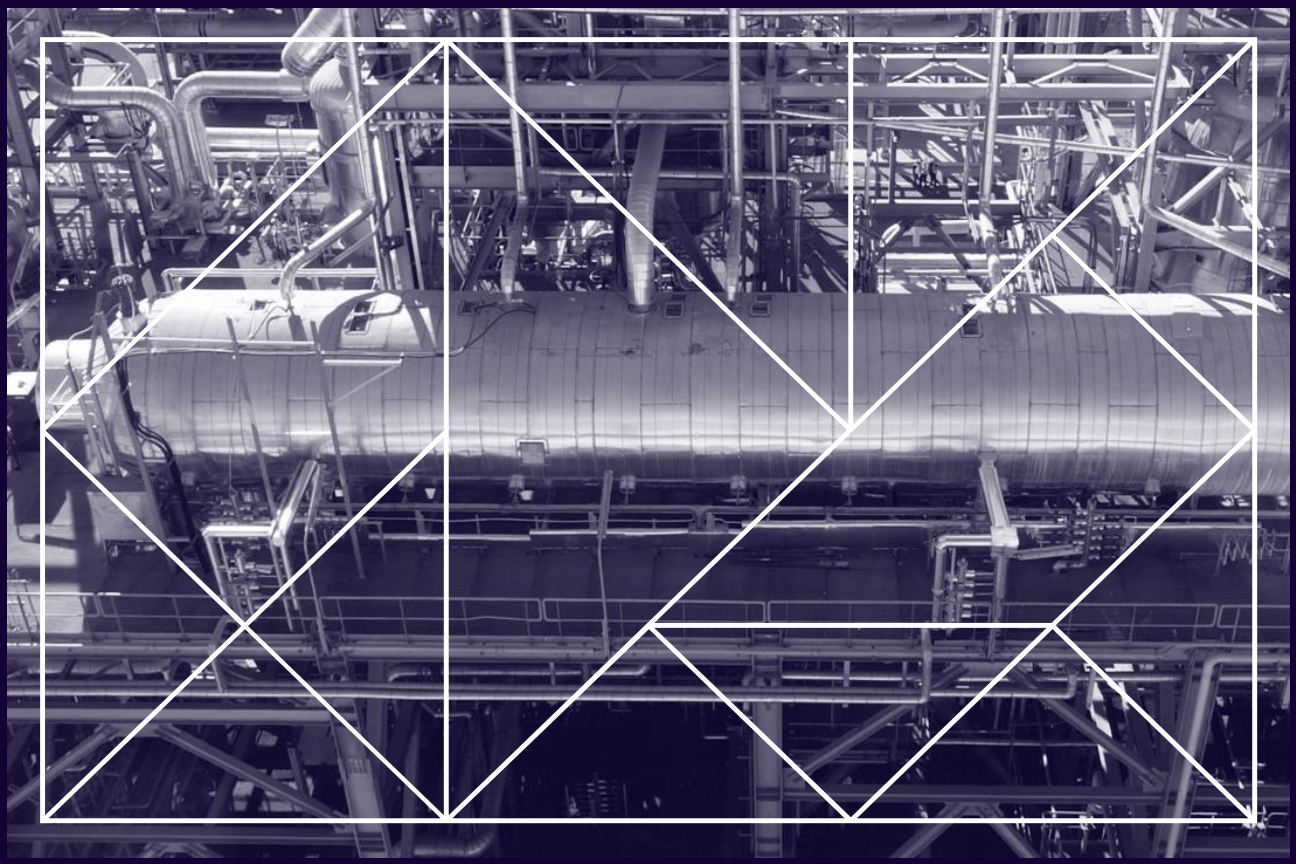
ACIL ALLEN

July 2021

Report to Department of Jobs, Tourism, Science and Innovation

Western Australian Gas and Downstream Opportunities Study



About ACIL Allen

ACIL Allen is the largest independent, Australian owned economic and public policy consultancy.
We specialise in the use of applied economics and econometrics with emphasis on the analysis, development and evaluation of policy, strategy and programs. Our reputation for quality research, credible analysis and innovative advice has been developed over a period of more than thirty years

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Overview and context

The discovery and development of Western Australia's vast oil and gas reserves has been one of the most significant drivers of the growth and diversification of the State's economy over the past 50 years.

The development of the North West Shelf project, including the Dampier to Bunbury Natural Gas Pipeline, has been the catalyst for the downstream development of a number of industries in the State, by providing the gas for power generation and feedstock for the production of a number of industrial products, including ammonia, ammonium nitrate, alumina, nickel and other processed minerals.

In more recent years, the major developments in the industry have been primarily around a number of significant LNG projects, which together has made Western Australia the largest exporter of gas in the world. While these projects have a domestic gas commitment, as required under the State's 2006 Domestic Gas Policy, unlike the earlier phase of gas developments in the State, this has not stimulated new downstream gas opportunities, with the last major downstream gas development being the Yara Pilbara Fertilisers plant that commenced production in 2006.

The downstream processing of Western Australia's natural resources has been a long held ambition of successive governments looking to support the development of new industries and broaden and diversify the State's economy.

This has been most recently reflected in the WA Government's overarching economic development framework, *Diversify WA*, which was officially launched in July 2019. *Diversify WA* articulates the WA Government's vision for the economy by supporting growth in value adding industries and in job creation across industries and regions, through diversification into new markets and building capacity in new sectors, particularly across regional WA, and through the creation of secure and quality jobs from industry diversification.

The biggest challenge that will impact on the industry longer term is the global response to climate change, which will see countries look to reduce their reliance on carbon intensive energy sources such as oil, gas and coal in favour of renewable energy sources. The WA Government released its *State Climate Policy* in 2020, which will need to be taken into consideration as it pursues its industry development objectives, as outlined in *Diversify WA*.

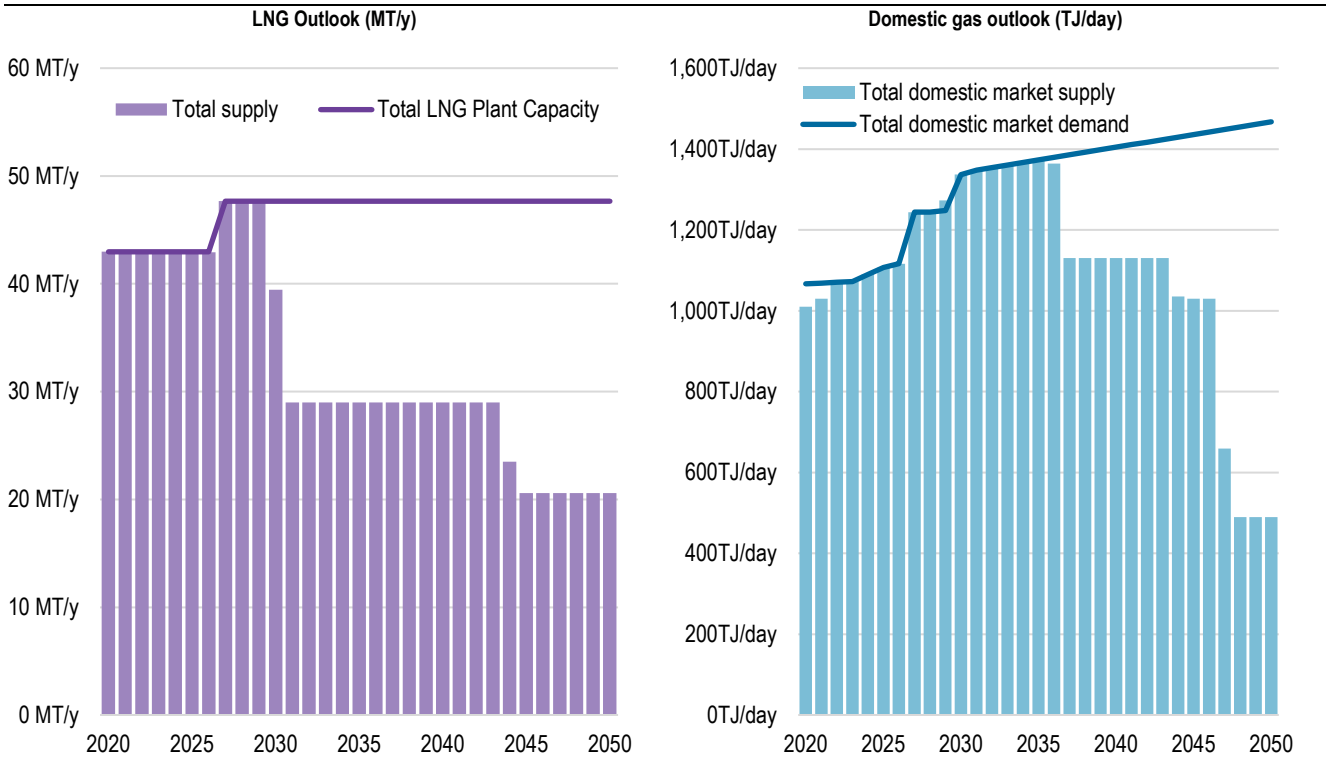
Against this backdrop of domestic and global challenges, in June 2020 the Department of Jobs, Tourism, Science and Innovation ('JTSI') engaged ACIL Allen to conduct a review into downstream and energy-intensive industry development opportunities in Western Australia.

In undertaking this study, ACIL Allen has used the combination of desktop research, stakeholder consultation and gas market modelling to assess the possible downstream gas opportunities that could be developed in Western Australia, and the critical success factors that are required to realise these opportunities in the future.

Gas Market Outlook

ACIL Allen used it gas market model, *WesternGasMark*, to provide a base case gas market outlook for Western Australia. ACIL Allen's modelling suggests the Western Australian domestic gas market will be well supplied over the next 15 years before the draw down of existing domestic gas reserves is inadequate to meet projected demand. The base case outlook also found the State's LNG producers may not have adequate reserves to continue to produce LNG at nameplate capacity throughout the modelling period, with a significant shortfall in gas feedstock projected to commence in 2032. A summary view of the outlook is presented below.

Figure ES 1 ACIL Allen Base Case WA gas market projection summary



Source: ACIL Allen

ACIL Allen's gas market modelling demonstrates there is likely to be capacity within the domestic gas market to support the formation of new downstream industry development projects. Even in a conservative scenario, where there is no upside assumed to existing reserves and no speculative projects modelled, the analysis suggests capacity for over 200TJ/day of additional demand from 2022 through to the end of the 2030s.

The domestic gas obligation of Western Australia's LNG producers under the domestic gas policy is projected to play an increasing role in meeting the needs of Western Australian industry and gas-fired power generation. Assuming this gas would otherwise be exported, the WA Domestic Gas Policy is important to ensuring continued supply in the local market.

ACIL Allen also found there to be significant domestic gas plant processing capacity both currently installed and expected to emerge over the projection period. This is one element of the WA Domestic Gas Policy in particular which has set the State up well to capitalise on any opportunities for downstream industry development. The installed domestic gas plant processing capacity, and existing pipeline network, mean there is ample gas infrastructure available to connect prospective buyers to current and emerging sellers.

ACIL Allen's cost of supply estimates suggest on a cost-only basis gas supply can be expected to be available in the Dampier zone (in north west Western Australia) for between $3.00/GJ and $3.50/GJ – excluding producer margins which have not been considered in this study. Importantly, the analysis indicates the cost of supply is expected to be relatively stable throughout the period, only rising in the 2040s as reserves begin to deplete and the market moves into a shortfall position.

Market perspectives

While the gas market modelling suggested the existing supplies of gas in Western Australia could support new gas-based downstream industry projects, there are a range of complexities associated with interactions between buyers and sellers in the market, as well as the challenges facing both the development of upstream supplies and downstream sources of demand.

In order to gain an understanding of the range of views and issues surrounding the potential for downstream gas opportunities in Western Australia, ACIL Allen undertook a targeted phase of stakeholder consultation process across industry and government to inform this study.

The stakeholder consultation process revealed clear and divergent views on the potential size, scale and nature of gas-based downstream processing industries in Western Australia. In ACIL Allen's view, most of the contention can be traced to different views on the gas market, and the operations and outcomes of the WA Domestic Gas Policy.

Overall, stakeholders agreed that the findings of this study, and any response from Government, must be consistent with the WA Government's broader policy objectives relating to economic development and climate change. Stakeholder feedback consistently raised the issue of the study objectives, and the need to explore downstream opportunities beyond gas as an energy source. There are a range of closely related industries, such as renewables, battery minerals, hydrogen, and other mineral processing industries, which are closely linked to the industry opportunities in focus for this study.

The policy environment, and public sentiment, have shifted markedly on climate change and emissions reduction since this study began. These issues were raised by stakeholders during the consultation process, and it is important the State Government is aware of this shift when considering the findings and recommendations from this study.

In ACIL Allen's view, the WA Domestic Gas Policy is well understood and achieves a high level of acceptance amongst for existing upstream and downstream industry players. There are differences of opinion regarding the primacy of its various objectives, its success in meeting these, and how the outcomes could or should be pursued. For greenfield gas developments and potential downstream gas developments, the policy alone is not considered to be a sufficient means of supporting industry development.

The Government's broader major projects facilitation role, and its role in supporting industry development through infrastructure, are viewed as additional, complementary means of addressing the requirements for significant new downstream gas developments to be progressed.

The domestic gas policy has ensured that the WA market is well supplied for its current needs, which was also supported by ACIL Allen's gas market modelling. For potential downstream gas developments that have not been successful to date in securing competitively priced, long term gas contracts of sufficient volumes, the view held by gas suppliers is that this is not a failure of the market, but rather that these projects are not sufficiently advanced to be able to enter into such negotiations. On the other hand, buyers do not believe suppliers are engaging in good faith.

Given the long term nature of upstream and downstream gas projects, the allocation and management of risk is a key consideration. The key risk for prospective downstream gas projects relates to their ability to secure long term gas contracts. Stakeholders believe the Government can play an important role in addressing additional risks for such projects through its important project facilitation role, including in the provision of land and infrastructure, and in helping to streamline approvals processes and native title negotiations.

Further changes to the domestic gas policy should only be made where a demonstrable case can be made for such a change. Gas suppliers consider that the domestic gas policy has been effective

in achieving the Government's objectives, while potential downstream gas buyers view the policy as ineffectual, requiring changes to strengthen transparency and enforcement of obligations. Any changes to the domestic gas policy will require careful consideration of these competing views, which were beyond the scope of this engagement to address.

Overall, ACIL Allen's stakeholder engagement program confirmed the need for further, detailed examination of the issues and challenges facing downstream industry development in Western Australia. Stakeholder engagement also revealed there are a number of opportunities, some of which are under active pursuit by industry, in this space in Western Australia.

Downstream gas opportunities identification

ACIL Allen's stakeholder engagement revealed a number of potential downstream industry development opportunities which were under active investigation in Western Australia. Stakeholders also identified a range of opportunities for value-added manufacturing and downstream processing of materials which were not within the scope of the study. These include green industries such as green hydrogen and green steel, where natural gas is not a primary input. Stakeholders also raised processing of the State's mineral endowment as an opportunity, which is considered out of scope due to gas being used as an energy source only.

In order to prioritise development opportunities within the scope of this study, ACIL Allen has completed a multicriteria assessment ('MCA') of a number of potential downstream gas opportunities, giving strongest regard to those opportunities in which natural gas is used as a feedstock rather than those where natural gas is a generally used as a fuel source. ACIL Allen used four criteria to assess the opportunities that emerged from its desktop research and stakeholder consultation:

1. Is the opportunity centred specifically on the use of natural gas in the production process?
2. Is there active interest (defined as an existing project, a project being publicly announced, or a project having commenced an environmental approvals process in the past five years) in the opportunity?
3. Is the opportunity conducive to low carbon production or decarbonisation over time, in line with the intent and directions provided by the State Climate Policy?
4. Is the opportunity subject to a Western Australian industry and/or economic development policy or strategic plan?

Using ACIL Allen's MCA, the three opportunities which ranked highest against the four criteria were the production of urea, methanol, and ammonia.

— **Urea** is a fertiliser applied across agriculture industries globally. Urea is a concentrated nitrogen based fertiliser that seeks to enrich soils for the purposes of improving cropping yields and the productivity of otherwise poor quality soils. It can be produced as either a solid or liquid chemical. There are currently three active urea projects in various stages of development in Western Australia: the Perdaman Chemicals and Fertilisers plant on the Burrup Peninsula, Strike Energy's proposed urea project in the Mid West, and the Derby Fertilisers and Petrochemical Complex in the Kimberley. Of these, the Perdaman project is the most advanced having received a funding commitment from the Western Australian Government for infrastructure as well as progressing to detailed environmental approval.

— **Methanol** is an alcohol-based chemical with wide application in the chemicals industry. It is used in the production of fuels, medicines, antifreeze, as well as transformation into a number of additives and reagents used across industry (including formaldehyde and acetic acid). It is one of the most widely traded chemicals in the world due to the complex production process and need for access to high volumes of natural gas. There has been active interest in

methanol projects in Western Australia in the past, including around the time Yara Pilbara's ammonia plant was commissioned in 2006.

— **Ammonia** is a basic organic chemical product which is among the most produced chemicals in the world. It has a wide range of applications, the majority of which are as an input into the production of other chemical compounds. According IHS Markit, approximately 80 per cent of the world's production of ammonia is used as a feedstock into nitrogen-based fertilisers (including urea). Yara Pilbara currently operates an ammonia plant on the Burrup Peninsula with a production capacity of 0.8mtpa. The facility is primarily for export of ammonia, although a portion of the ammonia production is retained for the production of technical ammonium nitrate (~0.3mtpa). Ammonium nitrate is produced by other projects across Western Australia.

For each of these prospective downstream opportunities, project proponents are responding to long term growth trends for basic chemical and fertiliser products from three main centres: China, India and South East Asia. Western Australia's relative location compared to other sources of natural gas feedstock is attractive to downstream project proponents.

ACIL Allen observed a range of other commonalities between these prospective downstream projects in Western Australia, which are important context when assessing the potential policy responses and interventions to assist in bringing projects to fruition. These include:

— Projects are long term in nature, typically with a plant life of at least 20 years,

— Projects are capital intensive, with limited direct employment following commissioning,

— Projects are export focussed, due to economies of scale benefits and a small local market,

— Projects are typically require bank finance and are well suited to this form of project financing, and

— Projects are typically integrated production and export projects.

Estimating the economic benefits of prospective downstream gas opportunities

As part of its assessment of the gas-based downstream industry development opportunity for Western Australia, ACIL Allen has completed preliminary **economic impact assessments** on three hypothetical projects in Western Australia. The assessments are intended to provide a perspective on the overall economic impact on the State economy of the successful delivery of a downstream industry project.

These assessments have been built from the bottom up, through the development of a simplified project financial model for three facilities identified as the most prospective opportunities for Western Australia. The project analogues are:

— Project 1: A **urea project** with capacity of two million tonnes per annum

— Project 2: A **liquid ammonia** project with capacity of one million tonnes per annum

— Project 3: A **methanol plant** with capacity of 2.5 million tonnes per annum

These projects are fundamentally similar, with gas feedstock and various chemical processes supported by capital equipment and an operational workforce. The projects are all targeting export markets.

To isolate the impact of the processing of gas, the economic impact assessment for each project has been based on the capital and operations associated with the project only. The economic impact of the upstream production of gas as a feedstock for the plant in each scenario is excluded from the analysis.

ACIL Allen has used its in house computable general equilibrium model, *Tasman Global*, to estimate the direct and indirect impacts of the three hypothetical project in terms of its impact on:

— **Real output**, in terms of Gross State Product. This reflects the change in production levels across the economy, taking into account the dynamic flow of labour and capital resources and how these impact on all sectors.

— **Real income**, which is a measure of the overall economic welfare impact of the project. Real income measures the net change in wages and salaries, company profits (retained in the jurisdiction) and taxation revenue, which are available for individuals, businesses and government to spend as they see fit.

— **Employment**, in terms of full time equivalent job years. This is the net change in total employment across the economy owing to the project, taking into account the demand for and supply of labour in the economy.

— **Taxation**, by major head of Commonwealth and State taxation.

Project 1: Export scale urea project

In this scenario, the downstream project is assumed to be a large-scale urea project, with a production capacity of two million tonnes of urea fertiliser per annum. As a demonstration of the scale of the project, Australia's total imports of urea fertilisers were around three million tonnes in 2020, meaning that the project could be targeted to export markets or as an import replacement into the Australian market.

Over a 20 year project life, a facility of this scale would consume approximately 850PJ of gas as a feedstock, with additional gas required for power generation if gas was the fuel source. The additional gas demand would be equivalent between a 10 and 15 per cent increase in Western Australia's baseline level of gas demand in 2020.

Overall, the project of this scale could generate an additional **$5.8 billion in GDP** over the 20 year operating life (plus two years of construction), or $263.9 million per annum. The vast majority of this would be realised in Western Australia ($5.2 billion in GSP, $234.1 million per annum), with the remainder generated across the other States and Territories ($0.7 billion, $29.8 million).

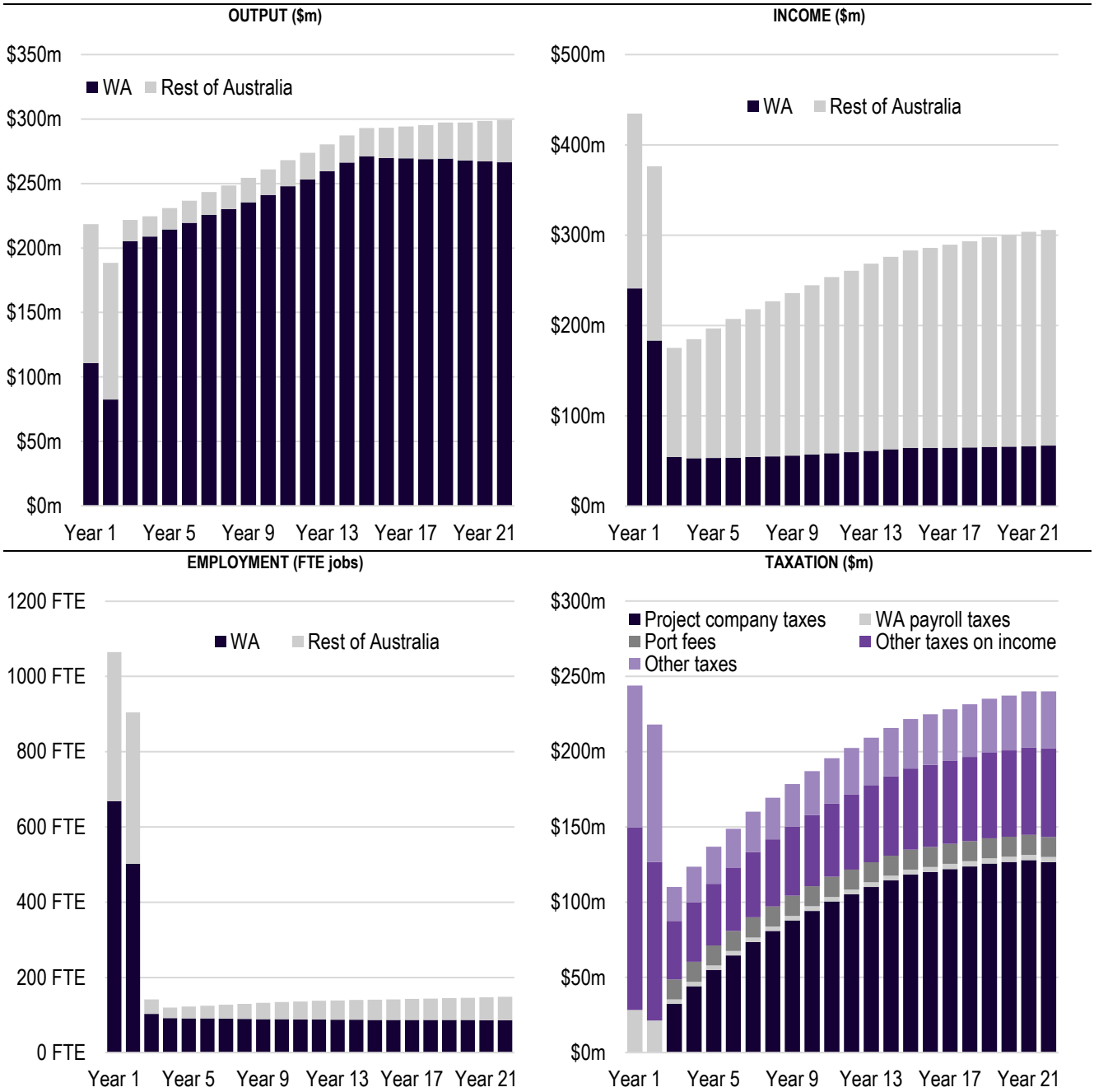
From an income perspective, ACIL Allen estimates that a project of this size would generate **$5.9 billion of real income benefits** over the 20 year project life, or $269 million per annum. Unlike output, the majority of income benefits flow to the Rest of Australia due to the large company tax payments flowing to the Commonwealth and the higher degree of after-tax profits being distributed to owners outside of Western Australia. The net welfare benefit of the project to Western Australians is still significant, generating some $1.6 billion over the life of the project, or $74 million per annum due to the income benefits from the additional job opportunities in the State.

Impacts on employment reflect the net overall change in employment levels across the economy as a result of the project. In dynamic economic models, crowding out effects – where scarce resources are redirected to their most productive use – result in net impacts on total employment which lower than direct impacts may allow. This is the case with this assessment, with an average operational **employment impact across the Western Australian economy of 89.2 FTE jobs**, which is around half of the direct employment assumed to be required for the project.

The other means by which an economic impact assessment can estimate the overall impact of a project is through the additional Commonwealth and State taxes collected. ACIL Allen estimates an export scale urea project would generate a total of **$4.4 billion in Commonwealth and State taxation benefits** over the 20 year project life, or $198.1 million per annum. The vast majority of the taxation benefits accrue to the Commonwealth, raising $4.0 billion across company income tax, excises and international trade taxation, and consumption taxes. Western Australian Government

revenue streams include payroll tax ($114 million, $5.2 million per annum) and port fees and charges ($266 million, $12.1 million per annum).

Figure ES 2 Economic impact of an export scale urea project



Source: ACIL Allen

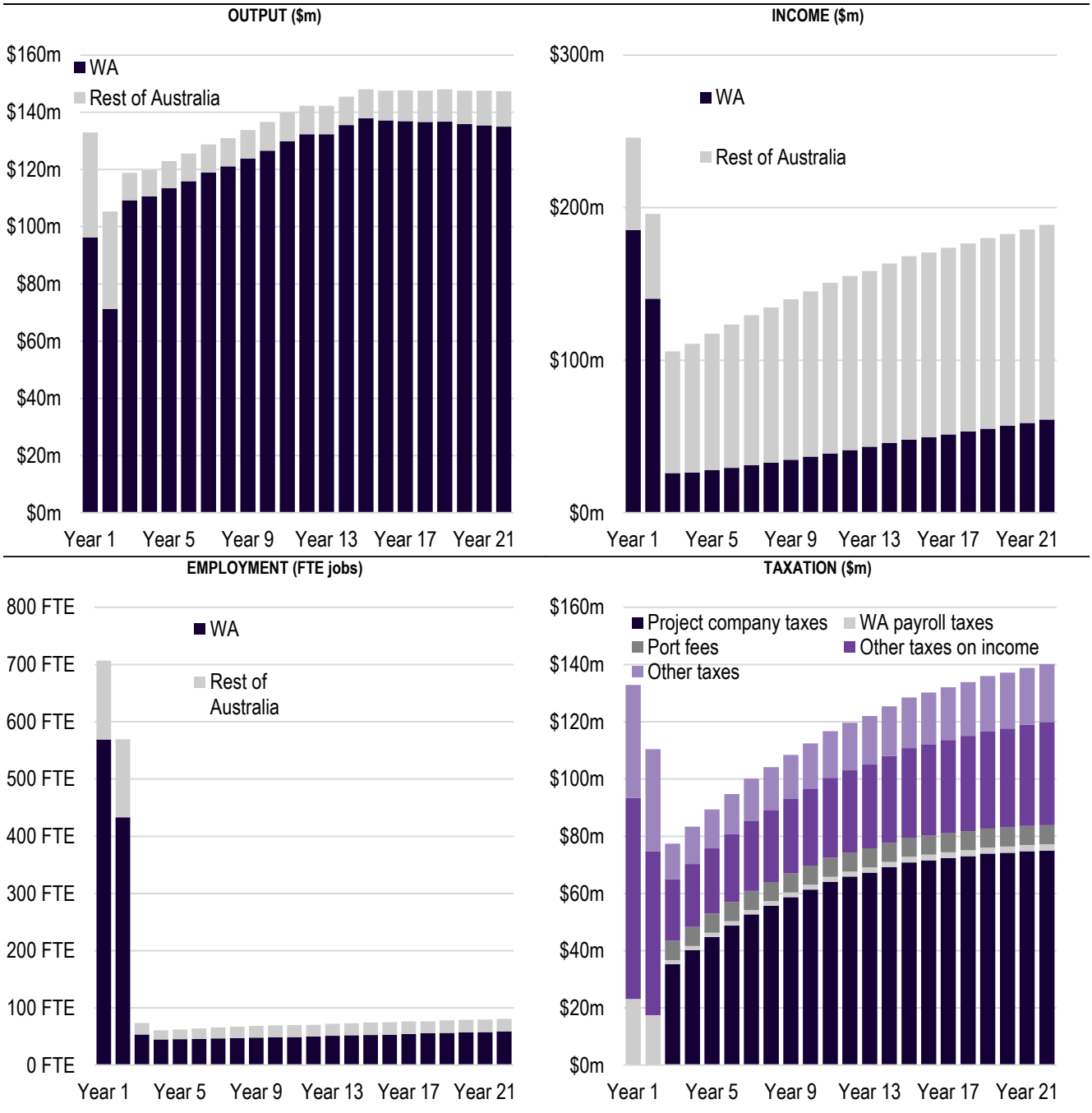
Project 2: Export scale ammonia project

In this scenario, the downstream project is assumed to be a moderate-scale liquid ammonia project, with a production capacity of one million tonnes of liquid ammonia per annum. This project is around 25 per cent larger than the Yara Pilbara ammonia facility, and reflects what is likely to be the minimum viable plant size for a greenfield development in Western Australia.

Over a 20 year project life, a facility of this scale would consume approximately 800PJ of gas as a feedstock, with additional gas required for power generation if gas was the fuel source.

Overall, ACIL Allen's economic impact assessment on a medium scale ammonia project suggests a project of this size would generate an additional **$3.0 billion in GDP** over the 20 year operating life (plus two years of construction), or $136.7 million per annum. The vast majority of this would be

Figure ES 3 Economic impact of an export scale ammonia project



Source: ACIL Allen

realised in Western Australia ($2.7 billion in GSP, $124 million per annum), with the remainder generated across the other States and Territories ($0.3 billion, $12.6 million).

From an income perspective, it is estimated that the project would generate **$3.5 billion of real income benefits** over the 20 year project life, or $159.2 million per annum. Unlike output, the majority of income benefits flow to the Rest of Australia, reflecting the large company tax payments flowing to the Commonwealth and the higher degree of after-tax profits being distributed to owners

outside of Western Australia. The net welfare benefit of the project to Western Australians is still significant, generating over $1.2 billion over the life of the project, or $53.4 million per annum.

ACIL Allen estimates the average operational **employment impact of the medium scale ammonia project across the Western Australian economy is 51.5 FTE jobs**, which is just over half of the direct employment assumed to be required for the project.

The taxation benefits arising from the ammonia project would generate a total of **$2.5 billion in Commonwealth and State taxation benefits** over the 20 year project life, or $117 million per annum. The vast majority of the taxation benefits accrue to the Commonwealth, raising $2.3 billion across company income tax, excises and international trade taxation, and consumption taxes. Western Australian Government revenue streams include payroll tax ($78 million, $3.5 million per annum) and port fees and charges ($133 million, $6.1 million per annum).

Project 3: Export scale methanol project

In this scenario, the downstream project is assumed to be an export scale methanol project, with a production capacity of 2.5 million tonnes of methanol per annum. The project uses a facility previously proposed for Western Australia around 20 years ago as an analogue, which proposed two 2.5 million tonne per annum production trains would eventually be developed. A facility with 2.5 million tonnes per annum of production capacity would be one of the largest methanol plants in the world.

Over a 20 year project life, a facility of this scale would consume approximately 1,600PJ of gas as a feedstock, with additional gas required for power generation if gas was the fuel source. The annual rate of consumption is equivalent to approximately two thirds of a year of feedstock gas for a small LNG train (such as one of the original trains of the North West Shelf project), or around a 20 per cent increase in Western Australia's domestic gas demand.

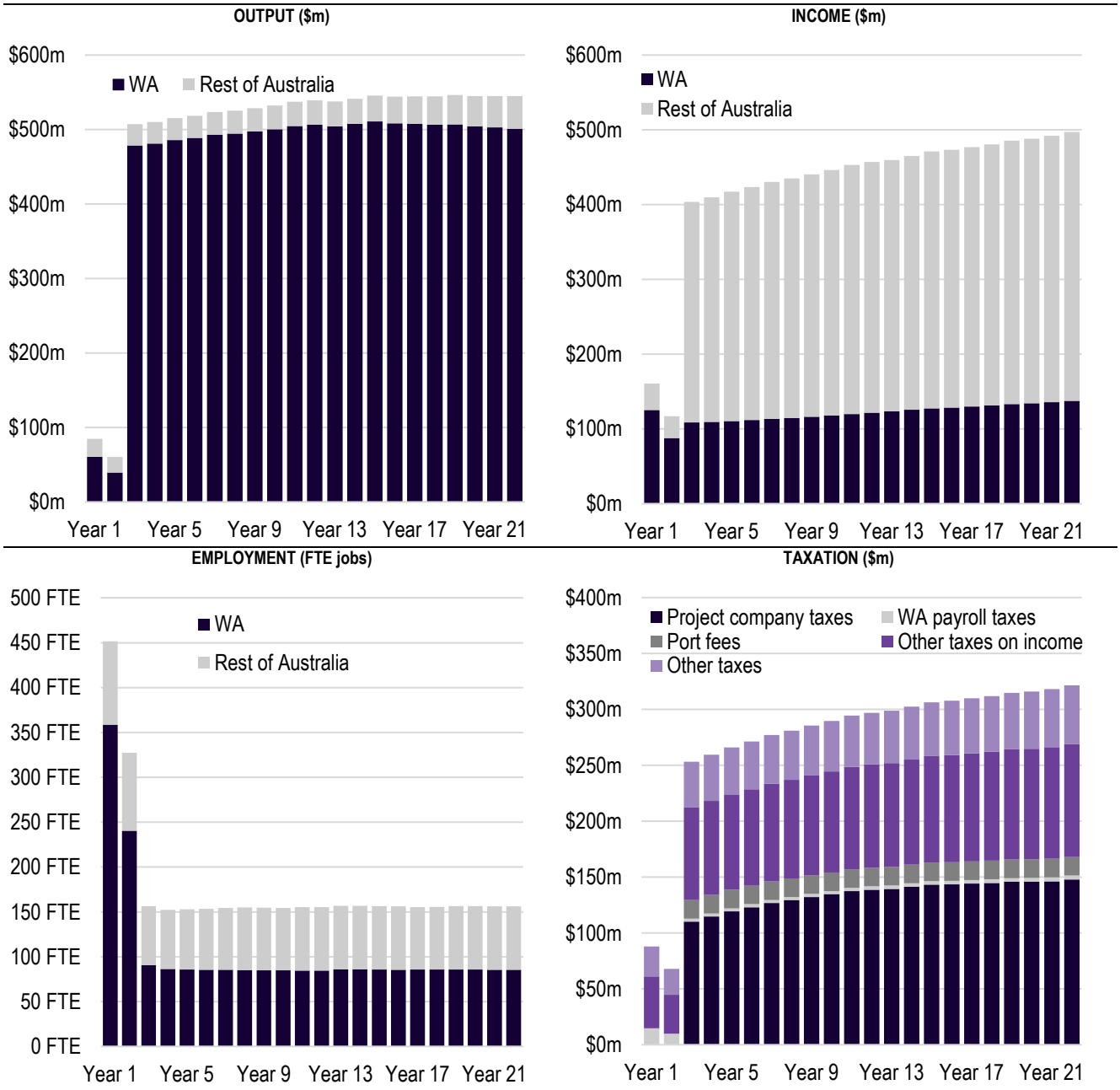
Overall, ACIL Allen's economic impact assessment on a medium scale ammonia project suggests a project of this size would generate an additional **$10.1 billion in GDP** over the 20 year operating life (plus two years of construction), or $491.9 million per annum. The vast majority of this would be realised in Western Australia ($10.1 billion in GSP, $458.7 million per annum), with the remainder generated across the other States and Territories ($0.7 billion, $33.2 million).

From an income perspective, ACIL Allen estimates that an export scale methanol project of this size would generate **$9.4 billion of real income benefits** over the 20 year project life, or $426.4 million per annum. The high level of real income retention relative to other projects reflects the significant taxation revenue streams associated with the profits of the facility, as well as the level of profit generated by the project. Given this, the majority of the income benefits accrue to the Rest of Australia, with the impact valued at $6.7 billion (or $305.4 million per annum).

The net welfare benefit of the methanol project to Western Australians is some $2.7 billion over the life of the project, or $120.9 million per annum.

It is estimated that the average operational **employment impact of the export scale methanol project across the Western Australian economy is 105.2 FTE jobs**, which is around two thirds of the direct employment assumed to be required for the project.

Figure ES 4 Economic impact of an export scale methanol project



Source: ACIL Allen

Like the urea and ammonia projects, it is estimated that a methanol project would generate **significant taxation payments to the Commonwealth and State Governments, totalling $6.0 billion** over the 20 year project life, or $274.5 million per annum. The vast majority of the taxation benefits accrue to the Commonwealth, raising $5.6 billion across company income tax, excises and international trade taxation, and consumption taxes. Western Australian Government revenue streams include payroll tax ($86 million, $3.9 million per annum) and port fees and charges ($333 million, $15.1 million per annum).

Implications for downstream industry development policy

While preliminary in nature, ACIL Allen's economic impact assessment demonstrates in a "success case" scenario that downstream industry projects can generate positive economic benefits for Western Australia. The benefits accrue as a result of the wages and salaries paid to operational

staff, purchases of goods and services – including utilities services and access to ports – to facilitate production, and from the profits and taxes paid by the projects themselves.

The scenarios analysed by ACIL Allen are on the downstream production facilities only. This means there is additional economic activity associated with the production of gas feedstock from Western Australian sources which is excluded from the scope of the assessment. If this gas feedstock was included in the assessment, the benefits would be substantially larger; particularly if the upstream project was a greenfield project. This is also true of taxation revenue, with the Western Australian Government able to realise production royalties from gas produced in onshore basins.

Furthermore, if the project results in the realisation of gas production that would otherwise not occur, the benefits are larger still. This is because if there is no path to market for the gas, it will remain in its reservoir and no additional economic value will be realised.

Critical success factors for downstream gas developments

It is evident from ACIL Allen's research there are a number of highly prospective gas-centric downstream industry development opportunities in Western Australia. This is further supported by the recent onset of active interest in the potential processing of natural gas into chemical and fertiliser products, by both current and new private sector interests in the State. ACIL Allen's preliminary economic impact assessment of various downstream industry projects suggest a strong economic benefit per unit of gas consumed.

In the formation of a major export project of any type there are a number of general commonalities required to achieve an investment decision. The project must have access to land, access to markets via ports, achievement of offtake agreements for production, secured supplies of raw inputs, and capital to pay for the project. It is also important for project owners to hold intellectual property with respect to their production processes and methods.

In the previous section, ACIL Allen identified that the most prospective opportunities within the scope of this study – urea fertiliser, methanol and ammonia – has a number of common features and attributes.

At its core, the **critical success factors framework for downstream industries** are driven by three mostly independent variables, being:

— **Location**. This is the extent to which the production facility is proximate to demand centres, and in particular to marginal demand centres (or the areas where demand is growing or set to grow). Location in this context also refers to the specific location of the plant itself relative to important infrastructure such as utilities and ports. This manifests in the costs required to transport a finished product from the plant to the end consumer.

— **Capital expenditure**. This is the extent to which business and public policy conditions are conducive to the development of a project. These factors influence the up front capital cost of the project in question, which impacts on the economics of the overall project. This manifests in the costs required to transport a finished product from the plant to the end consumer.

— **Gas**. This is the extent to which there is natural gas available to provide a feedstock and, to a lesser extent, energy source for the project. In this context, gas means more than simply a hypothetically available source of supply. It refers to access to gas on long terms, at the right specification, with stable prices.

Central to each of the above attributes is the **role of infrastructure and gas availability**, as well as the **broader policy environment** in the State from a major developments perspective. The

Western Australian Government has a role to play in both spaces, meaning there is scope to influence the development of gas-based downstream industries in the State.

Critical Success Factor 1: Location

Western Australia is ideally located to current and future global demand for a range of downstream industries. This is particularly true for the Pilbara, Kimberley and Gascoyne regions of the State, where access to markets in China, India and South East Asia is closer than any other location in Australia.

This ideal location is one of Western Australia's unique comparative advantages in the provision of bulk commodities and energy products, helping to catalyse the development of the iron ore and LNG industries over the past two decades. The State's location advantage manifests in a number of ways, but principally in the form of low freight costs versus other current and prospective locations for downstream projects.

Figure ES 5 Critical Success Factors Framework

Delivered product		Natural/comparative advantage factors	Role of infrastructure	Government policy & regulatory settings	Primary challenges
	Distance to market (Freight costs)	Western Australia's proximate location Location of Strategic Industrial Areas	Ports Land availability Pipelines Roads	N/A	Cost of greenfield sites and infrastructure
=	Capital expenditure (Development costs)	Cost of construction disadvantages	Funding and financing non-plant infrastructure	Environmental approvals Native title	High cost of doing business Project approvals lifecycle
	Gas (Gas cost, supply and terms)	Western Australia's large gas endowment	Pipelines and other midstream infrastructure	Western Australian Domestic Gas Reservation	Achieving suitable price and term combinations for domestic gas

Source: ACIL Allen

In the context of downstream projects, freight also refers to the distance between a production facility and the point of export. In this respect, collocation of a production facility with or very close to export facilities is an important potential source of competitive advantage. Western Australia's economic development framework more broadly recognises the importance of collocation of production and export facilities, through the Strategic Industrial Areas ('SIA') program. The SIA program is led by the Department and delivered by DevelopmentWA (the Western Australian Government's strategic land development authority), and are designed with the specific requirements of collocation of essential infrastructure and services in mind. The majority of Western Australia's SIAs are located within close proximity of current or planned ports infrastructure.

Another benefit of the State's SIA program is the long term planning associated with infrastructure corridors and other infrastructure, which improves the ability for project proponents to "plug and play" when developing projects.

Critical Success Factor 2: Capital expenditure

The production processes deployed in the gas-centric downstream processing industry are highly capital intensive. This means the development of new projects requires access to in excess of one billion dollars of capital funding to build and establish the various production processes, chains and infrastructure required to commence production. Once projects are established, costs tend to be mostly feedstock and utilities, with some labour costs, transport costs and marketing costs.

Stakeholder feedback suggested the time and capital required to establish new downstream projects in Western Australia was one of the State's major impediments to further development of the industry. Stakeholders suggested there was a "capital expenditure penalty" of at least 20 per cent over and above the capital cost of establishing a new project in the United States, and at least 40 per cent over and above the capital cost of establishing a new project in Mainland China. These views are supported by global benchmarking reports, although the 20 per cent premium may underestimate the differential.

Higher up front capital investment costs primarily affect the ability of a project to become bankable, and to bring together a combination of funding which is feasible to establish the project.

The high cost of establishing new projects in Western Australia is a product of a number of factors which are outside of the control of the Western Australian Government. This includes industrial relations laws (the vast majority of which are governed by the Commonwealth in relevant sectors), which result in higher pay and conditions than in other parts of the world, remoteness (which is of particular concern in the Pilbara and Kimberley regions), and the need to import and then transport modularised plant and equipment modules for installation from specialised manufacturing facilities throughout South East Asia.

However, there are a number of opportunities for the Western Australian Government to assist in reducing capital costs and project development risks, with the ultimate objective of reducing the time and cost of establishing new projects in the State. These measures were raised by stakeholders during the engagement process, and represent tangible opportunities for the Western Australian Government to improve the prospect of gas-centric downstream industry projects in the State.

Project formation and approvals

This measure is about the ability for the project to **access the appropriate land footprint** for its infrastructure. In Western Australia, the SIA program is an important means by which the State is able to offer development-ready land to industry for major projects. This critical first step was not raised as an issue by project proponents during ACIL Allen's stakeholder consultation program, which suggests existing Western Australian Government processes with respect to land tenure and allocation are functioning well.

Initiation of contact with the Department kick starts a number of processes, including assessment of options with respect to land availability and tenure. The most significant is an assessment of whether the project proponent qualifies for **lead agency status**. Lead agency status allows the Department to act as a primary point of contact on all matters relating to project formation and approvals, including consideration of State assistance where this is relevant or required. From a project formation and approvals perspective, lead agency status is vital to providing project proponents with a realistic chance of navigating the project approvals process.

When the subject of project approvals was raised by stakeholders during consultation, feedback principally centred on two elements of the Western Australian Government's regime: the Environmental Protection Authority's ('EPA') environmental assessment and approvals process, and processes centred on settling native title claims over lands.

— On **environmental approvals**, concerns were centred on the time required for a project to achieve approval rather than the specific requirements imposed by the EPA, which ultimately added to their project development costs, but more crucially increased the risk of an adverse change in the market.

  It is noted that the EPA's governing legislation was subject to review and amendment in early 2021, which is primarily focussed on "improving regulatory processes under Part IV to streamline the administrative efficiency of the environmental impact assessment process, and reducing duplication of assessments and approvals. To the extent these measures are successful, the time between a project being notified of a requirement to complete an environmental approval and the environmental approval being granted should reduce. The Department should monitor these developments and be proactive in addressing the situation through appropriate channels if the time taken to deliver environmental approvals does not improve as a result of the recent changes.

— **Native title** was raised by stakeholders as a concern, but less so relative to their concerns over environmental approvals. ACIL Allen considers this is likely because for the vast majority of potential project proponents who seek land in SIAs there are no substantial native title considerations, as these have been addressed by the Western Australian Government during the land assembly process. Appropriate management and recognition of the rights of Native Title holders is seen by stakeholders as an important component of the social licence to operate for major projects. While the Native Title Act is Commonwealth legislation, the Western Australian Government plays a role in the process through the Department of Premier and Cabinet and its Aboriginal Engagement Directorate. The State should seek to proactively and respectively engage with both project proponents and Native Title groups where this is required to progress projects.

Capital support for infrastructure

The opportunities which seem most compatible with Western Australia's current situation share a number of commonalities on the infrastructure side. This includes the need for access to water and electricity as inputs into the production process, and ports infrastructure to allow for the products produced to be exported into global markets.

The gas-centric downstream industry opportunities under consideration in this study are highly capital intensive, typically requiring project proponents to source debt funding. There are opportunities for the State Government to assist in alleviating the funding task of project proponents, by offering tailored and structured support in the form of infrastructure funding and subsidies as part of project development and approval.

This is not a new development within Western Australia as the State has a long history of providing this kind of support for major projects across sectors. At its most basic level, the development of SIAs represents a more interventionist version of this support as it sees the State Government assemble land and build the appropriate frameworks so they are ready for proponents as needed.

More recently, the Western Australian Government – through the Department of Jobs, Tourism, Science and Innovation – has helped to support the funding and development of port and seawater infrastructure for the Perdaman Urea Project in order for the project to reach a positive Final Investment Decision. Under this model, the State Government provides the up front capital required for the non-plant infrastructure, with the proponent paying the full cost of the infrastructure and an appropriate return on the State Government's capital through an annual charge once the project is operational.

By relieving the proponent of the up front capital funding task, the State Government is leveraging its balance sheet and reducing the overall risk of the project and the plant infrastructure developed by the proponent. In this case, the project proponent does not begin paying for the infrastructure

until it commences production, converting what would otherwise be a significant up front funding task into an operating cashflow consideration. The proponent's annual free cashflow is impacted, however it results in a less indebted balance sheet.

In addition, because Governments typically have a much lower cost of capital than private sector companies, when the up front capital for non-plant infrastructure is unbundled from the plant infrastructure, the State Government can assist in lowering the cost of capital of the project, thereby improving the economics of the project.

An up front capital funding approach to non-plant infrastructure also affords the State Government an opportunity for capital recycling through asset sales once the proponent's plant is commissioned and it is delivering a return.

While this approach is yet to be fully tested – as the Perdaman Project remains in the approvals process and is yet to achieve financial close – at face value it represents an opportunity for the State Government to support downstream projects in a tailored manner.

Critical Success Factor 3: Gas

Among the three critical success factors identified by stakeholders as most critical to establishing gas-centric downstream industries, discussions and opinions regarding the role of gas were most prominent. This stems from the role of gas as a vital input into the production process for most opportunities raised in the study.

In a Western Australian context, the challenges associated with gas are not simply a function of available supply, as demonstrated in ACIL Allen's gas market modelling. The gas challenge for downstream industries in Western Australia is the availability of gas for terms greater than 10 years and for fixed prices or prices which are unable to fluctuate significantly higher than the price struck at the time the gas supply agreement is formed. Stakeholders advised that in order to make downstream projects bankable, the gas price made available to them needed to be relatively secure and unable to fluctuate in line with energy prices more generally. This helps underpin the bankability of the downstream project as it allows the largest single variable production cost of the project to be locked in or kept within reasonably predictable bounds of the price underpinning the establishment of the project.

As discussed in Section 5, it is evident the gas price requirements for gas-centric downstream industry opportunities in Western Australia appears to be between AU$3.00 and AU$5.00 per GJ. In an environment where capital expenditure penalties of at least 20 per cent are likely to exist, it is likely projects would seek prices at the lower end of this range. ACIL Allen's analysis of Western Australia's gas market and the supply outlook estimates that there is likely to be gas available for delivery into projects at prices which are within these bands.

While the gas supply and demand outlook does, prima facie, appear to support the requirements of gas-centric downstream industries in Western Australia, the reality of matching gas supply and demand is significantly more complex and nuanced.

Market dynamics

There are a number of factors which seem to impact on the ability for buyers and sellers to meet in the middle when it comes to gas supply agreements for gas-centric downstream industry projects.

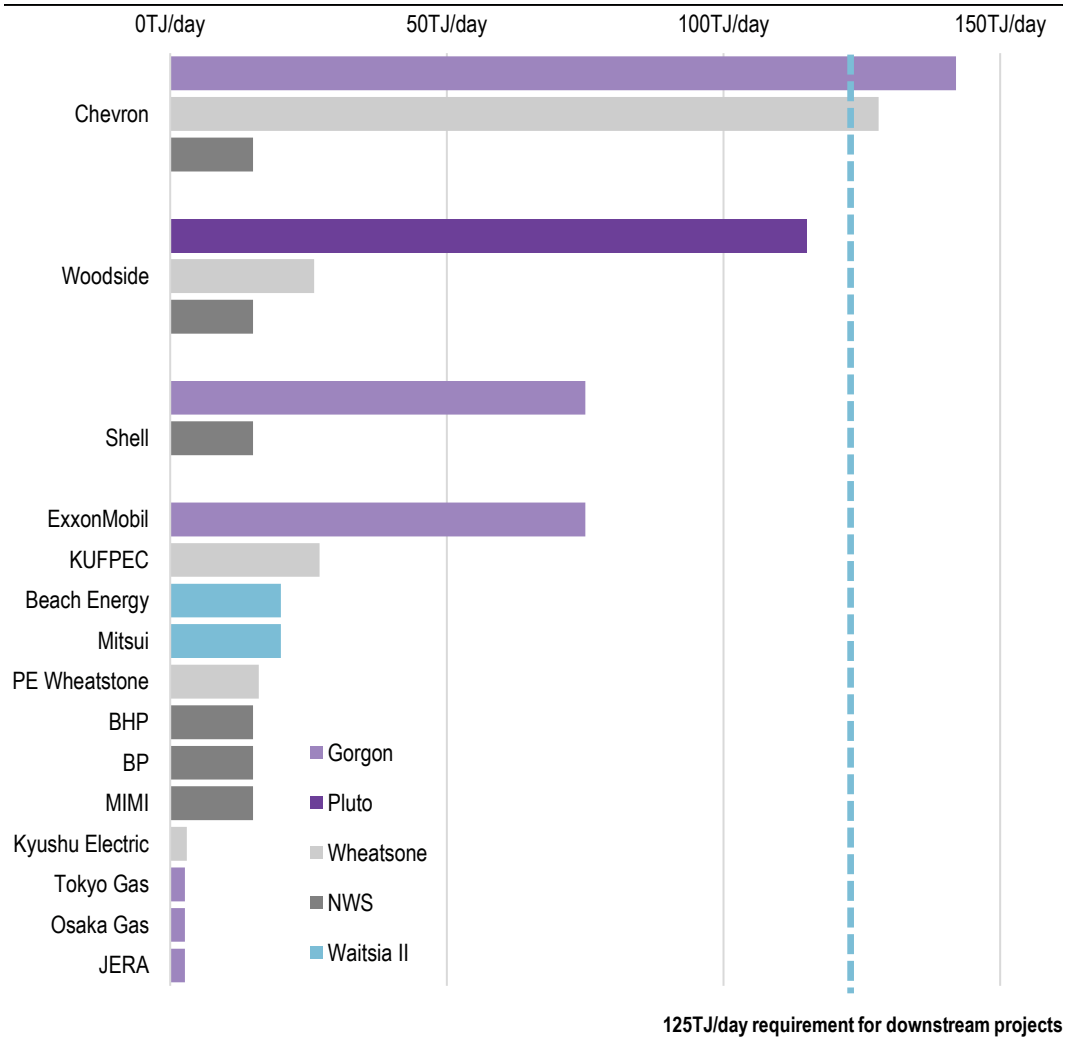
ACIL Allen notes the gas volume requirements for new downstream projects typically exceeds 100 TJ per day at start up (with active Western Australian proponents seeking at least 125TJ/day) and has the potential to increase further over time if the project were to add new trains. Proponents also prefer sourcing supply from a single source or point of aggregation, as building a "book" of supply introduces a variety of risks which reduce project bankability.

There are very few individual projects with the production and reserve capacity to supply the entirety of the needs of a downstream project (being 125TJ/day of production, and approximately 730PJ of total gas volume over a 20 year project life). This is further complicated by the ACCC's ban on joint marketing of gas. While the ban on joint marketing may lead to improved competitive tension among established buyers, it may also reduce the prospect of domestic market obligation gas tranches being utilised by new gas-centric downstream industry project proponents. This is because there are very few tranches of domestic gas which are of sufficient scale to meet the needs of downstream projects.

The ban on joint marketing has fragmented the gas supply potential of the domestic market obligation gas tranches available to be offered by commitment holders to the point where only two tranches could meet the needs of downstream projects in the long run – Chevron's share of the Gorgon Gas Project's combined 300TJ/day commitment (142TJ/day) and Chevron's equity share of the Wheatstone Project's combined 200TJ/day commitment (128TJ/day), although in both cases the maximum effective availability of these tranches is less than this (**Figure ES 6**).

At a project proponent level, only Chevron (combined plateau domestic gas obligation of 285 TJ/day) and Woodside (156TJ/day) hold large enough domestic market obligations to meet the needs of a downstream project in their own right.

Figure ES 6 Domestic market obligation gas tranches, TJ/day of plateau commitment by proponent and project, as of 31 December 2020

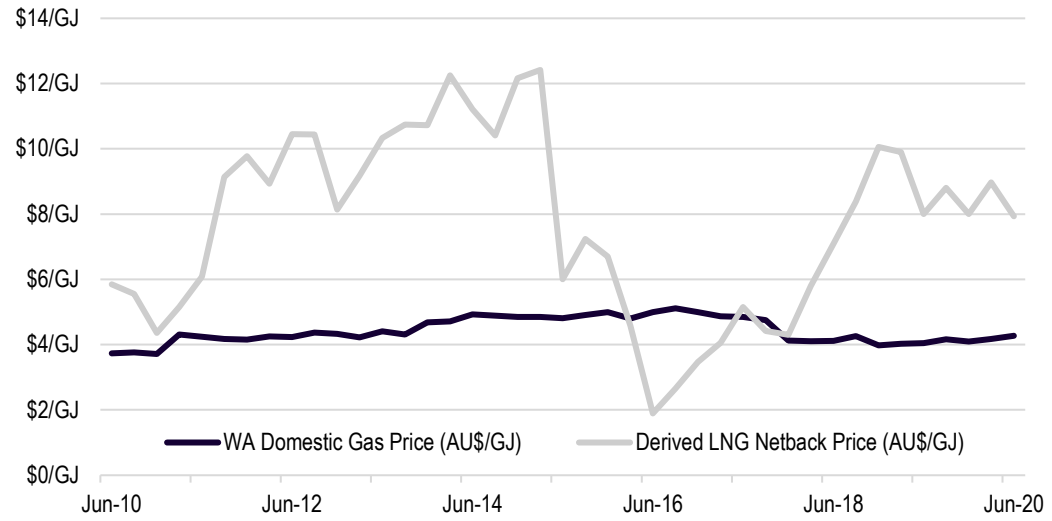


Source: Source: ACIL Allen, from JTSI.

Note: Pluto commitment is managed by Woodside on behalf of commitment holders. Beach Energy's Waitsia II commitment is to be met from existing Waitsia I production.

The economics of LNG netback pricing is a powerful incentive for upstream producers, and particularly those with direct connections to LNG facilities, with derived LNG netback prices realised by LNG producers in Australian dollars consistently above WA's domestic gas price, sometimes by up to AU$7.50/GJ (**Figure ES 7**).

Figure ES 7 Derived LNG netback price (Japan import terminal price, USD/mmbtu, converted to AUD/GJ at market exchange rate) vs WA DMIRS domestic gas price (AUD/GJ)



Source: ACIL Allen from World Bank Pink Sheet, RBA, DMIRS

ACIL Allen's gas market modelling finds Western Australia's domestic gas market will be increasingly served by LNG-linked gas, meaning these incentives are likely to become an even more important driver of the market supply dynamics over time.

It is important to note the LNG netback price does not reflect the cost of production for domestic gas. Rather, LNG netback is effectively a ceiling price which demonstrates the maximum input cost for natural gas which could be paid by an LNG producer and converted into LNG with the producer receiving no return on capital associated with their LNG plant. In this respect, the difference between the LNG netback price and the realised domestic gas price demonstrates the premium (or loss, when the domestic gas price exceeds the LNG netback price) which a gas supplier could earn selling gas into an LNG plant, all other things being equal.

The power of this incentive is demonstrated by the recent developments with respect to the Beach Energy/Mitsui Joint Venture Waitsia II Gas Project. In December 2020 the Western Australian Government finalised a gas commitment agreement and project development deed with the Waitsia Joint Venture. According to Beach Energy's 2021 half year results briefing, the company's combined Perth Basin projects (comprising Waitsia 1A, Waitsia II and Beharra Springs) has an expected payback period of three years on a capital investment of $700-$800 million, which includes the development of a gas processing facility with 250TJ/day of capacity as part of this development. This plant will be used to supply the domestic market following the completion of the LNG sales agreement period at the end of 2028.

Market transparency and information to aid in price discovery

Western Australia's gas market is less transparent by its structure, due to the extensive reliance on long term bilateral contracts between buyers and sellers. While in recent years some proponents

have taken to announcing gas contracts publicly, the information is not regularly available outside of AEMO's annual Gas Statement of Opportunities.

This lack of transparency means buyers have limited means to investigate project feasibility without engaging directly with buyers. This appears to be the root cause of accusations from gas suppliers that buyers were unsophisticated, or were not genuine in their approaches and were instead interested in discussing hypotheticals. Similarly, buyers reported suppliers would treat their exploration of project feasibility dismissively. This is unproductive and works against the ability of buyers and sellers to meet in the middle.

One path forward may be to improve market information and transparency through existing means of data collection by both the Department and AEMO. The Western Australian Government now makes publishing of the domestic gas agreements made under the WA Domestic Gas Policy mandatory. As new agreements are struck, this should provide the market with an improved capacity to understand how the policy functions, and how gas will be made available under these agreements. In addition, the Department has imposed additional gas market reporting obligations on domestic gas commitment holders as part of its most recent reforms to the WA Domestic Gas Policy.

This information could be used to provide regular, contemporary data on the outlook, driving transparency and breaking information asymmetries.

Western Australia's domestic gas policy in the context of gas-centric downstream project opportunities

ACIL Allen notes the scope of its engagement is not specifically centred on a review and analysis of Western Australia's domestic gas policy. However, the policy was raised by all stakeholders during stakeholder consultation, and is clearly material to the long term gas supply potential of Western Australia from the perspective of downstream projects.

One of the issues raised by stakeholders in relation to the impact of the domestic gas policy on gas-centric downstream projects was the **marketing in good faith** provision. The ability to achieve LNG netback pricing for natural gas acts as a powerful incentive in the economics of upstream projects in Western Australia. This incentive extends to gas earmarked for domestic market obligations as part of the sanctioning of LNG projects.

The WA Domestic Gas Policy requires proponents to market gas through the term of their LNG projects. The terms included in recent domestic gas agreements with the State (Waitsia Joint Venture Domestic Gas Commitment and the Woodside Pluto Acceleration Domestic Gas Commitment) suggest that a strong focus on ensuring gas is marketed in good faith. To the extent these terms and obligations reflect a new approach to enforcing the marketing in good faith provisions of the WA Domestic Gas Policy these are likely to result in improved dialogue between buyers and domestic commitment holders.

Another key consideration for the WA Government is the **strategic utilisation of LNG ullage provisions in revised WA Domestic Gas Policy.** The revised WA Domestic Gas Policy forbids export of "pipeline gas" as LNG except in exceptional circumstances can result in transformational impacts for projects which would otherwise be smaller and focussed on domestic markets. In the case of the Waitsia II project, the seven year LNG export licence will allow project owners with the financial returns to develop the project and build a large domestic gas processing plant, which can be used to support the domestic market following the export period. This approach to the WA Domestic Gas Policy presents the Western Australian Government with an opportunity to assist in improving the project economics of domestic-focussed gas developments, particularly where it may be able to achieve policy or industry development outcomes – including provision of tranches of supply which are suitable for gas-centric downstream industry projects.

More specifically, projected ullage at the North West Shelf project provides an opportunity for domestic-focussed projects to improve their initial project economics. While ACIL Allen's gas market modelling is not projecting significant ullage in a combined North West Shelf-Pluto Burrup Hub plant until after 2031, for an otherwise domestically-focussed project, an annual ullage of between 200 and 500TJ/day is an attractive proposition, particularly for projects with large reserves.

Application of the WA Domestic Gas Policy in this way is likely to entail significant costs, benefits, issues and risks, chief among them the notion of "picking winners". If this option were to be pursued it should be subject to significant checks and balances, including an increase in the capacity of the Department to assess these opportunities as they arise.

A further consideration is the impact that **domestic gas commitments will have on future exploration and development** in the industry. As of 31 December 2020, the total volume of plateau domestic gas commitments held by LNG project owners totals 733.5TJ/day – or approximately three quarters of total demand in the domestic gas market. The spectre of domestic market obligation gas looms over the investment decisions of other suppliers – principally those who only supply the domestic market. This feedback was provided during ACIL Allen's stakeholder consultation process, and has been assessed as one of the drawbacks of domestic gas reservation policies generally.

This "supply overhang" effect occurs because no matter the current structure of the market, and that the policy obligations of LNG commitment holders are expected to be delivered over the life of a project, actual delivery of LNG-linked domestic gas can vary from year to year and over the medium term. In this uncertain supply outlook, decisions to invest in large exploration campaigns and upstream supply development are more challenging – particularly when proponents do not have the option to sell into LNG facilities.

The effect is compounded in a Western Australian context due to the lack of liquidity in the market and the prevalence of bilateral contract. A new upstream project cannot sell into a spot market in the event it cannot secure one or more offtake partners. Over time, this effect could be expected to result in fewer domestic-focussed projects, particularly if the cost of supply of these projects was comparable or higher than LNG-linked domestic gas.

Which gas is the right gas?

The discussion contained in this section is critical to the central question of this study: what can be done to foster an investment environment more conducive to gas-centric downstream industries in Western Australia. It is evident there are a number of issues and challenges – structural, regulatory/policy and commercial – which impact the ability of prospective gas-centric downstream industry proponents to find gas on terms which are appropriate for their projects.

In ACIL Allen's judgement, these issues and challenges are difficult to overcome without a adjustments to the mechanisms underpinning the execution of the WA Domestic Gas Policy.

At the root of this finding is a lack of strategic alignment between the overall intent of the policy and the objectives of this engagement – and the Western Australian Government's industry development agenda in the downstream processing industry space.

That is not to say the policy is ineffective; on the contrary ACIL Allen's gas market analysis and the discussion contained in this section make it clear Western Australia's *existing* domestic gas buyers are served well by the policy. But *new* buyers, and in particular new buyers who need large tranches of relatively cheap gas on long terms, are not.

Recent activity in the downstream industries reinforces this view, with the major active projects in Western Australia all linked to greenfield upstream gas projects – that is, the Perdaman Urea

Project which will source gas from the Scarborough project, and Strike Energy's Mid West Urea Project which will source gas from the West Erregulla project.

Recommendations

The analysis undertaken through this study highlights the opportunities for Western Australia to foster industries which process its vast reserves of natural gas. These are presented below.

The role of gas and gas markets in downstream project development

There are a number of ways the Western Australian Government can give effect to its desired domestic market outcomes within mechanisms available within the WA Domestic Gas Policy. Feedback from stakeholders and ACIL Allen's analysis suggest greater enforcement of existing rules around marketing in good faith, and improved market transparency through dissemination of information which is collected by the Department, would improve the efficiency of the market.

Marketing in good faith provisions

Marketing in good faith provisions do not guarantee buyers can access gas on terms that meet their needs. Instead, these pillars are intended to nudge commitment holders to the negotiating table when buyers are seeking gas. Stakeholders raised concerns that suppliers were not engaging in good faith, and that these terms could or should be strengthened including formation of a specific clause around pricing and its basis. This is not supported, as intervention of this nature would significantly undermine the development of market outcomes, in an environment where there are a plethora of factors which are likely to be influencing the inability of buyers to reach adequate terms with DMO holders.

Under the Western Australian Government's approach of incremental change with respect to the WA Domestic Gas Policy, measures to strengthen marketing in good faith should instead focus on providing greater clarity and definition on a number of terms. This would allow the Western Australian Government to measure the extent to which the good faith terms within domestic gas agreements are being met.

Recommendation 1 Improving outcomes for downstream project proponents within the existing domestic gas policy framework: Marketing in good faith

The Western Australian Government may consider strengthening the marketing in good faith provision within the operations of existing domestic gas agreements, and new domestic gas agreements, struck under the WA Domestic Gas Policy by providing enhanced definitions on key terms. These changes could include specifying what constitutes:

- "reasonably stable and regular supply profile"
- "unreasonable accumulation of the domestic gas commitment"
- a "bona fide purchaser"

Such clarifications could include quantitative thresholds – such as an "unreasonable accumulation" being X per cent of the total commitment after Y years – or be more qualitative – such as what makes a purchaser becomes "bona fide" – in nature. This approach would provide the State, and commitment holders, with continued flexibility while also providing further incentives to bring gas to market where this does not occur.

Transparency and information asymmetries

Western Australia's gas market is illiquid, and concentrated on both the buy side and sell side (and particularly on the sell side). In literature these markets are often rife with information asymmetries, as information which would typically emerge through transactions and other interactions between buyers and sellers does is not made available.

Information flows are critical to the achievement of market outcomes. Through the WA Domestic Gas Policy and other regulatory functions of the State, and the information collection powers of other bodies involved in the gas market, the Western Australian Government occupies a unique position in that it has access to information about both buyers and sellers. Measures to push more of this information into the public domain, in a way which respects commercial sensitivities, would assist in breaking down information asymmetries.

Recommendation 2 Improving outcomes for downstream project proponents within the existing domestic gas policy framework: Transparency

Measures to transparently demonstrate of the operations of the WA Domestic Gas Policy could go further, given the information collected by the Department as part of its enforcement of the commitments of DMO holders and achievement of outcomes under the WA Domestic Gas Policy. Examples of initiatives include:

- more regular public communication of the market outlook and the State's perspective on this (ie more than once per year),
- introduction of more explicit performance objectives and targets for downstream industry development as it relates to the gas market, and
- development of official price benchmarks, augmenting the information collected by the Department of Mines, Industry Regulation and Safety.

These measures could be accommodated within the existing information available to the Western Australian Government under the WA Domestic Gas Policy, and the information collected and analysed by other government bodies such as AEMO.

Strategic utilisation of LNG export ullage

Recent changes to the application of WA Domestic Gas Policy introduced a ban on the export of domestic gas as LNG, closing off a potential commercialisation path for a raft of emerging upstream gas projects. The ability to sell gas as LNG has powerful commercial and economic implications for new upstream projects.The recent decision by the Western Australian Government to allow the Waitsia II Project to access ullage in the North West Shelf LNG plan in the first five years of its life provides a pathway to the commercialisation of otherwise challenging or stranded natural gas fields. Consideration should be given by the Western Australian Government to formalise an approach of allowing prospective gas producers to receive similar dispensation in return for the delivery of various economic and industry development objectives – including supplying domestic gas to new downstream industry projects.

Recommendation 3 Strategic use of LNG export licences to facilitate domestic supplies

The Western Australian Government should formalise its approach to allowing prospective (ie greenfield) domestic-only gas projects to access the projected ullage in LNG production trains as a way to improve the initial project economics of domestic gas fields. In return the Western Australian Government could secure commitments to supply domestic gas on terms which support the development of downstream industries following the period of LNG export. Such an approach should be transparent and subject to specific, publicly available criteria.

Becoming a "development ready" State

Stakeholder feedback and ACIL Allen's analysis found Western Australia faces a disadvantage in project development and capital expenditure, with project capital costs thought to be at least 20 per cent higher than comparable jurisdictions and substantially higher than less developed countries. While this is important, there is limited scope for the Western Australian Government to address this as it is largely a product of isolation, Commonwealth industrial relations laws, and the requirement to import large modularised project plant and materials.

The Western Australian Government can work to improve the efficiency and economics of project development through more streamlined regulatory approvals, and in particular environmental approvals processes. Stakeholders also raised concerns about the timing risks posed by Native Title processes and negotiations in some circumstances.

These issues were raised by stakeholders in the context of being "development ready" – meaning land and other infrastructure is prepared to a point where a new project proponent can readily access and commence its project after it is sanctioned. This is particularly important given stakeholder feedback suggests Western Australia's Strategic Industrial Areas program is an effective means by which to make land available for heavy industry.

Recommendation 4 Becoming "development ready" for downstream industries

The Western Australian Government should set a target to "complete" the pre-planning and information collection associated with Strategic Industrial Areas, particularly in the State's north west. This should include:

- Completion of baseline environmental information collection and studies relevant to Environmental Protection Authority interest
- Developing clear frameworks around Native Title on land earmarked for development, where this is possible and can be completed in a manner which respects the rights of Traditional Owners
- Confirming all appropriate planning arrangements are in place for infrastructure corridors and other access requirements (such as road easements)
- Engaging with Government Trading Enterprises and other utilities services providers to ensure planning for utilities is in place and is ready to meet the needs of project proponents.

ACIL Allen understands this work is underway, but this should be completed as a priority and relevant information made available to project proponents on an official WA.gov.au platform.

In reviewing the application and approvals processes made available to major project proponents as part of this study, it emerged that much of the material is out of date – in some cases by over ten years. This includes references to Western Australian Government Departments which no longer exist. These documents should be updated to make it easier for prospective project proponent to receive the right level of support from the Western Australian Government and have an understanding of what is required of them during project formation and approvals.

The Western Australian Government has completed a review of this material and should make this available as a matter of priority.

Further changes could be made to provide clarity on what constitutes a "State Significant" proposal, to provide guidance to industry and assist it in preparing information in a way which best articulates its case for achieving the most appropriate level of support. This may include the definition of thresholds for capital expenditure, employment or taxation revenue expected to be generated by the project. This could also include a more formal linkage between major strategic economic development documents such as DiversifyWA and a project's status as "State Significant".

Recommendation 5 Making contemporary project facilitation information available

As a matter of priority the Western Australian Government should update all relevant major projects facilitation documents which are made available to prospective project proponents, to reflect the contemporary Machinery of Government and approvals processes which can be reasonably expected to be asked of by a proponent. This should also include more firm definitions of which projects are eligible to achieve "State Significant" status.

Effectively targeting Government assistance

The opportunities considered as part of this study are highly capital intensive and required significant investment in infrastructure in order to gather the inputs they need and sell their products to global markets. This includes roads, power, water, gas and ports infrastructure, as well as the specialised plant and equipment required to undertake the production process for selected products.

In the gas-centric downstream industries space, there are opportunities for the State Government to assist in alleviating the funding task of project proponents, by offering tailored and structured support in the form of infrastructure funding and subsidies as part of project development and approval.

The Western Australian Government should consider development of a more formalised and publicised approach to understanding and offering incentives to major projects, as part of its project facilitation role. This would allow project proponents to better tailor requests to the State during project development.

Recommendation 6 Formalising the nature of project support available to project proponents

The Western Australian Government should formalise its approach to providing capital support for heavy industry projects. This should include the kinds of infrastructure and other support the Western Australian Government is willing to fund and/or provide, and general information with respect to terms.

This may include creating a more formalised linkage between the State's lead agency framework and eligibility for infrastructure support. The approach may also consider the development of approaches where proponents demonstrate the impact of their proposal, and request for support, on the economy.

Building the capacity of the Department to facilitate projects

There is potential to significantly change the way the Western Australian Government works to facilitate both upstream and downstream projects in the State. There are a range of out of scope industry development opportunities where there are existing State Government strategic plans, where the State could take a more activist role in project facilitation.

If the findings and recommendations of this report are carried and progressed, there will be a need for the Department to provide additional resources to ensure it can meet the needs of industry and expectations of government in driving outcomes. This role must extend beyond gas-centric downstream industry projects given the broad scope of the Western Australian Government's industry development, diversification and decarbonisation agenda, and general industry trends towards decarbonisation.

Recommendation 7 Enhancing project development and facilitation capacity

The Western Australian Government may consider building on its existing project development and facilitation capabilities within the Department to address the findings and directions provided in this report. This may include additional capacity to critically analyse and assess gas supply projects (specifically in the context of access to projected LNG ullage), brokering arrangements between projects to assist in reducing information asymmetries and aligning project outcomes, and offering and assessing targeted support to downstream project proponents in approvals and infrastructure.

This would allow the Department to take lead agency status in the development, diversification and decarbonisation of the State's economy across a range of industry sectors and policy objectives where the Western Australian Government has expressed interest or an intent for action.

Next steps

ACIL Allen has made seven recommendations to address the 19 findings made throughout this report. If the State Government decides to pursue these reforms, it is recommended that further industry consultation be undertaken, with both upstream suppliers and downstream buyers, and both established and new players, regarding the specifics of the recommendations made in this report.

In particular, industry should be consulted and its ideas sought on measures to improve the State Government's approach to project assistance and support, to ensure it is able to strike the right balance between being prescriptive and flexible. This is also important for any changes to the WA Domestic Gas Policy.

It is also clear that since ACIL Allen commenced work on this engagement with its stakeholder engagement program in September 2020 that public sentiment regarding climate change and emissions reduction has shifted markedly. Both public and private sectors are responding. These matters have not been considered in great detail in this report given the scope was centred on measures to progress gas-based downstream industry projects. In particular, there are emerging mechanisms for a number of products which are considered to be within the scope of the gas-based downstream industry sector to become less carbon intensive, or even carbon neutral. For some, the use of hydrocarbons like natural gas represents a critical part of the chemical processes required to produce products, with carbon captured as part of the production process (including urea – where there are two active projects in development in the State).

Should the State Government pursue the opportunity identified by this report, it should consider broadening the scope of opportunities and mechanisms available to promote industrial development in a low carbon or carbon-neutral manner. This is likely to require the State to weave together development opportunities identified in this report, including some which were considered out of scope because they were not gas-centric, with other initiatives such as renewable hydrogen and battery minerals technologies.

Measures raised but which are outside of the scope of this report

ACIL Allen's proposed reform agenda suggests there is an opportunity for the Western Australian Government to become more activist in its desire for more gas-based downstream industry development projects in the State. The reforms proposed should improve the prospect of more projects coming to fruition in the years ahead. However, there are opportunities to go further.

With respect to the gas market, there are further (and more interventionist) approaches that were proposed by stakeholders throughout ACIL Allen's engagement. These include, but are not limited to, the following:

— The State Government acting as an aggregator of supply for downstream projects, addressing issues of portfolio risk which appear to work against use of brownfield gas supplies as feedstock for new projects.

— Introducing more formal structures around domestic market obligations held by LNG producers, including requirements to produce and sell gas as oppose to market it, and requirements to meet production and sales targets which are time-bound.

— The development of a commerciality test and structured arbitration where buyers seek access to domestic market obligations but are unable to achieve an outcome through negotiation.

These approaches *may* result in further gas being made available to downstream industry projects. However, the level of intervention in the market could give rise to unforeseeable unintended consequences, and create sovereign risks. Given this, and the likely complexity associated with development and delivery of these proposals, no additional changes are suggested or supported at this time.

ACIL Allen also notes its scope of services did not permit an examination of a number of other important and material policy issues which may impact on the prospects of downstream industries in Western Australia. These include:

— Economic development mandates for Government Trading Enterprises, where GTEs may act in a less-commercial manner in some circumstances if economic or social benefits can be achieved.

— Measures to create additional upstream supply opportunities, including retention lease policy and regulations regarding access to unconventional onshore gas resources.

— The impact of more aggressive emissions reduction targets and policies at a global, Commonwealth and State level, particularly as they relate to gas-fired power generation and the associated impact on demand for gas in Western Australia.

These measures should be further explored by government as part of a second phase of work in its effort to deliver on its gas-based downstream industry development agenda.

List of report findings and recommendations

The list of findings and recommendations presented throughout this study is provided below.

Findings

Finding 1 Gas market outlook supportive of downstream industry projects

The gas market outlook in Western Australia appears to be positive for the prospect of future gas-based downstream industry projects in the State. There appears to be capacity for an additional 200TJ/day of sustainable supply at stable prices through to the end of the 2030s, even without expected additional upstream reserves within the Perth Basin and without the addition of material new sources of supply which are currently unproven. This supports further examination of the barriers and enablers for new downstream industry projects.

Finding 2 Market perspectives

There are divergent and strongly held views regarding the prospects, barriers and enablers of downstream industry development projects in Western Australia. There is a limited shared understanding of the commercial and economic incentives which are at play on both the supply side and demand side of the market for gas. Overlayed with the general commercial complexity, it is evident buyers, sellers and the government would benefit from a more collegiate and collaborative approach to achieving downstream industry development.

Finding 3 Active interest

ACIL Allen observed active interest in the potential for value-adding gas projects in Western Australia, centred on processing natural gas into basic chemical and fertiliser products for export markets. Additional projects beyond those named are also seeking to establish operations in Western Australia. Natural gas is primarily used as a feedstock in a chemical process, rather than as a source of energy, for these opportunities. Given this, the cost of supply is an important source of advantage or disadvantage for Western Australia.

Finding 4 Green steel

Green steel technologies represent a non-gas based downstream industry development opportunity for Western Australia, given its existing iron ore production and renewable energy potential. Further research and analysis should be conducted, as an extension of work underway to investigate the feasibility of green hydrogen and associated supply chains given the prospective role of the technology in the decarbonisation of the steelmaking process.

Finding 5 Opportunities outside of gas-based downstream industries

Stakeholders identified a range of opportunities for value-added manufacturing and downstream processing of materials which were not within the scope of the study. These include green industries such as green hydrogen and green steel, where natural gas is not a primary input. Stakeholders also raised processing of the State's mineral endowment as an opportunity, which is considered out of scope due to gas being used as an energy source only.

Finding 6 Demand growth is in our region

Prospective downstream project proponents are responding to long term growth trends for basic chemical and fertiliser products from three main centres: China, India and South East Asia. Western Australia's relative location compared to other sources of natural gas feedstock is attractive to downstream project proponents.

Finding 7 Prospective project commonalities

ACIL Allen observed a range of commonalities between prospective downstream projects in Western Australia, which are important context when assessing the potential policy responses and interventions to assist in bringing projects to fruition. These commonalities are sourced from ACIL Allen's analysis in this section, as well as the feedback of stakeholders in Section 4.

These include:

— Projects are long term in nature, typically with a plant life of at least 20 years,

— Projects are capital intensive, with limited direct employment following commissioning,

— Projects are export focussed, due to economies of scale benefits and a small local market,

— Projects are typically require bank finance and are well suited to this form of project financing, and

— Projects are typically integrated production and export projects.

Given the above, the value-adding gas opportunities of most interest to Western Australia exhibit many of the same attributes as LNG projects.

ACIL Allen also observed the target delivered gas price into a greenfield downstream industry project was consistently in the range of between $3.00/GJ and $5.00/GJ, with proponents generally seeking a price at the low end of this range.

Finding 8 Economic benefits of downstream industry developments in Western Australia

ACIL Allen's preliminary economic impact assessment of three model downstream industry projects in Western Australia demonstrates projects can have a positive impact on the State's output, income, employment and taxation. On this basis, realisation of one or more downstream industry projects would provide economic benefits to Western Australia and Western Australians.

Finding 9 Critical success factors for gas-based downstream industries

There are three primary determinants of the competitiveness of a gas-based downstream industry: the capital cost of establishing a project, the proximity of the project to sources of demand, and the price and contractual terms available for gas supply. Each of these factors is critical to a project achieving so-called bankability in order to proceed to a final investment decision.

Finding 10 Freight costs: Western Australia's competitive advantage

Western Australia's is located in close proximity to key sources of global demand growth in gas-based downstream project products. This is particularly true for regions in the State's north west. This advantage would be best served by the State's continued development and management of Strategic Industrial Areas.

Finding 11 Capital expenditure: Western Australia's competitive disadvantage

Stakeholder perspectives and ACIL Allen analysis finds Western Australia is at a competitive disadvantage with respect to the initial capital expenditure required to develop gas-based downstream industry projects. This is a function of the remoteness of prospective project locations and Australia's industrial relations system relative to other global locations.

Finding 12 Capital expenditure: Land assembly and preparedness

Prospective downstream project proponents raised concerns with respect to the time, complexity and costs associated with establishing a footprint for project development. Specific issues raised include environmental approvals and native title. Proponents were less concerned with the process of selecting and gaining a lease option over appropriate land, suggesting this process is effective.

Finding 13 Capital expenditure: Conferring lead agency status

The State Government's previous process for conferring lead agency status on a project is not well defined, while the guidance note available to project proponents had not been updated for some time meaning it did not reflect the current Machinery of Government. This may have worked against projects receiving the right level of support, and knowing what is required of them to achieve the right level of status within the Government's project coordination and facilitation framework. The State's revised guidance note addresses a number of these issues, although maintains ambiguity regarding which projects qualify for "State Significant" status and the process for doing so.

Finding 14 Capital expenditure: Supporting the development of non-plant infrastructure

There are opportunities for government intervention to support so-called "non-plant" capital items in integrated projects, such as gas pipelines and ports. This includes providing up front capital funding to lessen the up front financial commitment requirement for project proponents. Potential models include conversion of up front capital charges to operating expenditure set at rates which allow infrastructure owners to recover costs and earn a return once the project is operational.

Finding 15 Delivering gas at the right price for long terms

Downstream projects are typically funded via a combination of equity and debt, with the long term nature of projects particularly attractive for bank financing. This creates a number of important considerations in establishing project feasibility, including access to feedstock gas on long terms and stable prices.

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Finding 16 Gas feedstock: Matching demand and supply

At face value, ACIL Allen's gas market modelling, stakeholder consultation and research suggest gas volumes and the potential cost of supply are adequate to meet the needs of gas-based downstream projects. However, price and volume are not the sole determinants of gas as a critical success factor.

Finding 17 Gas market transparency

Western Australia's gas market is relatively opaque compared to other gas markets domestically and abroad. Government entities and regulators collect a range of information which, if disseminated regularly, would improve market transparency and lean against information asymmetries which exist between buyers and sellers.

Finding 18 LNG ullage as industry development policy

ACIL Allen notes its base case suggests there is set to be substantial ullage in major LNG infrastructure over the projection period. Under the revised WA Domestic Gas Policy the Western Australian Government could consider conditional access to LNG sales from otherwise domestic-only projects, with conditions centred on the realisation of further industry growth and development.

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Finding 19 Role of domestic market obligations in downstream projects

There are a range of structural factors and market incentives which work against the provision of block loads of gas on long terms by DMO holders for greenfield domestic users. These factors are unlikely to be overcome within the parameters of the existing commitments held by these suppliers. However a zone of opportunity exists for downstream projects where the upstream incentives are aligned, which appears to be more typical in greenfield upstream projects.

Recommendations

Recommendation 1 Improving outcomes for downstream project proponents within the existing domestic gas policy framework: Marketing in good faith

The Western Australian Government may consider strengthening the marketing in good faith provision within the operations of existing domestic gas agreements, and new domestic gas agreements, struck under the WA Domestic Gas Policy by providing enhanced definitions on key terms. These changes could include specifying what constitutes:

- "reasonably stable and regular supply profile"
- "unreasonable accumulation of the domestic gas commitment"
- a "bona fide purchaser"

Such clarifications could include quantitative thresholds – such as an "unreasonable accumulation" being X per cent of the total commitment after Y years – or be more qualitative – such as what makes a purchaser becomes "bona fide" – in nature. This approach would provide the State, and commitment holders, with continued flexibility while also providing further incentives to bring gas to market where this does not occur.

Recommendation 2 Improving outcomes for downstream project proponents within the existing domestic gas policy framework: Transparency

Measures to transparently demonstrate of the operations of the WA Domestic Gas Policy could go further, given the information collected by the Department as part of its enforcement of the commitments of DMO holders and achievement of outcomes under the WA Domestic Gas Policy. Examples of initiatives include:

- more regular public communication of the market outlook and the State's perspective on this (ie more than once per year),
- introduction of more explicit performance objectives and targets for downstream industry development as it relates to the gas market, and
- development of official price benchmarks, augmenting the information collected by the Department of Mines, Industry Regulation and Safety.

These measures could be accommodated within the existing information available to the Western Australian Government under the WA Domestic Gas Policy, and the information collected and analysed by other government bodies such as AEMO.

Recommendation 3 Strategic use of LNG export licences to facilitate domestic supplies

The Western Australian Government should formalise its approach to allowing prospective (ie greenfield) domestic-only gas projects to access the projected ullage in LNG production trains as a way to improve the initial project economics of domestic gas fields. In return the Western Australian Government could secure commitments to supply domestic gas on terms which support the development of downstream industries following the period of LNG export. Such an approach should be transparent and subject to specific, publicly available criteria.

Recommendation 4 Becoming "development ready" for downstream industries

The Western Australian Government should set a target to "complete" the pre-planning and information collection associated with Strategic Industrial Areas, particularly in the State's north west. This should include:

- Completion of baseline environmental information collection and studies relevant to Environmental Protection Authority interest
- Developing clear frameworks around Native Title on land earmarked for development, where this is possible and can be completed in a manner which respects the rights of Traditional Owners
- Confirming all appropriate planning arrangements are in place for infrastructure corridors and other access requirements (such as road easements)
- Engaging with Government Trading Enterprises and other utilities services providers to ensure planning for utilities is in place and is ready to meet the needs of project proponents.

ACIL Allen understands this work is underway, but this should be completed as a priority and relevant information made available to project proponents on an official WA.gov.au platform.

Recommendation 5 Making contemporary project facilitation information available

As a matter of priority the Western Australian Government should update all relevant major projects facilitation documents which are made available to prospective project proponents, to reflect the contemporary Machinery of Government and approvals processes which can be reasonably expected to be asked of by a proponent. This should also include more firm definitions of which projects are eligible to achieve "State Significant" status.

Recommendation 6 Formalising the nature of project support available to project proponents

The Western Australian Government should formalise its approach to providing capital support for heavy industry projects. This should include the kinds of infrastructure and other support the Western Australian Government is willing to fund and/or provide, and general information with respect to terms.

This may include creating a more formalised linkage between the State's lead agency framework and eligibility for infrastructure support. The approach may also consider the development of approaches where proponents demonstrate the impact of their proposal, and request for support, on the economy.

Recommendation 7 Enhancing project development and facilitation capacity

The Western Australian Government may consider building on its existing project development and facilitation capabilities within the Department to address the findings and directions provided in this report. This may include additional capacity to critically analyse and assess gas supply projects (specifically in the context of access to projected LNG ullage), brokering arrangements between projects to assist in reducing information asymmetries and aligning project outcomes, and offering and assessing targeted support to downstream project proponents in approvals and infrastructure.

This would allow the Department to take lead agency status in the development, diversification and decarbonisation of the State's economy across a range of industry sectors and policy objectives where the Western Australian Government has expressed interest or an intent for action.

ACIL ALLEN

Detailed report

II

1 Introduction

The discovery and development of Western Australia's vast oil and gas reserves has been one of the most significant drivers of the growth and diversification of the State's economy over the past 50 years.

The development of the North West Shelf project, including the Dampier to Bunbury Natural Gas Pipeline, has been the catalyst for the downstream development of a number of industries in the State, by providing the gas for power generation and feedstock for the production of a number of industrial products, including ammonia, ammonium nitrate, alumina, nickel and other processed minerals.

In more recent years, the major developments in the industry have been primarily around a number of significant LNG projects, including the Woodside operated Pluto LNG project (2012) and the Chevron operated Gorgon (2016) and Wheatstone (2017) LNG projects. Each of these LNG projects has a domestic gas commitment, as dictated by the WA Government's 2006 Domestic Gas Policy, which requires suppliers to make gas equivalent to 15 per cent of exports available for WA consumers.

However, unlike the earlier phase of gas developments in the State, these projects have not stimulated new downstream gas opportunities, with the last major downstream gas development being the Yara Pilbara Fertilisers plant that commenced production in 2006.

The downstream processing of Western Australia's natural resources has been a long held ambition of successive governments looking to support the development of new industries and broaden and diversify the State's economy.

This has been most recently reflected in the WA Government's overarching economic development framework, *Diversify WA*, which was officially launched in July 2019. *Diversify WA* articulates the WA Government's vision for the economy by supporting growth in value adding industries and in job creation across industries and regions, through diversification into new markets and building capacity in new sectors, particularly across regional WA, and through the creation of secure and quality jobs from industry diversification.

The biggest challenge that will impact on the industry longer term is the global response to climate change, which will see countries look to reduce their reliance on carbon intensive energy sources such as oil, gas and coal in favour of renewable energy sources. The WA Government released its *State Climate Policy* in 2020, which will need to be taken into consideration as it pursues its industry development objectives, as outlined in *Diversify WA*.

Against this backdrop of domestic and global challenges, in June 2020 the Department of Jobs, Tourism, Science and Innovation ('JTSI') engaged ACIL Allen to conduct a review into downstream and energy-intensive industry development opportunities in Western Australia. In particular, the Department is seeking advice on the following:

- Factors which influence the project economics of energy-intensive and downstream processing industries, through desktop research and consultation with industry
- Gas market modelling and analysis, to understand the market outlook, risks, pricing, negotiations and other considerations as they relate to energy-intensive and downstream processing industries
- Policy advice, in the form of the development of a suite of measures within the influence of the State Government, examining the benefits, costs and risks of the measures
- Estimating the economic impact of energy-intensive and downstream processing industries on the Western Australian economy.

1.1 About this report

ACIL Allen's role is to provide independent, fact-based advice and direction regarding measures available to the State Government to achieve stated economic development and diversification objectives, within the context of other policy work underway.

ACIL Allen's approach to undertaking this review has been based on the combination of desktop research, stakeholder consultation and gas market modelling. Together, these research tasks have provided the evidence base for ACIL Allen to advise the Department on the possible downstream gas opportunities that could be developed in Western Australia, and the critical success factors that are required to realise these opportunities in the future.

The evidence that ACIL Allen has gathered through each research phase is reflected and presented in the structure of this report.

- **Section 2: Economic and Policy Context** – provides an overview of the economic and policy context behind the evolution of the gas and downstream industries in Western Australia.
- **Section 3**: **Gas Market Outlook** – details ACIL Allen's baseline outlook for the gas market in Western Australia, which has been informed by intelligence gathered through research and stakeholder consultation, and modelled using ACIL Allen's proprietary gas market model for Western Australia, *WesternGasMark*.
- **Section 4: Stakeholder Perspectives** – provides an overview of the key issues and considerations from both current and future suppliers of gas and current and potential downstream buyers of gas in Western Australia.
- **Section 5**: **Identification of Opportunities** – provides a summary of the downstream gas opportunities that have been identified in this study through desktop research and analysis, and informed through the stakeholder consultation process.
- **Section 6**: **Estimating Economic Impacts** – provides an analysis of the economic impacts of the successful delivery of downstream industry development projects in Western Australia, using analogue projects of the identified opportunities in Section 5.
- **Section 7**: **Critical Success Factors** – provides a detailed summary of the critical success factors that will be required to underpin any future downstream gas opportunity in Western Australia.
- **Section 8**: **Policy Implications and Next Steps** – provides a summary of the recommended next steps to better understand the scale of the opportunity for the WA economy from new downstream gas development, and the steps that will be required to develop a set of policy recommendations that are understood and informed by industry.

1.2 Glossary of terms and abbreviations

Throughout this report, ACIL Allen has used a number of economic and industry specific terms which have been outlined below.

Table 1.1 List of acronyms

Abbreviation	Full name
/day	Energy units produced / consumed per day
ACCC	Australian Competition and Consumer Commission
AEMO	Australian Energy Market Operator
CAGR	Compound Annual Growth Rate
CAPX	Capital Expenditure
CGE	Computable General Equilibrium
CO2	Carbon Dioxide
CPI	Consumer Price Index
DBNGP	Dampier Bunbury Natural Gas Pipeline
DMO	Domestic Market Obligation
EPA	Environmental Protection Authority
FLNG	Floating LNG
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GJ	Gigajoule
GSP	Gross State Product
GTL	Gas-to-liquids
H2O	Hydrogen Dioxide (water)
IEA	International Energy Agency
JV	Joint Venture
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MCA	Multicriteria Assessment
MMBTU	Millions of British Thermal Units
MTPA	Million Tonnes Per Annum
NWS	North West Shelf
OECD	Organisation for Economic Cooperation and Development
OPEX	Operational Expenditure
PJ	Petajoule
SIA	Strategic Industrial Area
TCF	Trillion Cubic Feet
TJ	Terajoule
USD	United State Dollar
WACC	Weighted Average Cost of Capital

Source: ACIL Allen

Economic and policy context 2

This section provides the economic and policy context behind the evolution of the gas industry in WA.

2.1 A brief history of the development of the WA gas industry

Western Australia has experienced both gas industry and downstream processing industry development over the past 50 years. This section provides a brief overview of the key events in the emergence of the State's gas and downstream processing industries, while a timeline is presented in **Figure 2.1**.

2.1.1 The early years

The Western Australian Government played a major role in assisting the development of the State's gas industry. Through its energy utility, the (then) State Energy Commission of WA (SECWA), the State Government underpinned the development of the **North West Shelf (NWS) project** by signing long term "take or pay" contracts to purchase natural gas from the project for domestic consumption for a period of 20 years. With this initial State Agreement in place, the project was developed between 1980 and 1984 at a cost of $2.5 billion, including an onshore gas processing plant on the Burrup Peninsula. According to historical records, the venture was the largest engineering project in the world in the 1980s[1].

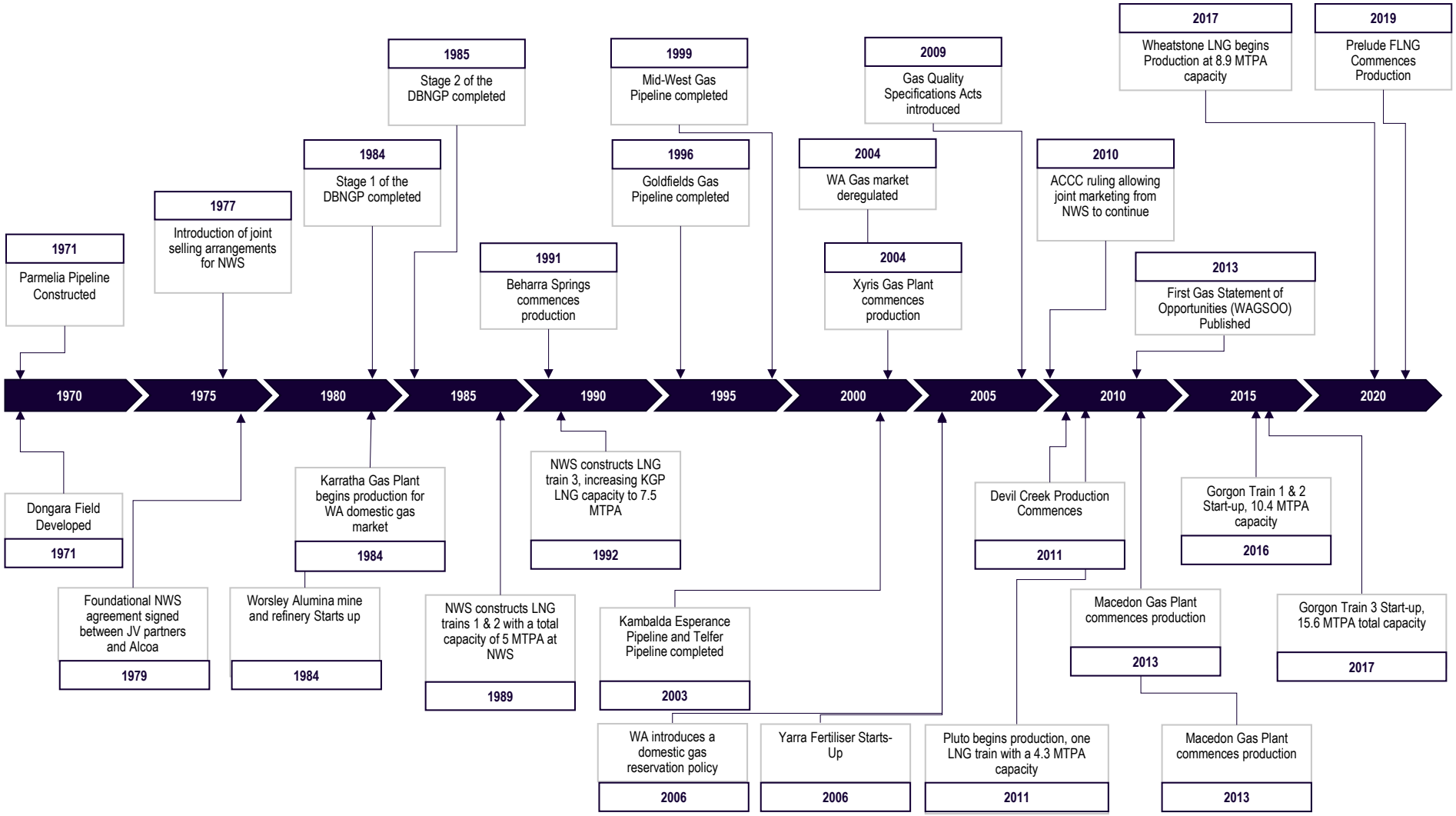
The other critical role performed by the State Government at the time was to fund the construction of the **Dampier to Bunbury Natural Gas Pipeline (DBNGP)**. The development of the DBNGP was undertaken through SECWA, with the support of Alcoa and the Commonwealth Government.

The NWS project is often referred to in phases. Phase One centred on the development of the Karratha gas plant, subsea gas pipeline and the production platform at North Rankin A. The domestic gas component of the development underpinned further industrial development in the south west of the State.

Shortly after the first phase of the development was commissioned, the NWS project secured long term supply contracts with Japanese industry and power generators, allowing it to begin development of liquefaction facilities. The first two LNG trains were completed in 1989, and the first LNG cargo was sent to Japan towards the end of the year. Further development phases were completed in the 1990s and 2000s.

[1] Murray, R. 1991. From the Edge of a Timeless Land: A History of the North West Shelf Gas Project. Allen & Unwin.

Figure 2.1 Timeline of important gas and downstream industry developments in Western Australia



Source:

Western Australia relies more on gas for its domestic energy production needs than any other State or Territory, owing in large part to the role of the NWS played in establishing the link between gas supplies in the north and consumers in the south. By supplying domestic gas through the DBNGP, the North West Shelf project has helped establish many of the State's key industries, including the alumina operations of Alcoa and a number of downstream gas project operating within the Kwinana Industrial Area. Approximately half of the domestic gas volumes were contracted to Alcoa during the early years of operation, with the remaining volumes were distributed primarily to Perth area homes and industry.

The **Harriet Gas Gathering Project at Varanus Island** was the next major gas development in Western Australia. The $150 million project commenced production in 1992, and was the first large-scale natural gas development to supply the State's domestic market since the first stage of the North West Shelf project.

2.1.2 The second wave

As the Western Australian economy developed, so to did its domestic gas requirements. In 2005, Santos commenced production from the **John Brookes offshore gas development** in the Carnarvon Basin. The $300 million Apache-operated domestic gas development included an upgrade to the existing Varanus Island facilities to increase the processing capacity to approximately 240 TJ/d.

During that year, Woodside also announced that it had discovered the Pluto gas field, and shortly after its discovery, the construction of Pluto LNG commenced in 2007 – Western Australia's first LNG development since the NWS project in the 1980s. By 2012, the construction of the 4.9 MTPA **Pluto LNG project** was complete, making it one of the fastest developed LNG projects in the world. The Pluto LNG project came into operation after the introduction of the State's domestic gas policy, with a domestic gas commitment struck with the Government in 2006 (see Section 0).

The introduction of the domestic gas policy in 2006 did not slow the development of the State's gas industry. At that time, the Government also signalled its intention to assist in supporting gas developments in Western Australia. An important regulatory change made at the time was to the gas specifications for the DBNGP, which proved to be a catalyst behind the development of the $1.5 billion **Macedon natural gas project** operated by BHP, which commenced production in 2013, with the capacity to be able to supply 20 per cent of Western Australia's domestic gas for the next 20 years.

By 2011, Western Australia had its third domestic gas processing facility, following the development of the offshore Reindeer field in the Carnarvon Basin and the construction of the **Devil Creek** onshore processing plant near Karratha. This provided a further boost to the state's domestic gas supply, with a gross production capacity of 215 TJ/day.

The Gorgon gas field was first discovered in 1980, in deep water west of Barrow Island (an A-class nature reserve) and after further testing and appraisal was confirmed as a world scale commercial gas reserve. Chevron Australia became the operator of the asset (as part of a deal with Western Australian Petroleum) and began the process of commercialisation. Following negotiation and finalisation of commercial agreements, the **Gorgon Gas Project** proceeded through State and Commonwealth Government approvals processes and reached Final Investment Decision in September 2009.

Construction on the three LNG trains plus domestic gas plant development began a year later, and the first LNG cargo departed Barrow Island in early 2016 and domestic gas supply to the Western Australian market by the end of 2016. Gorgon was the largest single resource project in Australia's history, with its 15.6 million tonnes per annum LNG facility complemented by a domestic gas plant with the capacity to supply 300 terajoules of gas per day to Western Australia.

The **Wheatstone Gas Project**, also operated by Chevron, reached final investment decision in 2011 after a discovery in 2004, and is a two LNG train plus domestic gas development. In October 2017, the Wheatstone Project shipped its first LNG cargo, and in March 2019 the Project began supplying WA's domestic market with natural gas.

The last major gas development in Western Australia was the development of Shell's **Prelude Gas Project**, which represented the world's first deployment of Floating Liquefied Natural Gas (FLNG) technology. The Prelude FLNG facility is located 475km off the coast of Broome and is 488m long and 74m wide, making it the largest offshore floating facility ever built. It commenced production in 2017, and has the capacity to produce 3.6 million tonnes per annum (mtpa) of LNG, 1.3 mtpa of condensate and 0.4 mtpa of LPG

Despite the number of upstream LNG and domestic gas developments that commenced production during this time, there was only one major downstream gas project developed during this time – the $700 million **Burrup Fertilisers** (now Yara Pilbara Fertilisers) liquid ammonia plant on the Burrup Peninsula. This project commenced construction in 2003, with the first export shipment was made from the Port of Dampier in June 2006. This was the first industrial development to be established on the Burrup Peninsula, which was facilitated by the State Government's $200 million infrastructure investment.

Some of the other proponents which were investigating downstream processing opportunities in the region around this time but which did not proceed include Methanex (methanol plant), Liquigaz (methanol) Syntroleum (synthetic hydrocarbons) and Dampier Nitrogen (ammonia / urea).

2.1.3 The gas industry today

The gas industry has been a significant driver of the growth and development of the WA economy since the NWS project commenced production in the early 1980s. In recent years, the contribution of the gas industry has increased considerably, as production commenced from the Gorgon and Wheatstone LNG projects, and the Prelude FLNG project.

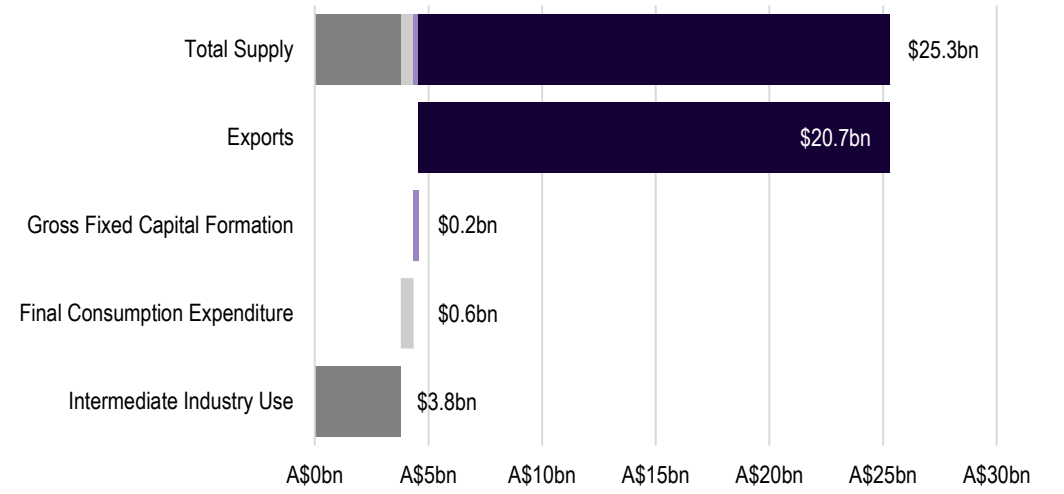
There have been numerous studies that have demonstrated the economic benefits from these projects, with the production of LNG for export generating billions to the Western Australian economy each year, and directly supporting thousands of jobs.

ACIL Allen estimates that in 2018-19, LNG exports alone contributed $20.7 billion to Western Australia's export income, which accounted for almost 7.3 per cent of all economic activity in the State (in Gross State Product terms).

While these direct impacts are significant and visible, the gas industry plays an equally important role in facilitating the growth and development of other industries and the domestic economy more broadly.

The Western Australian gas market supply chain is broken into three sectors; upstream producers, transmission and distribution networks and downstream consumers. As presented in **Figure 2.2**, the gas supply chain directly accounted for $25.3 billion to WA's Gross State Product in 2018-19, with the majority of this activity realised through exports of LNG ($20.7 billion). The remaining $4.6 billion was retained in WA and used to generate additional economic activity throughout the State.

Figure 2.2 WA Gas market supply chain, Contribution to GSP in 2018-19, $bn

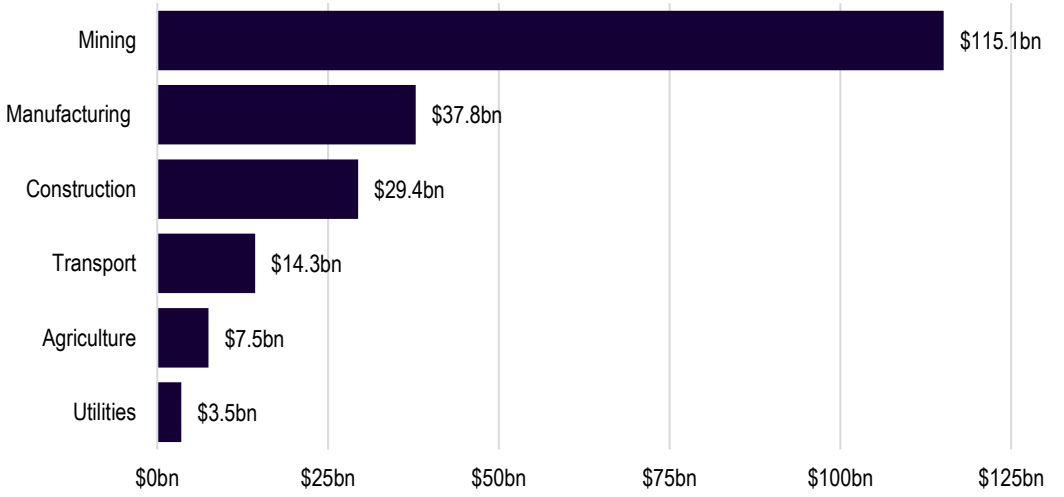


Source: ACIL Allen

The domestic gas supply chain directly consumed $0.6 billion of gas and made capital investment purchases of $0.2 billion in 2018-19. The supply chain is a key input into production from WA's key industries. These industries include mining, manufacturing and mineral processing, utilities, transport and logistics, and construction, and together they consumed $3.2 billion worth of domestic gas in 2018-19.

As presented below in **Figure 2.3**, ACIL Allen estimates that these industries together account for 65 per cent (or $207.6 billion) of all economic activity in WA during 2018-19. The State's mining industry accounted for $115.1 billion of this activity, and was followed by the manufacturing and minerals processing industry ($37.8 billion) construction industry ($29.4 billion), the transport and logistics industry ($14.3 billion), and the utilities industry ($3.5 billion).

Figure 2.3 Consumers of domestic gas and their contribution to the WA economy, 2018-19, $bn



Source: ACIL Allen

The main customers of WA's distribution pipeline network are energy retailers who buy natural gas in large volumes from producers for sale to customers. There are currently six gas retailers in WA; Alinta Energy, Kleenheat, Origin, AGL, Amanda Energy and Simply Energy. In addition, a number

of large manufacturing companies are of requisite scale that they purchase gas directly from producers via long term off take agreements (such as Coogee Chemicals, CSBP and Cockburn Cement). The State's domestic gas supply chain has allowed large-scale energy-intensive manufacturing to remain an important part of the Western Australian economy, where it has been somewhat diminished in other States and Territories. Lower gas prices owing to the availability of domestic gas also help reduce overall business costs in some regions of the State where labour and capital are generally more expensive.

Looking ahead, there are a number of significant projects in the pipeline that will be critical to maintaining gas production levels for both export and for domestic consumption, and in rebuilding the State's legacy of large-scale downstream industry developments. These include:

- Woodside's Scarborough Upstream and Pluto LNG Train Expansion project
- Perdaman Urea Project in the Burrup Strategic Industrial Area (linked to the sanctioning of the Scarborough project)
- Santos' offshore Carnarvon Basin developments, including the Spartan and Corvus fields,
- The Waitsia II LNG Export and Domestic Gas project – in particular the novel approach to field development where the proponent will be permitted to export gas for a short period of time before becoming a domestic-only project,
- Gas supply projects centred on recent discoveries in the onshore Perth Basin – in particular Strike Energy's Greater Erregulla domestic gas project, and
- Strike Energy's Urea Project in the Mid West region.

These upstream and downstream projects are discussed in further detail in Section 3 (Gas market outlook) and Section 5 (Opportunities identification) respectively.

2.2 Policy framework

The Commonwealth and the State Governments have a significant influence on the development of the oil and gas industry in Western Australia.

From a macroeconomic perspective, Commonwealth and State Governments must ensure that their economic and regulatory policy settings are supportive of major oil and gas developments in their jurisdiction. The Fraser Institute regularly surveys senior executives in the upstream oil and gas sector to identify which provinces, states, and countries, present the greatest barriers to investment in oil and gas exploration and production. In conducting the survey, the Fraser Institute asks respondents to indicate how different policy issues influence company decisions to invest in various jurisdictions. As detailed in Box 2.1 bellow, there are a range of policy considerations for governments to consider to ensure its jurisdiction is an attractive place to invest.

Western Australia typically scores well on measures of investment attraction for upstream industries – including for minerals projects, where the State is seen as a world-leading jurisdiction. The drivers of investment in downstream industries are different, and there is limited international benchmarking of this nature. Filling this gap in government and industry understanding is a critical objective of this study.

The citation of the Fraser Institute survey highlights the range of policy considerations for government when looking to encourage major new projects in a jurisdiction. For the purposes of this study, ACIL Allen has targeted its policy analysis to the key issues raised by industry stakeholders as part of the stakeholder consultation process. Further details and insights from stakeholders are presented in Section 4.

Box 2.1 Oil and gas industry policy considerations for oil and gas industry executives when considering investment locations

The Fraser Institute's annual survey of petroleum industry executives and managers regarding barriers to investment in oil and gas exploration and production facilities in jurisdictions around the world, asks respondents to indicate the degree to which each of the below 16 policy factors influence company decisions to invest in a particular jurisdiction.

- Fiscal terms—including licenses, lease payments, royalties,other production taxes, and gross revenue charges, but not corporate and personal income taxes, capital gains taxes, or sales taxes
- Taxation in general—the tax burden including personal, corporate, payroll, and capital taxes, and the complexity of tax compliance, but excluding petroleum exploration and production licenses and fees, land lease fees, and royalties and other charges directly targeting petroleum production.
- Environmental regulations—stability of regulations, consistency and timeliness of regulatory process
- Regulatory enforcement—uncertainty regarding the administration, interpretation, stability, or enforcement of existing regulations.
- Cost of regulatory compliance—related to filing permit applications, participating in hearings.
- Protected areas—uncertainty concerning what areas can be protected as wilderness or parks, marine life preserves, or archaeological sites.
- Trade barriers—tariff and non-tariff barriers to trade and restrictions on profit repatriation, currency restrictions.
- Labour regulations and employment agreements—the impact of labour regulations, employment agreements, labour militancy or work disruptions, and local hiring requirements.
- Quality of infrastructure—includes access to roads, power availability.
- Quality of geological database—includes quality, detail, and ease of access to geological information.
- Labour availability and skills—the supply and quality of labour, and the mobility that workers have to relocate.
- Disputed land claims—the uncertainty of unresolved claims made by aboriginals, other groups, or individuals.
- Political stability
- Security—the physical safety of personnel and assets.
- Regulatory duplication and inconsistencies (includes federal/provincial, federal/state, inter-departmental overlap, etc.)
- Legal system—legal processes that are fair, transparent, non-corrupt, efficiently administered.

Source: Fraser Institute

The remainder of this section will briefly present the WA Government's key policies that influence industry developed in Western Australia.

2.2.1 The WA Domestic Gas Policy

The Department of Jobs, Tourism, Science and Innovation oversees Western Australia's domestic gas policy, which is centred on securing the State's long-term energy needs and ongoing economic development by ensuring LNG export project developers make gas available to the Western Australian domestic market.

The domestic gas policy requires LNG project owners to demonstrate their ability to meet the policy as a condition of project approval. It is founded on three principles, being:

1. **Reservation**: gas equivalent to 15 per cent of total LNG production from a given project is made available to the Western Australian domestic gas market

2. **Infrastructure**: project owners develop and maintain the necessary infrastructure to meet their Western Australian domestic gas commitments
3. **Marketing**: project owners show diligence and good faith in marketing gas to the Western Australian domestic market

The Western Australian Government's domestic gas policy is given effect by agreements struck between the State and LNG project owners through the project approvals process. As per the above section, the policy was recently updated to prevent the export of gas from the WA pipeline network to the eastern states or overseas.

In August 2020, the Western Australian Government announced the following changes to the domestic gas policy framework:

— The Western Australian Government will not agree to export of gas via the WA pipeline network other than in exceptional circumstances.

— Supply of gas to markets on the east coast, whether via an LNG import terminal or a pipeline connection to east coast gas markets, is an export for the purposes of the policy

— LNG used in international shipping is also considered an export for the purposes of the policy.

There were no changes made to the existing WA Domestic Gas Policy as it relates to offshore LNG projects. The intent of this policy was two-fold: to provide improved security of supply to existing Western Australian domestic gas users, and to provide more direct incentives for future on-shore domestic producers to make gas available for industrial and downstream project development.

Domestic Gas Agreements

The policy has been given effect through domestic gas agreements struck with LNG project developers. The nature, specifics and confidentiality of the agreements have varied over time. There are six current domestic gas agreements, all of which are presented on the WA.gov.au website:

— **Chevron, Barrow Island Act 2003**: Gorgon domestic gas is being marketed in 2 tranches. The 300 TJ/day Gorgon domestic gas plant is constructed and commenced supply of the first tranche of about 150 TJ/day in 2016. The first tranche was sold jointly. Supply of the second tranche is expected by 2021 and is being individually marketed by the Gorgon joint venture companies.

— **Woodside, Pluto Domgas Arrangements 2006**: Pluto's domestic gas commitment took effect from 12 May 2017 and is equivalent to 115 TJ/day, based on current LNG export capacity. Woodside commissioned a 25 TJ/day Pluto pipeline gas facility in December 2018 and constructed a domestic LNG truck loading facility at the Pluto site which opened in April 2019 with an initial capacity of 0.1 MTPA (equivalent to 15 TJ/d). Woodside markets Pluto gas on behalf of the joint venture.

— **Chevron, Gas Processing (Wheatstone Project) Agreement, 2011**: The 200 TJ/day Wheatstone domestic gas facility commenced in March 2019. The joint venture companies market gas on an individual basis.

— **Woodside, North West Gas Development (Woodside) Agreement Amendment Act 2015**: The original North West Shelf State agreement domestic gas commitments concluded in 2014. From 1984 to the end of 2014, the North West Shelf project supplied 5,124 PJ to the domestic market. In 2015, the joint venture assumed a new domestic gas commitment in exchange for an 86 mt LNG export approval. Importantly, future users of the facilities are required to enter into domestic gas commitments consistent with the terms of the North West Shelf state agreement. During negotiation of the 2015 commitment, the North West Shelf Joint Venture struck domestic gas contracts for 42.743 PJ of gas. This volume is counted towards the new commitment. The joint venture continues to supply these and other pre-2015

contracts extending to 2020. At end 2014, 757 PJ of gas remained to be supplied under these contracts. In March 2020, a 25-year extension of to the state agreement was legislated to accommodate future backfill project timeframes.

— The **Waitsia Joint Venture agreement** was signed by the WA Government on 24 December 2020, permitting the Waitsia II Project access to the North West Shelf facility for the export of 7.5 million tonnes of gas between 2024 and 2028. A 15 per cent domestic gas commitment is applicable during this period. The Joint Venture partners – Beach Energy and Mitsui E&P – will develop a 250TJ/day domestic gas plant, and are only permitted to sell gas into the WA domestic market from 2029 onwards. The 250TJ/day domestic gas facility will be the first large-scale gas plant built in the highly prospective Perth Basin.

— The **Pluto Acceleration Project** was executed on 27 January, permitting Woodside to process Pluto field gas at the North West Shelf between 2022 and 2025. This gas will be transferred between the Pluto LNG Project and North West Shelf via a new interconnecting pipeline. The additional LNG production associated with Pluto Acceleration is subject to the State's existing LNG domestic market obligation. As part of this agreement, Woodside has also committed to making an additional 45.6 PJ of gas available to the domestic market from its North West Shelf reserves, from 2025 onwards.

While these agreements are structured towards achieving compliance with the domestic gas policy, they provide flexibility to support the long term viability of such projects. Flexibility is centred on the project inception and development phase of an upstream project, with the State expecting commitments which are papered to be met.

State Government perspective on operations of the WA Domestic Gas Policy

As part of its stakeholder consultation process, ACIL Allen received a submission from the Department which conveyed its perspective on the operations of the domestic gas policy framework, and specifically the domestic market obligation of LNG producers in Western Australia. This is presented below (**Box 2.2**).

2.2.2 Broader policy framework

Diversify WA

Diversify WA is the WA Government's economic development framework which articulates six priority sectors for development based on how the State's unique strengths match against the mega-trends that are shaping the global economy. It is through this framework that the WA Government is seeking to achieve the following outcomes:

— **A strong economy** – Supporting investment and trade to create jobs, assist economic growth and sustain our communities.

— **A more resilient economy** – By diversifying the industries which contribute to our economy, we can better ride out the highs and lows of economic cycles and commodity prices.

— **The creation of secure and quality jobs** – For our economy to grow, it's vital that we deliver stable, long-term jobs for Western Australians. Emerging industries, along with sectors including education, health and community services will support the economy and deliver the jobs for the future.

Diversify WA includes a number of changes within government to ensure a stable and predictable regulatory system. In the context of this study, some of the critical reforms include the establishment of **Infrastructure WA** and the **Industrial Lands Authority**.

Box 2.2 Operations and intent of the WA Domestic Gas Policy, according to the Department of Jobs, Tourism, Science and Innovation

The WA Domestic Gas Policy highlights three obligations for LNG exporters in order to ensure they make gas available locally. LNG exporters contractually agree to the obligations as a condition of project approvals:

- Reserve gas equivalent to 15 per cent of their exports.
- Access to domestic supply infrastructure.
- Market gas diligently and in good faith to local consumers.

Access to domestic supply infrastructure is central. With infrastructure in place, the government and market can be confident gas is available to meet demand. The policy stipulates local gas availability should coincide with commencement of LNG production and allow for a sustained supply of gas into the local market. In general, this is the basis for domestic gas infrastructure capacity requirements specified in contractual arrangements with the State. The State may agree to vary timing of obligations depending on the project and market circumstances.

In assessing marketing in good faith, commitment holders may secure the best price and terms they can in the local market, and optimise the timing of their supply in order to do so. They are not entitled to withhold gas from the market for the purposes of export or to optimise LNG operations. Dispute provisions in the agreements allow for independent scrutiny and provide for investigation and resolution of default in meeting obligations.

The WA Domestic Gas Policy web page highlights a policy has been in place from the beginning of the WA LNG industry. It was formalised in 2006 and updated in 2011 and 2020. (The 2020 update highlighted the government's industry development objectives, better compliance monitoring and market transparency and bars export of pipeline gas.)

It is noted that contractual arrangements struck with the State have differed over time. The State honours agreements struck at project inception to provide certainty for gas project developers. The State may agree changes in contractual arrangements or how the commitments are met. Under the policy, the government commits to communicating changes in LNG exporter's obligations to the local market as they arise.

There is a misconception that a commercial viability threshold is incorporated into marketing obligations and their enforcement. This is not the case. However, there are specific commercial viability provisions in two of the older agreements, Gorgon (2003) and Pluto (2006), which have not been invoked. In a general sense, project viability is a factor the State may consider, among others, in determining its position in negotiating commitment obligations at project inception.

Source: Department of Jobs, Tourism, Science and Innovation

In relation to priority sectors, *Diversify WA* highlights Energy as a focus for Government, specifically:

> *The availability of affordable, reliable energy supplies underpin our economy. Western Australia has substantial low carbon energy resources, particularly natural gas, and unparalleled opportunities to generate and safely store renewable energy. We are home to some of the world's best Petroleum Engineering and Technical Services (PETS) companies, we supply the majority of the world's lithium and we have all the other rare earth minerals necessary to produce lithium batteries. Given the world's ever growing demand for energy, especially clean energy, means Western Australia has an opportunity to be at the forefront of global energy production.*

The primary Government initiatives to support the energy sector specified in Diversify WA include:

- **Implement Future Battery Industry Strategy**: This Strategy aims to ensure WA has a world leading, sustainable and value-adding battery and critical minerals industry. Priorities include growing WA's participation in global supply chains, promoting the State's investment opportunities, with a particular focus on downstream/value-adding activities, certifying our

battery minerals, supporting energy storage applications, and developing our local capability. The Government's $6 million investment in the Future Battery Industry Cooperative Research Centre supports the Strategy's aims and activities. Implementation of the Strategy is overseen by a Ministerial Taskforce comprising leading industry players from across the State's battery and critical minerals sectors.

- **LNG Jobs Taskforce:** The LNG Jobs Taskforce has been formed by Government to help ensure Western Australia becomes an international hub of expertise in the LNG industry. It is chaired by the Premier and includes the Chief Executive Officers from Chevron, Woodside, Shell and Santos, as well as senior representatives from the Australian Petroleum Production & Exploration Association and Unions WA.
- **Renewable Hydrogen Council:** Under the guidance of the Minister for Hydrogen Industry, the Renewable Hydrogen Council is exploring opportunities for the development of a renewable hydrogen industry in Western Australia, complementing existing energy exports and a future battery industry.
- **Establish climate change policy**: This policy was released in November 2020 and is further detailed below.
- **Energy Transformation Strategy:** This Strategy includes the preparation of a Whole of System Plan for coordination and development of the power system for the South-West; and a Distributed Energy Resources Roadmap to ensure safe and secure integration of renewables and batteries in the State's power system.

Western Australian Climate Policy

In November 2020, the WA Government released its climate change policy, providing a clear articulation of its commitment to adapting to climate change and to working with all sectors of the economy to achieve net zero greenhouse gas emissions by 2050.

According to the policy, the WA Government is seeking to look beyond business-as-usual measures and to the significant actions in collaboration with industry and the community to boost the economy, prepare for climate change and achieve our aspiration of net zero emissions by 2050. The policy outlines the priority themes and practical actions the State Government is taking to enhance climate resilience and support the low carbon transition. These include:

- Clean manufacturing and future industries
- Transforming energy generation and use
- Storing carbon and caring for our landscapes
- Lower-carbon transport
- Resilient cities and regions
- Government leadership

In the context of this study, the Policy notes that reducing Western Australia's emissions will be a considerable challenge given our energy-intensive industries and projected growth in the resources sector. The Policy suggests that in order to reverse these trends – and continuing to grow our economy while transitioning toward net zero emissions – will require enduring commitment, investment in technology, and leadership from both the State and Australian Government.

The Policy represents an articulation of the Government's long term vision for the State, focussing on:

> *"…making significant new investments in cleaner energy solutions and low-carbon industries. These include new commitments for renewable energy generation and energy storage; additional support for renewable hydrogen and future battery*

industries including battery manufacturing; and programs to restore our unique landscapes and enhance our carbon sinks."

In the context of this study, it critical that the Government's objectives in supporting downstream gas developments are consistent with its Climate Policy.

Industry and government policy is shifting dramatically, even in the six months since the State Climate Policy was released. It is critical for both sectors to be mindful of carbon emissions and the impact on climate change when setting industry policy.

2.2.3 Major Project Facilitation

The Department of Jobs, Tourism, Science and Innovation assists a range of large and complex projects across the state on behalf of the WA Government, mainly in the resources and oil and gas sectors, but also major infrastructure and renewable energy projects.

The **Lead Agency Framework** provides that assistance with, or coordination of, approvals for a proposal is administered by one department: the lead agency. The lead agency is responsible for:

- assisting a proponent in undertaking pre-lodgement meeting to determine the complexity of a proposal and whether case management is appropriate
- facilitating the provision of advice from regulators to proponents on statutory and other requirements
- case-managing and facilitating approvals applications across government for proposals (including federal and local governments), where appropriate
- assisting proponents to identify the potential impacts of the proposal on matters such as infrastructure, the environment and regional communities as well as the social considerations that arise from the proposal.

The original Lead Agency Framework was released by the Government in October 2009. This guidance note has references to departments and agencies that no longer exist, but nonetheless provides the framework from which the level of assistance can be determined for particular projects. The Western Australian Government is currently reviewing this framework and plans to release a revised guidance note in 2021.

The level of assistance provided by lead agencies is determined by the level of complexity, the significance of the proposal to the State or the level of impact the proposal will have on the environment and infrastructure determines how assessment of those proposals is tailored to meet requirements.

The level into which a proposal falls will determine the level of case management provided by the lead agency and the type of reporting required by both the lead agency and the proponent. Lead agencies have developed their own criteria to enable them to recognise the type of proposal that will fall into each Level.

As part of the Lead Agency Framework for major resources and industrial projects, the Department acts as a conduit between project proponents and DevelopmentWA in relation to land access and tenure matter in the State's Strategic Industrial Areas.

2.2.4 Regulatory Approvals and Native Title

All major projects are subject to a range of approvals processes at the Local Government, State Government and Commonwealth Government levels. The most significant of these is the environmental approvals process, which in Western Australia is overseen by the Environmental Protection Authority ('EPA').

The EPA is a regulatory agency which provides advice to the responsible Minister under the *Environmental Protection Authority Act 1986*. The process typically follows a path of:

- initial referral (which can be done by any person or entity)
- assessment of potential impacts based on preliminary information, which governs a decision as to the level of the process to be undertaken
- five steps of assessment, including:
    1. scoping of the review (with the proponent)
    2. preparation of additional materials to inform the review (to be undertaken by the proponent)
    3. the review itself, which can include a requirement to make all documents and materials associated with the review public for the purpose of calling for submissions
    4. preparation and distribution of the draft assessment, and
    5. completion of the assessment
- the EPA reporting on the assessment and providing advice to the responsible Minister, including for any conditions or requirements to be imposed on the proponent, and
- implementation of any conditions or requirements on the proponent, as well as ongoing monitoring and reporting where required.

Another significant approvals process is the Native Title process governed by the Native Title Act 1993. Native Title is a law passed by the Australian Parliament that recognises the rights and interests of Aboriginal and Torres Strait Islander people in land and waters according to their traditional laws and customs. According to the Aboriginal Policy and Coordination Unit, 85 per cent of Western Australia's land and sovereign coastline is subject to a Native Title claim or has received a Native Title determination..[2]

Projects typically engage directly with Traditional Owners in the first instance, with legislative instruments in place as a process of formal negotiation and arbitration where direct agreement cannot be reached. This

[2] Western Australian Government. 2020. *Department of Premier and Cabinet Aboriginal Policy and Coordination Unit: About Us.* Accessed online at http://www.wa.gov.au

3 Gas market outlook

This section provides a detailed examination of Western Australia's domestic gas market. ACIL Allen has modelled the long-term outlook for the supply of domestic gas through its gas market model, WesternGasMark, with the key assumptions and parameters reflecting advice from market participants and the Department of Jobs, Tourism, Science and Innovation.

3.1 Introduction

Development of gas-centric downstream industries requires the development and delivery of reliable, price-competitive natural gas feedstocks. In order to test Western Australia's ability to service the needs of downstream industry projects, ACIL Allen has completed a gas market analysis and outlook using its in-house gas market modelling framework *WesternGasMark*.

Western Gas Mark ('WGM') is a linear programming and regression model which forecasts the WA gas market. The model is primarily based on a framework which simplifies the gas market into a series of project-based offers to supply and an overall level of market demand, with the lowest cost sources of supply producing first until the market demand is met. Gas is then drawn from project-based reserves for the year, reducing the amount of reserve available for future years. Projects which are unable to produce at the given level of demand hold onto reserves until the draw is required. Where there is insufficient gas reserves, a supply gap is created.

Further details with respect to ACIL Allen's modelling framework are presented in Appendix B.

In this engagement, ACIL Allen has utilised a simple, total market level of demand and individual project level supply estimates in order to answer one central question posed by this work: is there sufficient gas reserves and production capacity available to meet the needs of new, greenfield downstream industry development projects in Western Australia? And if so, are the prospective costs and prices adequate to meet industry needs?

3.1.1 Primary modelling assumptions

ACIL Allen has developed a range of assumptions, presenting these to the Department for its review, to allow for gas market modelling to be undertaken for this engagement. The assumptions are built up to represent a base case view of the market, considering the most likely projected events to occur over the study period. Several the project operators included in the modelling base case have published development plans as disclosed to the Australian Stock Exchange (ASX) and the public which may run contrary to the assumptions in this base case scenario. These assumptions are intended to test the market for stability and suitability for downstream projects based on probable and likely outcomes and is not directly reflective of the perspective of gas users or producers.

The modelling input assumptions were finalised at the end of December 2020, and may not reflect current market expectations, plans or announcements due to the changing and dynamic nature of

the industry. The most significant assumptions from an upstream supply perspective are summarised in **Table 3.1**. Further details on cost bands are provided in Appendix B.

Table 3.1 Critical gas market modelling assumptions

Project name	Primary project driver	Starting reserves (domestic)	Starting reserves (LNG)	Starting target domestic production	First production	Cost band	Comments
		PJ	PJ	TJ/day	Year		
Gorgon	LNG	3,285	43,965	300	Existing	LNG – low	
Wheatstone	LNG	2,000	11,340	200	Existing	LNG – low	
Waitsia I	Domestic	48	0	30	Existing	Dom – mid	
Waitsia II	Domestic	761	456	20	2024	Dom – low	Initial assumptions reflect Waitsia II during export phase. Project reverts to domestic-only in 2029 with capacity of 250 TJ/day.
Greater Erregulla	Domestic	1,055	0	80	2022	Dom – low	Comprises two stage development with ultimate production capacity of 125TJ/day. This is a conservative assumption.
Varanus Hub	Domestic	756	0	290	Existing	Dom – mid	
Beharra Springs	Domestic	50	0	15	Existing	Dom – mid	
North West Shelf	LNG	454	7,980	105	Existing	LNG – low	This project comprises existing NWS reserves and DMO commitments, including recent NWS Additional Agreement gas.
Pluto	Domestic	215	3,020	40	Existing	LNG – mid	This project comprises Pluto, Pyxis and associated DMO commitments including Pluto Acceleration gas.
Reindeer-Caribou	Domestic	263	0	100	Existing	Dom – mid	
Macedon	Domestic	672	0	100	Existing	Dom – mid	
Spartan	Domestic	79	0	100	2024	Dom – high	
Corvus	Domestic	1,260	0	215	2027	Dom – high	
Scarborough	LNG	1,664	9,432	190	2027	LNG – high	Scarborough runs at below plateau commitment (190TJ/day) for first five years due to oversupply.

Source: ACIL Allen from various sources

The data collection of the input assumptions is based on a collected of data from internal ACIL Allen sources, and presented to the Department for its comment and adjustment where required. This was particularly the case for gas supply offers under the WA Domestic Gas Policy, where the complexity of some legacy arrangements required iteration. Where information gaps were identified ACIL Allen made conservative assumptions. Information such as maximum capacity at the field is

typically confidential and not public but is a necessary constraint for the modelling mechanics to work accurately. The assumptions for this metric have been broadly assumed based on the size of the field, any publicly available supply intention, and the capacity of the infrastructure that the field is supplying. ACIL Allen has also made general assumptions regarding the cost of supply, which were presented to the Department for its review.

It is important to note the input costs reflect a perspective on the cost and price of domestic market obligation gas, and may not reflect the actual cost of production nor the final delivered price for natural gas produced at the respective field. In a general sense ACIL Allen has assumed gas produced by DMO holders is offered to the market on a Short Run Marginal Cost basis, with an implied prorated separation of upstream costs. ACIL Allen's scope of services did not allow for the testing and refinement of the input costs used for this study.

Assumptions regarding *WA Domestic Gas Policy* obligations have been sourced from the Department, and reflect the contractual domestic gas commitments entered into with the State by LNG project owners as part of LNG project approvals. Within the modelling framework, ACIL Allen assumes DMO gas is made available to the market in line with plateau production from LNG projects, noting in reality the supply profile of domestic gas is less smooth. Gas supply is made available at the project level, rather than the proponent level, as a simplifying assumption with the objectives of this component of the engagement in mind.

ACIL Allen's demand projections are based on the 2020 AEMO GSOO until 2030, after which they are based on a log-linear regression to the end of the projection period (2050). For illustrative purposes ACIL Allen has included two block loads intended to represent downstream industry projects in its modelling assumption, being:

— A 125TJ/day block load from 2027, intended to be an analogue for the Perdaman Urea Project

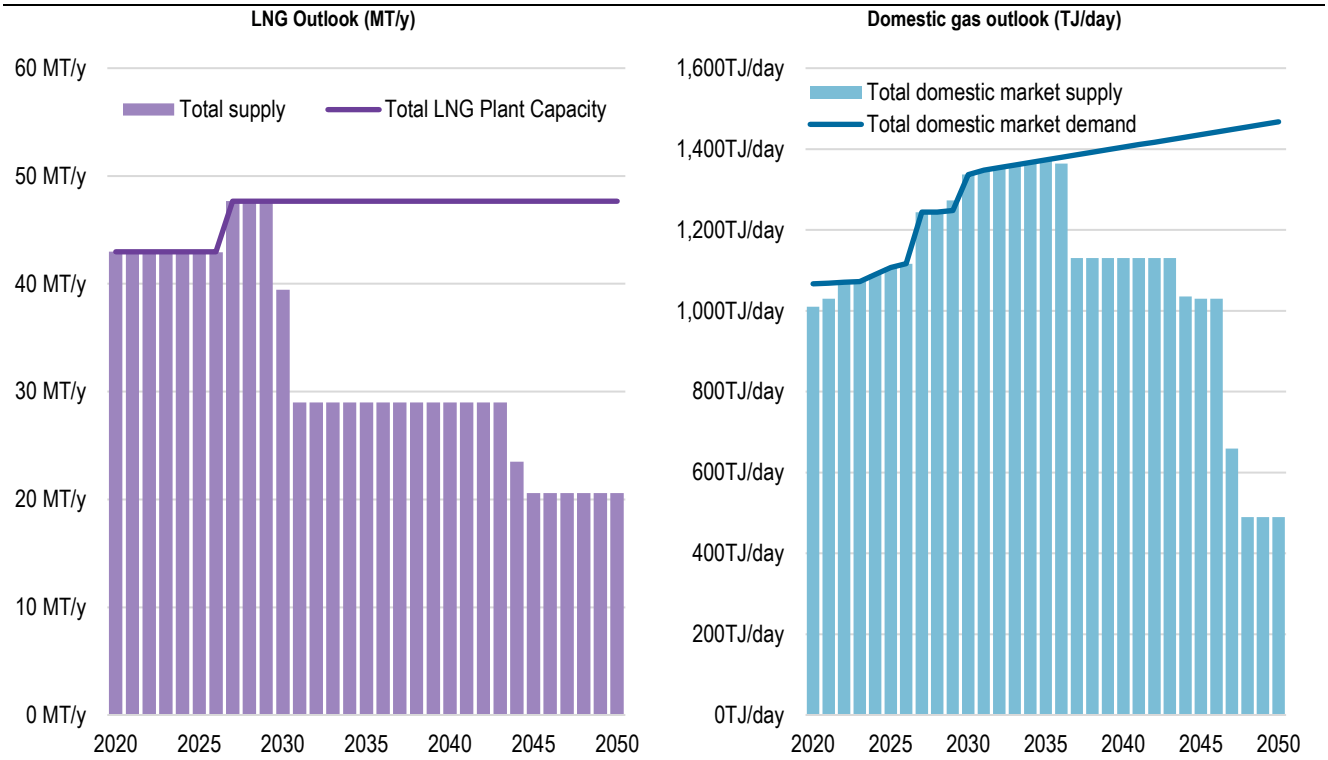
— A 90TJ/day block load from 2030, intended to be an analogue for a second, smaller downstream project

The results of ACIL Allen's base case LNG and domestic gas market outlook are presented in the next section.

3.2 Gas market outlook: Modelling results

Overall, ACIL Allen's base case gas market outlook suggests the Western Australian domestic gas market will be well supplied for the first 15 years of the period before the draw down of existing domestic gas reserves is inadequate to meet projected demand. The base case outlook also demonstrates the State's LNG producers may not have adequate reserves to continue to produce LNG at nameplate capacity throughout the modelling period, with a significant shortfall in gas feedstock projected to commence in 2032. A summary view of the outlook is presented below (**Figure 3.1**). The remainder of this section provides further detail and analysis.

Figure 3.1 ACIL Allen Base Case WA gas market projection summary



Source: ACIL Allen

3.2.1 Outlook: LNG sector

ACIL Allen's gas market modelling suggests the industry will produce at nameplate capacity, generating some 43 million tonnes per annum of LNG for export, rising to 47.7 million tonnes between 2027 and 2029. After this point, existing LNG linked reserves begin to deplete with no new major projects available to provide complete backfill and absorb this capacity. This results in an initial shortfall of around 7.4 million tonnes of production relative to nameplate capacity, rising to 18.7 million tonnes between 2031 and 2043, after which the depletion of the Wheatstone project results in a shortfall of 27.1 million tonnes.

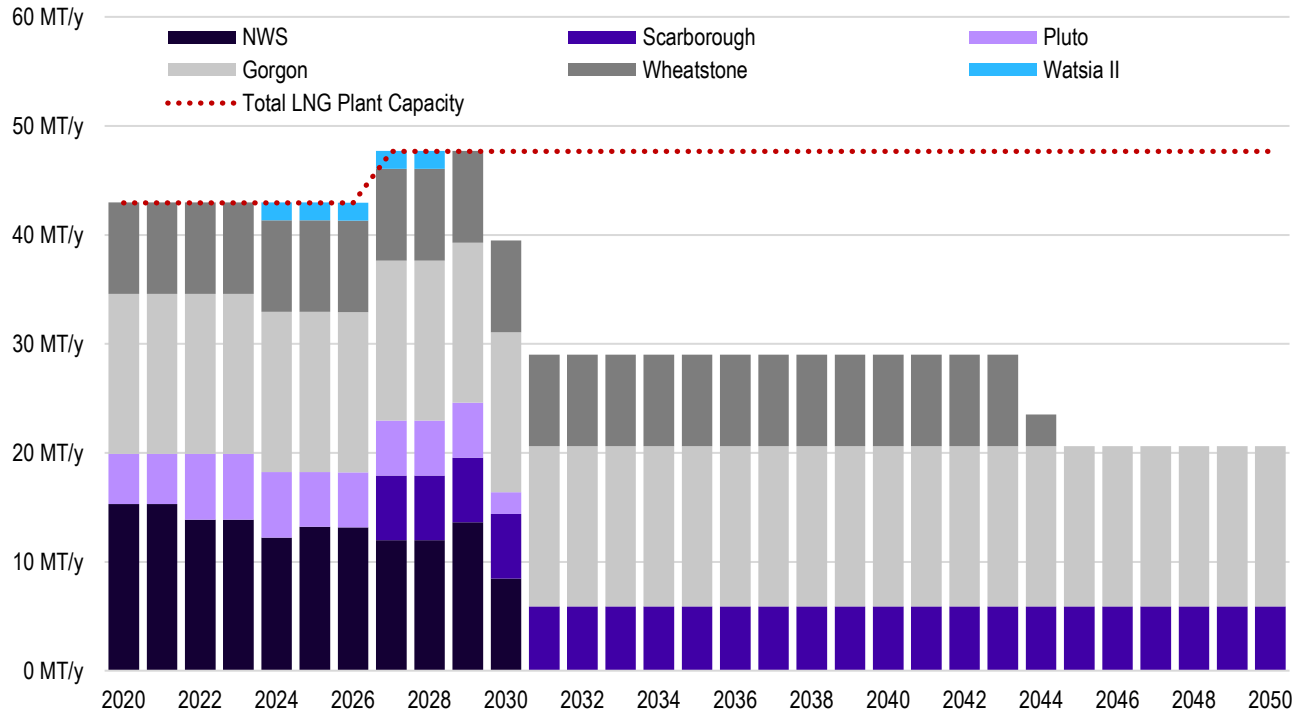
The profile of LNG production by contribution project is presented in **Figure 3.2**.

As demonstrated in the figure, the Gorgon and Wheatstone projects have substantial reserves that allow them to continue producing throughout most of the period, with Wheatstone producing at full nameplate capacity until 2043 and for approximately four months of 2044. By contrast, reserves at projects linked to the Burrup Hub (Scarborough, Pluto, North West Shelf) are insufficient to maintain production at the full nameplate capacity of the combined Burrup Hub.

ACIL Allen estimates the Burrup Hub ullage between 2030 and 2050 is equal to approximately 18.3 trillion cubic feet ('TCF') of natural gas, and to fill the peak ullage of 18.7 million tonnes per annum would require a production rate equal to approximately 2,900TJ/day – or over twice the size of the WA domestic gas market. This creates a significant upstream supply opportunity for additional very large gas supplies to backfill the capacity.

One such project is the Waitsia II project in the Perth Basin, which is slated to provide some gas to backfill the North West Shelf between 2024 and 2028. The field level analysis demonstrates the relatively small scale of the Waitsia II project in the context of other planned and operating LNG-scale developments operating in the State. The natural gas from the Waitsia II project accounts for 0.7 per cent of total LNG production projected to occur between 2020 and 2050.

Figure 3.2 ACIL Allen gas market outlook, LNG sector, project production vs overall system capacity, million tonnes of production per annum (MT/y)



Source: ACIL Allen

Overall, ACIL Allen's LNG projection demonstrates the importance of continued exploration, appraisal and development of the large-scale gas resources available in Western Australia. This is particularly important in the context of the new domestic market obligation gas these additional backfill projects may bring.

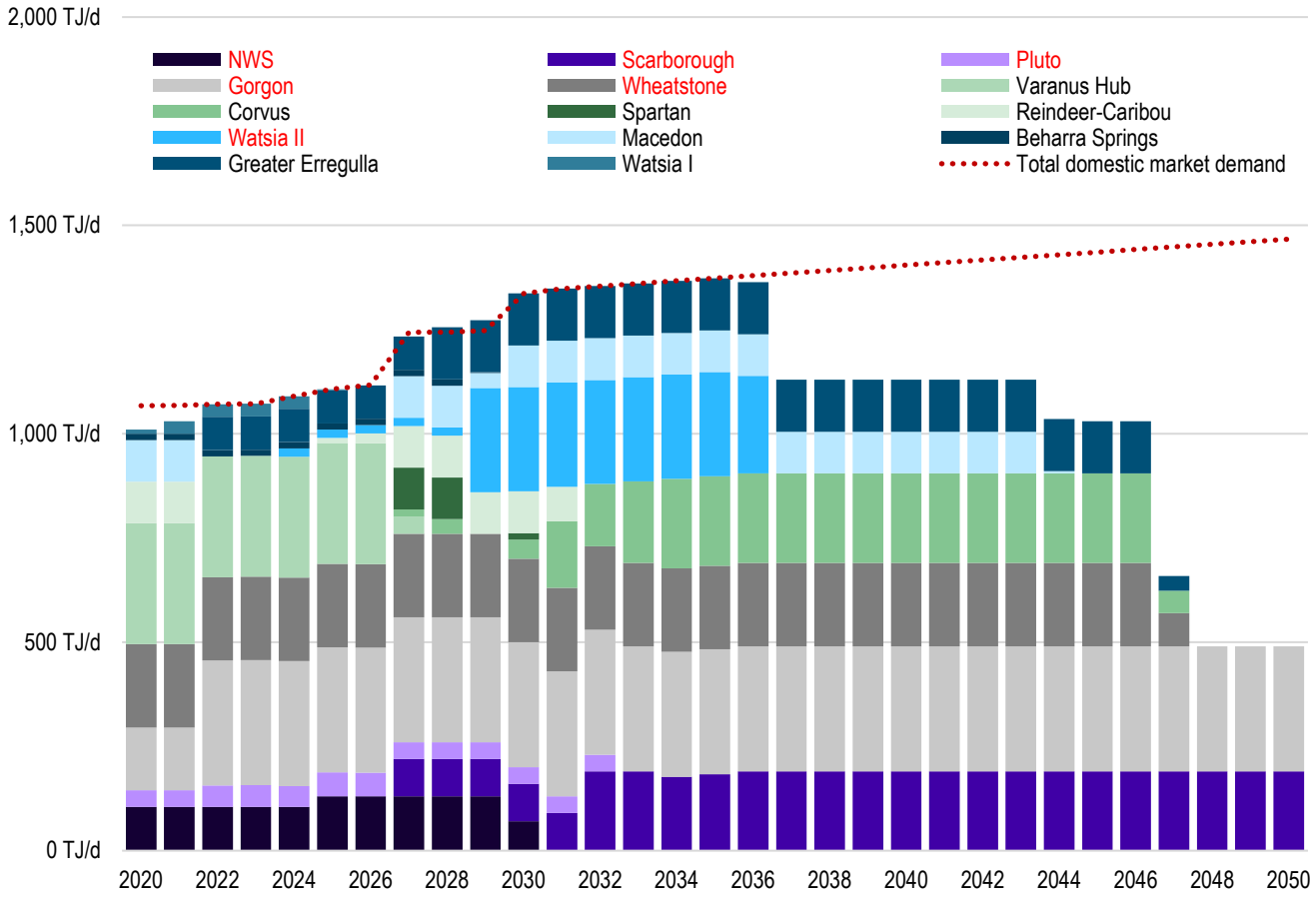
3.2.2 Outlook: Domestic gas market

ACIL Allen's gas market modelling suggests the modelling case level of demand will be well supplied throughout the first half of the projection period, with shortfalls expected to materialise towards the middle of the 2030s. The project dynamics are demonstrated below in **Figure 3.3**.

The projection demonstrates the important role of domestic market obligation gas in meeting the programmed level of demand, with domestic-focussed projects primarily clustered around meeting demand in the first half of the projection period. Further analysis is provided below.

The outlook demonstrates the role of DMO gas in the supply outlook, particularly beyond the mid-2030s shortfall period as existing domestic reserves are depleted. At an individual project level, the DMO gas from Gorgon, Wheatstone and Scarborough projects in particular represents a significant share of supply post 2035. Between 2020 and 2035 there is an important role for established domestic gas projects in the market, while Perth Basin gas emerges as a significant source of supply.

Figure 3.3 ACIL Allen Base Case gas market outlook, domestic sector, annual field production vs demand (TJ/day)



Source: ACIL Allen (red legend indicates supply is linked to LNG export)

There are a number of features of ACIL Allen's domestic market projection which make it a very conservative view of the outlook. These include:

— Conservative estimates of reserves from the Perth Basin. Specifically, ACIL Allen assumes the reserve at Waitsia II is 761 PJ (domestic component) and Greater Erregulla is 1,055 PJ. Waitsia II project owners have previously stated they expect the project to have up to 20 years of domestic supply potential, although it is unclear how this has changed following its export licence hence the cautious treatment of reserves. Meanwhile Greater Erregulla project owners have not issued an official reserve estimate, with the decision to assume a 1,055 PJ reserve effectively a holding assumption.

— DMO holders only offer to supply their agreed obligation, with no additional domestic gas flowing. This is a conservative assumption as if there are opportunities to supply domestic projects at netback prices additional gas may be expected to flow.

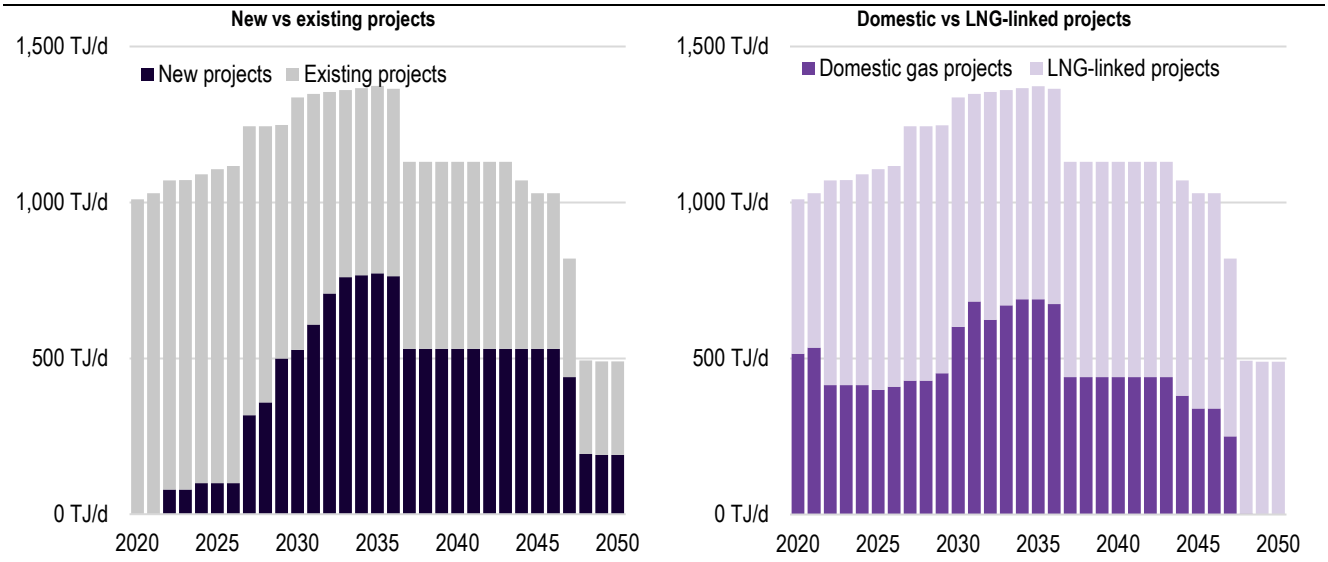
— More speculative sources of upstream gas supply are not included in the outlook. In the event of a shortfall in supply it is possible these speculative sources would become more likely to be developed, with implications for domestic prices. Examples of these projects include Bedout, Irwin, Equus (noting project owners are working on a development option which would pipe the gas to the east coast), and Roebuck.

Further breakdown of the gas market outlook is provided below.

Domestic market: Key project attributes

ACIL Allen's analysis shows the market is expected to be well supplied in the medium term through a combination of both new and existing projects, as well as projects which are domestically focussed as compared to those which are linked to LNG projects (**Figure 3.4**).

Figure 3.4 ACIL Allen gas market outlook, analytical breakdown of domestic gas supply, new projects vs existing projects supply and domestic-focussed vs LNG-linked projects supply, TJ/day



Source: ACIL Allen

As would be expected, existing projects accounts for 100 per cent of market demand in the first three years of the projection period, before new projects begin to enter the market. The most significant annual changes in new projects occur:

- on the entry of Scarborough domestic gas in 2027,
- on the entry of the Waitsia II domestic phase, which coincides with the exit of the North West Shelf domestic supply tranche
- upon the depletion of Waitsia II, with the market then moving back towards being majority supplied by existing projects (principally being Gorgon and Wheatstone domestic gas).

On the LNG-linked gas front, it is clear the projection expects domestic market obligation supply to become a dominant driver of the domestic market due to the assumed low cost of supply and large tranches of gas. The share of the domestic market served by LNG-linked domestic gas is projected to rise from 49 per cent in the first year of the study to an initial peak of peak of 66 per cent in 2028 (the second year of the Scarborough domestic market obligation). The share then progressively falls following the depletion of the reserves linked to the Burrup Hub and coinciding with growth in Perth Basin gas. By the end of the projection LNG-linked projects account for the entirety of market supply (noting the conservative treatment of more speculative sources of supply).

The dynamics of supply also demonstrate the benefits, costs and issues associated with domestic market obligation-linked gas as a foundation of supply in the domestic market. For instance, while LNG-linked domestic gas projects are projected to produce gas in large volumes at relatively stable rates throughout the projection period, domestic-only projects are faced with significant annual volatility. These issues are relevant to the scope of this study, and are explored further in Section 7.4.

Overall, ACIL Allen's domestic market outlook suggests existing levels of demand will be well supported through a combination of new and existing projects across all regions in the State. A

projected shortfall of gas in the final three years of the projection period can be largely set aside given it is some 30 years away.

3.2.3 Outlook: Assessing the opportunity

This section provides additional analysis relevant to establishing the potential of the WA gas market to supply new block loads of downstream gas. This analysis is included in this section, and is centred on assessing the potential scale of gas market opportunity and extent to which the assumed cost of supply for domestic gas developed in conjunction with the Department meets the needs of downstream industry projects.

To analyse the potential of the market to support gas-based downstream processing development projects, ACIL Allen reworks the outputs of its gas market model to consider the maximum scale of the supply offer which can be made by individual projects in a given year. The gap between maximum supply offer and actual demand represents the capacity of the market to supply block loads of gas.

In order to fully present this view of the market, ACIL Allen modifies the demand scenario to be a pure "trend" outlook, being the 2020 AEMO GSOO demand line extended out to 2050, removing ACIL Allen's assumed downstream project block loads.

Unconstrained supply: Sizing up the domestic gas opportunity

With the above capacity factors in mind, ACIL Allen has developed a modelled estimate of the maximum theoretical ability of the domestic gas industry to supply gas in each year of the projection. This maximum value is calculated by:

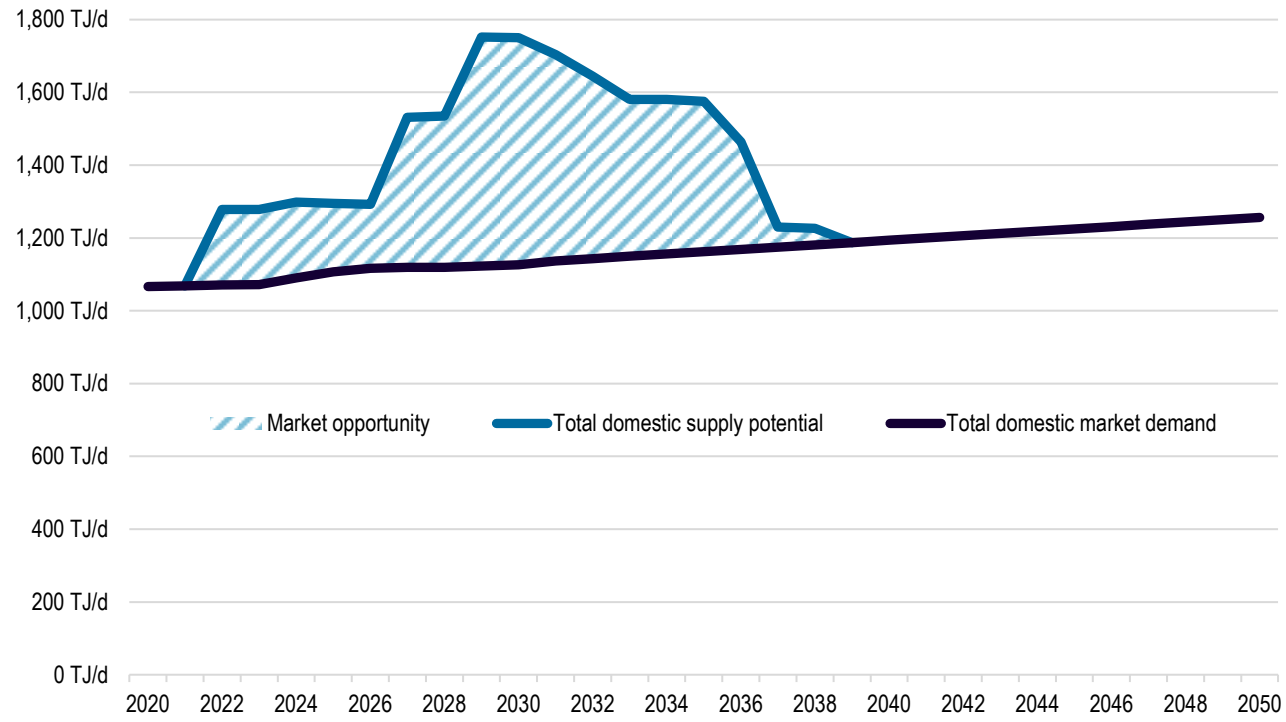
- taking the maximum field level production for each field (assuming LNG-linked producers will only produce at the maximum level of their obligation, while domestic projects are constrained by field supply capacity)
- constraining field production by either the maximum theoretical capacity to supply by the smaller of the field's end of year reserves or the maximum field production
- forcing this supply through the associated domestic gas plant on a cost-efficient basis, meaning in some years not all of the maximum supply capacity can be served and/or all domestic gas plant capacity is filled
- removing actual domestic market supply and calculating a residual.

The residual value represents the theoretical maximum additional capacity of the domestic gas market to supply new demand in a given year. Potential supply is presented as the shaded area in **Figure 3.5**.

Under this theoretical maximum capacity of supply framework, ACIL Allen's gas market projections suggest there is an initial capacity of 200TJ/day commencing in 2022, rising to a peak of over 625TJ/day in the early 2030s before gradually declining back to zero in the late 2030s (and moving into negative in line with the general shortfall projection thereafter).

While this is a largely theoretical exercise, the projection demonstrates the Western Australian domestic gas market as it is currently constructed has ample capacity to supply large tranches of gas under the right conditions. Put another way, gas supply in and of itself does not appear to represent a constraint on the ability of downstream industry projects to develop in the State.

Figure 3.5 Total domestic gas demand vs projected maximum annual domestic supply potential, TJ/day



Source: ACIL Allen

It is important to note this analysis is constrained by the conservative reserve estimates assumed for new projects, and by the exclusion of more speculative sources of supply. High level testing by ACIL Allen of scenarios where additional reserves are available push this generalised market offer surplus out well into the 2040s, suggesting ample supply potential exists across the sector.

It is also important to note the AEMO GSOO trend line does not account for declines in non-industrial uses of gas which are projected in other Western Australian Government policies, including the Whole of System Plan for the South West Interconnected System released in November 2020.

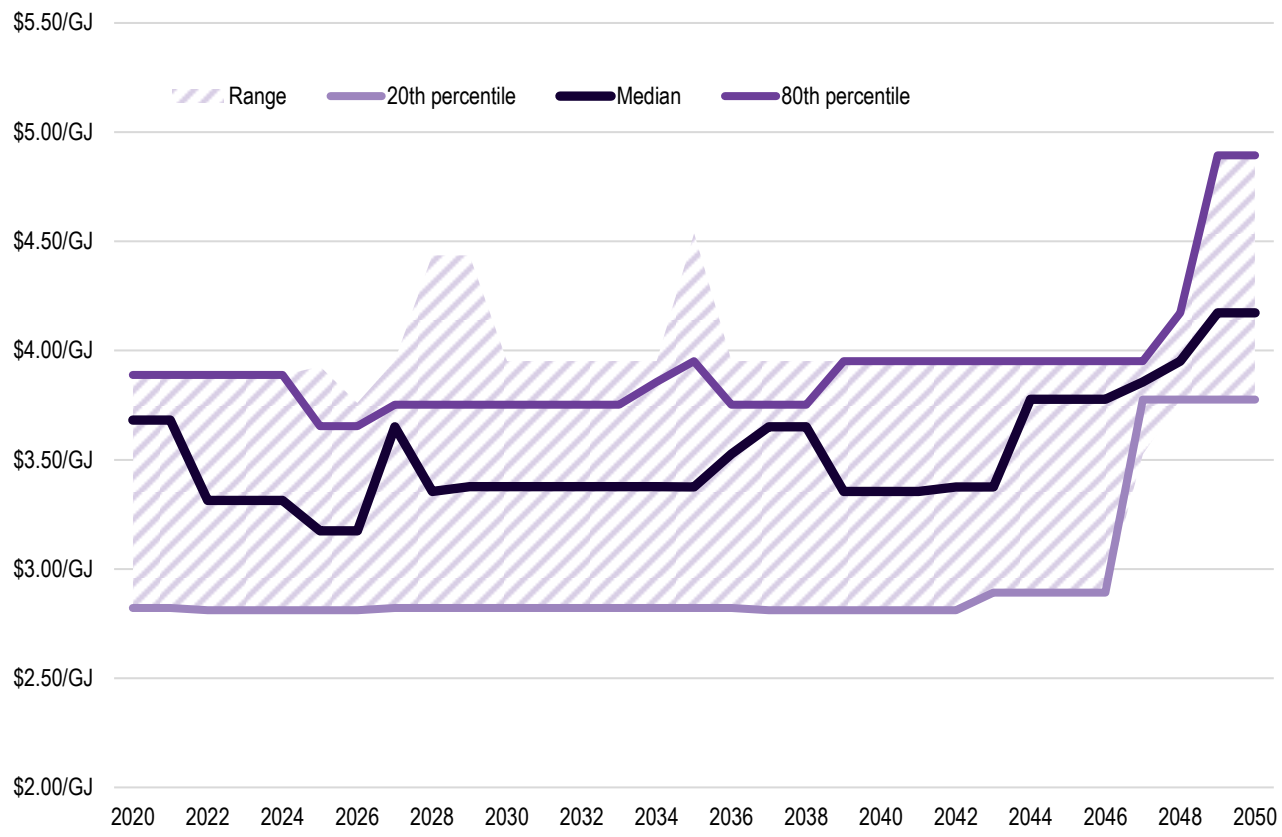
Cost of supply under baseline assumptions

Another important gas market consideration in this study is the ability for the local market to supply gas at delivered prices which meet the needs of downstream industries. While the cost of supply estimates developed for the purposes of this study by ACIL Allen for this study have not been independently verified or assessed, they reflect a reasonable basis to reflect on this question.

ACIL Allen has analysed the cost of supply of the projected supply stack (the individual projects which make up the complete tranche of gas supply offered in each year in the study), determining the minimum, maximum and median cost of gas per gigajoule on an annual basis in this stack. This excludes producer margins as there is limited data available on this, and margins likely reflect the commercial terms and other factors specific to individual supply agreements.

The results of the analysis are presented below (**Figure 3.6**).

Figure 3.6 Cost of supply stack analysis, minimum, maximum and median delivered gas price, $/GJ delivered to Dampier zone, real 2021 dollars



Source ACIL Allen

Note: The cost of supply estimates used to develop this analysis have not been tested or verified by stakeholders or market participants due to limitations on ACIL Allen's scope of services. These estimates are indicative only.:

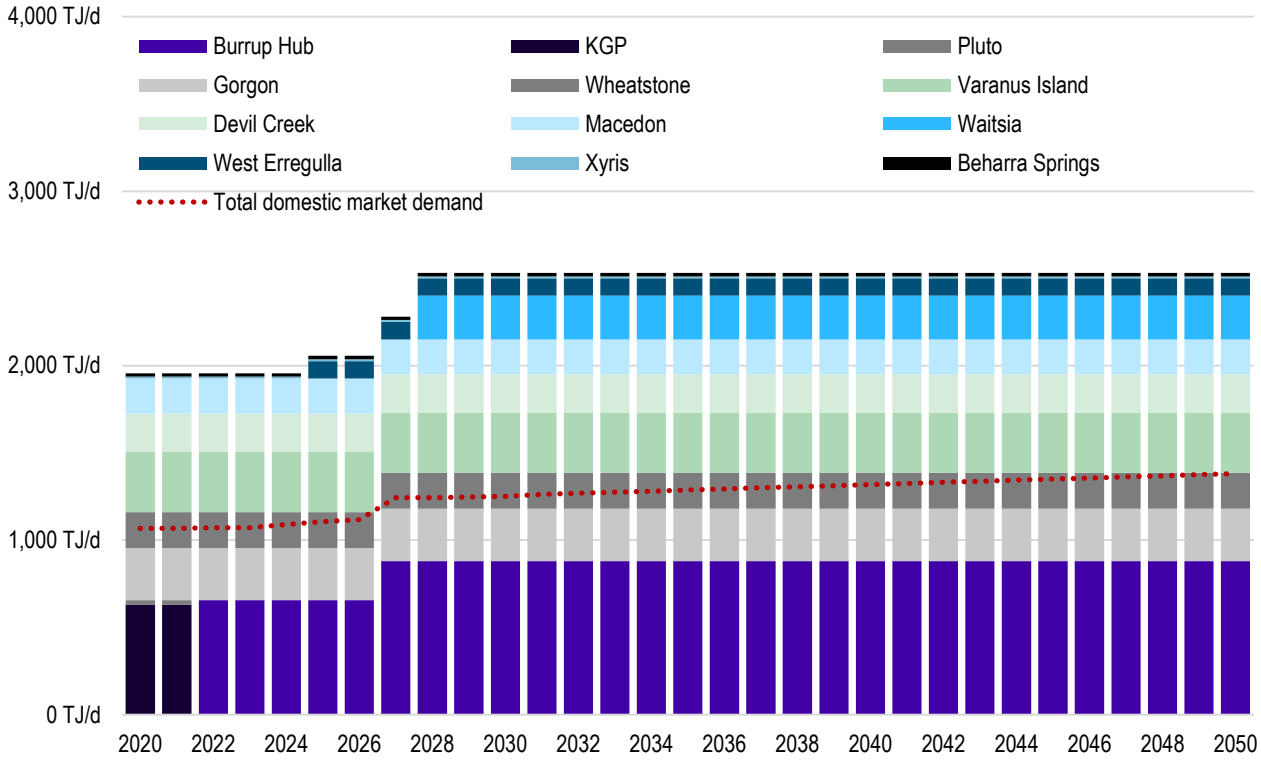
The indicative analysis demonstrates under the cost of supply assumptions developed for this study that the median cost of gas supply centres between $3.00/GJ and $3.50/GJ throughout the period, until the end of the period where the median rises above $4.00/GJ. At face value, this analysis suggests the State's domestic market has the capacity to supply gas at prices which can meet the needs of downstream projects (see Section 4 and Section 5).

Installed domestic gas processing plant capacity

One of the inputs into ACIL Allen's gas market modelling is the production capacity of current and anticipated domestic gas plants. Domestic gas processing plant capacity can act as a bottleneck in the supply chain where it is inadequate to process the entirety of gas demand or supply. Ensuring access and availability of domestic gas plant infrastructure is also one of the top line principals of the WA Domestic Gas Policy.

As **Figure 3.7** demonstrates, Western Australia's current and anticipated future domestic gas plant processing capacity is significantly larger than required to service demand. In fact, installed capacity is expected to be equal to on average 191 per cent of supply and consumption throughout the projection period.

Figure 3.7 Total installed domestic gas plant processing capacity vs demand, TJ/day, by plant



Source: ACIL Allen;

This suggests domestic plant capacity is unlikely to be a constraint on the ability for new block loads of demand coming online in the form of downstream projects. This also reflects the impact of the WA Domestic Gas Policy in requiring commitment holders to procure capacity to serve their domestic market obligations – some 1,385 TJ/day of capacity (61 per cent) is associated with LNG projects, while the 250TJ/day Waitsia II domestic gas plant is assumed to have been developed at this scale to serve its LNG export approval – taking the overall capacity share to 72 per cent.

3.3 Implications for downstream industry development policy

ACIL Allen's gas market modelling demonstrates there is likely to be capacity within the domestic gas market to support the formation of new downstream industry development projects. Even in a conservative scenario, where there is no upside assumed to existing reserves and no speculative projects modelled, the analysis suggests capacity for over 200TJ/day of additional demand from 2022 through to the end of the 2030s.

The domestic gas obligation of Western Australia's LNG producers under the domestic gas policy is projected to play an increasing role in meeting the needs of Western Australian industry and gas-fired power generation. Assuming this gas would otherwise be exported, the WA Domestic Gas Policy is important to ensuring continued supply in the local market. This also creates a risk in that adverse changes to the LNG market may put these supplies at risk, although this is not expected to be a factor in the short to medium term.

Meanwhile, there is significant domestic gas plant processing capacity both currently installed and expected to emerge over the projection period. This is one element of the WA Domestic Gas Policy in particular which has set the State up well to capitalise on any opportunities for downstream industry development. The installed domestic gas plant processing capacity, and existing pipeline network, mean there is ample gas infrastructure available to connect prospective buyers to current and emerging sellers.

ACIL Allen's cost of supply estimates suggest on a cost-only basis gas supply can be expected to be available in the Dampier zone (in north west Western Australia) for between $3.00/GJ and $3.50/GJ – excluding producer margins which have not been considered in this study, and adopting general estimates of transport costs to the Dampier zone, which may understate the cost of supply to certain locations (such as shipping gas from the Dampier zone to the Metro zone). Importantly, the analysis indicates the cost of supply is expected to be relatively stable throughout the period, only rising in the 2040s as reserves begin to deplete and the market moves into a shortfall position.

All things considered, ACIL Allen's gas market analysis suggests at an overall market level gas supplies are adequate to support new gas-based downstream industry projects in Western Australia. In this environment, it is understandable that there are strongly held views regarding the opportunities available to Western Australia through the development of gas-based downstream industries. However, simple, market-wide analysis of this kind does not consider the complexities associated with interactions between buyers and sellers in the Western Australian market, as well as the challenges facing both the development of upstream supplies and downstream sources of demand. These are explored in the remainder of this report.

Finding 1 Gas market outlook supportive of downstream industry projects

The gas market outlook in Western Australia appears to be positive for the prospect of future gas-based downstream industry projects in the State. There appears to be capacity for an additional 200TJ/day of sustainable supply at stable prices through to the end of the 2030s, even without expected additional upstream reserves within the Perth Basin and without the addition of material new sources of supply which are currently unproven. This supports further examination of the barriers and enablers for new downstream industry projects.

4 Stakeholder perspectives

This section provides a detailed summary of the key issues that were discussed by stakeholders through ACIL Allen's stakeholder consultation process. ACIL Allen has consolidated stakeholder feedback across a number of key themes.

4.1 Introduction

Understanding the potential for downstream gas processing opportunities in Western Australia is complex. In order to gain an understanding of the range of views and issues surrounding the potential for downstream gas opportunities in Western Australia, ACIL Allen undertook a targeted phase of stakeholder consultation process across industry and government.

The stakeholder consultation process was structured around the questions presented in ACIL Allen's Consultation Guide, which was presented to stakeholders ahead of each consultation to allow for preparations to be made. Broadly speaking, the Stakeholder Consultation Guide questions were directed towards gaining an understanding on:

- project economics of downstream gas industries and the critical success factors and barriers to such developments
- role of gas supply and energy market policy on the development of downstream gas industries
- the market outlook for gas, both in the short term and long term
- key policy issues influencing downstream gas opportunities, and
- the current experience for gas buyers and sellers in the formation of gas supply agreements.

The consultation process was deliberately broad, and focussed on direct engagement with commercial players on both the supply and demand side of the market in Western Australia. This was to ensure ACIL Allen was gathering a balanced perspective, and to provide stakeholders with the ability to give frank and fearless advice. This was particularly important given the contrasting views held by stakeholders depending on their position in the market, as will be demonstrated by our summary of the perspectives provided in the remainder of this section.

An extract of the questions as presented in ACIL Allen's Consultation Guide is presented in **Appendix A**. The list of stakeholders consulted as part of this engagement is presented in **Table 4.1**.

Stakeholder engagement list

Table 4.1 Stakeholder consultation list

Date	Organisation	Persons consulted	Industry/sector represented
APPEA		Claire Wilkinson, Karan Sharma	LNG Jobs Taskforce member
Strike Energy		Stuart Nicholls, Colby Hauser	Prospective gas producer
Western Gas		Tony Johnson, Will Barker	Prospective gas producer
Santos		Graham Weaver, Tracy Winters, Tom Baddeley	Current gas producer
ExxonMobil		Andrew Murphy	Current gas producer
Chevron		Cara Babb, Christopher de Kosta	Current gas producer
Methanex		Mark Zwitzer	Prospective gas consumer
JTSI Heavy Industry Development/SIA Workshop		Multiple agency representatives	State Government
Kwinana Smart Fuels		Peter Fennessy	Prospective gas consumer
ANZ Bank		Jonathan Bloch	Industry participant
Woodside		Ben Cranston, Sam Clark	Current gas producer
Synergy		Jason Froud, Antonia Cornwall	Current gas consumer
Wesfarmers Chemicals, Energy & Fertilisers / Kleenheat		Crispin Collier, Natalie Wallace	Current / prospective gas consumer
BHP		Natalie Connor, Sam Bartholomaeus	Current gas producer / current gas consumer
Coogee Chemicals		Richard O'Laughlin	Current / prospective gas consumer
Shell		Jamie Henderson, Lucia Lombardo	Current gas producer
Beach Energy		Paul Hogarth	Prospective gas producer
Yara Pilbara		Luke Blackbourn	Current gas consumer
Perdaman Chemicals, Energy and Fertilisers		Vikas Rambal	Prospective gas consumer
Dow Chemicals Australia		Karen Dobson	Industry participant

Source: ACIL Allen

4.2 Stakeholder themes

In order to distil the range of complex policy, regulatory, economic and financial issues impacting on the potential for downstream gas opportunities in Western Australia, ACIL Allen took detailed notes of each consultation. However, to ensure that stakeholders were willing to provide open and honest feedback on these issues, ACIL Allen advised that the notes from each session would remain confidential, with no attribution made in this report to individual stakeholders unless permission was granted. Instead, ACIL Allen has presented stakeholder feedback through six key themes, which collectively represent the key issues from stakeholders:

- Study objectives and outcomes
- Intent and purpose of the domestic gas policy
- Market failure in realising downstream opportunities
- Understanding and allocation of risk
- Improvements to domestic gas policy
- Broader role of Government.

In addition to the above stakeholder themes, the stakeholder consultation process was a critical source in the identification of downstream industry development opportunities – both those which are within scope and outside of the scope of this study. Further details and analysis are contained in Section 5.

For some of these key themes, there were sometimes opposing views held by some stakeholders. ACIL Allen has presented the range of views within these key themes to ensure that all views are represented. Each key theme is expanded further below.

4.2.1 Study objectives and outcomes

There were differing views expressed on the objectives of this study. On the one hand, there were strong views held by gas suppliers and upstream participants on the **opportunity to broaden the scope of the study to explore downstream opportunities beyond gas as an energy source or feedstock**. Given the Government's strong focus on renewables and battery minerals as part of its economic development agenda as articulated in *Diversify WA*, these stakeholders believed there were opportunities to broaden the scope of this study to include renewables as a feedstock, battery minerals, hydrogen, and less gas-intensive minerals processing opportunities.

On the other hand, for some stakeholders that indicated difficulties in securing long term gas contracts for their prospective downstream gas developments, they expressed the view that the **study should be focussed specifically on ways in which government policy can assist in requiring LNG suppliers with domestic market obligations ('DMO') to supply gas on terms which meet their requirements**.

4.2.2 Purpose and effectiveness of the WA Domestic Gas Policy

While there was broad **consensus that the domestic gas policy was well understood** in the marketplace, there were differing views held as what the purpose of the policy should be, and its effectiveness overall. There is a high degree of acceptance amongst existing gas suppliers which reflected a broader industry view that adherence to the policy was **part of their social licence to operate**.

However, the **application of the policy in practice is where differences emerged with stakeholders** – not only between gas suppliers and gas buyers, but also potential new gas suppliers, and potential new gas buyers.

Overall, existing suppliers and buyers were of the view that the **policy was effective in ensuring that tranches of supply were being made available at competitive prices and terms**. However, the effectiveness of the policy was more limited with respect to prospective gas suppliers and prospective gas buyers.

For gas suppliers, policy certainty is important, considering the long life of gas projects. In this regard, there were concerns raised of the recent changes to the domestic gas policy, which preclude "local" gas from being exported other than in exceptional circumstances, will make it more challenging for potential new onshore gas fields to be developed. This is a question of scale, and stable sources of demand, with access to an LNG export pathway providing both of these.

Stakeholders discussed the Waitsia Joint Venture Agreement, and its implications for domestic gas projects. While the State's decision aligns to the broader purpose of the 20 August changes to the WA Domestic Gas Policy, stakeholders raised concerns the **policy could create unforeseen consequences that result in less domestic gas projects coming to fruition**. Stakeholders were keen to ensure the State was aware of the benefits access to an LNG export pathway provide for upstream project economics.

For stakeholders representing prospective **downstream gas developments, they did not believe that the policy is able to address their long term gas requirements**. They believe that the **policy needs to be strengthened to improve transparency** in relation to marketing in "good faith". Stakeholders also raised the spectre of a commerciality test as an additional mechanism to ensure DMO gas was bought to market.

However, there was recognition from some stakeholders representing potential downstream gas developments, that their best chance of success in securing contracts on competitive terms was through greenfield gas developments. This reflects their current experience whereby **gas volumes that are being offered by DMO holders are sub-scale for major downstream project requirements**.

More broadly, there were views raised as to whether the domestic gas policy was an available lever for government to help foster potential downstream gas developments. In this regard, some stakeholders held the view that the Government's **broader major projects facilitation role, and its role in supporting industry development through infrastructure, are more effective in addressing the requirements for significant new downstream gas developments to be progressed**, with gas-related matters primarily a function of market forces within the constraints of the existing policy (noting stakeholders identified a number of matters they considered to be market failures – discussed below).

This view was supported by existing upstream suppliers, who when asked were generally of the view that there should be limited – or no – change from the status quo regarding the WA Domestic Gas Policy.

4.2.3 Market failure in realising downstream opportunities

There were diverging views expressed across the stakeholder groups with respect to whether the market was operating efficiently. In relation to the gas suppliers, there was a view that the **market was operating as efficiently as it could under the policy**, as evidenced by the ability of current domestic gas buyers being able secure their gas requirements, with sufficient capacity for additional tranches of gas to be made available to domestic buyers.

When these stakeholders were challenged as to why prospective downstream developments were unable to secure competitively priced long term gas contracts of sufficient volumes, the feedback was that this was **not a failure of the market, but rather a recognition that these potential downstream developments are not sufficiently advanced** to be able to enter into negotiations with gas suppliers.

For stakeholders representing prospective downstream gas developments, they believed there was a need to **strengthen the domestic gas policy to address the market failure** in not being able to secure long term gas contracts with DMO holders. This reflects a misalignment of each party's commercial objectives, where DMO holders are seeking to reduce commercial risk from long term contracts that lock in prices, while prospective buyers require long term contracts in order to shore up the project economics and secure financing. Prospective downstream buyers were of the view that the domestic gas policy should be strengthened to better incentivise suppliers to supply gas on terms that can support large scale gas-intensive domestic production.

While these views have merit and are understandable given the position each broad group holds in the market, ACIL Allen's analysis contained later in this report does not fully support the perspectives advanced by either buyers or sellers (see Section 7.4).

This perspective was held by most, but not all stakeholders representing prospective downstream gas developments. A strong and opposing view was presented by the Chairman of Perdaman Chemicals, Energy and Fertiliser, Mr Vikas Rambal, who did not believe there was an evident market failure.

> *"They are going to their Boards looking for funding with a $50,000 study. The issue isn't about gas supply, it's their balance sheets. They don't have the committed funds; they don't have the track record."*[3]

4.2.4 Understanding and allocation of risk

One of the consistent themes that emerged from the stakeholder consultation process, albeit from opposing perspectives, was the lack of understanding of the allocation of risk, and its commercial implications.

From an upstream perspective, stakeholders highlighted the **significant risks that are inherent in development of major gas fields**. While there are significant risks at the development phase of any gas project, the risks remain over the operational life of the project, which means that they must be managed in a way that minimises commercial risks and ensures the project owners are able to earn their required rate of return on their investment. Stakeholders commented that for those outside of the industry, these risks are often not appreciated by downstream buyers.

For gas suppliers, **early-stage downstream projects were viewed as a significant risk, particularly when the alternatives are established buyers and the LNG market more broadly**. Securing low risk markets is seen as a key means by which gas suppliers can lower the overall risk profile of its projects.

From a **downstream perspective, the noted that the key risk for their potential project is their (in)ability to secure long term contracts, which are critical to securing project finance**. However, it was also noted that the **WA Government can play an important role in addressing project financing risks by facilitating access to land, and through the provision of common user infrastructure** that is critical to the development of the project.

Another way in which the WA Government can assist in addressing mitigating risks for potential downstream gas projects is through the **support it can provide in streamlining approvals processes and in supporting native title negotiations**. For some stakeholders, these project risks are seen as barriers to the timely development of their projects.

[3] Vikas Rambal, Perdaman Chemicals, Energy and Fertiliser, Consultation meeting 16 November 2020.

4.2.5 Views on the WA Domestic Gas Policy

While the domestic gas policy was not the focus of this study, stakeholders were keen to discuss the policy and possible changes to enhance its overall effectiveness in achieving the Government's stated outcomes. Consistent with the feedback presented above, there were two broad perspectives that emerged from the stakeholder consultation process.

For gas suppliers, **policy certainty is important, and changes to the domestic gas policy should only be made where a demonstrable case has been made for such a change**. Gas suppliers were strongly of the view that the policy had been effective in achieving the Government's objectives, and therefore did not require further changes to be made. In this regard, gas suppliers noted that they were disappointed that the WA Government would make changes to the domestic gas policy without consultation with industry. The changes impact on the project economics of onshore gas developments, unless an agreement – like which was negotiated by the Waitsia Joint Venture – can be made with the Government.

For potential downstream gas projects, it was suggested that the domestic gas policy was not effective in addressing their long term gas requirements, and that this could be addressed through **changes to the policy to strengthen transparency and enforcement of obligations**. In particular, a number of stakeholders representing potential downstream gas developments suggested measures to bring gas suppliers to the negotiating table in good faith, such as developing a commerciality test, improving transparency, and a mandating a lower hurdle rate on DMO gas. Across this stakeholder group, there was a belief that gas should be supplied by DMO holders on the basis of **short run marginal cost**. In terms of enforcement, one stakeholder suggested that DMO holders should be required **to fulfil their obligation within a time period** in order to manage reserve risks.

Against this view, gas suppliers were adamant that they were willing sellers, but that the **prices being targeted by buyers were unrealistic and uneconomic**. As one stakeholder lamented:

> *"We can't get gas out of the ground at the price they want."*

And from another gas supplier:

> *"We can't just give away the gas."*

Against all these views, a number of stakeholders – both upstream and downstream – believed that the **domestic gas policy is not the only policy lever available to the State Government in support of new downstream gas developments**. Other policy levers **such as the Government being** a project facilitator may be effective in realising downstream gas opportunities in Western Australia. This will be further explored in the next section.

It is also important to note no stakeholder group called for abolition or wholesale changes to the WA Domestic Gas Policy, suggesting both buyers and sellers consider the policy is effective in meeting its primary objectives as they relate to maintaining adequate supplies for the domestic market.

4.2.6 Broader role for Government

While there were diverging views among industry stakeholders on the role of government with respect to the objectives and implementation of the WA Domestic Gas Policy, there was **general support for the role of government in setting its broader economic development framework, in helping to streamline project approvals and native title negotiations, and in providing infrastructure support and access to land**. Indeed, some stakeholders drew parallels of such an approach to that which supported the emergence of Western Australia's gas industry in the early 1980s (see Section 2.2.1).

A number of stakeholders commented on the need for the Government to ensure that its broader policy objectives are consistent, such the key priorities set out in *Diversify WA* and the State Climate Policy. In ACIL Allen's view, if stakeholder engagement were to have occurred closer to the presentation of its final report that issues of climate change and carbon emission abatement would have emerged as a central theme.

The role of government in leveraging its balance sheet to provide **infrastructure support and land access was seen by a number stakeholders representing prospective downstream gas developments as one of the "critical success factors"** to getting their project off the ground. One stakeholder commented that Western Australia:

> *"…was the only game in town {and that if] the capital investment disadvantage could be addressed, then WA would be the destination of choice for large downstream gas projects".*

On regulatory approvals, there was broad endorsement for a **greater commitment from the State Government in helping to streamline project approvals**, which can take years to complete. Questions were raised as to whether Streamline WA could be given higher priority status with Government, with many across the industry lamenting at the lack of progress of this initiative in delivering on its objectives.

The other key hurdle that stakeholders felt that Government support would be beneficial was in relation to native title negotiations with the traditional owners of the lands. While stakeholders were supportive of native title claims from traditional owners, they believed that **native title negotiations could be more efficiently and sensitively handled by Government taking the lead**, rather than the project developers.

Outside of the broader policy settings and through project facilitation, a number of stakeholders also raised the potential for the **Government to act as an aggregator in the gas market** to support large volumes of gas being made available for potential downstream gas projects.

4.3 Implications for downstream industry development policy

There are clear and divergent views on the potential size, scale and nature of gas-based downstream processing industries in Western Australia. In ACIL Allen's view, most of the contention can be traced to different views on the gas market, and the operations and outcomes of the WA Domestic Gas Policy.

Stakeholders agree that the findings of this study, and any response from Government, must be consistent with the WA Government's broader policy objectives relating to economic development and climate change. Stakeholder feedback consistently raised the issue of the study objectives, and the need to explore downstream opportunities beyond gas as an energy source. There are a range of closely related industries, such as renewables, battery minerals, hydrogen, and other mineral processing industries, which are closely linked to the industry opportunities in focus for this study.

The policy environment, and public sentiment, have shifted markedly on climate change and emissions reduction since this study began. It is important the State Government is aware of this shift when considering the findings and recommendations from this study.

In ACIL Allen's view WA Domestic Gas Policy is well understood and achieves a high level of acceptance amongst for existing upstream and downstream industry players. There are differences of opinion regarding the primacy of its various objectives, its success in meeting these, and how the outcomes could or should be pursued. For greenfield gas developments and potential downstream gas developments, the policy alone is not considered to be a sufficient means of supporting industry development.

The Government's broader major projects facilitation role, and its role in supporting industry development through infrastructure, are viewed as additional, complementary means of addressing the requirements for significant new downstream gas developments to be progressed.

The domestic gas policy has ensured that the WA market is well supplied for its current needs – a qualitative finding which is supported by ACIL Allen's quantitative modelling (see Section 3). For potential downstream gas developments that have not been successful to date in securing competitively priced, long term gas contracts of sufficient volumes, the view held by gas suppliers is that this is not a failure of the market, but rather that these projects are not sufficiently advanced to be able to enter into such negotiations. On the other hand, buyers do not believe suppliers are engaging in good faith. These issues are explored in more detail in Section 7.4.

Given the long term nature of upstream and downstream gas projects, the allocation and management of risk is a key consideration. The key risk for prospective downstream gas projects relates to their ability to secure long term gas contracts. The Government can play an important role in addressing additional risks for such projects through its important project facilitation role, including in the provision of land and infrastructure, and in helping to streamline approvals processes and native title negotiations. These issues are explored in more detail in Section 7.3.

Further changes to the domestic gas policy should only be made where a demonstrable case can be made for such a change. Gas suppliers consider that the domestic gas policy has been effective in achieving the Government's objectives, while potential downstream gas buyers view the policy as ineffectual, requiring changes to strengthen transparency and enforcement of obligations. Any changes to the domestic gas policy will require careful consideration of these competing views, which were beyond the scope of this engagement to address.

Overall, ACIL Allen's stakeholder engagement program confirmed the need for further, detailed examination of the issues and challenges facing downstream industry development in Western Australia. Stakeholder engagement also revealed there are a number of opportunities, some of which are under active pursuit by industry, in this space in Western Australia. These are the subject of the next section.

Finding 2 Market perspectives

There are divergent and strongly held views regarding the prospects, barriers and enablers of downstream industry development projects in Western Australia. There is a limited shared understanding of the commercial and economic incentives which are at play on both the supply side and demand side of the market for gas. Overlayed with the general commercial complexity, it is evident buyers, sellers and the government would benefit from a more collegiate and collaborative approach to achieving downstream industry development.

Opportunities identification 5

This section identifies and analyses downstream industry development opportunities in Western Australia, in the context of the scope of this study. The end of this section begins the discussion of various commonalities and critical success factors associated with downstream projects in Western Australia.

5.1 Introduction

Throughout ACIL Allen's two month stakeholder engagement process, it became clear there were a number of potential downstream industry development opportunities which were under active investigation in Western Australia. Consultation with both upstream and downstream stakeholders, State Government agencies and parties who were not directly involved in the space identified development opportunities where natural gas was central to the production process, and a range of opportunities where natural gas was less important.

The target of this study is an assessment of gas-based downstream processing industries and the associated opportunities in Western Australia. In a general sense, there are three broad ways this can be interpreted with respect to the type of opportunities available. These are:

- Opportunities where natural gas is **critical to the production of the intermediate or final product**, such as in use as a feedstock in a chemical process,
- Opportunities where natural gas is **critical to a process as a heating source or source of energy**, such as provision of heat for a furnace, and
- Opportunities where natural gas is **not critical but is generally used as a fuel source**, such as benefaction of minerals.

With respect to the above framework, ACIL Allen has identified a number of current and recent private sector project proposals in the gas-based downstream industry development space in Western Australia. The projects described below are those where there is publicly available information through an environmental approval application, or where the proponent has publicly stated its intentions to develop the project. These are introduced in **Box 4.1**.

A fourth group of downstream industry development opportunities emerged where natural gas may currently be used as either a critical or generally accepted part of a production process, but where there are opportunities for renewable energy penetration in the long term as either a replacement input or a product in itself. This specifically centred on the potential development of hydrogen supply chains, taking in grey, blue and green hydrogen. Further discussion of hydrogen in the context of this study is provided later in this section.

In order to prioritise its assessment of these development opportunities, ACIL Allen has completed a simple multicriteria assessment which is described further below in this section. In prioritising the opportunities for further investigation and analysis, ACIL Allen has given strongest regard to those opportunities which are central to the scope of services for this engagement: opportunities which

are gas-based insofar as natural gas is a critical component of the value chain. More specifically, opportunities where natural gas is used as a feedstock are given priority over those where natural gas is a critical source of energy, over those where natural gas was not critical but was generally used as a fuel source.

Box 5.1 Active Downstream Projects in Western Australia

There are four gas-centric downstream industry projects under consideration in Western Australia, with each at various stages of development and approval. These are briefly introduced below.

Perdaman Chemicals and Fertilisers Urea Project

Perdaman Chemicals and Fertilisers is actively developing the Perdaman Urea Project in the Burrup Strategic Industrial Area in the Pilbara region of Western Australia. The project is targeting a productive capacity of two million tonnes per annum of bulk solid urea, for export to global markets. The project is currently subject to the Environmental Protection Authority's approvals process. The project has secured a conditional gas offtake agreement with Woodside for the sale of 125TJ/day of natural gas. The project also received a concessional infrastructure package from the Western Australian Government, subject to the project achieving several conditions precedent including a final investment decision.

Burrup Methanol Plant

A consortium of existing downstream product producers, led by WCEF and including Coogee Chemicals, was recently developing plans for a methanol project in the Burrup Strategic Industrial Area in the Pilbara region of Western Australia. The project commenced preliminary environmental approvals with the Environmental Protection Authority in 2018 but no action has since been taken. The project remains active and is being pursued by a single party.

Strike Energy Urea Project

In January 2021 Strike Energy announced its intention to develop a urea project in the Mid West region of Western Australia. The project would use natural gas from Strike Energy's West Erregulla reserves as a feedstock. There is limited publicly available information beyond Strike Energy's initial statement to the market where it flagged it had achieved a conditional lease on land near Geraldton, and that it was seeking an offtake partner. The plant's planned productive capacity is 1.4 million tonnes per annum.

Source: ACIL Allen, from various sources

In this section, ACIL Allen will provide a brief overview of the broad suite of downstream industry opportunities, as well as deeper analysis of opportunities which have been identified as central to this particular study. Finally, the section will identify a range of commonalities and other features which are relevant to assisting the State Government develop appropriate frameworks and policy to foster the development of industries where they are considered a priority for the State.

Finding 3 Active interest

ACIL Allen observed active interest in the potential for value-adding gas projects in Western Australia, centred on processing natural gas into basic chemical and fertiliser products for export markets. Additional projects beyond those named are also seeking to establish operations in Western Australia. Natural gas is primarily used as a feedstock in a chemical process, rather than as a source of energy, for these opportunities. Given this, the cost of supply is an important source of advantage or disadvantage for Western Australia.

5.2 Identification of downstream industry development opportunities

ACIL Allen's research has identified four primary groups of downstream industry development opportunities which are relevant in a Western Australian context. The consideration and development of this long list of opportunities has been informed by a desktop review of the current and prospective future gas-based industry projects in the State, the feedback of stakeholders during stakeholder consultation, and further desktop research completed during and following consultation. In this respect, ACIL Allen's list of opportunities has been pre-emptively filtered to narrow down to those opportunities which are most prospective and conducive to Western Australia according to major project proponents.

In general, and as discussed in Section 4 – Stakeholder perspectives, ACIL Allen's research has identified that downstream industry development opportunities in Western Australia tend to be large-scale, export-oriented and highly capital intensive. As discussed above, the opportunities exist in four broad groups: gas-centric, gas as a heating source, gas used as a fuel source, and hydrogen industry opportunities. The primary downstream industry opportunities identified in the study are presented below.

Figure 5.1 Summary of downstream gas opportunities in Western Australia

Industry / opportunity	Primary role of gas	Level of transformation	Associated products and uses	Additional comments
Urea	Feedstock	Final product	▪ N/A (final product)	▪ Can be produced as a liquid or solid
Methanol	Feedstock	Intermediate	▪ Synthetic fibre ▪ Plastics	
Ethylene	Feedstock	Intermediate	▪ Variety of plastics, solvents and agricultural uses	▪ Precursor to many industrial chemical processes ▪ Can be produced from variety of hydrocarbons, not just natural gas
Ammonia	Feedstock	Intermediate	▪ Technical ammonium nitrate (explosive) ▪ Cleaning products ▪ Fertilisers	▪ Emerging potential use as a primary energy source (when produced using green hydrogen)
Liquefied natural gas (LNG)	Feedstock	Energy	▪ Used as combustion fuel, primarily in stationary energy applications	
Gas to liquids (fuel)	Feedstock	Energy	▪ Production of gasoline (passenger vehicle petrol) and automotive diesel oil	
Blue hydrogen	Feedstock	Intermediate	▪ Electricity and energy source (combustion) ▪ Energy storage ▪ Ammonia-based fertiliser (with nitrogen) ▪ Variety of industrial chemical processes	
Green hydrogen	N/A	Intermediate		
Steel and steel inputs	Energy source	Intermediate / final	▪ N/A (final product)	▪ Emerging technologies to decarbonise steelmaking processes are conducive to hydrogen
Aluminium	Energy source	Intermediate / final	▪ N/A (final product)	▪ Opportunity in the context of WA's current production of alumina and bauxite
Other minerals processing including battery minerals	Energy source	Intermediate / final	▪ Various products and intermediate vs end uses	▪ Opportunity in the context of energy intensiveness of minerals processing and current minerals production

Source: ACIL Allen

An initial description of the 11 prospective downstream processing industry opportunities identified during the study is provided in the next section, before a multicriteria assessment is used to narrow

down the longer list to the three most prospective. These most prospective opportunities are then considered in further detail, and are used to frame the remainder of the report.

5.2.1 Opportunity #1: Urea

Urea is a fertiliser applied across agriculture industries globally. Urea is a concentrated nitrogen based fertiliser that seeks to enrich soils for the purposes of improving cropping yields and the productivity of otherwise poor quality soils. It can be produced as either a solid or liquid chemical. A further structured description of urea in the context of the study is presented below.

Opportunity #1: Urea					
Description of plant & infrastructure requirements	An integrated urea project requires access to non-saline water, electricity and natural gas as a feedstock. High volumes of water and natural gas suggest pipelines are preferred. The plant is then able to produce the urea through an integrated process on site including preparation for export. As facilities tend to be large scale, direct linkage to port infrastructure is preferred where products are to be exported as this improves efficiency.				
Primary markets (based on value of imports)	India	USA	France	Australia	Thailand
	$3,088m (45.3%)	$1,999m (29.4%)	$736m (10.8%)	$677m (9.9%)	$628m (9.2%)
Value of international trade (2019, $m) and long term trend	**Value of international trade** $11,547 million (2019)		**International trade trends** 10 year CAGR: 1.7%		
Role of natural gas in production process	In simple terms, urea from natural gas is produced through a two step chemical reaction process where natural gas is decomposed into hydrogen and then ammonia (through steam reformation of methane) and carbon dioxide (as a biproduct), before the ammonia is stripped down to a compound which is then dehydrated to produce the pure urea.				
Information on gas attributes, volumes, price band required	According to stakeholders approximately 80% of the production cost for a unit of urea is the cost of natural gas as an input. Analysis of the Perdaman Urea Project suggests a feedstock of 125TJ/day for a 2.0mtpa facility, yielding a production ratio of 43.8GJ per tonne of urea. Stakeholder feedback suggests urea has a relatively high tolerance for gas prices compared to other gas-based industries given it is a high value product.				
Linkage to existing WA industry, project or new opportunity	There are currently three active urea projects in various stages of development in Western Australia: the Perdaman Chemicals and Fertilisers plant on the Burrup Peninsula, Strike Energy's proposed urea project in the Mid West, and the Derby Fertilisers and Petrochemical Complex in the Kimberley. Of these, the Perdaman project is the most advanced having received a funding commitment from the Western Australian Government for infrastructure as well as progressing to detailed environmental approval.				

5.2.2 Opportunity #2: Methanol

Methanol is an alcohol-based chemical with wide application in the chemicals industry. It is used in the production of fuels, medicines, antifreeze, as well as transformation into a number of additives and reagents used across industry (including formaldehyde and acetic acid). It is one of the most widely traded chemicals in the world due to the complex production process and need for access to high volumes of natural gas.

Opportunity #2: Methanol					
Description of plant & infrastructure requirements	Methanol production from natural gas takes place in three stages: firstly, the gas is converted into synthesis gas through a process of steam reforming. The synthesis gas then undergoes a catalytic reaction process to produce the methanol, finally the methanol goes through a purification process before being placed in storage. High Co2 gas fields are favourable for Methanol production gas Co2 is used as a raw input for the first-stage steam reforming process.				
Primary markets (based on value of imports)	China	Netherlands	USA	India	Indonesia
	$2,910m (42.7%)	$796m (11.7%)	$770m (11.3%)	$632m (9.3%)	$280m (4.1%)
Value of international trade (2019, $m) and long term trend	**Value of international trade** $6,765 million (2019)		**International trade trends** 10 year CAGR: 1.2%		
Role of natural gas in production process	Natural gas is the primary feedstock for Methanol. The Co2 separated from the natural gas, which is often present in offshore subsea reserves, is also used as an input to the reforming process.				
Information on gas attributes, volumes, price band required	A competitive methanol operation to succeed in the North-West of WA, the operation would need access to around 220 TJ/d of natural gas supply, which is around 15% of the current total domestic gas market.				
Linkage to existing WA industry, project or new opportunity	There has been active interest in methanol projects in Western Australia in the past, including around the time Yara Pilbara's ammonia plant was commissioned in 2006. The Coogee-led consortium investigating an opportunity in the Burrup SIA was considering methanol as its primary output.				

5.2.3 Opportunity #3: Ethylene

Ethylene is one of the world's most important basic chemical products. It is used as the foundation chemical for a range of plastics and solvents including polyethylene, lubricants and antifreeze for motor vehicles, and in the agriculture industry. It is produced from ethane, which is less abundant than methane in natural gas. The product is typically produced in high volumes at sites close to feedstock gas, and is then exported to plants for further processing into higher value added products. A further structured description of ethylene in the context of this study is presented below.

Opportunity #3: Ethylene					
Description of plant & infrastructure requirements	Ethylene can be produced through the steam cracking of light naphtha or ethane. For gas to ethylene production, ethane is steam cracked then chilled, and then fractionated through de-ethyleneister, de-methaneiser and de-ethaneiser columns to complete the process. Ethylene is then used to produce polymers, most commonly HDPE and LDPE for plastics manufacturing.				
Primary markets (based on value of imports)	China	Belgium	Indonesia	Netherlands	Sweden
	$2,384m (35.0%)	$1,880m (27.6%)	$619m (9.1%)	$569m (8.4%)	$125m (1.8%)
Value of international trade (2019, $m) and long term trend	**Value of international trade** $6,811 million (2019)		**International trade trends** 10 year CAGR: 3.7%		
Role of natural gas in production process	Ethane is a found in onshore and offshore conventional natural gas plays (as opposed to coal seam gas which is 100% methane). The ethane from the conventional natural gas is used as the primary feedstock.				
Information on gas attributes, volumes, price band required	Ethylene cracking is most favourable in geographies with access to stable and low-cost gas, where the gas has a high composition of ethane. In the Australian context, Qenos's Altona operations were originally developed as a naphtha cracking ethylene complex when built in 1983 and was converted to ethane at the height of Gippsland basin production in 1996 to utilise low-cost ethane from the Mobil Australia and BHP operated fields offshore Victoria.				
Linkage to existing WA industry, project or new opportunity	Ethylene is only one part of the integrated plastics manufacturing supply chain. Whilst there may be potential for downstream plastics opportunities to arise such as high density and low-density polyethylene (HDPE and LDPE), WA does not have a significant market where base plastics could be value added locally. With pricing for both ethylene and polymer derived base plastics indexed to regional benchmarks, WA would be unlikely to provide the market conditions for such a competitive vector of the petrochemical industry.				

5.2.4 Opportunity #4: Ammonia

Ammonia is a basic organic chemical product which is among the most produced chemicals in the world. It has a wide range of applications, the majority of which are as an input into the production of other chemical compounds. According IHS Markit, approximately 80 per cent of the world's production of ammonia is used as a feedstock into nitrogen-based fertilisers (including urea).[4] A further structured description of ammonia in the context of the study is presented below.

Opportunity #4: Ammonia					
Description of plant & infrastructure requirements	Ammonia plants are integrated chemicals production facilities, which require access to high volumes of non-saline water and natural gas (the two primary inputs in the production process) as well as electricity. Ammonia is produced as a gas which can be cooled to allow for ease of transport, typically via pipelines or bulk liquids vessels. Ammonia plants are often part of broader integrated chemicals production plants, including in urea plants (where an ammonia production train will provide feedstock for a urea train).				
Primary markets (based on value of imports)	India	USA	South Korea	China	Belgium
	$775m (11.4%)	$745m (10.9%)	$398m (5.8%)	$326m (4.8%)	$309m (4.5%)
Value of international trade (2019, $m) and long term trend	**Value of international trade** $4,469 million (2019)		**International trade trends** 10 year CAGR: (0.5%)		
Role of natural gas in production process	Ammonia is primarily produced through the steam reformation of natural gas. This involves the processing of natural gas into hydrogen, and injection of nitrogen compounds from the air. The process then results in the stripping of biproducts include carbon dioxide to produce the final ammonia gas.				
Information on gas attributes, volumes, price band required	Analysis by the International Energy Agency suggests ammonia requires 42GJ per tonne of liquid ammonia. Natural gas is the primary input into the production of ammonia, with water and nitrogen (from air) the other inputs. ACIL Allen understands ammonia plants require relatively low gas prices, with projects seeking between US$2 and US$4 per GJ gas prices on long terms, with term particularly important due to the lack of linkage between ammonia prices and energy prices generally.				
Linkage to existing WA industry, project or new opportunity	Yara Pilbara currently operates an ammonia plant on the Burrup Peninsula with a production capacity of 0.8mtpa. The facility is primarily for export of ammonia, although a portion of the ammonia production is retained for the production of technical ammonium nitrate (~0.3mtpa). Ammonium nitrate is produced by other projects across Western Australia.				

[4] IHS Markit. 2020. *IHS Markit Chemicals Economics Handbook, Ammonia (Summary)*. Accessed online at http://www.ihsmarkit.com/

5.2.5 Opportunity #5: Liquefied Natural Gas (LNG)

Liquefied Natural Gas ('LNG') is a processed form of methane gas which is able to be transported over long distances in specialised pipelines or vessels. Natural gas is first processed to remove impurities and then cooled to extremely low temperatures, resulting in the gas turning to liquid and reducing in volume by up to 600 times. The product is then "regasified" at import or receival terminals, where it can be used as an energy source or as an input into chemical production. Western Australia is one of the world's largest LNG producers, while the development of LNG projects has been the catalyst for existing heavy industry development in the State. A further structured description of LNG in the context of this study is presented below.

Opportunity #5: Liquefied Natural Gas (LNG)					
Description of plant & infrastructure requirements	LNG is produced in integrated supply chains linking upstream natural gas production and processing facilities to liquefaction chains and finally to export infrastructure. Liquefaction refers to the cooling of natural gas which has been processed to a standard specification. The process requires a large amount of energy, which is typically provided by the combustion of some of the natural gas produced in the supply chain. LNG is then distributed via pipeline or as in Western Australia is loaded onto specialised tanker vessels for export.				
Primary markets (based on value of imports)	Japan	South Korea	Indonesia	Spain	France
	$44,124m (32.0%)	$22,647m (16.4%)	$11,760m (8.5%)	$8,742m (6.3%)	$8,458m (6.1%)
Value of international trade (2019, $m) and long term trend	**Value of international trade** $130,843m (2019)		**International trade trends** 10 year CAGR: 66.1%		
Role of natural gas in production process	Natural gas is central to the production of LNG as the LNG itself is almost exclusively methane gas by the time it reaches the liquefaction stage. Other hydrocarbon components of the natural gas (such as condensate and LPG) are stripped throughout and can be sold separately.				
Information on gas attributes, volumes, price band required	The cost of extracting gas upstream is the primary variable cost associated with an LNG project once established, as LNG prices are set by long term contracts or a spot market. Infrastructure costs are generally treated as fixed costs over the life of a project. In Western Australia's experience LNG projects have been underwritten by the discovery of high volume, low cost supplies of natural gas. Over time, LNG production facilities could evolve beyond fully integrated supply chains to allow for upstream suppliers to sell gas into LNG production as opposed to it being an internal transaction.				
Linkage to existing WA industry, project or new opportunity	Western Australia's LNG industry has an installed capacity of 50 million tonnes per annum (including the offshore Prelude floating LNG plant). The owners of these LNG plants are responsible for fulfilling domestic market obligations of various sizes.				

5.2.6 Opportunity #6: Gas-to-liqiuds

Gas-to-Liquids refers to the opportunity to refine natural gas into heavier petroleum products for consumption. It is a relatively well developed technology, although the application has tended to be in niche regions of the world where there is access to abundance gas for processing. A further structured description of Gas-to-Liquids is presented below.

Opportunity #6: Gas to liquids					
Description of plant & infrastructure requirements	Gas-to-Liquids (GTL) technology is a highly complex process which in recent years has been highlighted by the Royal Dutch Shell technology used at the flagship Shel operated GTL plant in Qatar. The process begins by producing methane from the natural gas through the same process detailed above in **Figure 4.2.2.** The gas then goes through a synthesis process before being hydrocracked and distilled. Products that can be produced are naphtha, kerosene, diesel, ethene, LPG, and condensate.				
Primary markets (based on value of imports)	USA	Mexico	Nigeria	Indonesia	Singapore
	$42,702m (17.9%)	$29,051m (12.2%)	$19,369m (8.1%)	$19,25m7 (8.1%)	$18,146m (7.6%)
Value of international trade (2019, $m) and long-term trend	**Value of international trade** $238,378m (2019)		**International trade trends** 10-year CAGR: 2.9%		
Role of natural gas in production process	Natural gas is used as the primary import feedstock				
Information on gas attributes, volumes, price band required	The Kwinana Clean Fuels GTL project suggested a demand of around 50 PJ per year (~137 TJ/d) to be economical. A GTL project at thus scale could operate economically at < A$5 / GJ gas, but given the highly volatile pricing of refined petroleum products, the price would have to be consistently under that price band for the duration of the project operation.				
Linkage to existing WA industry, project or new opportunity	WA has very flat gasoline demand, and the export economics for gasoline from Western Australia are likely to be below par, even from a GTL plant with low-cost natural gas feedstock. GTL produced diesel would be welcome for use in the WA mining industry, where decarbonisation initiatives are beginning to ramp up and no feasible replacement for traditional oil based diesel exists.				

5.2.7 Opportunity #7 and #8: Blue and green hydrogen

Hydrogen was raised by a number of stakeholders as a potential downstream industry development opportunity for Western Australia. Hydrogen is a challenging industrial product to classify in a traditional assessment framework for a number of reasons, specifically:

— Hydrogen has multiple potential uses across society, including as a primary energy source through combustion, an energy storage solution, an input into chemical processes, and a substitute input with the potential to disrupt current chemical processes.

— Hydrogen can be produced through a variety of processes, which is where the terms “grey hydrogen”, “blue hydrogen” and “green hydrogen” emerge.

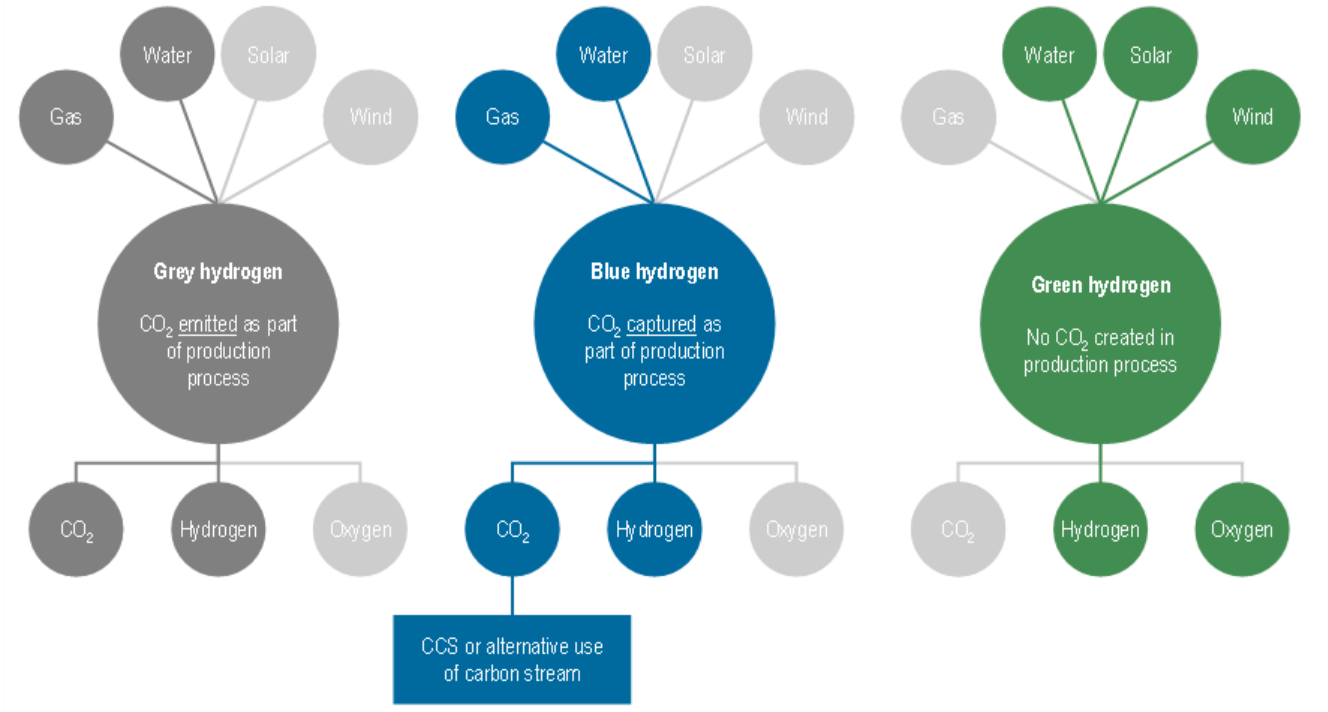
— Hydrogen technologies are not new or novel, and have been used in varying applications for decades. The current renewed interest is centred on the potential to deploy these applications at scale, or to apply them to solve different issues and challenges.

Underscoring this, ACIL Allen itself has been involved in the strategic discussion with respect to hydrogen in Australia since 2003 when it prepared the first *National Hydrogen Strategy*. At that time, ACIL Allen identified that hydrogen could be an important technology to assist in decarbonisation of industrial activity.

The scope of this study is to consider opportunities for the development of gas-based downstream industries in Western Australia. While hydrogen is central to this – hydrogen is an intermediate input in the production of ammonia and in turn urea, for example – the production of hydrogen as a new industry itself is typically centred on **renewable hydrogen**.

There are three primary production processes for hydrogen at an industrial scale. These are presented below (**Figure 5.2**). Hydrogen produced as part of the ammonia and urea production processes technically fulfills the definition of grey hydrogen, in that the carbon stream associated with the steam reformation process is part of a waste gas stream which is flared rather than used in the production process.

Figure 5.2 Hydrogen opportunities



Source: ACIL Allen adapted from Bloomberg

The Western Australian Government has a number of renewable hydrogen initiatives underway or in the planning phase. These include a *Renewable Hydrogen Strategy*, and within this a

Renewable Hydrogen Roadmap and *Renewable Hydrogen Fund* which is available for pilot projects and feasibility studies. In addition, the Western Australian Government commenced an Expression of Interest process for the development of a Renewable Hydrogen precinct at the Oakajee Strategic Industrial Area north of Geraldton in the Mid West region of the State.

Implications for this study

Given the above, ACIL Allen elected to exclude hydrogen from further consideration in this engagement. This is because this project is primarily centred on consideration of gas-based downstream industry development opportunities, while the Western Australian Government's focus is firmly on renewable hydrogen. In addition, hydrogen production in the context of gas-based downstream industry development appears to be primarily as part of the production process for other opportunities.

5.2.8 Opportunity #9: Steel and steel inputs

Steel production is one of the most critical industrial supply chains in the global economy. Steel is used to build cities and infrastructure in support of the world's growing population, to manufacture components for industrial plants and other developments, and as a component of appliances and machines in every sector of society.

According to the OECD,[5] global steelmaking capacity has more than doubled over the past 20 years, with total installed steel production capacity rising from 1.13 billion tonnes per annum to 2.36 billion tonnes per annum. The vast majority of this growth has occurred in China, which has increased its steelmaking capacity from 222.6 million tonnes to over 1.15 billion tonnes between 2000 and 2019. India has grown its capacity by a similar magnitude (albeit from a smaller starting position), with capacity rising from 34 million tonnes to 129.1 million tonnes. Together China and India account for 83 per cent of the growth in capacity over this period.

By contrast, Australia's steelmaking capacity has declined from 8.1 million tonnes to 5.4 million tonnes. At a local level, Western Australia has no major steelmaking facilities. This is despite Western Australia itself producing one third of the world's total iron ore supply[6].

Traditional steelmaking techniques are carbon intensive. The International Energy Agency concluded steel production contributes approximately seven per cent of global greenhouse gas emissions (in CO_2-equivalent terms), through the combustion of energy in blast furnaces and the chemical process involved in the formation of carbon steel from coal and iron.[7]

Like most heavy industry, steelmaking is driven by economies of scale and the ability to foster competitive and comparative advantages in inputs costs and production processes. This is why steelmaking capacity has surged in China and India in line with their respective economic development paths. Western Australia has traditionally been able to play a central role in the global steelmaking supply chain through provision of iron ore. However, the successful development of renewable hydrogen may present an opportunity for the State to move up the value chain and add additional value to iron ore prior to export.

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[5] OECD. 2020. *OECD World Economic Database, Industry and Services, Steelmaking Capacity (thousands of tonnes)*. Accessed online at http://www.stats.oecd.org/

[6] Department of Mines, Industry Regulation and Safety. 2020. *Resources economic statistics, 2019-20*. Accessed online at http://www.dmp.wa.gov.au/

[7] International Energy Agency. 2020. *Iron and steel technology roadmap*. Accessed online at http://www.iea.org/

The potential for **green steel** has been recognised by the Western Australian Government as an industry development opportunity as part of its State Climate Policy. Green steel involves a reorientation of the steelmaking process in two ways:

— replacement of carbon-based fuels (such as coal) used to provide heat in the production of pig iron with hydrogen. Pig iron is processed iron ore which removes oxygen and other impurities prior to the steelmaking process. The traditional approach results in carbon emissions (principally CO_2), while replacing this with hydrogen results in H_2O (water) as a biproduct. This approach still requires the addition of a carbon stream.

— replacement of blast furnaces (which inject heated oxygen into molten pig iron to create the chemical reaction that produce carbon steel) with electric arc furnaces powered by renewable electricity. The traditional blast furnace approach results in significant fugitive carbon emissions, while the electric arc furnace results in substantially less emissions – particularly if the heat of the electric arc furnace is generated with renewable electricity.

These technologies are early stage, with pilot projects underway in Europe.[8] At a local level, Fortescue Metals Group announced its plans for a pilot green steel project in January 2021.[9] It is thought Western Australia's potential opportunity is centred on the processing of iron ore into pig iron or equivalent products prior to export (the first of the two points above).

Implications for this study

Green steel represents an interesting and important opportunity for investigation, particularly given Western Australia's current comparative advantage in the production of iron ore and potential emerging comparative advantage in the production of green hydrogen. However, with the technologies associated with green steel still in development, and the opportunity being centred on the replacement of gas as an energy source, green steel is considered outside of the scope of the study.

Notwithstanding, it is evident from this initial desktop review that green steel represents an important emerging opportunity for Western Australia outside of gas-based industry development opportunities. The State Climate Policy includes a number of recommendations for future studies and investigations into the opportunity, which should be actioned.

Finding 4 Green steel

Green steel technologies represent a non-gas based downstream industry development opportunity for Western Australia, given its existing iron ore production and renewable energy potential. Further research and analysis should be conducted, as an extension of work underway to investigate the feasibility of green hydrogen and associated supply chains given the prospective role of the technology in the decarbonisation of the steelmaking process.

5.2.9 Opportunity #10: Aluminium

Aluminium is raised as a potential opportunity in the context of Western Australia's existing alumina and bauxite industries, and the abundance of bauxite resources in situ across the south west of the

[8] Mazengarb, M. 2020. *World-first fossil-free steel manufacturing plant completed in Sweden, Renew Economy published 1 September 2020*. Accessed online at http://www.reneweconomy.com.au/

[9] Forrest, A. 2021. *Excerpt from 2021 Boyer Lecture by Dr Andrew Forrest AO*.

State. The product does not strictly fit the profile of primary opportunities in this study as gas is not a feedstock for the production of aluminium, but rather it can be used as a heating source.

Aluminium is one of the world's most important and widely traded industrial commodities, with applications across industrial and consumer products. This is due to the relatively light weight and flexibility of the metal, and relative ease of alloying with stronger metals for an even more diverse range of products; including aeroplane hulls, electrical transmission infrastructure and shelf stable food containers.

Aluminium is the final product of a process which begins with bauxite, a rock with high aluminium content. Bauxite is mined in the south west of Western Australia, and beneficiated into the secondary product alumina at refineries which are located between mines and ports. Alumina is in turn used in a range of products, although the vast majority is further refined into aluminium and then aluminium alloys.

Western Australia produced 14 million tonnes of processed alumina in 2019-20, or 10.5 per cent of the world's alumina.[10] This would make Western Australia the second largest alumina producer in the world if it were its own country. The vast majority of this alumina is shipped to customers outside of Australia, with a small share retained for processing at Australia's four aluminium smelters in New South Wales, Queensland, Tasmania and Victoria.

According to Alcoa Australia and South 32, it takes approximately two units of alumina to produce one unit of primary aluminium – in addition to the heat, electricity and water used in the production process. If Western Australia were able to foster a globally competitive aluminium industry, the State's productive capacity could be as high as seven million tonnes per annum, which would see Western Australia sit behind just China as a producer.

Implications for this study

The aluminium production process differs from other mineral and metal production processes in that heat does not play as strong a role throughout the entirety of the value chain. The primary use of gas as a heating source occurs in the processing of bauxite into alumina, where the aluminium process is driven by electricity as opposed to heat. Given this, a decision was taken to exclude aluminium from further consideration in the study, as its production is not centred specifically on the use of natural gas.

5.2.10 Opportunity #11: Other minerals processing including battery minerals

The processing other mineral products outside of steel and aluminium was raised by stakeholders throughout the consultation process. This includes the processing of battery minerals and rare earth elements for use in energy storage technologies and other emerging technologies. Further processing of minerals products was raised in the context of Western Australia's mineral endowment and current success in some areas with processing of raw commodities into value-added products, such as nickel sulphate, lithium hydroxide and high purity alumina.

Implications for this study

While an important component of the State's heavy industry development, processing of minerals into value-added products is considered outside of the scope of the study. This is for two primary reasons. First, gas is used as an energy source only, meaning the objectives of the study are not

[10] Ibid.

relevant. Second, and more pertinently, the Western Australian Government has existing policy frameworks and plans to address opportunities specific to battery minerals and rare earths.

Finding 5 Opportunities outside of gas-based downstream industries

Stakeholders identified a range of opportunities for value-added manufacturing and downstream processing of materials which were not within the scope of the study. These include green industries such as green hydrogen and green steel, where natural gas is not a primary input. Stakeholders also raised processing of the State's mineral endowment as an opportunity, which is considered out of scope due to gas being used as an energy source only.

5.3 Multicriteria assessment of opportunities

The consideration of gas based downstream industries in Section 5.2 demonstrates there is strong interest and potential in this space in Western Australia. In order to narrow down the list to the most prospective opportunities, ACIL Allen has developed a simple multicriteria assessment ('MCA') framework. The purpose of the MCA is select three opportunities to carry forward as the "strawman" industries to assist in the articulation of gas market requirements, critical success factors and policy options for the Western Australian Government. These projects will also be subject to the high level economic impact assessment in the final section of the report.

5.3.1 Multicriteria assessment

MCA is a commonly used technique to assess policies, programs or investment opportunities, as it seeks to introduce a logical framework for first determining preferences and then assessing how well options meet preferences compared to all other options on balance across the suite of preferences. Typically an MCA is a two step process. The first step involves the development of a series of weighted selection criteria, which are intended to reflect the balanced priorities and/or outcomes an investment is seeking to foster. The second step involves scoring each option against each criteria, and then determining an overall score by multiplying the scores by the weights of the criteria.

In this case, ACIL Allen's MCA assesses each of the 11 opportunities introduced in the previous section on a simple Yes/No basis on four criteria. The three opportunities which score the highest are carried forward in the remainder of the report. These four criteria are:

1. Is the opportunity centred specifically on the use of natural gas in the production process?
2. Is there active interest (defined as an existing project, a project being publicly announced, or a project having commenced an environmental approvals process in the past five years) in the opportunity?
3. Is the opportunity conducive to low carbon production or decarbonisation over time, in line with the intent and directions provided by the State Climate Policy?
4. Is the opportunity subject to a Western Australian industry and/or economic development policy or strategic plan?

The criteria have been selected to ensure the opportunities which are identified are those which are most active and prospective here and now, over those which are more speculative in nature. The criteria also ensure opportunities which align to Western Australian Government policy are prioritised over those which are not aligned.

Where the scoring results in more than three opportunities being scored at a level which would see them carried forward, the MCA prioritises opportunities which score a "Yes" on the first criteria, then the second, and so on.

The results of ACIL Allen's MCA are presented below (**Table 5.1**).

Table 5.1 Multicriteria assessment of downstream gas opportunities

Assessment criteria	Urea	Methanol	Ethelene	Ammonia	Gas-to-liquids	LNG	Blue hydrogen	Green hydrogen	Steel	Aluminium	Other minerals
Q1: Gas-centric?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Q2: Active interest?	Yes	Yes	No	Yes	No	Yes	Yes	Yes	No	No	No
Q3: Renewables potential?	Yes	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes
Q4: WA policy / strategy?	No	No	No	No	No	Yes	No	Yes	No	No	Yes
Score (raw)	3/4	3/4	1/4	3/4	1/4	3/4	2/4	3/4	1/4	1/4	2/4
Final score	**6/7**	**6/7**	N/A	**6/7**	N/A	5/7	N/A	5/7	N/A	N/A	N/A

Source ACIL Allen:

The MCA suggests there are three opportunities which stand out against the rest, with scores of four out of five in the MCA. These are urea, methanol, and ammonia.

A fourth opportunity – green hydrogen – scored three out of four in the first stage scoring of the MCA, but due to its lack of status as a specific gas-centric opportunity it did not reach the same final score of six out of seven when the recount of the MCA commenced at the first criteria. Similarly, LNG was knocked out despite scoring three out of four in the first stage scoring due to a lack of low carbon potential (in this case, interpreted as the fact LNG can be decarbonised to an extent but not completely). A deeper examination of the infrastructure and production processes for a urea plant, methanol plant and ammonia plant are provided in the next section.

5.4 Identification of commonalities in short list options

This section provides further analysis and discussion of urea, methanol and ammonia in the context of the study.

5.4.1 Demand profile and outlook

For each of the three opportunities which have reached the shortlisting stage, growth in demand appears to be shifting towards the Indo-Pacific region. This is demonstrated by a ten year view of international imports by country,[11] which shows:

— The share of globally traded **urea** heading to markets in the Indo-Pacific region reached a ten year high of 24.9 per cent in 2019, above the decade average of 20.1 per cent. The shift has been particularly pronounced in the past three years with the share of trade growing from 15.2 per cent to 24.9 per cent.

[11] United Nations. 2021. *UN Comtrade Database.* Accessed online at http://www.comtrade.un.org/

— The gross value of imported **ammonia** products in the Indo-Pacific region has declined over the past five years, reaching US$1.8 billion in 2019. Research suggests a decline in the value of trade is a price issue, rather than a volume issue. However, the share of globally traded ammonia heading into the Indo-Pacific region has increased from 23 per cent in 2009 to 33.6 per cent in 2019.

— Over half of the world's traded **methanol** was destined for the Indo-Pacific region in 2019, with global imports totalling $5.7 billion. China alone imported some $2.9 billion of methanol in 2019, with its share of global imports increasing from 13.7 per cent in 2014 to 27.8 per cent in 2019.

Finding 6 Demand growth is in our region

Prospective downstream project proponents are responding to long term growth trends for basic chemical and fertiliser products from three main centres: China, India and South East Asia. Western Australia's relative location compared to other sources of natural gas feedstock is attractive to downstream project proponents.

5.4.2 Feedstock and production processes

As discussed in Section 5.2, each of the three products identified for further consideration in the study require natural gas as a critical feedstock for the chemical processes undertaken to produce the final product. According to various sources:[12]

— one tonne of **ammonia** requires between 38GJ and 46GJ of natural gas feedstock,

— in turn one tonne of **urea** requires 0.58 tonnes of ammonia, meaning the gas feedstock for one tonne of urea is approximately 22GJ to 26.7GJ of natural gas – closer to the lower end if ammonia is produced as part of an integrated plant due to fewer losses, and

— one tonne of **methanol** requires between 31GJ and 34GJ of natural gas.

There are additional energy requirements to provide electricity and heating to the production process for each opportunity, however there is no general rule of thumb for this due to capacity factors and thermal efficiency variables which are at play. The non-feedstock gas input requirements are substantially lower than feedstock requirements.

While the precise production process for each product differs, the general principles are the same. Natural gas feedstock is input into a series of production trains, which heat and cool the gas and inject the gas with or strip from the gas various molecules to produce intermediate and then finals products. The production processes typically require input of hydrogen, oxygen and/or nitrogen from the air and/or water.

Current production methods typically result in direct carbon dioxide emissions, particularly from ammonia and methanol. The IEA suggests a general rule of ~0.8 tonnes of carbon emissions per tonne of final methanol produced, and ~2.4 tonnes per tonne of final ammonia. Urea production can offset part of the emissions from ammonia production if part of an integrated production process, as carbon dioxide is combined with ammonia to form urea. Precise estimates of carbon emissions will depend on the CO_2 content of the natural gas feedstock used to produce the particular product.

[12] Sources include the International Energy Agency

5.4.3 Plant and infrastructure requirements

With the above production processes in mind, it is evident from a review of environmental approval documents lodged by project proponents[13] that there are a range of common infrastructure requirements for gas-centric downstream industry opportunities. These include:

- On-site power generation, which in the projects reviewed by ACIL Allen appears to typically centre on natural gas fired power generation,
- Access to non-saline water, which in the projects reviewed by ACIL Allen appears typically provided by an on-site desalination plant which is connected to a seawater supply pipeline and brine discharge pipeline,
- An air separation unit, to create pure oxygen or nitrogen from the air for input into the production process,
- Access to gas supply, which in the projects reviewed by ACIL Allen appears typically provided by a lateral pipeline from a major gas pipeline to allow natural gas to flow directly into the production plans,
- Storage tanks for fuels, intermediate products and final products prior to transport to export facilities, and
- Access to bulk export capabilities, centred on both landside and waterside infrastructure. On the land side, proponents require direct access to shiploading infrastructure, port-adjacent storage sheds and appropriate freight corridors. On the waterside, proponents require deep water berths that cater for bulk cargo ships, as products are sold as either liquid or bulk solid materials.

Of note is the majority of these facilities could be characterised as “non-plant” infrastructure, insofar as they are either providing inputs into a production process, or transporting the outputs from the production process to the point of export. This is an important consideration explored further in Section 7.3.1.

5.4.4 Gas input cost requirements

The economics of an individual downstream industry project vary considerably according to a number of factors. This issue is discussed is greater detail in Section 7. However, throughout the engagement ACIL Allen consistently observed that a delivered gas price of between $3.00/GJ and $5.00/GJ was considered to be a reasonably competitive price in the context of greenfield downstream industry projects in a Western Australian context. Many downstream proponents indicated they were seeking prices at the low end of this range – hence the challenge in securing supply.

All things being equal, a lower gas price would improve the project economics for a downstream industry proponent due to the significant impact gas feedstock has on the overall variable production cost of products. The feedstock price in effect sets the gross margin of the product, and the financial capacity of the project’s revenue to cover capital costs, financing costs, and deliver a rate of return. With many downstream projects subject to long term, fixed price offtake contracts for supply, a “long, low” gas price is preferred over shorter term contracting cycles.

[13] Projects reviewed include the Collie coal-to-urea project (Perdaman), Burrup Urea Project (Perdaman), the Methanol Complex, Burrup Peninsula (Methanex Corporation), Downstream Chemical Production Facility (Wesfarmers Chemicals, Energy & Fertilisers), and Ammonia Plant, Burrup Peninsula (Dampier Ammonia, now Yara Pilbara)

Finding 7 Prospective project commonalities

ACIL Allen observed a range of commonalities between prospective downstream projects in Western Australia, which are important context when assessing the potential policy responses and interventions to assist in bringing projects to fruition. These commonalities are sourced from ACIL Allen's analysis in this section, as well as the feedback of stakeholders in Section 4.

These include:

— Projects are long term in nature, typically with a plant life of at least 20 years,

— Projects are capital intensive, with limited direct employment following commissioning,

— Projects are export focussed, due to economies of scale benefits and a small local market,

— Projects are typically require bank finance and are well suited to this form of project financing, and

— Projects are typically integrated production and export projects.

Given the above, the value-adding gas opportunities of most interest to Western Australia exhibit many of the same attributes as LNG projects.

ACIL Allen also observed the target delivered gas price into a greenfield downstream industry project was consistently in the range of between $3.00/GJ and $5.00/GJ, with proponents generally seeking a price at the low end of this range.

Estimating economic impacts

6

This section of the report provides an overview of the prospective economic impacts of gas-based downstream industry development projects in Western Australia. ACIL Allen has prepared these impacts using information gathered throughout the engagement on the capital and operating structures of projects, and uses its economic impact model Tasman Global to analyse and articulate how projects of various sizes impact on the WA economy.

6.1 Introduction

As part of its assessment of the gas-based downstream industry development opportunity for Western Australia, ACIL Allen has completed preliminary **economic impact assessments** on three hypothetical projects in Western Australia. The assessments are intended to provide a perspective on the overall economic impact on the State economy of the successful delivery of a downstream industry project, by assessing the impact on Western Australia's:

- **Real output**, in terms of Gross State Product. This reflects the change in production levels across the economy, taking into account the dynamic flow of labour and capital resources and how these impact on all sectors.
- **Real income**, which is a measure of the overall economic welfare impact of the project. Real income measures the net change in wages and salaries, company profits (retained in the jurisdiction) and taxation revenue, which are available for individuals, businesses and government to spend as they see fit.
- **Employment**, in terms of full time equivalent job years. This is the net change in total employment across the economy owing to the project, taking into account the demand for and supply of labour in the economy.
- **Taxation**, by major head of Commonwealth and State taxation.

To complete this assessment ACIL Allen has utilised its in-house computable general equilibrium ('CGE') model, *Tasman Global*. Further details are provided in Appendix A.

These assessments have been built from the bottom up, through the development of a simplified project financial model for three facilities identified as the most prospective opportunities for Western Australia. The project analogues are:

- Project 1: A **urea project** with capacity of two million tonnes per annum
- Project 2: A **liquid ammonia** project with capacity of one million tonnes per annum
- Project 3: A **methanol plant** with capacity of 2.5 million tonnes per annum

These projects are fundamentally similar, with gas feedstock and various chemical processes supported by capital equipment and an operational workforce. The projects are all targeting export markets. Each product is also part of the same industry sector within *Tasman Global*. Given this, ACIL Allen's approach is based on a standardised discounted cashflow model with various inputs

and assumptions made regarding the capital cost and its contribution, gas inputs in terms of volume, revenue in terms of volume and price of product, and labour inputs in terms of direct operational employment required to facilitate the project. Further detail on the inputs and assumptions is provided in the next section.

It is important to note the analysis presented in this section is relatively high level, compared to a more typical economic impact assessment completed by ACIL Allen on individual investment projects. ACIL Allen typically has access to project information from a proponent, including detail on the capital and operating expenditure and source of supply, and more information on project funding for taxation purposes. However, this simplified approach allows ACIL Allen to assess the economic benefits of these projects, and so is fit for purpose for this study.

6.2 Inputs and assumptions

ACIL Allen has developed the inputs and assumptions for the economic impact assessment using the outputs from technoeconomic assessments undertaken on gas-based downstream projects. This means the discounted cashflow analysis is based on a series of parameters established through studies of operating facilities around the world. ACIL Allen has developed the assumptions using four primary sources, being:

- Technoeconomic studies, particularly International Energy Agency (2019) *The Future of Hydrogen* and International Energy Agency (2017) *Techno-Economic Evaluation of HYCO Plant Integrated to Ammonia/Urea or Methanol Production*
- Previous economic impact studies undertaken to support the public environmental approvals process in Western Australia
- Feedback provided by stakeholders, particularly with respect to breakeven gas prices, target production volumes, and funding models.
- Proprietary ACIL Allen information, using existing relationships built into economic models and calibrating inputs and assumptions using previous work undertaken in the energy and manufacturing industries.

The most significant assumptions developed for the assessment are provided in **Table 6.1**. In all project cases, the discounted cashflow models developed to act as the base for the economic impact assessment exhibits the following overall attributes:

- **Construction period:** Two years
- **Operations:** 20 years
- **Sales:** Projects export 100 per cent of production
- **Plant availability:** 95 per cent of production capacity produced annually
- **Project ownership:** 20 per cent Western Australian ownership, 30 per cent Rest of Australia ownership, 50 per cent Rest of World ownership (as a simplifying assumption).

To isolate the impact of the processing of gas, the assessment is based on the capital and operations associated with the project only. This means the economic impact of the upstream production of gas as a feedstock for the plant in each scenario is excluded from the analysis. To give effect to this, a technical assumption is made that Western Australia imports 100 per cent of the gas feedstock used to produce the final products. As a result, the outputs of the study are conservative, as any additional development spurred on by or required to be developed alongside the downstream industry project would generate its own economic impact.

Projects are analysed as a “success case”, with flat real prices set at a level which ensures each project delivers a financial return over the 20 year period inclusive of repayment of debt, interest

expenses and corporate income taxes. Each project delivers an Internal Rate of Return of in excess of 13 per cent, and a Return on Equity of over 30 per cent.

Table 6.1 High level assumptions for economic impact assessment inputs

Input	Urea	Ammonia (liquid)	Methanol
Production capacity	2.0MTPA	1.0MTPA	2.5MTPA
CAPX per tonne	$1,600/t USD	$1,100/t USD	$375/t USD
OPEX	3% of CAPX	2.5% CAPX	2.5% CAPX
Gas	22.8GJ/t (~119TJ/day)	42GJ/t (~109TJ/day)	33.9GJ/t (~232 TJ/day)
Staff	180 operational staff	100 operational staff	150 operational staff
Long term price	US$250 flat real	US$350 flat real	US$295/t

Source: ACIL Allen from EIA, IEA, Environmental Protection Authority, S&P, various sources

The remainder of this section presents the results of the economic impact assessment, focussed on the impact on the Western Australian economy.

6.3 Results

The results of ACIL Allen's economic impact assessment on each of the model projects is presented below.

6.3.1 Project 1: Export scale urea project

In this scenario, the downstream project is assumed to be a large-scale urea project, with a production capacity of two million tonnes of urea fertiliser per annum. As a demonstration of the scale of the project, Australia's total imports of urea fertilisers were around three million tonnes in 2020.[14] At this scale, the project would be for export, or import replacement into the Australian market.

Over a 20 year project life, a facility of this scale would consume approximately 850PJ of gas as a feedstock, with additional gas required for power generation if gas was the fuel source. The additional gas demand would be equivalent between a 10 and 15 per cent increase in Western Australia's baseline level of gas demand in 2020.

The results of the economic impact assessment for the urea project are detailed below.

Impact on output (Gross State Product and Gross Domestic Product)

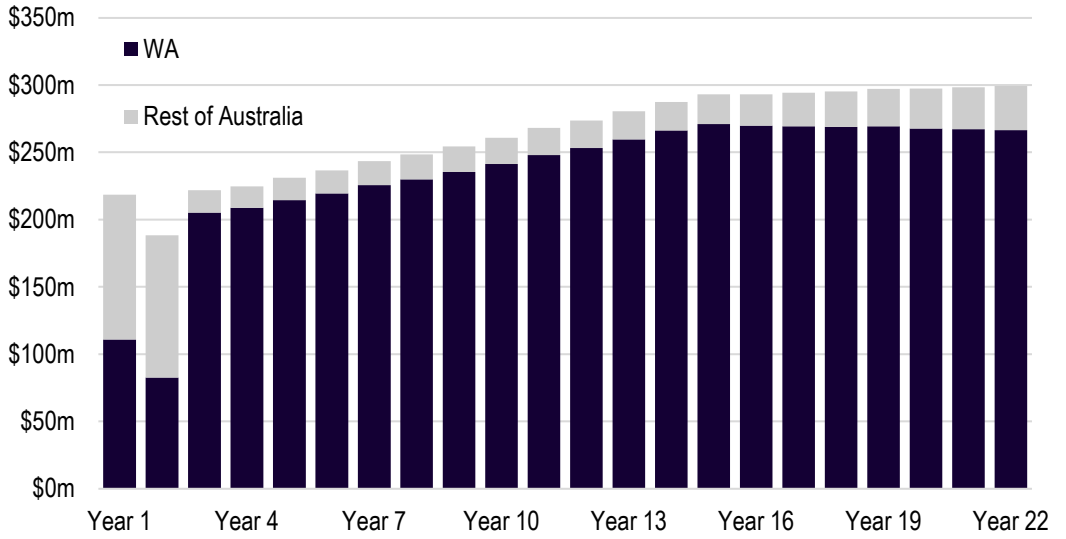
Overall, ACIL Allen's economic impact assessment on an export scale urea project suggests a project of this size would generate an additional **$5.8 billion in Gross Domestic Product** over the 20 year operating life (plus two years of construction), or $263.9 million per annum. The vast

[14] Argus Media. 2020. *Australia's urea import pace slows,* published 7 October 2020. Accessed online at http://www.argusmedia.com/

majority of this would be realised in Western Australia ($5.2 billion in Gross State Product, $234.1 million per annum), with the remainder generated across the other States and Territories ($0.7 billion, $29.8 million).

At a State level, the Gross State Product impact over the project's life is equivalent to a two per cent annual increase in the output of the manufacturing industry in each year of the study. The profile of the impact on the State's output is provided below (**Figure 6.5**). While the development of the project will generate additional economic activity during construction, once operational, the project will deliver additional gains to the State and national economy throughout the life of the project.

Figure 6.1 Real output impact of urea project, $m real 2021 dollars, by jurisdiction



Source: ACIL Allen

Impact on real income

Real income impacts reflect the net change in welfare across the economy, taking into account the cumulative impact on income earned by individuals, businesses and the public sector as a result of the project. ACIL Allen's assumptions regarding project ownership has a material impact on the welfare gains, as profits initially flow to these owners and only profits retained locally (in WA and Australia) are reinvested in the economy.

Overall ACIL Allen's economic impact assessment on a large scale urea project suggests a project of this size would generate **$5.9 billion of real income benefits** over the 20 year project life, or $269 million per annum. Unlike output, the majority of income benefits flow to the Rest of Australia, reflecting:

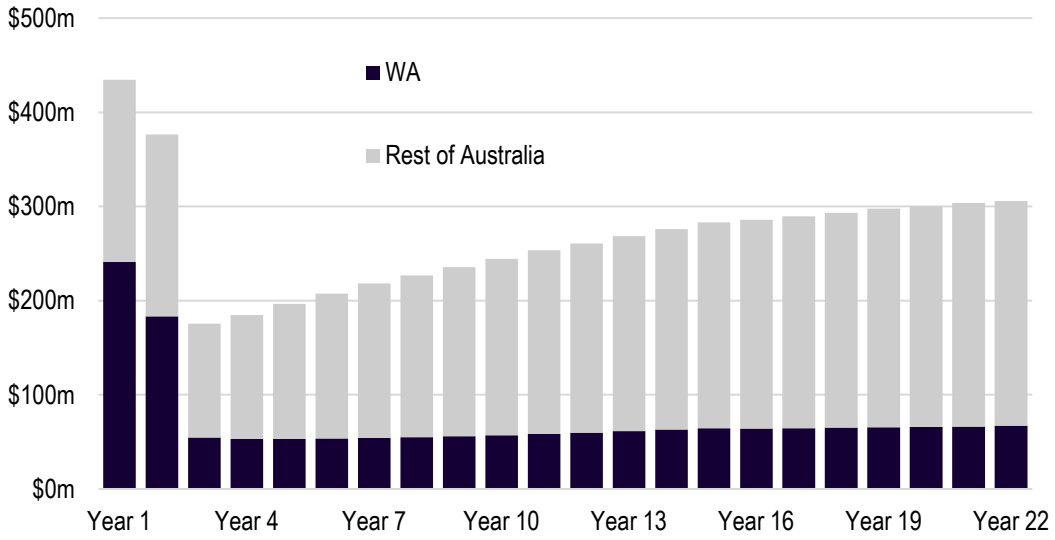
— the relatively low direct employment on the project (approximately 180 direct FTE jobs)

— company income tax receipts flowing to the Commonwealth Government

— higher degree of after-tax profits being distributed to owners outside of Western Australia

Notwithstanding, net welfare benefit of the project to Western Australians is some $1.6 billion over the life of the project, or $74 million per annum. The profile of the real income impact is presented below. The early spike in real income impacts reflects the additional labour and the purchase of goods and services required during the construction of the urea plant.

Figure 6.2 Real income impact of urea project, $m real 2021 dollars, by jurisdiction



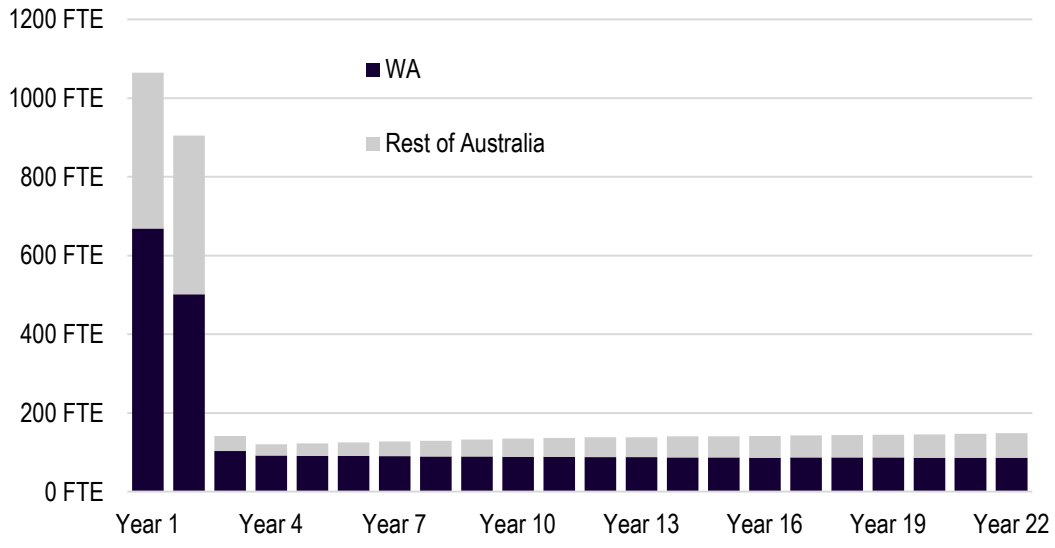
Source: ACIL Allen

Employment impact

Impacts on employment reflect the net overall change in employment levels across the economy as a result of the project. In dynamic economic models, crowding out effects – where scarce resources are redirected to their most productive use – result in net impacts on total employment which lower than direct impacts may allow.

This is the case with this assessment, with an average operational **employment impact across the Western Australian economy of 89.2 FTE jobs**, which is around half of the direct employment assumed to be required for the project. This is a result of assumptions which are currently used in ACIL Allen's CGE model, owing to a tightening labour market and continued border closures as a result of the COVID-19 pandemic. However, the employment impacts during construction are larger, generating some 585 FTE jobs across the two year construction period. The outputs of the study also demonstrate an average employment impact across the Rest of Australia of 47.9 FTE jobs. The profile of employment impacts is provided below (**Figure 6.3**).

Figure 6.3 Employment impact of urea project, FTE job years per annum, by jurisdiction



Source: ACIL Allen

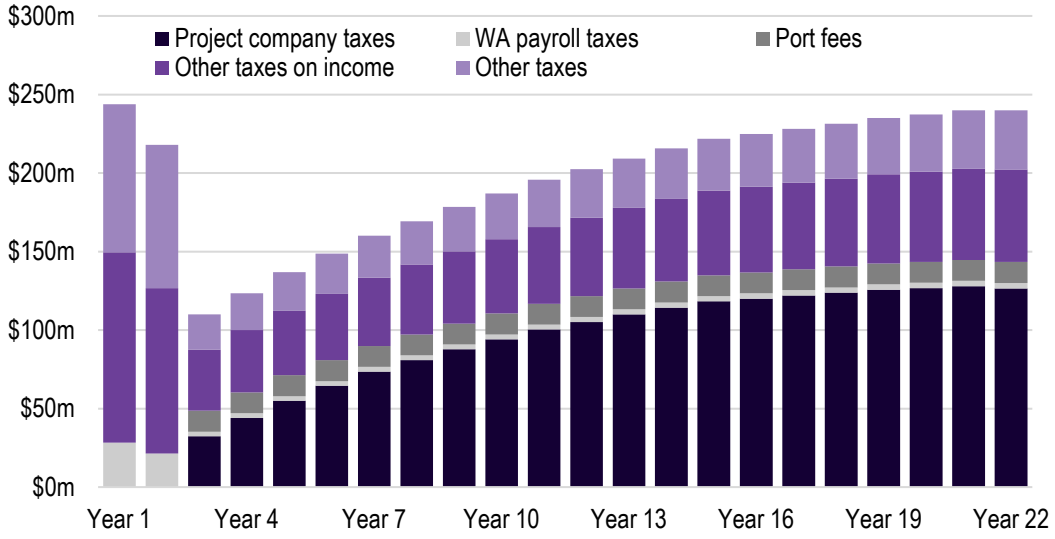
Taxation impacts

Overall ACIL Allen estimates an export scale urea project would generate a total of **$4.4 billion in Commonwealth and State taxation benefits** over the 20 year project life, or $198.1 million per annum. This estimate considers the impact of the capital structure of the project, with taxation benefits rising over time as the project repays debt and interest expenses decline.

The vast majority of the taxation benefits accrue to the Commonwealth, raising $4.0 billion across company income tax, excises and international trade taxation, and consumption taxes. Western Australian Government revenue streams include payroll tax ($114 million, $5.2 million per annum) and port fees and charges ($266 million, $12.1 million per annum).

The profile of taxation payments flowing from the project is presented below (**Figure 6.4**).

Figure 6.4 Real taxation impact of urea project, $m real 2021 dollars, by head of tax



Source: ACIL Allen

6.3.2 Project 2: Export scale ammonia project

In this scenario, the downstream project is assumed to be a moderate-scale liquid ammonia project, with a production capacity of one million tonnes of liquid ammonia per annum. This project is around 25 per cent larger than the Yara Pilbara ammonia facility, and reflects what is likely to be the minimum viable plant size for a greenfield development in Western Australia given capital disadvantages (discussed in Section 7.3).

Over a 20 year project life, a facility of this scale would consume approximately 800PJ of gas as a feedstock, with additional gas required for power generation if gas was the fuel source. This is only 50PJ (5.8 per cent) less feedstock gas than the large urea project analysed in Section 6.3.1, reflecting the higher gas feedstock requirement for ammonia.

The results of the economic impact assessment for the ammonia project are detailed below.

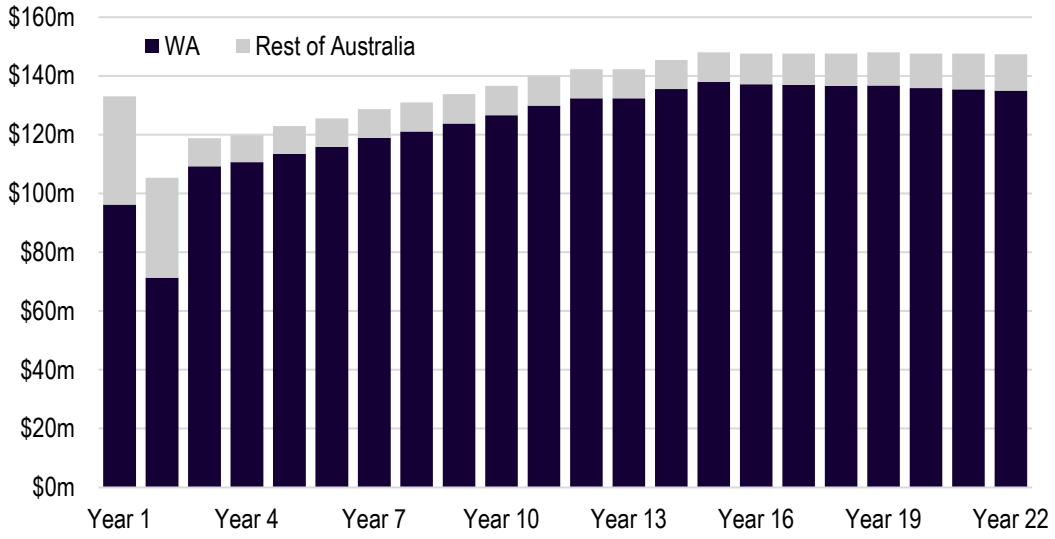
Impact on output (Gross State Product and Gross Domestic Product)

Overall, ACIL Allen's economic impact assessment on a medium scale ammonia project suggests a project of this size would generate an additional **$3.0 billion in Gross Domestic Product** over the 20 year operating life (plus two years of construction), or $136.7 million per annum. The vast majority of this would be realised in Western Australia ($2.7 billion in Gross State Product,

$124 million per annum), with the remainder generated across the other States and Territories ($0.3 billion, $12.6 million).

At a State level, the Gross State Product impact over the project's life is equivalent to a 1.5 per cent annual increase in the output of the manufacturing industry in each year of the study. The profile of the impact on the State's output is provided below (**Figure 6.5**). As with the urea project, the development of the project will boost economic activity during construction, and deliver ongoing gains to the State and national economy throughout the life of the project.

Figure 6.5 Real output impact of ammonia project, $m real 2021 dollars, by jurisdiction



Source: ACIL Allen

Impact on real income

Overall ACIL Allen's economic impact assessment on a medium scale urea project suggests a project of this size would generate **$3.5 billion of real income benefits** over the 20 year project life, or $159.2 million per annum. Unlike output, the majority of income benefits flow to the Rest of Australia, reflecting:

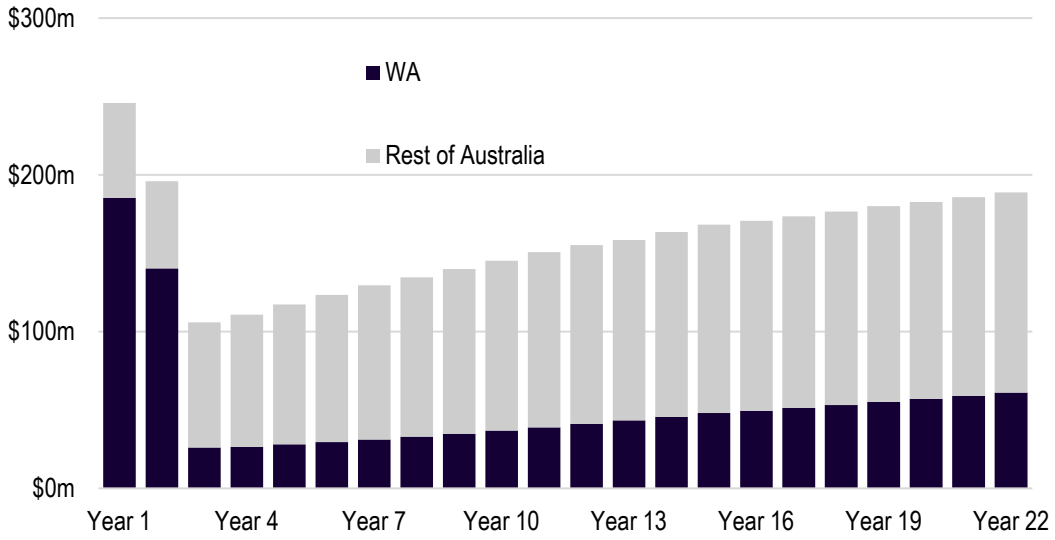
— the relatively low direct employment on the project (approximately 100 direct jobs)

— company income tax receipts flowing to the Commonwealth Government

— higher degree of after-tax profits being distributed to owners outside of Western Australia

Notwithstanding, net welfare benefit of the project to Western Australians is some $1.2 billion over the life of the project, or $53.4 million per annum. The profile of the real income impact is presented below. As with the urea project, the early spike in real income impacts reflects the additional labour and the purchase of goods and services required during the construction of the ammonia plant.

Figure 6.6 Real income impact of ammonia project, $m real 2021 dollars, by jurisdiction

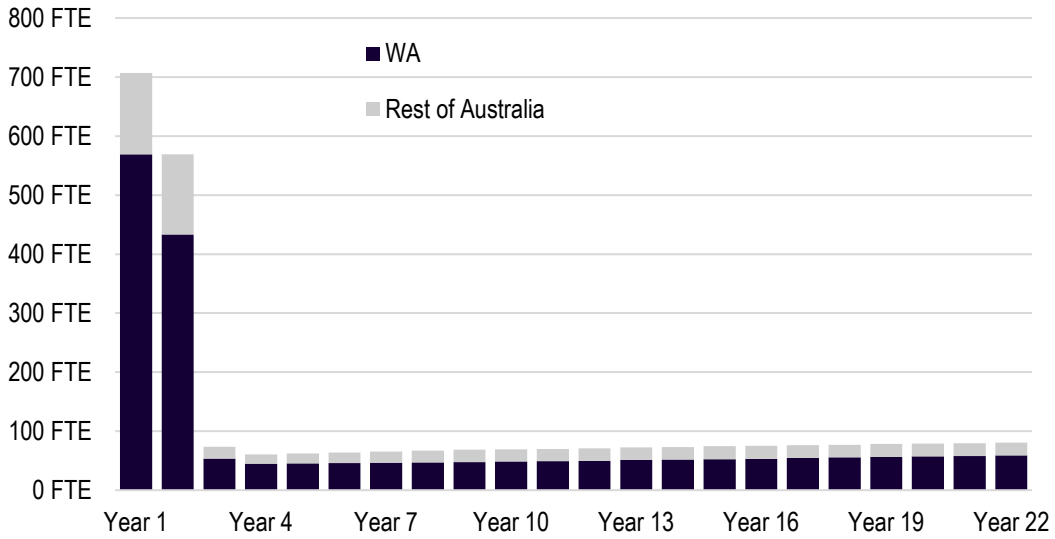


Source: ACIL Allen

Employment impact

ACIL Allen estimates the average operational **employment impact of the medium scale ammonia project across the Western Australian economy is 51.5 FTE jobs**, which is just over half of the direct employment assumed to be required for the project. This is a result of assumptions which are currently used in ACIL Allen's CGE model, owing to a tightening labour market and continued border closures as a result of the COVID-19 pandemic. However, the employment impacts during construction are larger generating some 501 FTE jobs across the two year construction period. The outputs of the study also demonstrate an average employment impact across the Rest of Australia of 20.5 FTE jobs. The profile of employment impacts is provided below (**Figure 6.7**).

Figure 6.7 Employment impact of ammonia project, FTE job years per annum, by jurisdiction



Source: ACIL Allen

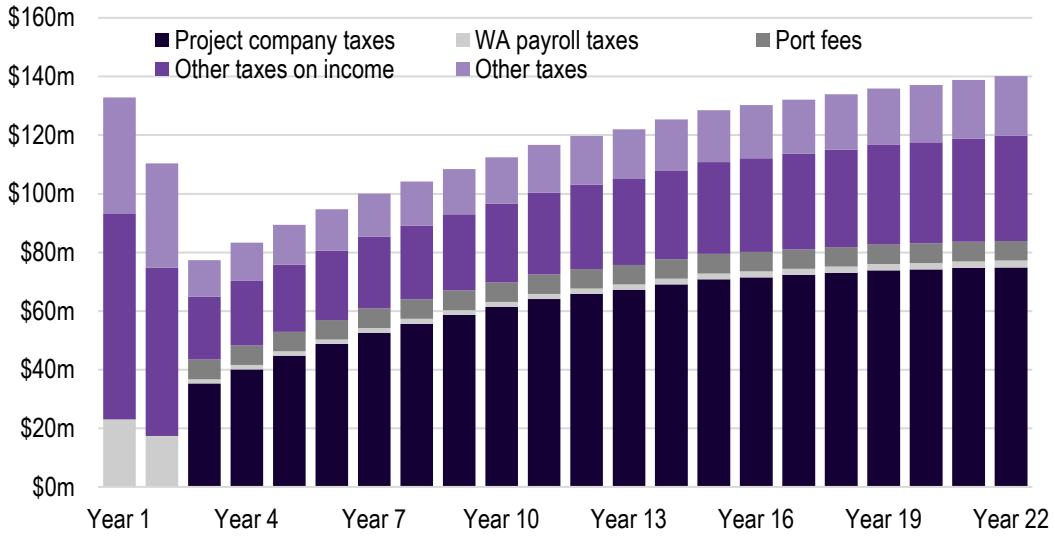
Taxation impacts

Overall ACIL Allen estimates an ammonia project would generate a total of **$2.5 billion in Commonwealth and State taxation benefits** over the 20 year project life, or $117 million per annum. This estimate considers the impact of the capital structure of the project, with taxation benefits rising over time as the project repays debt and interest expenses decline.

The vast majority of the taxation benefits accrue to the Commonwealth, raising $2.3 billion across company income tax, excises and international trade taxation, and consumption taxes. Western Australian Government revenue streams include payroll tax ($78 million, $3.5 million per annum) and port fees and charges ($133 million, $6.1 million per annum).

The profile of taxation payments flowing from the project is presented below (**Figure 6.4**).

Figure 6.8 Real taxation impact of ammonia project, $m real 2021 dollars, by head of tax



Source: ACIL Allen

6.3.3 Project 3: Export scale methanol project

In this scenario, the downstream project is assumed to be an export scale methanol project, with a production capacity of 2.5 million tonnes of methanol per annum. The project uses a facility previously proposed for Western Australia around 20 years ago as an analogue, which proposed two 2.5 million tonne per annum production trains would eventually be developed. A facility with 2.5 million tonnes per annum of production capacity would be one of the largest methanol plants in the world.

Over a 20 year project life, a facility of this scale would consume approximately 1,600PJ of gas as a feedstock, with additional gas required for power generation if gas was the fuel source. The annual rate of consumption is equivalent to approximately two thirds of a year of feedstock gas for a small LNG train (such as one of the original trains of the North West Shelf project), or around a 20 per cent increase in Western Australia's domestic gas demand.

The results of the economic impact assessment for the methanol project are detailed below.

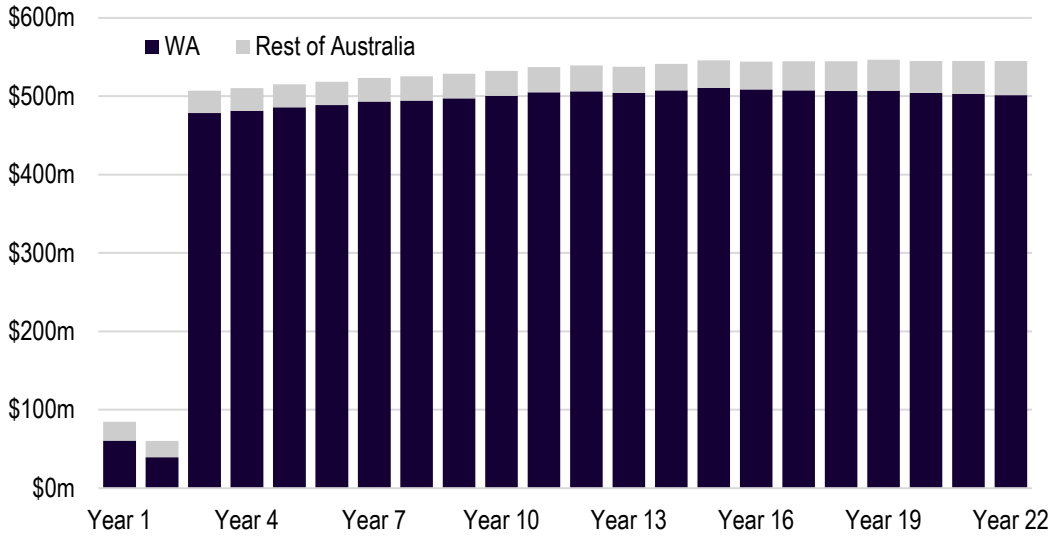
Impact on output (Gross State Product and Gross Domestic Product)

Overall, ACIL Allen's economic impact assessment on a medium scale ammonia project suggests a project of this size would generate an additional **$10.1 billion in Gross Domestic Product** over the 20 year operating life (plus two years of construction), or $491.9 million per annum. The vast

majority of this would be realised in Western Australia ($10.1 billion in Gross State Product, $458.7 million per annum), with the remainder generated across the other States and Territories ($0.7 billion, $33.2 million).

At a State level, the Gross State Product impact over the project's life is equivalent to a nearly five per cent annual increase in the output of the manufacturing industry in each year of the study. The profile of the impact on the State's output is provided below (**Figure 6.9**). The vast majority of the project's output impact is generated as a result of the operations of the facility, due to the relatively low capital cost relative to the productive capacity of the plant infrastructure, and production margin on methanol.

Figure 6.9 Real output impact of methanol project, $m real 2021 dollars, by jurisdiction



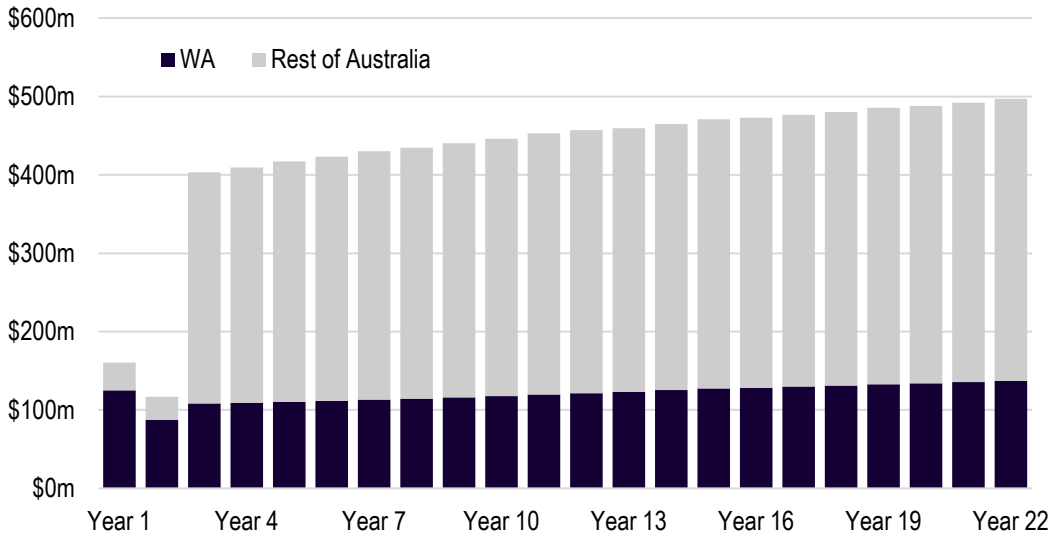
Source: ACIL Allen

Impact on real income

Overall ACIL Allen's economic impact assessment on an export scale methanol project suggests a project of this size would generate **$9.4 billion of real income benefits** over the 20 year project life, or $426.4 million per annum. The high level of real income retention relative to other projects reflects the significant taxation revenue streams associated with the profits of the facility, as well as the level of profit generated by the project. Given this, the majority of the income benefits accrue to the Rest of Australia, with the impact valued at $6.7 billion (or $305.4 million per annum).

The net welfare benefit of the methanol project to Western Australians is some $2.7 billion over the life of the project, or $120.9 million per annum. The profile of the real income impact is presented below. Unlike the previous projects, the real income benefit profile skews to the operational phase, on account of the taxation impacts and after-tax profit of the project under the inputs and assumptions used to define the discounted cashflow model.

Figure 6.10 Real income impact of methanol project, $m real 2021 dollars, by jurisdiction

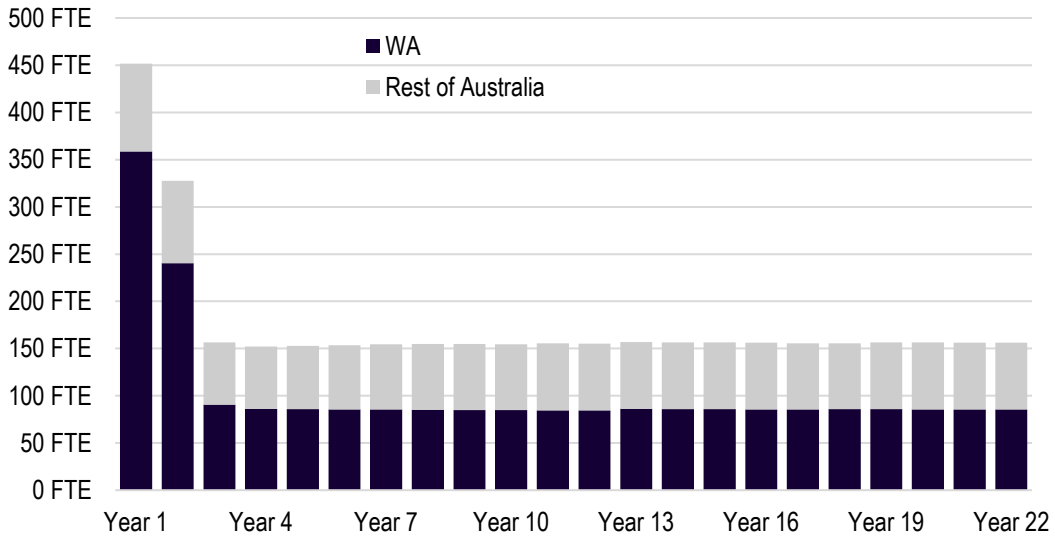


Source: ACIL Allen

Employment impact

ACIL Allen estimates the average operational **employment impact of the export scale methanol project across the Western Australian economy is 105.2 FTE jobs**, which is around two thirds of the direct employment assumed to be required for the project. This is a result of assumptions which are currently used in ACIL Allen's CGE model. The employment impacts during construction are larger, generating just under 300 FTE jobs across the two year construction period. This is smaller than the other two projects due to the relatively low capital cost of a methanol plant per tonne of capacity. The outputs of the study also demonstrate an average employment impact across the Rest of Australia of 71.4 FTE jobs. The profile of employment impacts is provided below (**Figure 6.11**).

Figure 6.11 Employment impact of methanol project, FTE job years per annum, by jurisdiction



Source: ACIL Allen

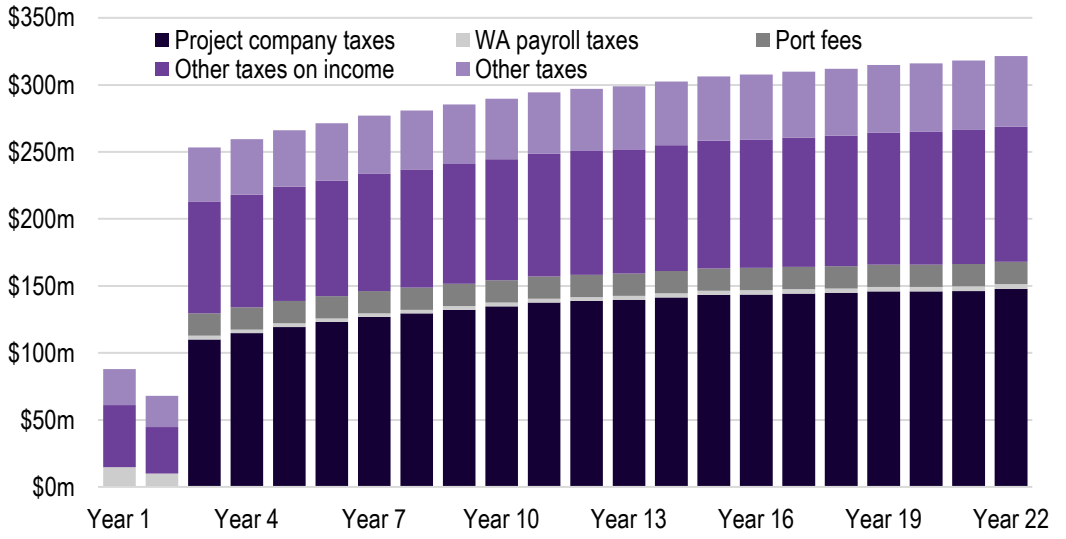
Taxation impacts

Overall ACIL Allen estimates a methanol project would generate a total of **$6.0 billion in Commonwealth and State taxation benefits** over the 20 year project life, or $274.5 million per annum. This estimate considers the impact of the capital structure of the project, with taxation benefits rising over time as the project repays debt and interest expenses decline.

The vast majority of the taxation benefits accrue to the Commonwealth, raising $5.6 billion across company income tax, excises and international trade taxation, and consumption taxes. Western Australian Government revenue streams include payroll tax ($86 million, $3.9 million per annum) and port fees and charges ($333 million, $15.1 million per annum).

The profile of taxation payments flowing from the project is presented below (**Figure 6.12**).

Figure 6.12 Real taxation impact of methanol project, $m real 2021 dollars, by head of tax



Source: ACIL Allen

6.4 Implications for downstream industry development policy

While preliminary in nature, ACIL Allen's economic impact assessment demonstrates in a "success case" scenario that downstream industry projects can generate positive economic benefits for Western Australia. The benefits accrue as a result of the wages and salaries paid to operational staff, purchases of goods and services – including utilities services and access to ports – to facilitate production, and from the profits and taxes paid by the projects themselves.

The scenarios analysed by ACIL Allen are on the downstream production facilities only. This means there is additional economic activity associated with the production of gas feedstock from Western Australian sources which is excluded from the scope of the assessment. If this gas feedstock was included in the assessment, the benefits would be substantially larger; particularly if the upstream project was a greenfield project. This is also true of taxation revenue, with the Western Australian Government able to realise production royalties from gas produced in onshore basins.

Furthermore, if the project results in the realisation of gas production that would otherwise not occur, the benefits are larger still. This is because if there is no path to market for the gas, it will remain in its reservoir and no additional economic value will be realised.

On this basis, there are apparent economic benefits to be realised from the successful development of one or more downstream industry projects in Western Australia. The remainder of

this report explores the barriers and enablers to development of projects like those explored in this section, before a series of recommendations are made.

The analysis also demonstrates there are significant income, employment and taxation benefits which are realised outside of Western Australia associated with downstream industry development projects. This is in part due to the various taxing powers of Commonwealth and State Governments, as well as the impact the additional taxation revenue has on Australia's other States and Territories.

Finding 8 Economic benefits of downstream industry developments in Western Australia

ACIL Allen's preliminary economic impact assessment of three model downstream industry projects in Western Australia demonstrates projects can have a positive impact on the State's output, income, employment and taxation. On this basis, realisation of one or more downstream industry projects would provide economic benefits to Western Australia and Western Australians.

Critical success factors 7

This section identifies, discusses and critically analyses the critical success factors for large-scale downstream industry development in Western Australia. The evidence base for this section is drawn from a range of sources, including stakeholder consultation, desktop review, and internal economic and policy analysis and discussion undertaken by ACIL Allen. This section will provide the evidence base for the development of a series of recommendations in the final section of the report.

7.1 Introduction

It is evident from ACIL Allen's research there are a number of highly prospective gas-centric downstream industry development opportunities in Western Australia. This is further supported by the recent onset of active interest in the potential processing of natural gas into chemical and fertiliser products, by both current and new private sector interests in the State. ACIL Allen's preliminary economic impact assessment of various downstream industry projects suggest a strong economic benefit per unit of gas consumed.

In the formation of a major export project of any type there are a number of general commonalities required to achieve an investment decision. The project must have access to land, access to markets via ports, achievement of offtake agreements for production, secured supplies of raw inputs, and capital to pay for the project. It is also important for project owners to hold intellectual property with respect to their production processes and methods.

In the previous section, ACIL Allen identified that the most prospective opportunities within the scope of this study – urea fertiliser, methanol and ammonia – has a number of common features and attributes. This was further reinforced during the stakeholder consultation process, which identified and allowed ACIL Allen to further develop a common understanding of the most critical drivers of the project economics of downstream industries in this space, which go beyond the commonalities such as securing offtake agreements.

This framework will be discussed at length in this section. At its core, the **critical success factors framework for downstream industries** are driven by three mostly independent variables, being:

— **Location**. This is the extent to which the production facility is proximate to demand centres, and in particular to marginal demand centres (or the areas where demand is growing or set to grow). Location in this context also refers to the specific location of the plant itself relative to important infrastructure such as utilities and ports. This manifests in the costs required to transport a finished product from the plant to the end consumer.

— **Capital expenditure**. This is the extent to which business and public policy conditions are conducive to the development of a project. These factors influence the up front capital cost of the project in question, which impacts on the economics of the overall project. This manifests in the costs required to transport a finished product from the plant to the end consumer.

— **Gas**. This is the extent to which there is natural gas available to provide a feedstock and, to a lesser extent, energy source for the project. In this context, gas means more than simply a hypothetically available source of supply. It refers to access to gas on long terms, at the right specification, with stable prices.

Central to each of the above attributes is the role of infrastructure and gas availability, as well as the broader policy environment in the State from a major developments perspective. The Western Australian Government has a role to play in both spaces, meaning there is scope to influence the development of gas-based downstream industries in the State. This section introduces and discusses each of the three critical success factors, ahead of the final section which discusses the role of government. ACIL Allen's critical success factors framework is summarised below (**Figure 7.1**).

Figure 7.1 Critical Success Factors Framework

		Natural/comparative advantage factors	Role of infrastructure	Government policy & regulatory settings	Primary challenges
Delivered product	=				
	Distance to market (Freight costs)	Western Australia's proximate location Location of Strategic Industrial Areas	Ports Land availability Pipelines Roads	N/A	Cost of greenfield sites and infrastructure
	Capital expenditure (Development costs)	Cost of construction disadvantages	Funding and financing non-plant infrastructure	Environmental approvals Native title	High cost of doing business Project approvals lifecycle
	Gas (Gas cost, supply and terms)	Western Australia's large gas endowment	Pipelines and other midstream infrastructure	Western Australian Domestic Gas Reservation	Achieving suitable price and term combinations for domestic gas

Source: ACIL Allen

The remainder of this section discusses each of the three primary success factors, Western Australia's relative advantages and disadvantages, and opportunities for influence.

Finding 9 Critical success factors for gas-based downstream industries

There are three primary determinants of the competitiveness of a gas-based downstream industry: the capital cost of establishing a project, the proximity of the project to sources of demand, and the price and contractual terms available for gas supply. Each of these factors is critical to a project achieving so-called bankability in order to proceed to a final investment decision.

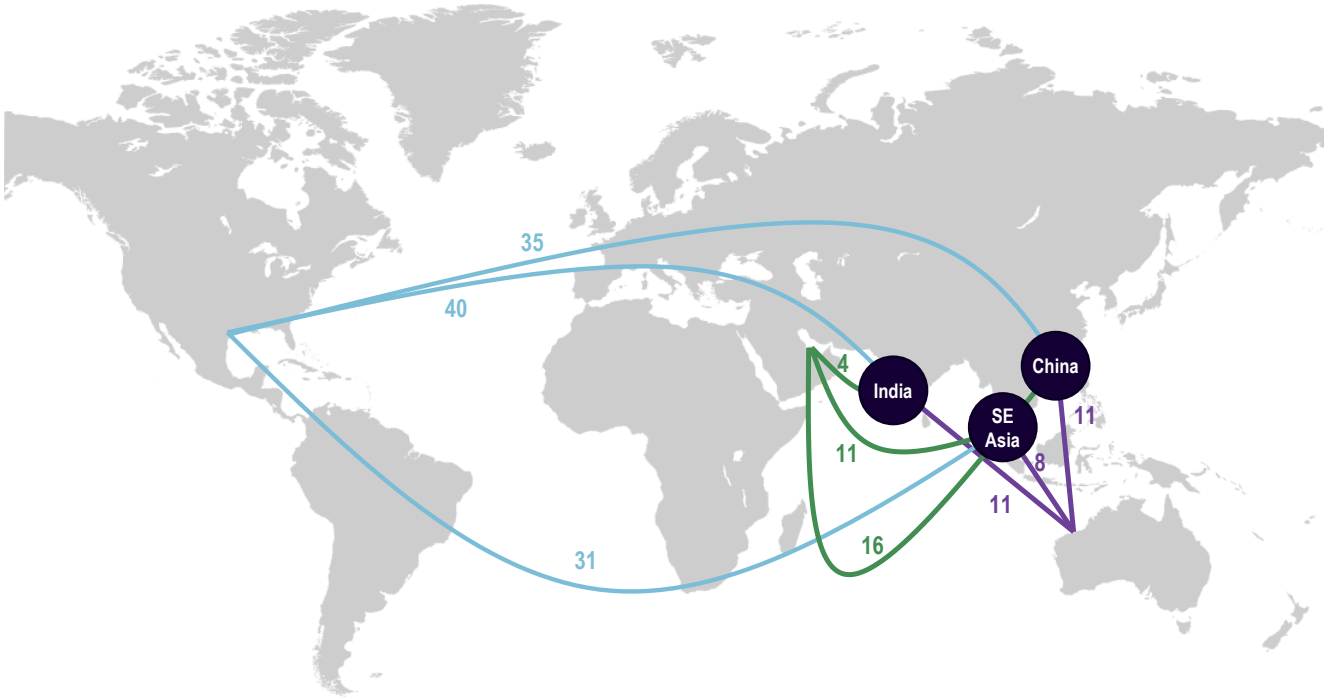
7.2 Critical success factor: Location and distance to market

As discussed in Section 5, it is evident from ACIL Allen's desktop review that Western Australia is ideally located to current and future global demand for a range of downstream industries. This is particularly true for the Pilbara, Kimberley and Gascoyne regions of the State, where access to markets in China, India and South East Asia is closer than any other location in Australia.

This ideal location is one of Western Australia's unique comparative advantages in the provision of bulk commodities and energy products, helping to catalyse the development of the iron ore and LNG industries over the past two decades. The State's location advantage manifests in a number of ways, but principally in the form of low freight costs versus other current and prospective locations for downstream projects. This is illustrated below (**Figure 7.2**).

ACIL Allen estimates Western Australia is either closer or at a comparable distance to key markets than other potential sources of downstream projects in all but one case, being the very short distance between the Middle East (measured from Qatar) and India (measured from Mumbai). In this case the north west coast of Western Australia is 11 sailing days away compared to four for India. In all other cases, Western Australia holds a comparable or clear advantage, particularly against the United States of America (measured from Houston, Texas).

Figure 7.2 Sailing distance between key markets, number of days (rounded to nearest day) at 13 knots



Source: ACIL Allen, from DPWorld SeaRates tool Note: lines do not represent actual shipping routes.*
Note: Purple = Distance from Port Hedland, Blue = Distance from Louisiana, Green = distance from Qatar

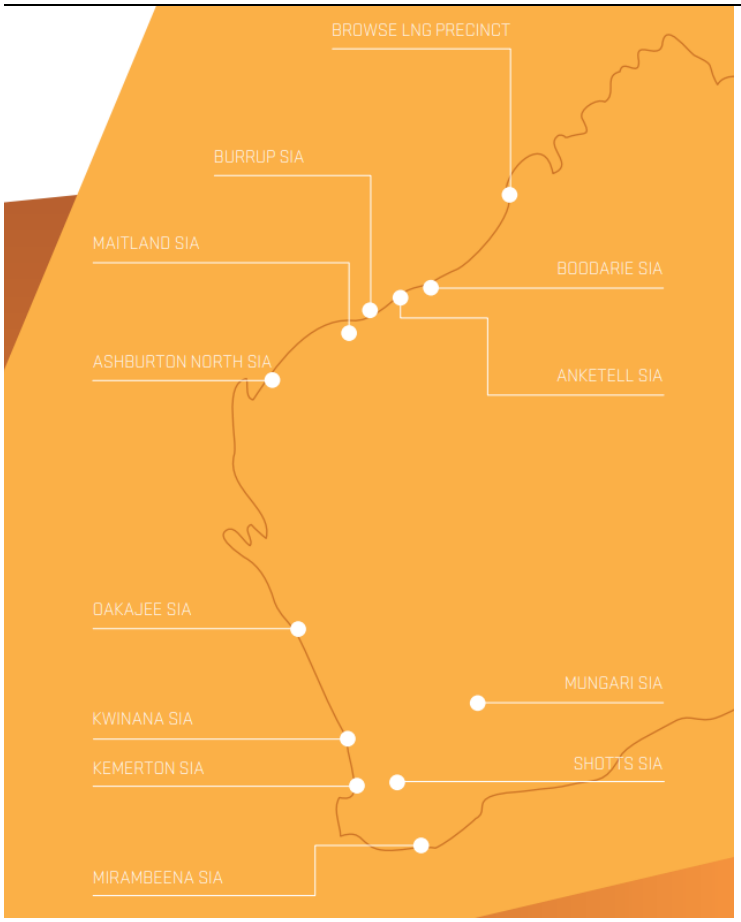
The close distance between Western Australia and key markets was identified by stakeholders from both upstream and downstream sectors as one of the State's key advantages in the formation of downstream projects. Stakeholders also noted this advantage was so significant that it could partially or fully offset high level considerations associated with Western Australia's disadvantage in project development costs and capital expenditure (see Section 4).

In the context of downstream projects, freight also refers to the distance between a production facility and the point of export. In this respect, collocation of a production facility with or very close to export facilities is an important potential source of competitive advantage. For example, the QAFCO ammonia and urea plant – the world's largest integrated urea fertiliser production facility with a capacity of 5.6 million tonnes of urea – is co-located with a specialised bulk export loading

facility at a deep water port.[15] Similarly, CF Industries Nitrogen Plant in the United States includes integrated bulk ship loading facilities as part of a complex of bulk chemicals and materials facilities on the banks of the Mississippi River.[16] To be fit for purpose, ports require deep water berths due to the use of large bulk carriers or tankers to transport goods from plant to customer.

Western Australia's economic development framework more broadly recognises the importance of collocation of production and export facilities, through the Strategic Industrial Areas ('SIA') program. The SIA program is led by the Department and delivered by DevelopmentWA (the Western Australian Government's strategic land development authority), and are designed with the specific requirements of collocation of essential infrastructure and services in mind. The majority of Western Australia's SIAs are located within close proximity of current or planned ports infrastructure, as demonstrated in **Figure 7.3**.

Figure 7.3 Western Australia's Strategic Industrial Areas



Strategic Industrial Areas collocated with ports (port within 5km)

- Browse LNG Precinct
- Burrup SIA
- Boodarie SIA
- Anketell SIA
- Ashburton North SIA
- Oakajee SIA
- Kwinana SIA
- Mirambeena SIA

Locations not collocated with ports infrastructure

- Maitland SIA
- Kemerton SIA
- Shotts SIA
- Mungari SIA

Source: ACIL Allen, from JTSI and DevelopmentWA

At a local level, the vast majority of the most recent downstream industry projects in the State have been collocated or plan to be collocated with ports infrastructure. Yara Pilbara, the State's most recent successful downstream project development, is located in the Burrup Strategic Industrial Area and has direct linkages to a bulk liquid export facility at the Port of Dampier. The Perdaman Urea Project is intended to be located in the Burrup Strategic Industrial Area, with the Western Australian Government committing to the upfront capital funding and ongoing operations of a new

[15] QAFCO. 2020. *Qatar Fertiliser Company, About Us*. Accessed online at http://www.qafco.qa/

[16] CF Industries. 2020. *CF Industries Annual Report 2020*. Accessed online at http://www.cfindustries.com/

berthing facility at the Port of Dampier to allow the project to be completely integrated from production to export (see Section 7.3 for further discussion of ports infrastructure). One alternative is in the case of the Strike Energy urea project, which has secured a long term lease option on land outside of the Oakajee SIA but close to the Port of Geraldton in the Mid West region.

Another benefit of the State's SIA program is the long term planning associated with infrastructure corridors and other infrastructure, which improves the ability for project proponents to "plug and play" when developing projects. For example, the Perdaman Urea Project is able to achieve direct access to the Dampier Cargo Wharf at the Port of Dampier in the Burrup SIA due to the presence of an infrastructure corridor with appropriate capacity for a covered conveyor belt system. Similarly, the Burrup SIA has established utilities services providers for water and electricity, and sits alongside natural gas transmission pipelines (due to the presence of domestic and LNG gas plants in the SIA). This is not the case for all SIAs, with some of the areas presently "unserviced" due to a lack of project proponents.

However, for the purposes of this study, it is clear the freight cost advantages for downstream industries are strongest in the SIAs to the north west of Western Australia. This includes the well-developed Burrup SIA, the less developed but active Ashburton North SIA, and relatively undeveloped Maitland SIA, Anketell SIA and Boodaire SIA.

Finding 10 Freight costs: Western Australia's competitive advantage

Western Australia's is located in close proximity to key sources of global demand growth in gas-based downstream project products. This is particularly true for regions in the State's north west. This advantage would be best served by the State's continued development and management of Strategic Industrial Areas.

Western Australia's SIA program is also important to the second critical success factor, being capital expenditure. Physical colocation of sites to ports, with pre-planned transport corridors and access to common user utilities infrastructure, assists in reducing the up front cost and risks associated with the development of greenfield projects. The SIAs also provide the State Government with opportunities to calibrate support and target interventions to assist projects where the case may be justified.

7.3 Critical success factor: Project development and capital expenditure

The production processes deployed in the gas-centric downstream processing industry are highly capital intensive. This means the development of new projects requires access to in excess of one billion dollars of capital funding to build and establish the various production processes, chains and infrastructure required to commence production. Once projects are established, costs tend to be mostly feedstock and utilities, with some labour costs, transport costs and marketing costs.

Capital investment required to develop gas-centric downstream industry projects can be broken into two broad tranches: plant and non-plant. In this context:

— **plant infrastructure** refers to the capital equipment required to transform inputs into the particular output – the production trains, on-site storage and specialised plant such as air separation units,

— **non-plant infrastructure** refers to the capital equipment required to feed inputs into the plant infrastructure, such as gas pipelines, utilities, conveyor belts to shiploading infrastructure or the next transport linkage where plant is not directly adjacent to a port, and roads into and out of the area, or infrastructure to take product from the plant to its end destination (including ports infrastructure).

This matter is further explored in Section 7.3.2.

Stakeholder feedback suggested the time and capital required to establish new downstream projects in Western Australia was one of the State's major impediments to further development of the industry. As discussed in Section 4, stakeholders suggested there was a "capital expenditure penalty" of at least 20 per cent over and above the capital cost of establishing a new project in the United States, and at least 40 per cent over and above the capital cost of establishing a new project in Mainland China.

Data on the standardisation of project costs is challenging to come by, as projects tend to be unique and structured to reflect the particular situation of the project in the location. Two global benchmarking reports sourced by ACIL Allen – the Turner and Townsend International Construction Benchmark Survey[17] and the Arcadis International Construction Cost Index[18] – suggest the general rule of thumb is correct although the 20 per cent premium may be underestimating the differential.

One recent example is the Perdaman Chemicals and Fertilisers Urea Project i6n the Pilbara region of Western Australia. In July 2020 Perdaman announced it has signed an Engineering, Procurement and Construction ('EPC') contract for its plant, with a total capital investment of AU$4.5 billion for a two million tonnes per annum facility (~AU$2,250/tonne).[19] A larger 4.4 million tonne facility, built by CF Industries in Louisiana in the United States and commissioned in 2015 had a capital cost of AU$5.3 billion (~$1,204/tonne).[20]

Finding 11 Capital expenditure: Western Australia's competitive disadvantage

Stakeholder perspectives and ACIL Allen analysis finds Western Australia is at a competitive disadvantage with respect to the initial capital expenditure required to develop gas-based downstream industry projects. This is a function of the remoteness of prospective project locations and Australia's industrial relations system relative to other global locations.

Higher up front capital investment costs primarily affect the ability of a project to become bankable, and to bring together a combination of funding which is feasible to establish the project. The term "bankable" was used frequently by stakeholders throughout the consultation process. In general terms it means the ability for the project to exhibit a number of attributes which would make it attractive to debt financiers. All things being equal, a higher capital cost requirement means project owners are required to source additional funding – most likely debt – which results in a requirement for additional interest costs and returns to shareholders for a particular volume of output. In relation to the economics of a project, the higher capital costs mean the two other primary components of the Critical Success Factor equation must be low enough to compensate.

[17] Turner & Townsend. 2020. *Turner & Townsend International Construction Benchmark Survey 2019 edition.* Accessed online at http://www.turnertownsend.com/

[18] Arcadis. 2020. *Arcadis International Construction Cost Indices, 2020 edition*. Accessed online at http://www.arcadis.com/

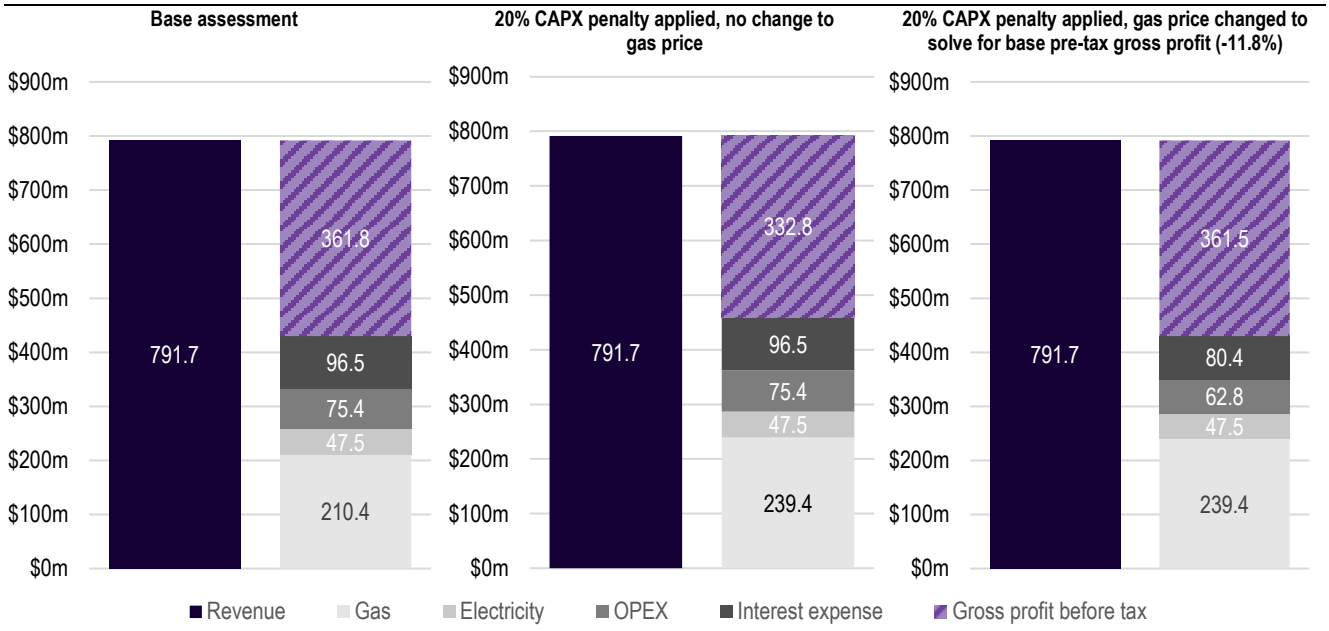
[19] Perdaman Chemicals and Fertilisers. 2020. *Article: $4.5bn Karratha Urea Project agrees EPC terms*.

[20] CF Industries. 2015. *CF Industries Annual Report 2015*. Accessed online at http://www.cfindustries.com/

To demonstrate this impact, ACIL Allen has applied the assumptions contained in a project economics model developed by the International Energy Agency[21] for a greenfield ammonia project to its project financial modelling framework. This framework is used to understand the various financial drivers of a project under various assumptions. In this case, ACIL Allen has used the assumptions on capital cost, operating costs and consumption of electricity and natural gas from the IEA report and built assumption sets for funding and financing (debt to equity ratios, debt term structure, interest rates) and inputs costs (gas and electricity) to present the project financial model.

Under the IEA assumptions, a project with a 20 per cent capital expenditure penalty applied to the up front capital funding requirement must achieve a gas price which is 12 per cent lower than otherwise to earn the same gross profit after tax in Year One of the projection (**Figure 7.4**). The capital expenditure penalty also lowers the after-tax return on the project by 600 basis points in Year 15 of the model (five years after debt is repaid), a measure of an extension in the time the project will take to earn a return on equity for the owners of the project.

Figure 7.4 Impact of 20% CAPX penalty on project economics for greenfield ammonia plant, $m by scenario



Source: ACIL Allen, from IEA Ammonia Project Economics database

The high cost of establishing new projects in Western Australia is a product of a number of factors which are outside of the control of the Western Australian Government. This includes industrial relations laws (the vast majority of which are governed by the Commonwealth in relevant sectors), which result in higher pay and conditions than in other parts of the world, noting also that stakeholders saw Western Australia's general labour environment as being a positive once projects were operational. Other factors include remoteness, which is of particular concern in the Pilbara and Kimberley regions, and the need to import and then transport modularised plant and equipment modules for installation from specialised manufacturing facilities throughout South East Asia.

However, there are a number of opportunities for the Western Australian Government to assist in reducing capital costs and project development risks, with the ultimate objective of reducing the

[21] International Energy Agency. 2019. *The Future of Hydrogen – Assumptions Annex*. Accessed online at http://www.iea.org/. This modelling framework assumes revenue is earned on a FOB basis, meaning the costs and prices reflect the value of the product prior to freight from the export port.

time and cost of establishing new projects in the State. These measures were raised by stakeholders during the engagement process, and represent tangible opportunities for the Western Australian Government to improve the prospect of gas-centric downstream industry projects in the State.

7.3.1 Project formation and approvals

One critical element of the formation of major projects is the ability for the project to access the appropriate land footprint for its infrastructure. In Western Australia, the Strategic Industrial Area ('SIA') program is an important means by which the State is able to offer development-ready land to industry for major projects. As discussed in Section 7.2 many of the SIAs are ideally located near ports infrastructure, providing major project proponents with direct access to export markets and opportunities.

Despite being a critical first step in the project development lifecycle, the issue of land availability and tenure was not raised as an issue by project proponents during ACIL Allen's stakeholder consultation program. This would tend to suggest existing Western Australian Government processes with respect to land tenure and allocation are functioning well. These processes involve DevelopmentWA as the development agency and the Department as lead agency, with the two parties working together with a proponent to find an appropriate location. This is supported by the presence of substantial information on current and future land opportunities – both within SIAs and on other large scale industrial/commercial development land – hosted by DevelopmentWA.

For example, for the Maitland SIA in the Pilbara region it is possible through review of material hosted on the DevelopmentWA website to determine:

- land is held as Crown reserve land and can be transferred to DevelopmentWA on a freehold basis for the purpose of long term leases to project proponents,
- a framework for achieving Native Title approval has been established under the Burrup and Maitland Industrial Estate Native Title Agreement, and that further engagement with Native Title Holders is likely to be required to establish a project,
- there are currently no utilities service providers with infrastructure within the SIA, and it is likely a proponent would be required to arrange for the provision of utilities it requires. However, the Dampier-to-Bunbury Natural Gas Pipeline ('DBNGP') runs through the estate area, and
- in order to commence the process of securing an option to lease a proponent should first contact the Department with a proposal.

Initiation of contact with the Department kick starts a number of processes, including assessment of options with respect to land availability and tenure. The most significant is an assessment of whether the project proponent qualifies for **lead agency status**. Lead agency status allows the Department to act as a primary point of contact on all matters relating to project formation and approvals, including consideration of State assistance where this is relevant or required.

The Department provides lead agency status for all economic and industry-centric projects, including:

1. Resources industry projects
2. State Agreements (including ongoing stewardship and management)
3. Tourism projects
4. International trade and investment proposals
5. Major industry infrastructure proposals.

Further discussion of the role of lead agency status and specifically regarding project assistance is contained in Section 7.3.2.

From a project formation and approvals perspective, lead agency status is vital to providing project proponents with a realistic chance of navigating the project approvals process. According to the Western Australian Government's lead agency status guidance note, there 11 Commonwealth, State and Local Government authorities[22] with responsibility in assessing and approving projects from a regulatory or policy perspective. These agencies are ultimately assessing whether a project makes sense in principle or in the abstract, rather than being directly involved in the delivery of the project itself.

When the subject of project approvals was raised by stakeholders during consultation, feedback principally centred on two elements of the Western Australian Government's regime: the Environmental Protection Authority's environmental assessment and approvals process, and processes centred on settling native title claims over lands. As with the high capital costs, these matters were raised pragmatically, with proponents acknowledging and respecting the role of these approvals in granting social licence to operate and minimising project impacts. However, it was evident the time taken to proceed through these processes was adding to project costs and risks.

Environmental approvals

On environmental approvals, concerns were centred on the time required for a project to achieve approval rather than the specific requirements imposed by the Environmental Protection Authority ('EPA').[23] Proponents advised this added to their project development costs, but more crucially increased the risk of an adverse change in the market.

The most recent and relevant example of this is related to the Perdaman Urea Project. The project was initially referred to the EPA by a third party on 7 May 2018, prior to the project receiving lead agency status from the Department. This triggered a requirement for Perdaman to engage with the EPA, albeit at a relatively high level. The project remains in the approvals process with a further two stages (of five in total) of approval required, some two years and nine months later.[24]

A review of the EPA's historic approvals suggests this length of time to complete an assessment has not always been the norm. For example, Pluto LNG Development progressed from a decision to assess to a ministerial statement of approval in 17 months between April 2006 and September 2007.[25] Similarly, a coal-to-urea project proposed by Perdaman Chemicals and Fertilisers in the late 2000s achieved environmental approvals in 18 months between April 2009 and

[22] It is important to note the guidance material hosted on wa.gov.au was last updated in 2011 and does not reflect the current Machinery of Government, and may not reflect contemporary project approvals pathways. ACIL Allen understands work is underway to update the public guidance note (discussed in Section 7.3.2).

[23] ACIL Allen's scope did not allow for consultation with the Environmental Protection Authority or other regulatory agencies to provide direct feedback on project approvals and the time required to assess the benefits, costs and risks of new projects.

[24] Environmental Protection Authority. 2021. *EPA Status of Formal Assessments under s.38 of the Environmental Protection Authority Act 1986*. Accessed online at http://www.epa.wa.gov.au/

[25] Environmental Protection Authority. 2021. *EPA Assessment 1632*. Accessed online at http://www.epa.wa.gov.au/

October 2010.[26] The Yara Pilbara ammonia project achieved environmental approval in 11 months between March 2001 and February 2002.[27]

ACIL Allen understands the EPA process with respect to the Perdaman Urea Project was more complex due to the area being subject to the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999,* that the approvals process would be more lengthy than a typical project in another location. However, the absent the specifics the increased length of environmental approval processes relative to history stands.

The EPA is governed by the *Environmental Protection Authority Act 1986*. This legislation was subject to a statutory review in 2019 and 2020, with amendments to the Act passed and gazetted in early 2021. It was the fourth set of changes made to the Act since its inception, the previous occurring in 2010. According to the accompanying Explanatory Memorandum, the 2020 amendments are primarily focussed on "improving regulatory processes under Part IV to streamline the administrative efficiency of the environmental impact assessment process, and reducing duplication of assessments and approvals".[28] Changes were also made to implement a Commonwealth Government commitment to reduce duplication in project approvals between Commonwealth and State Governments.

To the extent these measures are successful, the time between a project being notified of a requirement to complete an environmental approval and the environmental approval being granted should reduce. The Department should monitor these developments and be proactive in addressing the situation through appropriate channels if the time taken to deliver environmental approvals does not improve as a result of the recent changes.

Native title

Stakeholder concerns with respect to native title were less prevalent and significant than concerns with respect to environmental approvals. ACIL Allen considers this is likely because for the vast majority of potential project proponents who seek land in SIAs there are no substantial native title considerations, as these have been addressed by the Western Australian Government during the land assembly process.

The exception is in the Burrup and Maitland SIAs, where a native title agreement struck between the Western Australian Government and the Traditional Owners of the land, the Wong-Goo-Tt-Oo, Ngarluma Yindjibarndi, and Yaburara Mardudhunera peoples includes additional rights for negotiation and recompense from new projects.[29] The agreement requires prospective project proponents to negotiate with the Native Title holders as part of the approvals process for leases in these two SIAs.

Appropriate management and recognition of the rights of Native Title holders is seen by stakeholders as an important component of the social licence to operate for major projects. While the Native Title Act is Commonwealth legislation, the Western Australian Government plays a role

[26] Environmental Protection Authority. 2021. *EPA Assessment 1784*. Accessed online at http://www.epa.wa.gov.au/

[27] Environmental Protection Authority. 2021. EPA Assessment 1178. Accessed online at http://www.epa.wa.gov.au/

[28] Parliament of Western Australia. 2020. *Environmental Protection Amendment Bill 2020, Explanatory Memorandum*. Accessed online at http://www.parliament.wa.gov.au/

[29] WA Government. No date. *Burrup and Maitland Strategic Industrial Estates Agreement*. Accessed online at http://www.wa.gov.au/

in the process through the Department of Premier and Cabinet and its Aboriginal Engagement Directorate. This includes shaping the State Government's approach and engagement with Native Title groups and Aboriginal communities to resolve claims and leverage community defined opportunities. With this in mind, the State should seek to proactively and respectively engage with both project proponents and Native Title groups where this is required to progress projects.

Finding 12 Capital expenditure: Land assembly and preparedness

Prospective downstream project proponents raised concerns with respect to the time, complexity and costs associated with establishing a footprint for project development. Specific issues raised include environmental approvals and native title. Proponents were less concerned with the process of selecting and gaining a lease option over appropriate land, suggesting this process is effective.

7.3.2 Capital support for infrastructure

As discussed earlier in this section, in broad terms there are two types of infrastructure for major projects of the scale of gas-centric downstream industry projects: plant and non-plant infrastructure. Non-plant infrastructure includes the assets and capital equipment required to produce or transport the inputs for the plant infrastructure, as well as the logistics infrastructure required to move a finished product from the plant to export.

As discussed in Section 5, the opportunities which seem most compatible with Western Australia's current situation share a number of commonalities on the infrastructure side. This includes the need for access to water and electricity as inputs into the production process, and ports infrastructure to allow for the products produced to be exported into global markets.

The Western Australian Government provides assistance and facilitation services to major project proponents interested in investing in the State, through Department's role as provider of lead agency status.

When a project receives lead agency status, the Department assigns a dedicated project manager or project management team to coordinate project approvals, liaison with Government, and acts as a conduit for any support requested or required to make the project happen. This can often take the form of proponents requesting support in the development of infrastructure or provision of access to services into their project.

The extent to which a project may be considered for support has previously been driven by a "tier" system, according to the Western Australian Government's lead agency status guidance note.[30] There are three tiers (tier one, tier two and tier three) which proceed from one to three in importance, as well as a sub-categorisation of a project as a "project of State significance" – status which can be conferred by State Cabinet. Support for tier one and tier two projects is largely centred on project approvals and coordinating inter-agency interactions where these are required, while tier three projects receive more tailored support in navigating government approvals.

The guidance note as constituted provides limited details as to what makes a project fit into a particular tier, other than it may be driven by subjective assessment of the project's size or complexity. A project can be conferred state significance status where it is decided a project is of critical strategic significance to Western Australia or Australia.

[30] Western Australian Government. 2011. *Lead agency status guidance note*. Accessed online at http://www.wa.gov.au/

The Western Australian Government is currently revising its Lead Agency Framework, with an intent to roll this out for use via a guidance note in 2021. The revised note makes a number of changes, including clarifying the lead agency for all heavy industry projects (excluding routine mining and petroleum production and exploration projects) is the Department of Jobs, Tourism, Science and Innovation. The guidance note also makes clear the intent of the lead agency framework is to assist with navigating project approvals processes, with other considerations – such as infrastructure support and other concessions – treated separately.

Under the revised guidelines the three tier system has been maintained, although projects are now denoted as either:

— Routine (Level 1): Uncomplicated proposals, which are able to be accommodated through existing assessment processes. In this case, the lead agency provides referral and introduction services. The guidance note suggests the "vast majority" of proposals fall into this tier.

— Complex (Level 2): Proposals which have some form of complexity, in that the project is sensitive, or involve a proponent which is inexperienced in navigating approvals processes in Western Australia. Projects may also be triaged into this tier where they have significant capital investment or employment implications. The note also indicates each agency has its own criteria for what makes a project "Complex". In this tier the lead agency assigns a case manager who will work with the proponent throughout its approvals journey.

— State Significant Proposals: These are proposals the State Government defines as of critical strategic importance to Western Australia. State Significant Proposals are assigned a more senior project manager, or a project team, from the lead agency.

The revised guidance note does not provide industry with information on what constitutes a State Significant Proposal, other than this is a decision for Government.

Finding 13 Capital expenditure: Conferring lead agency status

The State Government's previous process for conferring lead agency status on a project is not well defined, while the guidance note available to project proponents had not been updated for some time meaning it did not reflect the current Machinery of Government. This may have worked against projects receiving the right level of support, and knowing what is required of them to achieve the right level of status within the Government's project coordination and facilitation framework. The State's revised guidance note addresses a number of these issues, although maintains ambiguity regarding which projects qualify for "State Significant" status and the process for doing so.

The gas-centric downstream industry opportunities under consideration in this study are highly capital intensive. As discussed earlier in this section, this means there is a need for project proponents to source funding which typically comes in the form of debt. There are opportunities for the State Government to assist in alleviating the funding task of project proponents, by offering tailored and structured support in the form of infrastructure funding and subsidies as part of project development and approval.

This is not a new development within Western Australia as the State has a long history of providing this kind of support for major projects across sectors. At its most basic level, the development of SIAs represents a more interventionist version of this support as it sees the State Government assemble land and build the appropriate frameworks so they are ready for proponents as needed. A less interventionist approach is the Western Australian Government's support for the funding and development of port and seawater infrastructure for the Perdaman Urea Project – funding which is contingent on the project achieving all project approvals and reaching a positive Final Investment Decision (see Box 6.1).

Box 7.1 Western Australian Government support for Perdaman Urea Project

On 18 August 2020 the then Minister for State Development, Jobs and Trade the Hon. Alannah MacTiernan announced conditional support for the Perdaman Urea Project in the Burrup SIA in the Pilbara region of Western Australia. The announcement of support was the culmination of over 12 months of work with the project proponent to develop an infrastructure package which best met the needs of the project while also limiting the State's downside risk exposure.

The Western Australian Government resolved to provide direct funding for the relocation of a road and detailed design work for two infrastructure solutions being an expansion in the Dampier Cargo Wharf and the seawater supply scheme for the SIA. The Government also resolved to provide conditional support for the upfront funding of the Dampier Cargo Wharf and the seawater supply scheme, subject to a NAIF loan, the project reaching financial close, all approvals being granted and the achievement of offtake agreements for the project itself – all of which are to say the State's support is contingent on the project proceeding, rather than being provided in advance.

ACIL Allen understands the Western Australian Government will provide up front capital funding for the project, in return for a long term user agreement between infrastructure owners and the proponent which will allow the State to recover costs and earn a return on capital.

A further example of the Western Australian Government providing support for a major project was the development of a bulk liquids berth at the Dampier Cargo Wharf in 2003.[31] The project was announced as a common user infrastructure project, with the initial customer being Burrup Fertilisers (now Yara Pilbara) and other customers – including Methanex, Liquigaz and Dampier Nitrogen – were to expected to follow thereafter. However, these opportunities were never realised. In order to facilitate the development, the Pilbara Ports Authority took out a 25 year loan which is set to conclude in 2030.[32] The Western Australian Government has continued to subsidise the Pilbara Ports Authority for the provision of the infrastructure, with the subsidy reaching $9 million according to the 2020-21 State Budget.[33] The Western Australian Government also provides a subsidy to the Water Corporation for the Burrup Seawater Pipeline, with $12.4 million paid in 2019-20.[34]

While the infrastructure request by the proponent to the Western Australian Government in 2003 was similar to 2020, the response of the State was significantly different. In both cases the State Government has provided or will provide capital to allow for the development of non-plant infrastructure to support the plant infrastructure of the proponent. However, in the more recent case, the State Government has de-risked the provision of the infrastructure in multiple ways. For instance:

— the State's funding is contingent on the proponent's funding of its own project – which is the proponent's responsibility,
— the State is only committed to its development subject to the foundation customer achieving project close and commencing its own development, and

[31] Western Australian Government. 2003. *Media Statement: Dampier Port to get new bulk cargo export facility, 5 August 2003*. Accessed online at http://www.mediastatements.wa.gov.au/

[32] Pilbara Ports. 2020. *Pilbara Ports Annual Report 2019-20*. Accessed online at http://www.pilbaraports.com.au/

[33] Western Australian Government. 2020. *WA State Budget 2020-21, Budget Paper 2, Vol. 1, pg 221 (Details of administered transactions – Department of Jobs, Tourism, Science and Innovation)*.

[34] Department of Jobs, Tourism, Science and Innovation. 2020. *JTSI Annual Report 2019-20, pg. 101*.

— the State is achieving full cost recovery from the foundation customer regardless of what happens with respect to other potential future users.

Funding non-plant infrastructure in this way still affords the project proponent an important benefit, in that it reduces the amount of up front capital funding it is required to source to make its project viable. In this respect, even though a proponent will ultimately pay for the full cost of the infrastructure and an appropriate return on the State Government's capital, this scenario results in a materially improved financial outcome for the proponent.

The better financial outcome is for two reasons.

First, by relieving the proponent of the up front capital funding task, the State Government is **leveraging its balance sheet and reducing the overall risk of the project** and the plant infrastructure developed by the proponent. Lowering the up front capital requirement means lower interest expenses, a lower risk of refinancing issues if refinancing is required, and an earlier return for equity holders in the project.

In this case, the project proponent does not begin paying for the infrastructure until it commences production, converting what would otherwise be a significant up front funding task into an operating cashflow consideration. The proponent's annual free cashflow is impacted, however it results in a less indebted balance sheet.

Second, Governments typically have a much **lower cost of capital** than private sector companies. For example, a report prepared by KPMG in 2019 found the after-tax weighted average cost of capital ('WACC') in the chemicals sector in Europe was 7.3 per cent.[35] By contrast, the WACC of the Western Australian General Government – measured by the opportunity cost of capital employed by the Department of Treasury – was 2.2 per cent.[36] Individual Government Trading Enterprises, such as the Water Corporation or Horizon Power, are likely to have WACCs which are higher than the General Government sector, and lower than the private sector, but these are not publicly available.

If the up front capital for non-plant infrastructure were bundled together with the capital for the plant infrastructure, this would mean the project proponent is faced with a WACC which may not be in keeping with the specific costs and risks of the non-plant infrastructure. By unbundling the infrastructure, and taking a direct interest in the non-plant infrastructure, the State Government can assist in lowering the cost of capital of the project as a collective and therefore improve the project economics of the project at large.

An up front capital funding approach to non-plant infrastructure also affords the State Government an opportunity for capital recycling through asset sales once the proponent's plant is commissioned and it is delivering a return. This opportunity was raised by stakeholders in the context of all non-plant infrastructure in the downstream industries sector, with the combination of high capital value, stable returns and long contract periods seen as particularly attractive to sovereign wealth funds, superannuation funds and reinsurers.

While the "Perdaman Model" is yet to be fully tested – as the project remains in the approvals process and is yet to achieve financial close – at face value it represents an opportunity for the State Government to support downstream projects in a tailored manner.

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[35] KPMG. 2020. *KPMG Cost of Capital Study 2019*. Accessed online at http://www.assets.kpmg.com/

[36] Western Australian Government. 2020. *Costing and Pricing Government Services: Seventh edition*. Accessed online at http://www.wa.gov.au/

Finding 14 Capital expenditure: Supporting the development of non-plant infrastructure

There are opportunities for government intervention to support so-called "non-plant" capital items in integrated projects, such as gas pipelines and ports. This includes providing up front capital funding to lessen the up front financial commitment requirement for project proponents. Potential models include conversion of up front capital charges to operating expenditure set at rates which allow infrastructure owners to recover costs and earn a return once the project is operational.

7.4 Critical success factor: Gas

A note on the gas market discussion and analysis contained in this section

ACIL Allen's scope of services is centred on the identification of impediments and enablers of gas-centric downstream industries in Western Australia. Gas market matters are central to this, however they are complex and multi-faceted given the role of natural gas across the Western Australian economy. ACIL Allen does not have the scope to fully explore the benefits, costs, impacts and risks of current and future interventions in the gas market, and raises issues in this section which are material to addressing its scope of services.

Gas market issues which have not been raised in this discussion include:

- retention lease policy,
- a proposed national domestic gas reservation policy,
- regulation of hydraulic fracture stimulation,
- the use or lack thereof of offsets under the WA Domestic Gas Policy, and
- pipelines, pipeline tariffs, and the impacts these have on the market.

Among the three critical success factors identified by stakeholders as most critical to establishing gas-centric downstream industries, discussions and opinions regarding the role of gas were most prominent. This stems from the role of gas as a vital input into the production process for most opportunities raised in the study.

In a Western Australian context, the challenges associated with gas are not simply a function of available supply. As demonstrated in Section 3, Western Australia has substantial current and potential domestic gas supply availability under a base case scenario, as well as abundant domestic gas processing plant capacity in strategic locations across the State. The gas challenge for downstream industries in Western Australia was summarised by one downstream project proponent stakeholder during ACIL Allen's stakeholder consultation:

> *The ultimate question we must answer when forming a project is how can we make our project bankable. And to be bankable, you don't just need gas. You need gas at the right price, locked in for a long period of time. It isn't enough to say that there is plenty of gas supply out there – there always has been. But the real challenge, and the reason why projects have not been getting off the ground, is there is no term gas, for the right price.*[37]

In this context, "term gas" refers to gas supply over long terms of ten years or greater, under contract with either fixed prices or prices which are unable to fluctuate significantly higher than the

[37] ACIL Allen. 2020. *Stakeholder consultation for WA Gas and Downstream Opportunities Study*. Stakeholder is not identified for confidentiality.

price struck at the time the gas supply agreement is formed. The notion of gas being available on "reasonable terms" was raised consistently by gas buyers throughout ACIL Allen's stakeholder consultation program. In this respect, it is important to acknowledge that simply referring to the quantity of available gas in a given year – as it is commonly referred to by, for example, the Australian Energy Market Operator in its annual Gas Statement of Opportunities – is insufficient when considering the potential for gas-centric downstream projects.

A similar phenomenon was observed in relation to price: consideration of price as what it costs to deliver a unit of gas to a project at a point in time is insufficient. Stakeholders advised that in order to make downstream projects bankable, the gas price made available to them needed to be relatively secure and unable to fluctuate in line with energy prices more generally. This helps underpin the bankability of the downstream project as it allows the largest single variable production cost of the project to be locked in or kept within reasonably predictable bounds of the price underpinning the establishment of the project.

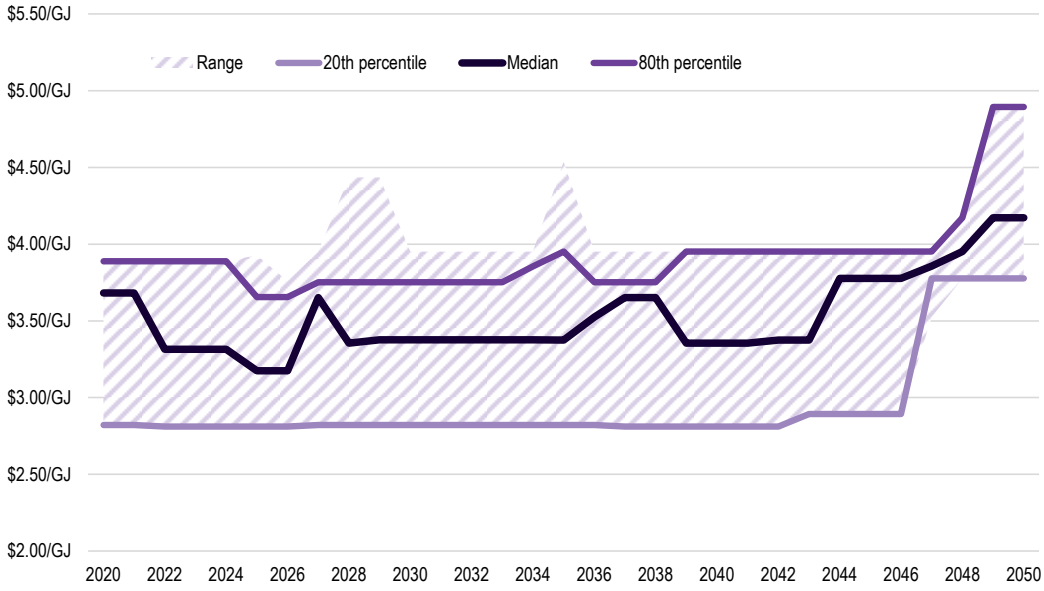
Finding 15 Delivering gas at the right price for long terms

Downstream projects are typically funded via a combination of equity and debt, with the long term nature of projects particularly attractive for bank financing. This creates a number of important considerations in establishing project feasibility, including access to feedstock gas on long terms and stable prices.

:

As discussed in Section 5, it is evident the gas price requirements for gas-centric downstream industry opportunities in Western Australia appears to be between AU$3.00 and AU$5.00 per GJ. In an environment where capital expenditure penalties of at least 20 per cent are likely to exist, it is likely projects would seek prices at the lower end of this range (assuming projects are funded predominately with debt – as per the example presented in Section 7.3). ACIL Allen's analysis of Western Australia's gas market and the supply outlook estimates that there is likely to be gas available for delivery into projects at prices which are within these bands (see Section 3).

Figure 7.5 ACIL Allen gas market outlook price band analysis, supply bands and estimated cost of supply into Dampier zone, $/GJ real 2020 dollars



Source: ACIL Allen

However, in reality there are a range of constraints which exist which do not reflect the neat projection of a potential supply curve. This principally relates to the nature of both demand and supply as "blocks" or tranches of gas to be contracted for a specific period of time, which varies depending on a raft of factors. While the gas supply and demand outlook does, prima facie, appear to support the requirements of gas-centric downstream industries in Western Australia, the reality of matching gas supply and demand is significantly more complex and nuanced.

The complexity of striking gas supply agreements exists on both the buyer side and the seller side. Each party has particular requirements and constraints, which make reaching agreement on supply of gas for long terms challenging.

Finding 16 Gas feedstock: Matching demand and supply

At face value, ACIL Allen's gas market modelling, stakeholder consultation and research suggest gas volumes and the potential cost of supply are adequate to meet the needs of gas-based downstream projects. However, price and volume are not the sole determinants of gas as a critical success factor.

7.4.1 Gas supply and demand dynamics for downstream projects

There are a number of factors which seem to impact on the ability for buyers and sellers to meet in the middle when it comes to gas supply agreements for gas-centric downstream industry projects.

ACIL Allen notes the gas volume requirements for new downstream projects typically exceeds 100 TJ per day at start up (with active Western Australian proponents seeking at least 125TJ/day) and has the potential to increase further over time if the project were to add new trains. Proponents also prefer sourcing supply from a single source or point of aggregation, as building a "book" of supply introduces a variety of risks which reduce project bankability.

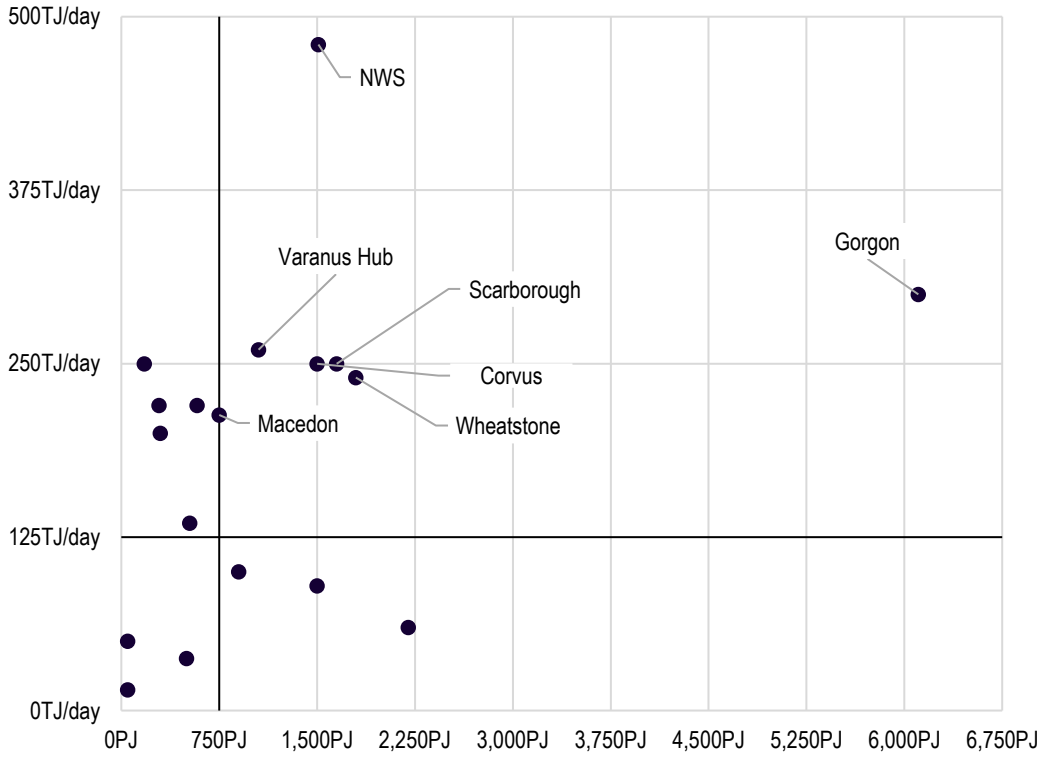
The gas supply requirements of downstream projects are the equivalent to 36.5 petajoules of gas per year (on average across the projects reviewed), or approximately 730PJ of gas over an initial 20 year project life (0.7 trillion cubic feet of gas). Based on current domestic gas market volumes, just one new gas-centric downstream industry project would represent a growth in demand of 10 per cent on current consumption – and around a 42 per cent increase in demand from the industrial and minerals processing sector under AEMO's WA GSOO definitions.[38]

As it stands, there are very few individual projects with the production and reserve capacity to supply the entirety of the needs of a downstream project (being 125TJ/day of production, and approximately 730PJ of total gas volume over a 20 year project life). This is demonstrated in **Figure 7.6**. The question of reserve capacity is not as significant as annual production capacity, but would be a factor in the formation of an agreement particularly for a greenfield downstream project.

A further layer of complication on the supply side exists in the form of the Australian Competition and Consumer Commission's ('ACCC') policy on joint marketing of gas. Prior to 31 December 2009, gas project owners could jointly market the gas produced at projects as a single entity. This automatic allowance was removed following concerns it was leading to anti-competitive behaviour and higher prices, with proponents now required to demonstrate there are public benefits to the arrangement prior to any approval. The ACCC did grant permissions for gas from the North West Shelf Joint Venture and Gorgon Joint Venture between 1 January 2010 and 31 December 2015.

[38] Australian Energy Market Operator. 2020. *AEMO WA Gas Statement of Opportunities 2020*.

Figure 7.6 Gas projects with combined capacity and supply potential to meet needs of a gas-centric downstream project, TJ/day of domestic gas capacity vs estimated reserves available for domestic use



Source: ACIL Allen (note: production capacity and reserves are domestic-only projects, and DMO for LNG projects, NWS is theoretical capacity given complexity of domestic gas commitment structure and proposed Burrup Interconnector project)

While the policy on joint marketing may lead to improved competitive tension among established buyers, it may also reduce the prospect of domestic market obligation gas tranches being utilised by new gas-centric downstream industry project proponents. This is because there are very few tranches of domestic gas which are of sufficient scale to meet the needs of downstream projects, as demonstrated below (**Figure 7.7**).

On an unconstrained basis, the ban on joint marketing has fragmented the gas supply potential of the domestic market obligation gas tranches available to be offered by commitment holders to the point where only two tranches could meet the needs of downstream projects in the long run. These are:

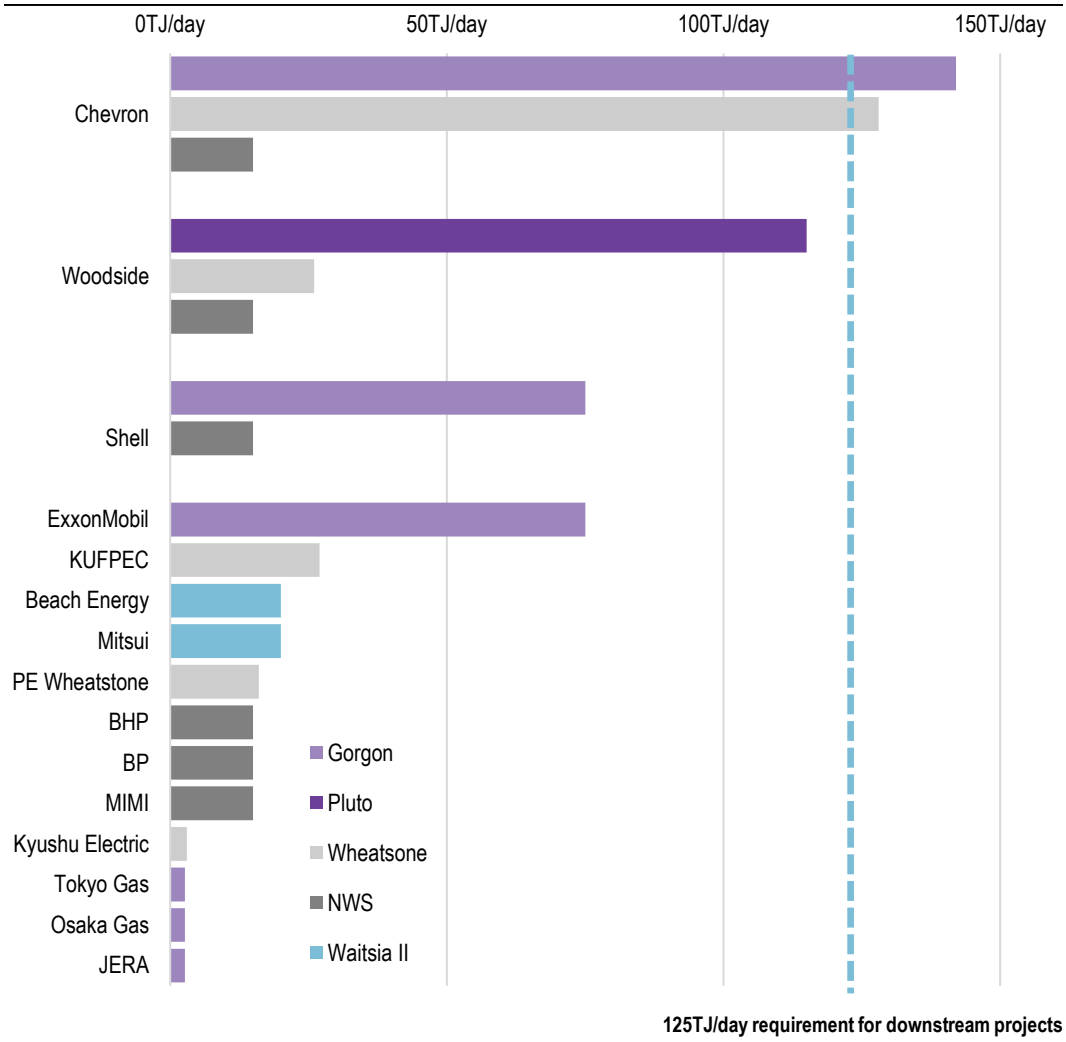
— Chevron's share of the Gorgon Gas Project's combined 300TJ/day commitment (142TJ/day), noting 150TJ/day of this was joint marketed prior to the ACCC ban, of which 125TJ/day was sold on a 20 year offtake agreement with Synergy, the Western Australian Government's power generator and retailer.[39] Taking into account the domestic gas obligation shares of non-operator project owners, the maximum effective availability of this tranche is estimated to be ~59TJ/day until 2035.

— Chevron's equity share of the Wheatstone Project's combined 200TJ/day commitment, being 128TJ/day. It is noted Chevron signed a seven year offtake with Alinta Energy of

[39] Western Australian Government. 2011. *Media Statement: Domestic gas secured through Gorgon contract, 30 November 2011*.

approximately 55TJ/day commencing in 2020, meaning the maximum effective availability of this tranche is 73TJ/day.

Figure 7.7 Domestic market obligation gas tranches, TJ/day of plateau commitment by proponent and project, as of 31 December 2020



Source: ACIL Allen, from JTSI.

Note: Pluto commitment is managed by Woodside on behalf of commitment holders. Beach Energy's Waitsia II commitment is to be met from existing Waitsia I production.

At a project proponent level, only Chevron (combined plateau domestic gas obligation of 285 TJ/day) and Woodside (156TJ/day) hold large enough domestic market obligations to meet the needs of a downstream project in their own right.

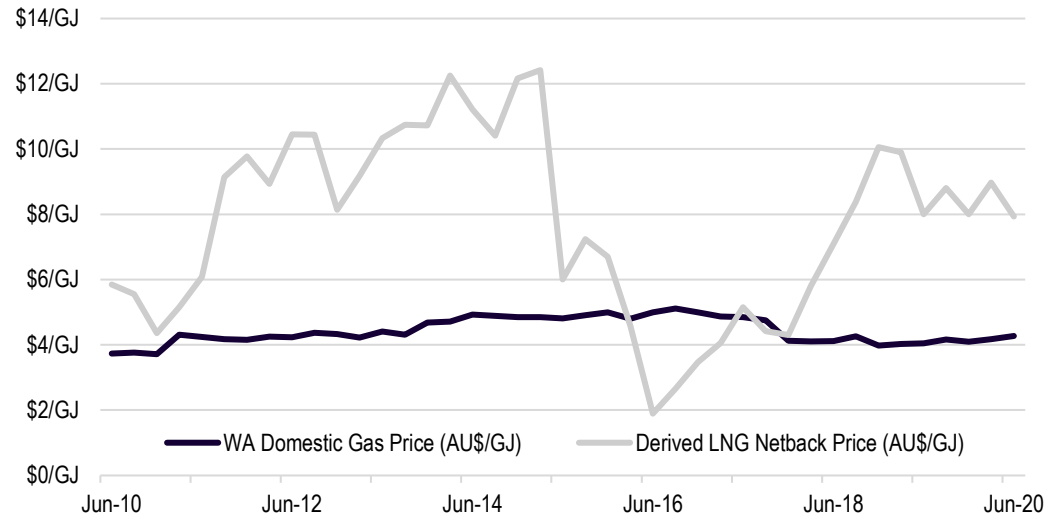
In addition, the agreement struck between the Western Australian Government and the North West Shelf Joint Venture pushes new domestic gas commitments associated with LNG produced at the North West Shelf upstream, as opposed to the LNG project owners themselves. This results in a further fragmentation of the domestic market obligations associated with LNG projects in the State, exacerbating the impact of the ban on joint marketing.

As the Department acknowledges in its submission to ACIL Allen with respect to the WA Domestic Gas Policy, the economics of LNG netback pricing is a powerful incentive for upstream producers, and particularly those with direct connections to LNG facilities. LNG netback pricing refers to the gas feedstock price for a given LNG price, determined by working backwards a delivered LNG price and removing the elements of the value chain associated with the transformation of natural gas into

LNG. During the 2011 Western Australian *Parliamentary Inquiry into Domestic Gas Prices*, LNG netback prices were estimated by removing approximately US$5.00 per mmbtu (~AU$7.33/GJ) from benchmark LNG prices to reflect the cost of liquefaction, shipping and regassification following import in a customers' end market.

All things being equal, at times of high LNG prices, or where LNG prices are expected to be high in the long run, the incentive to sell gas via LNG is strong. When LNG prices are low or are expected to fall, the incentive to sell gas into LNG is weaker. This is further complicated by the use of long term contracts for LNG pricing meaning not all gas is sold on spot markets. However, a brief review of derived LNG netback pricing against Western Australia's domestic gas price (as measured by the Department of Mines, Industry Regulation and Safety[40]) is instructive. Outside of the oil price crash of 2014 to 2016, derived LNG netback prices realised by LNG producers in Australian dollars have been above the DMIRS WA domestic gas price, in some quarters by up to AU$7.50/GJ (**Figure 7.8**).

Figure 7.8 Derived LNG netback price (Japan import terminal price, USD/mmbtu, converted to AUD/GJ at market exchange rate) vs WA DMIRS domestic gas price (AUD/GJ)



Source: ACIL Allen from World Bank Pink Sheet, RBA, DMIRS

ACIL Allen's gas market modelling finds Western Australia's domestic gas market will be increasingly served by LNG-linked gas, meaning these incentives are likely to become an even more important driver of the market supply dynamics over time.

It is important to note the LNG netback price **does not reflect the cost of production for domestic gas**. Rather, LNG netback is effectively a ceiling price which demonstrates the maximum input cost for natural gas which could be paid by an LNG producer and converted into LNG with the producer receiving no return on capital associated with their LNG plant. In this respect, the difference between the LNG netback price and the realised domestic gas price demonstrates the premium (or loss, when the domestic gas price exceeds the LNG netback price) which a gas supplier could earn selling gas into an LNG plant, all other things being equal.

[40] DMIRS domestic gas price is based on the total volume of domestic gas supplied into the Dampier to Bunbury Natural Gas Pipeline, Parmelia Gas Pipeline, or Goldfields Gas Pipeline as appropriate, at the point of entry into the pipe versus to the total volume of gas supplied into the pipe. In this respect, the price reflects the production cost plus margin of all domestic gas produced and sold in WA prior to shipping costs.

The power of this incentive is demonstrated by the recent developments with respect to the Beach Energy/Mitsui Joint Venture Waitsia II Gas Project. In December 2020 the Western Australian Government finalised a gas commitment agreement and project development deed with the Waitsia Joint Venture (see Section 2):[41]

According to Beach Energy's 2021 half year results briefing, the company's combined Perth Basin projects (comprising Waitsia 1A, Waitsia II and Beharra Springs) has an expected payback period of three years on a capital investment of $700-$800 million (100 per cent basis).[42] All things being equal this would imply Beach anticipates generation of between $233 and $266 million per annum of free cashflow (net of production, pipeline, liquefaction and transport costs) from LNG sales, or approximately $3.24 per GJ of net margin. Importantly, Beach and Mitsui plan to develop a gas processing facility with 250TJ/day of capacity as part of this development, which is included in the overall capital expenditure estimate. This plant will be used to supply the domestic market following the completion of the LNG sales agreement period at the end of 2028.

The transformational economic and financial impact of LNG backfill supply demonstrates the lure of selling into an established LNG facility as a means to establish new sources of supply.

7.4.2 Market transparency and information to aid in price discovery

As discussed in Section 4, there were concerns from both gas buyers and sellers with respect to the transparency of the domestic gas market as it relates to available supply and the prices available. This is manifesting in a number of minor issues, which when combined suggest information asymmetries may be working against price discovery by potential downstream industry projects.

Western Australia's domestic gas market is relatively small and somewhat illiquid compared to the East Australian gas market, and substantially more illiquid than gas markets in the United States (the two jurisdictions raised in the context of market information and asymmetries). AEMO estimates between three and five per cent of Western Australia's gas demand is served through spot markets,[43] compared to at least ten per cent in the Eastern Australian gas market.[44]

Meanwhile, the United States is served regular prices – including forward pricing curves based on derivatives and other financial hedging products – through the Henry Hub in Louisiana. The Henry Hub is a major gas transmission pipeline which links nine of the United States' gas regions, with the infrastructure serving as the settlement hub for futures contracts traded on the New York Mercantile Exchange.[45]

Western Australia's gas market is less transparent by its structure, due to the extensive reliance on long term bilateral contracts between buyers and sellers. While in recent years some proponents have taken to announcing gas contracts publicly, the information is not regularly available outside of AEMO's annual Gas Statement of Opportunities. Meanwhile, there is no recognised "market

[41] Department of Jobs, Tourism, Science and Innovation. 2020. *Waitsia Joint Venture gas commitment agreement.* Accessed online at http://www.jtsi.wa.gov.au/

[42] Beach Energy. 2021. *Beach Energy Half Year Results FY2021*. Accessed online at http://www.beachenergy.com.au/

[43] AEMO. 2019. *AEMO 2019 WA Gas Statement of Opportunities*. Accessed online at http://www.aemo.com.au/

[44] Australian Energy Regulator. 2018. *State of the Energy Markets 2018*. Accessed online at http://www.aer.gov.au/

[45] CME Group. 2021. *Introducing Henry Hub*. Accessed online at http://www.cmegroup.com/

price" for domestic gas in the State, on either a supply-weighted basis or marginal basis, with the annual GSOO and the Department of Mines, Industry Regulation and Safety's[46] the closest to benchmarks the State gets.

This lack of transparency means buyers have limited means to investigate project feasibility without engaging directly with buyers. This appears to be the root cause of accusations from gas suppliers that buyers were unsophisticated, or were not genuine in their approaches and were instead interested in discussing hypotheticals. Similarly, buyers reported suppliers would treat their exploration of project feasibility dismissively. This is unproductive and works against the ability of buyers and sellers to meet in the middle.

One path forward may be to improve market information and transparency through existing means of data collection by both the Department and AEMO. In particular, AEMO gathers extensive data on the ten year outlook period as part of its GSOO under the Gas Services Information rules. This data collection includes buyer and seller expectations regarding their contracted and uncontracted gas on an annual basis over the project period.[47]

It is noted the Western Australian Government now makes publishing of the domestic gas agreements made under the WA Domestic Gas Policy mandatory. As new agreements are struck, this should provide the market with an improved capacity to understand how the policy functions, and how gas will be made available under these agreements. In addition, the Department has imposed additional gas market reporting obligations on domestic gas commitment holders as part of its most recent reforms to the WA Domestic Gas Policy.

This information could be used to provide regular, contemporary data on the outlook, driving transparency and breaking information asymmetries.

Finding 17 Gas market transparency

Western Australia's gas market is relatively opaque compared to other gas markets domestically and abroad. Government entities and regulators collect a range of information which, if disseminated regularly, would improve market transparency and lean against information asymmetries which exist between buyers and sellers.

7.4.3 Western Australia's domestic gas policy in the context of gas-centric downstream project opportunities

ACIL Allen notes the scope of its engagement is not specifically centred on a review and analysis of Western Australia's domestic gas policy. However, the policy was raised by all stakeholders during stakeholder consultation, and is clearly material to the long term gas supply potential of Western Australia from the perspective of downstream projects. With this in mind, ACIL Allen has included the following section of its report on the domestic gas policy in respect of its impact on gas-centric downstream projects.

[46] DMIRS WA domestic gas price series is based on reporting of the total value of gas supplied into the Dampier to Bunbury Natural Gas Pipeline versus the total volumes in a given quarter. This is a sound basis for establishing a "weighted average cost of supply" metric as it reflects the gross price paid by buyers to bring gas into the major State's transmission pipeline. However, the data is only produced at a quarterly level once a year, and significantly lagged, with data to 30 June 2020 currently the latest available.

[47] Ibid.

Commercial considerations and marketing in good faith

As discussed earlier in this section, the ability to achieve LNG netback pricing for natural gas acts as a powerful incentive in the economics of upstream projects in Western Australia. This incentive extends to gas earmarked for domestic market obligations as part of the sanctioning of LNG projects.

As one stakeholder remarked during ACIL Allen's consultation process:

> *No one wants to be the executive to sign off on the domestic gas contract which costs the company billions in foregone revenue.*[48]

This is demonstrated by a simplified view of the revenue dynamics for LNG versus domestic gas.[49] When an LNG producer is faced with the prospect of selling 125TJ/day of gas into the domestic market on a ten year offtake for a price at the top of the acceptable range for a new downstream industry project ($3.60/GJ, as per ACIL Allen's assessment of the upper bound of prices in a local project context), it could be expected to raise $1.6 billion over ten years. If this gas was instead sold as LNG, and the proponent was able to effectively realise an LNG netback price for this gas (set at $7.70/GJ, as per ACIL Allen's assessment of the ten year average LNG netback price discussed earlier in this section), the proponent could raise $3.5 billion in revenue.

Adding a further layer of realism to the scenario, the LNG producer has the choice to either sell the 125TJ/day of gas into the domestic market over ten years, or to effectively "back end" the gas to the end of the productive life of the field and/or the end of life of the LNG production facility. This would push the sale of the gas into an 11th year of the modelling period (as it would be assumed the LNG trains would be full for the initial ten year period). To account for the additional risk associated with deferring sale of the gas into the future, a discount rate of 12 per cent is applied to revenue across both options.

As demonstrated in **Figure 7.9**, the deferral of gas sales into the 11th year of the modelling period, but realising an LNG netback price on the gas results in a discounted revenue stream of $1.13 billion over the modelling period, compared to $1.04 billion in the domestic gas sale approach – a difference of 8.8 per cent even after accounting for the risks associated with sales deferral. The effect would be larger if there was capacity to bring forward LNG sales beyond the tail of LNG production.

This is the effect the WA Domestic Gas Policy seeks to lean against, through provisions which require proponents to market gas through the term of their LNG projects. Beyond the reservation itself, and requirement to maintain access to the domestic gas pipeline network, the most significant provision is the "marketing in good faith" requirement.

The marketing provision in the WA Domestic Gas Policy was of significant interest to gas buyers in particular during ACIL Allen's stakeholder consultation program. The wording of the policy is relatively high level, however more specificity is provided in the terms of domestic gas commitments between the State and LNG proponents. For example, the recent Waitsia Joint Venture Domestic Gas Commitment for the Waitsia Gas Project includes terms such as:

— Actively and diligently marketing to a range of buyers, with a view to achieving a reasonably stable and regular supply profile for the commitment holders' domestic gas,

[48] ACIL Allen. 2020. *Stakeholder consultation for WA Gas and Downstream Opportunities Study*. Stakeholder is not identified for confidentiality.

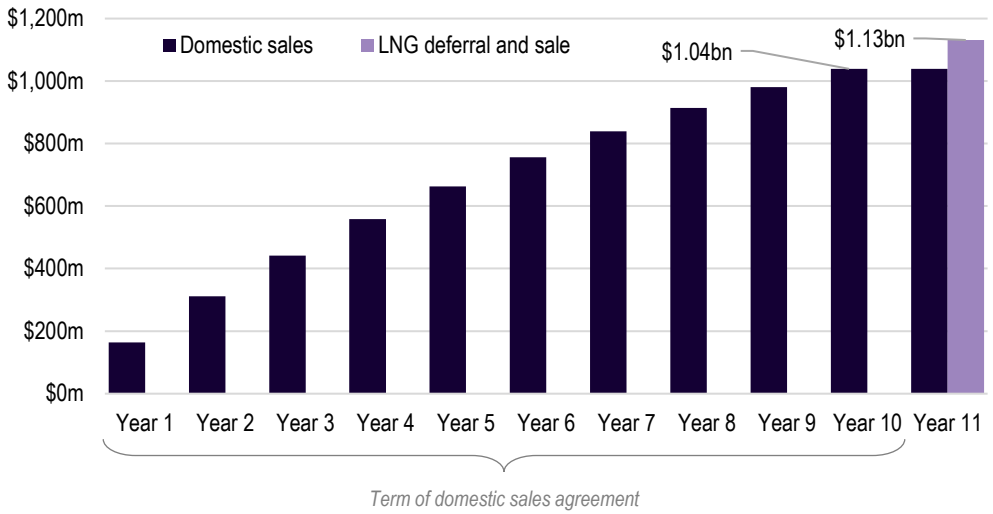
[49] The analytical framework was presented to ACIL Allen by Methanex during stakeholder consultation and represents a logical view of the trade-offs which exist in LNG-linked domestic gas markets.

— Avoiding unreasonable accumulation of the domestic gas commitment

— Negotiating in good faith with bona fide purchasers as to the price and terms of supply

Similar terms are included in the Woodside Pluto Acceleration Domestic Gas Commitment, and have been in place since the amended NWS Agreement was ratified in 2015.

Figure 7.9 Demonstration of tail incentives on LNG projects vs domestic gas sales, cumulative discounted revenue streams (12% discount rate), $bn



Source: ACIL Allen

While non-binding from the perspective of enforcing the sale of quantities of gas in a given year, the wording of the agreement leaves little doubt with respect to the Western Australian Government's expectations. To the extent these terms and obligations reflect a new approach to enforcing the marketing in good faith provisions of the WA Domestic Gas Policy these are likely to result in improved dialogue between buyers and domestic commitment holders.

However, the terms also place obligations on potential buyers. The commitment documents refer to "bona fide" purchasers, providing LNG commitment holders with an out clause if they believe a project proponent is not a genuine potential gas customer. This places the onus on project proponents to have advanced projects to the point where they can talk price and terms in practical terms, as opposed to the theoretical discussion reported to ACIL Allen during stakeholder engagement.

On pricing and terms, another significant point of contention was in relation to the price of gas made available from LNG commitments. It is clear gas-centric downstream industries require gas with prices which are well below LNG netback prices. However, according to ACIL Allen's gas market analysis the production costs (and therefore prices) available for gas in Western Australia are achievable. A number of perspectives were offered on this issue throughout the engagement, which ACIL Allen has summarised below (**Box 6.2**).

Strategic utilisation of LNG ullage provisions in revised WA Domestic Gas Policy

As demonstrated in Section 7.4.1, the revised WA Domestic Gas Policy which forbids export of so-called "pipeline gas" as LNG except in exceptional circumstances can result in transformational impacts for projects which would otherwise be smaller and focussed on domestic markets. In the case of the Waitsia II project, the seven year LNG export licence will allow project owners with the financial returns to develop the project and build a large domestic gas processing plant, which can be used to support the domestic market following the export period.

Box 7.2 Costing and pricing domestic gas

Throughout this engagement, ACIL Allen was presented with and considered a number of varied views regarding the costing and pricing of domestic gas – particularly in the context of LNG projects. In general, the approaches were common insofar as they centred on a "build up" of costs using various cost blocks associated with getting a volume of gas to a particular market, with differences in which blocks were applicable to domestic gas and in what ratio.

The three most common approaches (with ACIL Allen naming) are raised below. In ACIL Allen's view there is no right or wrong answer, with costing and pricing ultimately subject to market tolerance and other commercial drivers. It is important to note none of these approaches are a perfect conceptual framework, as the price paid for domestic gas is ultimately a reflection of outcomes between buyers and sellers.

The "All-In" approach

In this approach, all of the relevant capital and operating costs of the project in question should be considered when costing and pricing a unit of production. This is clearly the most appropriate way to cost and price domestic-only projects, however it was put to ACIL Allen that the domestic gas from LNG-linked projects should also be costed and priced in this way. This argument was made with two primary points: the project was sanctioned as primarily an LNG project and so all costs are in scope, but more significantly it was raised that much of the State's LNG-linked domestic gas would not be supplied without the ability to sell the vast majority of it to LNG.

The "Short Run Marginal Cost" approach (for LNG projects)

In this approach, only the operating costs associated with extracting gas upstream, transporting it to a domestic gas plant, and processing it at the plant should be considered as part of the cost and price of domestic gas. In this structure the proponent is required to forego a return on capital on the project for domestic gas sales, as the assertion is the project's economics are underpinned by LNG sales which allow the proponent to earn a return on capital.

The "Like For Like" approach

In this approach, the costs of bringing gas to market are determined based on disaggregation and allocation of costs as if the gas volumes earmarked for domestic sales were a standalone domestic project. For domestic only projects this cost should mirror the "All-In" approach, however for LNG-linked projects the key difference is all costs associated with LNG are removed, while the costing method attempts to disaggregate and apportion costs for shared capital (such as subsea wells and trunklines) based on the utilisation of these for domestic gas vs LNG.

Source: ACIL Allen

This approach to the WA Domestic Gas Policy presents the Western Australian Government with an opportunity to assist in improving the project economics of domestic-focussed gas developments, albeit with significant risks and political considerations. Under the revised WA Domestic Gas Policy, the specific provision which bans the export of pipeline gas is drafted at a high level. Specifically:

> *The Western Australian Government will not agree to export of gas via the WA pipeline network other than in exceptional circumstances*[50]

The policy does not define "exceptional circumstances", which provides the Western Australian Government with the ability to apply discretion where it may be able to achieve policy or industry

[50] Western Australian Government. 2020. *WA Domestic Gas Policy*. Accessed online at http://www.jtsi.wa.gov.au/

development outcomes – including provision of tranches of supply which are suitable for gas-centric downstream industry projects.

More specifically, projected ullage at the North West Shelf project provides an opportunity for domestic-focussed projects to improve their initial project economics. ACIL Allen is not projecting significant ullage in a combined North West Shelf-Pluto Burrup Hub plant until after 2031. However, in the context of an otherwise domestically-focussed project, the annual ullage of between 200 and 500TJ/day is an attractive proposition, particularly for projects with large reserves.

Application of the WA Domestic Gas Policy in this way is likely to entail significant costs, benefits, issues and risks, chief among them the notion of "picking winners". If this option were to be pursued it should be subject to significant checks and balances, including an increase in the capacity of the Department to assess these opportunities as they arise.

Finding 18 LNG ullage as industry development policy

ACIL Allen notes its base case suggests there is set to be substantial ullage in major LNG infrastructure over the projection period. Under the revised WA Domestic Gas Policy the Western Australian Government could consider conditional access to LNG sales from otherwise domestic-only projects with conditions centred on the realisation of further industry growth and development.

:

Impact of potential supply on exploration and development incentives

As of 31 December 2020, the total volume of plateau domestic gas commitments held by LNG project owners totals 733.5TJ/day – or approximately three quarters of total demand in the domestic gas market. ACIL Allen's gas market modelling found these domestic gas commitments play an increasing role in supplying the domestic market over time (see Section 3).

The spectre of domestic market obligation gas looms over the investment decisions of other suppliers – principally those who only supply the domestic market. This feedback was provided during ACIL Allen's stakeholder consultation process, and has been assessed as one of the drawbacks of domestic gas reservation policies generally.[51]

This "supply overhang" effect occurs because no matter the current structure of the market, and that the policy obligations of LNG commitment holders are expected to be delivered over the life of a project, actual delivery of LNG-linked domestic gas can vary from year to year and over the medium term. In this uncertain supply outlook, decisions to invest in large exploration campaigns and upstream supply development are more challenging – particularly when proponents do not have the option to sell into LNG facilities.

The effect is compounded in a Western Australian context due to the lack of liquidity in the market and the prevalence of bilateral contract. A new upstream project cannot sell into a spot market in the event it cannot secure one or more offtake partners. Over time, this effect could be expected to result in fewer domestic-focussed projects, particularly if the cost of supply of these projects was comparable or higher than LNG-linked domestic gas.

[51] Economic Regulation Authority. 2014. *Inquiry into Microeconomic Reform Opportunities for Western Australia: Final Report*. Accessed online at http://www.era.wa.gov.au/

7.4.4 Which gas is the right gas?

The discussion contained in this section is critical to the central question of this study: what can be done to foster an investment environment more conducive to gas-centric downstream industries in Western Australia. It is evident there are a number of issues and challenges – structural, regulatory/policy and commercial – which impact the ability of prospective gas-centric downstream industry proponents to find gas on terms which are appropriate for their projects.

In ACIL Allen's judgement, these issues and challenges are difficult to overcome without a **adjustments to the mechanisms underpinning the execution of the WA Domestic Gas Policy**.

At the root of this finding is a lack of strategic alignment between the overall intent of the policy and the objectives of this engagement – and the Western Australian Government's industry development agenda in the downstream processing industry space.

That is not to say the policy is ineffective; on the contrary ACIL Allen's gas market analysis and the discussion contained in this section make it clear Western Australia's *existing* domestic gas buyers are served well by the policy. But new buyers, and in particular new buyers who need large tranches of relatively cheap gas on long terms, are not.

Many of the issues and challenges discussed in this section centre on *existing* LNG project owners with *existing* domestic market obligations. A number of these issues and challenges are less applicable, or not applicable at all, for domestic-focussed producers, and indeed for *new* LNG linked gas supplies. Fundamentally this is because new projects are not faced with the same incentives and restrictions, as they are free to negotiate and build up offtake agreements for new gas on terms which can deliver a project. Once the project is established, and the capital is spent, the game changes.

Recent activity in the downstream industries space is revealing. The four major active projects in Western Australia are **all linked to greenfield upstream gas projects**. For projects which have publicly announced their gas supply intentions:

— the Perdaman Urea Project is to source gas from the Scarborough project, and

— Strike Energy's Mid West Urea Project is to source gas from the West Erregulla project.

To further summarise to this section of the report, ACIL Allen has prepared a matrix which demonstrates the alignment or misalignment of upstream and downstream projects by their status (new or existing) and whether they are domestic-focussed or LNG-linked on the supply side. The matrix demonstrates the best alignment between upstream and downstream proponents exists in the greenfield zones, where both buyers and sellers are best place to negotiate gas supply on terms which meet the needs of all parties.

In many respects, linking greenfield upstream and greenfield downstream projects during project feasibility and development results in a loose vertical integration of the downstream supply chain.

Finding 19 Role of domestic market obligations in downstream projects

There are a range of structural factors and market incentives which work against the provision of block loads of gas on long terms by DMO holders for greenfield domestic users. These factors are unlikely to be overcome within the parameters of the existing commitments held by these suppliers. However a zone of opportunity exists for downstream projects where the upstream incentives are aligned, which appears to be more typical in greenfield upstream projects.

Table 7.1 Assessment of potential for upstream and downstream project linkage potential

	Existing domestic only gas	Existing LNG linked domestic gas	New domestic only gas	New LNG linked domestic gas
Existing domestic gas projects	▪ No significant barriers, issues or challenges were identified by stakeholders. ▪ Tranches of gas are available to support existing buyers, at prices which appear to meet the needs of both parties. ▪ Both buyers and sellers in this quadrant have a higher risk tolerance and can accept shorter terms for gas sales agreements.	▪ The existing structure of the Domestic Market Obligation appears to be fit for purpose for this quadrant. ▪ Suppliers prefer the flexibility of short gas sales agreements which are tolerated by buyers. ▪ Both buyers and sellers in this quadrant have mature businesses and adequate balance sheet capacity, meaning demand and supply risks are low.	▪ Principal concerns exist on the supply side with existing proponents concerned about the supply overhang from LNG domestic market gas distorting incentives. ▪ Notwithstanding, there appear to be limited constrains or barriers to supply meeting demand where uncontracted demand tranches are available in support of new upstream investments.	▪ The existing structure of the Domestic Market Obligation appears to be fit for purpose for this quadrant, as evidenced by contracting activity.
New domestic gas projects	▪ Consistency in the application of the WA Domestic Gas Policy was raised, particularly related to the ability of existing domestic-only players accessing LNG ullage to assist in project economics. ▪ Lack of scale in existing domestic gas fields – either production capacity or remaining reserves – present challenge for long term offtake.	▪ At individual Domestic Market Obligation holder level, there are very few tranches of gas which are suitable for downstream project needs. ▪ LNG producers prefer contracting domestic gas on shorter terms to allow realisation of best available prices over term of their project. New domestic gas projects require long terms. ▪ Risks associated with new non-energy greenfield projects present a challenge for energy companies which can sell into highly liquid, oil-linked markets.	▪ The primary challenge in this quadrant is scale of supply. ▪ Perth Basin gas seen as a prospective source of supply for downstream projects subject to confirmation of reserves and commercialisation strategy. ▪ New domestic-only supplies from the Carnarvon Basin seen as too complex, costly and challenging to represent genuine opportunity for long term offtake agreements. ▪ Use of the revised Domestic Gas Policy provisions with respect to access to LNG projects can assist in building project economics but should be used cautiously.	▪ LNG linked projects provide scale and term required to meet needs of downstream projects. ▪ The opportunity exists prior to development of projects, for downstream proponents to be part of long term offtake as foundation customers. ▪ Netback pricing and tail sales incentives drive commercial outcomes for LNG but can be overcome with willing buyer. ▪ Stakeholder feedback underscored the importance of downstream projects being investment ready prior to negotiations.

Key: white = no issues, purple = unviable, blue = potential but barriers exist, green = most prospective linkages

8 Policy implications and next steps

This summary section of the report provides a snapshot of the findings and directions of ACIL Allen's engagement, including recommendations for consideration by the Western Australian Government specific to the scope of services.

8.1 Summary and recommendations

Throughout ACIL Allen's review, it became clear the opportunities for Western Australia to foster industries which process its vast reserves of natural gas are material and within reach. This overarching finding should be seen as the headline result of the study, despite the challenges associated with building linkages between gas suppliers and prospective downstream industry proponents.

In light of the 19 findings made throughout this report, ACIL Allen has developed seven prime recommendations for consideration by the Western Australian Government, across four reform areas. These are presented below.

8.1.1 The role of gas and gas markets in downstream project development

ACIL Allen's stakeholder engagement, research and analysis has identified three critical success factors for downstream projects to succeed in Western Australia. The most important of these factors is access to large tranches of gas, on long terms with stable prices. Gas feedstocks can represent up to 80 per cent of the operational costs of chemical and fertiliser projects.

In a Western Australian context, the availability of gas is not the primary challenge to overcome for downstream industry projects. Rather, it is access to gas on the right terms. With this in mind, ACIL Allen's findings with respect to this critical success factor suggest:

- The WA Domestic Gas Policy has served and is expected to continue to serve the State's established gas buyers well, with adequate supplies on terms which meet the needs of both buyer and seller.
- The current structure of the Western Australian gas market is not well suited to delivering larger tranches of gas on terms which are conducive to the needs of new and potential downstream industry projects.
- This has led to new and potential downstream industry proponents seeking opportunities for the Western Australian Government to strengthen the measures contained within the policy to force additional supplies into the market.
- Gas supplied under the domestic market obligations of the LNG industry cannot be fit for purpose, as tranches are not of adequate size and joint marketing bans mean individual commitment holders cannot combined their tranches in a way which meets the needs of a new downstream industry project.

— Bona fide downstream industry project proponents are turning to greenfield gas developments as their source of supply. This is because many of the market structure and incentive challenges are less present.

Given the above, a case could be made that the WA Domestic Gas Policy works against the needs of downstream industry projects. It is also worth noting the current WA Domestic Gas Policy is primarily focussed on maintaining adequate supplies for existing users as opposed to catering to the needs of potential large users. Recent changes to the WA Domestic Gas Policy tip the scales towards encouraging development, by closing off the export path to market – except in exceptional circumstances – for onshore gas.

There are a range of ideas and proposals which emerged throughout ACIL Allen's review which should be more thoroughly analysed and tested before being given consideration. This points to the need for a more detailed examination of the WA Domestic Gas Policy, the outcomes which are being achieved, and the opportunities to drive improved market outcomes for all participants.

There is no appetite for such a review to take place as this would give rise to significant reputational and sovereign risks, and work against the implementation of the policy which is based on the notion that once an agreement is struck that it will be fulfilled. While a review may result in improvements to the policy framework, it is unlikely that the benefits outweigh the costs when the impact of this uncertainty are taken into account.

Given this, there are a number of ways the Western Australian Government can give effect to its desired domestic market outcomes within mechanisms available within the WA Domestic Gas Policy. Feedback from stakeholders and ACIL Allen's analysis suggest greater enforcement of existing rules around marketing in good faith, and improved market transparency through dissemination of information which is collected by the Department, would improve the efficiency of the market.

Marketing in good faith provisions

Marketing in good faith provisions within contemporary agreements struck under the WA Domestic Gas Policy reflect three pillars:

— Actively and diligently marketing to a range of buyers, with a view to achieving a reasonably stable and regular supply profile for the commitment holders' domestic gas,

— Avoiding unreasonable accumulation of the domestic gas commitment

— Negotiating in good faith with bona fide purchasers as to the price and terms of supply

These provisions do not guarantee buyers can access gas on terms that meet their needs. Instead, these pillars are intended to nudge commitment holders to the negotiating table when buyers are seeking gas. Stakeholders raised concerns that suppliers were not engaging in good faith, and that these terms could or should be strengthened including formation of a specific clause around pricing and its basis. This is not supported, as intervention of this nature would significantly undermine the development of market outcomes, in an environment where there are a plethora of factors which are likely to be influencing the inability of buyers to reach adequate terms with DMO holders.

Under the Western Australian Government's approach of incremental change with respect to the WA Domestic Gas Policy, measures to strengthen marketing in good faith should instead focus on providing greater clarity and definition on a number of terms. This would allow the Western Australian Government to measure the extent to which the good faith terms within domestic gas agreements are being met.

Recommendation 1 Improving outcomes for downstream project proponents within the existing domestic gas policy framework: Marketing in good faith

The Western Australian Government may consider strengthening the marketing in good faith provision within the operations of existing domestic gas agreements, and new domestic gas agreements, struck under the WA Domestic Gas Policy by providing enhanced definitions on key terms. These changes could include specifying what constitutes:

- "reasonably stable and regular supply profile"
- "unreasonable accumulation of the domestic gas commitment"
- a "bona fide purchaser"

Such clarifications could include quantitative thresholds – such as an "unreasonable accumulation" being X per cent of the total commitment after Y years – or be more qualitative – such as what makes a purchaser becomes "bona fide" – in nature. This approach would provide the State, and commitment holders, with continued flexibility while also providing further incentives to bring gas to market where this does not occur.

Transparency and information asymmetries

Western Australia's gas market is illiquid, and concentrated on both the buy side and sell side (and particularly on the sell side). In literature these markets are often rife with information asymmetries, as information which would typically emerge through transactions and other interactions between buyers and sellers does is not made available. ACIL Allen identified a raft of information asymmetries throughout the engagement.

Information flows are critical to the achievement of market outcomes. Through the WA Domestic Gas Policy and other regulatory functions of the State, and the information collection powers of other bodies involved in the gas market, the Western Australian Government occupies a unique position in that it has access to information about both buyers and sellers. Measures to push more of this information into the public domain, in a way which respects commercial sensitivities, would assist in breaking down information asymmetries.

Recommendation 2 Improving outcomes for downstream project proponents within the existing domestic gas policy framework: Transparency

Measures to transparently demonstrate of the operations of the WA Domestic Gas Policy could go further, given the information collected by the Department as part of its enforcement of the commitments of DMO holders and achievement of outcomes under the WA Domestic Gas Policy. Examples of initiatives include:

- more regular public communication of the market outlook and the State's perspective on this (ie more than once per year),
- introduction of more explicit performance objectives and targets for downstream industry development as it relates to the gas market, and
- development of official price benchmarks, augmenting the information collected by the Department of Mines, Industry Regulation and Safety.

These measures could be accommodated within the existing information available to the Western Australian Government under the WA Domestic Gas Policy, and the information collected and analysed by other government bodies such as AEMO.

Strategic utilisation of LNG export ullage

Recent changes to the application of WA Domestic Gas Policy introduced a ban on the export of domestic gas as LNG, closing off a potential commercialisation path for a raft of emerging upstream gas projects. As demonstrated by this report, the ability to sell gas as LNG has powerful commercial and economic implications for new upstream projects.

The recent decision by the Western Australian Government to allow the Waitsia II Project to access ullage in the North West Shelf LNG plan in the first five years of its life provides a pathway to the commercialisation of otherwise challenging or stranded natural gas fields. Consideration should be given by the Western Australian Government to formalise an approach of allowing prospective gas producers to receive similar dispensation in return for the delivery of various economic and industry development objectives – including supplying domestic gas to new downstream industry projects.

Recommendation 3 Strategic use of LNG export licences to facilitate domestic supplies

The Western Australian Government should formalise its approach to allowing prospective (ie greenfield) domestic-only gas projects to access the projected ullage in LNG production trains as a way to improve the initial project economics of domestic gas fields. In return the Western Australian Government could secure commitments to supply domestic gas on terms which support the development of downstream industries following the period of LNG export. Such an approach should be transparent and subject to specific, publicly available criteria.

8.1.2 Becoming a "development ready" State

Stakeholder feedback and ACIL Allen's analysis found Western Australia faces a disadvantage in project development and capital expenditure, with project capital costs thought to be at least 20 per cent higher than comparable jurisdictions and substantially higher than less developed countries. While this is important, there is limited scope for the Western Australian Government to address this as it is largely a product of isolation, Commonwealth industrial relations laws, and the requirement to import large modularised project plant and materials.

However, this report found the Western Australian Government can work to improve the efficiency and economics of project development through more streamlined regulatory approvals, and in particular environmental approvals processes. Stakeholders also raised concerns about the timing risks posed by Native Title processes and negotiations in some circumstances.

These issues were raised by stakeholders in the context of being "development ready" – meaning land and other infrastructure is prepared to a point where a new project proponent can readily access and commence its project after it is sanctioned. This is particularly important given stakeholder feedback suggests Western Australia's Strategic Industrial Areas program is an effective means by which to make land available for heavy industry.

Recommendation 4 Becoming "development ready" for downstream industries

The Western Australian Government should set a target to "complete" the pre-planning and information collection associated with Strategic Industrial Areas, particularly in the State's north west. This should include:

- Completion of baseline environmental information collection and studies relevant to Environmental Protection Authority interest
- Developing clear frameworks around Native Title on land earmarked for development, where this is possible and can be completed in a manner which respects the rights of Traditional Owners
- Confirming all appropriate planning arrangements are in place for infrastructure corridors and other access requirements (such as road easements)
- Engaging with Government Trading Enterprises and other utilities services providers to ensure planning for utilities is in place and is ready to meet the needs of project proponents.

ACIL Allen understands this work is underway, but this should be completed as a priority and relevant information made available to project proponents on an official WA.gov.au platform.

In reviewing the application and approvals processes made available to major project proponents as part of this study, it emerged that much of the material is out of date – in some cases by over ten years. This includes references to Western Australian Government Departments which no longer exist. These documents should be updated to make it easier for prospective project proponent to receive the right level of support from the Western Australian Government and have an understanding of what is required of them during project formation and approvals.

The Western Australian Government has completed a review of this material and should make this available as a matter of priority.

Further changes could be made to provide clarity on what constitutes a "State Significant" proposal, to provide guidance to industry and assist it in preparing information in a way which best articulates its case for achieving the most appropriate level of support. This may include the definition of thresholds for capital expenditure, employment or taxation revenue expected to be generated by the project. This could also include a more formal linkage between major strategic economic development documents such as DiversifyWA and a project's status as "State Significant".

Recommendation 5 Making contemporary project facilitation information available

As a matter of priority the Western Australian Government should update all relevant major projects facilitation documents which are made available to prospective project proponents, to reflect the contemporary Machinery of Government and approvals processes which can be reasonably expected to be asked of by a proponent. This should also include more firm definitions of which projects are eligible to achieve "State Significant" status.

8.1.3 Effectively targeting Government assistance

The opportunities considered as part of this study are highly capital intensive and required significant investment in infrastructure in order to gather the inputs they need and sell their products to global markets. This includes roads, power, water, gas and ports infrastructure, as well as the specialised plant and equipment required to undertake the production process for selected products.

Proponents are responsible for sourcing upfront capital to funding the development of their projects. In the event the project was completely vertically integrated, the funding task would fall

squarely on the shoulder of the proponent itself – for example, an iron ore project is required to build the power, water, mine, stockpile, rail and shiploading infrastructure at a minimum, and may also be required to build a port.

In the gas-centric downstream industries space, there are opportunities for the State Government to assist in alleviating the funding task of project proponents, by offering tailored and structured support in the form of infrastructure funding and subsidies as part of project development and approval.

This is not a new development within Western Australia as the State has a long history of providing this kind of support for major projects across sectors. However, historic approaches have exposed the State to significant financial costs and risks, as evidenced by the continued subsidies provided by the Western Australian Government to the Water Corporation and Pilbara Ports Authority for infrastructure built in the Burrup Strategic Industrial Area almost 20 years ago.

A more strategic approach is to directly engage with project proponents to understand their infrastructure needs, and find tailored approaches to meeting them. The Western Australian Government should consider development of a more formalised and publicised approach to understanding and offering incentives to major projects, as part of its projects facilitation role. This would allow project proponents to better tailor requests to the State during project development.

One recent example of this is the Western Australian Government's funding of infrastructure for the Perdaman Urea Project, on a full cost recovery basis and contingent on the project achieving financial close before any infrastructure commences construction. This approach provides substantial benefits for the proponent as it alleviates part of the upfront capital funding requirement for the project, assisting in project viability.

Recommendation 6 Formalising the nature of project support available to project proponents

The Western Australian Government should formalise its approach to providing capital support for heavy industry projects. This should include the kinds of infrastructure and other support the Western Australian Government is willing to fund and/or provide, and general information with respect to terms.

This may include creating a more formalised linkage between the State's lead agency framework and eligibility for infrastructure support. The approach may also consider the development of approaches where proponents demonstrate the impact of their proposal, and request for support, on the economy.

8.1.4 Building the capacity of the Department to facilitate projects

The findings and recommendations contained in this report have the potential to significantly change the way the Western Australian Government works to facilitate both upstream and downstream projects in the State. In addition, ACIL Allen has identified a range of out of scope industry development opportunities where there are existing State Government strategic plans, where the State could take a more activist role in project facilitation.

If the findings and recommendations of this report are carried and progressed, there will be a need for the Department to provide additional resources to ensure it can meet the needs of industry and expectations of government in driving outcomes. This role must extend beyond gas-centric downstream industry projects given the broad scope of the Western Australian Government's industry development, diversification and decarbonisation agenda, and general industry trends towards decarbonisation.

Recommendation 7 Enhancing project development and facilitation capacity

The Western Australian Government may consider building on its existing project development and facilitation capabilities within the Department to address the findings and directions provided in this report. This may include additional capacity to critically analyse and assess gas supply projects (specifically in the context of access to projected LNG ullage), brokering arrangements between projects to assist in reducing information asymmetries and aligning project outcomes, and offering and assessing targeted support to downstream project proponents in approvals and infrastructure.

This would allow the Department to take lead agency status in the development, diversification and decarbonisation of the State's economy across a range of industry sectors and policy objectives where the Western Australian Government has expressed interest or an intent for action.

8.2 Next steps

ACIL Allen has made seven recommendations to address the 19 findings made throughout this report. If the State Government decides to pursue these reforms there is an important second step in the process which occur prior to enacting change.

Industry consultation should occur, with both upstream suppliers and downstream buyers, and both established and new players, regarding the specifics of the recommendations made in this report. In particular, industry should be consulted and its ideas sought on measures to improve the State Government's approach to project assistance and support, to ensure it is able to strike the right balance between being prescriptive and flexible. This is also important for any changes to the WA Domestic Gas Policy.

It is also clear that since ACIL Allen commenced work on this engagement with its stakeholder engagement program in September 2020 that public sentiment regarding climate change and emissions reduction has shifted markedly. Both public and private sectors are responding. These matters have not been considered in great detail in this report given the scope was centred on measures to progress gas-based downstream industry projects. In particular, there are emerging mechanisms for a number of products which are considered to be within the scope of the gas-based downstream industry sector to become less carbon intensive, or even carbon neutral. For some, the use of hydrocarbons like natural gas represents a critical part of the chemical processes required to produce products, with carbon captured as part of the production process (including urea – where there are two active projects in development in the State).

Should the State Government pursue the opportunity identified by this report, it should consider broadening the scope of opportunities and mechanisms available to promote industrial development in a low carbon or carbon-neutral manner. This is likely to require the State to weave together development opportunities identified in this report, including some which were considered out of scope because they were not gas-centric, with other initiatives such as renewable hydrogen and battery minerals technologies.

Measures raised but which are outside of the scope of this report

ACIL Allen's proposed reform agenda suggests there is an opportunity for the Western Australian Government to become more activist in its desire for more gas-based downstream industry development projects in the State. The reforms proposed should improve the prospect of more projects coming to fruition in the years ahead. However, there are opportunities to go further.

With respect to the gas market, there are further (and more interventionist) approaches that were proposed by stakeholders throughout ACIL Allen's engagement. These include, but are not limited to, the following:

— The State Government acting as an aggregator of supply for downstream projects, addressing issues of portfolio risk which appear to work against use of brownfield gas supplies as feedstock for new projects.

— Introducing more formal structures around domestic market obligations held by LNG producers, including requirements to produce and sell gas as oppose to market it, and requirements to meet production and sales targets which are time-bound.

— The development of a commerciality test and structured arbitration where buyers seek access to domestic market obligations but are unable to achieve an outcome through negotiation.

These approaches *may* result in further gas being made available to downstream industry projects. However, the level of intervention in the market would give rise to unforeseeable unintended consequences, and create sovereign risks. Given this, and the likely complexity associated with development and delivery of these proposals, no additional changes are suggested or supported at this time.

ACIL Allen also notes its scope of services did not permit an examination of a number of other important and material policy issues which may impact on the prospects of downstream industries in Western Australia. These include:

— Economic development mandates for Government Trading Enterprises, where GTEs may act in a less-commercial manner in some circumstances if economic or social benefits can be achieved.

— Measures to create additional upstream supply opportunities, including retention lease policy and regulations regarding access to unconventional onshore gas resources.

— The impact of more aggressive emissions reduction targets and policies at a global, Commonwealth and State level, particularly as they relate to gas-fired power generation and the associated impact on demand for gas in Western Australia.

These measures should be further explored by government as part of a second phase of work in its effort to deliver on its gas-based downstream industry development agenda.

ACIL ALLEN

Appendices

Stakeholder Consultation Guide

A

Between September and November 2020, ACIL Allen undertook a structured program of stakeholder consultation in order to gain a broad range of perspectives from market participants in relation to the potential downstream gas opportunities in Western Australia, and the identification of issues and challenges in the achievement of this objective.

ACIL Allen's consultation process was structured around a Consultation Guide, which was provided to stakeholders ahead of their consultation to allow for appropriate preparations to be made.

The Consultation Guide included details on:

— ACIL Allen's Scope of Works

— Background into Western Australia's gas market

— Details of Western Australia's domestic gas policy framework.

The consultation questions included in the Consultation Guide have been presented below.

A.1 Excerpt from ACIL Allen's Consultation Guide

CONSULTATION QUESTIONS

Initial questions

Prior to questions on specific issues and challenges associated with ACIL Allen's scope of works, please consider the following initial framing questions.

* *Prior to consideration of specific issues and challenges, can you please consider your organisation's role in the State's domestic gas market, and its recent experiences with the domestic gas policy?*
* *In your organisation's opinion, is the current domestic gas policy framework generally well understood by industry (gas suppliers and gas buyers)?*

Industry development questions

ACIL Allen's scope is principally centred on measures the Western Australian Government can take to provide a more attractive environment to current and potential future downstream industries, as a means to spur new major projects. Western Australia has a long history of major energy and downstream industry project development, but in recent years there have been a limited number of new projects in either the energy or energy-intensive manufacturing industries.

The following questions centre on the project economics of downstream industries.

* *What are the most prospective downstream and energy-intensive industry development opportunities available to Western Australia?*
* *What are the major requirements for new downstream industry development projects, in terms of land, labour and capital and other factors which you consider most relevant? Is Western Australia an attractive place to consider downstream industry development projects with this in mind?*
* *What does your organisation see as the most significant barrier to new energy-intensive or downstream industry projects in Western Australia?*

Energy is an important factor of production in its own right, which is an important driver behind Western Australia's domestic gas reservation policy. ACIL Allen is keen to explore the role of gas supply and energy market policy in the development of new downstream industry development projects in Western Australia.

* *Is gas available in the Western Australian domestic gas market on reasonable terms to support the formation of new downstream processing industries? Why or why not? What terms would be suitable?*
* *Are greenfield downstream processing and/or energy intensive manufacturing projects attractive as part of a portfolio approach (having multiple and varied customers) to developing new upstream gas projects? Why or why not?*
* *Is Western Australia's energy market situation a comparative advantage for these industries? How does Western Australia compare to the East Coast of Australia from an energy price and access perspective?*

* *Is the current approach of "showing diligence and good faith" in marketing domestic gas commitments effective in supporting downstream and gas intensive industries? Is the policy intent well understood across industry? Are there opportunities for refinement?*

Gas market outlook questions

The State's short term gas outlook suggests the domestic market will remain well supplied for existing levels of demand. However, there is limited capacity for new blocks of demand from major projects, and a tightening supply and demand balance without significant growth in demand. With this in mind, please consider the following questions.

* *What is your organisation's perspective on the short term gas market supply and demand outlook? Do you foresee any challenges associated with either the buy or sell side of the market within five years?*
* *What are the current suite of options to meet Western Australia's long term gas supply needs? How prospective are the next tranche of supply sources? Are there specific challenges to be overcome?*

State Government policy questions

Energy and energy policy are important enablers of industry, however there are a range of policies and other factors which influence Western Australia's relative position as an attractive place to develop energy-intensive and downstream industries projects. With this in mind, please consider the following questions.

* *What role does the domestic gas policy framework play in the project economics of new greenfield LNG developments? Would a pipeline of investment-ready downstream industry projects assist in improving the economics of the domestic gas policy from the perspective of LNG project owners?*
* *What are some of the other major drivers of energy-intensive and/or downstream industry project economics which ACIL Allen should consider as part of this study? What is the role of the State Government in improving project economics?*
* *What is the role of the State Government in the formation, development and implementation of new downstream and energy-intensive industry developments? What are the benefits and risks associated with your suggestion/s?*
* *What have other jurisdictions (States/Territories/Countries) done in terms of support for downstream processing industries which could be considered in Western Australia?*

Sectoral questions and general issues

The following questions are more specific to particular segments of the domestic gas market.

* *For **gas suppliers,** can you please describe your experience in dealing with current downstream processing project proponents with respect to the formation of gas supply agreements? Does this differ to other market sectors?*
* *For **gas suppliers,** can you please describe your experience in dealing with prospective downstream processing project proponents with respect to the formation of gas supply agreements? Does this differ to other market sectors? Are there any specific barriers to deal-making which should be considered as part of this study?*
* *For **gas buyers,** can you please describe your experience in dealing with gas suppliers with respect to the formation of gas supply agreements? Are there any issues or barriers which make it more challenging to develop projects?*
* *For **project funders**, what are the key characteristics of downstream industry development projects you look for when considering project feasibility and bankability?*
* *Are there any other issues that have not been addressed in this Consultation Guide which you consider relevant to ACIL Allen's scope of works?*

B ACIL Allen's Models

B.1 WesternGasMark

Western Gas Mark (WGM) is a linear programming and regression model which forecasts the WA gas market. The model comprises of the following 3 key components. Data is sourced live from AEMOs API each time the model is run, and utilizes ACIL Allen's in-house databases to form assumptions, combined with inputs from consultation and client engagement.

The model architecture of WesternGasMark optimally settles market allocations based on cost and gas availability, constrained by gas field reserves, production capacities and market obligations. The model solves supply for all zones and the field – plant allocations simultaneously to ensure all the allocations are optimised without bias.

Whilst the model solves for the most efficient allocation of resources, the WA gas market does not work in equilibrium. To assure that market resources are representing contracted or obligated allocations of gas constraints are added to assure these flows are met. For example, whilst it might be cheaper for Gorgon gas to supply the Goldfields, the minimum daily quantity for Varanus island is 50TJ/d so this volume overrides the most economical path to market. That volume from Gorgon will then be directed to the nearest (cheapest) market zone to full non-contracted demand.

ACIL Allen has incorporated data about the existing gas production network into the model – from upstream fields to pipeline distribution to large users.

Operational Resources

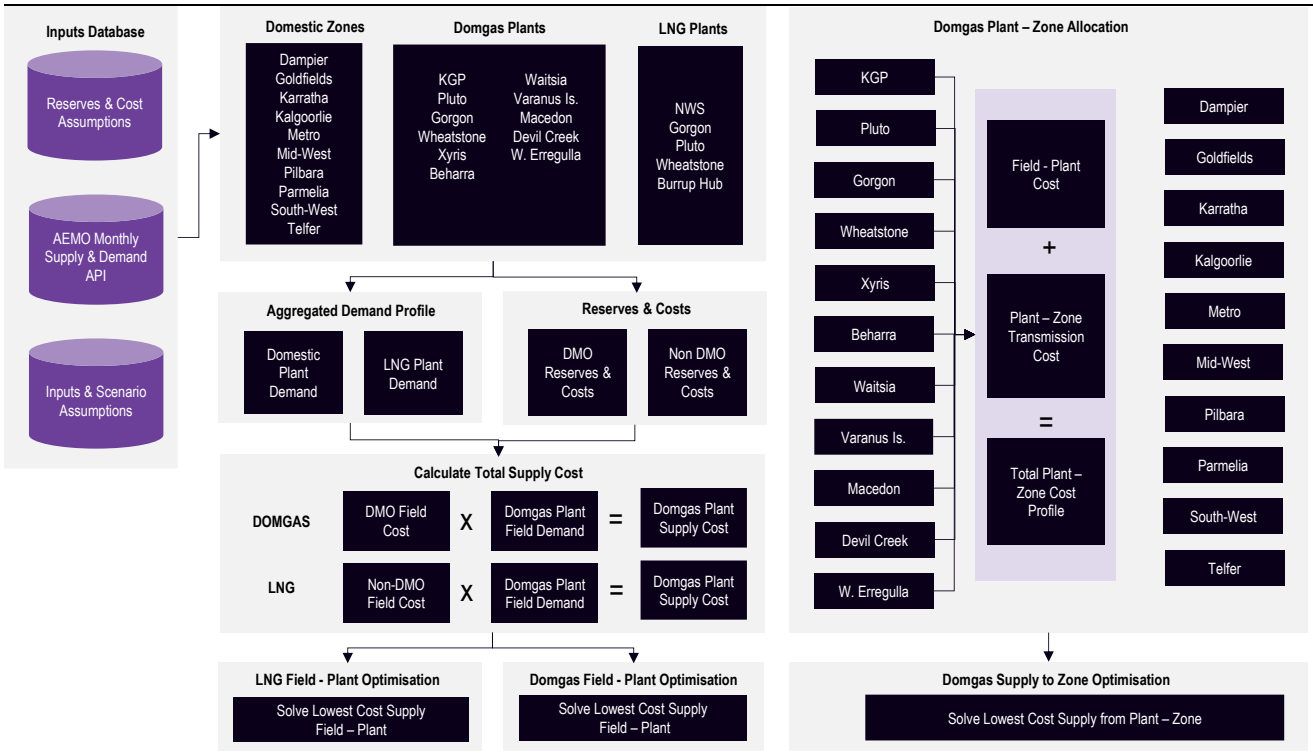
- Operational field information has been collected and assessed from various disparate data sources (ACIL Allen Gasmark, JTSI – WoodMac, consultation, Geoscience Australia, etc.) with the view to forming supply cost bands which we expect gas to be supplied at.
- The current domgas market operations data is sourced via the AEMO API which pulls in live monthly data from the API which provides gas plant outflows, zone inflows, storage capacity and distribution and pipeline capacity and flow rates.
- Whilst there is no plant level LNG production data available, we assume (as confirmed at consultation) that all LNG facilities produce at close to nameplate (~95 per cent) except for turnarounds and unplanned shutdowns.
- The end-of-life for existing fields is based of modelling of the expected draw down of reserves and represents both DMO and non-DMO allocations.
- ACIL Allen has developed base case assumptions about future gas projects expected to come online over the forecast period – considering current and expected market conditions

Future Resources

— As the existing operating fields in the model deplete over the time-series, we expect several new fields to come online to backfill existing facilities and underpin the construction of new facilities. For start-up times we have taken a qualitative approach which considers the historical project slippage and company fiscal capacity rather than applying start-dates in line with industry comments and market announcements.

— As new fields come online, with different supply cost bands, the overall weighted supply cost for each zone will change, providing a range of gas pricing that we could expect new entrants to market to be exposed to. Other pricing mechanisms that will eb considered are the short-term, medium-term, and long-term cost of supply which impact the production of natural gas throughout the project lifecycle.

Figure B.1 WesternGasMark schematic



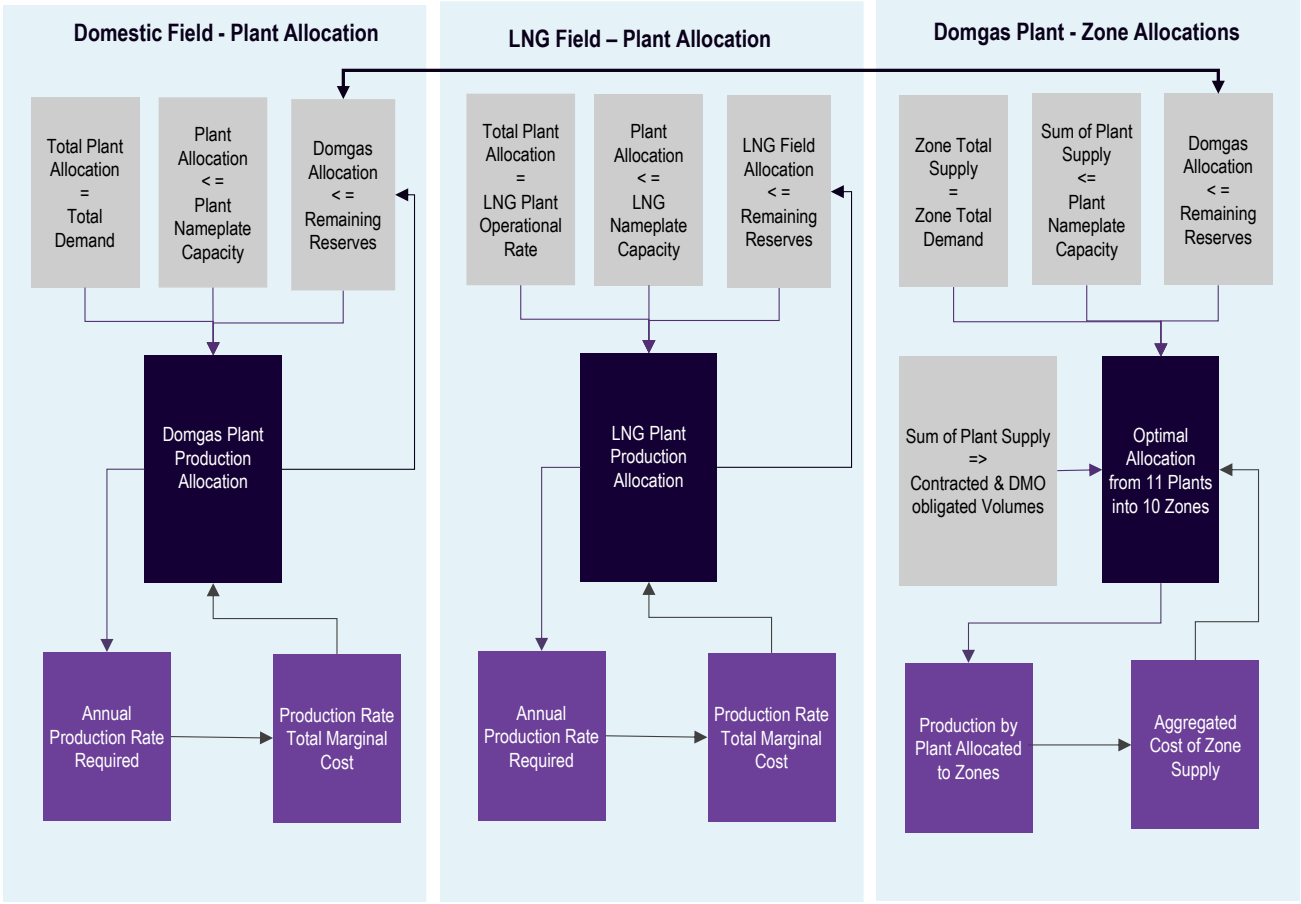
Source: ACIL Allen

Model Schematic

WesternGasMark runs on Microsoft Excel Visual Basic Code (VBA) which allows for multiple scenarios to be developed and run simultaneously, this allows for us to test the stability of the gas market when new project announcements are made, delays to development occur, or any other changes to market structure or project development plans are announced.

The model runs three simulations concurrently to allocate gas through the market from the field. The model distinguishes both fields and plants as separate entities, which allows for different fields to backfill a single plant over the course of the projected time-series. For example, scenarios can be run which allocate Clio-Acme to either Karratha Gas Plant (KGP), Gorgon, or Wheatstone, depending on the commercial arrangements that arise when that development reaches FID. Additionally, the model allows for the aggregation of plants into blocks, in the base case we assume this to be the case for KGP and Pluto domestic gas plants, that will become the Burrup Hub facility once the interconnector pipeline comes online.

Figure B.2 Overview of the Three Phases of Market Allocation in WesternGasMark



Source: ACIL Allen

As then above model schematic shows, the three simulations that are run in the model are as follows:

- **Domgas Field to Plant Allocation:** This model section generates volumes from each operational field to each plant, based on both market demand, contracted volumes, and domestic market obligation constraints. The model assumes that upstream producers will source gas from the lowest cost fields in the short run and forgo investment in higher cost-per-unit fields until lower cost operational fields are depleted. For LNG associated projects (with a DMO) the reserves available for domgas plants are limited to that of the obligation.
- **LNG Field to Plant Allocation:** LNG field to plant allocations calculates similarly to the domgas field to plant model, by prioritising the lowest cost fields in the short run. The reserves available to each plant are the sum of total reserves, minus the domestic market obligation proportion for each project.
- **Domgas Plant to Zone Allocations:** Allocating gas from the various plants in the market system to each zone is the pivotal engine in the model and handles how the market price responds to new demand in each region. The model options each plant to supply each zone, based on the aggregate cost profile of the plant, and account for a transportation cost factor which represents the additional cost of supplying from plants to zones that are spatially disparate. For example, whilst Perth Basin gas is cheaper to produce, the pipeline transportation factor means that it is less competitive than some fields in the North West for supplying northern regions such as Dampier and the Pilbara. Alternatively, Perth Basin gas becomes a much cheaper option for Perth Metro, South

West and the Midwest because of the combined low production cost and geographic proximity versus the North West offshore operations.

Constraints

Constraints are added to Linear Programming models to isolate the range in which the model will solve for, in this context this includes constraining the model to account for available reserves, field capacity (at the well), nameplate capacity of the gas processing facilities, minimum supply obligations as per the DMO policy, and existing commercial obligations to supply.

Assumptions used for this engagement

ACIL Allen's modelling assumption table is presented below.

Table B.1 Gas market modelling: Case assumptions

Field	Operational / Start-Up	Domgas Plant	LNG Plant	Input Cost of Production (ex-field)	Estimate of remaining reserves (end 2020)	Max Field Production Domestic	Max Field Production LNG
				$/GJ	PJ	TJ/day	TJ/day
NWS	Operational	KGP	KGP	2.08	10,074	480	2,720
Pluto	Operational	Pluto	Pluto	2.08	3,500	135	765
Gorgon	Operational	Gorgon	Gorgon	1.85	40,722	420	2,380
Wheatstone	Operational	Wheatstone	Wheatstone	1.85	11,983	240	1,360
Beharra Springs	Operational	Beharra Springs	NA	1.95	50	15	NA
Watsia I	Operational	Xyris	NA	1.85	48	50	NA
Varanus Hub	Operational	Varanus Hub	NA	1.88	1,051	260	NA
Reindeer-Caribou	Operational	Devil Creek	NA	2.48	580	220	NA
Macedon	Operational	Macedon	NA	2.48	750	213	NA
Julimar II	2023	Wheatstone	Wheatstone	1.85	10,000	90	510
Watsia II	2023*	Waitsia	KGP	1.85	1,180	250	250
Pyxis	2024	Pluto	Pluto	2.08	500	38	213
Spartan	2024	Varanus Hub	NA	2.75	300	200	NA
West Erregulla	2025	West Erregulla	NA	1.85	900	100	NA
Scarborough	2027	Pluto	Pluto	2.80	11,000	250	900
Corvus	2027	Devil Creek	NA	2.75	1,500	250	NA
Clio-Acme	2028	Burrup Hub	Burrup Hub	1.55	2,200	60	340

*Source: ACIL Allen, Department of Jobs, Tourism, Science and Innovation, various sources. Note: *Waitsia II transitions to a domestic only plant in 2027.*

Cost tiers used for the estimate of delivered costs are detailed below.

Table B.2 Domestic gas ex-field cost tiers for gas market modelling, $/GJ

Tier	Domestic-only	LNG
Low	$1.50-$1.75	$1.75-$2.00
Mid	$1.75-$2.00	$2.00-$2.50
High	$2.00-$2.75	$2.50-$3.50

Source: ACIL Allen

B.2 Tasman Global Computable General Equilibrium Model

Tasman Global is a dynamic, global computable general equilibrium (CGE) model that has been developed by ACIL Allen for the purpose of undertaking economic impact analysis at the regional, state, national and global level.

A CGE model captures the interlinkages between the markets of all commodities and factors, taking into account resource constraints, to find a simultaneous equilibrium in all markets. A global CGE model extends this interdependence of the markets across world regions and finds simultaneous equilibrium globally. A dynamic model adds onto this the interconnection of equilibrium economies across time periods. For example, investments made today are going to determine the capital stocks of tomorrow and hence future equilibrium outcomes depend on today's equilibrium outcome, and so on.

A dynamic global CGE model, such as *Tasman Global*, has the capability of addressing total, sectoral, spatial and temporal efficiency of resource allocation as it connects markets globally and over time. Being a recursively dynamic model, however, its ability to address temporal issues is limited. In particular, *Tasman Global* cannot typically address issues requiring partial or perfect foresight, however, as documented in Jakeman et al (2001), it is possible to introduce partial or perfect foresight in certain markets using algorithmic approaches. Notwithstanding this, the model does have the capability to project the economic impacts over time of given changes in policies, tastes and technologies in any region of the world economy on all sectors and agents of all regions of the world economy.

Tasman Global was developed out of the 2001 version of the Global Trade and Environment Model (GTEM) developed by ABARE (Pant 2001) and has been evolving ever since. In turn, GTEM was developed out of the MEGABARE model (ABARE 1996), which contained significant advancements over the GTAP model of that time (Hertel 1997).

B.2.1 A dynamic model

Tasman Global is a model that estimates relationships between variables at different points in time. This is in contrast to comparative static models, which compare two equilibriums (one before a policy change and one following). A dynamic model such as *Tasman Global* is beneficial when analysing issues where both the timing of and the adjustment path that economies follow are relevant in the analysis.

B.2.2 The database

A key advantage of *Tasman Global* is the level of detail in the database underpinning the model. The database is derived from the Global Trade Analysis Project (GTAP) database. This database is a fully documented, publicly available global data base which contains complete bilateral trade information, transport and protection linkages among regions for all GTAP commodities. It is the detailed database of its type in the world.

Tasman Global builds on the GTAP database by adding the following important features:

- a detailed population and labour market database
- detailed technology representation within key industries (such as electricity generation and iron and steel production)
- disaggregation of a range of major commodities including iron ore, bauxite, alumina, primary aluminium, brown coal, black coal and LNG
- the ability to repatriate labour and capital income
- explicit representation of the states and territories of Australia

— the capacity to represent multiple regions within states and territories of Australia explicitly.

Nominally, version 9.1 of the *Tasman Global* database divides the world economy into 150 regions (142 international regions plus the 8 states and territories of Australia) although in reality the regions are frequently disaggregated further. ACIL Allen regularly models Australian or international projects or policies at the regional level including at the provincial level for Papua New Guinea and Canada.

The *Tasman Global* database also contains a wealth of sectoral detail currently identifying up to 72 industries. The foundation of this information is the input-output tables that underpin the database. The input-output tables account for the distribution of industry production to satisfy industry and final demands. Industry demands, so-called intermediate usage, are the demands from each industry for inputs. For example, electricity is an input into the production of communications. In other words, the communications industry uses electricity as an intermediate input. Final demands are those made by households, governments, investors and foreigners (export demand). These final demands, as the name suggests, represent the demand for finished goods and services. To continue the example, electricity is used by households – their consumption of electricity is a final demand. Each sector in the economy is typically assumed to produce one commodity, although in *Tasman Global*, the electricity, transport and iron and steel sectors are modelled using a 'technology bundle' approach. With this approach, different known production methods are used to generate a homogeneous output for the 'technology bundle' industry. For example, electricity can be generated using brown coal, black coal, petroleum, base load gas, peak load gas, nuclear, hydro, geothermal, biomass, wind, solar or other renewable based technologies – each of which have their own cost structure.

The other key feature of the database is that the cost structure of each industry is also represented in detail. Each industry purchases intermediate inputs (from domestic and imported sources) primary factors (labour, capital, land and natural resources) as well as paying taxes or receiving subsidies.

B.2.3 Model structure

Given its heritage, the structure of the *Tasman Global* model closely follows that of the GTAP and GTEM models and interested readers are encouraged to refer to the documentation of these models for more detail (namely Hertel 1997 and Pant 2001, respectively). In summary:

— The model divides the world into a variety of regions and international waters.
  — Each region is fully represented with its own 'bottom-up' social accounting matrix and could be a local community, an LGA, state, country or a group of countries. The number of regions in a given simulation depends on the database aggregation. Each region consists of households, a government with a tax system, production sectors, investors, traders and finance brokers.
  — 'International waters' are a hypothetical region where global traders operate and use international shipping services to ship goods from one region to the other. It also houses an international finance 'clearing house' that pools global savings and allocates the fund to investors located in every region.
  — Each region has a 'regional household'[52] that collects all factor payments, taxes, net foreign borrowings, net repatriation of factor incomes due to foreign ownership and any net income from trading of emission permits.

[52] The term "regional household" was devised for the GTAP model. In essence it is an agent that aggregates all incomes attributable to the residents of a given region before distributing the funds to the various types of regional consumption (including savings).

- The income of the regional household is allocated across private consumption, government consumption and savings according to a Cobb-Douglas utility function, which, in practice, means that the share of income going to each component is assumed to remain constant in nominal terms.
- Private consumption of each commodity is determined by maximising utility subject to a Constant Difference of Elasticities (CDE) function which includes both price and income elasticities.
- Government consumption of each commodity is determined by maximising utility subject to a Cobb-Douglas utility function.
- Each region has *n* production sectors, each producing single products using various production functions where they aim to maximise profits (or minimise costs) and take all prices as given. The nature of the production functions chosen in the model means that producers exhibit constant returns to scale.
  - In general, each producer supplies consumption goods by combining an aggregate energy-primary factor bundle with other intermediate inputs and according to a Leontief production function (which in practice means that the quantity shares remain in fixed proportions). Within the aggregate energy-primary factor bundle, the individual energy commodities and primary factors are combined using a nested-CES (Constant Elasticity of Substitution) production function, in which energy and primary factor aggregates substitute according to a CES function with the individual energy commodities and individual primary factors substituting with their respective aggregates according to further CES production functions.
  - Exceptions to the above include the electricity generation, iron and steel and road transport sectors. These sectors employ the 'technology bundle' approach developed by ABARE (1996) in which non-homogenous technologies are employed to produce a homogenous output with the choice of technology governed by minimising costs according to a modified-CRESH production function. For example, electricity may be generated from a variety of technologies (including brown coal, black coal, gas, nuclear, hydro, solar etc.), iron and steel may be produced from blast furnace or electric arc technologies while road transport services may be supplied using a range of different vehicle technologies. The 'modified-CRESH' function differs from the traditional CRESH function by also imposing the condition that the quantity units are homogenous.
- There are four primary factors (land, labour, mobile capital and fixed capital). While labour and mobile capital are used by all production sectors, land is only used by agricultural sectors while the fixed capital is typically employed in industries with natural resources (such as fishing, forestry and mining) or in selected industries built by ACIL Allen.
  - Land supply in each region is typically assumed to remain fixed through time with the allocation of land between sectors occurring to maximise returns subject to a Constant Elasticity of Transformation (CET) utility function.
  - Mobile capital accumulates as a result of net investment. It is implicitly assumed in *Tasman Global* that it takes one year for capital to be installed. Hence, supply of capital in the current period depends on the last year's capital stock and investments made during the previous year.
  - Labour supply in each year is determined by endogenous changes in population, given participation rates and a given unemployment rate. In policy scenarios, the supply of labour is positively influenced by movements in the real wage rate governed by the elasticity of supply. For countries where sub-regions have been specified (such as Australia), migration between regions is induced by changes in relative real wages with the constraint that net interregional migration equals zero. For regions where the labour market has been disaggregated to include occupations, there is limited substitution allowed between occupations by individuals supplying labour (according to a CET utility function) and by firms demanding labour (according to a CES production function) based on movements in relative real wages.

- The supply of fixed capital is given for each sector in each region.

The model has the option for these assumptions to be changed at the time of model application if alternative factor supply behaviours are considered more relevant.

- It is assumed that labour (by occupation) and mobile capital are fully mobile across production sectors implying that, in equilibrium, wage rates (by occupation) and rental rates on capital are equalised across all sectors within each region. To a lesser extent, labour and capital are mobile between regions through international financial investment and migration, but this sort of mobility is sluggish and does not equalise rates of return across regions.
- For most international regions, each consumer (private, government, industries and the local investment sector), consumption goods can be sourced either from domestic or imported sources. In any country which has disaggregated regions (such as Australian), consumption goods can also be sourced from other intrastate or interstate regions. In all cases, the source of non-domestically produced consumption goods is determined by minimising costs subject to a Constant Ratios of Elasticities of Substitution, Homothetic (CRESH) utility function. Like most other CGE models, a CES demand function is used to model the relative demand for domestically-produced commodities versus non-domestically produced commodities. The elasticities chosen for the CES and CRESH demand functions mean that consumers in each region have a higher preference for domestically produced commodities than non-domestic and a higher preference for intrastate or interstate produced commodities versus foreign.
- The capital account in *Tasman Global* is open. Domestic savers in each region purchase 'bonds' in the global financial market through local 'brokers' while investors in each region sell bonds to the global financial market to raise investible funds. A flexible global interest rate clears the global financial market.
- It is assumed that regions may differ in their risk characteristics and policy configurations. As a result, rates of return on money invested in physical capital may differ between regions and therefore may be different from the global cost of funds. Any difference between the local rates of return on capital and the global cost of borrowing is treated as the result of the existence of a risk premium and policy imperfections in the international capital market. It is maintained that the equilibrium allocation of investment requires the equalisation of changes in (as opposed to the absolute levels of) rates of return over the base year rates of return.
- Any excess of investment over domestic savings in a given region causes an increase in the net debt of that region. It is assumed that debtors service the debt at the interest rate that clears the global financial market. Similarly, regions that are net savers gives rise to interest receipts from the global financial market at the same interest rate.
- Investment in each region is used by the regional investor to purchase a suite of intermediate goods according to a Leontief production function to construct capital stock with the regional investor cost minimising by choosing between domestic, interstate and imported sources of each intermediate good via the CRESH production function. The regional cost of creating new capital stock versus the local rates of return on mobile capital is what determines the regional rate of return on new investment.
- In equilibrium, exports of a good from one region to the rest of world are equal to the import demand for that good in the remaining regions. Together with the merchandise trade balance, the net payments on foreign debt add up to the current account balance. *Tasman Global* does not require that the current account be in balance every year. It allows the capital account to move in a compensatory direction to maintain the balance of payments. The exchange rate provides the flexibility to keep the balance of payments in balance.
- Emissions of six anthropogenic greenhouse gases (namely, carbon dioxide, methane, nitrous oxide, HFCs, PFCs and SF_6) associated with economic activity are tracked in the model. Almost all sources and sectors are represented; emissions from agricultural residues and land-use change and forestry activities are not explicitly modelled but can be accounted for

externally. Prices can be applied to emissions which are converted to industry-specific production taxes or commodity-specific sales taxes that impact on demand. Abatement technologies similar to those adopted in Australian Government (2008) are available and emission quotas can be set globally or by region along with allocation schemes that enable emissions to be traded between regions.

More detail regarding specific elements of the model structure are discussed in the following sections.

B.2.4 Population growth and labour supply

Population growth is an important determinant of economic growth through the supply of labour and the demand for final goods and services. Population growth for each region represented in the *Tasman Global* database is projected using ACIL Allen's in-house demographic model. The demographic model projects how the population in each region grows and how age and gender composition changes over time and is an important tool for determining the changes in regional labour supply and total population over the projection period.

For each of region, the model projects the changes in age-specific birth, mortality and net migration rates by gender for 101 age cohorts (0-99 and 100+). The demographic model also projects changes in participation rates by gender by age for each region, and, when combined with the age and gender composition of the population, endogenously projects the future supply of labour in each region. Changes in life expectancy are a function of income per person as well as assumed technical progress on lowering mortality rates for a given income (for example, reducing malaria-related mortality through better medicines, education, governance etc.). Participation rates are a function of life expectancy as well as expected changes in higher education rates, fertility rates and changes in the work force as a share of the total population.

Labour supply is derived from the combination of the projected regional population by age by gender and the projected regional participation rates by age by gender. Over the projection period labour supply in most developed economies is projected to grow slower than total population as a result of ageing population effects.

For the Australian states and territories, the projected aggregate labour supply from ACIL Allen's demographics module is used as the base level potential workforce for the detailed Australian labour market module, which is described in the next section.

B.2.5 The Australian labour market

Tasman Global has a detailed representation of the Australian labour market which has been designed to capture:

- different occupations
- changes to participation rates (or average hours worked) due to changes in real wages
- changes to unemployment rates due to changes in labour demand
- limited substitution between occupations by the firms demanding labour and by the individuals supplying labour, and
- limited labour mobility between states and regions within each state.

Tasman Global recognises 97 different occupations within Australia – although the exact number of occupations depends on the aggregation. The firms who hire labour are provided with some limited scope to change between these 97 labour types as the relative real wage between them changes. Similarly, the individuals supplying labour have a limited ability to change occupations in response to the changing relative real wage between occupations. Finally, as the real wage for a given occupation rises in one state relative to other states, workers are given some ability to respond by

shifting their location. The model produces results at the 97 3-digit ANZSCO (Australian New Zealand Standard Classification of Occupations) level.

The labour market structure of *Tasman Global* is thus designed to capture the reality of labour markets in Australia, where supply and demand at the occupational level do adjust, but within limits.

Labour supply in *Tasman Global* is presented as a three-stage process:

6. labour makes itself available to the workforce based on movements in the real wage and the unemployment rate;
7. labour chooses between occupations in a state based on relative real wages within the state; and
8. labour of a given occupation chooses in which state to locate based on movements in the relative real wage for that occupation between states.

By default, *Tasman Global*, like all CGE models, assumes that markets clear. Therefore, overall, supply and demand for different occupations will equate (as is the case in other markets in the model).

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