ECONOMIC IMPACTS

13

13.1 Introduction

The NT Budget 2017-18 estimates that the NT population is approximately 245,000, which equates to 1% of Australia's population. The structure of the NT's economy substantially differs from that of the national economy, reflecting its abundant natural resources, a large public sector, a sizeable Defence presence, and a small private sector that is significantly influenced by major projects.[1]

Over the past 12 years the NT economy has benefited from multiple major projects. Gross State Product (**GSP**), often referred to as real output, has grown from $15.2 billion in 2004-05 to $25.4 billion in 2016-17. However, economic growth is forecast to be moderate as the Territory moves from investment led growth to predominantly export driven growth. The relatively modest rate of growth in the short term reflects a transition to more historical levels of private investment.[2]

The Australian Petroleum Production and Exploration Association (**APPEA**) argued that resource development brings the potential for a substantial and stabilising public benefit. It further asserts that new industries are needed to support the NT economy as the Ichthys LNG project transitions from construction to production.[3] Multiple submissions from industry described the potential for substantial benefit to the Territory's economy by the development of an onshore shale gas industry based on the geological extent of prospective source rocks. For example, Falcon Oil and Gas Australia, which holds a 30% interest in exploration permits EP76, EP98 and EP117 (located in the Beetaloo Sub-basin), submitted that *"economic benefits cannot be quantified due to the infancy of the discovery and the need for further appraisal. However, should the project advance it would contribute to economic prosperity for decades to come through direct jobs on a range of skill levels and indirect jobs through the 'multiplier effect' when a new industry is created."* [4]

There is, however, considerable community concern that any onshore shale gas industry could have significant negative economic consequences, including a rapid increase in the cost of living for Territorians not involved in the industry, exacerbation of existing issues of inequality and disadvantage, and reductions in the financial viability and sustainability of existing businesses.[5]

13.2 Key issues

The final list of issues lists seven possible economic risks, including cumulative impacts, that are associated with the hydraulic fracturing of onshore shale gas reservoirs and its associated activities in the NT (see Appendix 2).

The Panel has received a variety of submissions on how the development of any unconventional shale gas industry might benefit, or have an adverse impact upon, the Territory's economy. The following discussion provides additional detail around known risks and other emergent issues.

13.2.1 Distribution of potential economic benefits

Origin describes an extractive business's role as that of a developer, to *"facilitate the transformation of a natural asset, which is a publicly owned good, into social or economic benefit for shareholders, governments and host communities."* [6] However, multiple submissions indicate that there is still significant public concern regarding how the revenue generated from potential future gas sales will be managed and divided.

NTCA stated that: *"equilibrium must be imbued, so that both landholders and tenement holders' rights and interests in the land are balanced, ensuring dichotomous entitlements and rights to economic benefits are fairly and adequately accommodated".* [7] and that: (*"advantages which flow from the access and use of the land to obtain resources (minerals/petroleum) beneath the surface of the soil are for the benefit of the resource tenement (profit) and the Northern Territory (licence fees*

1 NT Budget Economy Book, p 3.
2 NT Budget Economy Book, p 5.
3 APPEA submission 215, p 4.
4 Falcon Oil and Gas Australia Pty Ltd, submission 79 (**Falcon submission 79**), pp 2-3.
5 ALEC submission 88, p 13.
6 Origin submission 153, p 147.
7 Northern Territory Cattlemen's Association, submission 217 (**NTCA submission 217**), p 1.

and royalties), however is to the detriment of the landholder, who under the current Northern Territory regime, is only entitled to compensation where damage or loss arises after the Authorised Activities".[8]

Accordingly, the NTCA proposes that a tenement holder should not be entitled access to private leasehold land without first: *"obtaining written consent of the landholder by way of a conduct and compensation agreement (valid for no more than one (1) year), including provision for compensation payable by the tenement holder to the landholder as a result of the disruption / disturbance / granting of the right to enter the land for the purpose of undertaking necessary investigative or more intrusive activities."* [9]

13.2.1.1 Government revenue

Approximately 70% of the Government's annual income comes from the Commonwealth, with the remaining 30% from a Territory owned revenue source. Changes to goods and services tax funding allocation and national economic volatility have the potential for a greater impact on NT economic sustainability. Growing the NT economy will reduce this risk and its reliance on the Commonwealth.

While multiple submissions support onshore shale gas development as a means to gaining greater independence from the Commonwealth and to strengthen the NT economy, The Australia Institute nevertheless noted that, *"mining and gas royalties are a not a major source of funding for Australian state and territory governments"*.[10] It describes declining payments received under the Petroleum Resource Rent Tax and the lack of payment of company tax by gas companies as limitations to Government revenue. It went on to say that, *"balanced against the modest increases in revenue, costs that accrue to the state through infrastructure provision and other forms of subsidy need to be considered"*.[11]

13.2.1.2 Employment

In its 2015 report, Deloitte Access Economics (**Deloitte**) presented two scenarios (success and aspirational) for potential onshore gas development in the NT. Associated predictions for employment were between 4,200 and 6,300 full time equivalent (**FTE**) jobs above the base case by 2040.[12]

Industry has expressed an intention to invest in providing local training, jobs and business support, particularly in remote and regional areas.[13] Origin stated that its *"approach to living local and buying local will ensure economic benefits accrue in our areas of greatest activity and impact"*.[14] Pangaea also advocated an approach that supports a long-term focus towards community integration. Examples of 'local content' provided in its submission included employing pastoralists in seismic operations, traditional owners in civil access and construction works, local civil earthworks contractors, local waste disposal companies, and local camp and accommodation companies.[15] Multiple submissions received from a variety of Territory based businesses agreed on the need for local content with respect to employment.[16]

The NLC advised that many Aboriginal communities are remote and are largely dependent on welfare. Its submission described how a *"mature and well-designed onshore oil and gas industry"* offers the potential to address a number of economic pressures through potential income streams, including business development, training and direct employment.[17]

However, a range of submissions questioned the long-term employment benefits to rural and

8 NTCA submission 217, p 5.
9 NTCA submission 217, pp 2, 5.
10 Australia Institute submission 158, p 7.
11 Australia Institute submission 158, p 7.
12 2015 Deloitte report, p 5.
13 Falcon submission 79, p 3.
14 Origin submission 153, p 147.
15 Pangaea submission 220, p 5.
16 B Sullivan submission 160, pp 1-2; Mr Mark Sullivan, Flying Fox Station, MS Contracting, submission 166 (**M Sullivan submission 166**), pp 4, 8; D Armstrong submission 180, p 4.
17 NLC submission 214, p 33.

remote communities in the event that any onshore shale gas industry is developed. Models reliant on a largely FIFO workforce were widely criticised by the community during consultation sessions for lack of contribution at community or regional scales. The Northern Territory Chamber of Commerce and Industry also highlighted its concerns around the potential use of FIFO workers, demanding that gas companies be socially responsible by avoiding a FIFO workforce in order to maximise local employment and business opportunities.[18] The Australia Institute expanded upon these concerns, predicting that Territorians will have to compete with the many experienced workers no longer employed in the Queensland CSG sector as a result of that industry's decline since 2015.[19]

13.2.1.3 Purchase of local goods and services (indirect economic contribution)

Origin stated that production royalties would substantially increase and diversify the NT revenue base without affecting critical existing industries, such as cattle exports and tourism. Its submission stated that employees of local extractive businesses and their contractors buy locally, and they pay for local services including education, health services, transportation, accommodation, food and entertainment.[20] Having said this, the Panel notes concerns raised during community consultations that the presence of the gas industry in the community could cause the price of food, goods, and services to increase. Localised inflation was also raised as an issue by the NLC.[21]

13.2.1.4 Infrastructure development and induced economic effects

Origin references advantages provided by improved civic infrastructure and increased cash flow through local communities that will result from investment in any onshore shale gas extraction. Its view was supported by local submissions. Mr Mark Sullivan described required infrastructure, and the potential for development through the support of the oil and gas sector, for example, bitumen roads, bridges, regional power generation and distribution, communications, health centres and education facilities.[22] The Darwin Major Business Group stated that development of any onshore shale gas industry will attract investment in roads and regional infrastructure and deliver significant long-term benefits and opportunities to businesses and regional communities across the Territory.[23] Conversely, the NTCA raised the point that in underdeveloped regions where there is limited infrastructure, substantial capital costs may deter valuable private investment.[24]

The NLC advised that community infrastructure and development benefits that can be negotiated as part of a production agreement may assist in fostering community development and help to ease the economic pressures currently faced in remote and too often welfare dependent Aboriginal communities.[25]

13.2.1.5 Royalties

The NT Petroleum Royalty Overview provided by the Department of Treasury and Finance stated that: *"royalties are payments made to the Northern Territory Government as the owner of the petroleum, in consideration of a right granted to extract and remove petroleum and are calculated at the rate of 10 per cent of gross value at the wellhead on petroleum production. The Territory's royalty regime encourages present and future exploration and development of petroleum resources. At the same time it compensates the Northern Territory community for allowing the private extraction of the Northern Territory's non-renewable resources."* [26]

During community meetings held by the Panel, questions were raised as to how royalties would flow through to local communities that would be bearing the risks of any onshore shale gas industry. Many members of the public requested that a 'Royalties for Regions' program should be considered. The NTCA, for example, argued that, *"a policy similar to the Western Australia Royalties*

18 Northern Territory Chamber of Commerce and Industry, submission 493 (**NTCCI submission 493**), p 1.
19 Australia Institute submission 158, p 13.
20 Origin submission 153, p 147.
21 NLC submission 214, p 34.
22 M Sullivan submission, p 10.
23 Darwin Major Business Group, submission 494 (**DMBG submission 494**), p 1.
24 NTCA submission 217.
25 NLC submission 214, p 33.
26 NT Petroleum Royalty Overview, p 1.

for Regions program, to ensure economic benefits generated as a result of the unconventional gas industry are invested into the communities affected by the shale gas projects. Benefits should be in the form of investment in infrastructure and long term capital assets." [27]

13.2.2 Property values

Multiple submissions referenced the negative influence of any onshore shale gas development on, and in close proximity to, residential and agricultural properties.[28] Examples of the presence of CSG wells in Queensland leading to reduced property values and subsequent refusals by banks to accept those properties as security for finance or bridging loans were given.[29] Lock the Gate Alliance cited a 2011 submission by Rabobank Australia and New Zealand to the Australian Senate Inquiry into Management of the Murray-Darling Basin to the effect that, *"until such time as the comprehensive, detailed investigations into CSG exploration, mining and production activities are carried out, Rabobank is not able to opine as to whether the agriculture and energy industries can coexist."* [30]

But the notion of declining property values was rejected by some stakeholders on the basis that infrastructure improvements could benefit remote cattle stations.[31] For example, Mr Rohan Sullivan of Birdum Creek Station advised of *"understandable anger"* in relation to the current moratorium because it had halted Pangaea's 2016 infrastructure program worth $100M, including the commencement of the Western Creek Road upgrade in the Sturt Plateau. According to Mr Sullivan, other positive investments made by Pangaea included the installation of monitoring equipment in bores, the identification and mapping of a deeper aquifer that was previously only poorly understood, and LIDAR assessment of the area to assist with developing road infrastructure that will also assist with on-station dam development.[32]

Increases in housing values driven by 'boom' periods may have both positive and negative outcomes. CSIRO stated that increased housing values may be seen as a positive outcome for the owner of a house, but a negative outcome for someone seeking to purchase a house. Local tenants may not benefit from the direct income increases and may instead suffer from increased rents, poverty, and outmigration, especially in lower income households.[33]

APPEA stated that resolving housing pressure is clearly a matter of balance when a temporary workforce is involved. Communities will be keen to maximise the benefits that can accrue to resident workers rather than nonresident (or FIFO) workers. This shift will increase pressure on the existing stock of housing and will require new residences to be built. But once the workforce peaks and employment opportunities are reduced, excess housing supply can also cause problems.[34] APPEA advised that the industry needs to work closely with regulators, local government, and the local community, to collaboratively address housing needs.[35]

13.2.3 Impact on other industries

13.2.3.1 Reduced revenue and competition for resources

The Arid Lands Environment Centre (**ALEC**) stated that, *"shale gas will compete for access to resources within the dominant agricultural, pastoral and tourist industries of the Northern Territory"*. It specifically cited land and water access constraints that were required for continued livelihood.[36]

The NTCA submitted that, *"many of the areas targeted by tenement holders are rich agricultural areas with valuable water resources. Ideally, neither right to land should supersede the other"*.[37] It acknowledged that the considerable shale gas reserves located within the NT provided significant economic enticement to the Government, present and future, however, it noted that, *"fossil fuel reserves are finite, while livestock production and agriculture generally will operate in perpetuity"*.[38]

27 NTCA submission, 217 p 7.
28 D Tapp submission 11, p 2; R Dunbar submission 75, p 8.
29 Lock the Gate submission 171, p 60.
30 Lock the Gate submission 171, p 58.
31 B Sullivan submission 160, p 5.
32 R Sullivan submission 18.
33 T Measham submission 77, p 8.
34 APPEA submission 215, p 78.
35 APPEA submission 215, p 75.
36 ALEC submission 88, p 13.
37 NTCA submission 217, p 1.
38 NTCA submission 32, p 2.

Consolidated Pastoral Company Pty Ltd advised that, *"any adverse impacts on access to groundwater or the quality of groundwater would have a significant impact on the company and the Territory pastoral industry. Further any changes in land use on pastoral leases that limit the carrying capacity of the lease would have an adverse impact on the viability of the enterprise"*.[39]

Lock the Gate Alliance listed the deleterious impacts of onshore unconventional gas development known to affect agricultural land as *"intensification, fragmentation, disruption to agricultural operation and alienation of agricultural land, large water demand, vegetation clearing and the production of polluting waste."*[40] In relation to CSG development, it observed the potential for further economic losses from disruption of agricultural operations, spills and leaks of wastewater, or the spread of weeds.[41]

Tourism is a large economic driver of the NT economy. It was regularly raised that, *"our long established reputation as a unique tourism destination centred around our extraordinary natural landscapes and rich aboriginal culture"* may be affected by the onshore unconventional oil and gas industry.[42] The tourism industry in Central Australia is described as being highly vulnerable to any onshore shale gas development because of the perception that it has *"pristine, wild and natural landscapes"*.[43] Tourist operators from Mataranka also expressed concern regarding the viability of the tourism industry, in particular, the impact any onshore shale gas industry might have on the Roper River region and the water source that tourism operators rely upon.[44] The Amateur Fishermen's Association of the Northern Territory reiterated the economic and social value of the recreational fishing industry to the Territory: *"given the reliance of the Northern Territory's world class recreational fisheries upon intact water resources/ healthy ecosystems, and the significant, well established and sustainable social and economic benefits of the recreational fishing sector, it is clear that unconventional gas development presents risks that must be taken seriously".*[45]

13.2.3.2 Regional employment

A review of the socioeconomic impacts of CSG in Queensland by the Office of the Chief Economist stated that, *"there is evidence that some of the employment in the CSG sector has been drawn from other industries, as the growth in employment in CSG has been associated with a reduction in agricultural employment. However, the latter decline could also be attributed to drought, increased mechanisation, and a trend toward consolidation of farm ownership"*.[46] The review hypothesised that negative shifts from the agricultural sector could be a result of direct migration into mining jobs, or due to high labour costs encouraging a move toward less labour-intensive agriculture. The review described the limited availability and increasing cost of rural labour experienced by farming communities as a result of competition between CSG companies, especially at peak times such as planting and harvest.[47]

13.2.3.3 Environmental remediation

Multiple submissions raised the potential for groundwater and surface water pollution, land pollution, and air pollution, through various contamination pathways. The costs associated with either remediation, or potentially irreversible environmental damage, were understandably a significant issue for the community, particularly where those costs are perceived to be likely to be borne by the public (that is, Government or local authorities), and not the gas company responsible for the pollution and harm. This potential cost must be considered when determining whether any onshore shale gas industry will result in a net economic benefit to the NT.[48]

39 CPC submission 218, p 12.
40 Lock the Gate submission 171, p 6.
41 Lock the Gate submission 171, p 64.
42 P Ariston submission 269, p 1.
43 ALEC submission 88, p 14.
44 Somers submission 377.
45 AFANT submission 190, p 9.
46 Lock the Gate submission 171, p 50.
47 Lock the Gate submission 171, p 50.
48 R Dunbar submission 75, p 4.

13.2.4 Energy security

Multiple submissions described how the NT's entry into a potentially volatile global gas market could have implications on local electricity prices. According to The Australia Institute, *"potential connections to the chaos of the Eastern Australian market, or expansion of export facilities in Darwin" is "the biggest threat to security of gas supply in the Northern Territory.*[49]

Many submissions referenced the 2016 report *Pipe Dream, A Financial Analysis of the Northern Gas Pipeline* published by the Institute of Energy Economics and Financial Analysis. This report concluded that the *"construction of the North East Gas Interconnector (NEGI) is being proposed at a time in which global liquefied natural gas (LNG) markets are in a glut. The NEGI deal—if it were built—would occur under a monopoly arrangement whose economic benefits, if there are any, would be limited to foreign owners".*[50] In response, Deloitte argued that the experience of the US suggested that shale and tight energy sources will play a vital role in meeting future demand.

The NTCA proposed that the Panel investigate the merits of a gas reservation policy on behalf of all Territorians to ensure that NT residents have access to clean and affordable gas in the foreseeable future.[51] Conversely, other submissions argued that, *"fracking will inhibit investment and growth in the renewables sector".*[52]

13.3 Modelling economic impacts of hydraulic fracturing

To meet its Terms of Reference (see Appendix 1) the Inquiry is required to determine the economic risks and impacts of hydraulic fracturing in the NT. The Inquiry therefore engaged an economic consultant, ACIL Allen, to assess the economic risks and impacts of hydraulic fracturing in the NT. The Panel had oversight of all aspects of the consultancy, from preparing the scope of services (see Appendix 17), to approving assumptions and clarifying the update scenarios to be modelled.

This Chapter discusses the modelling process and provides an overview of ACIL Allen's key modelled results from its recently released report, *The Economic Impacts of a Potential Shale Gas Development in the Northern Territory* (at Appendix 16).[53]

It should be noted that all economic modelling involves applying a set of assumptions to quantitative models, and is therefore subject to uncertainty and should be treated with caution. ACIL Allen advises that the modelling undertaken for the Inquiry is subject to higher than usual uncertainty because the development of any onshore shale gas industry in the NT is at a very early stage.

13.3.1 Engaging ACIL Allen

In April 2017 the Inquiry released a public tender for an economic impact assessment of the potential onshore unconventional gas industry in the NT. The tender documentation required an assessment under the following three scenarios:

- **scenario 1:** (the baseline scenario): where the moratorium on hydraulic fracturing of unconventional shale gas reservoirs remains in place;
- **scenario 2:** the development of the onshore unconventional shale gas industry in the NT; and
- **scenario 3:** the development of unconventional shale gas reservoirs in the Beetaloo Sub-basin only.

Also required to be considered were the:

- economic risks associated with the three development scenarios, describing the actual and possible adverse impacts on and risks to the NT economy under the current regulatory regime; and
- the impacts of development on other industries in the NT, such as tourism, agriculture, horticulture and pastoralism.

49 Australia Institute submission 158, p 3.
50 Robertson 2016, p 3.
51 NTCA submission 32, p 2.
52 ALEC submission 88, p 14.
53 ACIL Allen 2017.

Six tenders were submitted and the tenders were carefully assessed against the Northern Territory Procurement framework. The tender was awarded to ACIL Allen. The cost of the tender was $287,719.

13.3.2 Change to the scope of works

The development scenario modelling sought to identify what would happen if the moratorium was lifted by the Government. However, it became clear early in the consultancy that there was very limited information regarding the shale resource, given the embryonic stage of shale gas development in the NT. To date there has been one fracture stimulated horizontal well that has been tested in a near-production setting, namely, Origin's Amungee NW-1H well in the Beetaloo Sub-basin. This well has delivered a positive production test result, but significant further testing is required to determine the scale, scope and qualities of any shale gas production potential in this Sub-basin alone, irrespective of the remainder of the NT.

In consultation with the Panel, ACIL Allen modified the initial scope of works to undertake economic modelling on the following development scenarios over a 25-year timeframe:

- **Baseline scenario:** the moratorium remains and nothing changes;
- **Calm scenario:** the moratorium is lifted, but only exploration and appraisal activity occurs for a period of three years and development is found to not be commercially viable;
- **Breeze scenario:** the moratorium is lifted, exploration and appraisal activity occurs and a small-scale development (100 terajoules per day (**TJ/day**)) (or 36.5 PJ per annum) takes place;
- **Wind scenario:** the moratorium is lifted and a moderate-scale (400 TJ/day) (or 146 PJ per annum) development occurs; and
- **Gale scenario:** the moratorium is lifted and a larger-scale (1,000 TJ/day) (or 365 PJ per annum) development occurs.

Given the absence of reliable data regarding the shale resource, the development scenarios make an assumption that the quantity of any onshore unconventional gas is not a constraint, rather, any constraint on the size of any potential development is on the demand side and is contingent on the development of a quantity of gas that can meet certain price points in the market.

In addition to the uncertainty regarding the scale of commercial quality shale gas reserves, ACIL Allen was confronted with a significant challenge in developing a set of underlying assumptions that would allow it to model onshore unconventional gas industry in the NT. Typically, economic modelling is conducted using a project or industry-level financial model. However, the nascent stage of development of a shale gas industry in the NT means that this information was limited and largely held in commercial confidence by potential industry participants.

This scope variation meant ACIL Allen was tasked with completing its economic modelling task using information in respect of, in its assessment, what a shale gas industry could look like in the NT.

It is also important to note that the change in the modelled scenarios meant that the results are 'location agnostic' insofar as they do not relate to development in a particular area, for example, the Beetaloo Sub-basin.

13.3.3 Information challenge

Typically, economic impact assessment modelling has a sound understanding of key variables such as:

- total commercial gas reserve;
- daily/monthly/yearly production estimates;
- capital and operating expenditure required to produce gas;
- pipeline and other supporting infrastructure requirements;
- overall gas unit costs; and
- a sales plan.

Given the very early stage of any onshore shale gas industry in the Territory, this information was not available to support the modelling.

To conduct the economic impact assessment modelling, ACIL Allen had to first develop a commercial financial model of an onshore shale gas industry in the NT. This was built using a range of assumptions, and the modelling does not represent an assessment of the commercial viability of an onshore unconventional gas industry development in the NT.

To articulate the potential economic impacts of an onshore unconventional gas industry in the NT, ACIL Allen consulted broadly to develop a set of conservative estimates of what a successful development might look. This included considering:

- the views of the Government, industry, non-gas industry stakeholders, traditional owners, non-government organisations including environmental groups, and representative bodies;
- its own expertise in gas markets and economic modelling;
- the experience of shale gas industry development in analogous regions across the world, particularly the Marcellus Basin shale gas play in Pennsylvania. Both the Marcellus Basin and the Beetaloo Sub-basin plays exhibit similar geological characteristics (assumed to be a mostly dry gas play, a similar shale formation, a similar depth and a similar geology); and
- the latest research, data and insights of shale gas industry economics, including using information from the Marcellus Basin, where more than 2,000 wells are drilled every year.

These estimates were presented to the Panel in July 2017 before modelling commenced.

13.3.4 Modelling process

Given the lack of information regarding an onshore shale gas industry for the NT, ACIL Allen conducted a cascading series of four modelling activities regarding gas markets, project development and project cash flow. Outputs from these modelling exercises were inputs to the economic impact assessments modelling.

13.3.4.1 Gas market modelling

After setting three scales of development of gas production (Breeze, Wind and Gale), ACIL Allen conducted base level gas market modelling where volumes of gas were offered to the market at $0.25 incremental prices, starting at $2/GJ. This modelled market took up a portion (or all) of the gas at that price based on market demand and how competitive the NT gas was. To determine final sales quantities and values, ACIL Allen calculated the revenue maximising sales mix per annum (quantity and price), and adopted this as the target rate of sales for the industry.

13.3.4.2 Project development modelling

Project development modelling was undertaken to understand the production and infrastructure requirements to meet the volume of gas to be placed in the market, using a bespoke shale well production schedule model.

The model required two major inputs: an assumed single average type curve of a hypothetical shale well (different for each scenario) and a series of assumptions regarding the infrastructure required to enable production to occur (wells, pads, gathering pipes, roads, water, camps and labour). This occurred in two streams and involved ACIL Allen creating two hypothetical companies to produce and transport shale gas under the four development scenarios. These hypothetical companies are:

- **ProjectCo:** which explores, appraises and develops the shale gas industry in the NT; and
- **PipelineCo:** which builds, owns and operates new pipeline infrastructure required to facilitate the sale of ProjectCo shale gas to market.

ProjectCo and PipelineCo are separate entities but interact through tariffs paid by ProjectCo to PipelineCo for the provision of pipelines to transport gas to market.

Key project development assumptions in the modelling are:

- **timing:** the development scenario modelling assumes the moratorium is lifted by the end of 2017-18, exploration and appraisal is undertaken in the period to 2019-20, development commences in 2020-21, and production begins in 2021-22;
- **gas quantity:** the volume of gas in situ is not a constraint, but the size of the market is;

- **dry gas:** all gas is 100% 'dry gas', with no higher value hydrocarbons, such as butane, ethane, propane or crude oil, targeted or available for extraction. A 'liquids rich' shale gas play results in a small increase in operating costs and a large increase in potential production revenue. The net effect of a liquids rich development is to significantly improve project economics; and
- **a single, average type curve:** which represents how much gas is produced from a single well at any point in time. ACIL Allen developed a single, average type curve based on advice from potential shale gas operators, information from similar fields in the USA and the Government. A typical shale gas type curve is a hyperbolic decline function, where the production of a well in the first period (typically reported in months) is very high relative to the average monthly production over the life of the well. A well's production declines rapidly from this initial production rate and continues to produce for a long period of time at very low levels.

These requirements are sensitive to well production, and ACIL Allen built an average type curve for production wells under each development scenario where gas production occurs based on assumptions regarding:

- **initial production rate:** the volume of gas produced in the first month of the well's life;
- **decline rate:** the speed in which the well's production declines per month;
- **estimated ultimate recovery:** the ultimate volume of gas that will be extracted from the well over its useful life; and
- **well life:** the useful production life of each well.

The parameters of ACIL Allen's development type curve assumptions are reported in **Table 13.1**.

Table 13.1: ACIL Allen type curve assumptions. Source: ACIL Allen.[54]

Scenario	Initial Production (mmscf/month)	Decline exponent	Decline rate (% per month)	EUR (Petajoules per well)	Well life (years)
Breeze	160	1.0	5.3%	8.4	20
Wind	160	1.0	3.8%	10.6	20
Gale	240	1.0	5.4%	12.7	20

This information was then used to estimate, for each development scenario where gas production occurs, a drilling schedule of how many wells would need to be built and when. The drilling scenario informed the need for well pads, roads, pipelines, labour and worker camps. The cost estimates to deliver infrastructure requirements were based on ACIL Allen's research and stakeholder feedback (see Chapters 5 and 6 of ACIL Allen's report at Appendix 16). Key elements of the project development include:

- to facilitate development and send gas to market, additional transmission pipeline infrastructure must be built. PipelineCo must build, own and operate all pipeline infrastructure for industry development;
- explicit development costs are included for wells/pads (drilling, roads, gathering pipelines and work camps);
- there are assumed 'learnings' where ProjectCo is able to reduce its cost per drilling operation over time (and therefore, cost per GJ of gas extracted) through repetition and incremental improvement;
- labour inputs by activity;
- pipeline specification and tariffs; and
- debt-to-equity ratio and debt terms, payments to Aboriginal landholders and pastoralists, government charges, local content and key macroeconomic variables.

54 ACIl Allen 2017, p 38.

Many stakeholders in ACIL Allen's consultations identified that water consumption associated with hydraulic fracturing could have negative economic and social impacts in the NT. ACIL Allen has used water consumption assumptions that are considered an upper limit of water used for hydraulic fracturing activities. In doing so, ACIL Allen has assumed that there is no water recycling in its industry development scenarios, whereas gas companies in submissions to the Panel have assumed a recycling factor of 30-50% of water used for fracture stimulation. Based on current Government policy settings, ACIL Allen has assumed, as it was instructed by the Inquiry to do, that there is no cost associated with water use (but see the discussion and recommendations in relation to charging for water in Chapter 7).

13.3.4.3 Project cash flow modelling

ACIL Allen developed a cash flow model to estimate financial flows. The modelling suggests that:

- under the **Breeze scenario**, there will be an initial rate of 33.4 TJ/day ramping up to 90 TJ/day in 2034 (and less than the 100 TJ/day target);
- under the **Wind scenario**, the maximum amount of gas that is sold is 315 TJ/day (less than the 100 TJ/day target). The majority of the gas is sold into the east coast market, and this requires the development of additional gas pipeline infrastructure;
- under the **Gale scenario**, the volume of gas and economies of scale in production mean NT gas is more competitive in east coast markets and as a feedstock for the production of liquefied natural gas, with production reaching 1,000 TJ/day by 2034.

The results of the financial modelling formed the basis for inputs to the economic impact assessment modelling.

13.3.4.4 Economic impact assessment modelling

Summary inputs and outputs of the ProjectCo and PipelineCo cash flow modelling were converted to a national accounting framework and processed through ACIL Allen's *TasmanGlobal* computable general equilibrium (**CGE**) model.[55] The four development scenarios were compared to the Baseline assessment of the future growth of the NT economy, to produce estimates of the potential economic impacts of each development scenario.

55 CGE economic models use economic data to estimate how an economy might respond to changes in policy, technology, or other external factors. CGE models are dynamic, and use elasticities to model how the response to an economic shock might change over time.

13.4 Economic impact assessment results

ACIL Allen used its in-house *TasmanGlobal* CGE model to model economic impacts of the development of any onshore shale gas industry in the NT. In line with the scope of works, modelling outputs are presented for three regions: the NT, the rest of Australia, and Australia. This was undertaken for the following macroeconomic variables:

- **real income:** which is a measure of the income that is available for consumption or saving after adjusting for inflation. It is a measure of economic welfare. Real income accrues to the owners (and taxers) of land, labour and capital. As such, if capital is sourced from interstate or overseas, real income growth attributable to this capital is reported as accruing to the source of that capital (that is, interstate or overseas) and not reported as real income growth in the NT. Similarly, for taxation, revenue will be allocated to the jurisdiction that receives the revenue;
- **real output:** which is a measure of value adding that occurs in the geographic area of an economy (for example, the NT or Australia) after accounting for changes in the prices of goods and services produced, and essentially comprises salaries paid to employees and profits accruing to businesses. Real output is often referred to as 'the economy', 'Gross State Product (**GSP**)' for the NT or 'Gross Domestic Product (**GDP**)' for Australia. Unlike real income, where the added value is attributed to the source of the input (for example, capital or labour), real output captures the added value that occurs in the region, irrespective of the source of the inputs;
- **real final demand:** which is a measure of the value of goods and services consumed in an economy, irrespective of where those goods and services are produced;
- **real employment:** which is full time equivalent employment. An FTE of 1.0 is equivalent to a full time worker, while an FTE of 0.5 signals half a full workload;
- **real population:** which is the resident population; and
- **real taxation:** which is taxation accruing, separately, to the NT and Commonwealth.

The economic impact assessment was run under five scenarios: the Baseline scenario and the four development scenarios which represent deviations from the Baseline scenario. **Table 13.2** reports key metrics for the Calm, Breeze, Wind and Gale development scenarios.

Table 13.2: Summary of economic impact assessment results for Calm, Breeze, Wind and Gale. Source: ACIL Allen.

	CALM		BREEZE		WIND		GALE	
	Total	Average	Total	Average	Total	Average	Total	Average
REAL INCOME								
Northern Territory	$35.2m	$1.4m	$937.2m	$36.0m	$2,818.1m	$108.4m	$5,777.5m	$222.2m
Rest of Australia	-$15.4m	-$0.6m	$3,339.9m	$128.5m	$9,120.0m	$350.8m	$12,508.8m	$481.1m
Total Australia	**$19.8m**	**$0.8m**	**$4,277.2m**	**$164.5m**	**$11,938.1m**	**$459.2m**	**$18,286.3m**	**$703.3m**
REAL OUTPUT								
Northern Territory	$4.1m	$0.2m	$5,107.9m	$196.5m	$12,126.1m	$466.4m	$17,534.7m	$674.4m
Rest of Australia	-$12.2m	-$0.5m	$406.5m	$15.6m	$3,011.7m	$115.8m	$1,732.1m	$66.6m
Total Australia	**-$8.2m**	**-$0.3m**	**$5,514.4m**	**$212.1m**	**$15,137.8m**	**$582.2m**	**$19,266.9m**	**$741.0m**
REAL FINAL DEMAND								
Northern Territory	$539.1m	$20.7m	$3,277.7m	$126.1m	$8,851.0m	$340.4m	$16,173.7m	$622.1m
Rest of Australia	-$19.7m	-$0.8m	$2,042.2m	$78.5m	$7,869.6m	$302.7m	$11,320.7m	$435.4m
Total Australia	**$519.4m**	**$20.0m**	**$5,319.9m**	**$204.6m**	**$16,720.6m**	**$643.1m**	**$27,494.4m**	**$1,057.5m**
REAL EMPLOYMENT (FTEs)								
Northern Territory	119	5	2,145	82	6,559	252	13,611	524
Rest of Australia	-119	-5	-2,145	-82	-6,559	-252	-13,611	-524
Total Australia	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
REAL EMPLOYMENT BY INDUSTRY (FTEs)								
Agriculture	-2	0	103	4	345	13	1,023	39
Mining	-10	0	-265	-10	-843	-32	-1,722	-66
Petroleum	-1	0	910	35	2,384	92	4,384	169
Manufacturing	-24	-1	-100	-4	-56	-2	-18	-1
Electricity and water	-1	0	-19	-1	-34	-1	-62	-2
Transport services	57	2	253	10	765	29	1,511	58
Construction services	17	1	141	5	671	26	1,538	59
Retail and wholesale trade	71	3	526	20	1,437	55	2,850	110
Government services	18	1	462	18	1,461	56	2,985	115
Other services	-6	0	133	5	429	17	1,124	43
Total industry employment	**119**	**5**	**2,145**	**82**	**6,559**	**252**	**13,611**	**524**
REAL POPULATION								
Northern Territory	262 persons	10 persons	5,061 persons	195 persons	15,480 persons	595 persons	32,252 persons	1,240 persons

Table 13.2: *Continued*

	CALM		BREEZE		WIND		GALE	
	Total	Average	Total	Average	Total	Average	Total	Average
REAL TAXATION								
NORTHERN TERRITORY								
Payroll tax	$3.5m	$0.1m	$74.8m	$2.9m	$227.2m	$8.7m	$288.2m	$11.1m
Royalties	$0.0m	$0.0m	$309.2m	$11.9m	$894.6m	$34.4m	$1,793.8m	$69.0m
Derived GST	$8.7m	$0.3m	$372.9m	$14.3m	$972.7m	$37.4m	$1,640.2m	$63.1m
Total Northern Territory	**$12.2m**	**$0.5m**	**$757.0m**	**$29.1m**	**$2,094.4m**	**$80.6m**	**$3,722.2m**	**$143.2m**
COMMONWEALTH								
Direct profits based tax	$0.0m	$0.0m	$162.3m	$6.2m	$602.1m	$23.2m	$935.8m	$36.0m
Other federal profits based tax	$36.6m	$1.4m	$988.8m	$38.0m	$3,437.5m	$132.2m	-$136.5m	-$5.3m
Other state and federal tax	$4.5m	$0.2m	$154.4m	$5.9m	$541.7m	$20.8m	$950.2m	$36.5m
Total Commonwealth	**$41.1m**	**$1.6m**	**$1,305.4m**	**$50.2m**	**$4,581.3m**	**$176.2m**	**$1,749.5m**	**$67.3m**
Total Australia	**$53.3m**	**$2.0m**	**$2,062.4m**	**$79.3m**	**$6,675.7m**	**$256.8m**	**$5,471.6m**	**$210.4m**

The economic impact assessment modelling suggests that there will be limited impact on sectors outside of any onshore shale gas industry and its supply chain. Significantly, the relatively modest labour requirement of any onshore shale gas industry means there is limited crowding out in the NT labour market as industries compete for the same labour.[56]

In addition, any onshore shale gas industry is likely to disturb a small surface area relative to the size of the NT (estimated 67 km^2 for Breeze, 232 km^2 for Wind and 476 km^2 for Gale) compared with the NT's total land area of 1,421,000 km^2. This means that the impact of any onshore shale gas industry on other key NT industries is likely to be minimal in terms of land use. It does not suggest land use impacts will be non-existent, rather it implies that, depending on the type of existing use, there may be scope to readily mitigate impacts.

13.4.1 Baseline scenario

In the Baseline scenario, the hydraulic fracturing moratorium remains in place, and key macroeconomic variables return to their long run averages following the one-off impacts of Ichthys-related construction and subsequent increase in LNG export values as production commences (that is, there will be a step change to a new higher value of exports but in annual percentage change terms, this will be represented as a one-off).

ACIL Allen's Baseline modelling projects that the NT's real output (the value adding that occurs in the NT reported as the accumulated value of wages and profits to produce goods and services in the economy) will grow by an average of 2.9% per annum over the 25-year modelled period (2018-43). Growth in real output is forecast at 8% in 2019 as the Ichthys LNG production exports lift. Beyond this initial spike, the real output growth rate is static to 2028, before annual growth rates start to weaken. Employment growth averages 1% per annum over the 25-year modelled period. It falls in the short term as the construction phase of the Ichthys LNG project nears completion.

Following the ramp up of the Ichthys LNG project, ACIL Allen forecasts that there will be a period of slightly above average growth through the 2020s as the Territory's aquaculture and horticulture industries grow faster than the rest of the economy and the Government's *10 Year Infrastructure Plan* is carried out. The impact on NT real output of any new offshore gas development to backfill Darwin LNG[57] is limited because the majority of infrastructure construction and supplies and

56 ACIL Allen 2017, p 136.

57 Construction of the Darwin LNG plant commenced in June 2003, with the plant being officially commissioned in January 2006. Gas is sent by a 502 km pipeline from the Bayu-Undan field to the plant at Wickham Point, where it is converted into LNG for sale to Tokyo Gas and JERA (a joint venture between Tokyo Electric and Chubu Electric) in Japan. The facility has the capacity to process 3.7 million tonnes of LNG per annum.

services for an offshore development will be imported.

Beyond the 2020s, ACIL Allen projects that the NT economy will grow in line with population, labour force participation and productivity growth. Real output is projected to grow from a $23.4 billion economy in 2018 to a $47.9 billion in 2043.

13.4.2 Calm scenario

In the Calm scenario, ProjectCo undertakes a three-year exploration and appraisal program but fails to progress any further because no commercial quality onshore shale gas reserve is discovered. It is assumed that the moratorium has been lifted, but operators walk away as it is not seen to be commercially viable.

The Calm scenario is also the basis for the first four years of the development scenarios where gas production occurs (Breeze, Wind and Gale), but instead of the assumption that no commercial quality shale gas reserve is discovered, it is assumed that commercial reserves are discovered for those three development scenarios where gas production occurs.

Under the Calm scenario, real final demand (the value of goods and services consumed in the NT) is estimated to increase by $539 million over the 25-year modelled period, with all of this occurring in the four-year appraisal period. Real output (the value adding that occurs in the NT, which is essentially the value of wages and profits in the economy) is estimated to increase by only $4.1 million because the vast majority of inputs in this early stage are assumed to be imported to the NT. Real income impacts are minimal at only $20 million over the 25-year modelled period. Over the 25-year modelled period, 119 direct and indirect FTEs will be created in the NT, all in the period to 2021. The NT also collects an additional $12.2 million in taxation revenue, and the Commonwealth collects an additional $41.1 million in taxation revenue over the 25-year modelled period, with all of this occurring in the period to 2021.

13.4.3 Breeze scenario

In the Breeze scenario, it is assumed that the moratorium on hydraulic fracturing is lifted at the end of 2017-18, that exploration and appraisal occurs in the period from 2018 to 2021, and that shale gas production commences in 2021-22. At the end of 2020-21, the facilities required to link to the Amadeus Gas Pipeline have been built and linked to the east coast market by the Northern Gas Pipeline (**NGP**). Gas is produced at an initial rate of 33.4 TJ/day in 2022, increasing to 90 TJ/day in 2034.

In this scenario, the development of an onshore unconventional gas industry has a significant impact on real income, which is a measure of economic welfare (or purchasing capacity), in both the NT and, most notably, in the rest of Australia. The real income impact of any onshore shale gas industry is largely accrued through the profits generated by the industry once it is operational, which also determines the level of profits based taxation paid by that industry. Overall, the majority of the real income impact of the development under the Breeze scenario is transferred from the NT to the rest of Australia. This is in the form of Commonwealth taxes (income tax, company tax and royalties), and because the equity ownership of the industry is assumed to be largely on the east coast of Australia (that is, because it is assumed the capital investment to develop the industry is largely sourced from the rest of Australia, modelled real income returns associated with this investment are allocated back to the rest of Australia).

The real income impact in Australia is estimated to be $3.34 billion over the 25-year modelled period at an average of $128.5 million per annum. In the NT, the real income impact is estimated to be $937 million over the 25-year modelled period at an average of $36 million per annum. Real income impacts in the NT are realised through increased employment and a redistribution of additional taxation payments to the Commonwealth being distributed back to the Government. Modelled royalty and payroll tax payments made to the Government, and payments made to pastoralists and Aboriginal landholders also contribute to the real income impact in the Territory.

Under the Breeze scenario, real final demand in the NT is estimated to increase by $3.3 billion over the 25-year modelled period (at an average of $126.1 per annum), with real output estimated to increase by $5.1 billion (at an average of $196.5 per annum over the 25-year modelled period). Real output is expected to increase over the modelled period consistent with increases in the level of production.

The Breeze scenario is estimated to create an additional 2,145 direct and indirect FTE jobs, at

an average rate of 82 FTE jobs per annum, and support an aggregate population growth of 5,061 persons, or an additional 195 persons per year. Over the modelled period, the NT collects an additional $757 million in real tax revenue (at an average of $29.1 million per annum over the 25-year modelled period), which includes $309.2 million in additional royalties, and the Commonwealth collects an additional $1.31 billion in tax receipts.

Information on the modelled impact of the Breeze scenario on a range of economic variables is reported in **Table 13.1**.

13.4.4 Wind scenario

In the Wind scenario, the target production rate increases to 400 TJ/day, with the majority of gas being placed into the east coast market, and requiring additional pipeline infrastructure to be developed as the capacity of the existing NGP is reached. The following investment into transmission gas pipelines is assumed to occur:

- tie into Amadeus pipeline;
- Amadeus duplication;
- NGP duplication; and
- Carpentaria Gas Pipeline duplication.

The real final demand impact in the Territory under the Wind scenario is largely accrued through the investment needed to fund any onshore shale gas industry's capital requirements and the additional investment needed for transmission gas pipelines. For the rest of Australia, the impact largely results from the household consumption impacts that accrue from rising real incomes resulting from the development, as well as further investment in transmission gas pipelines in eastern Australia.

Similar to the Breeze scenario, the Wind scenario has a significant impact on real income, in both the NT and the rest of Australia. The real income impact in Australia is estimated to be $9.12 billion over the 25-year modelled period at an average of $350.8 million per annum. In the NT, the real income impact is estimated to be $2.82 billion over the 25-year modelled period at an average of $108.4 million per annum.

Under the Wind scenario, real final demand in the NT is estimated to increase by $8.85 billion over the 25-year modelled period (at an average of $340.4 per annum), with real output estimated to increase by $12.13 billion (at an average of $466.4 per annum over the 25 year period). Real output is expected to change in line with levels of production.

The Wind scenario is estimated to create 6,559 additional FTE jobs over 25 years, at an average rate of 252 FTE jobs per annum, and support an aggregate population growth of 15,480 persons, or an additional 595 persons per year. Over the 25-year modelled period the Government collects an additional $2.09 billion in real taxation revenue (at an average of $80.6 million per annum over the 25-year modelled period), which includes $894.6 million in additional royalties, and the Commonwealth collects an additional $4.58 billion in tax receipts.

Information on the modelled impact of the Wind scenario on a range of economic variables is reported in **Table 13.1**.

13.4.5 Gale scenario

In the Gale scenario, it is assumed that the onshore shale gas industry has the volume of reserves and competitive production to enable it to progressively replace the offshore Bayu-Undan field as the gas feedstock for Darwin LNG, allowing Darwin LNG to continue to produce LNG at current volumes beyond 2022-23. This necessitates investment to expand the Amadeus Gas Pipeline to allow more gas to flow north to Darwin LNG.

For the economic modelling, it is assumed that Darwin LNG will continue to produce LNG at its current rate with or without gas from any onshore shale gas industry. In the Baseline scenario where the hydraulic fracturing moratorium stays in place, it is assumed that a new offshore development occurs and this gas backfills Darwin LNG. This is a critical assumption because it means that there is no incremental value associated with LNG production attributable to an onshore shale gas industry. The incremental value is the change to the production profile, profitability and local content of gas required to backfill Darwin LNG in an onshore scenario versus an offshore scenario.

It is also assumed in the Gale scenario that due to increasing economies of scale in production, falling costs allow for increased gas sales into the east coast gas market, potentially including partial backfill of an LNG train at Gladstone. The effect of large scale onshore shale gas production also results in a reduction in the wholesale price of gas in the east coast market, with the 'ripple' effect of the injection of more gas flowing west to east leading to less gas produced in Queensland fields moving south. Similar to Darwin LNG, there is no incremental value associated with LNG backfill.

This necessitates further investment in the NGP and Carpentaria Gas Pipeline over and above the investment assumed to be required to meet Wind scenario east coast exports. As a result, the industry is able to fulfil its full target production of 1,000 TJ/day by 2035.

Similar to the Breeze and Wind scenarios, the Gale scenario has a significant impact on real income in both the NT and the rest of Australia. The real income impact in Australia is estimated to be $12.51 billion over the 25-year modelled period, at an average of $481.1 million per annum. In the NT the real income impact is estimated to be $5.78 billion over the 25-year modelled period, at an average of $222.2 million per annum.

Under the Gale scenario, real final demand in the NT is estimated to increase by $16.12 billion over the 25-year modelled period (at an average of $622.1 per annum), with real output estimated to increase by $17.53 billion (at an average of $674.4 per annum over the 25-year period). Real output is expected to increase over the 25-year modelled period consistent with increases in production, until 2036 when there is a transfer between onshore and offshore gas for Darwin LNG feedstock.

The Gale scenario is estimated to create 13,611 additional FTE jobs over the 25-year modelled period at an average rate of 524 FTE jobs per annum, and support an aggregate population growth of 32,252 persons, or an additional 1,240 persons per year. Over the modelled period, the NT collects an additional $3.72 billion in real taxation revenue (at an average of $143.2 million per annum over the 25-year modelled period), which includes $1.79 billion in additional royalties, and the Commonwealth collects an additional $1.75 billion in tax receipts.

Information on the modelled impact of the Gale scenario on a range of economic variables is reported in **Table 13.1**.

13.5 Comparison with Deloitte report

The only other relevant research investigating the impact of an onshore shale gas industry developing in the NT is the 2015 Deloitte report, *Economic impact of shale and tight gas development in the NT*, commissioned by APPEA.[58]

The Deloitte research examined two potential growth scenarios based on the supply of shale and tight natural gas to the NT, east coast, and export markets between 2020 and 2040.

Both the ACIL Allen and Deloitte analyses used in-house CGE models, but varied quite significantly in terms of the assumptions used in the modelling exercise and the subsequent modelled outputs. A comparison of the assumptions and modelled outputs is reported in **Table 13.3** below.

58 2015 Deloitte report.

Table 13.3: Comparison of ACIL Allen and Deloitte assumptions and modelled outputs. Source: ACIL Allen.[59]

Item	APPEA/Deloitte		ACIL Allen		
Case name	**"Success"**	**"Aspirational"**	**"Breeze"**	**"Wind"**	**"Gale"**
Development modelling approach	Deloitte took the price of LNG, subtracted cost of processing and transmission pipeline, and used that to determine its target gas price. From there, it scaled CAPEX & OPEX estimates from a starting position that would allow all gas to be sold assuming a their market price, and had a different breakeven price for three market demand tranches (NT, East Coast and LNG). Deloitte assumed no market constraints.		ACIL Allen began by sizing its developments based on market tolerance, using *GasMark*. From there, ACIL Allen build its developments from the ground up using data to build a single average type curve, a well scheduling model, development cost assumptions by key components, and pipeline assumptions combining current pipeline capacity and new pipelines. ACIL Allen did not assume gas would be used to facilitate any new LNG development, and instead assumed in its base case that an offshore development would be required to backfill the DLNG facility.		
Economic impact assessment modelling approach	In-house CGE model		In-house CGE model		
Volume of gas (peak PJ/annum)	586 PJ/annum in 2040	910 PJ/annum in 2040	36.9 PJ/annum (2041)	108.3 PJ/annum (2042)	365 PJ/annum in 2043
Incremental LNG?	Yes, 100% incremental LNG. Two additional LNG trains to be built, with capital costs included in the economic impact assessment.	Yes, 100% incremental LNG. Three additional LNG trains to be built, with capital costs included in the economic impact assessment.	No LNG in this scenario.	No LNG in this scenario.	No incremental LNG in this scenario. It is assumed the onshore development displaces an offshore development.
CAPEX per well	$6.2m - $9.75m		$19.1m on average (including learnings)	$16.3m on average (including learnings)	$12.7m on average (including learnings)
OPEX per GJ	$0.53 - $0.89/GJ		$1.77/GJ on average (including learnings)	$1.59/GJ on average (including learnings)	$1.46/GJ on average (including learnings)
Wellhead cost per GJ (maximum case)	$1.90 - $2.67/GJ		$6.07/GJ on average	$5.03/GJ on average	$4.01/GJ on average
GTP impact (deviation from baseline in final year of study)	+$5.1bn (2040)	+$7.5bn (2040)	+$0.30bn (2043)	+$0.64bn (2043)	+$0.72bn (2043)
FTE impact (deviation from baseline in final year of study)	+4,195 FTE (2040)	+6,321 FTE (2040)	+80.1 FTE (2043)	+221.5 FTE (2043)	+558.1 FTE (2043)

Lock the Gate Alliance has suggested that the 2015 Deloitte modelling used a set of overly optimistic assumptions about how an onshore shale gas industry might develop in the NT, particularly with respect to demand and employment and cost.[60]

There are a number of critical differences between the Deloitte and ACIL Allen assumptions. Deloitte uses lower capital and operational costs, meaning that more gas can be produced competitively under its development scenarios. Additionally, and significantly, the Deloitte modelling included the construction and commissioning of additional LNG facilities in the NT, with capital costs and production making a significant contribution to growth in reported variables, such as real output and employment.

In the Panel's opinion, the ACIL Allen assumptions and modelling represent a much more realistic approach to estimating the economic impacts of any onshore shale gas industry in the NT.

59 ACIL Allen 2017, p 138
60 Lock the Gate submission 171, p 50.

13.6 Policy implications

ACIL Allen was required to describe the options available to the Government, whether through policy, regulatory reform, or otherwise, to maximise and sustain the benefits to Territorians if the moratorium is lifted and development commences. This included:

- undertaking a literature review of leading practice and options;
- providing relevant case studies where options have been implemented and an assessment of lessons learnt;
- describing options for how revenue from development can be retained in the regions affected by any onshore shale gas development, without impeding investment; and
- considering local procurement requirements, local training programs and other mechanisms to improve local capacity, as well as any 'Royalty for Regions' or similar programs, including case studies, examples, and lessons learnt relevant to the NT.

ACIL Allen identified three key issues that policy makers should consider: how to maximise the capture of benefits, how to distribute the benefits, and how to manage and minimise any downside risks.

For a small and narrow economy like the NT's, with a limited pool of excess and skilled labour, major projects (that is, projects of national or international scale) can have significant disruptive impacts on the economy, and society more broadly. The objective for policy makers is to maximise the benefits while minimising the risks and ensuring there is a high degree of certainty for all stakeholders.

ACIL Allen has identified the main risks for the Government as:

- managing an increase in Government revenue;
- managing increased demand for labour;
- maximising local expenditure and opportunities;
- managing potential industry coexistence issues;
- addressing potential infrastructure constraints; and
- having appropriate industry regulation.

ACIL Allen's assessment of these risks and potential policy options to address them are discussed below.

13.6.1 Increased Government revenue

Additional taxation revenue will flow to the Government if the moratorium is lifted directly through increased royalty and payroll tax payments, and indirectly through additional goods and services tax (**GST**) revenue distributed back to the NT. The Commonwealth collects GST, all of which is re-distributed to the jurisdictions, with the proportion each jurisdiction receives determined by the Australian Treasurer based on recommendations from the Grants Commission.

Additional revenue accruing to the Government over the 25-year modelled period under each of the development scenarios where gas production occurs is $757 million (at an average of $29.1 million per annum) in the Breeze scenario, $2.09 billion (at an average of $80.6 million per annum) in the Wind scenario and $3.72 billion (at an average of $143.2 million per annum) in the Gale scenario.

After collecting the additional revenue, the Government must decide how it will be used. This is primarily a distribution issue, with both geographic and intergenerational dimensions. While the pressure to spend any increased revenue is likely to be strong, there are also options for the Government to manage the additional revenue for the purposes of intergenerational equity.

ACIL Allen's research suggests there is a case for windfall royalty revenue to be treated differently to general government income.[61] This is because the Government is selling the right to mine a non-renewable resource, which is a one-off transaction. In this respect, mining royalties are different to taxes on income or consumption, which have perennial tax bases. Revenue raised from royalties should therefore be used to compensate society for the realisation of the value.

61 ACIL Allen 2017, p 152.

This can be done by investing in the physical or human capital of the economy, to improve its productivity, or by warehousing the revenue in a special fund. ACIL Allen identifies two ways to do this: a sovereign wealth fund, or a stabilisation fund.

Traditionally, wealth funds are used to accumulate revenue associated with windfall gains or with the extraction of non-renewable resources. The WA Government developed a sovereign wealth fund, the *Western Australian Future Fund*, in its 2012-13 Budget as a way of warehousing some of the proceeds of the iron ore royalty boom. The Fund received an initial capital injection of $1 billion between 2012-13 and 2015-16, and receives ongoing injections equal to 1% of the State's royalty revenue per annum.[62]

While well-intentioned, the broader settings of the WA Government's finances are not ideal to host a wealth fund given its significant public debt and high operating and cash deficits. This means the WA Government is effectively borrowing money to store in the fund. It is important to consider the state of public finances when making such significant, long-range decisions.[63]

There are also a number of examples of countries that use a sovereign wealth fund for the purposes of stabilising government finances. These kinds of funds tend to be short- to medium-term in focus, and are used as a 'banking' mechanism for countries with volatile, uncertain revenue bases. These funds tend to have strict rules around when money may be deposited and withdrawn. The objective of smoothing out fluctuations in government revenue is to avoid large deficits or increased spending of short-term increases in revenue.

Notwithstanding the potential value of wealth and stabilisation funds, several submissions to the Panel suggested an infrastructure deficit in the NT (this is supported by Government analysis, notably, with respect to transport infrastructure[64] and public housing), and it is likely that worthwhile projects, with long-term, intergenerational, benefits streams could readily be found to utilise any additional revenue that the Government receives as a result of development of any onshore shale gas industry.

This raises the issue of the distribution of benefits across the NT from additional tax revenue. There are several options to distribute benefits across regions, with one recent example being WA's 'Royalties for Regions' program. The Royalties for Regions program has the objective to promote and facilitate economic, business and social development in regional WA. It has been in place since 2008-09. The program quarantines 25% of royalty revenue (up to an annual amount of $1 billion) for spending on regional development projects, town beautification and social programs. Since December 2008 the program has invested over $6.9 billion into more than 3,700 projects to improve infrastructure and services across regional WA.[65] Since 2008-09 there have also been a series of changes to the program to improve transparency, decision-making, and accountability, and to shift its focus to job-creating projects rather than delivering community amenity projects and, importantly, to introduce an expenditure cap with annual reviews of the cap.

However, WA's independent Economic Regulation Authority (**ERA**) has noted that the quarantining of substantial revenue for regional projects reduces budget flexibility and inhibits proper capital prioritisation.[66] The ERA further states that: *"hypothecation of royalty income is not an ideal way to demonstrate the Government's commitment to regional development. Hypothecation results in an arbitrary annual allocation of total expenditure, rather than considering economic conditions, affordability, competing government priorities, or the quality of projects under consideration. It would be a coincidence if the amount allocated to regional projects under the program reflected the optimum level of expenditure."* [67]

The ERA also notes that the quarantining of royalties at a time when significant royalty revenue was having a negative impact on WA's GST allocation resulted in the proportion of the budget available for regional expenditure being higher than anticipated, and that the subsequent lack of budget flexibility contributed to Standard & Poor's downgrade of the WA's credit rating.

62 ACIL Allen 2017, p 153.
63 ACIL Allen 2017, p 153.
64 NT Government 2014.
65 WA Department of Primary Industries and Regional Development 2017.
66 Economic Regulation Authority Western Australia 2014, p 66.
67 Economic Regulation Authority Western Australia 2014, p 82.

Others have suggested that the Royalties for Regions program provides substantial infrastructure and service projects to regional communities, but have questioned the program's governance arrangements and the capacity to assess whether it is achieving its objectives.[68]

Based on the development scenarios modelled by ACIL Allen it is unlikely that revenue streams associated with the development of any onshore shale gas industry in the NT will be of a scale to warrant the development of a specialist fund for the purposes of fiscal stabilisation or intergenerational equity. Additionally, the literature suggests that there is no clear evidence of broader societal benefits to the NT from implementing policies to retain a proportion of royalty revenues in the regions where resource extraction occurs. However, ACIL Allen's analysis has noted that, based on its consultations, it is worth considering the benefits and costs of implementing such policy options given the significance to regional populations of ensuring that at least some of the additional taxation revenue is used to benefit residents in affected areas.

Recommendation 13.1

That in developing its budget the Government consider the source of royalty revenue to ensure that regions that are the source of taxation revenue benefit from any onshore shale gas extraction activity that has occurred in that region.

13.6.2 Managing an increased demand for labour

The development of any onshore shale gas industry in the NT has the potential for substantial labour benefits in the form of job creation, skills development, and workforce diversification. An increase in the demand for labour due to the development of the industry can be measured by the direct labour that is hired to work on the construction and operation phases of the development, as well as the indirect employment impact from the jobs generated by additional spending in the economy.

ACIL Allen estimates that the direct and indirect employment impact of the industry will be an average 82 FTE (Breeze), 252 FTE (Wind) and 524 FTE (Gale) per annum, with much of this employment likely to occur in regional areas where development activities would occur. It is through the salaries and wages associated with employment that regional communities are likely to see real benefits from the creation of an onshore shale gas industry, with increases in real income and living standards.

Any emergence of an onshore shale gas industry in the NT should create economic development opportunities in regional areas that will be in closer proximity to Aboriginal communities, or in regions with large Aboriginal populations. Private sector employment opportunities in these regions tend to be scarce, and relatively low rates of employment is one of the factors contributing to poor economic and social outcomes experienced by Aboriginal Australians. Research demonstrates that increasing Aboriginal employment rates would result in extensive economic, health and social gains to Aboriginal people and communities. The challenge for policy makers is to devise a strategy for improving employment as efficiently as possible, and that minimises expenditure in the form of labour market assistance for people who would have found a job in any event.[69]

The extent to which employment opportunities are realised will depend on the skill sets of local job seekers and the availability of training to gain the required skills. Consultation with local Aboriginal communities identified a preference to maximise the use of local job seekers to assist in keeping development benefits on country. The NLC also noted that many Aboriginal communities are remote and largely reliant on welfare, and that a mature and well designed onshore shale gas industry offers the potential to address a number of the economic pressures placed on people living under these conditions, including through direct employment and training opportunities related to the exploration and production of shale gas.[70]

Nonetheless, given the remote locations of the potential development sites, it is expected that there will be a need for a significant proportion of the workforce to be employed on a FIFO or DIDO basis. Over time, it is expected the local employment content of the industry will increase as the skills and experience of the local workforce grows.

68 Office of the Auditor General Western Australia 2014.
69 Gray et al. 2014.
70 NLC submission 214, p 33.

However, recent research in the UK context reports that: *"the expansion of the shale gas industry will not automatically deliver significant economic benefits to the local economies in which it operates, unless supply chains are embedded more firmly within the region and a higher proportion of the workforce is drawn from the local community."*[71]

This suggests that there is a strong incentive for Government to work with gas companies, local residents, Aboriginal people and local businesses to identify, as early as possible in the development process, opportunities to partner and develop the skills and processes necessary to be part of the supply chain for goods, services and labour.

There will be opportunities for the Government to maximise the workforce benefits of any onshore shale gas development and to ensure that these benefits are able to be accessed by all job seekers in the NT. There is a role for the Government in coordinating the requirements of any onshore shale gas industry with employment and training providers. This includes identifying the timing of any development and the skills required for the exploration, construction and production phases of the development. There is further opportunity to work with employment agencies and training providers to ensure that they match their services to the needs of any onshore shale gas industry. This will assist in maximising local employment benefits and promoting the distribution of those labour benefits to job seekers throughout the Territory.

There may also be advantages in setting local Aboriginal and non-Aboriginal employment targets.

Programs that aim to facilitate the flow of information between employers, trainers and job seekers will be important tools in ensuring positive local employment outcomes for the NT workforce.

Recommendation 13.2

That the Government work with stakeholders and gas companies to ensure that there is early knowledge of the labour and skills required for all phases of any onshore shale gas development to maximise local employment.

Recommendation 13.3

That the Government work with gas companies, training providers, local workers, job seekers, Land Councils and local Aboriginal corporations and communities to maximise opportunities for local people to obtain employment during all phases of any onshore shale gas development.

Recommendation 13.4

That the Government ensure that training providers and gas companies collaborate so that skill requirements are clearly understood by training providers, and that trainees acquire appropriate skills.

13.6.3 Maximising local expenditure and opportunities

Local content policy is founded on the principle of full, fair and reasonable opportunity for local businesses to secure work on large public and private sector projects. The development of any onshore shale gas industry in the NT offers opportunities for local businesses through an expected higher local spend. A recent example of local content is the Aboriginal-owned and Elliott-based Triple P Contracting, which has won a $200,000 per annum well monitoring contract with Origin that has required it to expand its workforce by two FTE.[72]

There is always the risk of a mismatch between the expectations of gas companies and the capabilities and services of local suppliers, which results in local businesses missing out on business opportunities. There is a role for the Government in ensuring that there is an information flow from gas companies regarding available local business opportunities. There is also a role for Government to work with local businesses to ensure that they properly communicate their capabilities and availability to industry. Encouragingly, many resource companies are realising that hiring and sourcing locally is a key element in building positive, long-term relationships with communities and regions, and can provide business benefits through cost reductions and

71 Whyman 2017.
72 Macdonald-Smith 2017.

efficiency improvements.

From a corporate perspective, local economic participation is seen as one means of maintaining an SLO, by giving communities a stake in the project, as well as having the advantage of having a supplier located nearby. From a community perspective, the participation of local businesses in a resource project is a means by which the benefits of resource development can flow into communities. The benefits of supply chain participation have become particularly apparent in Aboriginal communities where there are agreements to enable greater Aboriginal economic participation and to support the development of Aboriginal-owned enterprises.[73]

The desire to increase local content is not restricted to gas companies. Increasing local procurement is supported by Government in order to promote private sector-led development and improved living standards by strengthening the small to medium enterprise sector. The Government has a number of initiatives in place to capture the benefits from any onshore shale gas development, including the Building Northern Territory Industry Participation Policy, a procurement program requiring local content, and a partnership with the Industry Capability Network Northern Territory (**ICN-NT**), to ensure that the Government's commitment to local participation is met.[74]

There may also be benefits in setting local content targets for gas companies and contractors to maximise the capture of direct and indirect spending in the NT. There is further benefit in working with gas companies to promote the services of local businesses, particularly those in regional and remote areas insofar as it assists in distributing the benefits of development to businesses located throughout the Territory. Addressing information asymmetries by identifying the timing of development, and the goods and services required for the construction and operation phases of development, is an important role for the Government in maximising local content opportunities.

Recommendation 13.5

That the Government work with gas companies and local suppliers to ensure there is early knowledge of local supply and service opportunities for all phases of any onshore shale gas development.

Recommendation 13.6

That the Government work with gas companies and local suppliers (regional and Territory wide) to identify immediate supply opportunities and to map future potential supply opportunities. This should be done in consultation with the ICN-NT and the Chamber of Commerce.

Recommendation 13.7

That the Government work with gas companies, Land Councils, local Aboriginal corporations, Aboriginal communities, and businesses to identify local supply and service opportunities to keep sustainable economic benefits on country.

Recommendation 13.8

That the Government assist regional businesses to obtain quality assurance certification and to partner with larger suppliers to encourage greater local supply, employment and knowledge transfer.

13.6.4 Managing potential industry coexistence issues

The issue of industry coexistence and the ability for an onshore shale gas industry to 'fit in' with the existing industry structures of the NT was raised by most stakeholders consulted by ACIL Allen. Of concern is the extent to which any onshore shale gas industry may impede or distort the allocation of the economic factors of production, particularly natural resources such as land and water.

ACIL Allen's development scenarios anticipate that a potential onshore shale gas industry could disturb a land area between 67.7 km^2 (Breeze), 231.7 km^2 (Wind), and 475.9 km^2 (Gale).

73 Esteves and Barclay 2011.
74 Department of Trade, Business and Innovation 2011.

This represents 0.03% of the NT land mass in the Gale scenario. ACIL Allen has accounted for the opportunity cost of this land by assuming it is made unavailable for pastoralism. This is the primary channel of negative economic impact in the event of any onshore shale gas industry.[75]

Under the assumptions regarding water use, the industry may use between 4.2 GL (Breeze), 11.2 GL (Wind), and 28.2 GL (Gale) of water, respectively, over the 25-year modelled period. This represents average consumption of 0.17 GL (Breeze), 0.45 GL (Wind) and 1.13 GL (Gale) per annum under each scenario. This is significantly less than the Australian Bureau of Statistics' estimate of agricultural water use in the NT, namely, 47 GL in 2015-16.[76]

In stakeholder consultations ACIL Allen received information to suggest there are a range of options available to any onshore shale gas industry to source water, both potable and non-potable, in a manner that minimises tensions with existing users.[77] This suggests that water is unlikely to be a constraint on the development of any shale gas industry, and the prospect of a reduction in water availability for the non-shale gas industry users in the aggregate is limited. In an economic sense, this means there is unlikely to be a material opportunity cost from the use of water by any onshore shale gas development.

It is therefore unlikely that any onshore shale gas industry will impede the existing allocation of natural factors of production in the NT in an economic sense. However, it is important for the Government to remain aware of the activities of gas companies and to carefully monitor the draw on the Territory's natural resources. This should primarily occur through regulation.

Recommendation 13.9

That the Government work with gas companies, peak bodies of affected industries, and affected stakeholders to identify and resolve potentially negative economic impacts of any onshore shale gas development on other industries.

13.6.5 Addressing potential infrastructure constraints

The development of any onshore shale gas industry in the NT will place additional pressure on existing and planned infrastructure, including economic, social and civic infrastructure. There will be an increased demand for road, rail and port infrastructure to transport goods and personnel to and from any onshore shale gas development sites. There may also be additional pressure on social infrastructure such as health, education and civic services, particularly in regional areas where infrastructure often has limited capacity to respond to rapid increases in demand.

Development of infrastructure by, and for, any onshore shale gas industry has likely social and economic benefits for the NT, particularly for regional areas where much of the infrastructure development is likely to occur. Some of this infrastructure development will be undertaken by industry, but there is also a role for the Government to invest in economic infrastructure to enable growth. The Government's infrastructure priorities are detailed in the *Northern Territory 10-Year Infrastructure Plan,*[78] and regular review of the Plan will allow industry-related projects to emerge as priorities as they come closer to commencement. The current Infrastructure Plan includes projects to progressively upgrade the Stuart, Carpentaria, Buntine and Tablelands Highways, which could support the development of any onshore shale gas industry and minimise impacts on existing users.

The Australian Government has also committed in the May 2017 Budget to fund a pre-feasibility study and cost-benefit analysis of a potential gas pipeline linking the NT to Moomba in SA.[79]

The Australian Government's $5 billion Northern Australia Infrastructure Facility (**NAIF**) is another potential source of support for project-specific infrastructure, as well as infrastructure that can support multiple users or produce benefits to the broader economy and community.[80] A key objective of the NAIF is to support infrastructure development, recognising that infrastructure is a fundamental driver of economic change that can stimulate productivity and economic and employment growth, especially in remote areas, by encouraging private sector investment and increasing accessibility to markets.

75 ACIL Allen 2017, p 157.
76 ABS 2017b.
77 ACIL Allen 2017, p 158.
78 NT Government 10 year Infrastructure Plan.
79 Australian Government 2017c, p 93.
80 *Northern Australia Infrastructure Facility Investment Mandate Direction* 2016, made under the *Northern Australia Infrastructure Facility Act 2016* (Cth).

ACIL Allen's consultation found that there were perceived issues with some infrastructure that would support the development of any onshore shale gas industry, for example, the capacity of the Stuart and Carpentaria Highways to support increased development-related traffic volumes.

Similar to the challenges presented by managing industry coexistence, a key issue is finding public policy positions that create certainty for all stakeholders and that encourage development, while also balancing efficient resource use and societal concerns.

Recommendation 13.10

That the Government work with all levels of government, peak organisations, communities and gas companies to identify and manage infrastructure risks, including identifying options to fund any new infrastructure or upgrade existing infrastructure.

13.6.6 Appropriate industry regulation

Petroleum extraction is subject to significant regulatory requirements that reflect its heightened safety risks and potential adverse environmental impacts. During ACIL Allen's stakeholder consultation, gas companies unsurprisingly did not express dissatisfaction with the current regulatory regime for petroleum extraction in the NT.

The 2015 Fraser Institute's Global Petroleum Survey found that the Territory was rated as the third most development-favourable jurisdiction in Australia from a regulatory perspective and the 34th most favourable of the 126 jurisdictions surveyed by the Institute.

The most substantive issue regarding industry regulation was a perception the Government is not fully equipped to regulate any onshore shale gas industry. This was an issue that private sector, government and non-government organisation stakeholders raised with ACIL Allen. Regulatory enforcement is critical to facilitating an SLO. The significant land mass of the Territory, and the remote location of prospective shale gas developments, makes regulation of the industry difficult.

ACIL Allen noted that the level of funding for petroleum regulation in the NT is low compared with other jurisdictions in Australia. The level of funding is not necessarily a measure of the level of service delivery, but the difference between the NT and other jurisdictions suggests that this is an issue to be examined further, especially as the compliance and enforcement capacity of the regulator is a significant concern of the community. Given the current financial challenges there may be a need for the Government to examine innovative approaches to regulation, including the consideration of a levy on onshore shale gas companies to greater fund regulatory activities.

Leading practice principles suggest industry should 'pay its way' when it comes to regulation. This is because appropriate regulations and enforcement is critical to the industry earning an SLO and gas companies are also the major beneficiary of a regulatory regime that enables the safe development of the industry. There may therefore be scope to increase current fees and charges for the petroleum industry (which are very low at present) to fund any uplift in expenditure required to more adequately resource government regulators. This is discussed further in Chapter 14.

13.7 Conclusion

ACIL Allen's economic impact assessment modelling reports that lifting the moratorium on hydraulic fracturing in the NT will deliver tangible economic benefits in the form of increased income, output, employment and taxation revenue, and stronger population growth. Not surprisingly, the extent of economic benefits increases with the volume of shale gas that is extracted.

However, the potential negative impacts on other industries must be considered together with the policy options to mitigate those impacts, while identifying opportunities to maximise benefits that can accrue to local and regional communities (and the NT more broadly) from any onshore shale gas development.

It is acknowledged that any onshore shale gas industry development could put additional pressure on infrastructure, and potential funding options to alleviate this pressure must be examined. There are minimal coexistence risks as prospective shale gas regions have significant groundwater reserves, and the land area used by the industry is very small under all development scenarios.

The Panel has considered ACIL Allen's modelling and policy analysis and issues raised in the submissions in developing its recommendations. The recommendations aim to balance the twin goals of maximising local benefits (locally, regionally and across the NT) of the development of an onshore shale gas industry, while not disrupting the efficient allocation of resources (such as capital and labour) that will be necessary to make the industry competitive.

The Panel's principal recommendations identify the need for early and ongoing engagement between all stakeholders to identify risks and opportunities that may be associated with any onshore shale gas development. There is a clear role for the Government to work with stakeholders to develop and implement pathways that aim to mitigate risks and resolve conflict between stakeholders, especially where agreement between the parties cannot be reached.

The Panel is also of the opinion that the Government should work with all stakeholders to maximise local benefits from industry development, including local employment opportunities, and opportunities for existing and new local businesses to supply goods and services to the industry. While not being prescriptive with respect to how the Government uses any additional revenue, the Panel recommends that in developing its budget the Government consider the source of royalty revenue, and aims to ensure source regions benefit through greater infrastructure and services expenditure.