The World’s Most Significant Gas Fields

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Title: The Gorgon Project - Fuelling the Future of the Asia Pacific Region

The Greater Gorgon Area gas resources are strategically located with easy access to the Asia Pacific and the Gorgon Project is set to become one of the region's most significant developments. The Gorgon gas fields are located off the north-west coast of Australia and contain an estimated gas resource of over 40Tcf, representing about 25% of Australia's known gas resources. They are one of the most significant of Australia's numerous gas discoveries.

The Gorgon Project is being developed by an unincorporated joint venture consisting of three of the world's major energy companies: Chevron, Shell and ExxonMobil. Chevron Australia, with a 50 per cent interest, is the operator of the Gorgon Project. Shell and ExxonMobil's Australian subsidiaries each hold a 25 per cent interest.

The initial LNG development for the Gorgon Area gas fields will include:

- The installation of a sub-sea gathering system
- Sub-sea pipelines from the Gorgon field and Jansz field to Barrow Island
- A gas processing facility consisting of two five million tonne per annum LNG trains located on the central-east coast of Barrow Island
- CO2 removal and injection facilities, subject to technical and commercial viability
- A liquid hydrocarbon export terminal
- Innovative equity LNG marketing arrangements
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1.0 GENERAL DESCRIPTION OF THE GORGON PROJECT

FIGURE 1a
The Greater Gorgon Area Gas Resource Base

The gas fields of the Greater Gorgon Area (Figure 1a) are located 130 km off Australia’s northwest coast and 1200 km north of Perth, Western Australia. The fields lie on the continental shelf in water ranging in depth from 200 m to 1400 m. This region is scattered with islands, the largest of which is Barrow Island at 25 km in length, 10 km in width, and approximately 234 sq km in area.

The Gorgon gas field is located in Australian Commonwealth waters about 70 km west of Barrow Island, the nearest landfall, lying directly between Gorgon and the mainland.

The gas fields of the Greater Gorgon area contain an estimated gas resource in excess of 40 Trillion cubic feet (40 Tcf), equivalent to 25% of Australia’s total known gas resources. Development of these gas fields will further secure Australia’s position as a leading producer of LNG and pipeline gas.

The Gorgon Project will be operated by Chevron Australia Pty Ltd, which, with affiliates, has a 50% interest in the project. Subsidiaries of Shell and ExxonMobil each own a 25% interest in the Gorgon Project. Front end engineering and design started in mid 2005.

The Gorgon Project first phase will deliver gas to a nominal 10 million tonne per annum (MTPA) LNG facility. See Figure 1b. Approximately 2000 m³/day (12 000 bbl/day) of condensate will also be produced. Additional LNG trains and associated infrastructure may be added in the future.
FIGURE 1b
Gorgon Project Development Proposal

Gorgon Field

Subsea tie-back to Barrow Island

Jansz Field

2 x 5mtpa LNG trains & CO₂ Injection on Barrow Island

Domestic Gas Connection to the mainland

LNG Exports

Existing Domestic Pipeline

Karratha

Onslow

AUSTRALIA

Existing Domestic Pipeline

0 50
kilometres
2.0 MARKET IMPACT

Selection Criteria:
Production from the field has led to the development of a large downstream gas market or has enabled gas to become the leading fuel in a particular region. The effect of the field on the local economy or the market structure can also be considered.

2.1 Gorgon Project in Australia: Local and National impact

The economic benefits resulting from the proposed Gorgon Development will have national, state and regional dimensions. It will contribute substantial, positive economic benefits to Australia and Western Australia, derived from the combination of: export income; tax paid by the Joint Venturers; businesses and individuals employed; and the amount of money spent in the local economy.

At the national level some of the key benefits will include: approximately $17 billion in revenue from company tax and Petroleum Resources Rent Tax (PRRT); an increase in Gross Domestic Product (GDP) of approximately $3.6 billion by 2030; and an increase of exports in excess of $2 billion per year (at today’s prices) during operation.

At the State level, there will also be considerable benefits. Western Australia’s economic success depends on the resources sector. It is significant in national terms, accounting for:
• Over 48% of Australia’s mining and petroleum production;
• Over 60% of Australia’s mineral exploration investment;
• 70% of Australia’s petroleum exploration investment;
• 79% of Australia’s oil and condensate production; and,
• 100% of Australia’s LNG production.

Studies already carried out indicate that Western Australia’s economy is expected to benefit from the Gorgon Project by approximately $4 billion. There will also be improvements to business investment and Gross State Product (GSP) leading to flow-on benefits for business, employment and government revenues. See figure 2a.

FIGURE 2a
Gorgon Project Contribution to National & Western Australian GDP
(Net Present Value in 2002)
Western Australia and the Pilbara region will benefit from increased demand for goods and services that will further stimulate business development and employment opportunities.

The Gorgon Project is predicted to generate and sustain over 6000 jobs on average through the decades of operation, with 1700 generated in Western Australia. See figure 2b.

**FIGURE 2b**

Gorgon Project Contribution to National & West Australian Employment

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2.2 Innovative Marketing Approach

Historically the Asia-Pacific LNG market has involved project owners selling their product in a coordinated manner. The Gorgon Joint Venturers however have adopted an “equity marketing” model where each owner sells its share of the LNG produced separately. This is a first for a significant size project in the region. Equity marketing has lead to greater flexibility in the offerings that can be made to customers and more freedom for the owners to pursue the markets that meet their requirements. The strength of the three Gorgon Joint Venturers has been critical to the success of this innovative approach - between them they are involved in eight other LNG projects that are operating or currently under construction.

Chevron Australia has sold the majority of its share of LNG from the first phase of the Gorgon Project to Japanese buyers. Tokyo Gas will purchase 1.2 MTPA, Chubu Electric 1.5 MTPA and Osaka Gas 1.5 MTPA all over 25 years, for a total volume in excess of 100 million tonnes and estimated value of over US$22 billion. Supply is planned to start in 2010/11.

The balance of Chevron Australia's entitlement to LNG from the first two trains of the Gorgon Project will be available to supply markets such as North America, where Chevron Corporation is pursuing a portfolio of options for importing natural gas.
3.0 TECHNOLOGICAL ADVANCES AND CHALLENGES

Selection Criteria:
Difficulties faced in developing the reservoir required the application of new techniques, equipment or processes that have subsequently been applied in other upstream projects or are expected to be further developed for future gas production.

The remote location of the fields of the Greater Gorgon Area led the reserve to be labelled as “stranded” for many years, due to distance from land, water depth and the inerts content of the gas. To address these issues Chevron Australia will use first ever application of all subsea production system to feed an LNG train and will geo-sequester the produced reservoir carbon dioxide.

3.1 All sub-sea gas procurement system

The Gorgon Project will use an all subsea concept for wells and manifolds. All offshore facilities will be on the seafloor with no initial need for any permanent surface facilities. Up to 25 subsea wells will be drilled in the Gorgon field throughout its life in water depths ranging from 190 to 250m. Each group of wells will use “well jumpers” to connect them to “cluster manifolds” with between one and eight wells. Intrafield flowlines will then transfer fluids to the export feed gas pipeline. The production fluids (gas, water and some condensate, with production chemicals) will then be piped to Barrow Island via a 70 km subsea feed gas pipeline(s). Feed gas pipeline(s) will be corrosion resistant alloy (CRA) clad carbon steel or carbon steel. The well flow rates could range from less than 13 m³(st)/s to more than 110 m³(st)/s (40–340 million standard cubic feet per day (MMscfd)), with flow reducing over time as reservoir pressure declines.

The elimination of a platform reduces the safety risks associated with helicopters by avoiding the need for personnel to be permanently based offshore, or periodically required to visit the platform. It also avoids emissions associated with operation of the platform and significantly reduces overall capital costs, improving the international competitiveness and overall viability of the project.

3.2 Geo-sequestration of carbon dioxide emissions

Processing of gas from the Greater Gorgon Area into LNG will result in greenhouse gas emissions over the full energy lifecycle of the project. These emissions will be approximately half those that would be generated from the use of alternative hydrocarbon fuels such as coal or fuel oil by the Gorgon Project’s potential customers.

Production fluids from the feed gas pipelines will be fed into a slugcatcher(s) to separate the natural gas from the liquids. The gas from the slugcatcher will be rich in CO₂ with trace levels of hydrogen sulphide (H₂S). These two gases are collectively referred to as ‘acid gases’. The acid gases must be removed to meet the LNG product specification and to ensure that the CO₂ does not freeze in the liquefaction process and block the main cryogenic heat exchanger or other equipment. The acid gas removal units will utilize accelerated methyl diethanolamine (accelerated-MDEA or a-MDEA) in water as the solvent for CO₂ and H₂S removal.

Integration of a Gorgon Project Greenhouse Gas Management Strategy into the gas processing facility design has resulted in the adoption of greenhouse efficient practices such as waste heat recovery and a proposal to inject the carbon dioxide (CO₂) contained in the reservoir gas stream into a saline aquifer below Barrow Island, subject to technical and commercial viability. These actions represent a commitment to reduce emissions of greenhouse gases that exceed those of other LNG projects. Extensive monitoring of the injected CO₂ is planned and will assist with the ongoing management of the CO₂ injection operations. The proposed injection of reservoir CO₂ will reduce greenhouse gas emissions attributable to the project by 40% from 6.7 million tonnes per annum of CO₂ equivalent (MTPA CO₂e) to 4.0 MTPA CO₂e.

Benchmarking of LNG plant efficiency shows that the Gorgon Project will be amongst the most efficient LNG projects in the world with an estimated greenhouse efficiency of 0.353 tonnes of
CO₂e per tonne of LNG. This efficiency includes all emissions related to the production of the natural gas from the offshore fields, the energy required to inject reservoir CO₂ and the assumed volume of reservoir CO₂ vented. A range of ongoing management actions and longer term performance targets has been established with the objective of further reducing greenhouse gas emissions.

The Joint Venturers have experience in other parts of the world in operating systems designed to inject mixtures of CO₂ and H2S into subsurface formations. Chevron’s Acheson Field in Canada was one of the first to use this technique, referred to as ‘acid gas injection’, to dispose of CO₂ and H2S separated from a natural gas stream. Prior to this, these gases were vented or flared to the atmosphere. Chevron’s Canadian subsidiaries have successfully operated four such acid gas injection projects since 1990, with 21 years of cumulative experience.
4.0 SUSTAINABLE DEVELOPMENT

Selection Criteria:
This covers a wide range of issues including the exploitation of natural gas found in ecologically sensitive or environmentally challenging locations, through to issues arising from the production and treatment of acid gas to satisfy economic and environmental imperatives

4.1 The Challenges of working within a significant nature reserve

In 1910, Barrow Island was proclaimed as a Class A Nature Reserve. The Class A status of the island reflects its importance as a refuge for wildlife species, some of which are endemic to Barrow Island and some of which are extinct, or near extinction, on the mainland. Land use on Barrow Island is therefore restricted due to its classification as a reserve for conservation purposes. However, Barrow Island has also been actively used for petroleum exploration purposes since 1964, and has since become Australia’s largest onshore oilfield.

No more than 300 hectares (ha) of uncleared land is available for this and other future gas processing proposals on Barrow Island. This 300 ha is comprised of 150 ha that is reserved for the initial phase of the Gorgon Project, 50 ha that is reserved for easements for petroleum pipelines, control lines and ancillary services with the remaining 100 ha reserved for future developments.

The Reserve is vested in the Conservation Commission of Western Australia and managed by the Department of Conservation and Land Management (CALM) for the purpose of wildlife and landscape conservation, scientific study and preservation of features of archaeological, historic and scientific interest.

During the planning and design of the Gorgon Project, a range of mitigation measures to prevent or minimize adverse environmental impacts were taken into consideration. For example, the location for the feed gas pipeline shore crossing was moved to avoid sensitive rock wallaby habitat.

In many situations, where impacts cannot be avoided, the implementation of these measures will limit the degree or magnitude of the adverse impact or rehabilitate any impacted sites. In addition, much of the assessment work and many of the proposed management strategies and monitoring programs have and will contribute significantly to the substantial body of scientific knowledge and understanding of the ecology of the Development Area – thus providing benefit as environmental offsets.

The Joint Venturers have adopted the Western Australian Environmental Protection Authority's (EPA) definition which states that ‘best practice’ involves the prevention of environmental impact, or, if this is not practicable, minimizing the environmental impact, and also minimizing the risk of environmental impact through the incorporation of best practicable measures.

The EPA defines best practicable measures as technological and environmental management procedures which are practicable, having regard to, among other things, local conditions and circumstances, including costs, and to the current state of technical knowledge, including the availability of reliable and proven technology (EPA 2003).

Throughout the environmental risk assessment process the Joint Venturers have engaged specialists with recognised expertise in a broad range of environmental, social and economic fields. Risk assessments, including definition of consequences and identification of stressors and receptors, were undertaken by technical specialists with a long-standing knowledge and experience of working within the proposed Development area, and on Barrow Island in particular.

4.2 A world class quarantine system

The Gorgon Project on Barrow Island will pose new quarantine challenges to the conservation values of the island. Activities associated with the project will increase the volume of cargoes and
number of personnel movements compared to historical or current oilfield operations on the island. These numbers would be particularly pronounced during the construction phase, and would remain at higher than current levels during the operational phase. The higher number of personnel and cargo movements to Barrow Island therefore presents a substantial increase in the potential for non-indigenous organisms to be transported to the island.

To protect Barrow Island from potential introductions of non-indigenous species, the Gorgon Joint Venturers have developed a new approach to quarantine by developing a risk-based Quarantine Management System. As there is no precedent for a quarantine program of such rigor anywhere else in the world, the Joint Venturers have been guided by the specific advice of the EPA to develop quarantine protection for Barrow Island. As a consequence of this advice, the Joint Venturers established a Quarantine Expert Panel, initiated an extensive and transparent process of community consultation, and in concert with the community and experts, developed a set of standards for acceptable risk.

Quarantine management of Barrow Island was first implemented by operators of the oilfield in the 1960s, and through continuous improvement has provided an effective layer of protection to the conservation values of the island.

As a result of the quarantine program over the past 40 years, Barrow Island is the only island in the region free from introduced species such as cats, rabbits, rats and mice.

Refer to Figure 4a for Chevron Australia’s ‘Barrow Island Quarantine Policy’.
FIGURE 4a
Chevron Australia’s Barrow Island Quarantine Policy

Barrow Island Quarantine Policy

Chevron Australia Pty Ltd, the operator of the Barrow Island oilfield and the proposed Gorgon gas facility, is proud of its environmental reputation and performance on Barrow Island. As operator of both oil and gas ventures, Chevron will continue to hold overall management responsibility for operational activities on the island, and for operating in a manner that protects the conservation values of the Barrow Island Nature Reserve and the surrounding waters.

Central to this responsibility is our goal to prevent the establishment of introduced species on Barrow Island and in the surrounding waters. This will be achieved through the implementation of a Quarantine Management System that delivers world class performance and integrates quarantine management into business planning and operational processes.

Chevron will:

- Not compromise quarantine requirements;
- Identify and manage quarantine risks arising from our operation, with the objective of preventing the introduction and establishment of species to Barrow Island;
- Develop and maintain a positive quarantine culture in our staff, contractors and suppliers;
- Engage only contractors and suppliers who have demonstrated a willingness to meet or exceed our quarantine standards;
- Maintain a system of continuous improvement in our management of quarantine;
- Meet or exceed all legal requirements, be a responsible corporate citizen and demonstrate leadership in quarantine management;
- Provide the appropriate training to support the implementation and ongoing operation of the quarantine programmes;
- Set measurable quarantine targets and performance objectives;
- Ensure conformity with this policy by a comprehensive compliance program including audits;
- Have an open and transparent quarantine process that includes stakeholder engagement and reporting;
- Recognise and address government and community concerns on quarantine; and
- Respond quickly and effectively to any quarantine emergency with the potential to impact the biodiversity of the area.

Chevron will commit the necessary resources to ensure the effectiveness of this policy.

This policy, its intent and each person’s responsibility will be communicated to employees, contractors, subcontractors and visitors. All are required to comply with the processes, procedures and systems of work developed in accordance with this policy.

This policy applies to all activities on Barrow Island and in the surrounding waters.

Signed

James W. Johnson – Managing Director
Chevron Australia Pty Ltd
August 2005
5.0 FUTURE POTENTIAL

Selection Criteria:
Large remaining reserves or production levels that could be sustained for several decades to come are indicators of high potential, as are major possibilities for developing new production, enhancing existing production or increasing recoverable reserves by a very substantial amount.

5.1 Gorgon Project: Access to a Vast Resource Base

Development of this substantial Australian asset will secure Australia's future as a leading gas producer in the Asia Pacific Region and generate a new source of wealth for Western Australia and Australia.

With declining supplies of domestic crude oil and rising fuel demand, Australia and the Asia Pacific region will need to increasingly turn to its energy strength – natural gas. The Gorgon Project has the capacity to ensure Australia's position as a regional leader in clean energy.

The ingredients are already there:
- vast and growing reserves of natural gas;
- access to expanding energy-hungry markets in the Asia-Pacific region;
- a world demanding cleaner energy; and
- the experience and skill in the development and execution of large resource projects.

The gas fields of the Greater Gorgon Area contain in excess of 40 Trillion Cubic Feet of gas representing some 25% of Australia’s known gas resources. The Gorgon Project therefore has the potential to expand its LNG capacity to 20 million tonnes per annum from four LNG trains.

5.2 Establishing Australia as the World’s Leading LNG Supplier

The opportunities presented by the Gorgon Project ensure that Australia is well positioned to secure a significant share of the growing global LNG market. Australia offers a stable investment environment, significantly reducing investment risk for a long-term international LNG export development. In Australia, LNG projects receive strong support from Government at all levels.

The Gorgon Project will also help underpin the development of new technologies and skills, for example in disposal of CO2 by injection and subsea technology, creating capacity for future regional growth. The Gorgon Project could lead to further development of other regional gas resources identified in the area, extending and expanding the benefits of the initial development.

5.3 Potential to Develop Western Australian Domestic Gas Market

The Gorgon Joint Venture Participants are reviewing the potential for a future expansion of the Gorgon Project to include a domestic gas facility. Such a development could be a significant supplier to the gas network in Western Australia and provide an additional gas supply hub for the State.