any synergies associated with ethane and gas liquids transport and processing – as addressed at a high level, below.

In addition to the routes set out at Figure 9, it should be noted that the Hunter Gas Pipeline Project has received development approval from the NSW, Queensland and Australian Commonwealth Governments. The 833 kilometre pipeline is designed to transport gas from the Wallumbilla Gas Hub near Roma in Queensland to Newcastle in NSW via Narrabri, to connect to Jemena's Eastern Gas Pipeline.[63] If this were developed, there would be a route for Beetaloo Sub-basin gas via Wallumbilla effectively to Sydney, which would avoid the constraints on the South West Queensland Pipeline for Beetaloo Sub-basin gas to be transported south (in the event of a Wallumbilla connection).

[63] Hunter Gas Pipeline, *Hunter Gas Pipeline Project* (Website) <https://www.huntergaspipeline.com.au/hunter-gas-pipeline>.

As the ACCC noted in its January 2020 Gas Inquiry report, there are many proposals to build new pipelines on the East Coast, focussed on bringing new sources of supply to market, but some uncertainty as to whether they will be developed. Pipelines built to facilitate new sources of supply are often the outcome of memoranda of understanding between individual producers and the pipeline operators. Producers indicated to the ACCC in consultation that access to pipeline infrastructure is a barrier to commercialisation of 2C resources on the East Coast, and to avoid duplication of assets and other inefficiencies, the development of this infrastructure should be coordinated by governments and be operated on a third party access basis, where feasible.[64]

Figure 9 – Delivery pathways to available gas demand centres – Summary



Source: CORE Analysis

[64] Australian Competition & Consumer Commission, '*Gas Inquiry 2017 – 2025 Interim Report*' (Report, December 2019) < https://www.accc.gov.au/system/files/Gas%20inquiry%20July%202018%20interim%20report.pdf> (*'ACCC Interim Gas Report December 2019')*.

4.4 Cost and price analysis

Beetaloo Sub-basin gas supply has the potential to be competitive in the NT domestic market, and brownfield Darwin LNG market. There is a lower assessed probability of being able to achieve the low-cost gas required to meet the economic needs of new gas-intensive industrial consumers (without liquids revenue or other subsidy). The below gas cost relates to methane only.

Table 9 - Potential cost and price of Beetaloo methane delivered to NT markets (Source: CORE Analysis)

Market Segment	Beetaloo Cost (AU$/GJ)	Estimated Competitive Market Price (AU$/GJ) – existing consumers	Targeted price of new industrial consumers
NT Domestic			
Gas ex-field processing plant	5.50 – 6.00	Deliberately blank	
Transmission	1.50 - 2.00		
Total	7.00 – 8.00	Darwin - AU$6.50-8.00/GJ	Darwin – AU$6.00 to $8.00/GJ
NT LNG		**Competitive Price**	
Gas ex-field processing plant	5.50 – 6.00	Deliberately blank	
Transmission	2.00		
LNG toll	3.00		
Shipping to NE-Asia (US$0.50)	0.60-70		
Total	**11.10 – 11.70**	**Delivered NE-Asia AU$10.00 – 11.40; US$7-8/mmBtu (1)**	

Figure 10 – Potential northern evacuation route

Source: CORE analysis

CORE analysis indicates that Beetaloo Sub-basin gas supply has the potential to be competitive in the Eastern Australian (EA) domestic market, but is likely to require a lower cost/higher AU$LNG price or subsidy to be competitive as gas feed to Gladstone LNG projects. Costs are high level estimates and require further analysis at a later stage of Beetaloo Sub-basin appraisal.

Table 10 - Potential cost and price of Beetaloo methane delivered to the East Coast via Moomba

Market Segment	Beetaloo Cost (AU$/GJ)	LNG Market Price (AU$/GJ)
EA Domestic		
Gas ex-field processing plant	5.50 – 6.00	Deliberately blank
Transmission to Moomba	2.50 - 3.00[65]	
Total	**8.00 – 9.00**	**Moomba - $7-8.00/GJ**
EA LNG		
Gas ex-field processing plant	5.50 – 6.00	Deliberately blank
Transmission to Moomba	1.50 – 2.00[66]	
Transmission to Wallumbilla	1.00	
Transmission LNG line	0.50	
LNG toll	2.50	
Shipping to NE-Asia (USD0.50)	0.70	
Total	**11.70 – 12.70**	**Delivered NE-Asia:** **AU$10.00 – 11.40; US$7-8/mmBtu (1)**

Source: CORE analysis

[65] This tariff relates to gas entering Eastern Australia at Mt Isa and following a path along SWQP to Moomba. This is based on public tariffs.
[66] This tariff is estimated breakeven tariff for a new large scale pipeline from NT to Moomba.

Figure 11 – Eastern evacuation pathways via Moomba

Source: CORE analysis

Table 11 - Potential cost and price of Beetaloo methane delivered to the East Coast via QLD

Market Segment	Beetaloo Cost (AU$/GJ)	Target Market Price (AU$/GJ)
EA Domestic - Wallumbilla		
Gas ex-field processing plant	5.50 – 6.00	Deliberately blank
Transmission to Wallumbilla	2.50 - 3.00	
Total	**8.00 – 9.00**	
EA Domestic - Sydney		
Gas ex-field processing plant	5.50 – 6.00	
Transmission to Wallumbilla	2.25-2.75	
Total	**7.25 – 8.75**	**Wallumbilla - $7-7.50/GJ** Sydney - $8-9.00
EA LNG		
Gas ex-field processing plant	5.50 – 6.00	Deliberately blank
Transmission to Wallumbilla	2.50-3.00	
Transmission LNG line	0.50	
LNG toll	2.50	
Shipping to NE-Asia (US$0.50)	0.70	
Total	**11.20 – 12.70**	**Delivered NE-Asia** **AU$10.00 – 11.40; US$7-8/mmBtu (1)**

Source: CORE analysis

The above Table 11 relates to the routes outlined on the Figure 12 below. A new connection to Moomba may be a more direct route, as compared to the expanded Northern route, but may not have as many incidental customers as a Northern Route may have (e.g. in Mt Isa – if additional demand arises), and may not be as direct for LNG export from the East Coast.

Figure 12 – Eastern evacuation pathway via QLD

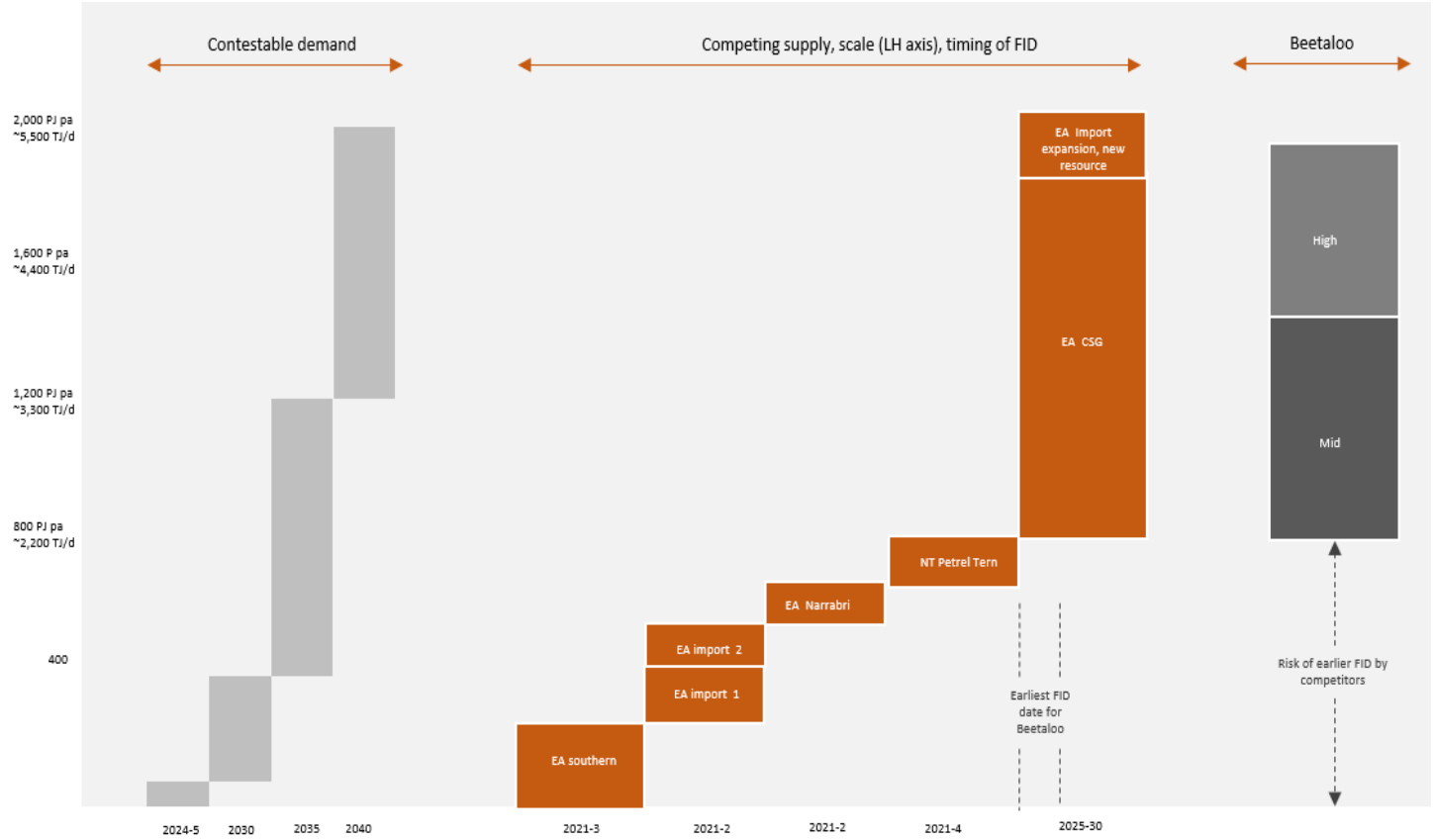
Source: CORE analysis

4.5 Competing sources of supply

This section provides an overview of sources of gas supply to meet contestable demand (projected demand not yet contracted) to 2040 that will serve as competition to the Beetaloo Sub-basin.

There is significant competition for supply in the 2024-2035 timeframe, (with certain FID decisions likely within 2 years) which appears a critical window for large-scale Beetaloo Sub-basin supply.

Figure 13 – Contestable demand windows



Source: CORE Analysis

The following table provides a summary of the competing sources of gas potentially facing the Beetaloo.

Table 12 – potential alternative supply sources to the Beetaloo

Potential Supply Source	Description	Potential Supply	Estimated timing- delivered to market	Estimated breakeven price AU$/GJ (ex-field)
ENI/Blacktip	The NT domestic market and NT export to Queensland is supplied primarily by gas sourced from Blacktip, and lower volumes from the Amadeus. PWC has a contract with ENI/Blacktip to 2034. CORE estimates that this gas has a price in the range of $6.00 to $6.50/GJ delivered to Darwin Based on CORE's preliminary analysis – there may be an opportunity for Blacktip to extend supply beyond 2034, and the price of this option relative to Beetaloo supply requires consideration.		Contract to 2034	6.50 – 7.00
Amadeus	Central Petroleum may further explore and develop Amadeus resources, and the realistic potential of this program requires further consideration. CORE estimates that production costs would be materially above AU$5/GJ, with some potential for subsidy from higher value production stream elements.		2022+	5.25 – 6.50
Petrel Tern	A discovered gas resource, estimated to be 2.7 Tcf, offshore is being evaluated for development, as a source of supply to NT for new industrial and LNG markets. CORE estimates that targeted production would be in the order of 75-100 PJ, with a minimum 20 year productive life. Little is available in the public domain regarding the cost, however CORE preliminary estimates are that it is unlikely to be below $6/GJ, and most likely closer to AU$6.50-7.00/GJ, delivered to Darwin, with a four year development timeframe.		2024+	6.25-7.00
Basins serving southern markets	Most of the contracted gas by volume in eastern Australia requires recontracting by 2024. Beyond this timeframe there is scope for extended supply from the Cooper, Otway, Bass and Gippsland Basins, however volumes are uncertain. Exploration and development programs are being pursued by several parties, including the Gippsland Basin JV (potential to be sold in	3,000+ PJ reserve/resource 250-300 PJ p.a. deliverability to 2030, uncertain thereafter	2022+ but unlikely to be net growth – rather offset natural decline	7.00 to 8.00

	part or full in the foreseeable future), Beach Energy and Cooper Energy. CORE considers that southern developed, undeveloped and near field exploration projects will secure markets to 2035, however volumes are expected to reduce materially over time (relative to 2020 and prior levels), creating an opportunity for new supply of 100-200PJ by 2030.			
Queensland CSG	There is a high level of uncertainty regarding the future cost and overall productivity of future CSG wells, as new areas are exploited to meet LNG and domestic demand. CORE analysis indicates that there will be 10-15,000 PJ of remaining reserves available to LNG and domestic market supply from 2030, with a weighted average marginal cost of AU$5-8 at Wallumbilla. CORE considers it likely that policy measures will favour supply to domestic markets if alternative resources are not commercialised by 2024-5	10,000 PJ+ from 2030 1,500 PJ p.a.	LNG contracts mature by 2034-5	5.00 (Marginal cost)– 8.00 (full lifecycle)
Narrabri, Gunnedah Basin, NSW	Santos is pursuing the development of Narrabri to deliver 40-70 PJ p.a. to a range of existing and new customers by 2025. Santos states that gas from the project will be made available to the NSW market via a pipeline linking in to the existing Moomba to Sydney pipeline.	40-70 PJ p.a.	2025+ delivery	$6.50 to $7.50/GJ
LNG Import	Four LNG import terminals are currently being evaluated, with potential supply capacity of up to 500-750 TJ/d for AGL's Cribb Point (Vic).	180 PJ p.a.; 500 TJ/d+	2023+	$8.50-10.50/GJ (note 2023+) with potential for lower shorter term contracts if low cost spot LNG is secured and lower prices are reflected in contracts.*

Source: CORE Analysis and project team

*There is some uncertainty here, as it may be that to get to the FID stage, the import terminal would need to sign up long term LNG and long term back to back contracts – depending on the customers sought to be supplied (e.g. large industrial users or electricity generators / retailers). Spare capacity via import terminals is unknown, and if available, may be short term only. In circumstances of lower prices, import terminal proponents may also be guarded about undercutting prices initially offered via the terminal, before the opportunity to recontract with foundation customers.

4.6 Issues of gas market significance

Based on the demand, supply, cost and price analysis completed by CORE, a number of issues of strategic significance have been identified.

Table 13 - Strategic Issues in the gas market

Strategic Issue	Description
Resource Assessment-Gas and Liquids	
There is evidence of a petroleum resource which requires attention to fully evaluate its potential.	Based on the technical and commercial fundamentals available to date, the Beetaloo Sub-basin is one of few new onshore gas resource development opportunities which has the potential to supply large volumes of high quality gas. However, despite promising evidence, more details are required for developers to make informed decisions. A two year appraisal program would ensure an adequate understanding of the petroleum system (gas, ethane, gas liquids) and implications for cost and value of extraction - pre FEED & FID. Additionally, understanding the full upstream geological and engineering system is critical. There are important learnings internationally and in Australia of the need to balance the 'business' of commercialisation and the 'science' of the subsurface.
There is potential for a high liquids production scenario as presented by RISC – up to and potentially over 500 million barrels of liquids	A liquids-rich scenario could potentially subsidise methane gas from the Beetaloo to AU$3-$4/GJ. This would make Beetaloo gas one of the lowest cost gas sources in the world and the lowest in Australia and would reduce costs to small business and households and help to reduce Australia's dependency on petroleum product imports.
Demand/Market	
There is adequate evidence of a contestable market to accommodate a large-scale development of Beetaloo from 2030.	The analysis demonstrates that Beetaloo can secure markets of over 3,000 TJ/d for gas and potentially large-scale ethane and gas liquids from 2030. The gas and ethane markets will require targeted discussion with potential off takers to determine the specific prerequisites for transaction – cost, time, scale, delivery point, infrastructure, finance etc. Key off takers and infrastructure developers will not engage with suppliers regarding evacuation until the Beetaloo has advanced to a greater degree of resource definition and certainty. An efficient path for Beetaloo's gas volumes to reach the market is also needed, involving expanded pipelines in the early phase and new pipelines once at full production.
Supply-side competition	
However, there is evidence of sufficient supply-side competition for this market. If competing projects proceeded, it would make it improbable that Beetaloo will secure large scale market before 2040 (with commitment required as early as 2025-26)	A range of supply-side competitors are at varying stages of pursuing large scale gas supply which target the same contestable markets available to the Beetaloo Sub-basin. These could include: Offshore, Petrel Tern (potential gas to domestic NT and NT LNG) • 2.7 Tcf – potential for 75-100 PJ p.a. for 20 years – up to 240 TJ/d LNG import terminal/s eastern Australia with the potential supply to EA domestic market, for example Cribb Point with 500 TJ/d and seasonal flexibility to 750 TJ/d • Preliminary analysis indicates that the introduction of an LNG import terminal will result in significant supply-side competition. • Stakeholders raised LNG import terminals as the most common substitution for Beetaloo gas. A pipeline company mentioned that terminals bring volume and shape to the market, particularly important during winters in Victoria. Terminals are also cheaper and quicker to bring into the market

Strategic Issue	Description
	and provide increased flexibility - relative to development of a large Sub-basin like Beetaloo. However, on the downside, the economic benefits of the large scale development as well as the security provided by a domestic supply do not manifest. • That said, to provide energy security, a smaller scale (with upscale flexibility), lightly regulated import terminal could play a complementary role to locally produced gas in the EA gas market.
Cost	
More evidence is needed on the cost of production, and consideration given to how this may change over time	A small variation in the cost of production or processing could be the difference between the resource competing effectively in the market or not. There is relatively thin evidence at this stage to support a rigorous assessment of the cost of Beetaloo gas on a delivered to market basis – across upstream, midstream and downstream elements. Appraisal drilling results will provide this evidence, and therefore assist with the understanding of the competitiveness of the resource. Focused attention is required to develop a quality assessment of the range of baseline costs and potential productivity gains over time. Petroleum systems are subject to transformational improvements in productivity under the pressure of changing markets and competition and general learning. This suggests there may be an opportunity to optimise the cost of Beetaloo Sub-basin gas supply to move it ahead of competitive supply sources.
Price	
There is a degree of uncertainty regarding forward price forecasts for sales gas, ethane, LNG and gas liquids prices, which continue to impact assessment of project economics	Under the Dry and Liquids rich Scenarios, the project economics of Beetaloo gas extraction will influenced by a number of prices and these must be understood at specific delivery prices to assess economics in more detail: • LNG • Gas at spec to Gladstone delivery point • Gas to Moomba • Gas to Mt Isa • Ethane ex Darwin, ex Port Bonython • Condensate and LPG at trucking delivery points (propane and butane prices).

As noted above, there is still uncertainty relating to the Beetaloo Sub-Basin's gas resource type, volume and cost of production. This uncertainty needs to be resolved as soon as possible if the resource is to be developed in time to meet the demand windows, and this will occur via further exploration and appraisal drilling. A small variation in cost of production or processing may make the difference between the resource being competitive or not. This issue is also covered below in Chapter 6.

There are potential competing sources of gas supply to Beetaloo Sub-basin gas. To meet the larger windows of gas demand at the right time and volumes (which is required given the likely gas volumes from the resource) the Beetaloo Sub-basin gas needs to be developed as quickly as possible.

5 Infrastructure Requirements

5.1 Summary

This Chapter outlines the various enabling, industry and service sector infrastructure requirements for the development of the Beetaloo Sub-basin. These were identified based on the industry growth and development scenarios through a gap analysis. It also includes policy constraints and regulatory barriers to the development of this infrastructure, and makes recommendations to governments. EPCT's input below builds on the costings and assumptions within the Infrastructure and Logistics Study[67] completed for the NT Government in 2019. Where we have taken a different view, this is noted.

The Beetaloo Sub-basin is very remote, and there is virtually no infrastructure yet developed, apart from minor road upgrades on the host farming stations, and the installation of a number of water bores. If the Beetaloo Sub-basin proves to be economic, most of the infrastructure required will therefore need to be developed from scratch.

However, without government intervention the related infrastructure is at risk of being fragmented. This could lead to additional capital expenditure resulting in higher delivered gas prices. For example, if numerous gas processing facilities are built instead of common, shared infrastructure, the total costs of developing the Beetaloo may be increased by an amount in excess of AU$2 billion. This would increase tariffs by approximately AU$0.50/GJ and prove significant in a market which, according to our analysis, is very sensitive to price differences of $1/GJ.

The necessary infrastructure requirements are summarised below (see Table 14). Based on this assessment and the policy and regulatory barriers identified in Chapter 6, we have set out recommendations for the NT and Commonwealth Governments below grouped as Priority 1 and 2. These are intended to be implemented over the short to medium-term to encourage fast and responsible exploration and appraisal of the Beetaloo Sub-basin. Considering the interrelated nature of these recommendations, these have been combined below (see Table 15).

[67] *Infrastructure and Logistics Study* (above n 12).

Table 14 - Infrastructure requirements summary

Infrastructure type	Included infrastructure	Current Condition			Required Investment to Production							Regulatory Environment
		Condition	Capacity[3]	Material to Development	Private	Public	Multi-user	Funding allocated[2]	Priority[1]	Approach to improvement	By	
Enabling	1.Roads		E	Med				Y	1	Upgrades to major arterial and key rural roads	2022	
Supports the growth of the industry but is located outside of industry tenements.	2.Ports		D	Med				N	3	Bulk liquids storage and gantry	2030	
	3.Rail		A	Med				N	P	Rail Siding (Daly Waters)	2024	
	4.Aerodromes		D	Low				Y	2	Shared user aerodrome upgrade	2028	
	5.Oil and gas pipelines		A	High				N	1	Upgrades to AGP and NGP (Appraisal gas)	2029	
	6.Utilities: Water		D	Low				Y	3	Regional water resilience improvements	2028	
	Wastewater		A	Med				Y	1	Katherine common user treatment facility	2024	
	Waste management		A	Low				Y	2	Waste transfer station developments	2024	
	Telecommunications		D	Med				Y	X	Regional digital automation pathway	2029	
	Power		A	Low				Y	P	Beetaloo regional microgrid	2029	
Social	1.Medical and health		D	Low				Y	1	Local Medical Partnerships	2027	
Attracts and retains the human resources	2.Long term housing		D	Low				Y	3	Nil	-	
	3.Community facilities		D	Low				Y	3	Katherine community development program	2025	
Industry	1.Workforce accom		D	Med				-	P	Industry led	2025	
Directly supports the proponent on the tenements	2.Land		A	Med				-	2	Develop zoning, planning and service infra	2025	
	3.Bulk freight		A	High				-	P	See Port and Rail upgrades	2024	
	4.Warehousing		D	Low				-	P	TBA		
	5.Utilities: Water		E	High				-	P	Transparent approvals process	2021	
	Wastewater		A	Low				-	P	See Wastwater upgrades	2022	
	Waste management		A	Low				-	P	See Waste management upgrades	2024	
	Telecommunications		D	Med				-	P	See Telecommunications upgrades	2029	
	Power		A	Low				-	P	See Power upgrade	2024	
	6.Infield Pipelines		A	Med				-	P	Nil	2022	
	7.Downstream			High				-	P	Nil	2032	
	8.CCUS			Low				-	X	Basin emissions management framework	2022	
Service sector	1.Drilling			High				-	X	TBA		
Indirectly supports the proponent or the value chain	2.Construction			Med				-	X	TBA		
	3.Logistics			Low				-	X	TBA		
	4.Maintenance			Low				-	X	TBA		
	5.Hospitality.			Low				-	X	TBA		

Notes:

Note 1: Priority 1 = High focus for Cth (establish strategy in 3-6 months), Priority 2 = Moderate focus (6-2 years), Priority 3 = Discretionary, P = Private sector delivered, X = To be determined

Note 2: Partial/full funding in place from Northern Territory or Commonwealth Budgets, or known development incentives in place.

Note 3: Investment required in: E = Exploration, A = Appraisal, D = Development, S = Sustain

Table 15 – Key infrastructure and direct action recommendations for Governments (**chronological order**)

Area	Recommendation	Responsible entity	When	Capital cost est AU$m[68]	Ref
Priority 1 Infrastructure					
Wastewater	B. Undertake a wastewater characterisation study (treatment selection) for a wastewater treatment facility to be located at Katherine. C. The Commonwealth should continue to leverage existing local ADF activity beyond wastewater to provide a continuous baseload of work to local trades.	Commonwealth (ADF)	2020	28	5.6.2.1
Ports	D. The NT Government should undertake a cost benefit assessment of the proposed Middle Arm Bulk Handling Wharf (2021).	NT Government	2021	0.5	5.6.1.2
Gas processing facility	E. NT Government to assess feasibility of a single, shared common user gas processing facility within the Beetaloo Sub-basin, to lower processed gas price.	NT Government	2021	0.5	5.5.1
Medical and Health	F. Ensure impact on local health services are assessed in Social Impact Assessment (SIA) Process and public private partnership (PPP) health clinics should be launched to support any increase in local population.	NT Government	2022	-	5.6.2.5
Roads	G. The Commonwealth and NT Governments should jointly expedite delivery of the proposed roads program (Stuart Hwy, Carpentaria Hwy, Western Creek Rd, Buchanan Hwy, Gorrie Dry Creek Rd). This includes the upgrade of highways and rural roads during the 2022-2026 period. These could be funded through the existing Infrastructure Investment Programs including the Roads of Strategic Importance program, and that road user charges remain applicable.	Commonwealth and NT Government	2022	427	5.6.1.1
Oil and Gas Pipelines	H. The Commonwealth should monitor progress on the required upgrades to the AGP, NGP and CGP to evacuate **appraisal gas** to the East Coast market in the Medium term. I. The Commonwealth should undertake detailed comparative cost benefit analysis of the Beetaloo-Moomba/Ballera, and Beetaloo-Wallumbilla Gas Pipeline routes, if NAIF is approached to support a new gas pipeline in the Long term.	Commonwealth	2022	150	5.5.2.2

[68] Estimated total capital cost (public and private), Australian dollars, $million.

Area	Recommendation	Responsible entity	When	Capital cost est AU$m[68]	Ref
Priority 2 Infrastructure					
Rail	J. The Commonwealth should consider expediting the development of Daly Waters Rail Siding in collaboration with One Rail and NAIF.	Commonwealth	2022	0.3	5.6.1.3
Land	K. Rezone key sites in Daly Waters, Larrimah and Elliott.	NT Government	2023	2	5.7.2
Aerodrome	L. The Commonwealth should take a leadership role in the development of a shared user aerodrome upgrade to accept larger aircraft.	Commonwealth	2024	38	5.6.1.4
Waste Management	M. The NT Government should consider development of new landfill and waste transfer stations at Elliott, Daly Waters and Mataranka, and prepare landfill capacity assessments for listed waste at Katherine and Shoal Bay landfill sites.	NT Government	2024	4	5.6.2.2

5.2 Infrastructure requirements for shale developments

Shale resources, like the Beetaloo, typically require more investment in exploration and appraisal than other fields. This is to understand not only size, composition, and flowrate, but also how it performs under different hydraulic fracturing regimes. Unlike conventional resources, this uncertainty is carried throughout the appraisal phase and into pilot phase (or early development phase). This compounds the risk by incorporating a longer time factor.

Early exploration results suggest the Beetaloo Sub-basin holds significant similarities to the Marcellus Shales in the USA. However, due the remote location of Beetaloo, in addition to the unknowns of the size and performance of the resource, there are significant infrastructure and regulatory barriers to efficient development of the basin. For the Beetaloo Sub-basin to be successful at scale, the costs of extraction and transportation need to be comparable with that of the USA. This has been reiterated by industry stakeholders consulted for this report.

However, in the USA a unique infrastructure ecosystem has driven capital and operational costs for gas field development to historically low levels. This has been driven by close proximity to existing population centres and competition, coupled with low regulatory hurdles and access to incentives (see Appendix C). Due to its remote location, the Beetaloo does not enjoy these advantages, while it faces strong competition from other sources for the exploration and appraisal investment required for production.

To compete for investment, a basin needs to be de-constrained in both the exploration and development phases. In the exploration phase, barriers are primarily in the form of clarity and predictability of the regulatory environment. In the development phase, barriers include clarity around the nature of the fiscal environment (i.e. royalties, taxes etc) and the costs of transporting appraised product to market (i.e. infrastructure, tariffs etc). By de-constraining exploration, a basin will be demarcated more quickly, improving resource probability. This can lead onto larger scale appraisal programs and the possibility that large scale, efficient infrastructure that can exploit economies of scale will be developed.

For the Beetaloo, this means the key unknowns and uncertainties surrounding the size and performance of the resource need to be removed quickly and efficiently. By focusing on mitigating the constraints that impact the exploration and appraisal phases allows a proponent to reach this level of certainty more efficiently. It also reduces the possibility of the government developing unnecessary infrastructure with inefficient costs ultimately being passed to the consumer.

The nature of any infrastructure constraint is either defined by:

- The condition of the existing infrastructure (including location)
- The capacity of the infrastructure to accept volumes predicted under the scenarios being assessed

- The materiality of the constraint to the specified phase i.e. what direct & indirect costs can be attributed to that constraint
- The phase in which the constraint is expected to occur (exploration, appraisal, development or sustain).

The ability of the government to contribute to the resolution of a constraint is defined by:

- The current/likely ownership of the infrastructure constraint (public or private)
- Whether the infrastructure is multi-sector user (i.e. agriculture, mining, tourism)
- Whether government funding (local, state or commonwealth level) is defined in part or full.

Supporting or incentivising alignment of development schedules and infrastructure investment will maximise opportunities for common user infrastructure and taking advantage of economies of scale. This will make it possible to avoid poor capital outcomes, such as the duplication of infrastructure for the Gladstone LNG projects.

5.3 Government's infrastructure responsibilities

Governments at the Commonwealth, state or territory and local level have a range of funding responsibilities for economic and social infrastructure (Table 16).

Table 16 - Government funding responsibilities[69]

Level of government	Economic infrastructure	Social infrastructure
Commonwealth	Aviation services (air navigation etc.) Telecommunications Postal services National roads (shared) Local roads (shared) Railways (shared)	Tertiary education Public housing (shared) Health facilities (shared)
State	Roads (urban, rural, local) (shared) Railways (shared) Ports and sea navigation Aviation (some regional airports) Electricity supply Dams, water and sewerage systems Public transport (train, bus)	Educational institutions (primary, secondary and technical) (shared) Childcare facilities Community health services (base hospitals, small district hospitals, and nursing homes) (shared) Public housing (shared) Sport, recreation and cultural facilities Libraries Public order and safety (courts, police stations, traffic signals etc.)
Local	Roads (local) (shared) Sewerage treatment, water and drainage supply Aviation (local airports) Electricity supply Public transport (bus)	Childcare centres Libraries Community centres and nursing homes Recreation facilities, parks and open spaces

The Commonwealth can further influence the provision of this infrastructure through:

1. Investment by government business enterprises (GBEs) and agencies
2. By providing funds to the States and Territories in the form of specific purpose payments

[69] Economics, Commerce and Industrial Relations Group, Parliament of Australia, *The Commonwealth Government's Role in Infrastructure Provision* (Research Paper no. 8 2003-04, March 2004) <https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/rp/rp0304/04rp08>.

3. Through the formulation of framework policies such as taxation provisions and National Competition Policy.

Generally, there are several reasons for government deciding to influence investment in infrastructure:

1. Raise levels of economic activity in the NT
2. To ensure the common user infrastructure stock meets the demand of users
3. Perceived market failure holding back investment
4. Positive or negative externalities
5. Natural monopolies.

Rather than directly investing, the government can also encourage private sector ownership with regulation of prices and anti-competitive practices.

In context of the Beetaloo Sub-basin, government participation appears to be warranted on several fronts (Table 17).

Table 17 - Justification for government participation

Basis	Cause	Impact of participation
Raise levels of economic activity in NT	Low, long term private sector investment in the NT. Short term economic contraction due to COVID-19	Long term sustainable jobs in regional NT. Creating greenfield construction jobs and safeguarding manufacturing jobs in the east.
To ensure common use infrastructure stock meets the demand of users	Mid-term gas supply shortages and underutilisation of distribution network for the domestic energy sector. Mid-term ethane supply shortages to Qenos.	Ensure the gas network continues to be utilised
Perceived market failure	Incomplete information of the productivity of the Beetaloo. Fluctuating gas prices and opaque price and contractual information means the signal for demand may be dampened	Well informed investment market (transparency) Well supplied gas market
Positive or negative externalities	Potential positive spillovers for the NT from this investment in terms of jobs and revenue created, and the broader public benefit of social and other infrastructure There may also be impacts on manufacturing sector in terms of cost of production of goods. Emissions targets, climate policy and company driven targets are increasingly a factor in investment decisions.	Positive spillover effects to the local community through improved infrastructure, employment opportunities and skills development Additional scrutiny on potential life-cycle emissions impacts.
Natural monopolies	High fixed cost linear infrastructure	Economic efficiency

The role of government is not isolated to direct investment, but also how it communicates the framework of policies at all levels. Feedback received during the consultation process on the existing policy frameworks is shared below (Table 18).

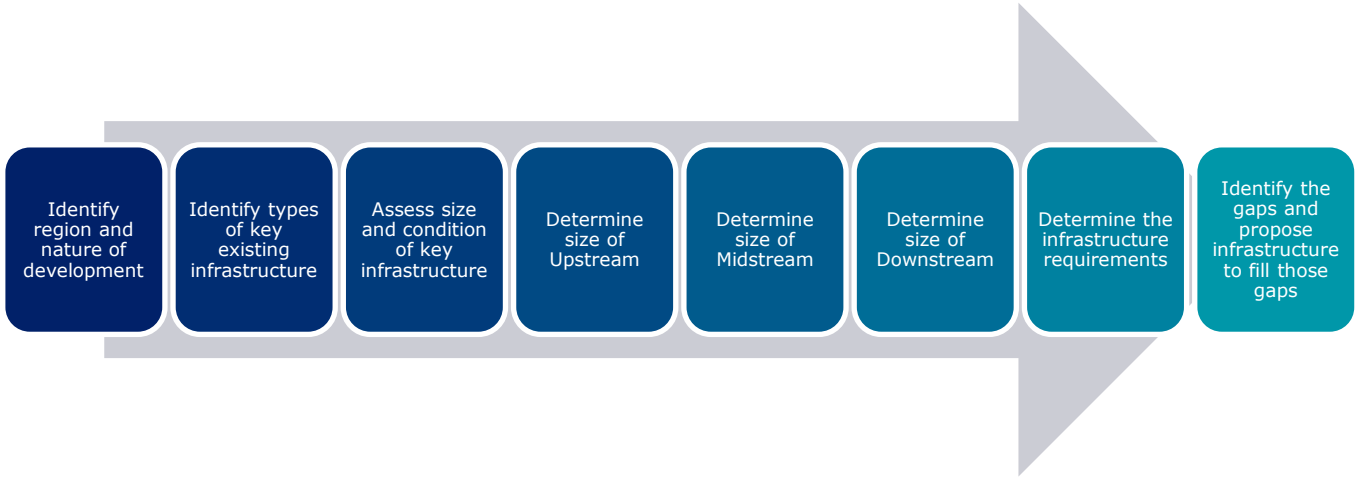
Table 18 - Policy feedback

Feedback	Area of concern	Level of government
Lack of clarity on long term emissions targets increases the risk of investing in Australia	Environment	Commonwealth
Lack of coordination between NT and Cth leads to uncertainty and miscommunication	General	Commonwealth/State
Uncertainty around the approach and cost associated with outstanding recommendations from the Hydraulic Fracturing Inquiry.	Commercial	State
Capacity of government to resolve a future increase in environmental approvals in a timely manner	Capacity	State
Security of tenure of fields is poor in comparison with other states i.e. SA	Commercial	State

5.4 Approach to determining infrastructure requirements

Governments should seek to balance the first mover risk and free-rider advantage as a potential barrier to exploration activity, where infrastructure is funded by the first developer but then becomes available to all subsequent developers. Consequentially, we have targeted infrastructure that will be of common use to multiple private investors. The provision on an open access basis, with or without common user charges, will ensure that costs borne by potential developers are borne equitably. The methodology used to determine the need for additional infrastructure is as follows:

Figure 14 - Methodology of determining infrastructure requirements



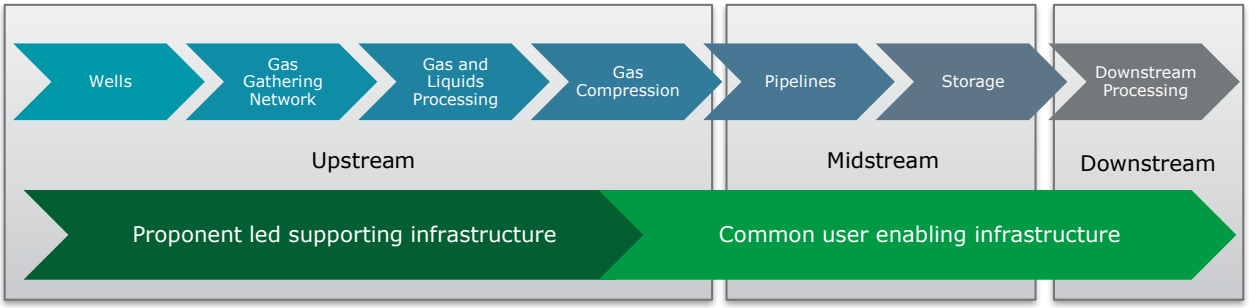
Where available and appropriate, a similar cost basis as adopted by KPMG (2019) is used, as requested by the Commonwealth. Where an alternative cost basis was found to be justified, the differences are noted in this report.

5.5 Sizing and nature of infrastructure requirements

5.5.1 Upstream

As discussed, the development of the Beetaloo Sub-basin could mirror the development pathways of the Marcellus shales in the USA. Experience from Marcellus guides a building block approach for defining the value chain, and its supporting and enabling infrastructure. A simplified overview is given below:

Figure 15 – High-level basin value chain



As exploration of the field continues, the precise nature of the Beetaloo Sub-basin development is still unknown. As such, a scenario assessment methodology has been adopted which considers the four development pathways identified in the KPMG / GHD / RISC report to the Northern Territory government in 2019.

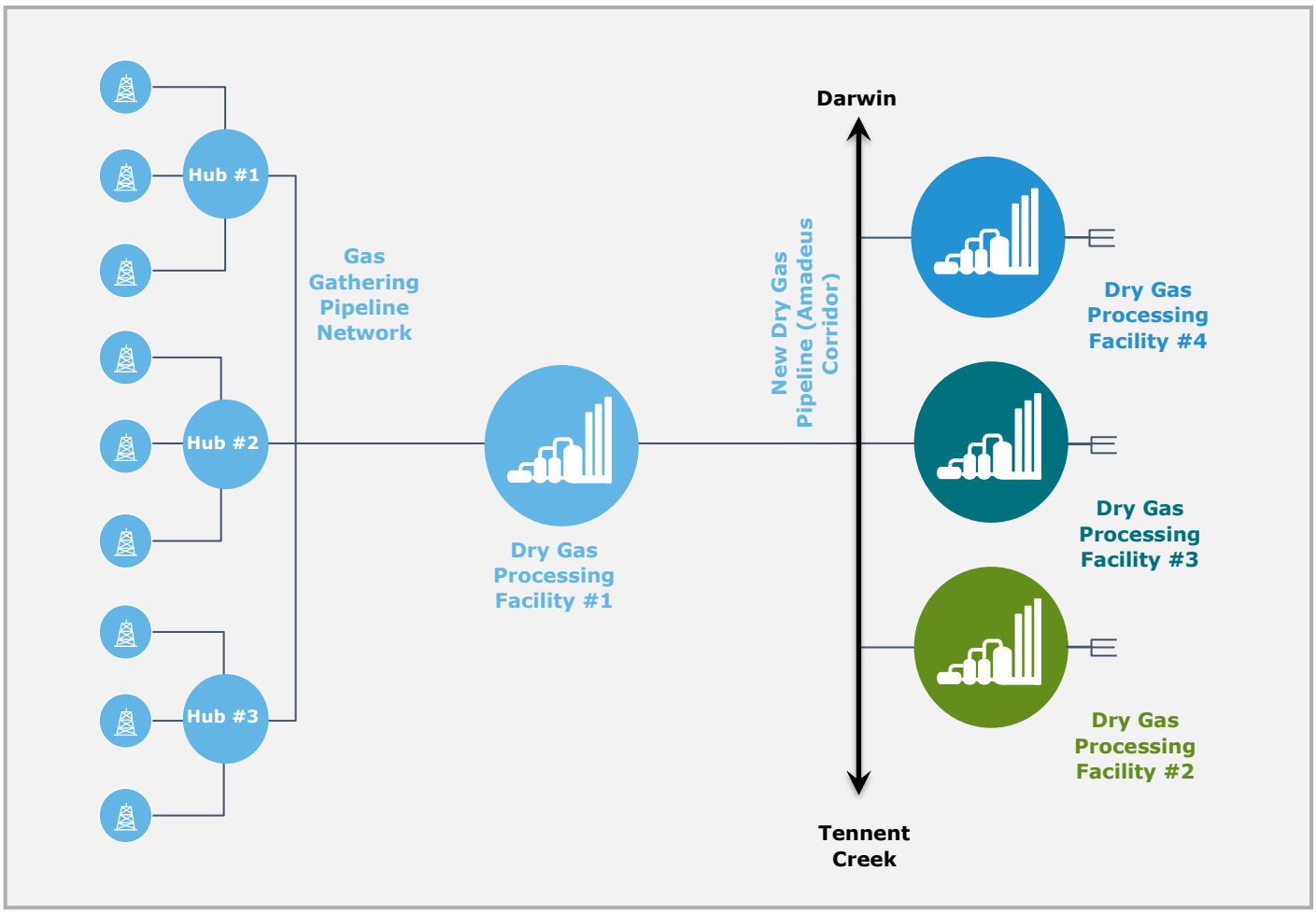
Table 19 - Development scenarios (KPMG 2019)

Play	Case	Total Gas Production (TJ/day)	Total Liquids Production (Bbl/day)
Middle Velkerri Dry Gas	Low	100	0
	Mid	1700	0
	High	3300	0
Kyalla Liquids Rich	High	1600	120,000

These scenarios provide a high-level basis for determining the size of the upstream elements of the development. There are multiple proponents with an interest in developing the upstream resource, including large and smaller operators. These operators could have differing objectives, such as LNG in Darwin, LNG in Gladstone, NT domestic or the east coast domestic market.

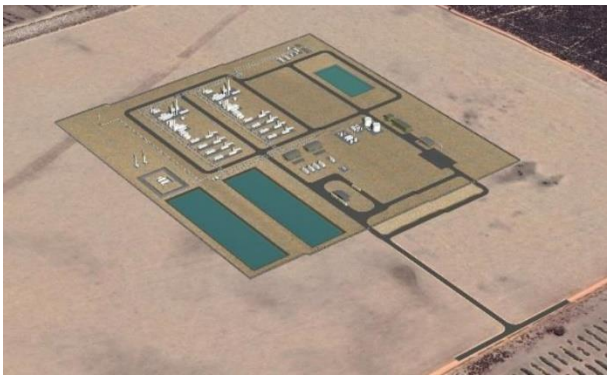
As a result, the most likely development scenario for upstream infrastructure is that proponents or infrastructure providers will separately plan and commission supporting infrastructure. This will lead to multiple smaller scale gas projects across the full supply chain (400-500 TJ/day) that may be phased over several years rather than one large basin scale development. Although this may lack significant economies of scale, it reflects the likely agility required of developers as they balance economic returns, commercial risk and expected levels of sustainability (local jobs and environmental impact).

Figure 16 - Upstream development (individual proponent led)



Sizing for gas processing facilities for these developers are based on both Australian and international metaphor projects, a strong example of which is the Mitsui Waitsia (Mitsui 2019) project located in the Perth basin. Though a conventional gas project and deemed not remote, the project is similar in scale to each node size being contemplated for the Beetaloo Sub-basin. The Waitsia project at 250 TJ/day utilises 2 x 125 TJ/day trains, which will be modularised in Fremantle, Western Australia, with imported components.

Figure 17- Waitsia phase 2 gas processing facility



Source: Mitsui 2019

The reference design for the upstream development will utilise a similar configuration, using multiples of the 125 TJ/day trains to meet the target production.

Table 20 - Upstream facility sizing

Play	Case	Total Gas Production (TJ/day)	Number of Wells (ea)	Well pads (ea[70])	Gathering network[71] (km)	Number of Gas processing trains (ea[72])	Gas Processing Facilities	Gas Compression (MW)
Middle Velkerri Dry Gas	Low	100	375	47	329	1	1 x 100TJ/day	10
	Mid	1700	2,200	275	1925	14	4 x 425TJ/day	200
	High	3300	2,225	279	1953	27	6 x 550TJ/day	380
Kyalla Liquids Rich	High	1600	3,520	440	3080	13	4 x 400TJ/day	180

KPMG (2019) state capital cost assumptions for the Beetaloo development as in Table 20. Key to these assumptions is:

1. Darwin is the only market for both gas and liquids
2. Large scale single proponent developments exploiting economies of scale
3. Large-scale common use of infrastructure.

Without government intervention, a disaggregated development scenario is more likely, as was seen in the development in the Surat Basin and the Marcellus Shales in the USA i.e. several mid/large-scale producers competing for the largest and most productive tier-1 resources, and a competitive fringe of smaller proponents efficiently exploiting Tier-2 resources. This would suggest that the KPMG capital costs are on the low side for gas processing (AU$0.77M/TJ/day) when compared to projects of a recent comparative size i.e. the Waitsia 2 development in Western Australia. A suggested alternative cost should be considered in order to understand sensitivity to the upstream capital cost, and future investigation. These are shown below.

Table 21 - Recommended gas processing cost adjustments

Cost Component	KPMG	Recommended
Gas Processing Costs (AU$ million) – Velkerri Medium	1,314	3,400
Gas Processing Costs (AU$ million/TJ/Day)	0.77	2.00

Though determining the improvement in capital cost requires further analysis, the differences in capital estimation between KPMG (2019) (which models a single common user facility) and this study (which models 5 individual facilities) provides some guidance. The difference is estimated to comprise over AU$2B in capex from gas processing alone, and could yield a saving of up to $0.50/GJ in tariff over the first 20 years of development for all gas users. Any cost savings are important to ensuring the success of the Beetaloo Sub-basin development.

Recommendation

E. NT Government to assess feasibility of a single, shared common user gas processing facility, to lower processed gas price.

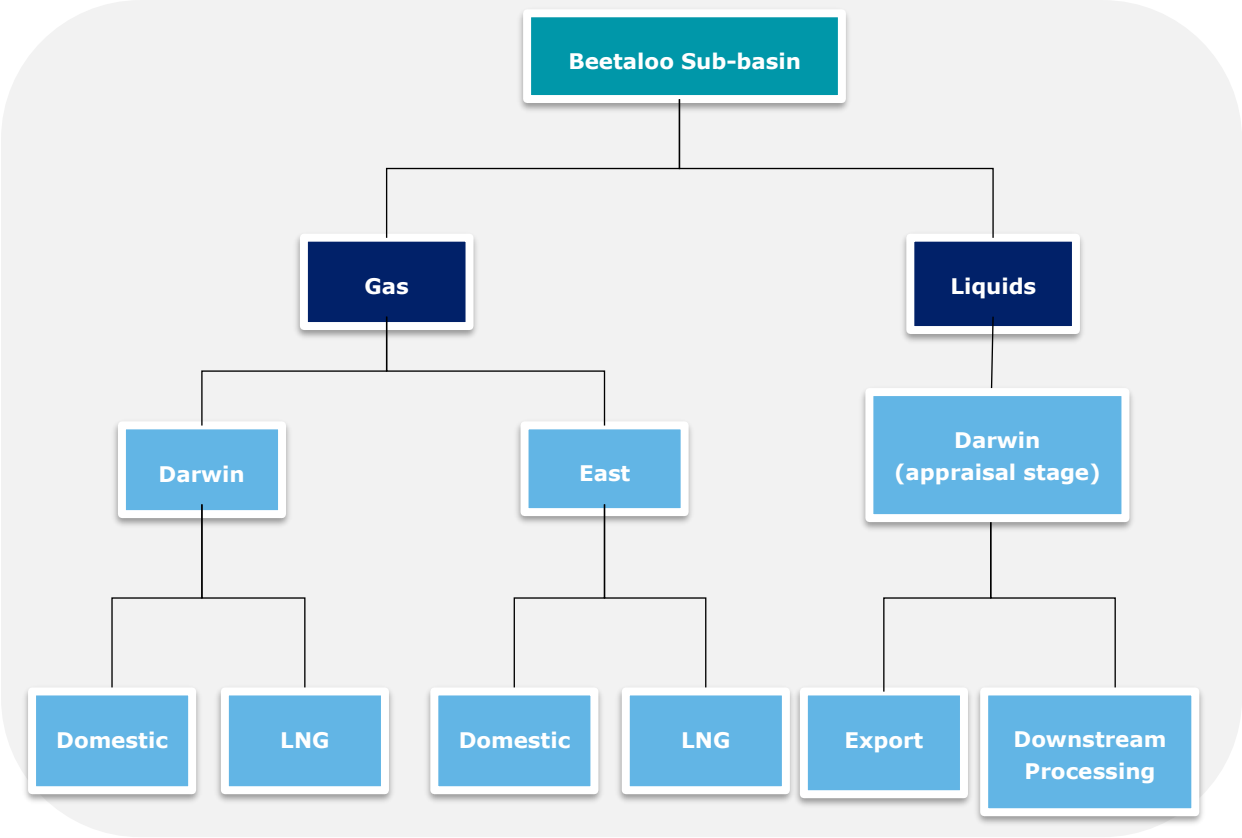
[70] Average number of wells per well pad for the development phase is 8 (KPMG 2019).
[71] Average diameter of the gas gathering network is 200mm, with an average of 7km per well pad (KPMG 2019).
[72] Figures have been rounded up, assuming some excess capacity will be retained.

5.5.2 Midstream

Several stakeholders stated that the development of infrastructure, in particular pipelines, is one of the primary barriers to development. This is because a pipeline is a large capital outlay and there is currently uncertainty over how it should be paid for, if the Beetaloo is to reach its full potential. The existing pipelines do not necessarily have the capacity to support the full Beetaloo resource.

The nature of midstream elements (pipelines and storage) of the Beetaloo Sub-basin development are separated not only by scenario, but also by location. Natural gas, depending on demand, can flow north to Darwin via the Amadeus pipeline corridor, or east, via the Amadeus gas pipeline corridor, Northern Gas Pipeline (NGP) corridor and the Carpentaria gas pipeline corridor. At these destinations, the gas can either be used as domestic gas (retail or industrial users) or exported as LNG from existing assets. Though there are some small-scale storage assets in the eastern gas network, the volume is very small in comparison to that held in the pipeline network.

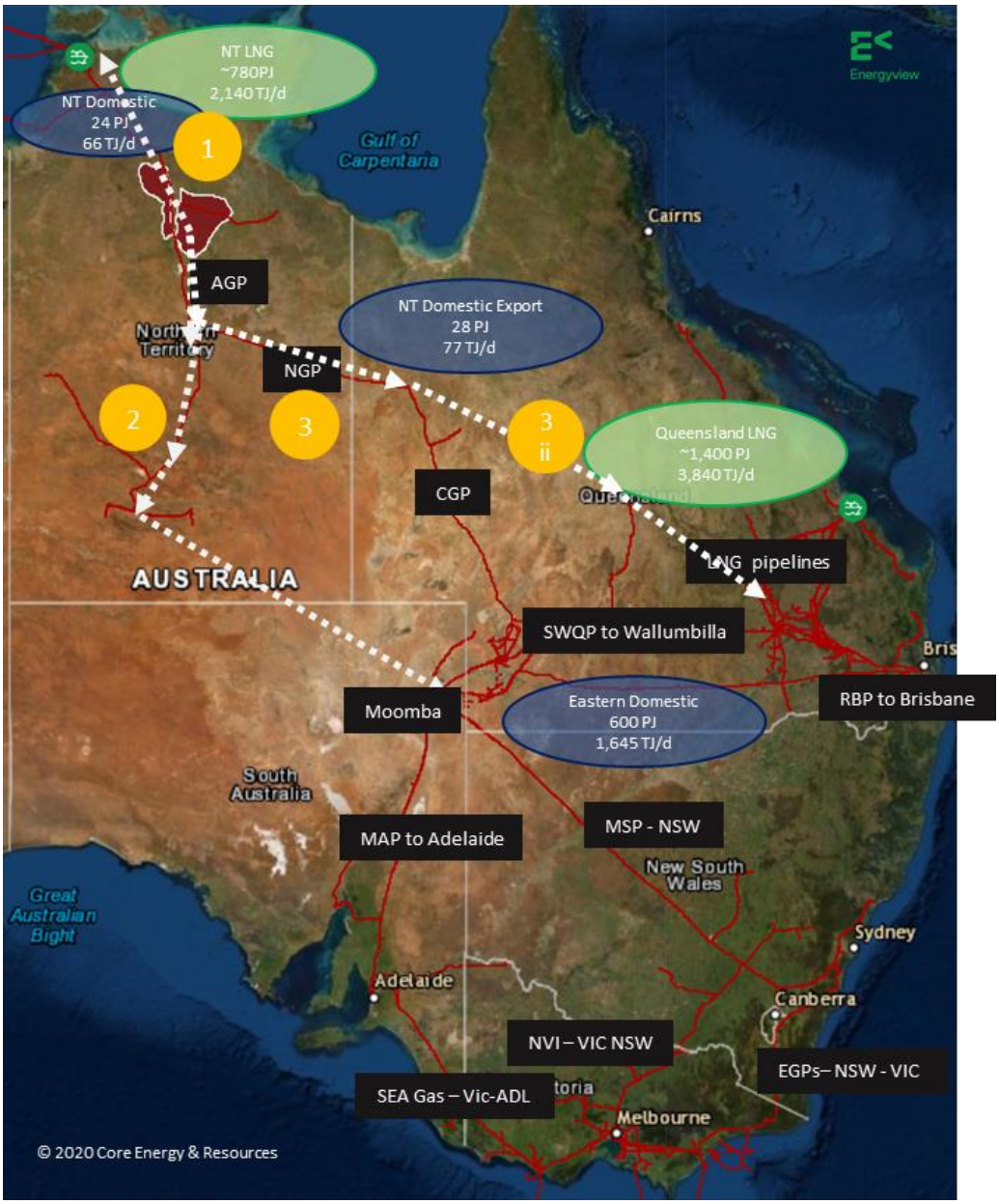
Figure 18 - Midstream gas options



There are new gas pipeline routes being conceptualised (indicated below) connecting Alice Springs with Moomba and Mount Isa with Wallumbilla via the Galilee Basin. However, these are considered speculative and have not yet achieved final investment decisions. This results in greater lead times, development risks and greater cost uncertainty, but it does not remove the validity of these options from consideration. We understand that the capital cost of the different new gas pipelines will be a contributing factor to a net benefits assessment of the available options, and therefore the lowest capital cost option will not necessarily be preferred.

Factors other than capital costs will also need to be considered, such as security of gas supply to the East Coast, and improving the number of gas market participants and sources of supply.

Figure 19 – Existing markets in NT and Eastern Australia and potential gas supply pathways (illustrative only)



Source: CORE Analysis

Based on the gas pipeline scenarios and market conditions developed for this report by CORE, the required upgraded gas pipeline sizes following existing pipeline corridors is considered below.

Table 22 - Recommended pipeline sizes (2031)

Play	Case	Total Gas Production (TJ/day)	Total Gas to Darwin (TJ/Day)	Total Gas to East Coast (TJ/Day)	Beetaloo to Darwin Gas Pipeline Size[73] (Vol TJ/Day)	Beetaloo to Wallumbilla, via NGP - Pipeline Size[74] (Vol TJ/Day)
Middle Velkerri Dry Gas	Low	100	41	0	Nil upgrade required	Nil upgrade required
	Mid	1700	534	822	DN450/18" (369 TJ/day)	Beetaloo to Mt Isa DN650/26" (732 TJ/day). Mt Isa to Ballera DN600/24" (694 TJ/day), Ballera to Wallumbilla DN600/24" (685 TJ/day).
	High	3300	1904	1096	DN1050/42" (1,739 TJ/day)	Beetaloo to Mt Isa DN800/32" (1,006 TJ/day). Mt Isa to Ballera DN800/32" (968 TJ/day), Ballera to Wallumbilla DN600/24" (685 TJ/day).
Kyalla Liquids Rich	High	1600	1548	0	DN1050/42" (1,383 TJ/day)	Nil upgrade required

Alternatives exist that have the potential for increasing the capital utilisation of existing infrastructure, nominally a potential new Beetaloo to Moomba Gas pipeline. In this case the full volume of the east coast demand would flow to Moomba, in a raw or semi processed state, unconnected to the existing gas network allowing processing of the raw gas at Moomba. For the Mid Dry Gas scenario, this would require a DN700/28" pipeline and for the High Dry Gas scenario a DN800/32" pipeline.

For the liquid rich scenario, a total of 120,000 barrels a day of oil and condensate will be produced. Early in the development phase, this is likely to be transported by truck/rail to Darwin and handled via existing infrastructure located at East Arm Wharf. Once full production is reached, a liquids pipeline from the Beetaloo to Darwin will be required, along with a fit-for-purpose liquid handling facilities. Preliminary sizing indicated that:

- The pipeline would be DN500/20"
- Storage facilities of approximately 150,000 m^3 at Darwin Port
- facilities to accept vessels up to 141,000 m^3 (length overall of 230m and a deadweight of 90,000 tonnes).

Alternatively, a liquids pipeline connecting the Beetaloo to Moomba would allow the liquids to be processed through the aged existing infrastructure at Moomba, providing ongoing feedstock to Port Bonython (SA).

Accessing viable markets for the produced gas and oil is a pre-condition to the successful development of the Beetaloo Sub-basin. The existing pipelines do not necessarily have the capacity to support the full Beetaloo resource in a mid or high gas scenario, and a new pipeline would comprise a very large capital outlay.

Prior to production, a phased approach will be deployed which provides a lower cost pathway to market for the exploration and appraisal volumes of gas and liquids. These pathways are described below.

Development Scenario	Phase	Technical Solution	Volume Range
High/Medium Dry Gas case	Exploration (Gas)	Trucked CNG/LNG to domestic NT market	0-80TJ/day
High/Medium Dry Gas case	Appraisal (Gas)	Incremental upgrades to AGP, NGP and CGP	80-200TJ/day
High/Medium Dry Gas case	Development/Sustain (Gas)	Market specific pipelines	>200TJ/day

[73] In addition to existing infrastructure. Current capacity of Amadeus Pipeline is 165 TJ/Day.
[74] In addition to existing infrastructure. Current capacity of NGP is 90TJ/day, Carpentaria Gas Pipeline is 128 TJ/Day.

High (Liquids)	Exploration (Liquids)	Via road Vopak Darwin or other	<8,500 Bbl/day
High (Liquids)	Appraisal (Liquids)	Via rail to Darwin or Adelaide	~8,500 Bbl/day
High (Liquids)	Development/Sustain (Liquids)	Liquids specific pipeline to Darwin	~120,000 Bbl/day

The proposed pipeline infrastructure requirements for the Development phase are outlined and the relative capital costs are given below in Table 23. These are considered final sizes required under the stated scenarios.

Table 23 - Proposed pipeline upgrades (required for development phase)[75]

	Infrastructure Type	Priority/ Material to Development	Title	Size	Volume (TJ/day)	Development Scenario	Distance (km)	CAPEX (AU$m)	CAPEX Norm ($AU/Inch.km)	Commissioning (Date)	Life (Yrs)
1	Pipeline	High (1)	Beetaloo to Darwin Gas Pipeline	18	369	Medium Dry Gas	600	$702	$65,000	2027	50
2	Pipeline	Med (2)	Beetaloo to Mt Isa Gas Pipeline	26	732	Medium Dry Gas	1022	$1,727	$65,000	2027	50
3	Pipeline	Med (2)	Mt Isa to Ballera Gas Pipeline	24	694	Medium Dry Gas	840	$1,310	$65,000	2027	50
4	Pipeline	Med (2)	Ballera to Wallumbilla LNG Pipeline	24	685	Medium Dry Gas	756	$1,179	$65,000	2027	50
1	Pipeline	Low (3)	Beetaloo to Darwin Gas Pipeline	42	1739	High Dry Gas	600	$1,638	$65,000	2026	50
2	Pipeline	Low (3)	Beetaloo to Mt Isa Gas Pipeline	32	1006	High Dry Gas	1022	$2,126	$65,000	2027	50
3	Pipeline	Low (3)	Mt Isa to Ballera Gas Pipeline	32	968	High Dry Gas	840	$1,747	$65,000	2027	50
4	Pipeline	Low (3)	Ballera to Wallumbilla LNG Pipeline	24	685	High Dry Gas	756	$1,179	$65,000	2027	50
1	Pipeline	High (1)	Beetaloo to Darwin Gas Pipeline	42	1383	High Wet Gas	600	$1,638	$65,000	2027	50
B	Pipeline	TBD	Beetaloo to Moomba Gas Pipeline	28	822	Medium Dry Gas	1567	$2,852	$65,000		50
B	Pipeline	TBD	Beetaloo to Moomba Gas Pipeline[76]	32	1096	High Dry Gas	1567	$3,259	$65,000		50

[75] Estimated total capital cost (public and private investment). Priority to be determined when results of appraisal phase are known.
[76] Due to downstream volume constraints, this is considered the maximum volume for this evacuation pathway. Volumes above this limit will be directed to Darwin or Gladstone for LNG.

The natural monopolistic characteristics of pipelines (e.g. high fixed capital costs with economies of scale) often result in the need for regulation to ensure economic efficiency. All pipelines that provide third party access in Australia are subject to one of three form of economic regulation: full regulation, light regulation and what is known as "Part 23". Unregulated pipelines are limited to those that are of a dedicated nature.

5.5.2.1 Exploration and early development

During the exploration, appraisal and early development of the Beetaloo Sub-basin the available gas volumes can be readily absorbed by the domestic gas market. Access is via the existing pipeline network, with the Amadeus and Northern Gas Pipelines being the critical local infrastructure, however, is not likely to be sufficient capacity on these pipelines to evacuate that appraisal gas.

Full open access is provided to the Amadeus Gas Pipeline currently. Tariffs are regulated by the Australian Regulatory Authority and capacity can be acquired through negotiation from the pipeline owner (APA Group) if available. The Northern Gas Pipeline provides open access through a rolled-in tariff to all shippers of $1.52/GJ (Firm Forward Haulage)[77]. It has a 15-year derogation from Part 23 of the National Gas Rules and Jemena has committed to lower the cost to all shippers in the event that additional capacity is added at a lower average cost. To meet East Coast gas market specification, nitrogen must be removed. Jemena offers this at an additional cost (NRSA tariff) of $0.78/GJ for a 10-year term.

The availability, transparency and pricing of Amadeus pipeline capacity will be an important regulatory consideration during the early development of the Beetaloo. This pipeline flows south to Tennant Creek where it connects to the Northern Gas Pipeline. Existing capacity on the Amadeus pipeline may be both fully contracted and fully utilised in future periods given the availability of gas in the north and the market for gas in East Coast. This is an important constraint to evacuating appraisal gas and is under consideration by the NT government.

Government may also seek to participate in any negotiations for incremental capacity expansion. APA will legitimately seek full cost recovery for changes to the Amadeus Gas Pipeline. Developers may consider construction of a new pipeline along the same easement. There is also the potential for inequity in outcomes for developers and the loss of economies of scale in capacity creation if each developer seeks independent outcomes. We understand the NT Government has commenced a pipeline feasibility study to ensure that the route North is developed efficiently.

Jemena's commitment to the rolled-in tariff will be closely observed by the market. Consideration has already been given to implementing regulatory 'coverage' of the Northern Gas Pipeline by the Australian Energy Market Commission, with the implication that it will be pursued should Jemena seek to maximise its currently exclusive position linking the Northern Territory and east coast gas markets.

H. The Commonwealth should monitor progress on the required upgrades to AGP, NGP and CGP to evacuate **appraisal gas** to the East Coast market, to support Medium term activities.

The principal issue with investing in large common user infrastructure is capital efficiency in ramped supply conditions. This results in small facilities that lack economies of scale, and is a natural market failure as it leads to long term inefficiencies. If the NT Government or even pipeline owners can guide alignment of production schedules and infrastructure construction, to meet pipeline construction or upgrade timetables, efficiencies of scale and cost savings will result.

5.5.2.2 Production phase

The scale of opportunities in the Beetaloo Sub-basin provides the potential for investment in new pipeline capacity. This has potential to be an efficient outcome and has the possibility of providing a cross-subsidy to domestic gas (in the case of a Beetaloo-Wallumbilla pipeline) as a majority of the tolls will be attributed to high-volume LNG exports. It has implications for other developers seeking to get gas to market, and the competitive dynamics of the gas market generally. However, it could also result in the sub-optimal development of multiple pipelines, with underutilised high fixed cost investments leading to higher tariffs.

While both APA Group and Jemena may loop and add compression to their existing assets, we consider the development of new pipelines may be cost competitive and will come with the added benefit of providing competitive pricing outcomes.

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[77] Jemena, *Northern Gas Pipeline Tariffs* (Website) <https://jemena.com.au/industry/pipelines/northern-gas-pipeline/services>.

We consider gas and oil pipelines (or upgrades) connecting the Beetaloo Sub-basin with Darwin to the north will be required at the earlier phases and a gas pipeline connecting to the Northern Gas Pipeline or to the southern markets will required post end 2020 – early 2030s. Gas pipelines from the Beetaloo through Alice Springs to Moomba could provide an effective competitive alternative to the Northern Gas Pipeline.

The proposed gas and liquids pipelines needed to develop the Beetaloo Sub-basin are significant capital investments. They have broad implications for the development of the Australian economy through the cost-effective delivery of gas and liquids, and the decisions on pipeline sizing and route selection will impact regional and sub-regional growth. Additionally, there are significant economies of scale associated with these investments that will be lost if proponents develop standalone alternatives. While significant pipeline investment is not anticipated to be needed until 2027, the development lead time is also reasonably long.

Government could play a role in coordination and development of a new pipeline or pipelines, potentially by utilising the 'competitive tender provisions' in Part 5 the National Gas Rules. These provisions allow the terms and condition of a competitive tender process to be set equally for all users of the pipeline including current and future users. A competitive tender process would also create the competition for the market at a point in time, which would also help to reduce the potential for anti-competitive behaviour from the monopoly infrastructure owner.

There is a role for the Commonwealth Government to assess the net economic benefits of the available alternatives and ensure the preferred route is selected and that it is scaled for use by all proponents.

Historically, both State and Commonwealth Governments have played a coordinating role in the development of large gas pipeline investments. Examples include the Western Australian Commonwealth Government underwriting the development of the Dampier – Bunbury pipeline (DBNGP) through take-or-pay contracts, and the Commonwealth Government coordinating competitors into each procuring gas through a common pipeline from Papua New Guinea.[78]

Though the DBNGP and PNG pipelines provides a blueprint for the Commonwealth Government to coordinate the development of key pipelines, NAIF can provide a more efficient pathway for government participation. This can be achieved through two pathways:

1. **Comparative cost-benefit-assessments** – This may be beneficial if NAIF can only provide subsidised finance to one in a series of competing concepts. Capital would gravitate to infrastructure with both the best commercial performance but also the superior net benefit for Australia.
2. **Underwriting economies of scale** – Incremental increase of capacity in pipelines or other infrastructure, though capitally efficient, can lead to long term inefficiencies and higher tariffs. Mobilising NAIF funding to provide early capital relief to projects as volume ramps up to economic scale, can yield superior cost performance in the long term.

Both approaches allow gas to flow efficiently to the market, with well controlled investment support aligned with supporting the national interest.

Recommendations

I. The Commonwealth should undertake detailed comparative cost benefit analysis of larger scale, new Beetaloo-Moomba/Ballera, and Beetaloo-Wallumbilla Gas Pipeline routes, if NAIF is approached to support **a new gas pipeline in the Long term**.

[78] Although each major gas retailer agree to contract for capacity on the proposed line, the project did not proceed.

5.5.3 Downstream

Several downstream industries are being considered for Darwin (Middle Arm) that could leverage off large volumes of product coming from the Beetaloo Sub-basin (See Appendix B.2). These are summarised below.

Table 24 - Proposed downstream industries

Project Name	Operator	Industry Sector	Target FID	Target start-up	Gas p.a. (PJ)	Reserve required (PJ)	Develop timeframe	Capex AU$m	Infrastructure required
TNG	TNG	Minerals Processing	2021	2026	5.4	220	2-3 years	AU$500 - AU$600	Rail siding
Coogee[79]	Coogee Chemicals	Methanol (methane)	2023	2026	14 - 40	300 - 800	2-3 years	AU$500	Port[80]
Darwin Clean Fuels	Darwin Clean Fuels	Downstream Refining (Condensate Cracker)	2022	2026	3.5 - 5	70 - 100	2-3 years	AU$1200	Port
Kittyhawk LNG	Gold Valley Energy	LNG	On hold	On hold			1-2 years		
Theoretical Ethylene Plant[81]	N/A	Downstream Refining (Ethane Cracker)	N/A	N/A			3-4 years	typically > AU$1.6 B	Port
Theoretical Ammonia Plant[82]	N/A	Fertilisers	N/A	N/A	~ 35	~700	2-3 years	typically AU$1.5 - AU$2.0 B	Port

The key competitive advantages the Downstream sector see in Middle Arm are:

1. Proximity to Asian Markets versus US production (Methanol, Ethylene, Minerals)
2. Access to long term gas supplies (Methanol, Ammonia)
3. Access to hydrocarbon liquids not linked to netback pricing (Ethylene).

Given similar capital and operational costs across global commodities, the key cost advantage the Northern Territory enjoys over US supply is the proximity to key Asian markets. On average, this provides an US$1/GJ advantage over Henry Hub prices on energy export projects, and similar on non-energy-based projects. This demonstrates the need for a lean approach to supporting infrastructure in order to remain competitive. We have not explicitly considered downstream assets on the East Coast due to the breadth and maturity of this market.

Several East Coast industries are reliant on domestic natural gas and ethane feedstocks. Methane and ethane are generally used as a chemical processing feedstock, process heat/steam or on-site power generation. These industries include petrochemicals, alumina, ammonia production, and generally consume approximately 250PJ of natural gas p.a.

[79] Current plans are to produce 300,000 tpa, but should also consider future expansion (taken to be 1,000,000 tpa).
[80] A separate study to consider wharfage options is being undertaken. Current indications are that this will cost AU$400 - A$800 million to construct.
[81] Assumes production of 1,000,000 tpa polyethylene.
[82] Assumes production of 750,000 tpa ammonia.

The largest consumers include:

- Qenos (Altona and Botany) - Australia's sole producer of polyethylene, which uses 40 PJ p.a.[83] of gas including ethane
- Rio Tinto Alcan (Yarwun) - Producing aluminium and consumes approximately 20 PJ p.a.[84]
- Orica (Kooragang Island) - Producing fertilisers and explosives consuming approximately 14 PJ p.a.
- Incitec Pivot (Gibson Island) - Producing fertiliser and explosives consuming approximately 13 PJ p.a.[85]
- Australian Paper (Maryvale Mill) - Producing pulp and paper consuming approximately 7.5PJ p.a.

Given the recent very high prices of gas in the east coast market, gas exposed industries are considering shutting in or exporting production, as per Coogee Methanol[86], rather than expansion scenarios. Through the consultation process, gas intensive industries have shared that a long term price below AU$7/GJ is required to stabilise the sector at a profitable level, and prices below AU$5/GJ is required before investment in additional capacity would be considered.

Depending on the final pathway for ethane, if via Moomba, the delivered price could be partially offset by the production of natural gas providing a pathway for expansion of polyethylene production by Qenos. As Asia is perceived by the petrochemicals sector to be the highest growth opportunity globally, if large volumes of ethane can be delivered cost competitively to Botany, additional ethane cracking investment would be likely.

5.6 Enabling infrastructure and regulatory requirements

5.6.1 Transport

5.6.1.1 Roads

We recommend upgrades to the major arterial and key rural roads that service the Beetaloo. Notably, the improvements which will provide the most benefit to development are ones that provide for the addition of a significant number of truck movements on local roads. Trucking volumes can be expected to be significant when drilling activity is underway, enabling the movement of drilling equipment, water and wastewater, fuel, and proppant.

Specific road upgrades and expected costings for consideration are outlined in Table 25 below.

[83] Australian Competition & Consumer Commission, '*Gas Inquiry 2017 – 2025 Interim Report*' (Report, September 2017) < https://www.accc.gov.au/system/files/Gas%20Inquiry%20-%20Interim%20Report%20-%20September%202017.pdf> ('*ACCC Interim Gas Report September 2017'*).
[84] Deloitte Access Economics, *Gas market transformations – Economic consequences for the manufacturing sector* (Report, July 2014) <https://chemistryaustralia.org.au/news-events/gas-market-transformations_economic-consequences-for-the-manufacturing-sector>.
[85] Department of Resoures, Energy and Tourism, *Case Study: Incitec Pivot – Gibson Island* (Case study, April 2009) <https://www.energy.gov.au/sites/default/files/incitec_pivot_plant_-_gibson_island.pdf>.
[86] ACCC Interim Gas Report September 2017 (above n 120).

Table 25 - Proposed roads upgrades[87]

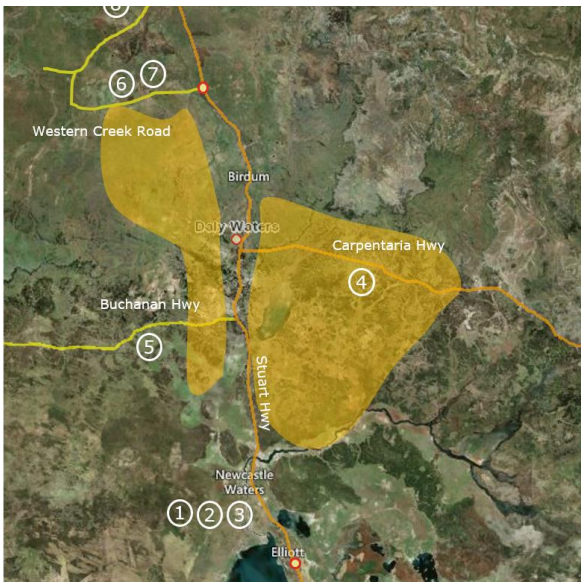
	Infrastructure Type	Priority/Material to Development	Upgrade Title	Size	Development Scenario	CAPEX (AU$m)	CAPEX Norm (AU$m)	Commissioning (Date)	OPEX Norm (AU$m)	Life (Yrs)
1	Highways	High (1)	Stuart Highway - Pavement	TBA	Medium & High (Dry Gas), High	TBA	$2M/km	2024	0.0022/km/yr	30
2	Highways	High (1)	Stuart Highway - Intersection upgrades		Medium & High (Dry Gas), High (Liquids)	$0.27	0.27ea	2023	0.0022/km/yr	30
3	Highways	High (1)	Stuart Highway - Capacity Upgrades - Upgrade widening of carriageway	60km	Medium & High (Dry Gas), High (Liquids)	$60	1/km	2023	0.0022/km/yr	30
4	Highways	High (1)	Carpentaria Highway - Upgrade to two lane sealed	140km	All	$150	1.1/km	2022	0.0022/km/yr	30
5	Rural Roads	Med (2)	Buchanan Highway - Upgrade to two lane sealed	67km	Medium & High (Dry Gas), High (Liquids)	$70	1.1/km	2024	0.0022/km/yr	30
6	Rural Roads	Med (2)	Western Creek Road (Ch 0 to 56) - Upgrade to two lane sealed	56km	All	$58	1.1/km	2024	0.0022/km/yr	30
7	Rural Roads	Med (2)	Western Creek Road (Ch56 to 92) - Upgrade to good gravel standard	36km	All	$27	0.75/km	2026	0.0022/km/yr	30
8	Rural Roads	Med (2)	Gorrie Dry Creek Road - Upgrade to good gravel	84km	Medium & High (Dry Gas), High (Liquids)	$62	0.75/km	2026	0.0022/km/yr	30

Source: EPCT using prior data prepared for NT DBTI

Expediting investment in the enabling roads infrastructure will provide a clear and unambiguous demonstration of government support for the development of the Beetaloo Sub-basin. Investment in highways should be prioritised due to the broad benefits to multiple users and difficulties in gaining contributions from exploration proponents.

[87] Estimated total capital cost (public and private investment).

Figure 20 - Map indicating relevant roads



Roads regulation

Road construction and maintenance is generally the responsibility of state and local governments. The exception is for private roads, which developers in the Beetaloo Sub-basin are likely to directly fund and construct to meet their local needs.

State and local governments receive Commonwealth Government funding under schemes such as the Infrastructure Investment Program, the Roads to Recovery Program, the Bridges Renewal Program, and the Black Spot Program. Of particular relevance to the Beetaloo Sub-basin is the Heavy Vehicle Safety and Productivity Program that seeks to fund infrastructure projects that improve the productivity and safety outcomes of heavy vehicle operations.

Stakeholder engagement confirmed that upgrades to the public roads were required, noting that such an investment would provide benefits from an efficiency and safety perspective, and would benefit regional communities, livestock transport industry, mining industry, tourism industry and general freight load. Upgrade of the Carpentaria Highway was identified as likely to have the biggest benefit to the broadest range of users.

Beetaloo Sub-basin developers should continue to be served by the available public (open access) road infrastructure. Developers contribute to this infrastructure through the current user pays regime through fuel excise, heavy vehicle user charges, and the fuel tax credit. While mechanisms that adjust the heavy vehicle usage charges and/or the fuel tax credit for developers might be considered to enhance cost recovery, these are likely to be relatively expensive to AUit and administer relative to their financial impact. Roads used by many users are generally treated as public goods, which leaves developers with the responsibility to construct private roads that leverage the public roads. Private roads will generally be on private land and for the sole use of the developer.

Recommendation

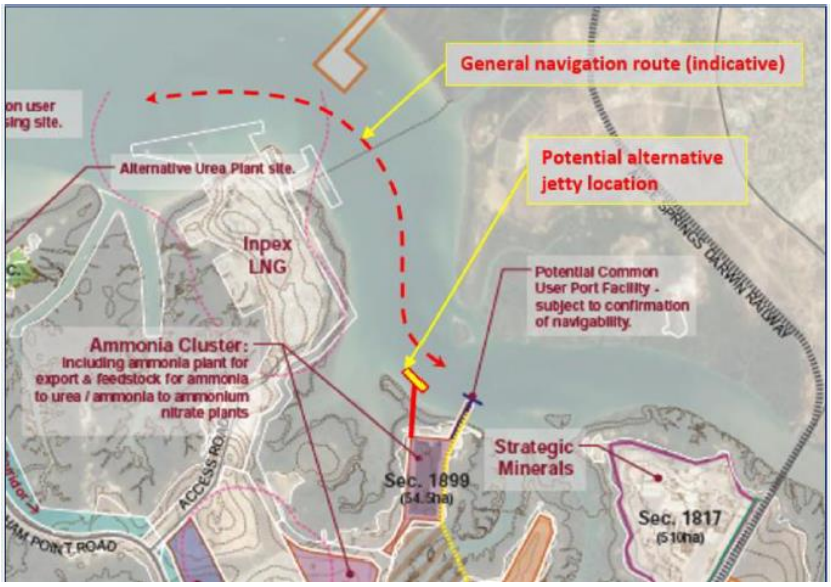
G. The Commonwealth and NT Governments should jointly expedite delivery of the proposed roads program (Stuart Hwy, Carpentaria Hwy, Western Creek Rd, Buchanan Hwy, Gorrie Dry Creek Rd). This includes the upgrade of highways and rural roads during the 2022-2026 period. These could be funded through the existing Infrastructure Investment Programs including the Roads of Strategic Importance program, and that road user charges remain applicable.

5.6.1.2 Ports

With ports providing key pathways to reduce transportation costs throughout the Sub-basin lifecycle, a long-term view is recommended for key nodes. Though the current Port of Darwin is under-utilised, it is limited by high costs and access to areas for substantial increases in storage volumes.

The NT Government's Gas Task Force is investigating the development of a Bulk Liquids and Dry Products wharf to be located at Middle Arm. This is envisaged to be a common user facility supporting exports from Darwin. Presently the Very Rough Order of Magnitude ranges of capital costs provided is AU$400-800 million, with AU$450 million being the median. Recent consultation indicates that site 7, at Preston Point is the preferred site location for the Port.

Figure 21- Proposed location of middle arm common user jetty



Alternatives are available in the short term which can incrementally receive smaller volumes made available during the appraisal phase (if the liquids rich scenario unfolds). Nominal upgrades to liquids handing above existing storage capacity at Vopak, located at East Arm Wharf can provide the short-term flexibility on volumes ex-Beetaloo.

Costs anticipated for an upgraded Vopak facility (based on the scenarios being considered) are as follows:

- 2 x 50 kilo-cubic metre LPG tanks (plus related infrastructure): ~AU$150 million
- 2 x 35 kilo-cubic metre condensate tanks (plus related infrastructure): ~ AU$30 million
- 4 LPG truck unloading bays: ~ AU$20 million
- 2 Condensate truck unloading bays: ~ AU$6 million
- 1 LPG jetty line plus one LPG MLA: AU$7 million

The proposed bulk liquids storage and offloading facility envisaged for Middle Arm is not deemed material to the development of the Beetaloo. During the Production Phase (liquids rich), with large and consistent volumes available, post 2030, additional storage should be considered for Darwin utilising land proximate to available bulk liquids wharf capacity. Consistent with shale developments in the Marcellus, the use of local sand as a proppant is considered likely over the use of imported sand. Relative to the KPMG study, this significantly reduces the need for imports under all scenarios, reducing long term costs. A bulk dry goods or marine-rail proppant unloading facility is not considered a requirement for the development of the Beetaloo Sub-basin.

Additional studies should be undertaken to understand the alternatives and incremental cost and benefit of developing a new common user Bulk Liquids and Solids Wharf on Middle Arm.

The Port of Bing Bong provides a long term, low cost option for transhipment of bulk materials into the eastern regions of the Beetaloo and the McArthur River Basins. Though not an appropriate location in the short term, it should be considered as a comparative option. We understand the NT Government has conducted this analysis already, which will be utilised when comparing to the Middle or East Arm options.

Table 26 - Proposed ports upgrades[88]

	Infrastructure Type	Priority/Material to Development	Upgrade Title	Size	Development Scenario	CAPEX (AU$m)	CAPEX Norm (AU$m)	Commissioning (Date)	OPEX Norm (AU$m)	Life (Yrs)
1	Port	Low (3)	Middle Arm Bulk Liquids Storage	150,000 m3	High (Liquids)	150	1000/m^3	2030	50/m3/y	50
2	Port	Low (3)	Middle Arm Bulk Liquids Wharf and Gantry	19,000 KL/day	High (Liquids)	300	42.60/M m3/year	2030	Included in storage costs	50
3	Port	Low (3)	Assessment of development potential of Port of Bing Bong	TBA	Medium & High (Dry Gas), High (Liquids)	TBA	TBA	TBA	TBA	TBA

Ports regulation

The NT Government own and operate Stokes Hill Wharf, Fisherman's wharf, Hornibrook Wharf and Frances Bay Mooring Basin. Landbridge (Darwin Port Operations Pty Ltd) operate the Marine Supply Base, East Arm Wharf, and Fort Hill Wharf.

Access to Darwin Port is regulated by the Utilities Commission of the NT which uses price monitoring as the form of price regulation over prescribed services. This approach provides transparency and the benchmarking of port charges. As well as existing surplus capacity at Darwin Port, the port continues to plan for the expansion of its infrastructure to support increased trade.[89]

Glencore own and operate the Bing Bong port as part of its McArthur River Mine operation. The port capacity is limited to barge transfers. Beetaloo Sub-basin developers may seek to use this port for minor transhipment of bulk materials, with stronger benefits for those proponents targeting the McArthur River basin.

Beetaloo Sub-basin developers have access to existing port facilities or can seek to develop port sites through government led processes. We conclude that given the options available, port access does not represent a barrier to Beetaloo Sub-basin development.

Recommendation
D. The NT Government should undertake a cost benefit assessment of the proposed Middle Arm Bulk Handling Wharf (2021).

Nominal upgrades to liquids handing above existing storage capacity at Vopak, located at East Arm Wharf can provide the short-term flexibility on volumes ex-Beetaloo. We do not anticipate the need for any changes to regulation or access, nor a requirement for government funding for this purpose.

The bulk liquids storage and offloading facility being considered by the NT Government is not material to the development of the Beetaloo Sub-basin. We anticipate that if pursued, capital will be provided by the private sector and that the asset would be considered within the Utilities Commission of the Northern Territory's price monitoring regulatory regime.

[88] Estimated total capital cost (public and private investment).
[89] Darwin Port, *2019 Year in Review* (Annual Report, November 2019) <https://www.darwinport.com.au/sites/default/files/uploads/2019/Year%20in%20Review%202019%20-%20Final%20Web%20Version%20-%202019-11-29.pdf>.

5.6.1.3 Rail

In alignment with the recommendations of the NT Fracking Inquiry, it is recommended to support the development of a railway siding at Daly Waters. This will enable the delivery of equipment and bulk materials from Darwin and elsewhere in Australia without interfering with the efficient operation of Adelaide - Darwin rail operations. Though other locations (i.e. Katherine or Tennant Creek) are being considered by stakeholders for a rail siding, the NT Government should consider engaging with One Rail to encourage development to take into account the recommendations of the NT Fracking Inquiry, including minimising road transportation on Stuart Highway. This would occur as the Sub-basin moves from Exploration to Appraisal phases (approx. 2022) when larger volumes of consumables are required in the region.

Rail regulation

The Adelaide – Darwin rail operations are subject to the AustralAsia Railway Access regime which is administered by the Essential Services Commission of South Australia (ESCOSA). Users of this line must also use a portion of the Australian Rail Track Corporation (ARTC) Interstate Network from Adelaide to Tarcoola which is federally owned with an access regime administered by the Australian Competition and Consumer Commission.

ESCOSA utilise light-handed regulation allowing negotiated access to the Tarcoola-Darwin railway line. A floor price is clearly defined, with a ceiling price defined as being "reasonable attributable cost".

The availability of capacity and regulatory oversight of the Tarcoola-Darwin railway line should provide for effective access to Beetaloo Sub-basin developers should they seek to transport equipment, raw materials, or product to Darwin Port or south to Adelaide and beyond.

Beetaloo Sub-basin developers have access to existing rail facilities and can seek to develop associated infrastructure in existing easements.

Recommendation
J. The Commonwealth should consider expediting the development of Daly Waters Rail Siding in collaboration with One Rail and NAIF.

We recommend the Commonwealth Government consider assisting the development of the railway siding at Daly Waters, potentially through ARTC as an initial step, with cost recovery to come later. Once a site is determined and a design completed, an EPC/D&C contracting approach can be used to secure a fixed price and schedule for development. We consider direct engagement with One Rail should be made towards the end of the exploration phase (2022) and the role of NAIF considered to ensure efficient location and sizing of operations.

A charging regime consistent with existing ARTC user charges can be employed to recover some of the associated capital cost, acknowledging that utilisation of the siding is dependent on Beetaloo Sub-basin development and appraisal activity, and that some cost recovery may be captured by higher utilisation of other ARTC infrastructure.

Over the medium term, the incremental benefit of potential Beetaloo Sub-basin activity should be included in the analysis of the proposed new Tennant Creek – Mount Isa rail line. However, we do not consider a new Tennant Creek – Mt Isa line to be crucial to the development of the Beetaloo Sub-basin at this stage, as sufficient alternative rail and road infrastructure exists.

5.6.1.4 Aerodromes

Aerodromes provide an important access point for the fly-in, fly-out (FIFO) workforce, with the proximity to both accommodations and work fronts critical in ensuring long term efficiency of the Sub-basin. As the Sub-basin develops, the transportation needs will change as the size of the workforce changes.

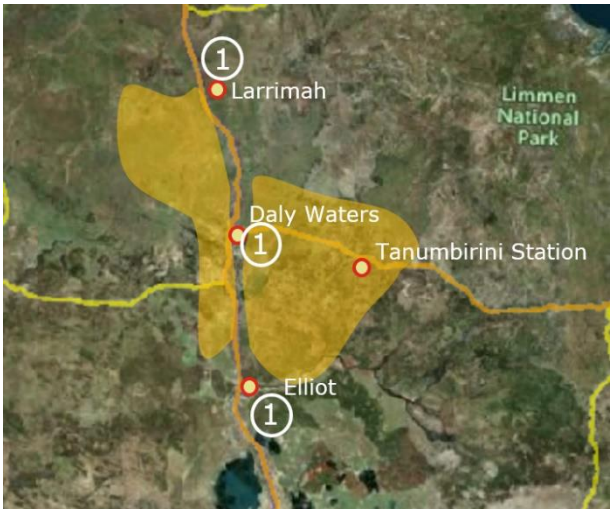
During the exploration phase, with risks seasonal flooding of roads affecting access to centralised infrastructure, the likelihood of a single common user aerodrome providing cost efficiencies, in comparison to distributed exiting airfields, is low. Ensuring all weather access and ensuring regular maintenance of existing rural aerodrome pavements close to work fronts, enables proponents to be self-sufficient in determining their transportation needs, and requesting upgrades as the fields develop.

During the Appraisal phase, the volume of workforce will increase and the need to accept larger charter flights (EMB 170 with 76 passenger capacity) ex-Brisbane or Darwin will be required. A common user aerodrome located proximate to the more advanced exploration areas is recommended, however the location should be determined through consultation with the development proponents.

Table 27 - Proposed aerodrome upgrades[90]

	Infrastructure Type	Priority/Material to Development	Upgrade Title	Size	Development Scenario	CAPEX (AU$m)	CAPEX Norm (AU$m)	Commissioning (Date)	OPEX Norm (AU$m)	Life (Yrs)
1	Aerodromes	Med (2)	Larrimah, Daly Waters or Newcastle Waters Shared user aerodrome upgrade	EMB 170	Medium & High (Dry Gas)High	38	-	2024	-	20

Figure 22 - Map indicating location of proposed aerodrome upgrades



Aerodrome regulation

The Civil Aviation Safety Authority (CASA) regulates civil aviation in Australia. As well as overseeing the safe operation of all flights in Australia, it categorises aerodromes based on the facilities available to limit those that can operate flights at that facility, and the types of flights that can be undertaken. Flight operation is a competitive open market.

Beetaloo Sub-basin developers can develop aerodrome facilities or make use of the existing facilities in the NT. A competitive market exists for the operation of flights and thus conclude that regulation of aerodromes does not present a barrier to Beetaloo Sub-basin development.

Recommendation
L. The Commonwealth should take a leadership role in the development of a shared user aerodrome upgrade to accept larger aircraft.

Workforce volumes are expected to increase as projects reach the appraisal phase, triggering the need for increased aircraft size and potentially competing interests in the location of upgraded aerodrome facilities.

The Commonwealth Government could take a leadership role in the coordination of proponent interests, to enable a common and centralised aerodrome upgrade to be pursued. The upgraded facilities could be directly funded by NT Government through the current aerodrome and airstrip upgrade program, with recovery of costs via usage charges and the rental of onsite facilities. Alternatively, private ownership could be pursued, which the

[90] Estimated total capital cost (public and private investment).

Commonwealth and/or NT Government could consider underwriting a portion. This has the potential to reduce the capital outlay and risk for investors.

Essential services

5.6.2.1 Wastewater

With some proponents presently trucking residual wastewater from Beetaloo to the Surat Basin in QLD for processing, the present costs of managing wastewater are prohibitive. In alignment with KPMG (2019) development of a common user facility co-located with Defence in Katherine is recommended to manage and dispose of residual brine.

Table 28 - Wastewater treatment upgrades

	Infrastructure Type	Priority/ Material to Development	Upgrade Title	Size	Development Scenario	CAPEX (AU$m)	CAPEX Norm (AU)	Commissioning (Date)	OPEX Norm (AU$m)	Life (Yrs)
1	Wastewater	High (1)	Development of Katherine wastewater treatment facility	Up to 150 KT p.a.	Medium & High (Dry Gas), High (Liquids)	28	-	2024	-	20

5.6.2.2 Waste management

With limited capacity to manage the existing small-scale landfills in Larrimah, Daly Waters and Elliott, contaminated waste should be transported to locations with greater capacity, such as Katherine, Tennant Creek or Darwin. To ensure cost effectiveness, it is recommended that a transfer station be developed near Daly Waters, and local landfill be increased in capacity to manage low level waste (see KPMG (2019) for further specifics).

Table 29 - Waste management upgrades (KPMG 2019)

	Infrastructure Type	Priority/Material to Development	Upgrade Title	Size	Development Scenario	CAPEX (AU$m)	CAPEX Norm (AU$m)	Commissioning (Date)	OPEX Norm (AU$m)	Life (Yrs)
	Waste Management	Low (3)	Upgrade to existing landfills		Medium & High (Dry Gas), High (Liquids)	$227/m2	-	2024	--	20
	Waste Management	Low (3)	Waste transfer station		Medium & High (Dry Gas), High (Liquids)	0.71	-	2024	-	20
	Waste Management	Low (3)	New landfill		Medium & High (Dry Gas), High (Liquids)	3.2	-	2024	-	20

The Northern Territory Water Act (1992) requires Beetaloo Sub-basin developers to obtain a water allocation licence and a licence to discharge water from the Department of Environment and Natural Resources.

Water allocation licences document the maximum quantity that will be allocated, with an annual process determining the allocation percentage. While this regulatory approach passes on the risk of insufficient water supply to users, it reflects a prudent regulatory framework. Beetaloo Sub-basin developers can take comfort from the large volumes of unallocated water currently, which may encourage them to over contract for their needed water so as to ensure its availability even in dryer years. The wastewater licence term is limited to two years, but this can be waived by the Controller of Water. We anticipate that Beetaloo Sub-basin developers will seek longer contractual rights as part of their decisions to proceed to production.

However, of greater concern to developers are the recommendations from the Scientific Inquiry into Hydraulic Fracturing in the Northern Territory (2018). These include the prohibition on reinjection of treated or untreated wastewater into aquifers or surface waters, the site-specific hydraulic modelling of local groundwater systems, and requirements regarding the testing of wells, the separation of well pads from bore holes and ongoing well monitoring. Developers expressed support for the intention of the report, but concern regarding the merit of the specific requirements given the significant costs which may be involved.

There is a potential role for the NT Government to coordinate and manage the application of wastewater measures and requirements. However we recommend the Commonwealth Government, potentially through the Australian Defence Force (ADF) and the RAAF Base Tindal, take the lead and coordinate with proponents on their potential use of a centralised wastewater facility at Katherine. This facility can then be scaled to meet the needs of the Beetaloo Sub-basin developers and the RAAF Base Tindal, which is 15km southeast of Katherine. We anticipate that the Commonwealth would own this facility, procure it under a Design and Construct (D and C) contract and charge proponents on a usage basis. This coordination should occur immediately.

More broadly, the expansion of ADF activity at Katherine may provide a foundation for the development and retention of a modest but material number of local tradespersons and others with qualifications relevant to development of the Beetaloo Sub-basin. We recommend the Commonwealth leverage this existing activity, seeking to provide a continuous baseload of work to local trades. Sustainable and longer term jobs are likely to be in maintenance rather than just the construction phase. This may require the strengthening of local content requirements, while also providing flexibility so that local work programs can be effectively managed.

Recommendations

B. The Commonwealth should immediately undertake a wastewater characterisation study (treatment selection) for a wastewater treatment facility to be located at Katherine.

C. The Commonwealth should continue to leverage existing local ADF activity beyond wastewater to provide a continuous baseload of work to local trades.

M. The NT Government should consider development of new landfill and waste transfer stations at Elliott, Daly Waters and Mataranka, and prepare landfill capacity assessments for listed waste at Katherine and Shoal Bay landfill sites.

5.6.2.3 Telecommunications

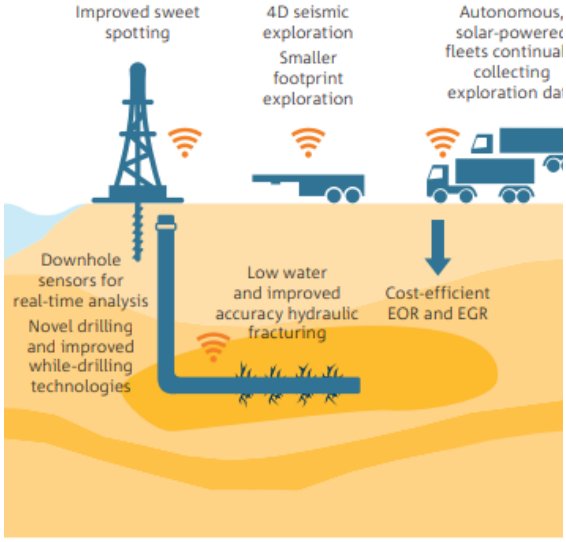


Figure 23 - A sample future vision for enhanced basin productivity (Adapted from CSIRO (2017))

Establishment of a 20Tbps fibre backbone presents a significant opportunity to improve more efficient appraisal and development of the resource, and increase the attractiveness of exploration and reduce local social impacts.

CSIRO (2017), outlines potential future visions for enhanced digital applications in the field in all phases of the project lifecycle, with a key priority being "High data-transfer-rate communication technology and/or data compression techniques to transmit large amounts of exploration and downhole data to the cloud". Once commissioned, through the improved backhaul of data, the "Terabit Territory" project has the potential to meet this requirement and provide the following high data density opportunities.

1. **Digital twin of the subsurface reservoir**. Creates opportunities for explorers to analyse quickly and more accurately the information anywhere in the world. It also provides an opportunity for the government of making that same information open access to increase the level of interest in the basin. Similar approaches have been made in the US by the Open Group to develop the Open Subsurface Data Universe (OSDU) to facilitate a vendor-neutral standard.
2. **Remote operations.** Being able to run operations remotely (with only repair and maintenance staff in the field) significantly reduces fixed and variable costs by reducing the head count in the field, and the subsequent life support (travel, accommodation etc.) costs. Using intelligent visual monitoring tools such as Osperity to undertake safety AUits, not only is safety enhanced by reducing personnel in harms-way, safety assurance of teams can be managed remotely.
3. **Optimising the frack over the cloud**. Hydraulic fracturing usually follows a plan, without a significant feedback loop to optimise the efficiency or effectiveness as data is received at the drill bit or well head. Having access to low latency fibre allows international specialists to analyse or deploy machine learning resources to improve the success of the exploration investment.

Telecommunications regulation

Australia has an open access regime to a core network of fibre optic cable, with competitive provision of mobile phone services by three main careers. In 2018 the Australian Competition and Consumer Commission found "*that the economic regulatory framework for the communications sector has proven to be capable of accommodating major changes to the sector, including allowing for appropriate responses during the transition to the NBN. In*

particular, we consider that Part XIC of the Competition and Consumer Act 2010 (CCA) provides the necessary tools for access regulation of monopoly and bottleneck communications infrastructure, including that being built by NBN Co, and we do not find that there is currently a need for significant changes to this regulatory regime."[91]

For Beetaloo Sub-basin developers, outcomes are limited by technology availability. Telecommunications during the early development and assessment phases is likely to be limited phone calls and data transfers via satellite. While expensive, this outcome is considered fit-for-purpose for what is a short-term activity at each location. Satellite phone technology remains a competitive solution for personnel that move among the remote sites and for the limited communication of data being communicated from wellhead locations.

In some locations, solutions can leverage the site proximity to the limited existing cell phone coverage of local towns and the fibre optic cable that generally follows the major road. While this represents a very limited portion of the Beetaloo, it does afford the opportunity for the competitive sourcing of telecommunications at site. These geographic limitations are largely removed if fibre optical cable is laid along with piping infrastructure for production. The competitive provision of local telecommunications services along with open access to the fibre optic backbone is considered fit-for-purpose for Beetaloo Sub-basin developers.

Noting that the NT Government has already ensured a significant upgrade to the fibre optic cable available in the NT, we do not anticipate the need for further Government involvement in the provision of telecommunications services at this stage. However, stakeholders did note that improved telecommunication infrastructure would be beneficial to the project as activity levels increase.

The suitability of telecommunications infrastructure should continue to be monitored by the NT government via industry engagement (ongoing), but does not appear to warrant a recommendation at this stage.

The long-term value of quality basin data will allow the NT and Commonwealth Governments to effectively market the Sub-basin for exploration investment against less well-known frontiers.

5.6.2.4 Power generation and transmission

As the Basin develops the demand for power will grow. Primarily for gas compression, power will also be required for produced water management, wellhead services and village services such as accommodation and administration. This is likely to be conventional diesel generation during exploration and appraisal, this will move to gas power generation during production. There will be the potential for deploying solar power to reduce costs and emissions, but this will be considered on a case by case basis by the proponent.

Due to the high cost of investing in transmission lines, reliability challenges experienced by the Darwin-Katherine-Mataranka grid and the superior access to fuel gas, it is unlikely that the proponents will seek connections with the grid in the first decade of operations (i.e. to the mid-2030s).

Power supply regulation

Regulation of the electricity sector in Australia ranges from highly structured electricity markets with open access regimes in the larger inter-connected systems to the monopoly provision of electricity as an essential services on smaller networks and to remote communities. In addition, remote private businesses including gas field exploration and extraction generally provide their own electricity solutions. Larger power users in the gas extraction and gas processing industries also typically operate stand-alone power solutions even when able to connect to public electricity infrastructure, for example Ichthys and Darwin LNG.

In May 2015, the Northern Territory Government has established the Interim Northern Territory Energy Market or I-NTEM in the Darwin-Katherine power system, a virtual market (i.e. no money transacted) to serve as a stepping stone to a competitive wholesale electricity arrangement. Work is currently underway to refine this arrangement to facilitate the connection of new solar farms near Katherine[92]. In other electricity networks throughout the Territory (e.g. Alice Springs and Tennant Creek), bilateral contracting between generators and retailers serves as the primary mechanism to trade energy.

Private electricity solutions at resource development sites in remote locations are almost exclusively diesel generation, although it is increasingly economic to reduce diesel consumption through the addition of solar (and

[91] ACCC, *Communications Sector Market study Final Report* (Report, 2018) 3.
[92] Northern Territory Government, *Northern Territory Electricity Market Priority Reform Program* (Government Program, June 2020) <https://business.nt.gov.au/business-reforms-and-initiatives/northern-territory-electricity-market-priority-reform-program>.

occasionally batteries). These systems are effectively subsidised through the stationary-use fuel excise exemptions and the federal renewable energy certificates regime.

We do not foresee any regulatory inhibitors to the development of the Beetaloo from the regulation of the power sector. The cost or availability of power solutions do not inhibit development activity of the Beetaloo. Generally, these costs form a relatively modest portion of total costs. However, the management of the supply chain can be time consuming, and the risk of non-supply is significant should it interrupt drilling activity.

The development of a competitive market for power supply on the Darwin-Katherine power system should ensure cost-effective power for downstream use and processing of the gas should this occur in Darwin. The proposed wholesale electricity market framework should enable opportunity for provision of electricity supply from government-owned corporations and private sector operators to meet this demand. The development may provide a benefit of additional and cleaner power generation for adjacent communities and towns.

We do not anticipate the need for further Government involvement in the provision of power supply.

5.6.2.5 Social infrastructure requirements

The regulatory environment relating to social infrastructure is almost entirely associated with the maintenance of standards. Meeting these standards in remote locations is relatively expensive when compared to the major population centres, but do not have a material impact on total gas field development project costs.

Beetaloo Sub-basin developers are more likely to be concerned with the time required to gain the needed permits and permissions to undertake social infrastructure.

Recommendation

F. The NT Government should ensure impact on local health services are assessed in the Social Impact Assessment (SIA) Process and public private partnership (PPP) health clinics are considered to support any increase in local population.

5.6.2.6 Medical and health facilities

Present medical and health infrastructure in the region has been established to support the existing residents and workforce. With challenges in attracting qualified medical staff to the regions, any substantial changes to the population relying on this service would quickly overwhelm the existing services.

When considering employment under the mid scenario, this is projected to be around 1,347 FTE higher than compared to the baseline according to Deloitte's modelling. While large, this value masks considerable growth in employment projected for the Beetaloo project region (5,341 FTEs at 2040) that is mostly supplied by other parts of the Northern Territory (1,645 FTEs) or Australia (2,349 FTEs) in the mid dry gas scenario. Further information can be found in section 6.3.2.

Though a majority of the NT based jobs will be FIFO ex-Darwin, substantial opportunities will exist for people located in the larger population centres of Katherine and Tennant Creek, increasing demand on the local services.

Though the proponents will bring their own medical teams to support themselves and the local contractors, this will not provide the out-of-hours support to the local population and external service sector.

5.6.2.7 Long-term housing and community facilities

There is sufficient land available in all local towns, with appropriate stock available in Katherine and Tennant Creek to suit any minor increase in population. Community facilities and planned improvements are appropriate for any minor increase in population.

5.7 Industry infrastructure requirements

5.7.1 Workforce

Final recommendations regarding leveraging existing ADF activity, specifically with wastewater, can be found in section 5.6.2.1.

The expansion of ADF activity at Katherine is providing a foundation for the development and retention of a modest but material number of local tradespersons and others with qualifications relevant to development of the Beetaloo Sub-basin. We recommend the Commonwealth leverage this existing activity, seeking to provide a continuous baseload of work to local trades. This may require the strengthening of local content requirements, while also providing flexibility so that local work programs can be effectively managed.

5.7.2 Land

There is sufficient land in all regional towns, though some barriers exist in the establishment of light industry. This is elaborated below. The relevant **land assessments and recommendations** are outlined in Figure 24.

Figure 24 - Land use in local towns

Town	Land Assessment[93]	Recommendations
Katherine	Katherine is zoned under the NT Planning Scheme, with land zoned for General Industry (GI), Light Industry (LI), and future development.	Nil
Mataranka	Mataranka is not covered under the NT Planning Scheme. Much of the surrounding area is classed as vacant Crown land, under Native Title. Accommodation in the township is heavily constrained, with current arrangements having workers stay at caravan park/motel style accommodation.	Nil
Larrimah	Much of the land in the town is vacant Crown land under Native Title (non-exclusive rights). Current accommodation arrangements are limited to caravan park/pub style accommodation. Due to its proximity to some of the prospective exploration areas Larrimah is well located to support the gas industry.	Development of zoning, planning and essential service infrastructure would be required to establish Larrimah as a service town to the gas industry.
Daly Waters	Daly Waters is not zoned under the NT Planning Scheme. Much of the land in the town is vacant Crown land under Native Title (non-exclusive rights). Current accommodation arrangements are limited to caravan park/pub style accommodation. Due to its proximity to prospective exploration areas Daly Waters is well located to support the oil and gas industry.	Development of zoning, planning and essential service infrastructure would be required to establish Daly Waters as a service town to the gas industry.
Elliot	Elliot is zoned under the NT Planning Scheme, and provides two parcels of land zoned for LI. Much of the township and surrounding land is vacant Crown land under Native Title. Current accommodation arrangements are limited to caravan park/pub style accommodation. Due to its proximity to prospective exploration areas Elliott is well located to support the gas industry.	Development of essential service infrastructure would be required to establish Elliot as a service town to the gas industry.
Tennant Creek	The town has two areas zoned GI, with plans to increase this zoning. Much of the land within the township is under non-exclusive rights Native Title, while much of the adjacent land is under Aboriginal Land Rights. Tennant Creek is located beyond the southern boundary of the Beetaloo Sub-basin. It could be used to support the gas industry through the provision of local personnel and training services.	Nil

[93] *Infrastructure and Logistics Study* (above n 12).

6 CGE economic impact assessment

6.1 CGE modelling approach

Economic activity involves a range of complex interactions between households, businesses and governments with these agents operating across regions and countries. A change in any part of the economy therefore has effects that reverberate throughout the initial scope of impact. For example, development of a new project or program might create economic opportunities in one region, but its introduction may make input resources relatively more scarce, affecting output in other sectors.

Computable General Equilibrium (CGE) models are the best-practice method available for examining the impacts of a change in one part of the economy on the broader economy. The reason for this is that it is able to explicitly account for behavioural response of consumers, firms, governments and foreigners while evaluating the impacts of a given policy change. At the same time, it observes resource constraints meaning that the estimated economic impact which comes from a CGE model will account for 'crowding out' whereby increased activity will draw resources from other sectors.

In this Chapter, unless otherwise stated, all monetary units are in Australian dollars.

6.2 Modelled scenarios and input parameters

The economic impacts of the Beetaloo gas development is estimated by comparing individual policy scenarios against a baseline scenario. The difference between these scenarios details the net economic impacts of the Beetaloo project across various regions and sectors.

The business as usual scenario is based on historical data embedded in DAE-RGEM. The policy scenarios are informed by the analysis reported in Chapter 4 and focus on the development of the Sub-basin in the Beetaloo project region (defined here as the Barkly SA3 area). The three policy scenarios are broadly similar in that they describe a significant increase in gas production from the Sub-basin (and consequently Australia) beginning in 2024 with peak production reached in 2035. A summary of the individual cases is described below:

Baseline — where the Beetaloo Sub-basin is not developed

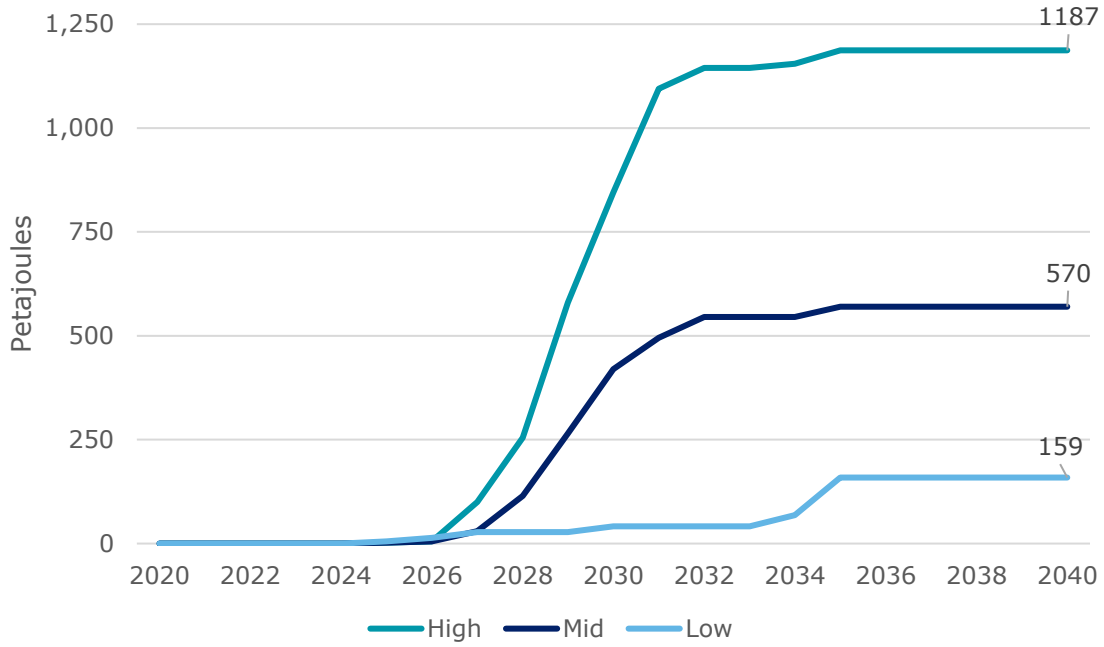
Policy Scenarios

High — where the Sub-basin is developed and reaches peak production in 2035 (3,252 TJ per day). A marginally greater share of gas is sold to the LNG export market, at the expense of the NT and east coast markets.

Mid — where the Sub-basin is developed and reaches peak production in 2035 (1,562 TJ per day). Gas is sold principally to the LNG export market, and the NT and east coast markets.

Low— where the Sub-basin is developed, and reaches peak production in 2035 (159 TJ per day) and gas is sold predominantly into the east coast market, and into the Northern Territory.

Figure 25 - Beetaloo Sub-basin gas production under policy scenarios, PJ p.a.



Source: CORE energy analysis

6.3 Results

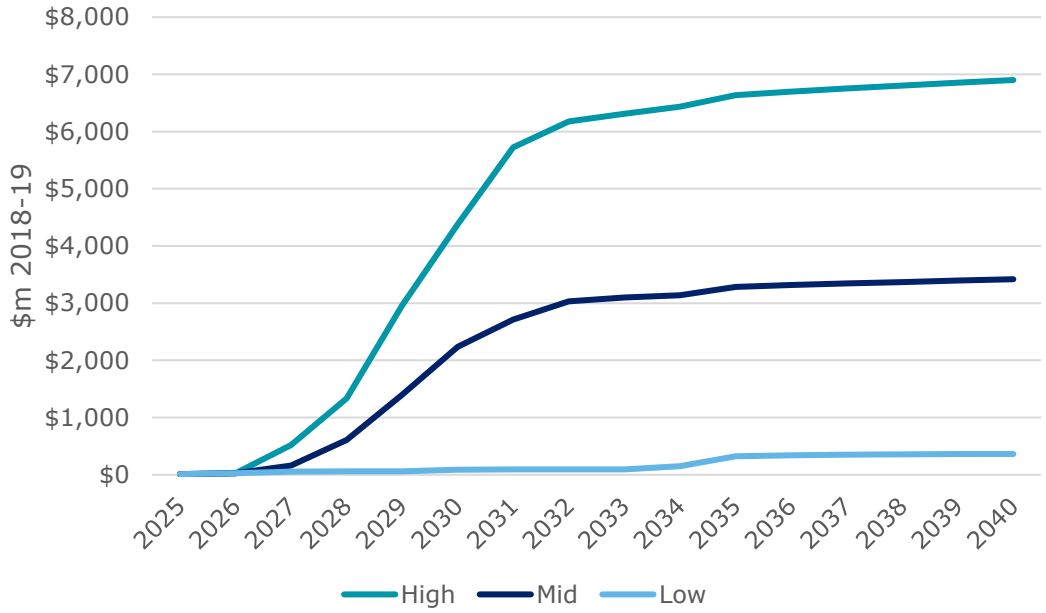
This section summarises the results of the economic impact analysis, stepping through the impact of developing the sub basin on economic activity, employment and other sectors in the economy. Results presented here describe the net impact of the project, i.e. deviations from the baseline and are in 2018-19 dollars and cumulative terms unless otherwise stated.

6.3.1 Economic activity

Development of the Sub-basin has a significant impact on economic activity in both the project region, and when considering NT and Australia wide impacts. Compared to the baseline, Gross Regional Product (GRP) for the Beetaloo region is estimated to be around $3.4 billion higher in 2040 in the mid scenario ($18.0 billion in present value terms discounted at 7 per cent).

Impacts under the high and low scenarios follow a similar path to that of the mid case, due to the similarities in timing of the base development across these cases. The magnitude of impacts differs significantly across each scenario, reflecting the scale of gas produced. For the high scenario, GRP impacts swell to $6.9 billion by 2040 ($36.8 billion in present value terms) and reaches $362 million by 2040 in the low case ($1.3 billion in present value terms).

Figure 26 - Cumulative impact to Gross Regional Product, Beetaloo region



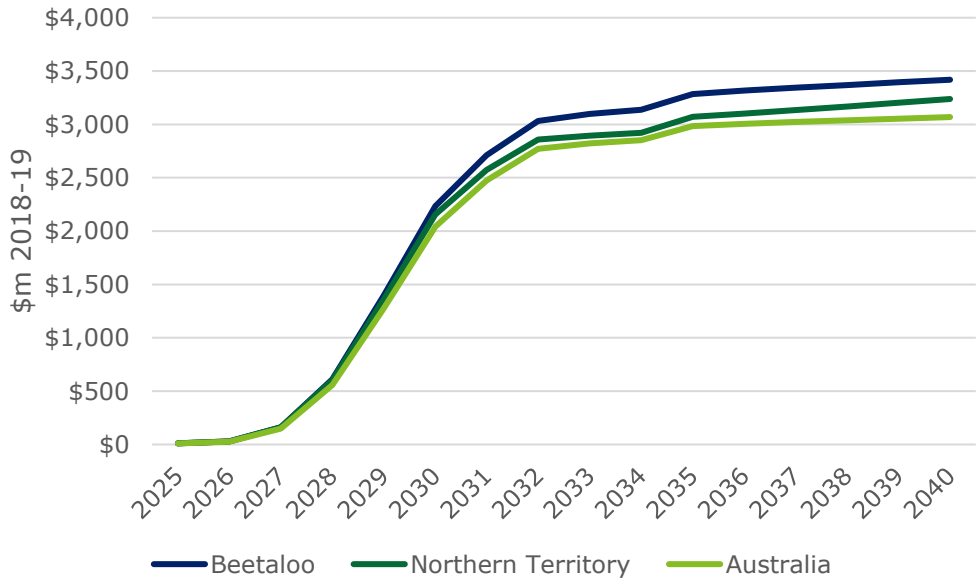
Source: DAE-RGEM

Note: Figures reported above are net impacts and refer to $ increase compared to the baseline scenario

In relative terms these increases are significant, with the low case causing the Beetaloo region's GRP to be around 16 per cent higher in 2040 that compared to the baseline. For the mid and high scenarios this increase in relative terms is around 148 per cent and 298 per cent respectively.

For Australia and the whole of Northern Territory, the increase in GRP is smaller than that in Beetaloo, as the economy transitions, moving resources from other regions to support the development of the basin. Despite this, the overall impact of the project is positive. Under the mid scenario GDP in the Northern Territory is estimated to be around $3.2 billion higher than in the baseline, and for Australia as a whole the increase is around $3.1 billion.

Figure 27 - Cumulative impact to regional Gross Regional Product, mid scenario



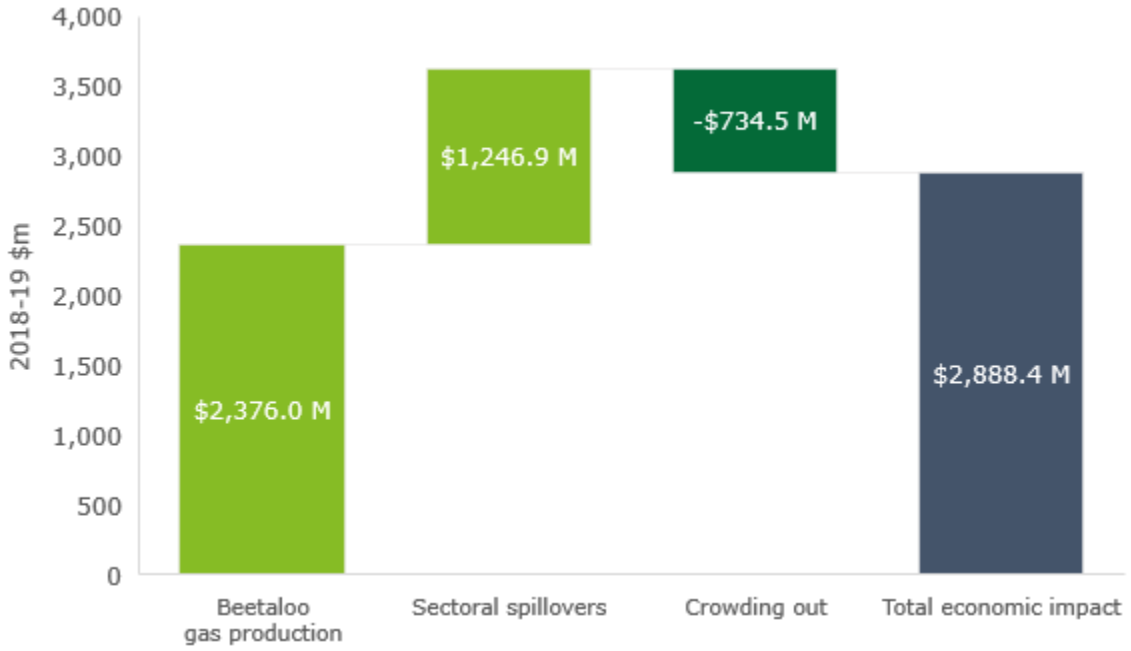
Source: DAE-RGEM

Note: Figures reported above are net impacts and refer to $ increase compared to the baseline scenario

Much of the positive impact to Australian GDP reflects greater activity in the gas sector, directly resulting from the development of the Beetaloo Sub-basin. By 2040 the gas industry in Beetaloo is projected to be around $2.4 billion higher in terms of industry value added compared to the baseline. This also creates significant 'spillover' effects in which other industries across Australia benefit. By 2040 spillovers are projected to total around $1.2 billion much of which is localised to the Beetaloo project region (around 80 per cent) with the basin's development also creating significant opportunities for most sectors in the region. The services sector in particular is a significant contributor to increased economic activity outside of the gas industry. This is because the basin's development drive real incomes in Australia higher and supports greater domestic expenditure in Australia.

As with any project or program, some crowding out is also projected to occur. This occurs for two reasons. First the development of the basin increases competition for productive resources (e.g. land, capital or labour) which sectors such as agriculture, manufacturing and mining find increasingly challenging to obtain. Second, development of the Sub-basin drives a significant increase in Australian exports. This supports greater demand for Australian dollars by the rest of the world and causes an appreciation of the Australian dollar which hurts other exporting industries, such as agriculture, manufacturing and other mining. The estimated value of this 'crowding out' is projected to total around $735 million by 2040 and importantly reflects slower growth than would have been expected compared to the baseline, not in absolute terms.

Figure 28 - Impacts to national Gross Domestic Product at 2040 via changes in industry value added, mid case



Source: DAE-RGEM

Note: impacts here are relative to the base case

6.3.2 Employment

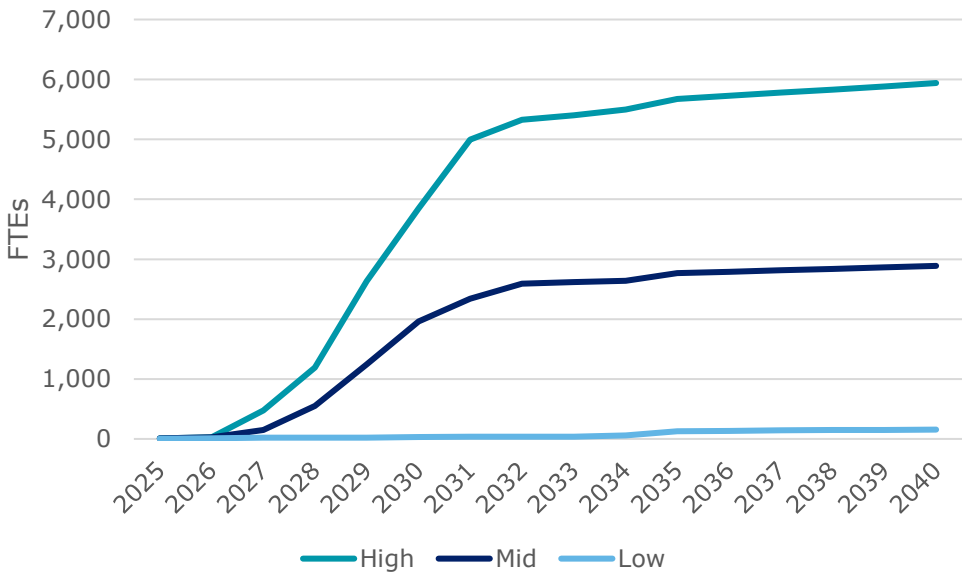
The impact to employment of developing the Sub-basin mirrors that to economic activity. Under all three scenarios, employment is estimated to be higher for the Beetaloo project region, Northern Territory and Australia as a whole. In addition, the employment impacts to Beetaloo are larger than that in the northern Territory and Australia reflecting the adjustments made by the economy.

In the mid scenario, employment in Australia is projected to be around 1,347 Full Time Equivalent (FTEs) positions higher than compared to the baseline. While large, this value masks considerable growth in employment projected for the Beetaloo project region (5,341 FTEs at 2040) that is mostly supplied by other parts of the Northern Territory (1,645 FTEs) or Australia (2,349 FTEs).

Figure 29 - Cumulative impact to Australian employment at 2040, mid scenarios

As with the impacts to GRP, the effect of the basin's development on employment is similar across the three scenarios in terms of timing, but differs significantly in magnitude. At 2040 under the high scenario, there is projected to be an increase in Australia of around 6,000 FTE positions compared to the base case. For the low scenario this increase is around 156 FTEs.

Figure 30 - Cumulative impact to Australian employment, policy scenarios



Source: DAE-RGEM

Note: impacts here are relative to the base case

6.4 Sensitivity analysis

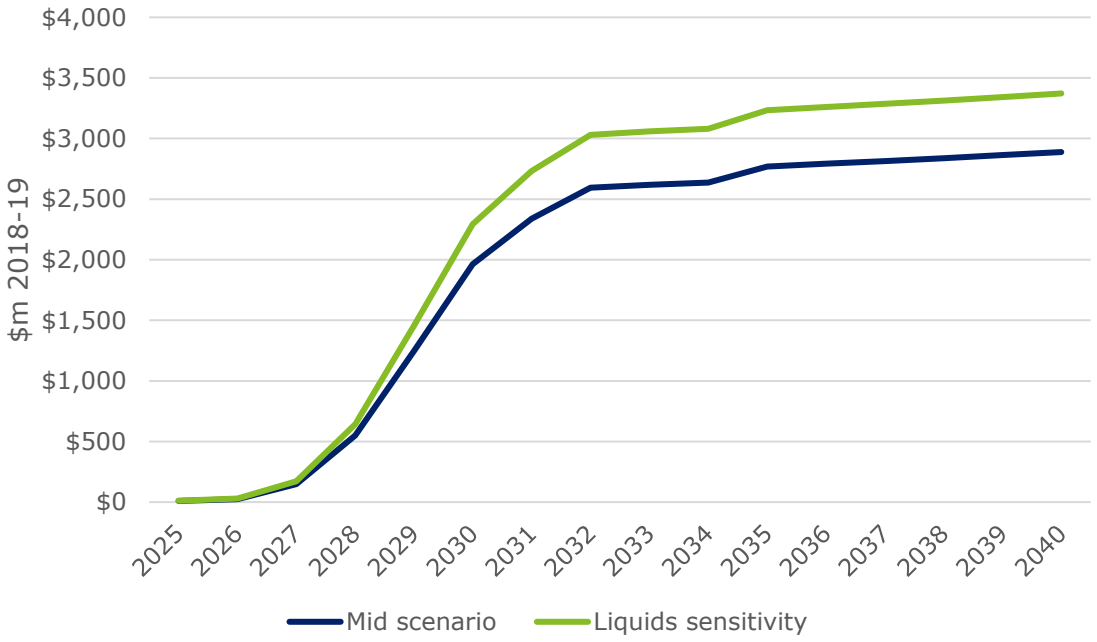
Uncertainty is an enduring feature of any potential product. This includes developing the Beetaloo Sub-basin where products (i.e. gas mix), end markets (e.g. domestic vs overseas) and even logistics requirements involve several potential possibilities. Sensitivity analysis provides a lens with which to test some of these uncertainties.

Sensitivity: Beetaloo produces dry and liquid gas

In the liquids rich scenario, the Beetaloo Sub-basin is assumed to be developed to deliver liquid gas (i.e. with propane, butane and condensate in addition to methane), as informed by the RISC scenarios with further analysis from CORE. Under this scenario the development of the Sub-basin delivers 570 PJ of dry gas by 2040, as well as an additional 320 PJ of liquids. The production of liquids is assumed to be sold at a relatively higher average price allowing the dry gas to be sold downstream at a lower, more competitive average value.

The liquids sensitivity shows that the economic impact to the Beetaloo region would be a net increase of GRP for the Beetaloo region, as well as the whole of the Northern Territory and Australia. By 2040 GRP in Beetaloo is projected to be around $3.4 billion higher than compared to the base line. This compares with a cumulative increase of $3.0 billion projected under the mid scenario where the basin produced 570 PJ of dry gas only and at a higher average price.

Figure 31 - Cumulative impact to Beetaloo Gross Regional Product, mid scenario and liquids sensitivity



Source: DAE-RGEM

Note: impacts here are relative to the base case

The sectoral impacts of the liquids sensitivity are also broadly consistent with that of the mid scenario.

7 Climate, energy, environmental and economic policy/regulatory recommendations

7.1 Summary

Policy or regulation that inhibits or adds uncertainty to the development of the Beetaloo Sub-basin will limit the exploration and appraisal activity developers are willing to undertake. Regulatory approval processes at the Territory or Commonwealth level do add to the costs and timeframes of project development, with the aim of ensuring the project is safe and environmentally responsible. Feedback from stakeholders indicated that total well costs have increased in the order of millions already, with the partial implementation of the requirements of the NT Fracking Inquiry.[94] As at September 2020, of the Fracking Inquiry recommendations:

- 60 are complete (43%)
- 76 have commenced (56%) and
- 2 are not yet commenced (1%)

Recommendations not yet implemented create uncertainty for proponents and investors, and comprise a real barrier to development. This feedback was provided consistently across gas market participants.

Deloitte has made the following recommendations regarding climate and energy, to be investigated further by the Commonwealth and/or the NT Government (see Table 30).

Table 30 – Recommended climate, energy, environmental policy and regulatory changes

Policy/regulation area	Recommendation	Responsible entity	Timeframe	Reference
Climate	N. Deloitte recommends that the NT Government undertake comparative emissions modelling for Scope 1 and 2 emissions from the Beetaloo Sub-basin. This may assist to comply with the NT Fracking Inquiry recommendation 9.8 regarding no net increase in life cycle GHG emissions. This study could be run in partnership with the Commonwealth government.	NT Government in partnership with the Commonwealth Government	Immediately	7.2

There may be an opportunity to pursue heritage and environmental approvals for the entire Beetaloo Sub-basin area on a non-project specific basis. These approvals would identify areas of availability and restriction and could pre-approve some activity. They would form building blocks on which project-specific approvals could be pursued. For Beetaloo Sub-basin developers this will reduce the time, cost and uncertainty associated with the regulatory approval process.

To encourage exploration and appraisal activity, governments should consider the steps they can take to ensure regulatory certainty for gas field development activities and the commercial operation of gas fields for their extended life. We note that a critical area of regulatory uncertainty of particular importance to the Beetaloo Sub-basin development is greenhouse gas emissions policy and recommendation 9.8 from the NT Fracking Inquiry. We see value in this being addressed as a priority to provide certainty for developers.

[94] *NT Fracking Inquiry* (above n 1).

7.2 Climate

7.2.1 Emissions and carbon offsets

Emissions from gas extraction represent a key issue for development of the Beetaloo Sub-basin with public expectations for governments and companies to act on climate change increasing significantly. Following the recent Australian bushfires, research undertaken by the Australian National University found that nearly 80 per cent of Australians had been directly or indirectly impacted by the fires. The same poll found that 49.7 per cent of people reported the environment as one of the top two issues facing Australia in January 2020, compared to 41.5 per cent of respondents in October 2019.[95]

The NT Fracking Inquiry highlighted the risks related to Scope 1 and 2 emissions from the development of the Beetaloo Sub-basin. As it stands, the NT Fracking Inquiry estimated that a gasfield producing 365 PJ/year would also produce 26.5 $MtC0_{2\text{-}e}$, whilst a gasfield producing 1,240 PJ/year would produce 38.9 $MtC0_{2\text{-}e}$.[96] In the second case, this does not include a further 60 $MtC0_{2\text{-}e}$ produced overseas as a result of LNG exports.[97] As such, the risk assessment of the full life-cycle emissions from a new 1,240 PJ/year gas field indicated an "unacceptable" risk for Australian and global emissions.[98]

Ultimately the NT Fracking Inquiry recommended that the "NT and Australian governments seek to ensure that there is no net increase in the life cycle GHG emissions emitted in Australia from any onshore shale gas produced in the NT."[99]

The NT Government supported recommendation 9.8 in their response to the Inquiry. The Northern Territory Climate Change Response provides a long-term vision aimed at giving insight into the approach to addressing climate risk and creating new economic and business opportunities including the following aspirational objectives:

- Facilitating the long-term growth of the renewable energy industry to diversify and strengthen the Territory economy (low-carbon economic growth) and enable new export industries underpinned by renewable energy
- Continuing to build on existing initiatives to reduce greenhouse gas (GHG) emissions across the economy to achieve a long-term aspirational target of net zero emissions by 2050
- Responding to climate risk and adapting to the observed and projected impacts.

Recommendation 9.8 in the Inquiry pointed out a number of existing policies and initiatives, including the Large Scale Renewable Energy Target (LRET) and Emissions Reduction Fund (ERF), as a means for industry to offset these emissions, via purchase of Large Scale Generation certificates (LGCs) or Australian Carbon Credit Units (ACCUs).[100]

Beetaloo proponents are actively investigating purchasing and/or generating both domestic and international environmental products to offset emissions. For example, Santos, which has already committed to reducing their emissions by more than 5 per cent across their existing Cooper Basin and Queensland operations by 2025, is already generating ACCUs from their 1,250-hectare tree plantation near Injune, Queensland. This plantation created 30,000 ACCUs in 2018, meaning approximately 30,000 tonnes of CO_2 was abated through this project in that year.[101] Additionally, in conjunction with BP, Santos also announced in March 2020 that they would undertake engineering studies on a CCS project in the Cooper Basin which would inject 1.7 million tonnes of CO_2 p.a. into a former gas reservoir. The Cooper Basin project could eventually be expanded to inject 20 million tonnes a year. This is subject to complementary Commonwealth Government policy (i.e. making CCS projects eligible for ACCU generation).[102]

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[95] The Australian National University Centre for Social Research and Methods, *Exposure and the impact on attitudes of the 2019-20 Australian Bushfires* (Report, 2020) <https://csrm.cass.anu.edu.au/sites/default/files/docs/2020/2/Exposure_and_impact_on_attitudes_of_the_2019-20_Australian_Bushfires_publication.pdf>.
[96] NT *Fracking Inquiry*.
[97] Ibid.
[98] Ibid.
[99] Ibid.
[100] Ibid.
[101] Santos, *2019 Climate Change Report* (Company Report, 2019) 27 <https://www.santos.com/wp-content/uploads/2020/02/2019-climate-change-report.pdf>.
[102] Sonali Paul, 'BP, Santos carbon capture pact may rekindle dormant Australia plans' (Reuters, 4 March 2020) <https://www.reuters.com/article/us-australia-carboncapture/bp-santos-carbon-capture-pact-may-rekindle-dormant-australia-plans-idUSKBN20R155>.

Considering this, there are a number of potential options for the Commonwealth to incentivise further offsetting of Scope 1, 2 and 3 emissions from the Beetaloo Sub-basin. Such actions have been recently highlighted in the recommendations of the King Review.[103] Two such recommendations which could have a direct impact on offsets projects in the Beetaloo Sub-basin are outlined below (see Table 31). With this in mind, the broader King Review recommendations could increase the number of options for offsetting Scope 1, 2 and 3 emissions across the Australian economy, not just the Beetaloo Sub-basin. The implementation of the broader recommendations from the King Review should increase both demand and supply of ACCUs, thereby creating more numerous opportunities for offsetting emissions from the Beetaloo Sub-basin. Deloitte also notes that the Commonwealth has either agreed, agreed-in-principle to and/or noted all of the recommendations of the King Review – this includes scoping a CCS/CCUS method.[104] The Commonwealth also announced a $50 million investment in the Carbon Capture Use and Storage Development Fund in September 2020.[105]

Table 31 – Selected King Review recommendations

Summary	Relevance to Beetaloo emissions offsets	Commonwealth response
Reference 5.1 – Allow certain ERF methods to award ACCUs on a compressed timeframe. This would reduce the barriers faced by projects with high upfront capital costs.[106]	This recommendation could be relevant to offset projects related to the development of on-shore gas, such as Oil and Gas Fugitives.[107] Further consultation with project proponents in the Beetaloo Sub-basin (i.e. Santos, Origin and Pangaea) should be undertaken to investigate this.	Agreed-in-principle
Reference 6.11 – Amend the ERF legislation to enable a method to be developed for carbon capture and storage and/or carbon capture utilisation and storage.[108]	Santos, amongst other oil and gas majors, has previously announced strategies around utilising CCS/CCUS across their operations which could potentially include the Beetaloo Sub-basin (see above). Developing a methodology for such projects to generate ACCUs could assist with offsetting the associated high capital costs.	Agreed

Recommendations

N. The NT Government should undertake comparative modelling for Scope 1 and 2 emissions from the Beetaloo Sub-basin. This may assist to comply with the NT Fracking Inquiry recommendation 9.8 regarding no net increase in life cycle GHG emissions. This could be run in partnership with the Commonwealth.

7.3 Energy

Since 2016, reforms to the broader energy market have become progressively more important to both Commonwealth and State Governments as a result of increasing penetration of renewable energy sources and, most importantly for Beetaloo, the increasing price of domestic gas (until 2020).[109]

As described above, the increasing price of gas has had an impact on commercial and industrial (C&I) customers on the East Coast, which ultimately impacts on employment and broader economic growth. For example, one C&I user informed the ACCC that higher gas prices were the major factor in delaying a $15 million expansion of their

[103] Department of Industry, Scence, Energy and Resources, *Report of the Expert Panel examining additional sources of low cost abatement* (Final Report, February 2020) <https://www.industry.gov.au/sites/default/files/2020-05/expert-panel-report-examining-additional-sources-of-low-cost-abatement.pdf>
(*'King Review'*).
[104] Minister for Energy and Emissions Reduction, *Australian Government response to the Final Report of the Expert Panel examining additional sources of low-cost abatement ('the King Review')* (Government Response, May 2020)
<https://www.industry.gov.au/sites/default/files/2020-05/government-response-to-the-expert-panel-report-examining-additional-sources-of-low-cost-abatement.pdf>.
[105] Minister Taylor announcement 17 September 2020, https://www.minister.industry.gov.au/ministers/taylor/media-releases/investment-new-energy-technologies
[106] *King Review* (above n 162).
[107] CER, *Project Application Form Guidance – Oil and Gas Fugitives* (CER Guidance) <
http://www.cleanenergyregulator.gov.au/DocumentAssets/Documents/Oil%20and%20gas%20fugitives%20-%20project%20application%20guidance.pdf>.
[108] Ibid.
[109] ACCC, *Gas Inquiry 2017 – 2025* (Interim report, January 2020) 1 <https://www.accc.gov.au/system/files/Gas per cent20inquiry per cent20- per cent20January per cent202020 per cent20interim per cent20report.pdf
>.

operations in regional Victoria. The expansion was expected to add more than 100 staff to their existing 330 strong workforce. This user further stated passing on prices to clients resulted in some customers converting to imported products.[110]

In response to higher gas prices and other structural issues associated with the changed gas market, the Commonwealth introduced the Australian Domestic Gas Security Mechanism, and is considering adding a gas reservation policy to the mix.

7.3.1 Australian Domestic Gas Security Mechanism

The Australian Domestic Gas Security Mechanism (ADGSM) was established in 2017 to help ensure sufficient supply of natural gas to meet forecast needs.

Alongside the ADGSM, the Commonwealth Government and representatives of the east coast LNG exporters have executed to a Heads of Agreement, in which commitments were given to maintain a secure and affordable supply of gas to the domestic market. These commitments have been agreed for the 2020 calendar year and ensure that in the event of a shortfall, the east coast LNG exporters will offer uncontracted gas to the domestic market on reasonable terms to meet the shortfall.[111] Following a review of the ADGSM in 2019 it was determined that the ADGSM has been working effectively and therefore will remain in place as scheduled until the end of 2023.[112]

7.3.2 Domestic gas reservation policy

On 24 January 2020 the Federal Minister for Resources announced that the Commonwealth Government would begin assessing options for a national gas reservation policy. By requiring gas producers to sell a portion of extracted gas into the domestic market, it is assumed that domestic supply will increase, which could contribute to lower domestic gas prices.

Although we currently have limited visibility of how such a policy would be structured, the Minister indicated that it could be similar to the Western Australian Domestic Gas Policy.[113]

Under this policy in WA, LNG projects must demonstrate their ability to meet the policy as a condition of project approval. LNG projects commit to make domestic gas available by:[114]

1. Reserving domestic gas equivalent to 15 per cent of LNG production from each LNG export project
2. Developing and obtaining access to the necessary infrastructure (including a domestic gas plant, associated facilities and offshore pipelines) to meet their domestic gas commitments as part of the approvals process
3. Showing diligence and good faith in marketing gas to the domestic market.

There are costs and benefits associated with such a policy for both producers and consumers. Although the Western Australian policy aims to increase domestic gas supply it ultimately may also impose a net economic loss due to higher costs incurred by gas producers. When additional gas is diverted to the domestic market, producers must accept lower domestic prices than they otherwise would internationally. As a result, gas producers are less able to cover operating expenditure and provide a return on investment, thereby reducing incentives to further explore or produce gas.[115] On the other hand, by effectively "subsidising" the cost of gas, the Western Australian reservation policy has helped industries that were gas intensive – such as mineral processes, electricity generators and those in the mining sector.

If a reservation policy were to apply in the Beetaloo Sub-basin, it would have cost and regulatory implications for proponents. It should be noted that Deloitte Access Economics modelled the effect of introducing a reservation policy in the eastern states in 2013 for the Australian Petroleum Production & Exploration Association (APPEA).[116] This study found that the economic costs of such a policy outweigh any advantages for domestic gas users, and

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[110] Ibid 75.
[111] Heads of Agreement – available at https://www.industry.gov.au/regulations-and-standards/australian-domestic-gas-security-mechanism
[112] Ibid.
[113] Western Australian Government, *WA Domestic Gas Policy* <https://www.jtsi.wa.gov.au/economic-development/economy/domestic-gas-policy>.
[114] Ibid.
[115] Bureau of Resources and Energy Economics and Department of Industry, *East Coast Domestic Gas Market Study* (Departmental Study, 2014) 107.
[116] Deloitte Access Economics, *The economic impacts of a domestic gas reservation* (Report, October 2013) <https://www.appea.com.au/wp-content/uploads/2013/10/DAE-Economic-impacts-of-gas-reservation-2.pdf>.

Australians are worse off as a result. The study used a combination of a tax and subsidy regime to represent the effect of the reservation policy.

7.4 Environment

In addition to the regulatory issues identified above, we have also addressed potential environmental impacts to the development. Deloitte has not conducted a full environment assessment as part of this study. There are other very detailed environmental impacts assessments which have been completed or are ongoing, such as the Commonwealth's Geological and Bioregional Assessment (GBA).

7.4.1 Biodiversity

Development of gas basins can be associated with biodiversity loss if it involves displacing native wildlife or destroying habitat and vegetation. If the project site coincides with the habitat of native or endangered species, the impact on flora and fauna in the area should be considered.

According to the NT Fracking Inquiry, the proposed site for the Beetaloo Sub-basin development does not coincide with any endangered wildlife or habitat. However the recent geological and environmental baseline assessment (GBA) of the Beetaloo region[117] found that the area potentially includes 14 threatened species, 13 migratory species, one species that is both threatened and migratory, and 21 listed marine species. There is one territory reserve that occurs entirely within the Beetaloo region – Bulwaddy Conservation Reserve. There are a further four that are within the extended Beetaloo region. Additionally, four species that are classified as threatened under the EPBC Act have been recorded in the Beetaloo region since 1990. It is likely that these species are still there. These species will be considered further in Stage 3 (impact analysis and management assessment) of the GBA.

7.4.2 Water

Water is a critical resource for human and community function, and also has an important role traditional Aboriginal cultures in terms of its spiritual link to Aboriginal sacred sites and religious customs (NT Fracking Inquiry). Notably water security is a prominent concern of community stakeholders of onshore gas developments.[118] In addition to the management of such concern, sustainable approaches to onshore gas developments using surface and groundwater resources, requires the protection of water quantity, water quality, and aquatic ecosystems.

The development of the Sub-basin may involve disturbance or pollution of nearby water sources. Potential risks relating to gas exploration and development, in particular CSG, include:[119]

- The impact of water pressure changes on freshwater aquifers and the replacement of extracted water
- The disposal of produced water and the management and disposal of fracking fluids

The following objectives were developed in the NT Fracking Inquiry in relation to analysing these risks:

- Ensure surface water resources are used sustainably
- Ensure regional groundwater resources are used sustainably
- Ensure local groundwater resources are used sustainably
- Maintain acceptable quality of surface water resources
- Maintain acceptable quality of groundwater resources
- Protect surface water dependent ecosystems
- Protect groundwater dependent ecosystems
- Protect surface water and groundwater aquatic biodiversity.

In planning for the development of the Sub-basin, consideration of these potential impacts and objectives should occur through processes such as environment and social impact assessments at appropriate stages of the development.

As this project involves fracking, the impact on surrounding groundwater, in particular, needs to be considered. As this is a shale development, the work involves deeper drilling than with a CSG project. However, numerous studies

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[117] *Beetaloo GBA Stage 2 Report* (above n 15).
[118] *NT Fracking Inquiry* (above n 1).
[119] Office of the Chief Economist, *Review of the socioeconomic impacts of coal seam gas in Queensland* (Report, 2015) ('*Review of the socioeconomic impacts of coal seam gas in Queensland*').

have found that the use of fracking does not pose a significant risk to the environment if it is subject to the implementation of appropriate controls and standards.[120]

The NT Fracking Inquiry estimates that development of the Beetaloo will require around 20,000-60,000 ML of water over the next 25 years. This water is to be obtained from groundwater sources, as one of the recommendations of the Inquiry was the prohibition of surface water for petroleum activities.

While there are some knowledge gaps relating to groundwater dependent ecosystems in the Beetaloo Sub-basin, it is estimated that such ecosystems would be unlikely to develop in the Sub-basin. This is because the groundwater table in the region is typically greater than 30 metres deep and not connected to the surface.[121] As such, any drilling relating to Beetaloo is unlikely to disrupt any existing or future groundwater dependent ecosystems. The Beetaloo geological and bioregional assessment found that there are two nationally important wetlands within the greater Beetaloo area.

Indeed, if all the recommendations of the NT Fracking Inquiry are followed, the impacts on groundwater are likely to be low or very low. This is supported by the findings of a recent report by the Gas Industry Social and Environmental Research Alliance relating to coal seam gas extraction in the Surat Basin. The report found that water samples from a local creek adjacent to one of the study areas, in the vicinity of well sites, did not indicate any signs of contamination relating to the coal seam gas activities.[122]

7.4.3 **Visual amenity**

The development of infrastructure, and other visual impacts relating to the project such as smoke and pollution, may have a negative impact on the visual amenity enjoyed by nearby residents and those passing by the development area. Visual amenity can also be impacted by the introduction of additional pests, vermin, litter, birds and traffic. The social impacts of visual amenity of the project are estimated to be minimal as a result of the highly remote location of the Beetaloo Sub-basin, the co-existence of the operations with pastoral activities, and the low residential populations proximate to the development, as noted in the Beetaloo Sub-basin social impact assessment case study,[123] however consultation should be closely maintained with those potentially affected residents.

7.4.4 **Ambient noise**

Various machinery, infrastructure and vehicles are currently required for exploration of the Sub-basin and will be required if development activities advance. This will be associated with an increase in the amount of ambient noise created in the area, and a resulting negative externality for anyone subject to the additional noise. The extent of the impact will depend on the proximity of the project to residential, commercial and recreational use areas. Analysis of the proposed site indicates that the project is in a remote area, and the existing residential population is limited, and as such, the likelihood and frequency of exposure to additional noise is anticipated to be minimal.

7.4.5 Beetaloo Geological and Bioregional Assessment

The Beetaloo Geological and Bioregional Assessment (GBA) was released by the Commonwealth Government's bioregional assessment program on 15 May 2020. The purpose of these GBAs is to provide transparent scientific information to better understand the potential impacts of unconventional gas and coal mining developments on water and the environment.[124] This analysis then informs regulatory frameworks and appropriate management approaches.

The GBA program will assess the potential impacts of selected shale and tight gas development on water and the environment and provide independent scientific advice to governments, landowners and the community, business and investors to inform decision making. Geoscience Australia and CSIRO are conducting the assessments. The Program is managed by the Department of Agriculture, Water and the Environment and supported by the Bureau

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[120] Andrew Garnett, UQ, personal communication.
[121] *NT Fracking Inquiry* (above n 1).
[122] GISERA,
Assessing the potential impacts of hydraulic fracturing on water and soil quality in the vicinity of well sites in the Surat Basin, Q ueensland (Final Report, March 2020) < https://gisera.csiro.au/wp-content/uploads/2020/04/Water-12-Milestone-7-final-report.pdf>.
[123] *NT Fracking Inquiry* (above n 1).
[124] Australian Government, *Bioregional assessments* (Website, May 2020) <https://www.bioregionalassessments.gov.au/>.

of Meteorology. This GBA program has been separated out over three distinct stages, which are outlined in greater detail below. Stages 1 and 2 have been completed.

Stage 1 – Rapid regional basin prioritization

In consultation with state and territory governments and industry, three geological basins were selected as a part of this program based on prioritisation and ranking in Stage 1. These geological basins were chosen based on which geological basins has the greatest potential to deliver shale and/or tight gas to the East Coast Gas Market within the next five to ten years:

1. Cooper Basin
2. Isa Superbasin
3. Beetaloo Sub-basin.

Stage 2 – Geological and environmental baseline assessments

In Stage 2, geological, hydrological and ecological data were used to define 'GBA regions': the Cooper GBA region in Queensland, South Australia and New South Wales; the Isa GBA region in Queensland; and the Beetaloo GBA region in NT.

The key relevant environmental sensitivities we have noted, are informed by the view of the GBA user panel:[125]

- Industrial chemicals used for drilling and hydraulic fracking
- Hydraulic fracturing and well integrity.

Environmental impacts of industrial chemicals used for drilling and hydraulic fracking

The GBA Stage 2 assessment for the Beetaloo Sub-basin identified a total of 116 chemicals used in drilling and hydraulic fracturing at shale, tight and deep coal gas operations between 2011 and 2016.[126] A Tier 1 qualitative (screening) environmental risk assessment (ERA) of the identified chemicals found that:

- 42 chemicals are of 'low concern'
- 33 chemicals are of 'potentially high concern'
- 41 are of 'potential concern'.

The identified chemicals of potential concern and potential high concern would require further site specific quantitative chemical assessments to be performed to determine risks from specific gas operations to aquatic ecosystems.[127] Further, laboratory-based leachate tests on powdered rock samples collected from formations in the Beetaloo GBA region identified several elements that could be substantially mobilised into solutions by hydraulic fracturing fluids.[128] As a direct result of the above findings regarding potential impacts on water quality, the GBA highlighted that there remains significant public concern regarding fracking activities. Further analysis is to be undertaken in Stage 3 of the GBA.

Environmental impacts of hydraulic fracturing and compromised well integrity

The GBA also found a **low likelihood** of the occurance of any hydraulic fracturing and compromised well integrity.[129] However, further assessment in Stage 3 of GBA of the 'Hydraulic fracture growth into aquifer' impact scenario, as well as compromised well integrity impact scenarios ('Migration of fluids along casing between geological layers' and 'Migration of fluids along decommissioned or abandoned wells') are seen as vital, considering "their importance to government and the community."[130]

Quantifying the likelihood of potential rate of subsurface flow (fluids along wells) in the Beetaloo GBA region, was identified as a priority impact scenario. This is a knowledge gap for government and the community.[131] Spatial analysis will improve understanding of the environmental impacts of well integrity failure and its likelihood of occurring in the Beetaloo GBA region.[132]

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[125] *Beetaloo GBA Stage 2 Report* (above no 8) 210.
[126] Ibid 226.
[127] Ibid.
[128] Ibid.
[129] Ibid 227.
[130] Ibid.
[131] Ibid.
[132] Ibid.

The Beetaloo GBA identified a number of potential impacts associated with all life-cycle stages of shale gas development in the Sub-basin. It further defines a set of pathways which represent the logical chain of events, either planned or unplanned, that may link shale gas development activities with potential impacts on water and the environment within the Beetaloo Sub-basin

For the purposes of this report, to avoid duplication, Deloitte has not set out a great deal of detail from the Beetaloo GBA.

Stage 3 – Impact analysis and management

Finally, Stage 3 of the GBA will include impact analysis and management, which will analyse the potential impacts to water resources and matters of environmental significance to inform and support Commonwealth and Territory management and compliance activities. Workshops have been held to understand how the impact assessment work to occur in Stage 3 can be tailored to support user needs.[133] Stage 3 is being undertaken currently and is expected to be completed by 2021.

[133] See Consultation Summary - https://www.bioregionalassessments.gov.au/assessments/geological-and-bioregional-assessment-program/stakeholder-engagement/geological-and-bioregional-assessments-stage-3-workshops-consultation-summary

8 Community and social policy/regulatory recommendations

8.1 Summary

In addition to economic impacts, the development of the Beetaloo Sub-basin would have both direct and indirect impacts on communities in the NT. Changes resulting from development may influence demographics and social structures, environmental outcomes, infrastructure and service use demands. Using qualitative analysis, this Chapter considers such impacts in the proximate regions to the Beetaloo Sub-basin (Katherine-Daly and Barkly) to inform recommendations to best manage the opportunities and challenges in the development of the Sub-basin.

Further to local community impacts, broader social impacts are likely to occur across the NT. However as these impacts are dependent on the approach taken to develop the Beetaloo Sub-basin such as the location of the workforce, and approach to the extraction of gas from the field, it is not possible to provide substantive recommendations. Accordingly these broader impacts have not been addressed at this time.

Community and social policy approaches are considered to maximise benefits and mitigate risks from the development of the Beetaloo Sub-basin on communities localised to the development. Such approaches also work to effectively manage community impacts in the establishment and maintenance of a social license to operate, which is identified as a key risk in the efficient development of the Beetaloo Sub-basin.

Table 32 – Summary of recommended community and social licence changes

Area	Recommendation	Responsible entity	Timeframe	Reference
Community Impacts	O. Commence workforce and community impacts baseline assessment via the SREBA. The potential impact of the development on local health services should be assessed through the Social Impact Assessment process in order to inform demand for health clinics during the ramp and production phases.	NT Government	Short term	8.4.3
Community Impacts	P. As part of the NT Benefits Policy Plan for developers, ensure that skill development for local people that would support longer term job opportunities are included.	NT Government	Long term	8.4.3

8.2 Community profile

This section outlines the current socio-economic profile for the proximate regions to the Beetaloo Sub-basin, providing a context for considering the social impacts that may result from the development of the Sub-basin.

The Beetaloo Sub-basin is in a very remote area of Australia, with the boundaries of the Sub-basin incorporating both the Katherine-Daly and Barkly Regions of the Northern Territory. The Sub-basin spans an area of approximately 30,000 square kilometres[134] and encroaches on a number of small towns, major highways, and sites of cultural or conservational significance.

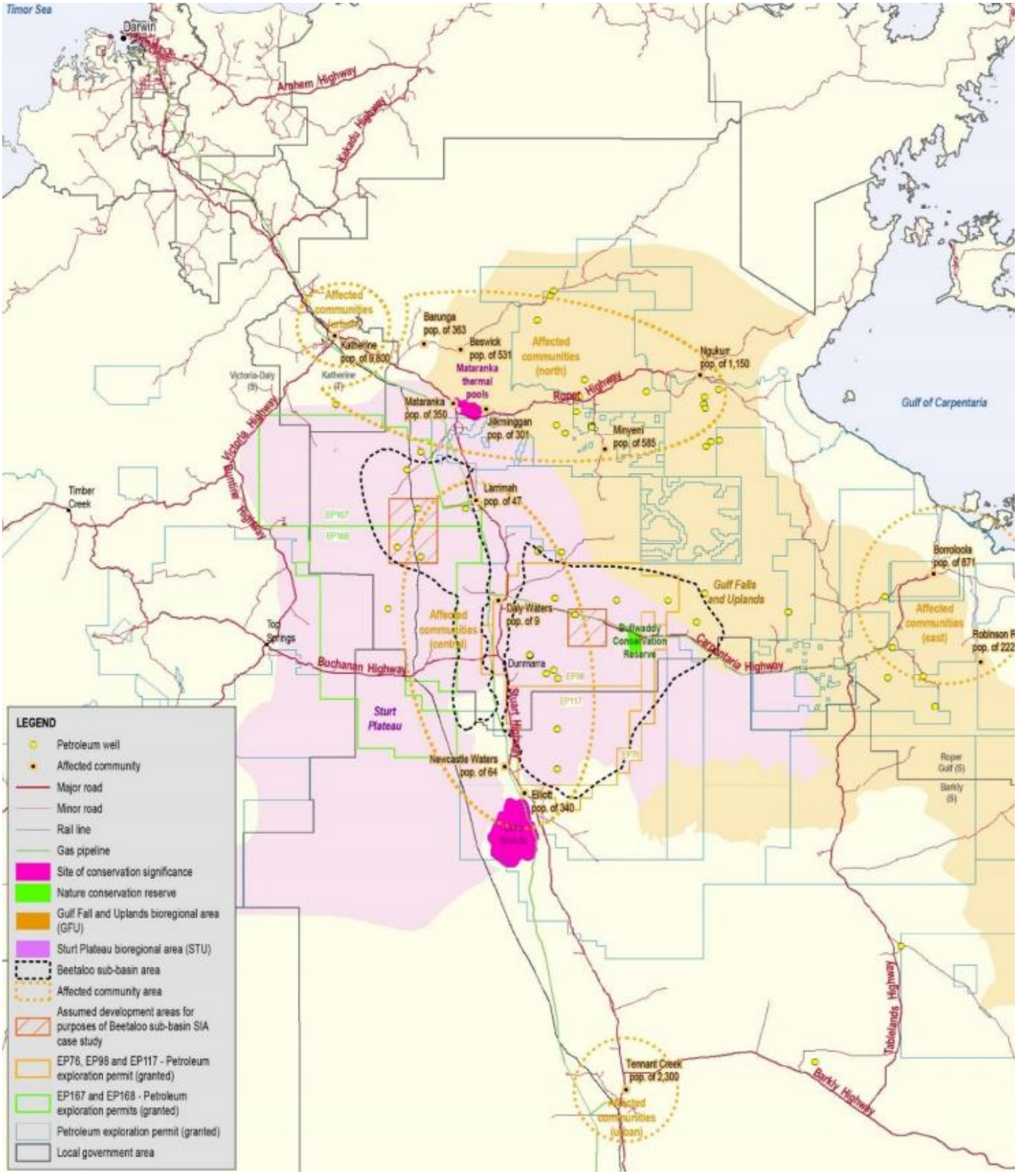
The boundaries of the Beetaloo Sub-basin incorporate several small towns with low residential populations. A social impact assessment of the development of the Beetaloo Sub-basin[135] completed in 2018 identified four social

[134] *Beetaloo GBA Stage 2 Report* (above n 15).
[135] Coffey, *Beetaloo Sub-basin Social Impact Assessment Case Study* (Report, 2018).

catchments containing affected communities impacted by the development. This is shown in Figure 32, and includes:

- Urban: Katherine (town) and Tennant Creek.
- North: Barunga, Beswick, Mataranka, Jilkminggan, Minyerri and Ngukurr.
- Central: Larrimah, Daly Waters, Dunmarra, Newcastle Waters and Elliott.
- East: Borroloola and Robinson River.

Figure 32 – Communities impacted by development of Beetaloo Sub-basin



Source: Coffey, 2018

Early drilling and development activities for the Beetaloo Sub-basin are currently concentrated near to the communities of Daly Waters, Larrimah and Elliot. Daly Waters is a small town in the boundaries of the Sub-basin, with a residential population of 9. The next closest community to Daly Waters is Larrimah, this town has a residential population of 47 (194 when including surrounding areas). Being highly remote and with limited human capital resources, these localities currently have limited economic capabilities. Established infrastructure and services in these towns caters predominantly to tourists and transport services, including accommodation, fuel and meals. With limited residential populations near the Sub-basin it is likely the workforce supporting the development will be Darwin based or FIFO. Accordingly, impacts from the early drilling and potential developments in the Sub-basin on the towns of Larrimah and Daly Waters are likely to be minimal.

The two nearest regional centres of Katherine and Tennant Creek offer the next closest locations with suitable infrastructure and service capabilities to support gas development activities such as rail, road and air transport; medical and education services; and human capital. As Tennant Creek and Katherine are still some distance from what could be the epicentre of the activity, it is not assumed this would be the best service centre, as it may be preferable for the workforce to be flown in more directly. Further to workforce supply, Katherine and Tennant Creek may have opportunities for growth in providing support services and logistics.

The communities affected by the development of the Sub-basin fall under the responsibility of three local governments. To establish a baseline to measure potential development outcomes from the Sub-basin, the current socio-economic profile of each local government area is explored in Table 33. The analysis highlights opportunities to target benefits from the development of the Beetaloo Sub-basin to enhance outcomes in the proximate regions relating to population growth, education and training.

Table 33 – socio economic profile of regions proximate to Beetaloo Sub basin

	Katherine Town Council	Barkly Regional Council	Roper Gulf Regional Council
At 2019	Regional centre neighbouring the Sub-basin, town centre is 280km from Daly Waters, a key drilling site	Regional Centre neighbouring the Sub-basin, most populated town is located 400km from Daly waters and 250km from Elliot key drilling sites.	Region incorporates a number of towns in the Sub-basin boundaries, such as Larrimah and Daly Waters.
Estimated residential population	10,623	7,369	7,428
Population growth rate (last 10 yrs)	2.6%	-6%	6%
GRP in 2019 ($ m)	946	395	313
Unemployment	3.5%	8.3%	12.5%
Tertiary qualified residential workforce	33.9%	35.8%	19.4%
Residential workforce with no qualifications	31.2%	32.9%	44.9%
Population aged +15 years holding a bachelor	13.4%	8.4%	5.2%
Population aged +15 years with vocational qualification	20.1%	14.4%	11.9%

Source: National Institute of Economic and Industry Research.

Further to the broad socio-economic context of the regions proximate to the Beetaloo Sub-basin, focused consideration of Aboriginal communities in the regions impacted by development is required. Nearly one-third (30 per cent) of the NT population identify as Aboriginal or Torres Strait Islander[136].This is much higher than the national average, which is just over 3 per cent[137]. In addition Aboriginal and Torres Strait Islander communities are a focus of social impact considerations because Indigenous Australian's experience higher levels of social disadvantage compared to non-Indigenous Australia's. For example, Aboriginal Australians have, on average, lower levels of school attendance, higher unemployment rates, lower levels of educational attainment, lower participation rates and lower average weekly income. This disadvantage is more significant in the NT where Aboriginal people face greater socio-economic and educational challenges than non-Aboriginals in the Territory and people in the rest of Australia.

[136] Department of Treasury and Finance, ABS, Australian Demographic Statistics, Australia, Cat. No. 3101.0.
[137] AIHW, *Profile of Indigenous Australians* (Report, September 2019).

Outside of the major centres of Darwin and Katherine, the Territory exhibits high levels of disadvantage as measured by the Index of Relative Socio-Economic Disadvantage (IRSD) and the Index of Education and Occupation (IEO)[138].This warrants a particular focus on Aboriginal communities in regional and remote NT, such as those near the Beetaloo Sub-basin.

Despite progress being made over the past decade Aboriginal Territorians had lower educational outcomes than their non-Aboriginal counterparts in 2016, with 2 per cent of Aboriginal Territorians holding a bachelor or post-graduate degree, compared with 22 per cent of non-Aboriginal Territorian's. In addition, 22 per cent of Aboriginal Territorians do not stay in education past year 9, compared with 5 per cent of non-Aboriginal Territorians.

Importantly, research[139] has shown that supporting Aboriginal skills, employment, and business growth could help alleviate critical social problems for Aboriginal people in the NT. The current levels of social and economic disadvantage experienced by Aboriginal Territorian's, and the potential to alleviate this by targeting social and economic benefits from the Beetaloo Sub-basin development, provides a strong incentive for action.

The socio-economic measures for the communities near the Beetaloo Sub-basin, show a common experience of lower educational outcomes, limited population growth, and high levels of disadvantage. This baseline highlights the opportunity to leverage the resulting social and economic opportunities from development of the Beetaloo Sub-basin. It represent both the most immediately impacted, as well as those with higher degrees of social and economic need. The use of existing regulatory approaches, the capability of operators, and strategic and targeted investments by the NT and local Governments, supported through the Commonwealth are identified as opportunities to realise the community benefits offered through the Beetaloo Sub-basin development.

8.3 Social licence

Social and local community expectations regarding industry activity associated with natural resource extraction have evolved over recent decades. This includes increasing desires for community involvement in decision-making, expectations that communities will receive a greater share of benefits, and demands for assurances regarding appropriate regulation.

Resource extraction projects such as the Beetaloo Sub-basin can generate a range of impacts across social and environmental domains. It presents risks to the function and prosperity of communities. The effective management of these impacts and close engagement with communities, to build trust in the industry, is increasingly recognised as a critical element of a successful project. For example the CSIRO's Gas Industry Social and Environmental Research Alliance (GISERA) provides quality assured scientific research and information to communities in gas development regions, on social and environmental matters. This has helped to mitigate the degree of community conflict and social resistance targeted at industry development activities.

The cost of conflict between resource extraction operations and stakeholders can be extensive, and may include:

- Loss in productivity;
- Opportunity costs resulting from an inability to pursue projects;
- Reputation management costs; personnel costs to the manage conflicts;
- Capital costs relating to asset management;
- Risk management including higher insurance costs; and
- Redress regarding social and environmental obligations.[140]

An example of costs resulting from social conflict in Australia is the reduced credit valuation of AGL Energy by Credit Suisse – a discount of 2.9 per cent. According to Credit Suisse AGL was not able to "address the concerns of the most vocal opposition to its presence in the Gloucester Valley" coal-seam gas activities[141]. AGL ultimately announced it would not proceed with the Gloucester Gas Project[142].

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[138] Australian Bureau of Statistics, *Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA)* (Catalogue No 2033.0.55.001, 2016).
[139] Deloitte Access Economics, *Economic Impact Analysis of Aboriginal Contracting Framework* (Final Report, 2019).
[140] Franks, D, Davis, R, Bebbington, A, Ali, S, Kemp, D and Scurrah, M, 'Conflict translates environmental and social risk into business costs' (2014) 111(21) *PNAS*.
[141] Credit Suisse, *Equity Research - AGL Energy* (Report, March 2014).
[142] AGL, *Gloucester Gas Project* (Company Website) <https://www.agl.com.au/about-agl/how-we-source-energy/gloucester-gas-project>.

Conditions for establishing and maintaining a social licence to operate are specific to the relevant stakeholders or communities impacted. This will change over time as the social context and operating experience adjusts. The significance of local variables to a social license to operate emphasises the importance of close and ongoing relationships between communities and companies. In a local context, companies establish and maintain a social licence to operate through behaviours (such as listening, keeping promises, reciprocity and dealing fairly) that build legitimacy, credibility and trust. In addition to local factors and company behaviours, broader company factors such as environmental performance, history, culture and attitudes also impact on their social license. In the case of CSG developments in QLD, the activities occurring across the industry were recognised as an important consideration in the establishment and maintenance of social licence to operate[143].

Stakeholder consultation with operators in the Beetaloo Sub-basin has confirmed extensive investment in the establishment and maintenance of a social licence to operate. The continuation of these activities is identified as a key requirement to the efficient facilitation of the development of the Beetaloo Sub-basin.

The CSIRO identified that in addition to operators, government has a key role in establishing trust and acceptance of an extractive project. Specifically, the study notes that public acceptance of a project will be enhanced if the community believes that the government has established laws to hold the project and its proponents to account.

NT laws governing petroleum operations include the Petroleum Act 1984, Petroleum Regulations 1994, Petroleum (Environment) Regulations 2016 and the Schedule of onshore petroleum exploration and production requirements. The Petroleum Act contains provisions for considering native title interests, including way of life, culture and traditions of Aboriginal land owners and traditional custodians. Other key regulatory measures to support social licence include maintaining the rights of Aboriginal persons (Land Rights (NT) Act 1976, Native Title Act 1993, NT Aboriginal Sacred Sights Act), maintaining the rights of pastoralists (NT Pastoral Land Act), and support the local industry and workforce benefits (Territory Benefits Policy).

Effort by NT Government and the Commonwealth to provide communications such as that offered through GISERA could be an effective tool in providing a foundation that better enables operators to establish and maintain a social license to operate in the Beetaloo Sub-basin.

8.3.1 Community feedback

Deloitte engaged with a range of local stakeholders to identify local impact considerations from the proposed development of the Beetaloo Sub-basin. Stakeholders engaged included local community leaders, resource industry operators, NT Government representatives, and community representative bodies. A discussion of the key themes and considerations arising from these engagements is outlined below.

Timing: Community stakeholders highlighted the importance of social engagement approaches that are suitably considerate of the lifecycle of the engagement, and impacts on communities. This included the importance of early engagement of stakeholders to share information and build trust and relationships. The importance of recognising that a project has an end date, and the risk of creating project dependencies was also noted. Early engagement between companies and communities, and innovative approaches to identifying opportunities for transition post-project was a key consideration in the development of the Beetaloo Sub-basin.

Communications: The importance of good communication between operators and local communities was a key consideration of community stakeholders. In particular, with respect to opportunities that will arise from projects for education, training, employment, and contracting. Approaches to communication recommended by stakeholders included operator engagement with Territory and Local Governments, engagement with industry association bodies, a local presence by operators in impacted communities, hosting of information events and workshops, online engagement opportunities, and direct support of operators for contractors and community members.

Innovation: Community stakeholders highlighted opportunities to identify innovative approaches to supporting outcomes in local communities. These include those outside of the immediate considerations of the project, such as the impact of communications infrastructure on local communities, the use of freight for community benefits, and activities that support local industry development like tourism. Approaches to identifying and addressing such opportunities focused on local governance arrangements that bring together a range of stakeholders with insights on opportunities, and solutions to realise potential benefits.

[143] *Review of the socioeconomic impacts of coal seam gas in Queensland* (above n 146).

Flexibility: Community stakeholders highlighted that the capacity of local businesses and community organisation tends to be limited to smaller projects and contracting opportunities. Accordingly, approaches that are flexible to support these factors to engage in project opportunities are needed. This may include activities to break down large contracts, targeted efforts to build business capability, and identification of small project opportunities e.g. establishment of a seedbank. Requirements for assessment of opportunities and established targets for engagement of local communities enable greater benefits to be realised by local communities.

In addition to early operator engagement with communities through multiple communications channels, using flexible and innovative approaches, key opportunity exists for the NT Government and industry operators to engage collaboratively to establish scale in social engagement activities in the development of the Beetaloo Sub-basin. Currently the NT Government is collecting information and advice about local participation through the Territory Benefits Policy. This offers a key platform for the coordination of workforce and industry development initiatives relevant to the project. Furthermore, industry operators have a range of community participation activities that could be scaled through greater efforts to coordinate and collaborate.

Feedback from local stakeholders indicated that Jemena's approach to social engagement in the Barkly region, during its development of the Northern Gas Pipeline is a model for successful community outcomes. A case study of this approach (below) highlights the importance of community engagement which supplements regulatory approaches in the establishment and maintenance of a community acceptance.

Box 1 - Case study – Jemena – Northern Gas Pipeline Project

Jemena is a major utilities infrastructure company in Australia, responsible for the construction of the Northern Gas Pipeline from Tennant Creek to Mount Isa. Planning, construction and commissioning of the project occurred between 2016 and 2018.

Jemena indicated that a number of social and economic benefits from the project in the Barkly Region, including a spend of over $15 million through the project, award of 30 per cent of all contracts to local businesses, employment of 264 local persons, delivery of training programs resulting in 26 graduates in Tennant Creek, and a variety of sponsorships and community engagement activities.[144]

A key element of the Jemena approach included the establishment of an industry participation plan, as required through the NT Government's *'Building the Northern Territory Industry Participation Policy'* (now replaced by the *'Territory Benefits Policy')*. The policy required the establishment of a plan which supports the participation of local business in projects and enhancement of Territory business and industry capacity. To inform an approach to industry, Jemena undertook a demographic study in the Barkly Region and Mount Isa, gaining insights on key data and trends including industry capacity and employment ratios.

Jemena attribute early and extensive engagement with government, industry and community stakeholders as a key element of their industry development outcomes. This included working with industry representative groups, attending and hosting industry information events, and providing dedicated support (e.g. multi-day workshops) to local businesses to tender on the project contracts.

Utilising the evidence developed from their demographic study Jemena developed an employment plan which involved five to six weeks of training prior to engagement on the project, 98 per cent of participants graduating with a certificate II in infrastructure and resources preparation. Recognising that some barriers to employment would inhibit such outcomes in some cohorts, Jemena worked with a local social enterprise to support employment in low skilled work.

Reflections from Jemena highlighted the following key attributes for successful community engagement outcomes:
- Early engagement, ensuring adequate notice to enable planning and capacity building for engagement in project activities.
- A local presence and commitment to the community; and
- Engagement and coordination of stakeholders across the community to support solution finding and community buy-in.

When considering social impact activities, Jemena noted the importance of being realistic to the limitations of project activities, including that the relative life of the project means that some employment outcomes may be short-term, and that sponsorship of community initiatives is likely to only be possible during the project.

[144] Jemena, *Thank you Tennant Creek* (Company Website).

A case study of Origin's local engagement activities in the NT following exploration activities in the Beetaloo Sub-basin highlight the variable focus of engagement approaches, depending on the stage of the projects

Box 2 - Case study – Origin – Beetaloo Sub-basin Project

Origin describes itself as an integrated energy company, with activities in energy exploration, production, generation and retail. Origin with joint venture partners Falcon Oil and Gas is undertaking exploration activity in the Beetaloo Sub-basin. The exploration program includes three permits covering an area more than 18,500 square kilometres and will involve three stages taking place over a five-year term.[145]

Origin's approach to social engagement is currently focused on three considerations, including: engagement and agreement establishment and management with impacted land holders (Native Title holders and host pastoralists) on exploration permits; local industry engagement and procurement; and delivery of broader community benefits. Some of the successes reported by Origin include a current local procurement spend averaging to date 60 per cent of the project's addressable spend, successful engagement of local Aboriginal contractors on the project, and the delivery of multiple community assistance and partnership activities resulting in local benefits such as the development of an AFL standard football field in the town of Elliot.

To best support local communities, Origin highlighted the importance of expectation and information management at early stages of development projects. For example, a field trip to the USA highlighted negative outcomes from local businesses investing in assets and infrastructure prior to key decision points in the project lifecycle. Similarly, it was noted that activist activities present a real threat to the success of projects in the early stages.

While the outcome of drilling will dictate the future social impact activities considered by Origin, key considerations will include workforce impacts on the NT and local communities, industry development support, and Aboriginal business engagement.

8.4 Societal/cultural impacts

8.4.1 Aboriginal heritage

The development of the Beetaloo Sub-basin may encroach on or impact Aboriginal heritage sites or protected areas, limit access to cultural practice, and impinge on the cultural and spiritual connections held by Aboriginal peoples. The extent of these possibilities will depend on the relationship between the development of the Sub-basin with native title, land rights and the number, location and significance of heritage sites, which is to be determined dependant on the results of drilling and decisions of operators in pursuing further development activities.

Notably, the NT Fracking Inquiry highlighted that Aboriginal people from communities who made submissions to the panel, almost universally expressed concern about the development of any onshore shale gas industry on their country. However, this may not be a complete view, with exploration permits granted for exploration activities in the Beetaloo Sub-basin, and negotiation of land use agreements in the Beetaloo Sub-basin for production activities yet to be tested.

The Beetaloo Sub-basin incorporates lands with differing titles, including Aboriginal lands under the Land Rights Act as well as lands under Pastoral of Native Title Lease. Where development occurs on Aboriginal lands, the Land Rights Act, and the Native Title Act provide legal frameworks, for informing and consulting with Aboriginal owners and native title holders about development on their land.

In addition to native title and land rights provisions, the Aboriginal Areas Protection Authority (AAPA) has responsibility for overseeing the protection of Aboriginal sacred sites on the land and sea across the NT[146]. Since 1989 AAPA has registered 131 sacred sites in the Roper Basin (incorporating Mataranka, Larrimah, Ngukurr and Minyerri amongst other communities). The quantity of sacred sites in the region offers an indication of the significant scale of Aboriginal heritage considerations in the development of the Beetaloo Sub-basin.

The scientific inquiry into hydraulic fracturing in the NT noted that concerns were expressed to the inquiry, about the damage of sacred sites, and places of spiritual significance to Aboriginal people, from the development of onshore shale gas industry. The result of damage to sacred sites or disruption to traditional practices may be significant, including a disruption to cultural practices, feelings of powerlessness, loss of control and have impacts on future generations.

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[145] Origin, *Beetaloo Sub-basin Project Fact Sheet* (Company Website).
[146] Aboriginal Areas Protection Authority, *About Us* (Website) <www.aapant.org.au>.

Further to the risks to sacred sites, it is recognised that for Aboriginal people, development of the onshore gas industry in the NT may risk access to traditional country, capacity to transfer knowledge, and the maintenance of social cohesion if benefits and opportunities from developments are not equally distributed.

An indication of the economic value associated with cultural losses for Aboriginal communities in Australia and the NT has been established in Federal Court ruling by Justice Mansfield later upheld by the High Court, of approximately $3.3 million for impacts on native title, including $1.3 million for non-economic/cultural loss, considering the spiritual relationship between the Indigenous people and their country[147].

Currently the *Native Title Act 1993 (Cth)*, *Environment Protection and Biodiversity Conservation Act 1999* (Cth), *Aboriginal Land Rights (NT) Act 1976* and the *Aboriginal Sacred Sites Act* (NT) provides for the management and regulation of the risks to Aboriginal heritage, which had been identified as risks associated with further development of the Beetaloo Sub-basin.

8.4.2 Non-Aboriginal heritage

The project may also encroach on some Non-Aboriginal heritage sites or protected areas. The extent of the issue will depend on how many heritage sites are identified within the project area, and how culturally significant they are. Cultural heritage can generally be defined as 'ways of living built up by a group of humans beings, which is passed from one generation to the next' and can be both tangible and intangible attributes.[148]

The Northern Territory heritage register has 12 listed public heritage sites for the Roper Gulf Regional Council LGA, 10 of which have been declared, and included in the town of Daly Waters and Larrimah near to where early exploration activity in the Sub-basin is currently occurring.

Heritage sites in the NT are managed under the NT Heritage Act 2011, which aims to provide for the conservation of the Territory's cultural and natural heritage, and establishes controls to protect and maintain cultural heritage, such as approval process to carry out work on a heritage place or object. In addition to the established controls to maintain cultural heritage in the NT, with some flexibility in the location of developments in the Beetaloo Sub-basin, there is potential to avoid and or minimise potential impacts on heritage sites in the region.

8.4.3 Social cohesion

Social cohesion is defined as the willingness of members of a society to cooperate with each other in order to survive and prosper. It is recognised as an important element of social development outcomes including health and economic outcomes.[149]

The development of the Beetaloo Sub-basin has the potential to impact social cohesion through the introduction of variables to impacted communities, which challenge the established social and cultural practices and norms. For example, the introduction of human capital to the Region associated with the development of the Sub-basin is likely to change the social and economic profiles of the Region. The extent of social cohesion impacts will depend on multiple variables. These include inputs to the local communities associated with the development, such as the number of temporary workers migrating to local communities. Also the existing status of communities impacted by the development, such as their current population size and their cultural norms or sense of identity. For example, while a moderate number of temporary workers integrating into the community may help build social cohesion by growing social networks and the local economy, a large influx of temporary workers or new residents to a community is likely to disturb cultural traditions, or the established sense of identity in the community. Some variables are broadly known to negatively disrupt social cohesion, such as a large influx of male non-resident labour, as evidenced in the experience of industry development in regional and remote Queensland.[150]

As highlighted by industry stakeholders, gas projects tend to be less impactful on social cohesion when compared with other mining and resource projects, because of the nature of the work, which enables higher rates of engagement of the local workforce, as opposed to non-resident specialist workers. However, projections for the development of the Beetaloo Sub-basin indicate significant workforce requirements over the life of the

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[147] Human Rights Law Centre, *High court recognises significance of cultural and spiritual loss in native title decision* (Case Summary, 2019) <https://www.hrlc.org.au/human-rights-case-summaries/2019/7/23/high-court-recognises-significance-of-cultural-and-spiritual-loss-in-native-title-decision>.
[148] *Cultural Heritage Legislation (Indigenous and non-Indigenous) Guidelines 2018* (Cth).
[149] Dick Stanlye, 'What do we know about social cohesion: The research perspective of the Commonwealth Government's Social Cohesion Research Network' (2003) 28(1) *The Canadian Journal of Sociology.*
[150] *Review of the socioeconomic impacts of coal seam gas in Queensland* (above n 146).

development, suggesting the need for focused social impact consideration. The risk of social disturbance resulting from community opposition to gas developments forms another key social cohesion consideration.

Opposition to gas developments have been seen to both act as a tool to build and break down social cohesion. For example, the proposed development of the Kimberley Gas Hub impacting James Price Point. It resulted in fracturing relationships between the Aboriginal communities. The traditional owners of the area, the Jabirr Jabirr people, supported the development, yet the Goolarabooloo family led a strongly opposition to the development[151]. Conversely, the Northern Rivers Region of far north NSW organised community resistance to CSG development. It resulted in broad social cohesion against development activities, with a NSW electoral commission vote gaining a 97 per cent voter participation rate and 86.9 per cent of all votes against the question 'Do you support CSG exploration and production in the Lismore City Council area?".

Concern in relation to social cohesion between Aboriginal communities that may arise from the distribution of financial benefit from the development of Aboriginal lands was raised as a consideration in the NT Fracking Inquiry.

A number of social risks have been identified including: risk to social cohesion arising from substantive workforce changes; the experience of social cohesion risks associated with gas developments; concerns relating to the distribution of benefits between communities; the efforts required to build the social capital of the local communities; and the need to support the integration of new workers with the existing community.

Industry and local governments, through their community engagement and development activities, are well placed to support initiatives to measure, develop and manage social cohesion resulting from resource development activities.

A key tool to managing social cohesion in the development of the Beetaloo Sub-basin is a Strategic Regional Environmental Baseline Assessment (SREBA). This provides a mechanism through which communities and industries can gain confidence and clarity in approaches to the management of significant social, economic and environmental implications that may arise from the development of the sub-basin.

A SREBA could be further supported by the NT Government's '*Territory Benefits Policy'*, to guide local benefits planning, including employment for NT based private sector projects.

Through the SREBA, strategic decisions at all levels of Government (local, Territory and Commonwealth) could be facilitated in a manner to support social development outcomes that support the dual goals of developing the Beetaloo Sub-basin and supporting community benefits and cohesion.

Recommendations

O. Commence workforce and community impacts baseline assessment via the SREBA. The potential impact of the development on local health services should be assessed through the Social Impact Assessment Process in order to inform demand for health clinics during the ramp up and production phases.

P. As part of the NT Benefits Policy Plan for developers, ensure that skill development for local people that would support longer term job opportunities are included.

8.4.4 Empowering local development and decision-making

Community empowerment involves processes that enable communities to increase control over factors and decisions that shape their lives[152]. This might include increasing assets, and building capabilities to gain access, networks and or a voice that enhances control. Resource development projects such as the potential projects in the Beetaloo Sub-basin have the ability to empower local communities by supporting capability development and empowering local decision-making. This might be through education, training and local governance initiatives.

Case studies of local empowerment of Aboriginal communities in resource development activities in Western Australia are detailed in the Chamber of Minerals and Energy of Western Australia *'Growing Aboriginal Participation'* publication, which recount activities focusing on education and training, business engagement and community

[151] Lily O'Neill, 'The Bindunbur 'Bombshell': The True traditional owners of James Price Point and the politics of the anti-gas protest' (2019) 42(2) *UNSW Law Journal*.
[152] World Health Organisation, Community Empowerment, 7th Global Conference on Health Promotion.

partnerships. Other empowerment activities might include support for Indigenous governance boards, investment in cultural awareness training, and benefit payments.

As the Beetaloo Sub-basin development involves gas, it is possible that some required labour can be sourced locally, this is likely to result in some improvement in local employment, skill development, and empowerment outcomes. However distributional effects are important in the consideration of the impact of the project on local development. Job opportunities tend to only be made available to those who already possess a certain level of skill requirement. As such, those without the required skills may be further disadvantaged, unless unskilled workers are supported to engage in the training required to improve their skill set, to benefit from opportunities arising from developments such as those proposed in the Beetaloo.

Industry, local and the Territory governments are best placed to support activities that maximise local empowerment opportunities, such as the forecasting of labour force requirements, skill and capability needs and training and educational needs in local communities. Local development outcomes will be best supported through a SREBA reinforced by the NT government '*Territory Benefits Policy'*, to guide local benefits planning, including employment for NT based private sector projects, and targeted investment by operators in strategic skill development that best meets the needs of local communities.

8.4.5 Generating broad skill sets in the Aboriginal workforce

Development of skills in Aboriginal workers is a particularly important outcome from developments such as those proposed in the Beetaloo, due to the higher rates of disadvantage experience by Aboriginal peoples, and the significant proportion of the population in the NT that identifies as Aboriginal.

Increasing the share of Aboriginal workers and companies employed in the Territory, like in the case of the proposed NT Government's *Aboriginal Contracting Framework*[153] will support Aboriginal employment and business opportunities in the Territory. Enhanced Aboriginal employment outcomes are associated with positive social impacts and can help break the cycle of disadvantage in Indigenous communities. Some of these impacts include:

- Reduced income disparity between Aboriginals and non-Aboriginals
- Increased employability
- Improved mental health
- Improved family functioning
- Improved long-term outcomes for children
- Increased intergenerational wealth
- Increased community services
- Reduced crime
- Creation of a role model for businesses.

The extent of these impacts will depend on how many Aboriginal people are employed by the project, and what roles Aboriginal people are employed in. Currently employment strategies are managed independently by operators, however frameworks such as the NT government '*Territory Benefits Policy'*, guide local benefits planning, including employment for NT based private sector projects.

The policy encourages project proponents, early in their planning phase, to understand the capabilities of the local industry and workforce and consider strategies they can adopt to enhance the local benefit outcomes through their project, while also realising the long-term advantages of locally based, capable suppliers and labour.

Notably, as the NT Government will act as a central resource for the consideration of private sector projects and their Territory Benefits Plans, it could play an important role in analysis of workforce capability and needs assessments, employment, training and contracting opportunity assessment, and coordination of benefits activities across proponents, communities and associated stakeholders (e.g. training institutions). A SREBA will help to inform a strategic approach to Aboriginal employment by informing the current skills base line and community expectations in relation to training and employment outcomes.

[153] *DAE Aboriginal Contracting Framework EIA* (above n 152).

8.4.6 Payments to landholders

Some of the Beetaloo Sub-basin operations require access to land belonging to private landholders. Under the Native Title Act 1993, permit holders must reach an agreement with Aboriginal custodians on compensation for use of the land. These compensation amounts are determined commercially on the basis of willingness to pay and willingness to accept, and are usually not disclosed outside of the two parties.

8.4.7 Housing availability and price

The development and extraction of resources in remote areas can lead to large, temporary influxes of non-resident workers into otherwise small local communities. This can lead to pressure on housing availability and pricing in the region, as some townships may not have capacity to house the incoming workers as well as the existing residents, and the non-resident workers may temporarily push up the price of housing in the area due to their demand and relatively higher incomes. The introduction of gas development in some regions has led to a reduction in poverty, but also comes with the trade-off of higher housing costs.

For example, house prices and rents in Chinchilla were traditionally lower than the Queensland median prior to CSG developments, but then rose to above the state median during CSG development.[154] In the case of the Ichthys LNG plant, the relatively small capital city of Darwin experienced a significant spike in rental costs as the construction phase of the plant brought in thousands of workers in 2012. The median rental price for a house reached as much as $671/week in September 2013, up 28 per cent in less than two years from $523/week in December 2011.[155] The median rent for a house has since dropped down below $500/week now that construction of Ichthys has finished, but the height of construction created a rental squeeze that put pressure on locals.

[154] *Review of the socioeconomic impacts of coal seam gas in Queensland* (above n 146).
[155] NT Department of Treasury and Finance, *Northern Territory Economy – Housing* (Website) <https://nteconomy.nt.gov.au/housing>.

Appendix A: Stakeholder Engagement

Representatives from across stakeholder groups were consulted on the potential development of the Beetaloo Sub-basin, including stakeholders from market bodies, producers, industry bodies and potential off-takers. As expected, stakeholders held a diverse range of views on the issues in the Australian gas market, and Beetaloo in particular.

A.1 Key issues affecting the Australian gas market and how Beetaloo will fit in

An issue raised by multiple stakeholders was the uncertainty facing the gas market. Factors contributing to the uncertainty are the potential impact of import terminals, the unknowns surrounding the lifting of Victoria's moratorium on oil and gas exploration, and potential regulatory changes across all jurisdictions. Naturally, the impact of COVID-19 is an additional factor contributing to the uncertainty around the future of the Australian gas market.

Several stakeholders referred to AEMO's recently released 2020 Gas Statement of Opportunities (GSOO) as their best reference for current issues or future issues for the gas market. These include shortages starting to emerge from the decline of the southern gas fields, pipeline and infrastructure constraints developing in Northern Australia, the impact of seasonality and NEM generation intermittency, and significant pipeline constraints identified from 2024.

Some stakeholders are considering that gas could be a replacement for coal in a lower emissions energy market, so Beetaloo could contribute to the baseload supply and reliability of Australia's energy, alongside renewables. Gas producers in particular recognise the importance of gas as a transition fuel and have made it a key driver for continued exploration and development of gas. They see the requirement of a large amount of gas in the short-term so the market can continue, and in the long-term to replace coal.

Other stakeholders mentioned that there has been too much on the import of foreign resources for Australian use and on the development of Australian resources for export. They believe that it's important for Australia to develop resources for domestic use. This will also assist in the development of Australian industry and employment through increased supply potentially impacting on price, and a higher chance of long-term beneficial outcomes for the Australian gas industry. Increased supply, and increased certainty of supply is particularly important if large long-term gas-related investments are to take place in Australia. Some manufacturers stated that gas costs represent up to 80 per cent of their total operating expenditure. For these companies to invest in large manufacturing plants, the first step is securing long-term gas at a reasonable price. The Australian gas market, as it stands, needs to provide more certainty in order to attract further manufacturing investment. Government bodies also conceded that it is a big jump for a gas-intensive company to relocate, particularly when they are competing in a market where there is lots of competition in WA and overseas. For example, the progression of a methanol plants requires a feed study at huge cost, and this step is not until there is certainty of gas.

Most stakeholders interviewed are non-committal on the question of whether Beetaloo itself can solve current issues in the market, although market bodies and potential off-takers generally hold the view that Beetaloo could increase the competitiveness of the gas market and reduce gas prices. Further, market bodies believe there is an opportunity for Beetaloo to address the supply issues they foresee arising from 2024. Some also mentioned the possibility of Beetaloo primarily exporting in Australian summer when northern hemisphere demand is highest, and reserving most of its output for domestic use in Australian winter months when more gas is required at home. Government bodies sees Beetaloo as a promising resource, but not a near-term solution to the volume shortages, especially considering the uncertainty around the resource. The general impression of stakeholders of the development of the Beetaloo Sub-basin is one of cautious optimism.

A.2 Expected demand for Beetaloo gas

In discussions with stakeholders there was no strong consensus on how much demand for Beetaloo gas there could be. Several factors impact the ability to forecast with certainty, such as government regulations, climate change policies and lack of certainty on potential developments in the industry. COVID-19 will also have as yet un-guessable impacts on a range of industries in Australia and overseas, with flow-on effects that may continue for years.

Some market bodies believe that current demand for gas in Darwin is 25-30PJ p.a., but this could be reduced to 6PJ in response to the NT government's renewable energy targets. They hold that upcoming industrial projects such as Coogee's 2024 Darwin methanol plant have the potential to increase demand, but that export LNG is likely to be a larger driver. Some market bodies hold that Beetaloo is only likely to be developed for export – GSOO 2020 forecasts that industrial and GPG demand is set to decrease further than previously expected. Exploration permit-holders expect that initial demand in the mid-2020s could be 100-200TJ per day, but this could scale to 1000TJ a day by 2030.

Potential off-takers have stated that sourcing gas locally and the existence of multiple sources of gas are very important to them, however they may only see Beetaloo as a second-choice option, or have existing contracts for the short to medium term that would prevent them entering into early contracts with Beetaloo. One potential off-taker indicated that their demand would be in the order of 10-25PJ p.a. However, one producer was sceptical about demand for gas in the NT, saying that the local market is saturated and the only way to prove the resource at scale is to deliver it to the east coast as this will be cheaper than building a new LNG plant. In such a case, a developer would need to build up over time, initially starting at 100TJ/day and moving to 200-300TJ/day from the export pipeline.

One exploration permit-holder in the Beetaloo Sub-basin stated that there is no limit to the scale of the potential market for Beetaloo gas, with markets potentially being the whole of Australia as well as the Asian market. However another stakeholder mentioned that supply is likely to go to the east coast before LNG exports are considered, as LNG plants are an expensive investment. Additionally, this east coast supply is likely to be developed in an incremental way, e.g. starting at 100TJ/day and ramping up to 300, so that the economics can be understood before considering expansions such as exports from Darwin.

Several stakeholders raised the issue of transportability – that the gas demand itself is unimportant, if there is no efficient path for Beetaloo's gas volumes to reach the market.

Some stakeholders suggested that that markets that Beetaloo will supply will depend on how much it contains and of what. For example, if the resource has high propane and butane content, it is likely to be sent to Darwin for processing. If the resource is large (1,300TJ/day), some of it would have to be refrigerated. If the resource is very large (3,400TJ/day), it would require significant downstream processing - LNG or other. Some stakeholders think that to get to this scale would take around a decade (similar to Qld), and under this scenario the east coast market would consume around 600TJ/day, with the majority of the rest being exported. This scenario would require infrastructure to the extent of five LNG trains and a 42-inch pipeline. One exploration permit-holder mentioned that the resource is very well understood, and what can be extracted (oil, dry gas, wet gas) depends on where you drill in the basin.

One producer estimates that first production (early 2020s) from some of the horizontal wells will be 10TJ/day, ramping up to 100TJ/day around the mid-2020s before reaching full-scale production of 1,000-2,500TJ/day by 2030.

Another producer's base case is for first gas in the mid-2020s with a scale up to full production in the late-2020s. They expect that if the resource is liquids rich, then those liquids would be exported and the economics would improve markedly and Beetaloo would be competitive internationally.

Others mentioned that what happens with the resource, in terms of liquefaction or piping, will depend on what is best value.

In general, stakeholders were not in favour of a domestic reservation policy, stating either that such a policy would result in a deadweight economic loss or that there is no supply to apply the policy to, as most prospective resources are already contracted to other projects.

One off-taker mentioned that they have completed a pre-feasibility study for a new chemical manufacturing plant. This would utilise 30TJ/day, 90 if they can get capacity up to desired capacity. That sort of scale is required for the project to be economical. Certainty of gas supply is important for this – the facility going ahead unless Petrel or Beetaloo come online. It was suggested that it is possible for a new processing facility to be built on the East Arm that could tap straight into the supply from Beetaloo. However, in the long-term this facility would not have synergies associated with being near other facilities on Middle Arm, and may also disturb residents as East Arm is relatively close to the city.

A.3 Alternatives to Beetaloo

Stakeholders have raised a number of potential alternatives to Beetaloo. The most common likely substitution is import LNG, either through east coast import terminals such as that announced by AGL in 2017 or shipped into Darwin. This ensures Australia can take advantage of low international spot prices, with major exporters such as the US or Qatar offering competitively priced dry gas. On the other hand, an off-taker has indicated that their attempts to obtain cheap gas from the USA through Darwin have been fruitless, so they would prefer a local solution. A pipeline company seems confident that a single import terminal will beat Beetaloo to market. They mentioned that terminals bring volume and shape to the market, particularly important during winters in the south. Terminals are also cheap and quicker to bring into the market relative to a large Sub-basin like Beetaloo.

An off-taker has previously publicly implied that they will obtain their gas from Asia through the Port of Darwin, but they are now investigating local sources of supply and would welcome multiple options, supporting the re-opening of Victorian gas exploration and other gas exploration in Australia. A retailer mentioned that they view gas from import terminals and local gas as perfect substitutes – their supply is usually a mix of the two and will move towards LNG imports if the local netback price is uncompetitive. If Beetaloo was given government assistance, this retailer mentioned they would be a purchaser as long as it stacks up against the alternatives – they are not overcommitting to LNG.

One retailer was also vocally supportive of an import terminal, and also views a future large gas discovery as a potential solution to meet domestic demand. Several stakeholders raised Moomba storage as a current alternative to Beetaloo, but the consensus view is that storage at Moomba may not be viable in the longer term. Some stated that the market needs more supply, not more storage. Although storage may be useful in addressing the seasonality of demand in Australia. A pipeline from Beetaloo to the south may be wasteful if it is only used four months per year. Stakeholders also raised the point that some of the facilities at Moomba are antiquated and not capable of processing the full Beetaloo load.

One producer stated that if Beetaloo can equal international parity then it will outcompete imports. The same producer also questioned the commerciality of import terminals, given the cost of transmission pipelines in Australia outside of major load centres (i.e. Melbourne).

One pipeline company had a view that there are varying levels of competition for gas across Australia:

- There is not a lot of competition for gas in **Vic**, because the current fields are maturing and the current regulatory regime prevents much new competition.
- In **NSW**, when Narrabri comes into the market it will deliver a few hundred TJs straight into NSW, they are just not sure when – this will address a lot of the future unmet demand in the state.
- In **Qld**, the Arrow Surat Gas Project is coming forward in the near future, with a lot of it being directed to LNG trains.
- In **SA**, operations for Beach and Santos are mature, but could potentially bring more into the market.
- The east coast and NT do not face a lot of competition from **WA**. WA has made it clear that it will not be involved in interstate pipelines for some time, due to the sheer distance.

A.4 Potential barriers to development and mitigation strategies

Several stakeholders including market bodies raised the question of whether it is cost-effective to transport Beetaloo gas to the east coast, presumed to be the main market for the gas. One off-taker raised similar concerns about the cost of exploration and operations.

Industry associations hold a strong view on the impact of activists campaigning against any Beetaloo development and believe that these activists will not behave ethically in the pursuit of their goal of stopping development. They also believe that current regulatory and climate change policies pose a risk to its success.

Market bodies raised concerns that supply will not match market demand. One also flagged the risk of two pipelines being built (including the NGP) and therefore neither of them operating at capacity, short-term financing risks related to spot prices and the spread of COVID-19, and that Beetaloo would be operating in a very competitive market between WA gas exports and imports from overseas. A pipeline company is also of the view that once there is a consumer and producer ready to commit to underwrite part of the pipeline, supply and demand

do not always align immediately, so may be a role for government in underwriting the ramp up period for the pipeline.

Several stakeholders stated that the development of infrastructure, in particular pipelines, is one of the primary barriers to development. This is because a pipeline is a large capital outlay and there is currently uncertainty over how it should be paid for, if the Beetaloo is to reach its full potential. The existing pipelines do not necessarily have the capacity to support the full Beetaloo resource, with some saying that certain pipelines should have been built at double capacity with this in mind. Some infrastructure, such as the AGP, could be augmented to increase capacity by around 120-130 TJ/day for example, according to a pipeline company. However this may not be enough under the Mid and High scenarios. The development of processing facilities does not require as much commitment as pipelines, as these facilities are modular and can be expanded periodically. Another pipeline company considered that the barriers are not pipeline-related, rather they are related to the timing of the drilling program to prove up the resource, and meeting the NT Fracking Inquiry recommendations.

Another major barrier that stakeholders identified was the sheer remoteness of the location of Beetaloo. Getting personnel and major infrastructure to the site is difficult and expensive when the closest major towns of Katherine and Tennant Creek are over 150km away. Some exploration companies indicated that the majority of their workforce will be FIFO or DIDO from Darwin. Some operators see Katherine as the logistics hub for medical and air haulage, but think that it is more economical to expand some of the existing infrastructure rather than move it all to these towns.

In addition to the remoteness of the site, stakeholders emphasised that the Beetaloo area is also susceptible to a highly seasonal climate. Most exploration and production activity would be undertaken in the dry season, with operations largely paused during the wet season. However, some operating expenses are incurred regardless of whether the site is active or not. For example, if a rig is built during dry season, the lease must be paid year-round, even if is not active during the wet season. In addition, COVID-19 impacted operations at the start of the 2020 dry season, so even if the impacts are short-lived, operations are unlikely to fully restart until the 2021 dry season. Any operations that take place in the wet season are relatively more expensive, as this poses difficulties for vehicles amongst other things.

Stakeholders including pipeline companies are of the view that the development of shared infrastructure would be important in making Beetaloo as economic as possible. There is a value proposition in not duplicating infrastructure unnecessarily, like in the case of Gladstone. They think there should be a commercial arrangement for common use facilities for gas, water etc. where they are shared on a tolling basis.

For chemical producers considering a new development in Darwin, the two key components are suitable ports and wharf facilities, as well as a competitively priced supply of gas. Other infrastructure such as roads, power and water were already in place.

Government regulations, and in particular the recommendations from the NT Fracking Inquiry, are making some end users and exploration permit-holders apprehensive about the profitability of Beetaloo. Some were of the view that the NT Government enthusiastically embraced all of the recommendations with the intention of restarting the industry without realising the implications of all of the recommendations. Exploration permit-holders are of the view that many of the recommendations are unnecessary, and add excessive costs to their operations. One exploration permit-holder stated that the 35 recommendations that have already been implemented have raised well costs by $35 million per well. They think that the government needs to be careful about implementing the remainder of recommendations while keeping the gas industry in NT competitive. Some permit-holders take the NT Fracking Inquiry Recommendations as given – they don't expect the labour government to renege on any of them. But they also think governments should provide some support to help operators comply with these recommendations.

Some stakeholders say the existing ports and roads will suffice under the current situation, but may need to be developed in the case of a NT manufacturing hub.

A.5 Potential benefits from the development

One market body believes Mt Isa would benefit from Beetaloo gas on its journey to the east coast. They also hold that Beetaloo could add to the security of Australia's local gas supplies by offering extra supply to the market, meaning that the Australian Domestic Gas Security Mechanism is less likely to be activated.

One exploration permit holder holds that Beetaloo can be sized to meet NT and east coast demand when it is needed from the mid-2020s, reducing the need for imports.

Several stakeholders claimed that there will be significant opportunities for community engagement and local employment throughout the project. Whilst some aspects of the development, such as drilling, are quite technical, there is already a lot of expertise in the NT that can be utilised. Exploration permit-holders mentioned that this is a priority for them, and they have mechanisms in place to maximise the use of local resources. This is because it is not just an investment for them, it is a 40-year relationship with local communities. One off-taker mentioned that they could redeploy the workers from the Inpex Ichthys plant to the development of a new chemical plant in Darwin, utilising those existing local skills.

One pipeline company indicated that a manufacturing hub in Darwin is a possibility, albeit a long-term one. They indicated that it would take a long time to develop, and the current oil price situation makes that difficult. Conversely, they think that the current oil price situation has created an opportunity for the industry to slow down and get organised, and the market is well set to recover. Beetaloo's remoteness also makes a manufacturing hub difficult, as it takes some time to prove the resource and tie up investment.

A.6 Other views and insights

A common topic raised in our discussion with stakeholders was the lifting of the moratorium on onshore gas exploration in Victoria and the potential impact on supply. Most stakeholders hold the view that it is too early to know how this will affect the gas market.

One off-taker's view is that the more suppliers in the market, the better. They believe that the NT Government would like local manufacturers to benefit from NT supply, rather than all supply flowing to the east coast.

Stakeholders raised the point that Beetaloo needs to be competitive on a delivered basis in the market relative to the US Gulf. Australia has a small advantage over the US when it comes to shipping to eastern Asia (around $1/GJ according to some stakeholders), but the US has other advantages like cheaper labour and better-located infrastructure.

Appendix B: Methodology and CGE Assumptions

The study includes several different work streams in order to fully determine the requirements of the development of the Beetaloo, building on the prior work and scenarios constructed for the Northern Territory government. The major streams, and the team responsible, are as follows:

- Gas market background, Beetaloo context and lessons learnt from international and national jurisdictions – Deloitte
- Gas demand and supply scenarios – CORE Energy
- Infrastructure requirements including regulatory impediments and further costings – EPC Technologies
- Computable General Equilibrium modelling – Deloitte.

B.1 Gas demand and supply scenarios – CORE Energy & Resources

CORE Energy & Resources provided the demand and supply forecast scenarios that will inform the scale of the market that can be expected. These scenarios include demand, supply, price and cost, for both domestic and LNG markets.

Table 34 - Key variables influencing EA Domestic Gas Consumption between 2020-40

Variable Existing	Description	Low	Best Estimate	High
GPG gas use	• EA2018-19 total domestic GPG gas fuel use is estimated at 150 PJ p.a. (weather normalised). • These scenarios address the feasible range of future gas consumption by the electricity generation segment.	• ~20 per cent reduction in GPG to 2027 due to substitution in favour of lower emission technologies meaning reduction of 25-50 PJ p.a. and aided by electricity and gas system interconnection and energy storage. • Growth in GPG from 2028 to address NEM system reliability/intermittency with consumption averaging around 125 PJ p.a. to 2040.	• ~20 per cent reduction in GPG to 2027 due to substitution in favour of lower emission technologies meaning reduction of 25-50 PJ p.a. and aided by electricity and gas system interconnection and energy storage. • Stronger growth in GPG from 2028 to address NEM system reliability/intermittency with consumption averaging around 155 PJ p.a. to 2040.	• ~20 per cent reduction in GPG to 2027 due to substitution in favour of lower emission technologies meaning reduction of 40 PJ p.a. and aided by electricity and gas system interconnection and energy storage. • High growth in GPG from 2023 to address NEM system reliability/intermittency with consumption averaging around 165 PJ p.a. to 2040.
Residential and Commercial	• Represents gas use by households, and businesses connected to 10 distribution networks across EA • Demand driven by connections growth (per cent new residences with gas and average usage per connection) • Risk that electricity heat pump, solar and other water heating could begin to take market share	• 2019 188 PJ, falling to 168 by 2040. • Major contributor is reduction in use of gas for room heating, in favour of R-C air conditioning and other room heating sources.	• 2019 188 PJ, falling to 185 by 2040. • Major contributor is lower reduction in use of gas for room heating, in favour of R-C air conditioning and other room heating sources.	• 2019 188 PJ, growing to 204 PJ by 2040. • Growth in connections offsets loss of demand per connection. Higher density dwellings assumed to favour gas for water heating.

Variable Existing	Description	Low	Best Estimate	High
Industrial	• A small number of very large gas users, and large number of low to mid intensity • Large users typically receive gas directly from transmission system and smaller users from distribution system • Demand varies from operational electricity, heat application to feedstock for industrial production such as ammonia, alumina. • Major risk is global competitiveness with large loss of industrial capacity over last 10 years. • Risk of major consumers with low priced legacy contracts becoming challenged.	• 2019 250 PJ falling to 145 by 2040 • High level of net • Capacity loss • Energy efficiency • Fuel switching	• 2019 250 PJ falling to 206 by 2040 • Moderate level of net • Capacity loss • Energy efficiency • Fuel switching	• 2019 250 PJ falling to 221, by 2040 • Low level of net • Capacity loss • Energy efficiency • Fuel switching • Losses offset partially by new load of 15 PJ (see below)

Source: CORE Analysis

B.1.1 Domestic Demand

Opening/historical actual demand was confirmed by reference to AEMO Gas Bulletin Board data (which covers NT and EA gas pipeline flows). CORE utilised its proprietary Energyview platform to derive three scenarios (High, Mid and Low) of domestic gas demand for NT and eastern Australia. Energyview develops scenarios of demand on a bottom up basis, having regard to demand drivers within each consumer segment, by jurisdiction. Three consumer segments were considered:

- Gas-powered electricity generation (GPG) – built up by generator dispatch in a competitive NEM bid/dispatch setting
- Industrial - built up by major consumer and analysis of smaller consumers within each distribution gas network
- Residential and small business – built up by analysis of projected gas network connections p.a. and scenarios of average consumption by tariff segment.

CORE's demand scenarios have been subject to comparison against projections developed by AEMO (presented within the 2020 Gas Statement of Opportunities report).

B.1.2 LNG Demand

Opening/historical actual demand was determined by reference to results released international by LNG industry organisations (e.g. the International Group of Liquefied Natural Gas Importers (GIIGNL) and BP Statistical Review

(lagged one year). CORE has utilised its proprietary Energyview platform to derive three scenarios (High, Mid and Low) of global LNG demand. Energyview develops scenarios of demand on a bottom up basis, having regard to demand drivers within each LNG consuming and producing country and related projects/infrastructure

CORE's demand scenarios have been subject to comparison against leading international energy research organisations, including IEA, EIA, IEEJ and the Oxford Energy Research Institute.

B.1.3 Domestic Supply

Existing supply has been confirmed via AEMO Gas Bulletin Board data and company disclosures. CORE has utilised its proprietary Energyview platform to derive three scenarios (High, Mid and Low) of domestic gas supply for NT and eastern Australia. Energyview develops scenarios of supply on a bottom up basis, having regard to reserves/resources, contracts and field performance within each petroleum basin.

CORE has also relied upon certain RISC estimates relating to the Beetaloo, included within the KPM/GHD/RISC report for the Northern Territory Government, as requested by the Commonwealth.

Three resource classifications are considered, consistent with international Petroleum Resource Management (PRMS) guidelines:

- Reserves – developed and undeveloped
- Contingent resources
- Prospective resources.

CORE's scenarios have been subject to comparison against projections developed by AEMO (presented within the 2020 Gas Statement of Opportunities report), noting that CORE provides a range of underlying data to AEMO.

B.1.4 LNG Supply

Opening/historical actual demand has been confirmed by reference to results released international LNG organisations, BP Statistical Review and company disclosures.

CORE has utilised the Energyview platform to derive a most likely scenario of global LNG supply. Energyview develops scenarios of demand on a bottom up basis, having regard to LNG liquefaction projects in operation, under development or expected to reach FID and commence production prior to 2035. CORE's supply scenarios have again been subject to comparison against leading international energy research organisations, including IEA, EIA, IEEJ and Oxford Energy Research Institute.

B.1.5 Domestic Supply Cost

CORE utilised its proprietary Energyview platform to derive a best estimate of the cost of domestic gas supply sources for NT and eastern Australia. Energyview receives outputs from cost models which resolve for the breakeven price of gas for each resource classification:

- Reserves – developed and undeveloped
- Contingent resources
- Prospective resources.

The NPV analysis which underpins the breakeven price, incorporates assumptions relating to capital cost, operating cost, royalties and an after tax return on capital of 10 per cent, real. CORE relied upon Beetaloo break even prices included within the earlier KPMG/GHD/RISC report.

CORE's cost estimates are consistent with those used by AEMO (developed by CORE for AEMO and also consistent with disclosures by ACCC which are developed by CORE). CORE's scenarios have been subject to comparison against a range of independent public disclosures, where available, which are somewhat limited.

B.1.6 LNG Supply Cost to NE Asia

CORE utilised its proprietary Energyview platform to derive a most likely estimate of the cost of LNG for all projects which are considered competitors to supply global markets, and NE Asian market in particular, to 2035. CORE's supply cost estimates have been subject to comparison against leading international energy research organisations, including IEA, EIA, IEEJ and Oxford Energy Research Institute.

B.1.7 Domestic Price Delivered to Darwin and Key Demand Nodes in East Coast

CORE utilised its proprietary Energyview platform to derive a best estimate of the range of domestic gas prices for NT and eastern Australia markets. Energyview receives outputs from price models which derive prices based on prevailing contract prices, and expected future changes in price based on supply/demand dynamics and linkages to Gladstone fob LNG prices and global LNG spot prices, netback to Gladstone and Darwin.

CORE's price estimates are consistent with those used by AEMO (developed by CORE for AEMO) and information disclosures by ACCC Gas Inquiry, which CORE assists with. CORE's price scenarios have been subject to comparison against a range of public disclosures, where available, including ACCC LNG netback price disclosure.

B.1.8 LNG Price Delivered to NE Asia

CORE utilised its proprietary Energyview platform to derive a most likely range of prices for LNG, delivered to NE Asia in the 2030 to 2040 timeframe. Prices were determined having regard to the supply/demand balance, legacy prices, movements in competing project costs (capital, operating, shipping et al).

CORE's price estimates have again been subject to comparison against leading international analysts, commentators, and energy research organisations including IEA, EIA, IEEJ and Oxford Energy Research Institute.

B.2 Infrastructure requirements – EPC Technologies

EPC Technologies has built on the KPMG / GHD / RISC report to further analyse and cost the infrastructure requirements for the Beetaloo development, and the relevant regulatory environment.

This stream has also utilised information submitted to the NT Fracking Inquiry to identify the infrastructure specific to Beetaloo and any regulatory requirements or concerns for this infrastructure. Information about relevant infrastructure has been incorporated into the CGE modelling. This analysis also supported the development scenario narratives and identified the infrastructure constraints that the project may face, and provide recommendations for government investment to accelerate the project.

B.3 The Deloitte Access Economics regional general equilibrium model

The Deloitte Access Economics regional general equilibrium model (DAE-RGEM) belongs to the class of models known as Computable General Equilibrium (CGE), or Applied General Equilibrium (AGE) models. Other examples of models in this class are the Global Trade and Analysis Project (GTAP) model, the Victoria University Model (the Vic-Uni Model) and The Enormous Regional Model (TERM).

Like GTAP, DAE-RGEM is a global model, able to simulate the impact of changes in any of the 140 countries in the GTAP database (including Australia) onto each of the 140 countries. The ability to incorporate the flow-on impacts of changes that may occur in rest of the world is a key feature of global models that is not available in single-country models, such as the Vic-Uni Model or TERM.

However, like those models, DAE-RGEM is a bottom-up model of regional Australia. Therefore, DAE-RGEM is able to project the impacts on different States and sub-State regions of Australia of changes occurring in any region of Australia or in rest of the world within a single, robust, integrated economic framework.

DAE-RGEM projects changes in macroeconomic aggregates such as GDP, employment, export volumes, investment and private consumption. At the sectoral level, detailed results such as output, exports and imports by commodity and employment by industry are also produced.

B.3.1 Key features of DAE-RGEM

DAE-RGEM is based on a substantial body of accepted microeconomic theory. Key features of the model are:

- The model contains a 'regional household' that receives all income from factor ownerships (labour, capital, land and natural resources), tax revenues and net income from foreign asset holdings. In other words, the regional household receives the gross national income (GNI) as its income.
- The regional household allocates its income across private consumption, government consumption and savings so as to maximise a Cobb-Douglas utility function. This optimisation process determines national savings, private and government consumption expenditure levels.
- Given the budget levels, household demand for a source-generic composite goods are determined by minimising a CDE (Constant Differences of Elasticities) expenditure function. For most regions, households can source consumption goods only from domestic and foreign sources. In the Australian regions, however,

households can also source goods from interstate. In all cases, the choice of sources of each commodity is determined by minimising the cost using a CRESH (Constant Ratios of Elasticities Substitution, Homothetic) utility function defined over the sources of the commodity (using the Armington assumption).

- Government demand for source-generic composite goods, and goods from different sources (domestic, imported and interstate), is determined by maximising utility via Cobb-Douglas utility functions in two stages.
- All savings generated in each region are used to purchase bonds from the global market whose price movements reflect movements in the price of creating capital across all regions.
- Financial investments across the world follow higher rates of return with some allowance for country specific risk differences, captured by the differences in rates of return in the base year data. A conceptual global financial market (or a global bank) facilitates the sale of the bond and finance investments in all countries/regions. The global saving-investment market is cleared by a flexible interest rate.
- Once aggregate investment level is determined in each region, the demand for the capital good is met by a dedicated regional capital goods sector that constructs capital goods by combining intermediate inputs in fixed proportions, and minimises costs by choosing between domestic, imported and interstate sources for these intermediate inputs subject to a CRESH aggregation function.
- Producers supply goods by combining aggregate intermediate inputs and primary factors in fixed proportions (the Leontief assumption). Source-generic composite intermediate inputs are also combined in fixed proportions (or with a very small elasticity of substitution under a Constant Elasticity of Substitution (CES) function), whereas individual primary factors are chosen to minimise the total primary factor input costs subject to a CES (production) aggregating function.

B.3.2 Key assumptions of DAE-RGEM

DAE-RGEM is underpinned by the following assumptions:

- All markets are competitive, and all agents are price takers.
- All markets clear, regardless of the size of the shock, within the year.
- It takes one year to build the capital stock from investment and investors take future prices to be the same as present ones as they cannot see the future perfectly.
- Supply of land and skills are exogenous. In the Business as usual case, supply of natural resource adjusts to keep its price unchanged; productivity of land adjusts to keep the land rental constant at the base year level.
- Land moves within agricultural sectors; natural resource is specific to the resource using sector.
- All factors sluggishly move across sectors.
- Labour and capital move imperfectly across sectors in response to differences in factor returns. Inter-sectoral factor movement is controlled by overall return maximizing behaviour subject to a Constant Elasticity of Transformation (CET) function.
- For internationally traded goods (imports and exports), the Armington assumption is applied whereby the same goods produced in different countries are treated as imperfect substitutes. But, in relative terms, imported goods from different regions are treated as closer substitutes than domestically produced goods and imported composites (home-bias). Goods traded interstate within the Australian regions are assumed to be closer substitutes than overseas imports.

Appendix C: Observations from international jurisdictions

Australian operators may draw from overseas experiences to avoid the difficulties that other countries have faced. Each country is unique, with different challenges and attributes that make shale extraction attractive – but shale gas exploration and development in the United States of America (USA), Argentina and Canada each hold relevant lessons for the development of the Beetaloo Sub-basin.

These countries were chosen for several reasons, including similarities in challenges faced in the development stage, from infrastructure deficiencies (as seen in Argentina), and the challenges associated with remoteness and impacts on regional communities (as seen in Argentina and Canada). The USA was chosen as a key case study due to the massive growth of its shale industry since 2007, and some of the lessons around government assistance and cooperation between developers are informative to the Beetaloo Sub-basin development.

The relevant experiences in the USA, Argentina and Canada are explored in depth in the following sections. Key observations relating to the Beetaloo Sub-basin are summarized below.

Countries	Observations
USA	Policies surrounding compulsory pooling and subsurface mineral rights were important in **addressing land ownership rights** and fast-tracking development of shale gas projects.
USA	**Government assistance** was important for developing shale projects in the USA. This included tax breaks for operators such as deductions for drilling, "percentage depletion" and directly funding research and development for associated technologies.
Argentina	There are significant challenges associated with **developing gas infrastructure in remote regions**, particularly in liquefaction capacity for exports. The shortfall in infrastructure in Argentina's Vaca Muerta Basin means that projects operating in the Basin are only able to supply an already over-saturated domestic market and are unable to tap into the lucrative international market.
Argentina, Canada	There are both challenges and opportunities associated with **stakeholder engagement**, as seen in Canada and Argentina, where there are legal requirements to consult with and accommodate affected Indigenous groups, especially if operations affect treaty rights.
Canada	There are challenges associated with ensuring that **regional communities** capture the economic benefits without shouldering a substantial portion or all of the cost, as seen in Canada and other mining operations heavily dependent on fly-in, fly-out (FIFO) workers. In these cases, healthcare services can become overburdened, local procurement policies overwhelmed, leading to depopulated regional centres and the vast majority of economic benefits flowing out of the region through FIFO salaries and wages. The workforce needs to balance distribution of economic and non-economic benefits fairly, and to ensure that smaller communities are protected.

C.1 International shale gas exploration and development

C.1.1 USA

The shale boom in the USA has fundamentally changed the global energy market, making energy independence feasible for the first time in decades by turning the nation into one of the most formidable energy superpowers in the world. The shale boom may have hit its stride in 2007, but its success was underpinned through a mixture of maturing industry-friendly policies that supported technological advances such as hydraulic fracturing, tight-oil extraction and horizontal drilling.[156] The industry rapidly expanded despite the 2008 Global Financial Crisis, expanding from the Barnett Shale of northern Texas to the Bakken Shale in the Dakotas and the Marcellus in the Appalachia. The economic impacts of the shale gas revolution are undisputed, with Bonakdarpour and Larson (2012) estimating that the short run economic effects of US shale gas development (relative to a constrained shale gas development scenario) include a 1.1 per cent increase in GDP, a 3 per cent increase in industrial production, one million more US jobs and an increase in average household disposable incomes of US$926 per year.[157]

The factors that supported the success of the shale gas revolution are not unique to the USA, and some of these factors could be applicable towards the development of the Beetaloo Sub-basin. These include:

- The USA's technological advances and how rapid progress allowed shale oil to cross-subsidise gas development
- The role of mineral rights legislation and the rules around land ownership
- The nature and extent of government (both Federal and State) interventions
- The existence and regulation of gas pipeline infrastructure.

Technological advances

The shale boom in the USA accelerated as technological advances made it possible to extract deposits of resources that were previously uncommercial to drill. These technologies, which were deployed on a rapid and wide scale, included a new method of hydraulic fracturing known as "slick-water fracturing." This involved adding chemicals to water to increase the fluid flow, improving the efficiency in fracturing the shale.[158] Slickwater operations are significantly more water intensive than earlier fracturing methods, with an average horizontal well requiring between 12 - 20 million litres of water during a well's life.[159] However, the USA' relative water abundance at key shale basins in the USA, as well as the facilitating regulations concerning water consumption for industry,[160] means that producers use this technique to secure additional shale gas output.

With regard to the Beetaloo Sub-basin and water supply for similar fracking operations, some surface water and groundwater sources will not be able to be utilised due to environmental regulation and the high degree of rain seasonality in the NT. With this being the case, water supply will need to be managed differently to the USA, including utilising more storage. This is already occurring at across the Beetaloo Sub-basin during exploration phases which has been noted through our stakeholder feedback. The costs of the water management on a per-well basis are substantial in the NT.

Other technologies widely deployed throughout US shale basins include horizontal drillings,[161] which opened access to reservoirs where vertical drilling was not possible. It also allowed more wellheads to originate from a single surface location, reducing the number of rig moves and thus making it easier and cheaper to complete and produce gas from wells. Walking rigs reduced the cost of drilling by as much as 30 per cent,[162] by allowing rigs to "walk" from wellbore to wellbore, without having to be deconstructed and reassembled each time. Extending the length of lateral pipelines and increasing the number of stimulations per-well further reduced production costs.

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[156] Joseph Nyangon, 'The U.S. Shale Gas Revolution and Its Implications for International Energy Policy' (2015) 3(1) *Green Monitor: Technology & Policy Review* <https://ssrn.com/abstract=3243581>.
[157] IHS, *The Economic and Employment Contributions of Unconventional Gas Development in State Economies* (Report, June 2012) <https://marcelluscoalition.org/wp-content/uploads/2012/06/State_Unconv_Gas_Economic_Contribution_Main.pdf>.
[158] Salmaan Khan, 'Government Roads, Subsidies and the Costs of Fracking' (2014) *Mises Institute*.
[159] M. Le, 'An assessment of the potential for the development of the shale gas industry in countries outside of North America' (2018) 4(2) *Heliyon*.
[160] Accenture, *Water and Shale Gas Development* (Report, 2015) <https://www.accenture.com/t20150527t211219__w__/it-it/_acnmedia/accenture/conversion-assets/dotcom/documents/local/it-it/pdf_2/accenture-water-and-shale-gas-development.pdf
[161] https://www.eia.gov/analysis/studies/usshalegas/pdf/usshaleplays.pdf>.
[162] Reuters, *Drillers spend on costly 'walking' rigs to lure customers* (Article, 27 August 2015) <https://www.reuters.com/article/drilling-rigs/drillers-spend-on-costly-walking-rigs-to-lure-customers-idUSL3N10T3B920150826>.

These technologies allowed companies to dramatically reduce the cost of drilling, making it more competitive to recover natural gas and oil in "wet gas" basins such as Eagle Ford, the Marcellus and Bakken.[163] Wet gas basins are distinguishable from "dry gas" because of the existence of oil or gas condensates which can be sold in addition to the natural gas typically extracted,[164] and are generally seen as more attractive due to the additional income stream effectively subsidising the cost of methane development.[165]

Some surface water and groundwater sources will not be able to be utilised in the Beetaloo development due to the relevant environmental regulation and the very high degree of seasonality of rain in the NT. Therefore water supply will need to be managed quite differently than in the US, including utilising more storage, as well as recycling and re-use, as is already occurring at the exploration phase (noted through stakeholder feedback). The costs of the water management requirements in the NT are not insignificant, on a per-well basis.

Land ownership

In the USA, the owner of the land usually also has the rights to the subsurface mineral rights, unlike most other countries where the government owns any minerals found underneath the surface.[166] In the USA, the government's role is thus limited to taxing profits and regulating externalities. Subsurface mineral rights give private landowners a stake in shale projects and incentivise/fast track projects where it is perceived it could provide a windfall. The production density is quite different to Australia. In the USA, production areas tend to be very small, allowing numerous companies to drill in close proximity to each other and produce from the same basin. This is not the case in Australia, where the tenements are huge in comparison, and generally managed by a single company (sometimes in in conjunction with farmers).

Thirty-eight states, including resource-rich Texas and South Dakota[167], have laws that allow for compulsory pooling – which allows oil and gas companies to force landowners to lease their land to extract mineral resources under their land if access is required to extract resources. Compulsory pooling orders may only be made once a certain percentage of landowners in a proposed "drilling unit" have signed drilling orders – varying from 25 per cent in Virginia, to 90 per cent in Ohio.[168] Compensation is still provided for the non-consenting owner for the extracted resources.

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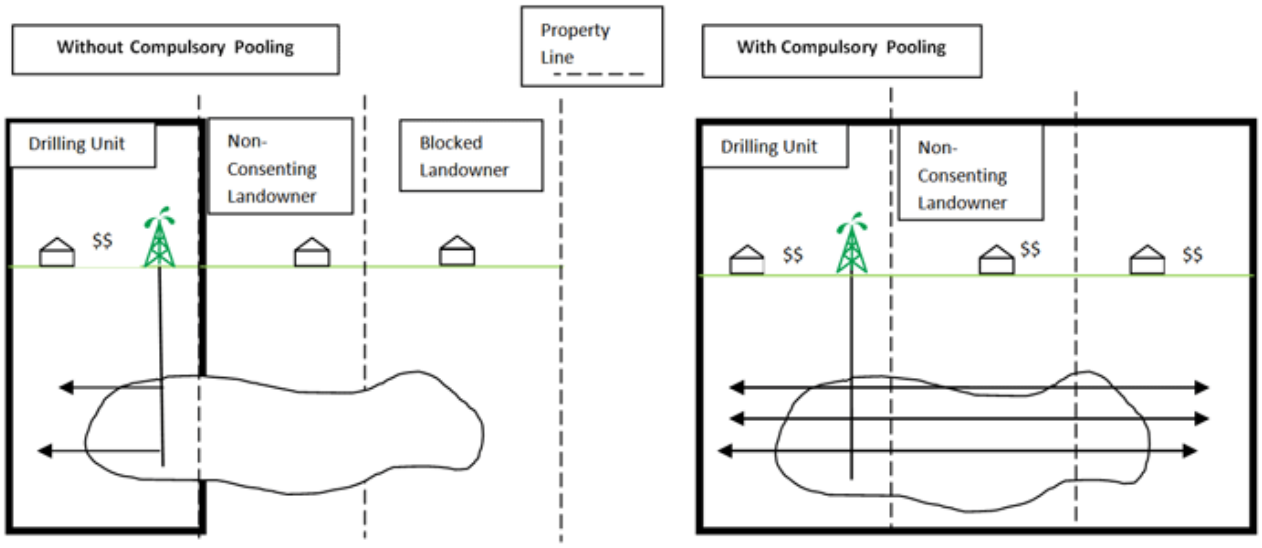
[163] EF Midstream, *Shale Gas Primer update* (Market Update, 2013) <https://www.efmidstream.com/sites/default/files/resources/resources_shale-gas-primer-update-2013.pdf>.
[164] Environmental and Energy Study Institute, '*Fracking Products*' (Report, 2011) <https://www.eesi.org/files/fracking_products_120111.pdf>.
[165] D. Reynolds and M. Umekwe, *Shale-Oil Development Prospects: The Role of Shale-Gas in Developing Shale-Oil*, Energies.
[166] Danelle Gagliardi, 'Made in America: Why the Shale Revolution in America is Not Replicable in China and Argentina' (2015) 14 *WASH. U. GLOBAL STUD. L. REV*. <https://openscholarship.wustl.edu/law_globalstudies/vol14/iss1/10>.
[167] M. Baca, 'State laws can compel landowners to accept gas and oil drilling' (2011) *Propublica* <https://projects.propublica.org/tables/forced-pooling.html>.
[168] A. Harder, 'Compulsory Pooling Laws: Protecting the Conflicting Rights of Neighboring Landowners' (2014) *National Conference of State Legislatures* <https://www.ncsl.org/research/energy/compulsory-pooling-laws-protecting-the-conflicting-rights-of-neighboring-landowners.aspx>.

Figure 33 – land ownership and compulsory pooling structure examples



Source: National Conference of State Legislatures (2014)

In the Northern Territory, half of rural land is Aboriginal Title land, and the other half is Crown land. Access to land for exploiting resources is subject to the *Minerals Title Act 2010* (NT), with petroleum activities regulated under the *Petroleum Act 2011* (NT). The Crown exercises rights over all petroleum titles which is very different to the legal framework supporting shale gas development in the USA.

Petroleum activities are not guided by specific provisions concerning land access arrangements if resources are to be extracted under private land, meaning that the affected parties are expected to negotiate privately. Guidance can be found in the "Onshore Oil and Gas Guiding Principles".[169] Mandatory land access requirements are limited to requirements on Aboriginal and pastoral lease land.

The difference in mineral rights and ownership between the USA and Australia – particularly in relation to engaging with landholders to extract resources underneath their land mean that while drillers in the USA only need to consent from a certain threshold of landowners (depending on the state), potential producers in the Beetaloo Sub-basin are expected to negotiate privately with all affected parties – potentially extending the resource extraction time frames and adding to the cost of total extraction in the basin.

It should also be noted that where Aboriginal freehold land exists in the NT, there is a right to veto exploration. As part of its response to the NT Fracking Inquiry, as of 2019, some areas are now no longer open to access for petroleum exploration, being classified as 'no-go' zones.

Government interventions

Interventions by governments of both Federal and State levels in the USA was crucial for building the foundations on which the shale revolution kicked off in 2007. Government interventions were wide ranging in scope, and included directly researching new drilling and extraction methods, to tax breaks and other tax incentives to encourage research and development in the petroleum and gas industry. These interventions were seen to be crucial as they developed the technological tools and provided financial assistance to industry players by reducing the costs associated with drilling.

Legislation that acted to provide direct subsidies to the sector included deductions for drilling new wells, as well as legislation for "percentage depletion" tax deductions that allow for income tax deductions to reflect declining production of reserves.[170] Legislation that allows 100 per cent of drilling and other associated well-costs to be

[169] Northern Territory Government, *Onshore Oil and Gas Guiding Principles* (Government Policy Document, 2015).
[170] Environmental and Energy Study Institute, *Fact Sheet: Fossil Fuel Subsidies: A Closer Look at Tax Breaks and Societal Costs* (Article, 2019) <https://www.eesi.org/papers/view/fact-sheet-fossil-fuel-subsidies-a-closer-look-at-tax-breaks-and-societal-costs>.

deductable[171] made unconventional oil and gas extraction one of the most tax-advantaged investments available and heavily incentivised domestic energy production in the USA (compared to imports, for example).

Government also supported the industry via direct research – the Federal Government played a pivotal role with the opening of the Gas Research Institute in the 1970s. This Institute was charged with developing new drilling and extraction methods and was followed by other Federal initiatives to set up pilot demonstration projects for commercially extracting natural gas from shale through drilling and fracturing methods.[172] Other technologies that came through Federal guidance included micro seismic imaging.

Over three decades, the Federal Government has contributed over $100m in fracking R&D projects like those mentioned above, and billions in tax concessions. The Natural Gas Policy Act provided incentive pricing for shale gas and other forms of unconventional natural gas via high availability of tax deductibility of costs and tax credits – together these have stimulated the development of unconventional gas in the USA.

Gas pipeline infrastructure and associated regulation

The final key factor that drove the US's shale boom is the extent of existing gas pipeline already existing near the commercial shale fields in Texas and North and South Dakota. Greater pipeline access, a large domestic demand and liquefaction infrastructure means oil and gas extracted from the shale fields can be more cheaply delivered to either domestic or international markets without having to account for the significant expenses relating to developing new infrastructure. However, that said, the average pipeline capacity utilisation of gas pipelines between 1998 and 2013 only averaged 54 per cent, therefore there may have been opportunities for more efficient investment.[173] The density of the USA's pipeline network is in stark contrast to Argentina – where the lack of supporting infrastructure has been a significant impediment to development of the Vaca Muerta shale.

The need for supporting infrastructure is also evident in the Beetaloo, and as noted in the Chapter 5, it will be important for new or expanded infrastructure including gas pipelines to be developed in an efficient way, so that the transport tariff permits the overall cost to be competitive.

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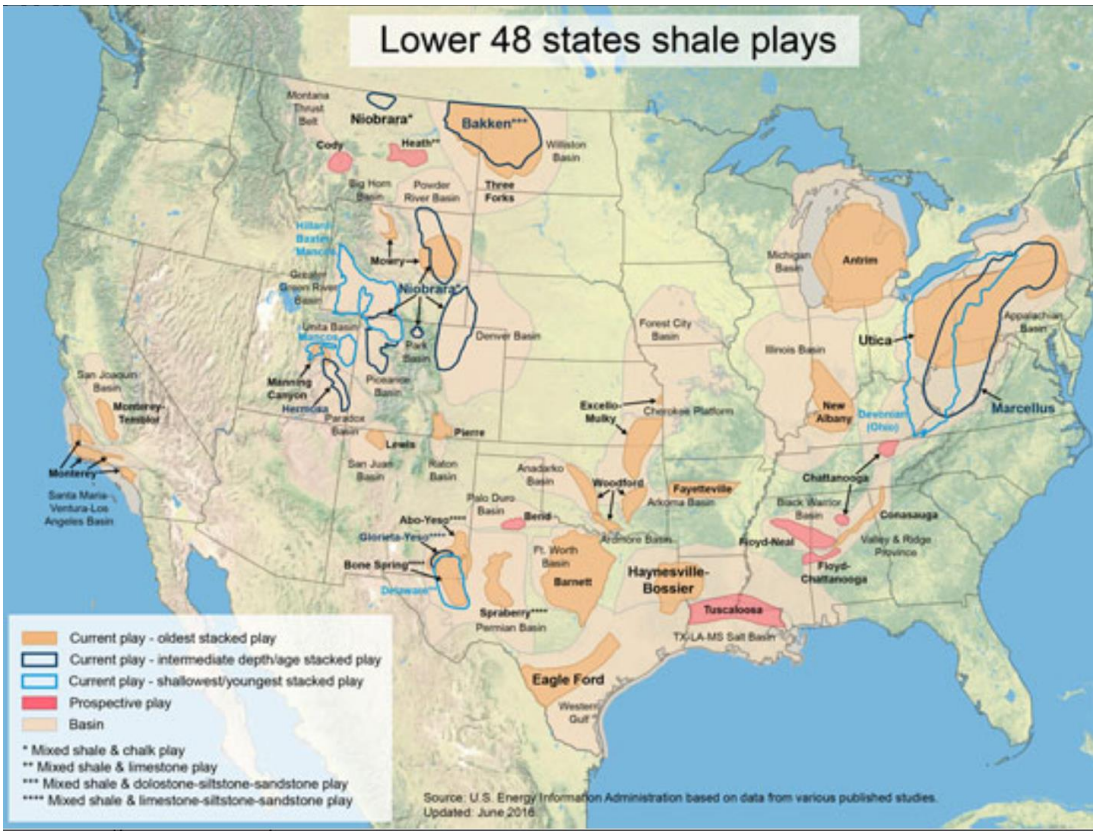
[171] Aresco, *Oil Investing Tax Breaks – Invest in oil and deduct 100% of intangible drilling costs off your taxable income for 2019* (Article, 2019) <https://www.arescotx.com/about-aresco/oil-investing-tax-shelter/>.
[172] Breakthrough Institute, *US Government Role in Shale Gas Fracking History: A Response to Our Critics* (Article, 2012) <https://thebreakthrough.org/issues/energy/us-government-role-in-shale-gas-fracking-history-a-response-to-our-critics>.
[173] US Department of Energy, *Natural Gas Infrastructure Implications of Increased Demand from the Electric Power Sector* (Government Report, 2015) < https://www.energy.gov/sites/prod/files/2015/02/f19/DOE%20Report%20Natural%20Gas%20Infrastructure%20V_02-02.pdf>.

Figure 34 – Lower 48 states shale plays in the USA



Source: U.S. Energy Information Administration (2014 – updated 2016)

C.1.2 Argentina

Argentina provides another shale gas study, hosting the Vaca Muerta shale in central-west Argentina. The development of this shale deposit showcases some of the immense challenges associated with developing a highly remote area with limited existing infrastructure and supporting local industries – an environment that mirrors some of the challenges facing the development of the Beetaloo Sub-basin.

On top of the area's remoteness, Argentina's political and economic challenges, as well as challenges relating to stakeholder engagement, have repeatedly stymied the Vaca Muerta project. Whilst comparisons to Australia here are less concrete, due to Australia's stronger financial position and a more proactive approach to stakeholder management the Argentine case study highlight how snowballing challenges can derail large developments.

Infrastructure challenges

Located in the sparsely populated and mountainous central-west regions of Argentina, the Vaca Muerta formation shares some geographical similarities with the Beetaloo Sub-basin – a harsh environment with underdeveloped transport infrastructure and a lack of other service companies that are operating at scale. The difference is especially stark when compared to the shale gas developments in the USA, where abundant infrastructure and supporting industries were crucial factors that led to the breakneck development of the US shale fields.

With limited pipeline capacity, especially to regional export markets in Chile, Uruguay or Brazil and a lack of liquefaction capacity[174] for gas to enter the lucrative international market, the gas that has been produced from the Vaca Muerta formation has largely only supplied the domestic market. This oversaturation of the domestic market has suppressed the price of domestic gas, reducing demand for additional production in the Vaca Muerta[175] and locking in a cycle that undermines Argentina's ability to accelerate the development of these remote shale fields.

[174] Energy Information Administration, *Growth in Argentina's Vaca Muerta shale and tight gas production leads to LNG exports* (Article, 2019) <https://www.eia.gov/todayinenergy/detail.php?id=40093>.
[175] Institute for Energy Economics and Financial Analysis, '*Political and Economic Crisis Throws Argentina's Energy Market into Disarray*' (Article, 2019).

Figure 35 - Location of Vaca Muerta shale

Source: Total Petroleum, Unconventional Resources 2020 – Vaca Muerta[176]

Political challenges

The challenges associated with the Vaca Muerta's remoteness and the limited existing infrastructure were exacerbated by Argentina's relatively weak political and economic situation through the development period – making it difficult for the government to adequately support a capital-intensive endeavour. Developing such a remote area, with the infrastructure and service requirements needed to support an export-led shale development in the Vaca Muerta is expected to require substantial subsidies over the long term, which the Argentine government may find difficult to afford – given high inflation, currency devaluation and fiscal deficits.

The Argentinian government had also previously guaranteed a price higher than the production costs of gas. Projects that were selected for the subsidy were paid an additional US$3.50/mmBTU above the market price of US$4.00/mmBTU.[177] As part of the $57bn bail-out by the IMF, Argentina was required to reduce production and consumption subsidies.[178] Given that most foreign companies who are currently involved in the area have made it clear that their participation is dependent on continued subsidies, it is expected that subsidy reductions would slow down the development of the Vaca Muerta Shale. The reduction in subsidies was announced in January 2019 but was applied retroactively for 2018 production – thereby effectively halting any new projects.

Whilst Australia may currently be in a stronger economic position than Argentina, with greater gas demand at higher prices, the political challenges around supporting a project of this scope and scale remain. There is currently support at both the Commonwealth and NT governments for the development, however the lesson from Argentina is that external factors can mean that this support is not necessarily guaranteed throughout the life of the Beetaloo Sub-basin development. Stakeholders interviewed through the consultation process indicated that political risk is considered in assessing and investing in new developments. Key stakeholders indicated that they consider a very high risk to the project is the activity of NGOs lobbying all levels of government with campaigns against the development.

[176] See https://www.ep.total.com/en/areas/unconventional-resources/vaca-muerta-key-project-our-future-growth-strategy-unconventional
[177] F. Cabrera, '*Argentina: Fracking projects contradict the government's agenda*' (Article, 2018) < https://www.boell.de/en/2018/11/29/argentinas-paradox-g20>.
[178] International Monetary Fund, '*Argentina Country Report*' (Report no 19/99).

Stakeholder management

Local and indigenous peoples who live in the Vaca Muerta shale region have been impacted by gas development in the region. Provincial legislation in Argentina mandates chemical content transparency by fracking companies, however while there is a "right of access to information", it has been noted by the Center for Human Rights and the Environment that violations regarding fracking investment contracts in the region are "systemic".[179]

Indigenous communities in Argentina (including the Mapuche communities of the Neuquen and Chubut Provinces) have been outspoken against the advancement of fracking operations in the Vaca Muerta shale formation. Argentina has also ratified the ILO Convention 169 – which entitle indigenous peoples with specially defined rights, such as a right to public consultation and participatory engagement for decisions related to development models and opportunities. [180]

Argentina has inconsistent government policies, with a parallel Environmental Unit established within the Mining Ministry which covers environmental impact of mining (instead of the within the Environmental Ministry's jurisdiction).[181]

C.1.3 Canada

The development of shale gas industry in Canada bears some similarities with the USA – from its deep capital markets, infrastructure to transport oil – including some exporting infrastructure, plentiful water supplies and numerous private energy firms with an appetite for risk. Canada has historically exported heavily to the USA (96 per cent of Canada's oil and gas exports go to the USA), but with the growth of US shale, Canada has sought different markets for its oil leading to planned developments of liquefaction facilities and pipelines to the West Coast to serve demand in Asia.

However, Canada has a number of constraints on development of further shale projects. Canada's pipeline approvals include strong regulatory requirements and consultation with Indigenous and local communities. An overreliance on a FIFO workforce can also overburden essential services, such as healthcare and housing. FIFO workforces also lead to depopulation in regional centres, with the vast majority of economic activity flowing out of the regions through FIFO salaries.

Canada also has moratoria on fracking in the following provinces: New Brunswick, Newfoundland and Quebec in the East and the Yukon in the Canadian Northwest.[182] There is no nation-wide policy on fracking, and production from various shale gas basins are beginning to expand in the remote areas of British Columbia and Alberta aided by reduced royalties for deep drilling and credits for building roads and pipelines in remote regions.

Pipeline regulation

Canada has some of the most expensive, time and resource intensive processes relating to pipeline development in the world, requiring approval of the Governor General, provincial and federal environmental assessments and a legal duty to consult and accommodate First Nations groups in affected areas. This duty includes accommodating groups who have established treaty rights and is required to be integrated into environmental assessment and regulatory review.[183] There is a two tiered system, where Group 1 is a tight form of regulation, and Group 2 which is regulated only if there is a complaint received.

A significant pipeline regulation assessment was required for the Trans Mountain Expansion project (TMX) which would increase the capacity of exporting from Alberta to export terminals in British Columbia from 300,000 b/d to 890,000 b/d. The application for expansion was submitted to the National Energy Board in 2013 and was approved in 2016 – subject to 157 conditions. Following the election of the New Democratic Party provincial government in British Columbia, legal actions were initiated to challenge the approval process with various First Nation groups arguing the Canadian government had failed to properly consult on the pipeline[184] and excluded analysis of the

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[179] Talliant et al, '*Human Rights and the Business of Fracking*' (Report, Centre for Human Rights and Environment)< https://www.ohchr.org/Documents/Issues/Business/ForumSession4/FrackingAndUNGPs.pdf>.
[180] Ibid.
[181] Talliant et al (above n 98).
[182] D. Minkow, '*What you need to know about fracking in Canada*', (Article, The Narwhal, 2017) <https://thenarwhal.ca/what-is-fracking-in-canada/>.
[183] S. Stimpson, '*The ongoing battle for pipeline projects in Canada*' (Article, 2019) < https://www.torys.com/insights/publications/2019/09/the-ongoing-battle-for-pipeline-projects-in-canada>.
[184] G. Morgan, '*With its legal hurdles all but cleared, Trans Mountain's challenges move to a different court – the street*' (Article, February 2020) *Financial Post.*

impact of increased marine traffic in its environmental assessments.[185] The last of these legal challenges have only just been surmounted with the Federal Court of Appeal's ruling in February 2020.[186]

Community engagement

Provinces own the onshore energy resources within their borders and are the primary regulator of their development. Generally, exploration and production rights for oil and gas are obtained through a bidding process, excluding Quebec – which operates on a first-come, first-served basis. Exploration licenses include the right to search for hydrocarbons but do not give ownership of surface rights. Landowner consultation is required to conduct exploration activities, and Indigenous consultation is also required on decisions that may impact Indigenous rights or title on their land.

Indigenous community engagement in Canada aims to ensure First Nations receive advanced case-by-case notice of industry developments in their territories, but recent developments may indicate that they have little influence on the timing, rate or location of company operations. They also do not have adequate means to engage with provincial government or energy companies on broader issues relating to reasonable industrial activities within their areas.

Impacts on regional communities

Regional developments of remote areas typically use FIFO workforces, whose impacts are consistent with other boom-and-bust developments in resource development. Rapid development can lead to pressures on the healthcare system and the cost of housing.[187] Additional burdens on the healthcare system (such as injuries relating to work) increase alongside mining operations, but regional areas typically have shortages of healthcare professionals.[188]

FIFO workforces reduce the regional economic benefits that local areas could capture, leading to further depopulation of regional centres. This depopulation also detrimentally impacts regional centres' ability to fulfil local procurement policies – with many lacking the capacity to supply such specialised operations. As workforces, and their support staff are usually recruited from metropolitan regions, there is minimum investment by companies into these local areas, and the vast majority of economic activity flows out of the region through FIFO salaries in a process often described as a "hollow economy".[189]

Other factors

Water extraction by drillers is regulated by two agencies that issue long term licenses or year-long permits. Year-long permits are typically used because they require less regulatory review, Groundwater withdrawals typically are not regulated – permits are required to sink water wells but an unlimited amount of water can be taken from them, and water can be purchased from other well owners. [190]

Alberta's energy development[191], and the mandate for shale gas development lies with the Alberta Energy Regulator (AER) – and also provides guidelines for completing, producing, and abandoning oil and gas wells in the province. It regulates environmental issues, deep-well disposal, water management, land access and product transportation. A directive was set out concerning additional subsurface requirements for hydraulic fracturing operations (well integrity, well setback distances and storage of flowback water).

Canadian shale development also is expected to lead to risk of degradation of permafrost at certain location – the effects of hydraulic fracturing on permafrost aquifers need to be taken into consideration when considering the risks of fracking.[192]

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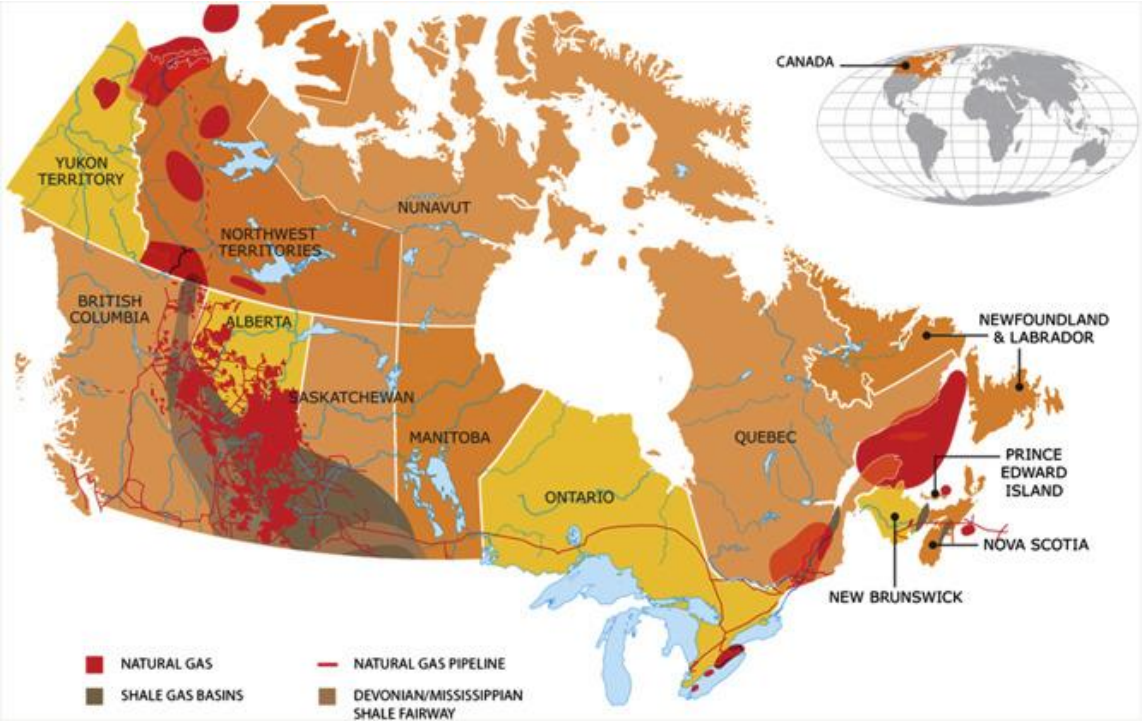
[185] Olszynski M. 2018, 'Federal Court of Appeal Quashes Trans Mountain Pipeline Approval: The Good, the Bad, and the Ugly', *University of Calgary Faculty of Law.*
[186] Kennedy M. 2020, 'Canadian Court clears the way for Trans Mountain Pipeline Expansion, *NPR.*
[187] Yukon Legislative Assembly 2015, 'Final Report of the Select Committee Regarding the Risks and Benefits of Hydraulic Fracturing', *Yukon Legislative Assembly.*
[188] Erny-Albrecht et al. 2014, 'Fly-in Fly-out/Drive-in Drive-out practices and health service delivery in rural areas of Australia', *PHCRIS.*
[189] Mckenzie F. 2010, 'Fly-in Fly-out: The Challenges of Transient Populations in Rural Landscapes'.
[190] Kusnetz N. 2011, 'Oh, Canada's become a home for record fracking', *ProPublica.*
[191] Cherry et al. 2018, 'Environmental Impacts of Shale Gas Extraction in Canada', *Council of Canadian Academies.*
[192] Yukon Legislative Assembly 2015, 'Final Report of the Select Committee Regarding the Risks and Benefits of Hydraulic Fracturing', *Yukon Legislative Assembly.*

Figure 36 – Canadian resource deposits



Source: Shale Gas: Exploration and Environmental and Economic Impacts (2017)

Appendix D: Summary of Northern Territory Opportunities – including gas intensive manufacturing hub

D.1 The aspiration

This Appendix is a stand-alone summary of potential opportunities and benefits for the Northern Territory. There is some duplication with other parts of the report. The NT gas industry currently comprises production in the onshore Amadeus basin, and offshore through the Bayu-Undan, Ichthys and Blacktip fields.

The Beetaloo Sub-basin has gained significant interest given the opportunity it presents for the Northern Territory gas industry. It lies within the larger McArthur Basin and spans approximately 30,000 square kilometres (estimated to be larger than any of the North West Shelf conventional gas resources and comparable with several of the major US shale gas basins. It is estimated the Beetaloo Sub-basin contains approximately 70 per cent of the Territory's prospective shale gas resources and has been responsible for around 50 per cent of the total $505 million of exploration investment in the NT since 2010.[193]

Based on current and future capabilities, the NT Government is committed to becoming a world class gas production, manufacturing and services hub by 2030. The 'five point plan' to help achieve this is listed below:

- Expand the world-scale Darwin LNG export hub
- Grow the Northern Territory's service and supply industry
- Establish gas-based processing and manufacturing
- Grow research, innovation and training capacity
- Contribute to Australia's energy security.

Whether it will be feasible to establish a gas-based processing and manufacturing industry depends on the following drivers:

- Opportunities for methane-based products, energy intensive industries, condensate refining and production of ethane-based products
- Early opportunities from offshore gas fields lending themselves to methane-based products
- Future opportunities from onshore gas fields expanding opportunities to include ethane-based petrochemicals
- Land availability for gas-based manufacturing industries.

D.2 CGE economic impact assessment

Economic activity involves a range of complex interactions between households, businesses and governments with these agents operating across regions and countries. A change in any part of the economy therefore has effects that reverberate throughout the initial scope of impact. For example, development of a new project or program might create economic opportunities in one region, but its introduction may make input resources relatively more scares, affecting output in other sectors.

Computable General Equilibrium (CGE) models are the best-practice method available for examining the impacts of a change in one part of the economy on the broader economy. The reason for this is that it is able to explicitly account for behavioural response of consumers, firms, governments and foreigners while evaluating the impacts of a given policy change. At the same time, it observes resource constraints meaning that the estimated economic impact which comes from a CGE model will account for 'crowding out' whereby increased activity will draw resources from other sectors.

[193] *NT Fracking Inquiry*

The economic impacts of the Beetaloo gas development is estimated by comparing individual policy scenarios against a baseline scenario. The difference between these scenarios details the net economic impacts of the Beetaloo project across various regions and sectors.

The business as usual scenario is based on historical data embedded in DAE-RGEM. The policy scenarios are informed by the analysis reported in the above Chapters, and focus on the development of the Sub-basin in the Beetaloo project region (defined here as the Barkly SA3 area). The three policy scenarios are broadly similar in that they describe a significant increase in gas production from the Sub-basin (and consequently Australia) beginning in 2024 with peak production reached in 2035. A summary of the individual cases is described below:

Baseline — where the Beetaloo Sub-basin is not developed

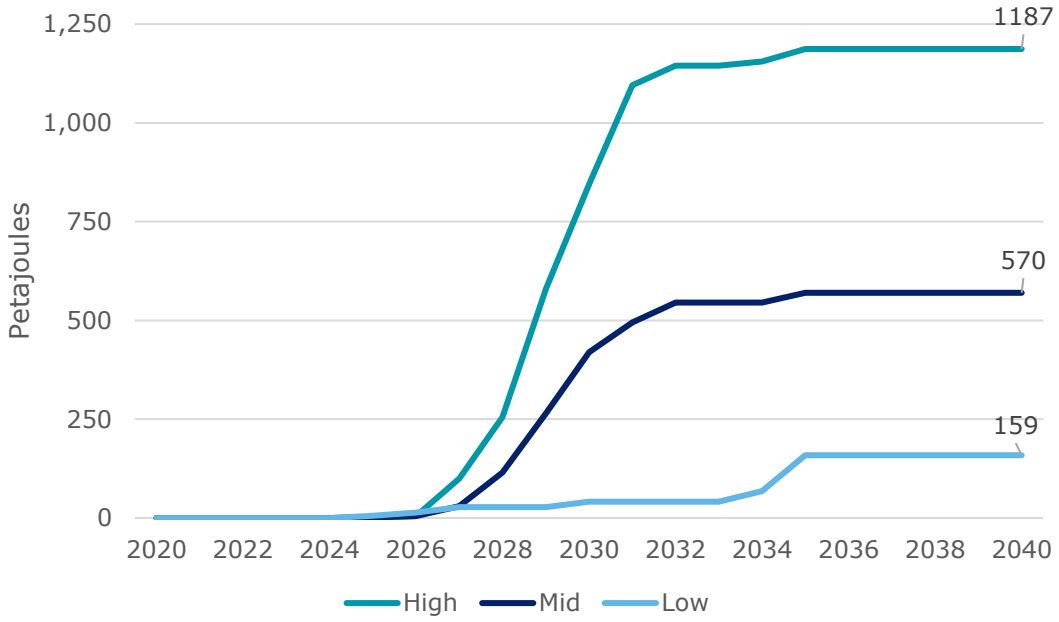
Policy Scenarios

High — where the Sub-basin is developed and reaches peak production in 2035 (3,252 TJ per day). A marginally greater share of gas is sold to the LNG export market, at the expense of the NT and east coast markets.

Mid — where the Sub-basin is developed and reaches peak production in 2035 (1,562 TJ per day). Gas is sold principally to the LNG export market, and the NT and east coast markets.

Low— where the Sub-basin is developed, and reaches peak production in 2035 (159 TJ per day) and gas is sold predominantly into the east coast market, and into the Northern Territory.

Figure 37 - Beetaloo Sub-basin gas production under policy scenarios, PJ p.a.



Source: CORE energy analysis

D.3 Benefits to the Northern Territory

The establishment of a gas- based processing and manufacturing hub in the Northern Territory could provide numerous benefits in addition to the economic and employment opportunities discussed above.

- Gas is a primary input for the production of plastics, fertilisers and other chemicals. Whilst natural gas is highly substitutable for electricity and heat purposes, this is often not the case for gas use as a feedstock. For some products, gas use for feedstock is 85 per cent of total gas use, with the remainder for energy and heat. This can represent 80 per cent of production costs. Gas-reliant industries tend to be highly productive and hire highly-skilled workers.
- The gas feedstock chemical sector has been estimated to contribute an estimated $44.6 million for every PJ of gas used in Australia, compared with $6.0 million for LNG exports and $0.4 million for GPG, illustrating

the importance of securing natural gas supplies to Australia's economy (as described in the ACIL Allen report for Chemistry Australia)
- Capacity to empower local communities by supporting capability development and empowering local decision-making, this might be through education, training and local governance initiatives necessary in the establishment of a gas-based processing and manufacturing hub.
- A moderate number of temporary workers integrating into the community may help build social cohesion by growing social networks and the local economy.
- Increasing the share of Aboriginal workers employed in the Territory, like in the case of the proposed Aboriginal Contracting Framework[194], is associated with positive social impacts and can help to break the cycle of disadvantage in Indigenous communities.
- Opportunities for strategic engagement and partnerships with Charles Darwin University, including through the North Australian Centre for Oil and Gas, the Advanced Manufacturing Alliance, and vocational education and training.

Additionally, the development of a competitive market for power supply on the Darwin-Katherine power network should ensure cost-effective power for downstream use and processing of the gas should this occur in Darwin. The development may provide a benefit of additional and cleaner power generation for adjacent communities and towns.

D.3 Stakeholder views

Representatives from across stakeholder groups were consulted on the potential development of the Beetaloo Sub-basin, including stakeholders from market bodies, producers, industry bodies and potential off-takers. Throughout the stakeholder engagement process the aspiration of a gas intensive manufacturing hub was discussed with key themes summarised below:

- That a manufacturing hub in Darwin is a possibility, albeit a long-term one. They indicated that it would take a long time to develop, and the current oil price situation makes that difficult. Conversely, they think that the current low oil price situation has created an opportunity for the industry to slow down and get organised, and the market is well set to recover.
- Existing ports and roads will suffice under the current situation, but may need to be developed in the event of development of an NT manufacturing hub.
- The first step is securing long-term gas at a reasonable price – chemical manufacturers consulted stated that gas costs can represent up to 80 per cent of their total operating expenditure.

D.4 Conclusion

To determine the feasibility of a gas-based intensive manufacturing hub in the Northern Territory more detailed comparative costing and analysis is required. We understand this is already in train by the Northern Territory government, so a further recommendation is not required.

[194] Deloitte Access Economics, *Economic Impact Analysis on the Aboriginal Contracting Framework* (Report, 2019) ('*DAE Aboriginal Contracting Framework EIA*').

Limitation of our work

General use restriction

This report is for the Commonwealth Government Department of Industry, Science, Energy and Resources. This report is not intended to and should not be used or relied upon by anyone else and we accept no duty of care to any other person or entity.

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