

5. Alternatives

5.1 Introduction

The DIPE guidelines (August 2000) state that an outline of the main alternatives studied by the developer and an indication of the main reasons for the developer's choice is required in the Draft EIS. Furthermore, where alternatives are available, which may still allow the objective of the project to be met, the existing environment should also be detailed.

A broad range of alternatives has been considered. Many of the alternatives will be, or already have been, eliminated on economic, technical, environmental or regulatory grounds.

The main alternatives examined in the validation of this project's feasibility are:

- Implications of 'No Development';
- Alternative Development Sites and Pipeline Routes;
- Alternative Facilities;
- Alternative Environmental Process Options; and
- Management of Greenhouse Gas Emissions.

5.2 No Development Option

The petroleum exploration and production industry is important to Australia's overall economic welfare and provides the nation with a reliable and competitively priced source of energy, which directly meets 52 percent of Australia's primary needs. The industry's economic contributions include the following:

- Production value (1999/00) - \$12 bn;
- Exports (1999/00) - \$8.5 bn;
- Import Replacement Value (1999/00) - \$5 bn;
- Income Tax (1999/00) \$1.4 bn;
- Resource Taxes (2000/01) - >\$3.0 bn;
- Industry Output Multiplier – 1.8 to 2.4;
- Employment – 20% production change leads to a 0.4% employment change; and
- GDP – 20% production change leads to a 0.5% change in GDP (APPEA, 2001).

The above contributions reflect direct benefits to the economy, however, companies which operate within the industry provide capital, infrastructure, expertise, technology diffusion and frequently facilitate the capturing of export market opportunities for related industries. It also supports the service sector. A recent study has indicated that nearly 900 businesses in Western Australia alone, including many regional areas, are involved in providing services to the oil and gas industry. A strong and expanding industry will continue to offer a significant long term contribution towards the nation's economic growth (APPEA, 2001).

Although Australian petroleum supplies are currently experiencing a high level of self-sufficiency, this is expected to decline in the next few years, unless there are further commercial discoveries with crude oil and condensate production rates set to decline by 33 percent by 2005 and 50 percent by 2010. An increased reliance on imports of fuel products has implications for national security, management of environmental/greenhouse issues, the balance of payments and jobs in the Australian economy.

If this project does not proceed there will be negative implications for Australia and East Timor where revenues from upstream gas production have a significant role to play. In Australia, upstream royalties and taxes account for 2–4% of government revenue annually (pers. comm Noel Mullen, APPEA 2001), whereas in East Timor; success at Sunrise and Bayu-Undan provide the most immediate opportunity for the rebuilding one of the worlds newest and poorest nations.

Failure to develop Greater Sunrise will also see Australia and East Timor miss opportunities to supply energy exports to global markets where due to its cleanliness and convenience, LNG is in increasing demand.

Failure to commercialise Greater Sunrise will miss an opportunity to increase employment in the gas sector, including downstream gas industries. It will also fail to realise a return on the considerable investment made by the Sunrise Joint Venture since the discovery of the resource. Since 1998 some AU\$200 million has already been attracted to the project and invested in identifying development options and potential markets.

The commercialisation of Timor Sea gas will be essential if Darwin is to avoid increased dependence on less environmental-friendly fossil fuels, such as oil and coal. Opportunities to improve greenhouse efficiency in energy use would be missed as would Australia's opportunity to develop its second LNG industry which provides the basis of large scale exports of natural gas to global markets.

5.3 Alternative Development Sites and Pipeline Routes

5.3.1 LNG Onshore/Offshore

The feasibility of locating an LNG Plant in the Darwin Region based on Timor Sea gas resources was the main focus of a feasibility study undertaken by the NAGV in 1997. The study examined markets, engineering, environmental and economic aspects of the proposed project and the possibility of capturing anticipated market opportunities in the Asian region for LNG and the Northern Territory and adjacent states for domestic gas. The 18-month feasibility study concluded that development of Timor Sea gas was technically feasible but ultimate success depended on the capture of markets and project economics (Woodside, 1998).

In 2001 Phillips Petroleum Co. tabled an onshore LNG concept for Greater Sunrise gas based on a LNG sales opportunity on the west coast of the USA with El Paso Energy. Phillips, as a joint venture participant in Greater Sunrise, has led the marketing effort opposite El Paso to progress this opportunity. Under the co-operation principles, alternative LNG proposals could be tabled by any of the Sunrise Joint Venture participants.

In 2001 Shell tabled a floating LNG concept for Sunrise. Floating LNG (FLNG) may present environmental advantages, as well as reducing cost and construction time. FLNG was considered in the NAGV Feasibility Study (1998) as a possible option. A FLNG terminal would be the first of its kind globally. However, the option of developing the FLNG concept will be progressed through a separate approvals process and so is not considered in this EIS. While the FLNG barge itself is not considered in this EIS, the capacity for the gas field to be developed to supply such a facility is well within the scope of the proposal set out in this document.

5.3.2 Subsea Pipeline Routes

The effect that a pipeline will have on the environment largely depends on the route chosen. Consequently, route selection is of prime importance to minimise any adverse environmental effects. Recognising this, several pipeline route selection studies have been undertaken, since first realisation of the Sunrise Gas Project. The objective of these studies was to identify potentially feasible routes for a pipeline running from the Greater Sunrise gas fields to Darwin.

The Sunrise Gas Project started out as a standalone pipeline with no potential sharing of resources with the Bayu-Undan field. The first shortlist of pipeline routes was therefore based on a more direct route from Sunrise to Darwin. Three routes were shortlisted; one ran across Melville Island, one to the east, and the other to the west of Bathurst Island. Studies undertaken in 2000 showed that routes to the

West of Bathurst Island were preferred. A number of routes were examined running from Greater Sunrise to the Bayu-Undan Wye piece and two routes shortlisted, Route 05 and 06, as shown in **Figure 5-1**.

No significantly sensitive habitats were encountered along Route 05. Route 06 displayed more extensive areas of hard substrate, supporting epibenthic communities but no particularly abundant communities were found. Baseline environmental conditions were determined by Bowman Bishaw Gorham (BBG) during marine assessments conducted during 2000 and 2001 (refer to **Section 6.6**) around the proposed platform and FSO locations.

Route 05 – Preferred Alignment: Refer to **Section 3.3.2**.

Route 06 – Alternative Option: Route 06, 245.8 km in length, runs in a south-easterly direction towards the Wye piece and does not enter the JPDA. The pipeline runs through Melita Valley and ‘The Boxers’. Water depth at the Sunrise Gas Field is -140 to -400 m and drops to its lowest level (-180 m LAT) at Melita Valley (KP¹ 105 and KP 120). The shallowest depths are experienced at ‘The Boxers’ where between KP 165 and KP 200 an average of -37 m LAT is reached but drops to -80 m in places. Along this route the following engineering designs might be necessary to counteract the uneven profile.

- | | |
|--|------------------------|
| <input type="checkbox"/> Pre Lay Rock Dump | KP 86.78 to KP 86.92 |
| <input type="checkbox"/> Pre-lay Rock Dump | KP 96.05 to KP 96.12 |
| <input type="checkbox"/> Pre-lay Rock Dump | KP 106.04 to KP 106.12 |
| <input type="checkbox"/> Pre-Lay Rock Dump | KP 168.29 to KP 168.34 |
| <input type="checkbox"/> Pre-Lay Rock Dump | KP 187.62 to KP 191.00 |
| <input type="checkbox"/> Stabilisation Rock Dump | KP 175.00 to KP 187.00 |
| <input type="checkbox"/> Stabilisation Rock Dump | KP 194.00 to KP 200.00 |

The thickness of the concrete coating would have to be increased through the ‘The Boxers’ (between KP 165 and KP 175) to maintain stability.

In summary, both routes to varying degrees pass through valleys and shoals. However, Route 05, the preferred and shortest route, does not experience fluctuations in water depths to the same extent as Route 06. Route 06 requires additional stabilisation and rock armour. Route 05 by running in a more westerly direction, results in a longer co-operation pipeline, the installation of the pipeline is relatively straightforward due to a reduction in the quantity of rock armour and degree of stabilisation required.

From the proposed location of the ‘Wye’ piece, Greater Sunrise gas would be transported to Wickham Point through a pipeline installed within the corridor previously approved for the Bayu Undan environmental assessment.

5.3.3 Alternative Platform Locations

In 2000/2001, Bowman Bishaw Gorham on behalf of Woodside undertook environmental surveys in two separate studies of three shallow bank tops and a proposed platform location in a deep-water location, to identify suitable locations for platform structures in the Sunrise Gas Field area. The banks were identified as Sunrise Bank, Sunrise South Bank and Sunrise West Bank. The Sunrise South Bank was identified as most suitable of the shallow banks from an environmental perspective.

¹ KP - Kilometre Point

However, it was determined during screening studies that use of a Bank required extended corrosion resistant flowlines, leading to a more costly development than that proposed. Therefore, the platform structure will not be located on one of the banks but at the deep-water platform location, which is suitable from both an environmental and technical perspective.

The banks are described in more detail in **Section 6.6.1** and shown in **Figure 6-10**.

5.4 Alternative Facilities

5.4.1 Drilling Rigs

For the platform wells, studies have been conducted to balance the greater cost of installing individual subsea wells against the cost of providing a drilling platform and the risk/cost of drilling extended reach wells with a resident platform facility. The comparative ease of re-entering wells with a surface wellhead has also been factored into these studies.

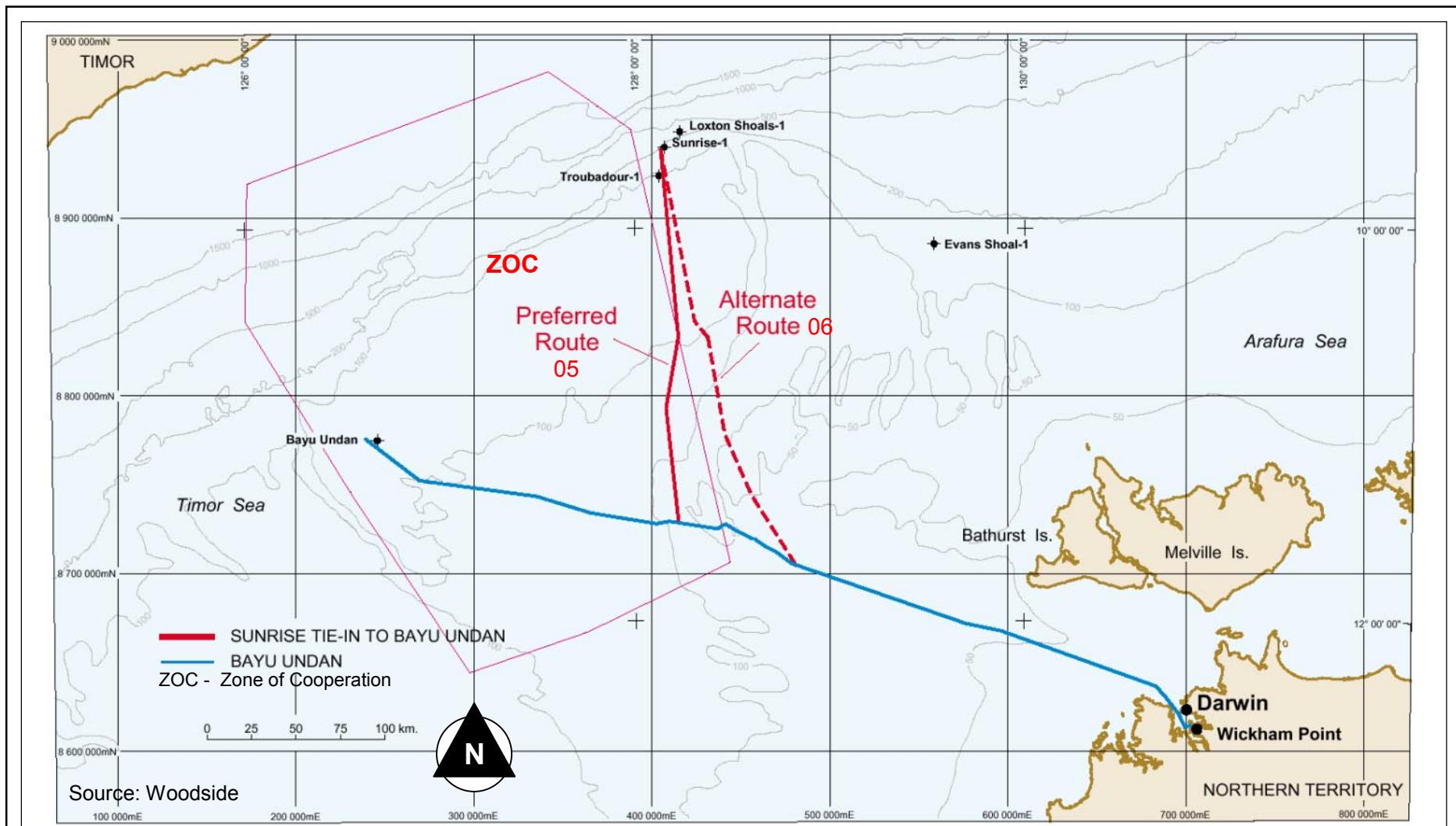
Various platform drilling rig options have also been investigated to minimise the impact of platform facilities, while optimising the platform drilling capability and minimising capital investment in drilling equipment.

Self-Erecting Tender Rig (SETR): This option is similar to the SSETR (Refer to **Section 3.2.6**) except the tender is a flat-bottomed barge rather than a semi-submersible. Studies are being conducted to determine their sea-worthiness in the open seas of the Project area and in these water depths. Drilling costs and drilling rig availability may be improved since there are more SETR barges available in the South East Asian Region.

Permanent Platform Rig: A permanent drilling facility installed on the platform is not being considered as a preferred option at this time because:

- It would require a heavy lift vessel to install the rig onto the platform;
- The rig is not available for work on other projects should the opportunity eventuate;
- Maintenance would all have to be conducted offshore (an expensive option), not on the beach; and
- The majority of rigs being built these days are modular, demountable rigs.

Modular Platform Rig (MPR): A MPR has been demonstrated to mitigate much of the risk associated with the SSETR, (Reference Case) option. The rig is likely to be custom-built for the Project, to achieve the Extended Reach Drilling (ERD) capability and is thought likely to remain in Darwin, available for well interventions between drilling campaigns, should this be required, or for deployment on other drilling projects in the interim. There are interface issues with the platform which have to be addressed, eg platform loading, capping beam spacing and deck area and facilities, before this option can be considered as a preference to the current SSETR in the 'reference case'. Accommodation of the rig crew and safety issues concerning proximity of personnel to hazardous areas and provision of safety systems have also to be addressed, as there are likely to be 3 - 4 wells drilled from a wellhead platform before the PCUQ facility is installed. Once the PCUQ is installed, accommodation and services could be provided by the PCUQ.



SINCLAIR KNIGHT MERZ

Sinclair Knight Merz
263 Adelaide Terrace
P.O. Box H615 Perth
WA 6001 Australia
Ph: (08) 9268 4500

Subsea Pipeline Preferred and Alternative Route Options

Figure 5-1

Project No.: DE2090.100
Figure prepared by: T.Lee
Date Prepared: 16/10/01

5.4.2 Offshore Processing Facilities

An assessment comparing three main concepts was conducted by Woodside to determine the preferred offshore platform as follows:

- Jack-Up - Hull and topsides with a separate but bridge-linked Wellhead Platform and remote FSO (**Figure 5-2**).
- Technip Jack-Up - Hull and topsides (with accommodation built into the hull) and a separate but bridge-linked Wellhead Platform and remote FSO.
- Float-over - Integrated deck topsides with float over installation onto a steel jacket with a separate but bridge linked Wellhead Platform and remote FSO.
- Floating Production Barge with subsea wellhead facilities.
- Floating Production Barge with a separate Wellhead Platform.

The Jack-up platform concept was selected as the outcome of an internal design competition with a large floatover-installed integrated deck and a floating production barge - all specified to achieve the same processing function. All options were found to be feasible, and the evaluation process covered cost, schedule and assessments of health, safety environmental and technical risks. The jack-up emerged in the leading position by a small margin in each main area of the evaluation, enabling the decision to be readily endorsed by all JV partners.

5.5 Alternative Environmental Process Options

The Sunrise Gas Project can demonstrate that the best available technologies for reduction of environmental impact of discharges and emissions have been given due consideration. In this regard Woodside produced the report entitled '*Environmental Design Review*' (Woodside, May 2001). Several available technologies have been considered and benefit-cost analysis performed before deciding on the recommended option.

The Woodside Environmental Policy (**Appendix B**) states that Woodside shall seek continuous improvement in energy efficiency and update environmental standards in light of developments in technology, legislation, industry practice and changing community expectations. The Woodside 'Venting and Flaring Policy' requires that "venting and flaring of hydrocarbons will be minimised with the design and operational philosophy of each facility, using best available technical and procedural solutions at reasonable cost".

Emissions and discharges to the environment can be classified under the following broad groups:

- Atmospheric Emissions;
- Discharge to sea;
- Chemicals; and
- FSO/ Tanker Venting/ Ballast Water discharge.

Atmospheric Emissions: The issues to be considered with regard to atmospheric emissions include:

- Reduction of CO₂ emissions by minimising continuous flaring;
- Reduction of unburned hydrocarbon emissions by eliminating continuous venting (Global Warming Potential for methane is 21 times CO₂);
- Minimise unburnt aromatics (BTEX) to atmosphere (carcinogenic); and
- Eliminate Ozone Depleting Substances (ODS).

Discharges to Sea: Wastewater will originate from a number of sources, including produced formation water (PFW), drainage water and sources such as cooling water and ballast water. Factors to be considered include:

- Legislation with respect to free hydrocarbons and particularly dissolved hydrocarbons is becoming more stringent.

- Need to limit total hydrocarbons consisting of free suspended hydrocarbons and dissolved hydrocarbons in water.
- Achieving total oil in water (OIW) target in gas condensate field is difficult.
- Condensation of regeneration offgas to recover heavy hydrocarbons exacerbates the problem of dissolved hydrocarbon (BTEX) in water.
- Investigation into the feasibility of water injection displays potential for an injection well.
- Ballast Water and cooling water management.

The following options exist with respect to an injection well:

- Shallow new well;
- Injection through the annulus of a production well to a shallow formation possibly in combination with drilled cuttings;
- Dedicated slimline well to formation depth; and
- Workover of a production well at the end of its production life.

The technical risks with injection through the annulus are higher than shallow injection well and remains unresolved to date. The ‘workover’ option will require water injection to be delayed until a suitable depleted production well is available. Until such time, a hydrocyclone degasser system can be used to treat water for disposal overboard.

In summary a range of process options which provides the best environmental performance have been identified during the preliminary engineering. Work is continuing to identify in more detail which of these options provides the best environmental performance and which will meet the technical requirements of the final development concept.

5.6 Greenhouse Emissions and Environmental Implications

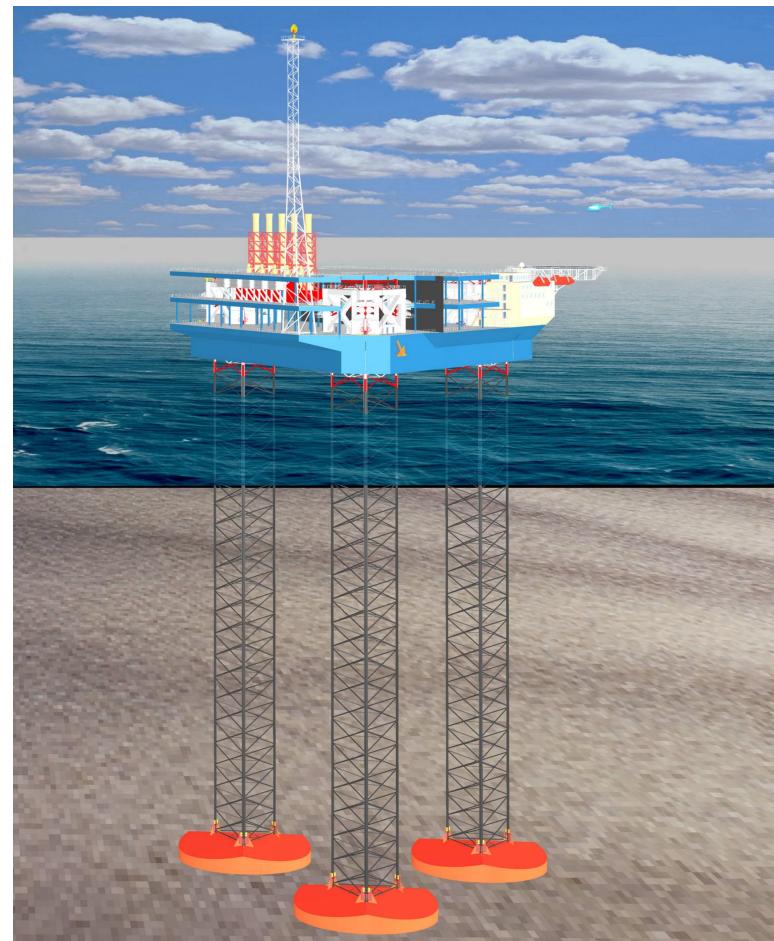
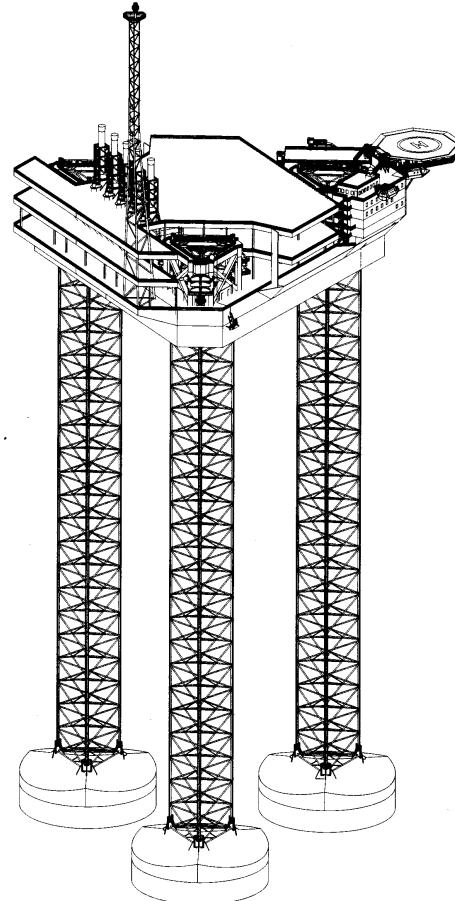
A number of greenhouse gas reduction measures are being considered for the Sunrise Gas Project, including emissions reduction and energy efficiency measures, and market-related measures (joint implementation) offsets. Specific measures to be considered as part of the Sunrise Gas Project are:

- The development and implementation of a greenhouse strategy to minimise emissions of greenhouse gases;
- Design and operational measures to minimise offshore flaring and venting;
- The reduction of methane emissions to negligible levels through the combustion of regeneration offgas;
- Maximising the use of waste heat from gas turbines; and
- To adopt industry best practice in greenhouse efficient technology and practice wherever practicable (NOI, PPK, 1998).

Natural gas is a clean burning energy source offering significant environmental and cost advantages over other fossil fuels. The LNG export industry replaces other higher carbon density fossil fuels that would otherwise be used for power generation in rapidly industrialising countries across the Asian region, reducing global greenhouse emissions. With Kyoto Protocol targets to be met, LNG and natural gas is set to play a crucial role in attaining the necessary targets, however, the protocol is yet to address how Australia can continue to produce LNG exports without being unduly penalised for emissions incurred in the production process.

Woodside strongly believes in the benefits of natural gas as an alternative to less environmentally favourable fossil fuels, and believes its use can do much to alleviate air pollution in the highly urbanised and industrial centres of Asia, America and Europe. At the same time, Woodside are making concerted efforts to reduce greenhouse emissions in their own operations, and in recent years have had considerable success.

Australia's LNG participants, including Woodside, endorse the view that natural gas will play an important role in reducing worldwide greenhouse emissions. From wellhead to customer, LNG and natural gas generate significantly lower greenhouse emissions per unit of energy than alternative fossil fuels. While gas production and LNG processing lead to increased greenhouse emissions within the producing country, a far greater reduction in emissions accrues to the customer. As a result, the world environment is a net beneficiary when gas displaces other fossil fuels, particularly coal, as an energy source (**Figure 5-3** and **Figure 5-4**).



Source: Woodside

SINCLAIR KNIGHT MERZ

Sinclair Knight Merz
263 Adelaide Terrace
P.O. Box H615 Perth
WA 6001 Australia
Ph: (08) 9268 4500

PCUQ (Jackup)

Figure 5-2

Project No.: DE2090.100
Figure prepared by: T.Lee
Date Prepared: 16/10/01

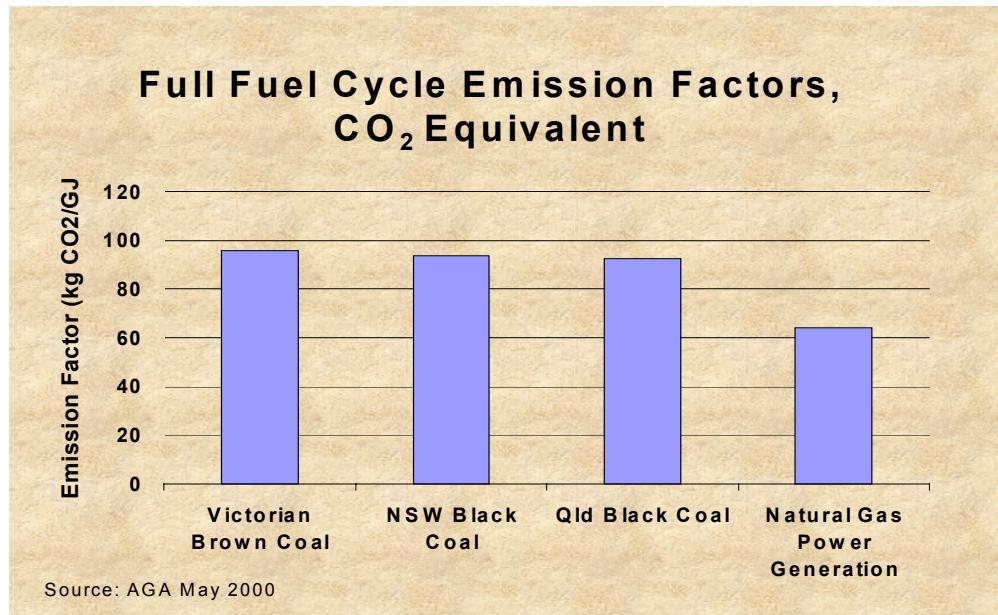


Figure 5-3 Full Fuel Cycle Emission Factors CO₂ Equivalent

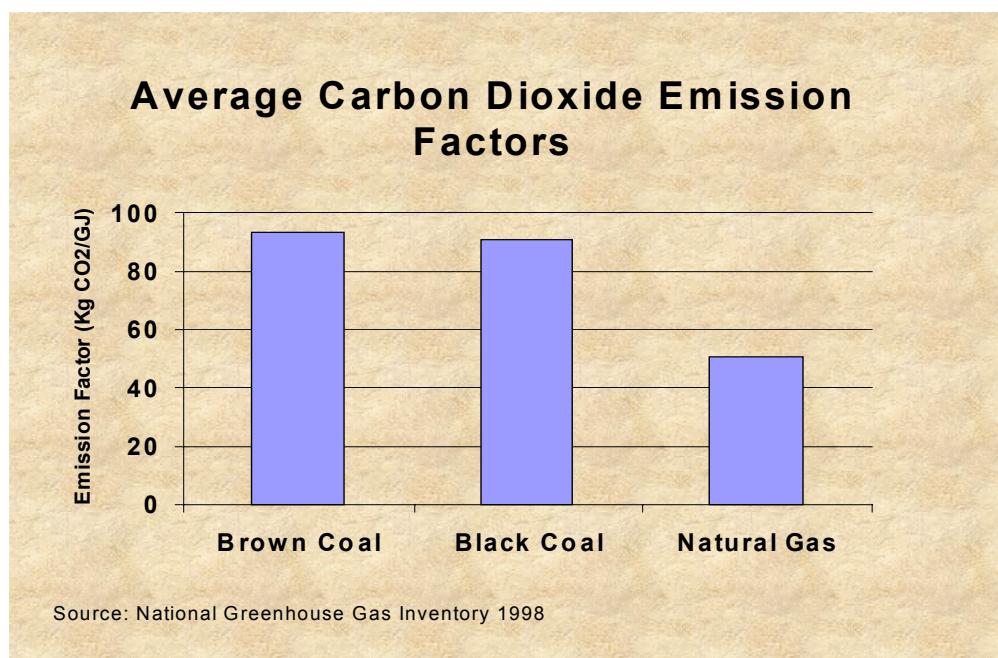


Figure 5-4 Average Carbon Dioxide Emission Factors

