ZeroGen

smarter, cleaner power

Initial Advice Statement

4 July 2006

Table of Contents

List of Tables

Appendix

ABBREVIATIONS

AGO	Australian Greenhouse Office
APIA	Australian Pipeline Industry Association
CASA	Civil Aviation Safety Authority
CCS	Carbon Capture and Storage
CCSD	The Cooperative Research Centre for Coal in Sustainable Development
CHMP	Cultural Heritage Management Plan
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO2CRC	The Cooperative Research Centre for Greenhouse Gas Technologies
CSIRO	Commonwealth Scientific and Industrial Research Organization
dB	Decibel
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
EP Act	*Environmental Protection Act 1994*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
EPP Air	Environmental Protection (Air) Policy
EPP Noise	Environmental Protection (Noise) Policy
ERA	Environmentally Relevant Activity
EPRI	Electric Power Research Institute (of America)
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GOC	Government Owned Corporation
IAS	Initial Advice Statement
IGCC	Integrated Gasification Combined Cycle
IGOC	Integrated Gasification Open Cycle

ILUA	Indigenous Land Use Agreement
IPCC	Intergovernmental Panel on Climate Change
km	Kilometres
kW	Kilowatts
LETDF	Low Emission Technology Demonstration Fund
m	Metres
ML	Megalitre
MW	Megawatts
MWh	Megawatt-hour
NEM	National Electricity Market
NEPM	National Environmental Protection Measure
NRMW	Department of Natural Resources, Mines and Water
P&G Act	*Petroleum and Gas (Production and Safety) Act 2004*
PIF	Department of Primary Industries and Fisheries
Project	ZeroGen
ROW	Right-of-Way
SDPWO Act	*State Development and Public Works Organisation Act 1971*
SEVT	Semi-evergreen Vine Thicket
Stanwell	Stanwell Corporation Limited
syngas	Synthesis Gas
TOR	Terms of Reference
TJ	Terajoules
WMO	World Meteorological Organization

EXECUTIVE SUMMARY

INTRODUCTION

ZeroGen Pty Ltd is proposing to build and operate a world-first demonstration plant, at commercial-scale, that integrates the gasification of coal with the capture and safe storage of carbon dioxide (CO_2) emissions to generate low emission base-load electricity. Base-load electricity is the minimum amount of electric power delivered or required over a given period of time at a constant rate. Base-load generators supply electricity almost continuously to provide power to maintain industrial processes such as manufacturing and minerals processing and essential services such as hospitals and street lighting. The demonstration project is called ZeroGen (Project).

The Project is seeking declaration as ‘significant project’ under Section 26 of the *State Development and Public Works Organisation Act 1971* (SDPWO Act) based on the information provided in this Initial Advice Statement (IAS) and summarised in Table ES-1. Declaration will require an Environmental Impact Statement under Part 4 of the SDPWO Act.

Table ES-1: Items for Consideration in Determining Declaration as a Significant Project

Item for Consideration	Reason
IAS	Information in this IAS in relation to the nature of, the reason for and the potential impacts of the Project and due to the high level of stakeholder interest in carbon storage.
Planning Schemes or Policy Framework	The Project will encompass the Planning Schemes for 4 local authority areas. The Project will support government policies such as: • Queensland Government’s Smart State Strategy 2005-2015, by developing clean coal technologies. • Queensland Government’s Greenhouse Strategy, objective to reduce greenhouse emissions and facilitate carbon sequestration. • Australian Government’s Securing Australia’s Energy Future.
Potential Effect on Relevant Infrastructure	Infrastructure requirements will include the need for: • Water: 2,000 Megalitres (ML) per annum. • Gas: 110 Terajoules (TJ) per annum for start up and as a support fuel. • Electricity: 1-6 Megawatts (MW) for start up and operation of compressor sites. Extent of negotiations with infrastructure providers including: Powerlink, Main Roads, Queensland Rail, Telstra, Ergon Energy and possible water authorities.
Employment Opportunities	The Project has the potential to provide direct employment for up to 700 construction and 125 operational personnel. In addition the Project will provide incentive for additional employment development in Queensland.

Item for Consideration	Reason
Potential Environmental Effects	The potential environmental impacts including land clearing, water usage, waste disposal and noise and air emissions. Environmental benefits would include: • Reductions in pollution due to higher energy efficiency in electricity generation; and • Enhanced capture of other air pollutants through coal-based gasification technology.
Complexity of local, State and Australian Government requirements	Applicability of existing legislation to manage the interaction of the available technologies. Negotiations with at least 4 local authorities. Variety of land tenures associated with the pipeline and carbon storage including: freehold, leasehold, crown reserves, state lands, existing easements and mining tenures. Numerous environmental approvals and licences from agencies such as the Environmental Protection Agency (EPA), Department of Natural Resources, Mines and Water (NRMW) and Department of Primary Industries and Fisheries (PIF). Potential Australian Government involvement through the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). Negotiations with up to 6 Traditional Owner representative groups concerning Native Title and Cultural Heritage. Negotiations with approximately 70 landholders.
Investment requirements	Financial feasibility will depend on a range of funding sources both private and government.
Strategic Significance of the Project	Potential for significant reductions in greenhouse gas (GHG) emissions as a result of electricity generation using coal as a fuel source. Preserving Australia's and particularly Queensland's relatively low cost, reliable base-load electricity generation whilst reducing the effects of GHG. Accelerating the commercial deployment of clean coal technology both within and outside Australia.

The demonstration Project consists of two main segments: an Integrated Gasification Open Cycle (IGOC) power plant and the capture and safe storage of CO_2 in deep saline aquifers. The capture and safe storage of CO_2 is generally known as carbon capture and storage (CCS).

The IGOC plant will produce hydrogen rich fuel from pulverised coal by chemically converting the coal to a synthesis gas (syngas) consisting of hydrogen and CO_2. The hydrogen rich component of the syngas will be used to drive a gas turbine to generate electricity. The by-product of using hydrogen in this process is water. The CO_2 will be captured, transported and injected for safe storage in deep saline aquifers. The CO_2 captured for storage will only be from the gasification plant which will be purpose built for the Project. It is estimated that this demonstration Project will result in a net saving of up to 420,000 tonnes of CO_2 per year when the plant is operating at the maximum expected capacity and availability.

While the individual elements of this technology have been developed and are in use overseas there is currently no commercial-scale project that integrates coal-based gasification and CCS in the world. ZeroGen aims to prove the integration of these technologies and thereby open the way for accelerating the commercial uptake of coal-based gasification and CCS. Through ZeroGen facilitating the commercialisation of the technologies, at full commercial-scale and assuming an Integrated Gasification Combined Cycle (IGCC) plant is deployed, there is the potential for CO_2 emissions to be cut by approximately 80% relative to conventional coal-fired power stations.

The Project's first phase is a test drilling program of geological sites in the northern Denison Trough in June 2006. This test program has received the relevant regulatory approvals and is necessary to collect data to confirm the geology of the area to safely and securely store CO_2 in deep saline aquifers. This phase of ZeroGen is substantially in advance of other CCS projects in Australia.

The Project will be undertaken by ZeroGen Pty Ltd, which is currently a subsidiary of Stanwell Corporation Limited (Stanwell). Stanwell is a Queensland Government-Owned-Corporation (GOC) that owns and operates electricity generation facilities which represent about 20% of the State's installed capacity. It is envisaged that in the near future ZeroGen will be transferred to a Project Board and that Stanwell will be engaged to provide ZeroGen Pty Ltd with all services related to the Project. International companies such as Royal Dutch Shell plc, a global CO2 sequestration leader, and Shell Global Solutions International BV are also involved in providing technical advice and technological components. The Project has also been endorsed by the world's largest electricity research organisation, the United States of America-based Electric Power Research Institute (EPRI).

The financial feasibility of the Project is dependent on financial support from a range of sources. This includes the Australian and State Governments, the coal industry and potential equity partners.

A number of sites have been investigated for the Project. Based on current research it has been determined that the gasification and power generation plant will be undertaken at the Stanwell Energy Park, 29 kilometres west of Rockhampton. The captured CO_2 will be transported by pipeline for safe storage in the northern Denison Trough near the towns of Emerald, Springsure and Rolleston. A study route for the transmission pipeline has been determined based on desktop studies of the region taking into account various terrain, environmental and economic constraints.

PROJECT RATIONALE

The rationale for undertaking the Project is to find a technological solution to the twin challenges of providing base-load electricity to meet growing industry and community demand while simultaneously reducing GHG emissions to the atmosphere. Australia has an abundance of coal resources (approximately 80,000 million tonnes) conservatively valued at $100 billion[1]. Coal is currently the lowest-cost energy source for base-load power in Australia. It is also the largest commodity export by value and is, therefore, responsible for substantial direct and indirect economic benefits in Australia. In its 2004 white paper "Securing Australia's Energy Future" the Australian Government noted that coal "produced 78% of (Australian) electricity in 2000-01". It also estimated that demand for stationary energy services such as base-load power is projected to grow by 50% by 2020. An issue with generating base-load electricity from traditional coal-fired power stations however, is the emissions of CO_2. Carbon dioxide is one of the GHGs that many observers believe is contributing to climate change. Indeed, the white paper estimated that energy production and use contributed 68% of Australia's GHGs in 2002.

Greenhouse gases are of concern because they tend to trap heat in the atmosphere potentially leading to an increase in the Earth's overall temperature. The Commonwealth Scientific & Industrial Research Organisation (CSIRO) has predicted[2] that impacts of temperature increase to Australia could result in:

- Reduced rainfall in current agricultural producing areas;
- Reductions in native pasture growth;
- Reduction in snow-covered areas in the Australian Alps; and
- Bleaching and damage to the Great Barrier Reef.

The CSIRO has also noted that the "average surface temperature of Australia increased by 0.7^{o}C over the past century – warming that has been accompanied by marked declines in regional precipitation."

Many gases exhibit 'greenhouse' properties. Some of them occur in nature (i.e. water vapour, carbon dioxide, methane and nitrous oxide), while others are exclusively human-made (e.g. gases used for aerosols). Greenhouse gas from electricity generation is predominantly in the form of CO_2.

Carbon dioxide is a naturally occurring gas made up of one carbon and two oxygen atoms. It occurs as a result of burning organic matter (e.g. coal, natural gas, wood fuels) in the presence of oxygen. It can also be produced by the decomposition and fermentation of certain organisms and through respiration from living organisms (e.g. humans, animals and plants). Carbon dioxide is used commercially in producing carbonated drinks such as water, "soft drinks," beer, as a refrigerant (i.e. dry ice) and as a fire extinguisher.

Carbon dioxide naturally occurs underground within geological formations throughout Australia, including within the northern Denison Trough in Queensland. While CO_2 is not explosive, is non-

[1] ACIL Tasman, 2006, Project Stanwell – An Economic Benefit Analysis of the Proposed Stanwell IGCC-CCS Demonstration Project, February, pA1-A7.

[2] Climate Change Impacts on Australia and the Benefits of Early Action to Reduce Global Greenhouse Gas Emissions, A consultancy report for the Australian Business Roundtable on Climate Change Preston, B.L. and Jones, R.N. February, 2006

flammable and not poisonous, in large volumes and in confined spaces it blocks oxygen and may prevent respiration. Injection of CO_2 into underground storage areas has been safely undertaken for many years by the petroleum industry as part of enhanced oil and gas recovery projects.

PROJECT BENEFITS AND COSTS

There are a range of key national, state and regional public benefits from undertaking ZeroGen. These are detailed in Section Three however, in summary these include:

- Demonstrating the world-first integration of coal gasification and CCS technologies at a commercial scale;
- Sustaining the value of Australia's coal, minerals resources and minerals processing activities which are conservatively valued at over $100 billion per annum and the hundreds of thousands of jobs these sectors support often in rural and regional communites. The coal industry alone employs over 10,000 people in Queensland and provides approximately $500 million in coal royalty payments to the State Government;
- Facilitating Australian experience and knowledge in these technologies that may create new job and export opportunites;
- Accelerating the widespread uptake of the technology by the generating industry thereby supporting its commercial deployment in Australia by 2030. By accelerating the commercial uptake of the technologies Australia's Gross Domestic Production (GDP) is estimated to grow by an addition $1.1 billion dollars in today's dollars[3];
- Proving the viability of safely storing CO_2 in Australia's deep saline aquifers to enable deep cuts in GHG emissions. The knowledge gained through ZeroGen could enhance the deployment of the technologies to reduce GHG emissions not only in Australia but also in other large energy consuming nations such as China, India and the United States that have similar geological structures;
- Facilitating dialogue among researchers, industry participants and government on this technology's potential to reduce GHG emissions;
- Contributing to necessary legislative and policy changes in relation to deploying this technology;
- Raising the public awareness of the benefits of these technologies among key stakeholders;
- Enhancing Australia's energy security;
- Providing a pathway to the hydrogen economy; and
- Directly employing approximately 700 construction and 125 operating jobs in Central Queensland and stimulating consumption and flow-on employment arising from the Project's capital and operating expenditures.

[3] ACIL Tasman, 2006, Project Stanwell – An Economic Benefit Analysis of the Proposed Stanwell IGCC-CCS Demonstration Project, February.

Assuming the technologies being demonstrated by ZeroGen are not proven commercial by 2030 the economic costs for Australia are likely to be an annual reduction in GDP of approximately $3.65 billion in today's dollars[4]. This reduction is largely as a result of reduced coal exports.

PROJECT DESCRIPTION

The Project is comprised of two elements: an IGOC plant and CCS.

The IGOC is primarily a power station that uses the thermal content of coal to generate a syngas to fuel a conventional open cycle gas turbine plant. Coal, oxygen and steam are reacted under high pressure and temperature to create the syngas which is primarily hydrogen and carbon monoxide (CO). The syngas is cooled and cleaned of any unwanted materials (e.g. ash) and then reacted to convert the CO into CO_2 producing additional hydrogen. This process is capable of converting and recovering a total of 80% of the carbon from the coal as CO_2. The CO_2 is captured from the syngas stream of the gasifier unit and then compressed to a supercritical fluid. Waste generated in the process includes vitrified coarse slag, fly ash, sulphur, sludge from water and waste water treatment and water.

Power is generated by combustion of the high hydrogen syngas in an open cycle gas turbine, although a combined cycle gas turbine could be used as an alternative. A combined cycle power plant (IGCC) is an IGOC plant with additional equipment that raises steam by recovering heat from the open cycle plant's hot exhaust gases to generate additional power using a steam turbine. The combined cycle plant is more energy efficient than an open cycle plant and produces more power per unit of CO_2 emissions but is more expensive than an open cycle plant. The basis of the Project is for an IGOC power station. However, ZeroGen will consider the option of installing an IGCC plant subject to capital constraints.

The compressed CO_2 will be transported by a 220km conventional transmission pipeline to Queensland's northern Denison Trough region (refer Figure 1-1 in the Appendix). This has been identified by the Australian Government as having suitable structures for the storage of CO_2. The area contains significant natural gas deposits that already contain relatively high levels of naturally occurring CO_2 and the region is also seismically stable. Using a series of wells and distribution pipelines, the CO_2 will be injected up to 2km below the surface into saline aquifers for permanent storage.

The key components of the Project will be:

- Gasification Unit – for converting the coal to a cleaned, high hydrogen syngas and will include coal milling, air separation and syngas cleanup units as well as the gasifier;
- Power Block – consisting of a gas turbine adapted for high hydrogen fuel as well as for natural gas;
- Supporting Infrastructure – this will include coal handling, gas metering, water systems, fire detection, waste management and relevant buildings (e.g. control room, laboratory, workshop and warehouse);
- Compression and transportation – including compressors, pumps, pipelines (300mm main line and 150-25mm distribution line), control systems and metering; and
- Injection wells – standard petroleum industry wells using stainless steel materials to reduce the potential for corrosion.

[4] Ibid.

The Project will require up to 700 construction and 125 operational personnel. Construction personnel are expected to be housed in construction camps near the Stanwell Energy Park or along the pipeline route. Operational personnel would live in accommodation in the wider Stanwell and Rockhampton area.

COMMUNITY CONSULTATION

ZeroGen is committed to being a good corporate citizen. ZeroGen views constructive and collaborative stakeholder consultation as essential to the long-term success of the Project. To this end, ZeroGen's community consultation program is guided by a commitment to engage with stakeholders in a transparent and collaborative manner enabling two-way communications between the sponsors and the stakeholders.

The range of two-way communication tools include:

- A dedicated website, www.zerogen.com.au;
- A series of Project fact sheets (available on the website);
- Newspaper advertisements and other media announcements through radio and television;
- Letter box drops;
- A dedicated toll free number -1800 735 044;
- A dedicated toll free fax number- 1800 735 844;
- Email- zerogen@phillipsgroup.com.au and
- Reply paid postal - Reply Paid 105, Fortitude Valley Qld 4006.

Official comment on the Project can be made at two critical points in the EIS process:

- When the draft Terms of Reference (TOR) is released for comment and input; and
- When the Environmental Impact Statement (EIS) is released for public comment.

ZeroGen is keen to hear at any time from stakeholders who have questions or comments. These can be made via the range of communication tools listed above.

POTENTIAL ENVIRONMENTAL IMPACTS AND MANAGEMENT

Considerable information on the terrain, vegetation and hydrology of the Stanwell Energy Park has been acquired through studies for various projects under consideration for the park. In addition, a route selection study has been carried out for the area between Stanwell and the northern Denison Trough. This desktop study encompassed a 70km wide corridor looking at key environmental and terrain constraints. Base data on terrain, vegetation and watercourses has been compiled.

The studies identified areas of potentially dispersive soils, remnant vegetation and protected species. Due to the extensive clearing that has previously occurred in the Stanwell Energy Park there are no key constraints identified with the IGOC site within this area. Pipelines and injection sites have a high degree of flexibility in their location and can therefore avoid most, if not all, key constraints such as protected vegetation and critical habitats.

Key activities that may impact upon the environment include:

- Land clearing and earthworks - this will include approximately 110 hectares for the IGOC plant, 1-2 hectares per injection well site and 30m width of pipeline Right-of-Way (ROW). Clearing of these areas has the potential to expose the land to erosion causing loss of topsoil and sedimentation to waterways. Erosion management will be a key management measure during all phases of construction;
- Sourcing of water for the operation of the IGOC - this will be sourced from the Stanwell Power Station via existing allocations from the Fitzroy River;
- Discharge of water from the IGOC evaporation cooling water system into Neerkol Creek – ZeroGen will discharge water of a quality similar to the existing discharge for the Stanwell Power Station;
- Noise generation – primarily during operations and associated with the IGOC and the compressors for the CO_2;
- Air emissions – again primarily during operation of the IGOC and compressors but also considering dust generation during construction;
- Approximately 700 workers required for construction – potential impacts on accommodation and social infrastructure (e.g. health, education and recreation in the region);
- Transportation of construction and operational materials;
  - Construction - major plant, equipment and line pipe.
  - Operation –230,000 tonnes per annum of coal.
- Infrastructure:
  - Water: 2,000 per annum.
  - Gas: 110TJ per annum, for start up as a support fuel.
  - Electricity: 1-6MW for start-up and operation of compressor sites.

To date the Project has not identified any environmental fatal flaws. The potential impacts on all elements of the environment will be investigated in detail during the EIS and Environmental Management Plans (EMPs) will be drawn up based on the outcome of the EIS studies (refer Table ES-2).

Table ES-2: List of Detailed Environmental Studies Proposed

Discipline	Topic
Engineering	• Detailed Engineering Design • Safety Case for the IGOC Plant • Preliminary Hazard and Risk Assessment to AS2885 (pipeline)
Flora	• Identification of areas of conservation significance (including regional significance) • Rare and Endangered Plant Study • Vegetation Survey of Selected Pipeline Corridor
Fauna	• Identification of areas of conservation significance (including regional significance) • Rare and Endangered Fauna Study • Habitat and Fauna Survey of Selected Pipeline Corridor
Geophysical	• Geology – including risk assessment for sequestration • Terrain and Soil Evaluation • Water Crossing Study
Cultural and Social	• Cultural Heritage and Native Title Studies • Social Impact Assessment • Economic Analysis
General Environmental	• Air Quality Assessment • Construction and Operations Noise impacts • Surface and Ground Water Impacts

PROJECT APPROVALS

Approvals for the Project will include:

- Generation Authority pursuant to the *Electricity Act 1994*;
- Licences for pipeline and sequestration pursuant to the *Petroleum and Gas (Production and Safety) Act 2004* (P&G Act);
- Environmental authorities under the *Environmental Protection Act 1994* (EP Act) for Environmentally Relevant Activities (ERAs);
- Development Permits for Material Change of Use pursuant to the *Integrated Planning Act 1997* for the development of the IGOC; and
- Other permits and approvals as required (e.g. works in a watercourse)

The Project will make a referral to the Australian Government under the *Environment Protection and Biodiversity Conservation Act 1999.*

PROJECT SCHEDULE

Test Drilling commences	2Q 2006
Application for Significant Project Declaration	2Q 2006
Development of EIS Terms of Reference	2Q 2006
EIS Study Commences	3Q 2006
EIS Released for Public Comment	4Q 2007
Regulatory Approvals Granted	2Q 2008
Construction Commences	2Q 2008
Construction Ends	2Q 2010
Plant Commissioning Ends	4Q 2010
Demonstration Commences	1Q 2011
Demonstration Ends	4Q 2020

ZeroGen has been structured to reduce risk and provide exit opportunities. The decision to proceed with the Project is dependent on a number of factors such as the results of the test drilling program which provide a critical go/no go decision point. Other factors include the successful completion of the EIS and cultural heritage and Native Title negotiations that provide the relevant government approvals. The Project is also dependent on ZeroGen being able to secure funding and approval from the Board of ZeroGen Pty Ltd and its Shareholding Ministers.

1.0 INTRODUCTION

1.1 Project Overview

ZeroGen Pty Ltd is proposing to build and operate a world-first demonstration plant that integrates the gasification of coal with the capture and safe storage of carbon dioxide (CO_2) emissions to generate low emission base-load electricity. Base-load electricity is the minimum amount of electric power delivered or required over a given period of time at a constant rate. Base-load generators supply electricity almost continuously to provide power to maintain essential services such as hospitals and street lighting and energy intensive industrial processes such as manufacturing and minerals processing. It also enables Queensland citizens and families to use their electrical appliances almost continuously.

The Project is seeking declaration as 'significant project' under Section 26 of the *State Development and Public Works Organisation Act 1971* (SDPWO Act) based on the information provided in this Initial Advice Statement (IAS) and summarised in Table 1-1. Declaration will require an Environmental Impact Statement under Part 4 of the SDPWO Act.

Table 1-1: Items for Consideration in Determining Declaration as a Significant Project

Item for Consideration	Reason
IAS	Information in this IAS in relation to the nature of, the reason for and the potential impacts of the Project and due to the high level of stakeholder interest in carbon storage.
Planning Schemes or Policy Framework	The Project will encompass the Planning Schemes for 4 local authority areas. The Project will support government policies such as: • Queensland Government's Smart State Strategy 2005-2015, by developing clean coal technologies • Queensland Government's Greenhouse Strategy, objective to reduce greenhouse emissions and facilitate carbon sequestration. • Australian Government's Securing Australia's Energy Future.
Potential Effect on Relevant Infrastructure	Infrastructure requirements will include the need for: • Water: 2,000 Megalitres (ML) per annum. • Gas: 110 Terajoules (TJ) per annum for start up and as a support fuel. • Electricity: 1-6 Megawatts (MW) for start up and operation of compressor sites. Extent of negotiations with infrastructure providers including: Powerlink, Main Roads, Queensland Rail, Telstra, Ergon Energy and possible water authorities.

Item for Consideration	Reason
Employment Opportunities	The Project has the potential to provide direct employment for up to 700 construction and 125 operational personnel. In addition the Project will provide incentive for additional employment development.
Potential Environmental Effects	The potential environmental impacts including land clearing, water usage, waste disposal and noise and air emissions. Environmental benefits would include: • Reductions in pollution due to higher energy efficiency in electricity generation; and • Enhanced capture of other air pollutants through coal-based gasification technology.
Complexity of local, State and Australian Government requirements	Applicability of existing legislation to manage the interaction of the available technologies. Negotiations with at least 4 local authorities. Variety of land tenures associated with the pipeline and carbon storage including: freehold, leasehold, crown reserves, state lands, existing easements, mining tenures. Numerous environmental approvals and licences from agencies such as the Environmental Protection Agency (EPA), Department of Natural Resources, Mines and Water (NRMW) and Department of Primary Industries and Fisheries (PIF). Potential Australian Government involvement through the EPBC Act. Negotiations with up to 6 Traditional Owner representative groups concerning Native Title and Cultural Heritage. Negotiations with approximately 70 landholders.
Investment requirements	Financial feasibility will depend on a range of funding sources both private and government.
Strategic Significance of the Project	Potential for significant reductions in greenhouse gas (GHG) emissions as a result of electricity generation using coal as a fuel source. Preserving Australia's and particularly Queensland's relatively low cost, reliable base-load electricity generation whilst reducing the effects of GHG. Accelerating the commercial deployment of clean coal technology both within and outside Australia.

The Project consists of two main segments: a coal-based gasification plant and the capture and safe storage of CO_2 in deep saline aquifers. The capture and safe storage of CO_2 is generally known as carbon capture and storage (CCS).

The gasification plant will produce hydrogen rich fuel from pulverised coal by chemically converting the coal to syngas consisting of hydrogen and CO_2. The hydrogen rich component of the syngas will be used to drive a gas turbine to generate electricity. The gasification plant may be an Integrated Gasification Open Cycle (IGOC) or Integrated Gasification Combined Cycle (IGCC) plant. A combined cycle power plant is an open cycle power plant with additional equipment that raises steam by recovering heat from the open cycle plant's hot exhaust gases to generate additional power using a steam turbine. The combined cycle plant is more energy efficient than an open cycle plant and produces more power per unit of CO_2 emissions but is more expensive than an open cycle plant. The basis of the project is for an IGOC power station but an IGCC plant will be considered as a technology option subject to capital constraints.

The CO_2 will be separated, captured, transported and injected for safe storage in deep saline aquifers in the northern Denison Trough. Carbon dioxide is the fourth most abundant naturally occurring gas in the world. It is a part of our everyday lives as we expel it from our bodies when we exhale and plants use photosynthesis to convert it to sugars and other energy. Commercially there are many applications for CO_2 but the most common are dry ice, carbonated water, soft drinks and beer. It is not explosive and is not flammable. However, like natural gas, very high concentrations of CO_2 in a confined space may prevent respiration.

Carbon dioxide occurs naturally in reservoirs underground and is commonly present in natural gas and oil fields. The Emerald/Springsure region is located in geological terms in an area called the northern Denison Trough which the Australian Government has investigated for its suitability to safely store CO_2 for a number of years. These studies have identified the northern Denison Trough as an ideal test site as it is a sedimentary basin that has safely and securely trapped and stored large volumes of CO_2 and natural gas for millions of years. The area also has a very low level of seismic activity.

It is proposed that the gasification plant will be located at the Stanwell Energy Park near Rockhampton in Central Queensland (refer Figures 1-1 and 1-2 in the Appendix). The captured CO_2 will be transported approximately 220 kilometres west by a buried conventional gas transmission pipeline to the northern Denison Trough. From here the CO_2 will be injected into saline aquifers for safe storage up to two kilometres below the ground surface, using drilling technology available in the natural gas industry (refer Figure 1-3 in the Appendix). The CO_2 stream for the CCS element of the project will be sourced from the purpose built IGOC plant. It will not involve capturing and storing CO_2 emissions from the existing Stanwell Power Station.

ZeroGen Pty Ltd believes that there are a range of key national, state and regional public benefits to be achieved from undertaking the ZeroGen Project. At base, the integration of these available technologies by ZeroGen may enable Queensland to use its hundreds of years of coal supply to generate base-load electricity for use by businesses, hospitals, communities and families with almost zero GHG emissions. There is the potential to also develop the knowledge from the integration of these technologies into new enterprises either for domestic application or for export to other countries that want to use coal to generate electricity but with reduced GHG emissions. If this is achievable, the technologies demonstrated by ZeroGen may also sustain the future of Queensland's significant export thermal coal industry. The benefits of the Project are detailed in Section 3.0.

1.2 Purpose and Scope of Document

The purpose of this IAS is to:

- Assist the Coordinator-General to make a decision on a declaration of the project as a 'significant project' under Section 26 of the *State Development and Public Works Organisation Act 1971* which would initiate the statutory impact assessment procedures of Part 4 of the Act;
- Provide information to stakeholders to assist them to determine the nature and level of their interest in the project; and
- Enable the preparation of Terms of Reference (TOR) for the Project's Environmental Impact Statement (EIS).

This IAS is intended to scope the potential impacts that will be investigated in detail prior to the Project being granted appropriate approvals. Terms of Reference for the EIS will be developed based on the potential impacts outlined in this report and the requirements of relevant government agencies and other stakeholders through a public consultation process. An EIS and associated EMP will be prepared as part of the approvals process.

1.3 Project Proponent

The Project will be undertaken by ZeroGen Pty Ltd, which is currently a subsidiary of Stanwell Corporation Limited (Stanwell). It is envisaged that in the near future ZeroGen will be transferred to a Project Board and that Stanwell will be engaged to provide ZeroGen Pty Ltd with all services related to the Project. Stanwell is a Queensland Government-Owned-Corporation (GOC) that owns and operates electricity generation facilities which represent about 20% of the State's installed capacity. In addition to its major coal-fired asset in Central Queensland, Stanwell has a significant renewable energy portfolio of hydro and wind powered stations located in Queensland's north and south-east and in Victoria. Stanwell is also working with Griffin Energy to construct a wind farm in Western Australia.

ZeroGen will also involve other major participants including major generating research organisations and equipment and service providers. The project has been peer reviewed and has received the endorsement of the United States of America based EPRI which is the world's largest power generation research body. International companies such as Royal Dutch Shell plc, a global CO2 sequestration leader, and Shell Global Solutions International BV are also involved in providing technical advice and technological components. These organisations are substantial international businesses that have significant financial strength and expertise with a keen commercial interest in advancing the technologies being demonstrated by ZeroGen. Leading Australian organisations such as the Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC) have also provided project peer reviews.

1.4 Financing

The financial feasibility of the Project will depend on a range of funding sources including the Queensland and Australian Government funds to tackle climate change, the coal industry and potential overseas equity partners.

As stated above, ZeroGen is a demonstration project. In the research continuum, demonstration projects are generally the pre-cursor to full commercial deployment and industry uptake. As a result, ZeroGen is not competitive relative to traditional coal-fired power stations, for example, in the National Electricity Market (NEM). A small amount of electricity will be generated for sale in the NEM. However, the exact output will be dependent on whether an open cycle power plant or a combined cycle power plant is used.

1.5 The Sites

1.5.1 Gasification Plant

The gasification plant will be located in the Stanwell Energy Park adjacent to the existing conventional coal-fired Stanwell Power Station in Central Queensland (refer Figure 1-4 in the Appendix). The site was selected because of a range of factors. These include access to:

- Existing hard infrastructure such as coal transport and handling systems, good quality roads, the airport and the electrical transmission network;
- Essential services such as water;
- Coal from the Bowen Basin;
- Soft infrastructure such as skilled workers, commercial facilities, medical services and accommodation facilities for workers; and
- Proximity to the northern Denison Trough as a site to safely store the captured CO_2.

1.5.2 Carbon Capture and Storage

The northern Denison Trough has been selected as the proposed location for the safe storage of the CO_2 (refer Figure 1-5 in the Appendix). This location has been selected based on a number of scientific studies by the Australian Government and expert geological consultants[5] that show that the northern Denison Trough has the potential to provide long-term and secure storage of large volumes of CO_2.

The northern Denison Trough contains geologic structures that have trapped natural gas and naturally occurring CO_2 for millions of years. Indeed, the region's natural gas fields such as Arcturus and Turkey Creek contain approximately 34% CO_2. As an example of the region's geological storage potential, the region's natural gas fields have produced approximately 35.9 million barrels[6] of oil equivalent (or approximately 2.6 million barrels of oil equivalent per annum). The very low level of seismic activity in the northern Denison Trough also is a factor in this region being selected.

Proving the potential of safely storing CO_2 in deep saline aquifers in the northern Denison Trough is one of the key objectives of ZeroGen. To achieve this, ZeroGen's phase 1 test drilling program which commenced in June 2006 after having received the relevant regulatory approvals. This test drilling program is one of the most advanced CCS projects associated with power generation in Australia and involves drilling three wells located approximately 50km northeast of Springsure, south of Emerald.

A corridor study[7] for a transmission pipeline to transport the CO_2 from the gasification plant to the northern Denison Trough has been carried out with the objective of locating an optimal route for detailed study (i.e. study route). The study route (refer Figure 1-6 in the Appendix) has been

---

[5] Northern Denison Trough CO_2 Storage Site Results of Reservoir Modelling, MBA Petroleum Consultants (MBA), July 2005.

[6] One barrel of oil is equivalent to approximately 160 litres

[7] Stanwell to Denison Trough CO_2 Pipeline Corridor Study, Resource Land Management Service (RLMS), March 2005

selected based on avoidance of major terrain and environmental constraints which impact on project economics. During the EIS process, and through engineering design and cultural heritage surveys, the route will be further refined. A guiding principle in this process will be the avoidance of significant environmental and cultural heritage sites, where practicable.

The mechanical design of the pipeline will be based on *AS 2885-1997 Pipelines Gas and Liquid Petroleum*. This pipeline will be engineered to safely transport CO_2 at approximately 12,000 kPa to the sequestration location before being boosted to approximately 17,000 kPa for injection.

2.0 PROJECT RATIONALE

2.1 Greenhouse Gas Emissions and Climate Change

The objective of ZeroGen is to demonstrate technologies that can address the challenge of reducing GHG emissions to atmosphere from coal-fired base-load electricity generation. This is described in more detail below.

2.1.1 Why do we need to be concerned about GHG emissions and climate change?

There is growing consensus among citizens, governments, non-government organisations, academic researchers and industry both in Australia and overseas that human-induced GHG emissions are contributing to climate change. Greenhouse gas emissions are of concern because they affect the way sunlight and heat enter and leave Earth's atmosphere. Greenhouse gases tend to trap heat in the atmosphere potentially leading to an increase in the Earth's overall temperature which, as is widely believed, can lead to climate change.

The Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) has predicted[8] that impacts of temperature increase to Australia may result in:

- Reduced rainfall in current agricultural producing areas;
- Reductions in native pasture growth;
- Reduction in snow-covered areas in the Australian Alps;
- Greater climatic variability and more extreme weather events; and
- Bleaching and damage to the Great Barrier Reef.

Recognizing the potential problems caused by climate change, the World Meteorological Organization and the United Nations Environment Programme established the Intergovernmental Panel on Climate Change[9] (IPCC) in 1988. The IPCC recently prepared a special report[10] highlighting the fact that the CCS process offers significant potential to enable "deep" cuts in GHG emissions. Deep cuts are radical or dramatic reductions in CO_2 emissions, for example, 60% by 2050.

The Australian Government also established the Australian Greenhouse Office (AGO)[11] and recently provided $500 million for the Low Emissions Technology Demonstration Fund (LETDF)[12] to encourage the commercial uptake of low emission technologies. The Queensland Government has also released its Greenhouse Strategy[13] and on 26th April 2006 announced a $1 billion fund to tackle climate change.

---

[8] Climate Change Impacts on Australia and the Benefits of Early Action to Reduce Global Greenhouse Gas Emissions, A consultancy report for the Australian Business Roundtable on Climate Change Preston, B.L. and Jones, R.N. February, 2006

[9] http://www.ipcc.ch/

[10] http://arch.rivm.nl/env/int/ipcc/pages_media/SRCCS- final/IPCCSpecialReportonCarbondioxideCaptureandStorage.htm

[11] http://www.greenhouse.gov.au/

[12] http://www.greenhouse.gov.au/demonstrationfund/

[13] http://www.epa.qld.gov.au/publications?id=1246

Industry has also recognised climate change as an important issue. The Australian Coal Association announced on the 16th March 2006 that it would establish the Coal21 Fund[14] that aims to raise in the order of $300 million over the next five years to support the implementation of the COAL21 National Action Plan This Plan includes research, development and demonstration of clean coal technologies. On the 7th April 2006, six Chief Executive Officers of major Australian companies (i.e. Westpac, IAG Insurance, Origin Energy, BP Australasia, Visy Industries and Swiss Re) also released a report calling for early action to reduce GHG emissions.[15] The insurance industry in particular is concerned about climate change as weather and climate are part of their core business. The industry's ability to calculate, price and spread weather-related risk is reduced by a changing and less predictable climate.[16]

2.1.2 What are Greenhouse Gases and in particular CO_2?

Many gases exhibit 'greenhouse' properties. Some of them occur in nature (i.e. water vapour, CO_2, methane and nitrous oxide), while others are exclusively human-made (e.g. hydrofluorocarbons). Carbon dioxide emissions have been the most significant contributor to human-induced GHG emissions since the industrial revolution. Carbon dioxide is the fourth most abundant naturally occurring gas in the world and is made up of one carbon and two oxygen atoms. It occurs as a result of burning organic matter (e.g. coal, natural gas or wood fuels) in the presence of oxygen. It can also be produced by the decomposition and fermentation of certain organisms and through respiration from living organisms (e.g. humans, animals and plants).

Carbon dioxide occurs naturally underground and is found in natural gas and oil fields such as Turkey Creek and the Arcturus fields in the northern Denison Trough. Often, the presence of high levels of CO_2 in natural gas fields renders gas extraction uneconomic.

As stated previously, CO_2 is used commercially in the production of a range of goods consumed today. These include carbonated drinks such as water, 'soft drinks', and beer, a refrigerant (i.e. in its solid state as dry ice) and fire extinguishers. In many areas CO_2 is found naturally in the form of carbonated water and there is one beverage bottling plant in Victoria that uses the naturally occurring CO_2 found in geologic structures to produce soft drinks.

2.1.3 What is the largest source of CO_2 emissions?

Research by various government bodies has shown that "the production and use of energy is Australia's largest source of greenhouse gas emissions."[17] According to the Australian Greenhouse Office, the energy sector accounted for 68% of the GHG emissions generated in Australia in 2002 and this figure is likely to increase to 71% by 2020. The energy sector incorporates stationary sources such as power stations, manufacturing industries and petroleum refining, fugitive emissions and transport. The largest GHG contributor in the energy sector is electricity generation from stationary sources.

---

[14] http://www.deh.gov.au/minister/env/2006/mr16mar206.html

[15] The Australian, Korporaal, G. and Trounson, A. CEOs in Call for Greenhouse Action, 7th April 2006.

[16] The Impact of Climate Change on Insurance against Catastrophes, 2003, Coleman T. Chief Risk Officer and Group Actuary, Insurance Australia Group.

http://stephenschneider.stanford.edu/Publications/PDF_Papers/IAG-Climate_Change_Paper.pdf

[17] Low Emissions Technology Demonstration Fund (LETDF), Statement of Challenges and Opportunities, Australian Government

2.2 The Need for Technological Solutions to Enable "Deep" Cuts in GHG Emissions

Since the industrial revolution, there has been a significant and sustained increase in global atmospheric CO_2 levels. An increase in the global average temperature of 0.7 degrees Celsius has occurred since the turn of last century (refer Figure 2-1 in the Appendix). According to the IPCC, most of the warming observed over the last 50 years is attributable to human activities.

Many scientists argue that due to the historic build-up of human-induced GHG emissions in the atmosphere since the industrial revolution, radical or "deep" cuts in GHG emissions are required. Furthermore, these scientists suggest that these deep cuts are required sooner rather than later. Indeed, the Australian Government's LETDF targeted technologies capable of reducing GHG emissions for commercial deployment between 2020-2030[18].

All stakeholders can play a significant role in reducing GHG emissions. Electricity consumers for example can reduce GHG emissions by being more efficient in their use of power thereby reducing the overall demand for electricity. Electricity generators can increase generation from renewables such as solar, wind and hydro that do not emit GHGs and explore alternative technologies such as clean coal to reduce emissions.

A key disadvantage of renewable electricity generation is the fact that variability in weather events such as rain and wind speed limit their capacity to supply electricity continuously as required for base-load. There are also sometimes significant environmental and stakeholder issues with the construction of new dams or wind farms that create industry and financial uncertainty. Also, given that 78% of Australia's total electricity generation in 2001 was supplied by coal, there are limited opportunities to transition to an electricity supply mix based on renewables in the short-term.

The technologies being demonstrated by ZeroGen offer the potential to achieve "deep" cuts in GHG emissions. ZeroGen's demonstration of coal-based gasification and CCS offers the potential to produce base-load electricity with CO_2 intensities significantly less than traditional coal-fired power stations and equal to or significantly less than natural gas depending on scale and power plant configuration. The gasification plant's production and use of hydrogen rich syngas to generate electricity also provides a pathway to the hydrogen economy. The by-product of burning hydrogen is water.

To facilitate "deep" cuts in CO_2 emissions the technology must be deployed on a large scale. However, the full integration of all components of coal-based gasification and CCS has not yet been undertaken anywhere in the world. In addition, technical advances are required to reduce costs and improve operating efficiencies before the technology can be competitive relative to traditional coal-fired generating plants. To prove the integration of the technology, and thereby open the way for accelerating the commercial uptake of coal-based gasification and CCS, ZeroGen Pty Ltd has commenced this Project.

[18] http://www.greenhouse.gov.au/demonstrationfund/

3.0 PROJECT BENEFITS AND COSTS

This section considers the Project's benefits and costs.

3.1 Benefits

3.1.1 National Economic

Using the Tasman Global Computable General Equilibrium model,[19] ACIL Tasman has estimated the impact of the commercial deployment of the technologies being demonstrated by ZeroGen. ACIL used a reference case that assumes an emissions saving target for the Australian electricity generation industry of 30 million tonnes per annum CO_2 by 2030.[20] Two Technology Scenarios have been tested against the Reference Case:

- ZeroGen accelerates the uptake of coal-based gasification with CCS; and
- Coal-based gasification with CCS technology is not commercial before 2030.

For the case where ZeroGen accelerates the uptake of coal-based gasification with CCS technology[21] the economic benefits[22] for Australia would include an annual Gross Domestic Production (GDP) increase worth about $1.1 billion per annum in today's dollars by 2030. The net present value of the GDP increases through to 2030 is some $3.3 billion, which is made up of, amongst other items:

- An average 1.1% reduction in the wholesale cost of electricity generation over the period 2015 to 2030;
- A $1.9 billion reduction in the total cost of generation over the period to 2030, with a present value cost saving of $540 million;
- Avoided capital costs of generation of up to $360 million per year during the technology deployment phase, as a result of having access to the technical knowledge arising from the demonstration program; and
- An increase in coal exports of 2.1% in 2030 valued at about $800 million per annum in today's dollars, helping to maintain the value of Australian coal resources (conservatively worth $100 billion), as well as minerals and metals such as bauxite, copper, iron ore, magnesium, nickel, silver, lead, zinc and mineral sands that require energy intensive processes to transform them into products.

The case for non commercial before 2003 is discussed in Section 3.2.

---

[19] ACIL Tasman, 2006, Project Stanwell – An Economic Benefit Analysis of the Proposed Stanwell IGCC-CCS Demonstration Project, February, pA1-A7

[20] Ibid, Executive Summary

[21] Assuming up to five years acceleration in uptake of the technology and improved "learning curve" of operation by halving the gap between initial and final levels of plant availability,

[22] Ibid, Executive Summary

3.1.2 Regional Economic Development

The ZeroGen demonstration Project will involve significant economic activity in the Central Queensland region. Over the 15 years of the Project construction and operation, regional expenditure will likely boost regional incomes, consumption and employment.

ACIL Tasman estimates that at the peak of construction in 2009/10, the Fitzroy economy is estimated to be between $185 million and $251 million larger than without the Project and employment in the region is predicted to be 1,488 to 2,147 higher.[23]

The impact of the operating phase of ZeroGen was estimated for Queensland and the region of Fitzroy. Employment in the Fitzroy region in 2019/20 is anticipated to be between 396 and 552 higher than if the Project does not occur.[24] This represents the peak impact.

On balance, it should be expected that the operations phase of ZeroGen may have a small positive impact (up to $17 million) on the value-added of the Queensland economy.[25] However, ZeroGen will have a strong positive employment impact on the Queensland economy. Job creation will peak in 2019/20 when employment growth will be 464 to 758 higher than without the Project.[26]

3.1.3 Preserving the Value of Australian Resources

Australia's coal and minerals industries[27] rely on relatively low cost, reliable base-load electricity to be internationally competitive. These industries account for:

- Eight per cent of the Australian economy as measured by GDP, currently amounting to about $75 billion per annum;
- More than 40% of merchandise exports and 30% of total exports of goods and services, currently worth around $65 billion per annum;
- Employment, directly and in dependent activities, of over 330,000 people throughout Australia – many of them in regional and remote areas;
- Exports of relevant mining technology, equipment and services valued at approximately $2 billion per annum (e.g. 60% of the mining software used in operations around the world is exported from Australia);
- Around 24% of private new capital expenditure in Australia;
- Total government revenue payments of $4.6 billion per annum; and
- Significant infrastructure development – since 1967 the sector has built 26 towns, 12 new ports and additional port bulk handling infrastructure at many existing ports, 25 airfields and over 2,000 kilometres of railway line.

[23] Ibid, p34

[24] Ibid, p35

[25] Ibid, p35

[26] Ibid, p36

[27] Ibid, p28

3.1.4 Significant Cuts in Greenhouse Gas Emissions

Modelling by ACIL Tasman[28], estimates that there is potential for coal-based gasification with CCS to provide about 21% of total Australian electricity generation by 2030. This suggests that the technologies proposed by ZeroGen, if commercially deployed, have the potential to far exceed the 2% emissions cut required by the Australian Government through its LETDF.

The CO_2 intensity of an electricity generation facility can be expressed in terms of kg CO_2 per MWh of power exported from the facility. An indicative CO_2 intensity path for ZeroGen is provided in Table 3-1.

Table 3-1: Indicative CO_2 Intensity Path

Power Generation Facility	CO_2 Intensity (kg CO_2/MWh)
Conventional Coal-Fired Plant	~ 910
Conventional Open-Cycle Gas Turbine	~ 616
Proposed ZeroGen Demonstration Facility (IGOC Configuration)	~ 580
Conventional Combined-Cycle Gas Turbine	~ 400
Proposed ZeroGen Demonstration Facility (IGCC Configuration)	~ 350
Fully Commercial IGCC Facility	~ 100 to 150

The data in Table 3-1 reveals that the knowledge gained from the development of ZeroGen has the potential to produce base-load electricity using coal that enables "deep" cuts in CO_2 emissions to atmosphere. The current demonstration Project configuration produces base-load electricity with a CO_2 intensity approximately 30% less than a conventional coal-fired plant. If an IGCC configuration is adopted, it can be seen that ZeroGen can produce base-load electricity with a CO_2 intensity that is approximately 66% less than a conventional coal-fired plant.

The data in Table 3-1 also reveals that at full commercial scale and assuming an IGCC configuration, the technologies being demonstrated by ZeroGen have the potential to generate base-load electricity with a CO_2 intensity approximately 80% less than conventional coal-fired plants. The technology can also generate base-load using coal with between 25% and 33% of a combined cycle gas fired power plant.

3.1.5 Accelerating the Commercial Deployment of the Technology

One of the key objectives of ZeroGen is to facilitate the commercial uptake of the technologies, which it is demonstrating, by the electricity generating industry. Before commercialisation can occur the technologies need to be integrated and proven, the ability to safely store CO_2 needs to be validated and technical advances (particularly in coal gasification components) need to occur that drive efficiencies and cost reductions. In addition, other crucial issues need to be addressed before the technologies can be commercialised including a value being placed on CO_2 and policy and regulatory certainty.

---

[28] ACIL Tasman, 2006, Project Stanwell – An Economic Benefit Analysis of the Proposed Stanwell IGCC-CCS Demonstration Project, February.

As stated, ZeroGen is the first project in the world to integrate coal-based gasification and CCS. Other projects around the world utilise individual technology elements (refer Figure 3-1 in the Appendix) but none to date have combined them in one project at commercial-scale. The FutureGen project in the United States of America is currently in the process of seeking a site.

The value of ZeroGen can be seen in statements made by the United Kingdom House of Commons Science and Technology Committee[29] that recently wrote:

"Most of the technology is already proven and available but there is a lack of experience in integrating the component technologies in single project at the scale required. Multiple full scale demonstration projects using different types of capture technology and storage conditions are urgently needed."

ZeroGen will contribute significantly to developing experiences that will reduce the risks of deploying this technology in an Australian environment. The CCS element of the Project is well advanced and test drilling commenced in June 2006 to gather data to validate computer modelling that suggests the northern Denison Trough is able to safely and securely store CO_2.

Coal-based gasification is presently uncompetitive compared to conventional coal-fired power stations particularly in the absence of a CO_2 price or abatement policy. However, the EPRI, via the Coalfleet for Tomorrow initiative suggests that over the next two decades there is a targeted technology roadmap for plant improvements that reduce capital costs (refer Figure 3-2 in the Appendix). The experiences gained by ZeroGen, particularly in an Australian operating environment, will significantly contribute to enhancing these technology improvements.

A fundamental obstacle to the commercial uptake of the technologies demonstrated by ZeroGen is the absence of an appropriate value for CO_2 not just in the short-term but in the long-term as the economic life of power plants is often in excess of 30 years. Leading commentators such as Professor Warwick McKibbin (Professor of International Economics at the Australian National University and Board Member of the Reserve Bank of Australia) have frequently stated that the technologies capable of cutting GHG emissions such as that being demonstrated by ZeroGen will not be commercially viable until a value is placed on CO_2.

Given that ZeroGen is a first-of-kind project in the world, policy and regulatory uncertainty will significantly affect not only the Project but the commercialisation potential of the technology. One of the benefits of ZeroGen will be to identify and resolve these issues early and through the development of shared experiences and learnings, enhance its commercialisation potential.

3.1.6 New Industry Development

The core technologies, such as the gas turbine involved with ZeroGen, are likely to be imported. However, combined implementation of the technologies is new and there is much scope for refining the existing technologies to suit the requirements of electricity generation in an Australian setting.

The opportunities for Australian industry include:

- Development and diffusion of knowledge and skills associated with integrating coal-based gasification with CO_2 capture, transportation and storage processes; and

[29] House of Commons Science and Technology Committee, 2006, Meeting the UK Energy and Climate Needs: The Role of Carbon Capture and Storage. First Report of Session 2005-06, Volume 1. United Kingdom.

- Development of services associated with storage of CO_2 in sedimentary basins, including injection and monitoring.

Australian and international coal mining and electricity generation service companies are the logical vehicles to take these new services forward domestically and in export markets. In the case of Australian companies they have already achieved exports of mining technology, equipment and services of approximately $2 billion per annum, with 60% of the mining software used in operations around the world being sourced from Australia.[30]

3.1.7 Supporting Government Policies

In addition to the Project sustaining the viability of coal-industry related jobs and creating significant new jobs, it will provide in-principle support and, where practicable, implement a range of government policies and strategies at the local, state and national level. These include:

- Developing clean coal technologies as articulated by the Queensland Government's Smart State Strategy 2005-2015;
- Implementing the Queensland Government's Greenhouse Strategy and the specific objective of "reducing greenhouse gas emissions and facilitating (sic) carbon sequestration."
- Implementing the Queensland State Government Building and Construction Contracts – Structured Training Policy (10% Policy);
- Supporting, where practicable, the Indigenous Employment Policy for Queensland Government Building and Civil Construction Projects (20% Policy);
- Supporting the Australian Government's "Securing Australia's Energy Future" energy policy; and
- Supporting various regional and local government sustainable development strategies.

3.1.8 Facilitating Australian Research and Development

ZeroGen will lower the expected costs of adopting lower emission technology relative to other abatement opportunities through:

- Reducing the lead-time for adoption through social acceptance, resolution of regulatory frameworks and increased knowledge of technologies;
- Reducing perceived technology risk which, given the high capital intensity of the technology, is likely to significantly reduce the cost of financing commercial deployment; and
- Improving the availability of plant and management processes, by enabling better anticipation of design and operational issues associated with specific conditions of operation, including:
  - Fuel performance in gasification;
  - Slagging;

[30] ACIL Tasman, 2006, Project Stanwell – An Economic Benefit Analysis of the Proposed Stanwell IGCC-CCS Demonstration Project, February, p30

- o CO2 pipeline operation risks; and
- o Storage, injection and monitoring in geological structures that are not depleted oil or gas reservoirs.

As stated in Section 3.1.5, there are several facilites around the world that demonstrate various components of power generation and CCS processes (refer Figure 3-1 in the Appendix). However, ZeroGen will be the first in the world to implement a fully integrated power generation and carbon storage process.

3.1.9 Other Environmental Benefits

Aside from the benefits associated with GHG emission abatement, other environmental benefits of the technologies proposed by ZeroGen are likely to include:

- Reductions in pollution by solid and gaseous waste through the development of coal-based gasification technology leading to higher energy efficiency in electricity generation; and
- Enhanced capture of other air pollutants through coal-based gasification technology.31

3.1.10 Pathway to Hydrogen Economy

A major benefit of coal gasification plants is the ability to co-produce hydrogen as well as electricity. This co-production ability could contribute significantly to the introduction of hydrogen for use in transport fuels and, potentially, provide a feed stock for the manufacture of liquid fuels based on coal as the energy source. This would be a step on the pathway to a hydrogen economy.

3.1.11 Australia's Energy Security

Queensland has significant coal reserves that have the potential to supply the state with many hundreds of years of electricity supply. Unlike other regions or countries that are dependent on importing energy, Queensland families, communities and businesses have a high degree of energy security. This is likely to be maintained into the future through the use of clean coal technologies such as that being demonstrated by ZeroGen. In addition, the technologies being demonstrated by ZeroGen may enable the production of liquid and hydrogen fuels from coal that may also reduce Australia's reliance on oil imports. This further enhances the nation's fuel security.

3.2 Costs

Assuming the technologies being demonstrated by ZeroGen are not proven commercial before 2030 ACIL Tasman's modelling shows the economic costs[32] for Australia, when compared to the Reference Case, are an annual GDP reduction worth about $3.65 billion per annum in today's dollars by 2030; the net present value of the GDP reduction through to 2030 is some $5.8 billion, which is made up of, amongst other items:

---

[31] US Government Subcommittee on Clean Air, Wetlands and Climate Change, Hearing On Compliance Options for Electric Power Generators, January 29, 2002, Testimony of Edward Lowe, Gas Turbine-Combined Cycle Product Line Manager, General Electric Power Systems, p3-4

[32] ACIL Tasman, 2006, Project Stanwell – An Economic Benefit Analysis of the Proposed Stanwell IGCC-CCS Demonstration Project, February, Executive Summary

- An average 2.6% increase in the wholesale cost of electricity generation over the period 2015 to 2030;
- A $4.8 billion increase in the total cost of generation over the period to 2030, with a present value of $1.2 billion; and
- Reduced coal exports of 1.8% in 2030 valued at almost $2 billion.

4.0 PROJECT DESCRIPTION

This Section provides a description of the Project's key components including the gasification plant, pipeline and carbon storage wells.

4.1 Project Alternatives

4.1.1 Technology

Power plant technologies that include gas turbine combined cycle, nuclear, renewables and supercritical coal can produce electricity with less CO_2 emissions than the current generation of coal fired pulverised fuel power plants. However, they have some distinct disadvantages including:

- Gas turbine combined cycle plants using natural gas as a fuel are restricted in their large-scale deployment due to the limited availability of the very significant quantities of natural gas required at competitive prices;
- Nuclear power plants can deliver electricity with no air emissions from their operation but have significant other issues within Australia that preclude their current deployment. These include stakeholder concerns about waste storage, costs and the fact that in some states such as Queensland nuclear power generation is not a part of the government's energy policy;
- Electricity generation from renewable energy also produces electricity with no air emissions. However, they are limited either due to their cost, regulatory uncertainty or ability to provide significant base-load power when it is required; and
- The coal fired options in Australia have access to sufficient fuel but have the environmental disadvantage of higher CO_2 emissions. This disadvantage can be removed by the commercial uptake of the clean coal technologies such as that being demonstrated by ZeroGen.

4.1.2 Location

Gasification Plant

The location study for the gasification plant considered six sites across two general locations:

- Central Queensland:
  - Stanwell Energy Park Site;
  - Blackwater Coal Mine Site; and
  - Gladstone Coastal Site;
- Southern Queensland:
  - Tarong Power Station Site;
  - Millmerran Power Station Site; and
  - Kogan Creek Power Station Site.

Factors considered in determining the location of the plant included the potential for capital cost reductions due to modularised construction, reduced coal feed costs due to mine mouth location, carbon storage site proximity, access to water, rail, skilled labour and soft infrastructure including retail, accommodation and medical services. The analysis found that the Stanwell Energy Park and proximity to the Stanwell Power Station was an appropriate location meeting all the relevant criteria.

CO_2 Pipeline

An initial corridor study for a pipeline from the Stanwell Energy Park to the northern Denison Trough has been carried out to enable the selection of a study route for the main transmission pipeline. This study route has been selected based on an assessment of the key constraints and the selection criteria that involved a range of considerations, including:

- Terrain constraints;
- Land tenure;
- Native Title;
- Cultural Heritage;
- Land use;
- Mineral and petroleum exploration and mining activity;
- Ecological sensitive areas;
- Protected areas; and
- Crossings of other infrastructure and watercourses.

Seven significant route definition considerations stand out from this study including:

1. Blackdown Tablelands National Park and the surrounding mountainous terrain;
2. Constraints in active mining areas and their significant related infrastructure;
3. Assessment of cropping areas north east of Duaringa and on the Comet Downs over the northern Denison Trough;
4. The possibility of utilizing Postman's Gap and crossing Blackwater Mine;
5. The crossing of Dawson, Expedition and Shotover Ranges;
6. Potential complications in the use of the Capricorn Highway Transport Corridor (i.e. future expansions and realignments of the highway, electrification of the railway, location of optic fibre cable); and
7. Final terminus point.

Based on a review of these criteria a study route has been established (refer Figure 1-6 in the Appendix). The proposed route extends due west of the Stanwell Energy Park via the town of Blackwater and south west from the town of Comet for a distance of approximately 220km. The route avoids open cut coal mines (e.g. Blackwater) and mapped areas of remnant 'endangered' and 'of concern' regional ecosystems and vegetation communities (e.g. Expedition Range, Taunton National Park and the Duaringa, Walton, Arthurs Bluff and Amaroo State Forests). The study route will be further refined based on the EIS studies, cultural heritage surveys, land access and engineering design requirements.

CO_2 Storage

The most likely number of CO_2 injection wells is estimated to be 16, with the possibility of up to 24 being required depending on the storage capacity of the saline aquifer and capital costs. With a spacing of 3km between wells, the distribution system from the main pipeline outlet to the wells will extend over a distance of 48km to 72km.

A corridor study will be conducted on the distribution network when the final location of the injection wells is decided. The final well locations will be decided based on the results of the test drilling and exploration program. This is because the exact location of the wells will not be known until the data from the test drilling program is analysed. However, topographical and environmental maps of the area have been reviewed to ensure that no significant issues are likely to be encountered. The location of the injection wells will also take into consideration areas or sites of cultural heritage.

4.2 Project Components

4.2.1 Gasification Plant

The plant will take solid coal feedstock and convert this to a hydrogen-rich syngas, which will then be processed for use as fuel for the open cycle gas turbine power block. Natural gas will be the start-up and backup fuel for the gas turbine generator.

The key elements of the IGOC plant are the gasification unit, the power block and support infrastructure.

Gasification Unit

The Gasification or Syngas Block is comprised of a number of units (refer Figure 4-1 and Figure 4-2 in the Appendix) that pulverise the coal, provide oxygen and nitrogen for the process, convert the coal to a gas and separate the gas to enable capture of the CO_2. The units include:

Coal Milling

The coal milling plant reduces the coal to the appropriate size for processing. This unit will contain two parallel trains comprising a bunker, a gravimetric coal feeder and a roller mill similar to that used in convention pulverised coal fuel boilers.

Air Separation Unit

The air separation unit supplies the required oxygen and nitrogen for the process. This unit will be a conventional cryogenic unit in which the air is compressed, cooled and then dried with solid adsorbent (see item A in Figure 4-1 in appendix).

Gasification Block

In the gasification block the pulverised coal is converted to a syngas. The gasifier is a tall, slim, cylindrical vessel that consists of an external pressure shell with an internal cylindrically shaped membrane wall that encloses the gasification reaction zone (see item B in Figure 4-1 in the Appendix). Wastes created in the gasification block are a vitrified non-leachable coarse slag and slag fines. The coarse slag is sent to on-site secure disposal areas and the slag fines are recycled back to the coal handling system.

Syngas Cleanup Units

The syngas from the gasifier contains a number of unwanted materials (e.g. sulphur, fly ash) which are removed in the cleanup units (see item C in Figure 4-1 in the Appendix). The syngas is also chemically modified to provide the required proportion of hydrogen for the gas turbine generator and the CO_2 is removed for compression and storage. The technology for removal of sulphur is the 'Sulferox' process and removal of the CO_2 is by the Genosorb process. The Sulferox process produces a solid sulphur product whilst the Genosorb process produces a high purity gaseous CO_2.

Waste Water Treatment

Some waste waters from the process plant are pre-treated to remove trace quantities of gas which require thermal treatment prior to release to the atmosphere. Pre-treated waste waters and other waste waters from the process are treated to create clean recycled water which is used for water make up in the plant. Wastes created in the waste water treatment plant are crystalliser slurry, biotreater solids and raw water treatment solids. The waste stream will be mixed with the fly ash from the syngas cleanup unit and sent to on-site secure disposal areas.

Open Cycle Power Block

The open cycle power block consists of a gas turbine generator (see item D in Figure 4-1 in the Appendix). This power block is identical to a natural gas fired open cycle power station, except that the gas turbine is specially adapted to accept the high hydrogen syngas fuel, with a range of compositions which will allow the gas turbine to operate beyond contemporary experience using high hydrogen syngas from gasification plants.[33]

Supporting Infrastructure

The principal supporting infrastructure will include:

Coal Handling System and Storage

Existing Queensland Rail infrastructure and Stanwell Power Station coal train unloading facilities will be utilised for the transport and handling of coal. The Project will develop a new coal conveyor linking the Stanwell Power Station facilities to the ZeroGen coal stockpile which will be adjacent to, but separate from, the existing Stanwell Power Station coal storage area. The stockpiling facilities will comprise a covered live stockpile area and a long term storage area. A front-end loader will be used to reclaim coal from the stockpile and deliver it to the coal bunkering conveyor system. The coal bunkering conveyor system will transport the coal to the coal bunkers within the coal milling section of the syngas block. Slag fines will be introduced to the coal as it is transported by the coal bunkering conveyor system at a rate that is proportional to the flow rate of the coal.

The coal bunkering system will be designed to allow coal bunkering operations to be completed within an operating shift each day.

[33] EPRI – private communication, based on 2003 IGCC studies, criteria may be changing, Stanwell Corporation Limited, HBIRD Pro document #528766.

Natural Gas Metering, Conditioning and Distribution

As natural gas will be the start-up and backup fuel for the gas turbine generator gas metering, conditioning and distribution systems will also be installed on the site. The gas metering facilities will comprise flow measurement equipment and a gas chromatograph. The gas conditioning facilities will comprise filters, a pressure let-down station and a water bath heater. Gas will be distributed around the IGOC site via a simple piping system.

Distillate Storage and Distribution

Due to the nature of the gasification process distillate will be required for the start up of the gasification unit. On-site storage may include 2 x 20m^3 distillate storage tanks along with a tanker unloading facility and distillate forwarding pumps.

Water Systems

As discussed in Section 4.4.2 raw water for ZeroGen is expected to be sourced from surplus allocation available from the Stanwell Power Station. This water will be stored in the existing Stanwell Power Station water supply dam from where it will be transported to the ZeroGen facility. The Project will include a pipeline to transport the raw water from the Stanwell Power Station water supply dam to the main process plant. No on-site raw water storage facilities will be provided within the ZeroGen plant.

Potable water for ZeroGen will be supplied from the existing Stanwell Power Station. The Project will include a piping and pump system to distribute this water around the ZeroGen facilities. On-site potable water storage facilities will not be provided on the ZeroGen site.

Waste Management System

Wastes that will be generated during operation of the IGOC plant include vitrified coarse slag, fly ash, sulphur, sludge from water and waste water treatment and efflluent.

Coarse slag from the main process plant will be transported to a road hopper via a number of slag transport conveyors. Adequate buffer storage capacity will allow a single dump truck to be employed as the means for transporting coarse slag from the road hopper to a slag disposal area north-west of Stanwell Power Station's existing ash disposal area (refer Figure 4-3 in the Appendix). Slag fines from the main process plant will be transported by front end loader and dumped into a slag fines storage bunker via a slag fines conveyor. The slag fines will then be metered onto a conveyor and ultimately discharged onto the coal bunkering conveyor, at a rate proportional to the coal bunkering rate, and recycled back to the gasifier process.

Fly ash from the main process plant will be blended with both crystalliser slurry and dewatered sludge from the main process plant to form a 'dense phase' slurry. This slurry will be pumped to the fly ash disposal area located to the north-west of the existing Stanwell Power Station ash disposal area (refer Figure 4-3 in appendix). The fly ash disposal area will be lined, and ultimately capped, as the means for managing the potential for leaching.

Sulphur (filter pressings) from the sulphur removal process will be transferred from the main process plant via dump truck to the sulphur disposal area adjacent to the fly ash disposal area (refer Figure 4-3 in the Appendix). The sulphur disposal area will be lined, and ultimately capped, to prevent leaching. The potential opportunity for the sulphur to be used in the manufacture of sulphuric acid or fertiliser in an off-site facility has been considered but the very small production quantities of sulphur do not favour this.

Sludge from the water and waste water treatment will be mixed with the fly ash for on-site disposal.

Effluent with include sewage, process waste water from cooling tower blowdown and stormwater. Sewage will be processed through an on-site sewage treatment plant and a pipe network and pumps will be installed to service the Project's facilities. Stormwater and 'release' quality waste water from the main process plant cooling towers are proposed to be discharged into Quarry Creek under similar principles as the existing Stanwell Power Station. Trace quantities of gas from waste water pre-treatment will be thermally treated prior to release to atmosphere.

Fire Detection and Protection System

A pressurised fire ring main system comprising fire water tanks, pumps, hydrants and monitors will be included within the site. Fire detection systems will also be installed.

Buildings

Buildings on the site will include:

- Control room;
- Substation;
- Laboratory;
- Workshop; and
- Warehouse.

4.2.2 Carbon Capture and Storage

Compression and Transportation

The captured CO_2 will be compressed and transported about 220 kilometres by pipeline from the Stanwell Energy Park for underground storage in Queensland's northern Denison Trough (refer Figure 1-5 and item E in Figure 4-1 in the Appendix).

The compression and transportation process requires a compression plant, a booster pump, main pipeline, distribution system, leak detection, power systems, control system, metering and interfaces with the power plant. The compression plant, motor control centre, control room, administration building, workshop and warehouse will be located in the Stanwell Energy Park. Furthermore, there will be a remote facility building located at the distribution system, near Rolleston.

The main pipeline diameter is nominally up to 300 mm whilst the diameter of the distribution line to the injection wells may vary from 150 mm to 250 mm. The pipeline will be a fully welded, steel pipe designed and constructed in accordance with *AS 2885-1997 Pipelines Gas and Liquid Petroleum*.

Valve stations are expected to be located at approximately 30km intervals in order to minimise the potential volume released from accidental pipeline discharge. Additional stations will be located at river crossings and through built-up areas. Dirt tracks would be constructed between valve stations and main roads.

Transporting CO_2 by pipeline is a relatively mature technology. For example, CO_2 is safely piped from Colorado to West Texas in the United States of America to be used in enhanced oil recovery operations.

A typical staged approach to pipeline development and construction is depicted in Figure 4-4 in the Appendix, whilst Figure 4-5 in the Appendix shows typical construction activities during the construction of a pipeline.

CO_2 Storage

The principles that govern the accumulation and storage of petroleum and naturally occurring CO_2 within sedimentary rock are similar to those that apply to the injection and storage of anthropogenic CO_2. The petroleum industry has developed a wealth of information on the geology of sedimentary basins, the fluids contained within the sedimentary layers and the methods for monitoring, extracting and transporting those fluids.

For many years, CO_2 has been injected into sedimentary rock as part of enhanced oil recovery and gas recovery projects. Only recently has CO_2 been injected into underground sedimentary reservoirs for the purpose of long-term storage in order to reduce the impact of GHG emissions.

Few projects have been undertaken primarily for the geological storage of CO_2. The initial focus of research has been the injection of CO_2 into depleted oil and gas fields. However, there are few depleted oil and gas fields that are located near large scale CO_2 emitters that are of sufficient size to accommodate future CO_2 emissions.

It has been recognised globally that the safe storage of CO_2 in deep saline aquifers has considerable potential where an entrapment mechanism can be clearly demonstrated. Because of the enormous capacity of saline aquifers to accommodate CO_2 emissions, they will be the key to achieving the geological storage of a large proportion of future, worldwide CO_2 emissions.

The CO2CRC has undertaken an evaluation of Australia's sedimentary basins to determine those ones with the potential to safely store large volumes of CO_2. Three such basins occur in Queensland, the closest to Stanwell Energy Park with good CO_2 storage potential being the northern part of the Denison Trough, located between Emerald and Rolleston in Central Queensland.

The Denison Trough is a Permo-Triassic basin containing a number of producing natural gas fields. Data from the petroleum exploration wells and seismic surveys have been used by independent geological experts to create computer geological models and reservoir simulations to determine the suitability of the northern part of the Trough for the safe storage of CO_2 emissions from the proposed gasification plant. To test the computer modelling and verify the suitability of the northern Denison Trough for CO_2 storage, ZeroGen is drilling and testing evaluation wells. These commenced in June 2006.

The risk of CO_2 leakage, called containment risk, from the deep saline aquifers in the northern Denison Trough has been assessed as very low for the location chosen. The containment risk analysis took into account the geological configuration of the basin, the absence of present day seismic activity and the placement of wells away from sites that could act as future leakage points.

It is proposed to inject the CO_2 for storage using standard well drilling technology used for oil and gas production wells. The injection wells will be completed using stainless steel casing, tubing and well heads to reduce the potential for corrosion as a result of the CO_2. Every injection well will have an automated emergency shutdown wellhead (5,000 psi), full telemetry including web based monitoring reports, full meter skids for monitoring CO_2 injection volumes and CO_2 monitors and emergency notification. A non-bituminised access road will be provided to each well. Each wellhead will be fenced with steel pipe and have suitable information/warning signs.

A CO_2 monitoring program will involve seismic surveys, the drilling of monitoring wells and the installation of a network of stations that measure the level of CO_2 over the CO_2 storage site.

4.3 Operational Processes

4.3.1 Gasification Plant

The coal, oxygen and steam are introduced to the gasification zone through four burners where they react under high pressure and temperature to form a synthesis gas (syngas) which consists predominantly of hydrogen and carbon monoxide with some impurities and inert gases.

The mineral matter in the coal forms a molten slag which runs down the inside surfaces of the membrane wall into a water bath at the bottom of the gasifier where it is removed as a vitrified non-leaching coarse slag.

The syngas is then cooled in a water tube boiler. The raw syngas exiting the cooler is laden with fine ash called fly ash which is then filtered out through a high temperature filter from which it is removed for disposal. The syngas is then cleaned to remove any remaining solids. Waste material from this process is recycled through the gasifier.

The gas is then treated to convert trace contaminants such as hydrogen cyanide and carbonyl sulphide in the gas to ammonia and hydrogen sulphide. The syngas is then passed through a shift reactor to convert the carbon monoxide to CO_2 to make it available for separation as well as to increase the proportion of hydrogen in the syngas. The syngas processing facility will be capable of converting approximately 80% of the carbon from the coal fuel to CO_2 to make it available for transport and storage.

The target of the demonstration is to reduce CO_2 emissions to less than 600 kg/MWh. This is significantly less than the current best available pulverised coal (supercritical) boiler at around 780 kg/MWh[34]. This target applies to the complete plant including all auxiliary and CO_2 compression losses. The CO_2 is then removed from the gas and sent for carbon storage.

The resultant hydrogen gas is sent to the power block where it is combusted in the gas turbine which drives a generator and produces electricity for export to the grid and plant auxiliary loads. The hot exhaust gases from the gas turbine are discharged to atmosphere.

The process includes a waste water recycling system to recover water for re-use in the system and for preparing solids for on-site disposal. Waste water from the gasification process is treated in a biotreater to remove organics and nutrients. Clarified water from the biotreater is filtered, combined with reject water from the raw water treatment and processed in a high efficiency reverse osmosis unit and by partial crystallisation. Solids from the biotreater, the raw water clarification and crystalliser slurry are combined with fly ash for on-site disposal. Clarified water from the high efficiency reverse osmosis unit and clean distillate from the crystalliser are combined and recycled as make-up water.

---

[34] Based on a best practice efficiency of 41.7% (Sinclair Knight Merz, “Australian Greenhouse Office January 2000 Integrating Consultancy – Efficiency Standards for Power Generation Report”, Section 5.5.1 Black Coal) and an emissions factor for Queensland black coal of 90.3 kg CO2e/GJ based on point source (Scope 1) emissions (“AGO Factors and Methods Workbook”, December 2005).

4.3.2 Carbon Capture and Storage

Pipeline

Given that the pipeline will be underground, land users are able to resume previous land use activities on top of the pipeline provided that the use does not include excavation activities. Whilst deep-rooted vegetation cannot be re-established directly across the pipeline (due to potential damage to the pipeline or its corrosion protection systems) shallow root cropping and grassland re-establishment is encouraged and no long-term impacts would be expected to such areas.

Typical operational activities for a pipeline will be very similar to those for any other gas transmission pipeline and will include:

Routine Operation and Maintenance - this includes ground and aerial patrols, repair of equipment, pigging and cleaning of the pipeline, corrosion monitoring and remediation, and easement and lease area maintenance including access roads. Aerial and/or ground inspections will include detection of third party activities on or near the ROW, detection of erosion, monitoring of rehabilitation success and detection and control of weed species.

Prevention of Pipeline Damage - Prevention of damage due to third party activity will be achieved through appropriate depth of cover, signposting of the pipeline, one call "Dial Before You Dig" programs, regular inspection of the pipeline ROW to spot any construction or earthmoving activities in the area and third party education on the potential dangers of carrying out activities in proximity to the pipeline. Security fencing, gates and locks will be provided around all major above ground facilities (e.g. mainline valves) to inhibit accidental or unauthorised tampering.

Cathodic Protection Inspection - Pipeline corrosion will be prevented by the protective external coating and cathodic protection systems. The cathodic protection system will be checked regularly to ensure that the protection voltages are within limits and to monitor any likely areas of corrosion activity. The cathodic protection system and external coating system work independently to protect the pipeline from corrosion.

CO_2 Storage

Known remote oil field operations in onshore Australia have been used as a guide in determining the operational requirements for the CO_2 storage site. The operation will comply with the required legislative and regulatory regime.

The field will, as far as practicable, be operated remotely probably adjacent to the outlet of the main pipeline transporting CO_2 from the Stanwell Energy Park to the storage site. The facilities will be located adjacent to or nearby the facilities established by the pipeline operators for the main CO_2 pipeline, distribution lines and pumping station.

Down hole activities are expected to be:

- Five yearly inspection of the well integrity;
- Five yearly corrosion check; and
- Monitoring of CO_2 saturation levels.

Duties of field operations staff located at the storage site will include the maintenance of monitoring equipment and taking measurements of CO_2 levels, particularly in the vicinity of well heads, as verification of the readings at the detector stations.

4.4 Process Inputs

4.4.1 Coal

Stanwell Power Station is currently supplied with coal from the Bowen Basin approximately 150km west of the Project site. The Project will require an additional 230,000 tonnes of coal per annum.

Work done by the Cooperative Research Centre for Coal in Sustainable Development (CCSD) ranked the various coals in the Bowen Basin in terms of their requirement for flux addition. According to the CCSD thermal black coals in the Bowen Basin possesses characteristics (as either a single deposit or multi-deposit blends) which would allow these coals to be used by the Project. Coal deposits in the Bowen Basin are capable of supplying the Project well beyond the Project life.

4.4.2 Water

The Project is likely to require around 2,000ML per annum of water. Stanwell Power Station currently has a 24,000 ML per annum allocation provided under a long-term agreement with SunWater through the SunWater owned and operated assets: Eden Bann Weir and Stanwell Pipeline. Stanwell Power Station has approximately 2,000ML per annum of spare water capacity from its allocation and it is believed that commercial arrangements can be put in place for this spare capacity to be made available to the Project[35]. A range of alternative arrangements have also been considered which could be pursued if for some reason the spare capacity of Stanwell Power Station is not available or for the future development of the facilities to IGCC.

4.4.3 Auxiliary Power

Gas

Natural gas in the order of 110TJ per annum is required for the IGOC as a start up fuel and as a support fuel for the gasifier.

Electricity

Under normal operating conditions the IGOC auxiliaries and the main CO_2 compressor, will draw their supply directly from the output of the gas turbine. Approximately 1 to 2MW of power would be required for short periods under abnormal conditions (e.g. start-up or gas turbine trip).

The remote compressor sites for the pipeline and carbon storage would be powered from the grid and, depending upon operating regimes, would require up to 270kW.

4.5 Process Outputs

4.5.1 Carbon Dioxide

It is expected that the Project will capture up to 60.8 tonnes of CO_2 per hour while the plant is operating. This will represent a net saving of up to 420,000 tonnes of GHGs gas per year when the plant is operating at the maximum expected capacity and availability.

[35]Other projects under consideration for the Stanwell Energy Park are considering the use of SunWater infrastructure but not the Stanwell Power Station water allocation.

4.5.2 Electricity

As stated in Section 1.4, ZeroGen is a demonstration project. As a consequence, its primary objective is to advance learning and knowledge from the world-first integration of the technologies. Given this, the Project will produce a small amount of electricity for input to the NEM. The electricity supplied to the market will be traded by Stanwell as part of its generation portfolio. The potential use of a combined cycle gas turbine in place of an open cycle gas turbine could lead to increased output.

4.6 Air Emissions Management

4.6.1 Construction

The only anticipated significant air emissions associated with construction are dust and emissions from vehicles, plant and equipment particularly diesel generators.

The details of emissions control will be addressed in the EIS and subsequent EMP. However, at this stage it is expected that water trucks will be used for dust suppression and all vehicles, plant and equipment, including the diesel generators will be required to comply with the relevant standards/codes.

4.6.2 Operation

The key operations emissions would be associated with the power generating plant. The key point sources would include:

- Gas turbine stack;
- Coal milling and drying vent;
- Flare; and
- Waste gas combustor.

The power generation plant will be required to remove a substantial amount of carbon from the fuel supply to the gas turbine so that CO_2 intensity is low. The emissions guidelines for the total plant will be made up of those from the syngas block and those from the power block. Under normal steady-state operations it is expected that the bulk of emissions will be generated in the power block, however it is important that overall emissions be managed. The syngas block will be required to control both direct emissions to the environment and transfer of pollutants to the power block in the fuel which may subsequently be emitted. Pollutants that will require special consideration include oxides of nitrogen and sulphur, although the majority of the sulphur will be removed during the syngas process. These issues will require consideration in the development of the process scheme.

The main emission related to the CO_2 pipeline, associated facilities and the CO_2 injection wells would result from venting of sections of the pipeline for maintenance purposes. This would be an infrequent event. Some fugitive emissions may be experienced and these would be managed through regular inspections and maintenance. An unscheduled compressor maintenance, which does not correspond to the scheduled maintenance of the power plant, may result in the need to vent CO_2 from the power plant for a short period. Unscheduled maintenance would be an upset condition with a low probability of occurrence and of short duration.

The compressors will be electrically driven and thus no on-site emissions will be generated.

The venting of CO_2 from the compressor will need to be monitored as part of the site EMP (although these volumes are very small). Furthermore, the associated vent will be designed to the relevant standards to ensure site and public safety is not compromised.

4.7 Waste Management

4.7.1 Construction

Wastes generated during construction will include domestic and putrescible (from kitchens), paper, cardboard and timber from packaging, scrap steel, grey water from ablutions, sewage, drilling muds, waste oils from workshop and vegetation, which has been removed during clearing operations.

The treatment, storage and disposal of wastes will be addressed in the EIS and supporting EMPs. Whilst full details of waste disposal are not known at this point it is envisaged that during construction the sites will be closely managed to avoid adverse impacts from solid or hazardous wastes. This is likely to include:

- The use of recyclable materials where possible;
- Provision of on-site waste collection bins;
- Separate storage and disposal of regulated and hazardous wastes;
- Waste minimisation and management training to all site employees; and
- Removal of all waste construction material from the site on completion.

The disposal of drilling mud from the drilling of the CO_2 storage wells is prescribed by the *Petroleum and Gas (Production and Safety) Act* (Qld) (P&G Act). The drilling mud is deposited in a pit on-site and at the end of the drilling operations the mud pit is fenced and allowed to dry over 12 months before being covered with top soil.

Drilling muds that are associated with horizontal directional drilling under watercourse crossings during pipeline construction usually require off-site disposal by the drilling contractor.

4.7.2 Operation

Gasification Plant

As discussed in Section 4.2.1 (Waste Management System) wastes that will be generated during operation of the IGOC plant include vitrified coarse slag, fly ash, sulphur, sludge and crystalliser slurry from water and waste water treatment, water and CO_2. The latter item is to be disposed of by carbon storage which is addressed separately.

A number of configurations are still under consideration for the plant. However, whether the plant is an IGOC or IGCC (wet or dry cooled) the type and volume of wastes is essentially the same. The key difference would be in the increased volume of waste water in a wet cooled system.

The vitrified coarse slag material, which is a non-leachable, non-hazardous solid, can be used in ceramic production, as a substitute for small aggregate in concrete manufacture or in road base material. Fly ash can also be used in ceramic and cement production.

Elemental sulphur extracted during the process can be utilised in industrial facilities (e.g. nickel refineries, sulphuric acid manufacture).

Whilst markets for these materials will be investigated during the front end engineering and design phase it is anticipated that the volumes of these wastes generated by the Project may not be commercially viable for the described applications. As such it is expected that these materials will be disposed of to landfill on the Stanwell Energy Park site (refer Section 4.2.1).

Sludge and crystalliser slurry from the waste water treatment plant will need to be disposed of and it is anticipated that this will also be by disposal on-site in the plant fly ash storage area. This material should not contain any material not already created by the Stanwell Power Station for disposal in their fly ash disposal dam.

Waste oil and grease will be collected and removed from site by licensed contractors. Recycling will be used if available. Where waste oils and greases are stored on-site prior to disposal this will be done in a responsible manner with measures in place to prevent contamination.

General rubbish will be collected and disposed of in accordance with the local council requirements.

Carbon Capture and Storage

The main regulated waste associated with gas pipeline operation is normally low volume, low level contaminated soil/gravel (e.g. from pesticides or compressor oil). Minor maintenance activities are likely to be undertaken at the remote facility building. These facilities will have spill kits available should they be required.

The waste management strategy for the CCS will be based on the principles of “Reduce, Reuse, Recycle” and appropriate disposal. Opportunities for recycling materials will be investigated and implemented where practicable (depending upon the availability and capacity of local facilities).

All hazardous wastes will be appropriately stored in bunded areas away from watercourses and in accordance with legislative requirements.

4.8 Project Workforce and Housing

It is anticipated that up to 500 personnel will be required for the construction of the IGOC plant with a further 200 personnel being involved in the construction of the pipeline and carbon storage sites.

The construction phase of the project will provide opportunities for local employment, for example manual labour positions, plant operators and hire, catering supplies, transport and courier services, fencing services and waste management subcontracts. Equipment installation and pipe welding tend to be highly specialised activities however, recruitment practices will provide opportunities for appropriately qualified personnel in the local area.

In addition to direct employment opportunities, further employment opportunities could arise from vehicle hire and maintenance requirements, general fabrication activities and provision of campsite infrastructure.

The operational workforce for the IGOC plant is expected to be approximately 120 personnel of which 10% would comprise management [36] and administrative staff, with the remainder being

[36] Shell Global Solutions – “Project Stanwell – IGOC Power Station, Alternate 2”, 26/01/2006, Rev 0, Appendix 13e Opex for Stage 2, p4.

comprised of technical services staff (10%) [37], plant maintenance personnel (35%) [38] and plant operations personnel (both day and shift positions) (45%)[39].

The operation of the pipeline and carbon storage wells is expected to involve around 5 field operators on a roster in which one or two operators are present seven days a week, 12 hours per day and a senior person five days a week. This would be supported by head office based operations management and engineering support services.

Due to the size of the construction workforce and limited availability of accommodation in an area dominated by mining, the construction workforce is expected to be housed in self-sufficient construction camps. The possible exception to this will be in the Stanwell area where some workers may be accommodated in existing accommodation.

It is estimated that one campsite will be required for the IGOC and up to three campsites during the pipeline construction. Drilling operations for the carbon storage wells will include dedicated accommodation facilities within their footprint. The exact location of the construction camps will be determined once the construction program is finalised. The construction crews will generally work a three weeks on, one week off schedule.

At this stage it is not anticipated that any night work will be required. However this possibility has not been eliminated. ZeroGen will work closely with relevant stakeholders to ensure that they are notified prior to any night work and that any disruptions are minimised.

4.9 Hazard and Safety Issues

4.9.1 Hazard and Risk

ZeroGen seeks to demonstrate the integration of available technologies. Pipelines are recognised as a safe and efficient means of transporting gas and are widely used in Australia for the transport of natural and coal seam gas. Underground storage of gas is also widely used within the petroleum industry and is a recognised methodology for holding gases for future use (e.g. Underground Gas Storage facility at Port Campbell in Victoria). The reinjection of CO_2 has also been carried out on a number of oil and gas production developments in the past as part of standard enhanced oil and gas recovery procedures. However, not withstanding this, all developments present some level of risk.

ZeroGen has implemented a comprehensive risk management system that it applies to its business operations and all new projects. This includes a series of risk assessment workshops to identify and assess potential risks in all activities/tasks, for each phase of the project, and then to develop appropriate control measures. This information is then used to develop the project risk register and risk maps. A preliminary risk register and map have been created and these will be further developed in the next phase of the Project with, potentially, new items added and/or modifications made to existing items. The control measures identified in the early phase of the Project will be enacted in the next phase with the intention of reducing the Project risk.

In addition, risks associated with the pipeline will be assessed in accordance with AS 2885. These will include threats (e.g. corrosion, bushfire), location specific risks (e.g. flooding) and external issues (e.g. 3rd party interference). A combination of physical and procedural measures will be applied to the pipeline to ensure design and management meet appropriate safety standards.

---

[37] Ibid.

[38] Ibid.

[39] Ibid.

4.9.2 Safety

Stanwell will provide support services to assist in the development of the Project. As a result, the Project will progress through all stages of development utilising current Stanwell policies, systems and ideals for health and safety. Stanwell has implemented a significant upgrade of its health and safety policies and procedures and training of employees over the last few years and the systems are benchmarked as best practice.

Construction Phase

The strategy for the construction health and safety risks will be addressed and incorporated in the contracting and procurement arrangements. The lump sum turn key contractor will be required to prepare a Health and Safety Plan to control health and safety risks associated with construction and commissioning activities.

The strategies for risk control will also be further addressed and detailed in the Project Health and Safety Management Plan and Risk Register where appropriate to ensure a detailed plan is implemented.

Operation Phase

Operational health and safety risks will be identified and incorporated into the risk register and operations processes and procedures for the facility. Control measures will be identified at the appropriate time and will be dependant on contracting arrangements. The strategies for risk control are to be further addressed and detailed by the operational Health and Safety Management Plan and Start up and Operations Strategy to ensure the operation is safely and effectively implemented.

5.0 COMMUNITY CONSULTATION

ZeroGen is committed to being a good corporate citizen. ZeroGen views constructive and collaborative stakeholder consultation as essential to the long-term success of the Project. To this end, ZeroGen's community consultation program is guided by a commitment to engage with stakeholders in a transparent and collaborative manner.

5.1 Consultation Objectives

The objectives of ZeroGen's community consultation program are:

- Encourage stakeholder involvement and participation in the decision making process to facilitate enhanced outcomes;
- Provide information to stakeholders about the nature and scale of the Project, potential impacts and timelines of ZeroGen thereby enabling them to make informed decisions;
- Enable a process where the Project proponent can receive feedback from stakeholders on issues of interest;
- Maintain open and transparent communication on all aspects of the Project and the environmental impact assessment work;
- Provide a range of opportunities for stakeholders to identify key issues for consideration in the EIS; and
- Proactively work with stakeholders to develop recommended strategies that will minimise negative impacts.

5.2 Consultation Process

The process of consulting with the community will involve a number of activities. Relevant stakeholder groups, agencies and individuals have been identified to ensure information is provided with respect to their specific interests.

Relevant agencies across the three tiers of government will be extensively consulted as part of the process of securing government approvals. Public and private meetings will be held with individual landholders, Traditional Owners, specific interest groups such as chambers of commerce and relevant environmental groups. Face to face briefings will also be provided to the community's elected representatives. Many of these meetings will be held as early as possible in the EIS process to ensure stakeholders are informed about the project at the earliest possible opportunity.

In terms of the CO_2 test drilling program relevant stakeholders, including local government officials, landowners and Traditional Owners in the Emerald/Springsure area, have been consulted on this phase of the project. An article outlining the intent and likely impacts of the test drilling program has been distributed to approximately 1000 ratepayers in the April 2006 edition of the Bauhinia Shire Council newsletter.

A range of two-way communication tools will be implemented to inform stakeholders and to elicit their views on issues of interest throughout the EIS process. These communication tools include:

- A dedicated website, www.zerogen.com.au;
- A series of project fact sheets (available on the website);
- Newspaper advertisements and other media announcements through radio and television;

- Letter box drops;
- A dedicated toll free number -1800 735 044;
- A dedicated toll free fax number- 1800 735 844;
- Email- zerogen@phillipsgroup.com.au; and
- Reply paid postal - Reply Paid 105, Fortitude Valley Qld 4006.

Stakeholders will have the opportunity to officially comment at two critical points in the EIS process:

- When the draft TOR is released for comment and input; and
- When the EIS is released for public comment.

However, ZeroGen is keen to hear at any time, via the range of communication tools given above, from community members who have questions or comments.

6.0 EXISTING ENVIRONMENT, POTENTIAL IMPACTS AND MITIGATION

This section of the IAS provides a general overview of the existing environment, potential impacts and mitigation measures associated with the Project.

A range of impacts may potentially occur as a result of the Project. ZeroGen intends to undertake thorough investigations and detailed planning through the engineering design processes and pipeline route refinement phases to minimise potential adverse impacts. Additional studies are planned (refer Section 8.3) to refine the proposed pipeline route alignment and determine the actual level and significance of impacts associated with the construction and operation of the Project. Studies undertaken for the ZeroGen Project will take into account potential interactions and cumulative affects of other projects being considered for the Stanwell Energy Park (e.g. Queensland Coke and Power Plant Project and Stanwell 300MW Gas Turbine Peaking Power Station).

6.1 Topography, Geology and Soils

6.1.1 Existing Environment

Gasification Plant

The development areas within the Stanwell Energy Park have been mostly cleared and are used for power station facilities and cattle grazing. It is proposed that the IGOC plant be located to the west and in close proximity to the existing Stanwell Power Station (refer to Figure 4-3 and Figure 1-2 in the Appendix).

Studies carried out for other projects under investigation for the Stanwell Energy Park have noted that the area is underlain by rocks of the Stanwell Coal Measures comprising Early Cretaceous mudstone, arenite, claystone and coal. Weathering in these rocks generally extends to depths of 8-10m. Quaternary alluvium, comprising clay, silt, sand and gravel beds, occur on the floodplains of Neerkol and Quarry Creeks. Minor occurrences of colluvial and slopewash deposits have also been mapped within the Stanwell Energy Park locality.

The terrain of the area comprises generally flat and locally stepped alluvial terraces adjacent to Neerkol and Quarry Creeks.

The Stanwell Energy Park is known to have highly dispersive erosion prone soils[40]. Dispersive soils may erode if exposed and left unprotected leading to the loss of topsoil and sedimentation of watercourses.

Soils studies to determine the required erosion mitigation measures for the actual IGOC plant site will be carried out as part of the EIS studies for the Project.

[40] Australian Magnesium Project Environmental Impact Statement, Vol. 1, Dames and Moore, December 1999

Carbon Capture and Storage

Pipeline

The topography of the area through which the pipeline route passes varies from undulating plains in the Comet region to hilly/mountainous areas in the Boomer and Mt Morgan Ranges and undulating river valleys in the Callide Creek and Dawson River Downs.

Geology across this region includes Tertiary and other Cainozoic deposits in the Comet region, laterosed Tertiary deposits in the tablelands of the Woorabinda region and Permian volcanics and sediments, with areas of Devonian-Carboniferous sediments, in the Boomer Ranges. The Mt Morgan Range is formed from Palaeozoic rocks, of which the dominant rocks are volcanics, with areas of igneous rocks and small areas of folded meta-sediments.

Major topographic constraints identified between the proposed IGOC plant site and the northern Denison Trough are the Blackdown National Park and the Central Queensland open-cut coal mines and mining leases. These topographical features create a barrier to a direct east-west route from the IGOC plant to the northern Denison Trough.

Topography, geology and soils studies will be carried out as part of the EIS. Soils studies will include field verification through targeted sampling and a risk based contaminated land assessment.

Pipeline routes have considerable scope for flexibility and the preliminary route has been selected to avoid major topographic constraints and mining leases.

CO_2 Storage

The proposed CO_2 storage area is in the northern Denison Trough between Emerald and Rolleston. Desk top studies have found that the area is largely undulating plains dominated by Tertiary and other Cainozoic deposits, with mid-catena deposits being slightly more prominent.

Reservoir modelling studies[41], based on desktop data, for the northern Denison Trough have shown that, from a technical viewpoint, this area should be suitable for the injection and long term storage of up to 1.2 million tonnes of CO_2 per year for up to 25 years. The test program is collecting data to assess the results of these modelling studies.

Further geotechnical studies will form part of the EIS and engineering studies during development of the Project.

[41] Northern Denison Trough CO_2 Storage Site Results of Reservoir Modelling, MBA Petroleum Consultants (MBA), July 2005.

6.1.2 Land tenure

IGOC Plant

The IGOC plant is to be sited on freehold land that currently forms part of the Stanwell Power Station.

Carbon Capture and Storage

Detailed tenure searches have yet to be undertaken. However, it is known that the area is extensively covered by existing petroleum and mining leases. The majority of the design route for the pipeline traverses cleared farm lands of freehold tenure specialising in extensive beef production or is within low voltage transmission line easements. The pipeline study route has been selected to avoid as far as practicable any mining leases so as to minimise potential impacts on the development of the State's natural resources and to provide a safe route for the pipeline. Landowners and mining interests will be consulted in relation to the pipeline route and injection sites during the EIS phase of the Project.

Detailed tenure searches to identify actual landowners will be carried out during the EIS studies.

Native Title

ZeroGen will require native title assessment to enable the Project to proceed under the *Native Title Act 1993* (Cth). A search of the National Native Title Tribunal database identified a number of native title claimant groups with an interest in the area affected by the Project. These include:

- Darumbal People;
- Gangulu People;
- Kagoulu People and Kangoulu People #2;
- Ghungalu; and
- Garingbal and Kara Kara.

ZeroGen will implement a community consultation program (see Section 5.0), as part of its overall development program. Indigenous peoples with a registered interest in the area will be included in this process and ZeroGen will seek the support of all the groups affected on an inclusive basis in its negotiations for affected sections of the pipeline route. These groups will also be consulted on an inclusive basis in relation to the cultural heritage surveys and easement access.

6.1.3 Potential Effects and Mitigation

Construction

Clearing of the land exposes soil to wind and rain increasing the potential for erosion and, in proximity to watercourses, reduction in stream water quality (e.g. increased turbidity and suspended solids). Construction planning will take into account weather conditions with the aim of minimising the potential for erosion and sedimentation to occur, thus reducing the risk of adversely impacting water quality.

IGOC Plant

The power generation plant is to be located on land already cleared within the Stanwell Energy Park (refer Figure 1-2 in the Appendix). It is anticipated that vegetation clearing will be minimal at this site. Thus the key environmental activity during construction will be the management of earthworks required to accommodate the plant and equipment. The plant and equipment will be pre-assembled in modular form, to the extent practicable, for installation on-site.

At this stage the extent of earthworks is not known but is expected to be restricted to the foundations for the major plant and equipment (e.g. gasification unit, gas turbine). Extensive cut and fill work is not anticipated.

During construction a permanent access track will be created to the site. A temporary hard stand for laydown of equipment and materials will also be required. The access track and hardstand area will be constructed of gravel and the foundations for the building and equipment will be concrete. The IGOC plant will be enclosed by a security fence.

The IGOC plant is to be located within land designated for industrial development and therefore, will be compatible with the intended land use.

Pipeline

Pipeline construction is a linear production process involving a number of crews working sequentially, typically about 4-5 days apart. Each crew would normally achieve a production rate of around 3-4km/day. Typical activities which impact upon the land include:

Access - During construction, access tracks will be required to areas such as the pipeline easement, work areas and campsites. As far as practicable existing roads, tracks and disturbed areas will be utilised so as to minimise disturbance to the surrounding areas. The selection of access track routes will be based on the objectives for the pipeline route selection and subject to the conditions of the EMP.

Clearing – To accommodate all the required equipment and materials, provide a safe working space and maximise the protection of topsoil an average 30 metre wide ROW will be required for construction. The ROW is cleared of heavy vegetation with root stock left in the ground where practicable to stabilise the area and reduce erosion. In scrubby areas vegetation will be stockpiled for respreading as part of the restoration process. Breaks will be left in stockpiled vegetation to allow continued access for fencelines, tracks, stock and drainage lines. Where fencelines are required to be breached gates will be installed. Large mature trees will be preserved wherever practicable.

Grading - The ROW will be levelled to the required gradient using graders, excavators and bulldozers. Topsoil will be removed, where required, and stockpiled separately for reuse during rehabilitation.

Trenching - Either a wheel trencher or an excavator will be used to dig the trench in which the pipe will be laid. In rocky terrain rock saws (a type of trenching machine) or excavators using rock picks are likely to be used. Where this is not practicable blasting may be required but would probably be very limited. The length of trench left open at any given time will be the minimum practicable dependent on land use and prevailing conditions. Breaks will be left in the trench, in line with vegetation stockpile breaks, to facilitate stock and wildlife crossing. Methods will be adopted to prevent fauna entrapment.

Clean up and Restoration - Clean up and restoration measures will generally involve removal of foreign material (e.g. construction material and waste), surface contouring, respreading topsoil, respreading vegetation and reseeding/revegetation (typically with native grass or other approved species). Restoration will be undertaken in accordance with good pipeline construction practice and will ensure that:

- Topsoil cover is re-established and all land and waterways disturbed by project activities are returned to a stable condition as soon as possible after construction;
- Land is returned as close as possible to its previous productivity;
- Stable landforms are re-established to original topographic contours;
- Natural drainage patterns are reinstated;
- Erosion control measures (e.g. contour banks, filter strips) are installed in erosion prone areas; and
- Disturbed habitats are recreated.

Interference to landholder activities as a result of the pipeline and carbon storage activities should be minimal and each landholder will be consulted regarding the Project to discuss their specific requirements. There will be no displacement of residents for the construction of the Project and displacement of existing forms of land use along the pipeline route will be only temporary.

Where the pipeline crosses any major road or rail infrastructure, this will be discussed with the Department of Main Roads and Queensland Rail so as to minimise disturbance to traffic.

Carbon Capture and Storage

The safe storage of CO_2 will involve the drilling of a number of wells and the injection of CO_2 in a supercritical state. The total depth of the injection wells is a function of the depth at which the CO_2 remains in a supercritical state. For the area of interest in the northern Denison Trough this has been determined as 1,000 metres below the surface. The reservoir into which the CO_2 would be injected is approximately 1,000 metres thick thus the wells will need to be drilled to a total depth of up to 2,000 metres (i.e. 2km) below the surface. During drilling operations, a one to two hectare cleared area at each well site is required for the drill rig and supporting infrastructure. Once completed, an area of only a few square metres is required around each of the injection wells, thereby causing little or no long-term disruption to landholder activities. This is the standard approach used in the natural gas industry.

There is considerable flexibility in positioning individual injection wells because of the extent of the zone in which the reservoirs occur at a suitable depth. Wells can be positioned to avoid areas of environmental and cultural heritage significance and to minimize landholder impact.

Operation

Areas in the Stanwell Energy Park and along the proposed pipeline route contain potentially erosion prone soils. This will be assessed further as part of the EIS process and appropriate soil conservation works will be identified. It will be imperative that stormwater management and ROW maintenance are regularly undertaken to ensure that the integrity of soil conservation works installed during restoration are maintained and vegetative cover is promoted to ensure minimal soil loss.

The EMP will detail appropriate maintenance requirements with regards to sediment and erosion control for the ROW. With the implementation and maintenance of erosion control in accordance with codes such as the Australian Pipeline Industry Association (APIA) Code of Environmental Practise impacts on soil loss and water quality are expected to be low.

6.2 Water

6.2.1 Existing Environment

IGOC Plant

Discharge

Watercourses on Stanwell Energy Park are two ephemeral creeks (i.e. Neerkol and Quarry) which form part of the sub-catchment of the Fitzroy River. Continuous flow in Neerkol Creek downstream of the Stanwell Power Station is due to licensed discharges by Stanwell Power Station into Quarry Creek from the existing power station. The Project will also be seeking to discharge some water into this system and this will be negotiated with the EPA during the EIS/environmental approval process.

Stormwater flow on the Stanwell Power Station site is via on-site stormwater dams. At this stage it has not been fully determined how stormwater on the Project site will be managed. However, if new dams are constructed as part of the Project, ZeroGen will consult NRMW about this activity.

Sources

The Fitzroy River is controlled by the Fitzroy River Water Resource Plan. This plan has identified that the lower Fitzroy River has up to 100,000ML per annum of allocatable water. Rockhampton City Council, which owns and controls the Fitzroy River barrage located downstream from Eden Bann Weir, has spare water allocation that it is prepared to make available on medium term commercial arrangements.

The Premier of Queensland on the 26th April 2006 announced that the government will raise the Eden Bann Weir and build a new weir at Rookwood. This is expected to deliver up to 86,000ML per annum of additional water.

The Stanwell Pipeline, owned by SunWater, connects the Stanwell Energy Park to the Fitzroy River at the Fitzroy River Barrage. This pipeline has some spare capacity which may be available to Projects within the Stanwell Energy Park.

As discussed in Section 4.4.2 Stanwell Power Station has a small amount of spare capacity in its existing water allocation which is anticipated to be sufficient for the Project needs.

Carbon Capture and Storage

Water resources within the pipeline route predominantly feed the Fitzroy River catchment which as stated is controlled by the Fitzroy Water Resource Plan. Key watercourses include:

- Nogoa River;
- Mackenzie River;
- Comet River; and
- Gogango Creek.

6.2.2 Potential Effects and Mitigation

Construction

Alteration to topography or drainage will be minimised as far as possible during construction. Design of the IGOC plant layout will endeavour to avoid impacts to the ephemeral creeks in the vicinity of the proposed site.

A number of watercourse crossings will be required for the construction of the proposed pipeline. The actual location of the crossings will be dependent on the final pipeline alignment, which is dependent upon the outcomes of the EIS, cultural heritage surveys and engineering design studies. The construction of the proposed pipeline will not permanently modify any watercourses, although there is the potential for temporary disruption during construction of the pipeline crossings. The construction method for watercourse crossings will be dependent on site factors (e.g. hydrology, stream substrate and geology, environmental sensitivities and engineering feasibility), with the aim to minimise both environmental impacts during construction and the need for future remedial work during the operation of the proposed pipeline.

The EMP will detail all appropriate sediment and erosion control requirements for the project. With the implementation of erosion control measures in accordance with the APIA Code of Environmental Practice impacts on soil loss and water quality are expected to be low.

Operation

No permanent alteration to any watercourses is anticipated as a result of the Project. However, the IGOC is planning to discharge effluent from the waste water treatment plant and stormwater runoff into the local creek system. This creek system forms part of the Fitzroy River catchment and EIS studies will assess the impact of these flows on the catchment and associated ecosystems.

6.3 Ecological Values

6.3.1 Existing Environment

IGOC Plant

Vegetation in the Stanwell Energy Park is predominantly grasslands with some shrubland. Some remnant vegetation is known in the area including the Australian Government protected Semi-evergreen Vine Thicket (SEVT) and *Eucalyptus raveretiana* (Black Ironbox). Known areas of SEVT are well clear of the Project site. Black Ironbox is found in creek beds and may therefore be present in Neerkol or Quarry Creeks. This will be investigated in detail during the EIS.

Carbon Capture and Storage

Studies into a preliminary design pipeline route and carbon storage area have identified areas of potential remnant vegetation (e.g. some open forest and riparian zones) and a number of potentially protected areas and species (e.g. *Paradelma orientalis; Eucalyptus reveretiana, Corchorus hygrophilus, Trymalium minutiflorum*). However, as previously stated, pipeline routes and, to a slightly lesser extent carbon storage sites, have a high capacity for flexibility to enable key sensitive areas to be avoided and adverse impacts to be mitigated.

Three areas of ecological significance to be avoided in selecting the design route were:

- Blackdown Tablelands National Park;
- Taunton National Park; and

- Conservation Reserve – Western Side of Shotover Range.

Vegetation along the design route includes grasslands, open woodlands and areas of brigalow with some areas of semi-evergreen vine thicket on hill slopes. Woodlands include Narrow-leaved Ironbark *Eucalyptus creba*, *E. coolabah* and rosewood *A. rhodoxylon*. Specific species include: *A. shirleyi,* bloodwood *Corymbia spp*, brigalow *A. harpophylla*, bulloak *Angophora leiocarpa*, cypress *Callitris glaucophylla*, Dawson gum *E. cambageana*, forest red gum *E. tereticornis*, gum-topped box *E. moluccana*, Lancewood *Acacia catenulate*, lemon scented gum *C. citriodora*, Moreton Bay Ash *C. tessellaris*, narrow-leaved white mahogany *E. tenuipes*, red bloodwood *C. erythrophloia*, silver-leaved ironbark *E. melanophloia* and spotted gum *C. citriodora*

A search of Australian Government and State databases has identified protected fauna species recorded within the study area. A total of 37 protected species (2 amphibians, 5 mammals, 8 reptiles and 22 birds) were identified as having the potential to occur within the pipeline study area.

Detailed flora and fauna studies will be carried out as part of the EIS.

6.3.2 Potential Effects and Mitigation

Construction

Ecosystems

Potential impacts on ecosystems during construction will be associated with the clearing for the pipeline and to a lesser extent for the carbon storage wells. The most likely impacts may be associated with fragmentation due to vegetation clearing and disturbance associated with edge effects. The construction of the IGOC plant should not have any significant impacts on ecosystems.

Where practicable, the pipeline route and well sites will avoid ecosystems protected by the Australian Government and Regional Ecosystems listed as ‘endangered’ and ‘of concern’ under the Queensland *Vegetation Management Act 1999*. Selection of the final route alignment will take into account minimisation of fragmentation to protect the viability of remnant vegetation. Detailed studies and mapping will be undertaken as part of the EIS process.

Flora and Fauna

Clearing of vegetation will be required for the various elements of the Project. Clearing for the IGOC plant will be minimised by the selection of a site on land that has been previously cleared and impacts to flora and fauna are expected to be minimal.

The pipeline will require the clearing of a strip of land to an average width of 30m along the pipeline ROW. The carbon storage sites will require the clearing of 1-2 ha per well depending upon whether there is a single or twin well site established.

Vegetation clearing will be undertaken in accordance with best practice for minimising/avoiding impacts on significant vegetation, minimising the practical width of clearing for construction and keeping surface disturbance and soil removal to a minimum.

The impact of clearing a ROW up to 30m wide is dependent on the type and nature of vegetation to be disturbed, its function as fauna habitat or linkage and topographical features such as slope and aspect. If large trees are removed these species would take many years to regenerate and this will be avoided wherever practicable. However, most impacts are considered to be temporary especially where active rehabilitation measures are put in place. Detailed flora studies will be undertaken as part of the EIS process to enable impacts on common and scheduled flora species to be minimised.

The main impacts of construction on fauna would be short term increases in disturbance from construction noise, vehicle movements and dust production or mortality from traffic and truck movement. Clearing of vegetation may also result in loss of habitat. It is anticipated that in most cases significant isolated habitat trees will be able to be avoided.

Analysis of preferred habitat requirements for each scheduled fauna species, as well as searches of the Birds Australia and Queensland Museum databases and an ecological survey will be carried out as a part of the EIS.

Due to the flexibility in pipeline route and well site selection, impacts on flora and fauna are expected to be low.

Operation

Operation of the IGOC plant should not have any impacts on vegetation fragmentation and fauna corridors.

The environmental effects of operation and maintenance of the proposed pipeline and carbon storage sites are considered to be low. A maintenance track (generally only light vehicles) will be required along the pipeline routes and the ROW is likely to be kept cleared of large vegetation (trees and bushes) to a width of 6m. Grasses will also be re-established using native varieties.

Effects on ecosystems of a 6m wide grassed corridor will be assessed as part of the EIS process. Based on the provisional desktop studies a 6m wide corridor, given that it avoids all areas of SEVT, is not considered likely to constitute fragmentation of the identified ecosystems or to result in any inhibition of natural ecosystem function or fauna movement in these ecosystems.

Another possible threat to ecosystems and native flora and fauna is the introduction and spread of pest species. Pest plant species can displace native species, which in turn can impact on fauna habitat and food sources, thereby altering ecosystem function and threatening a broad range of native flora and fauna. Where vehicles are travelling over distances, particularly from weed infested areas to weed free areas, weed introduction can be a serious issue.

A rigorous weed management plan will be implemented for the Project. Weed species and locations will be identified during the EIS process and the recommended management measures will be documented in the weed management plan.

6.4 Noise

6.4.1 Existing Environment

There are several existing noise sources that influence the ambient noise levels in the Stanwell Energy Park area. These include:

- Capricorn Highway;
- Existing railway line;
- Stanwell Power Station;
- Local road network; and
- Localised noise sources associated with human occupation.

Background noise level monitoring has been undertaken by Stanwell at various sites around the locality. This has indicated that the background noise level at receptors during the night varied between 33-53 dB(A)(L_{Aeq}). During the day this level is around 44-52 dB(A)(L_{Aeq})[42].

Existing background noise in the vicinity of the pipeline and storage wells is likely to be typical of rural areas.

6.4.2 Potential Effects and Mitigation

Construction

Construction noise will be associated with transport of materials and equipment, earthworks and installation activities. The key area of impact is potentially in the Stanwell area as the pipeline and carbon storage well sites are likely to be predominantly remote from residential and other sensitive receptors. In addition pipeline and well drilling will be short term activities and should not cause significant inconvenience to local residents.

Construction of the IGOC will be a longer term activity creating typical building site noise levels. Whilst of longer duration than the pipeline and well drilling activities the noise impacts will again be transient and will not cause a long-term noise nuisance.

Operation

The *Environmental Protection (Noise) Policy* (EPP Noise) sets values that the State is endeavouring to achieve in relation to the ambient noise level. For Queensland's residential population this is a maximum of 55dB(A). However, the existing acoustic environment should not be allowed to significantly deteriorate.

There are no long-term adverse noise impacts expected in relation to the pipeline itself, only the booster station close to the CO_2 storage site. The final location of the booster station will be determined in the next phase of the project and will take into account the location of noise sensitive receptors (e.g. residences or schools).

Noise impacts for the pipeline alone would be short-term associated with very occasional maintenance. These can be managed through timing and consultation with landowners.

Noise modelling for the IGOC plant and any booster station sites will be undertaken as part of the EIS studies. Any modelling undertaken will take into consideration the potential for cumulative effects of both the existing Stanwell Power Station and other projects proposed for the Stanwell Energy Park. Results of these studies will be used to determine noise limits for the Project.

6.5 Air Quality

6.5.1 Existing Environment

Meteorological and air quality conditions at the Stanwell Energy Park have been monitored over the period 1997-2003 by Stanwell Power Station providing a basis for studies into further development on the site. All measured air quality parameters were generally below the relevant Queensland air quality guidelines and those put forward in the National Environment Protection Measure (NEPM) adopted by the National Environment Protection Council for major urban population centres in Australia[43]. The Fitzroy Shire Council, within its Planning Scheme has

[42] Queensland Coke and Power Plant Project: Environmental Impact Statement. January 2006.

[43] Initial Advice Statement Coke Plant and Power Station Plant Project December 2004

identified nitrous oxide and sulphur oxide emissions as an issue for the Stanwell area. Eight short-term exceedences of the guidelines have been noted over six years of monitoring.

6.5.2 Potential Effects and Mitigation

Construction

The main impact to air quality from construction of the Project would be as a result of dust generation during construction activities. This can be mitigated by the use of water trucks as necessary. Dust control may be appropriate where construction activities are carried out in close proximity to residences or main roads. Increased vehicle use on unsealed roads may also cause localised dust impacts to residences located adjacent to haul routes. These impacts will generally be of short-term duration as the construction team works through an area.

Air quality may also potentially be affected by emissions generated from equipment and vehicles utilised during construction however, this will be of a localised nature only. The effect on air quality will be minimised through ensuring that the contractor only uses equipment that is properly maintained and in sound working order.

Given the isolated nature of potential emission generation, impacts on air quality associated with the construction of the Project are expected to be low.

Operation

Air emissions modelling and the potential impact on the local air shed of the Project will be carried out during the EIS. This work will build on existing work undertaken as part of other projects being considered for the Stanwell Energy Park. Any modelling undertaken will take into consideration the potential for cumulative effects of both the existing Stanwell Power Station and other projects proposed for the Stanwell Energy Park. Studies will take into account human health and well being in accordance with Part 2 Section 5 of the *National Environment Protection (Ambient Air Quality) Measure* (NEPM) and the requirements of the *Environmental Protection (Air) Policy* (EPP to Air). Outcomes of this work will be used to determine air emission limits to be taken into consideration during the design of the Project.

6.6 Social Environment

6.6.1 Existing Environment

The Project affects parts of Fitzroy (IGOC plant and pipeline), Duaringa (pipeline), Bauhinia and Emerald (pipeline and CO_2 storage) shires. The majority of the shires are rural and mining communities supported by a number of small towns and larger regional service centres.

The major activities of the four Shires are predominately cattle grazing, broad scale grain cropping and coal mining with the Fitzroy shire being the home of the Stanwell Power Station. The coal industry is also a significant presence in the region, with Blackwater servicing six major coal mines. The export earnings generated from coal in this area are a significant portion of Australia's Gross Domestic Product. The region also incorporates a number of state forests and conservation reserves, covering terrain which was historically unsuitable for clearing.

6.6.2 Potential Effects and Mitigation

Construction

The Project will encounter the full range of infrastructure including roads, railway lines and powerlines. The proposed IGOC plant site is located adjacent to the existing Stanwell Power

Station which is serviced by a number of transmission powerlines of various voltages. Pipelines typically minimise their proximity to powerlines due to the potential for induced currents in the pipeline.

Detailed design of the IGOC plant and CCS will include identification of all infrastructures in the Project area.

Due to the remote location of portions of the Project (i.e. the pipeline and storage wells) and the shortage of available accommodation in the overall Project area it is anticipated that the workforce will be accommodated in dedicated camps. Accommodation availability for the construction phase of the Project and competition from other potential projects will be investigated during the EIS process.

Whilst the workforce is expected to be accommodated in dedicated campsites there is the potential for the workforce to utilise community facilities particularly in and around the Stanwell area. The impacts on recreation, health and education facilities as a result of the presence of the proposed workforce will be investigated in detail during the EIS taking into account availability and capacity to absorb a large workforce. It is likely that workforce expenditures in the local community will increase local business activity.

The construction of the Project will bring around 500 workers into the Stanwell area for the duration of the IGOC plant construction period plus an additional 150-200 workers for a short period for construction of the pipeline. A portion of this workforce will be recruited locally where practicable providing employment opportunities for local residents and contractors.

ZeroGen will negotiate with principal contractors to comply with the *State Government Building and Construction Contracts - Structured Training Policy* (10% Policy). This policy ensures the training of apprentices, trainees and cadets and the upskilling of existing workers. ZeroGen also intends to support, where practicable, the Indigenous Employment Policy for Queensland Government Building and Civil Construction Projects (20% Policy) although construction of the Project's major components do not occur within the policy's specified Indigenous communities.

Operation

ZeroGen anticipates that the operation of the gasification plant, pipeline and safe storage of CO_2 will have minimal dislocation on the existing social environment of the Fitzroy Shire and City of Rockhampton. As stated in Section 4.8, the Project is likely to generate approximately 120 operational jobs for the IGOC plant and up to five new jobs for the CO_2 pipeline.

Employees for these new operational jobs will be sourced from the local community where practicable. This has the potential of reducing any significant social dislocations. Should a proportion of the operational workforce need to be recruited from outside the region, it is envisaged that the capacity of the existing social infrastructure in the Fitzroy Shire and City of Rockhampton will be able to support these numbers. These communities are already providers of sophisticated social services, relative to other communities in the broader region.

6.7 Transport and Infrastructure

6.7.1 Existing Environment

The Stanwell Energy Park is located in proximity to the Capricorn Highway and the Blackwater to Gladstone railway line. The Capricorn Highway will be a major transport corridor for the Project. Areas further west have limited access points and transport routes will be reviewed during both the EIS and construction planning period.

6.7.2 Potential Effects and Mitigation

Construction

Transport and traffic issues associated with the construction phase of the Project will include transport of major items (e.g. turbine unit), pipe, construction plant and equipment, camp accommodation and workforce movements. The number of transport movements will depend upon the size of selected pipe, whether construction camps are required and the size of the total workforce.

At this stage of the Project, no estimates are available for the likely number of transport trips required. However a typical IGOC plant would be expected to generate approximately 200 major item and plant equipment movements, 100 civil works movements and 1500 concrete truck movements in total[44]. Steel pipe is typically transported in 12-18 metre lengths (depending upon pipe diameter) on extended semi-trailers. The number of pipes that can fit on a single vehicle depends on the pipe diameter (e.g. for 200mm diameter this is typically 750m or 40 pipe lengths). An accommodation camp for around 200 workers would typically take about 100 transport movements. The likely number of transport movements will be reviewed during the EIS and the potential impacts (e.g. damage to road surface) and mitigation measures (e.g. improvements to any road intersections) in relation to the affected roads determined.

Given the temporary nature of construction activity in a specific area, increased traffic impacts are expected to be low.

Operation

Coal will need to be supplied to the IGOC plant and it is anticipated that this will be achieved through the use of the existing Stanwell Power Station rail loop which is connected to the main Blackwater rail system via a dedicated spur line. Provision of coal to the IGOC plant is anticipated to require one additional train load of coal every 9 days. On-site, the coal will be transported by a coal loader conveyor.

Other supplies (e.g. limestone and chemicals) would be transported to site by road. Limestone transport is anticipated to require approximately 1 x 40 tonne truck per day. Chemicals are expected to add no more than 1 x 20 tonne truck every 4 days.

Maintenance of the pipeline and carbon storage sites is not expected to generate any long term significant impacts on the built environment.

6.8 Cultural Heritage

6.8.1 Existing Environment

Two cultural heritage surveys of the Stanwell Energy Park area have been previously undertaken and indicate that any cultural material in the area planned for the IGOC plant is likely to take the form of stone artefacts as scatters or isolated finds.

A search of the Register of National Estate for the pipeline study corridor identified four sites in the region:

[44] Concrete pours for the IGOC can contribute significantly to transport movement if delivered from outside the plant. An alternative option is to set up a concrete batching plant on-site however this will not be decided until closer to construction.

- Former Stanwell Railway Station, east of the Stanwell Energy Park;
- Huxham Sanatorium, 1.5km east of the Capricorn Highway near Westwood;
- Blackdown Tablelands (natural heritage site); and
- Taunton Scientific Reserve (natural heritage site, part of the Taunton National Park).

The proposed pipeline route will be designed to avoid any impacts to National Estate locations.

6.8.2 Potential Effects and Mitigation

Construction

Construction activities will disturb land surfaces and therefore have the potential to impact upon cultural heritage material, particularly artefact scatters and scar trees.

ZeroGen is committed to the protection of cultural heritage sites and the sensitive handling of any accidental discovery of sites. cultural heritage surveys will be conducted to determine whether the Project will impact any anthropological issues or sites. The outcome of the investigations will provide input into the final pipeline route and the management of all construction works. These investigations will be conducted in consultation with indigenous peoples/groups that have an interest in the area.

ZeroGen will negotiate the development of a Cultural Heritage Management Plan (CHMP) with the relevant indigenous peoples. This plan will document the procedures to be followed during construction to ensure the ongoing protection of any identified sites of significance.

All studies, consultation and development of the CHMP will be in accordance with the requirements of the *Aboriginal Cultural Heritage Act 2003*.

Operation

It is envisaged that there would be no long-term impacts on items of cultural heritage as a result of the Project.

6.9 Visual Amenity

6.9.1 Existing Environment

The IGOC plant site will be within the Stanwell Energy Park adjacent to the Stanwell Power Station. Stanwell Power Station contains a 210m stack and two 130m hyperbolic cooling towers. The tallest structure proposed for the IGOC plant will be the gasification unit followed by the turbine hall and vent stack. The gasification unit is approximately 100m tall but in addition there may be a 20m tall trace waste gas thermal treatment flue (i.e. total height of 120m).

The site is bounded to the north by the Capricorn Highway and Stanwell township is located to the north of the Highway.

Some elements of the plant are likely to be visible from the highway. However, visual buffering in the form of natural vegetation will be preserved where practicable to reduce this impact.

The pipeline and carbon storage wells will be located in remote rural areas. The pipeline will be buried for its full length with only above ground marker posts and cathodic protection markers being left visible.

6.9.2 Potential Effects and Mitigation

Construction

Clearing of the ROW through formerly timbered areas will have visual impacts from locations where works are visible from roads or by individual land owners. By ensuring that restoration works adhere to a sound and well compiled EMP, the negative aesthetics of a landscape with a cleared ROW can be quickly and greatly reduced. This can be facilitated by respreading vegetative debris and incorporating a pasture reseeding component as part of the restoration process.

As the opportunity for public viewing of construction activities will be limited to areas of already cleared vegetation short-term impacts on visual amenity are expected to be low.

Operation

The IGOC plant is proposed to be sited adjacent to, and south west of, the existing Stanwell Power Station. Timbered hills have been retained by the Stanwell Power Station as an environmental buffer to the south. Other surrounding land use includes agricultural land and rural residential properties to the north of Stanwell Power Station.

Owing to the size of the Stanwell Power Station elements and the character of the local setting the effect of the IGOC plant should be minimal by comparison to the Stanwell Power Station. Some elements of the plant are likely to be visible from the Capricorn Highway and the Stanwell Township. Site landscaping and the selection of appropriate, non-reflective, construction materials would further minimise any potential impact from the IGOC plant.

The pipeline will be buried for its full length with only above ground marker posts and cathodic protection markers being left visible. Injection sites will have the minimum practical footprint.

7.0 ENVIRONMENTAL MANAGEMENT

The Proponents are committed to best practice environmental management. Their approach is to design, construct and operate the Project to minimise its environment impact.

The Project currently proposes to implement an Environmental Management System consistent with the approach outlined in relevant Australian Standards (principally AS/NZS ISO 14001:2004).

It is intended that an integral component of the environmental management system will involve the preparation and implementation of an environmental management plan, particularly in relation to:

- Ground and surface water;
- Flora (including weeds) and fauna;
- Air quality (including greenhouse gases);
- Noise;
- Road use;
- Chemical and dangerous goods;
- Waste Management;
- Cultural Heritage; and
- Health and Safety incidents and complaints.

8.0 PROJECT APPROVALS

8.1 State and Local Government Approvals

8.1.1 State

ZeroGen is seeking designation of the Project as a 'significant project' under the *State Development and Public Works Organisation Act 1971*. The Act sets out the requirements for environmental assessment and public review of the EIS.

A number of permits and licences will be required for the Project including:

- Generation Authority pursuant to the *Electricity Act 1994*;
- Licences (pipeline and sequestration) pursuant to the *Petroleum and Gas (Production and Safety) Act 2004*;
- Environmental authorities under the *Environmental Protection Act 1994* (EP Act) for ERAs including:
    - ERA 17 - Fuel Burning
    - ERA 18(b) Power Station – generating power by consuming fuel at a rated capacity of 10MW electrical or more for a fuel other than natural gas;
    - ERA 9 Gas Producing – commercially producing hydrocarbon gas by any method including the reforming of hydrocarbon gases;
    - ERA 22 – Screening;
    - Various waste management ERA's depending on treatment of coarse slag, fly ash, waste water, sludge, sulphur and carbon dioxide;
    - ERA 21(c) construction of a pipeline and ERA 21(e) for operation of a pipeline; and
    - Confirmation of carbon storage requirements as outside of the P&G Act requirements there are no current ERA's for carbon storage.

Other legislation that may apply to the project includes:

- *Aboriginal Cultural Heritage Act 2003;*
- *Environmental and Other Legislation Amendment Act, 1997*; 45
- Environmental Policies under the EP Act that must be complied with include:
    - Environmental Protection (Noise) Policy, 1997 Qld (EPP Noise)
    - Environmental Protection (Air) Policy, 1997 Qld (EPP Air)
    - Environmental Protection (Water) Policy, 1997 Qld (EPP water)
- *Petroleum and Other Legislation Amendment Act 2004;* and
- *Petroleum and Gas Regulations 2004.*

---

[45] Amendments to the EP Act to include petroleum activities are currently under consideration by the EPA

8.1.2 Local Government

A Development Permit for Material Change of Use under the *Integrated Planning Act 1997* will be required for the IGOC plant.

Activities conducted under the *Petroleum and Gas (Production and Safety) Act 2004* (e.g. transport and underground storage of CO_2) are exempt from the requirements of the *Integrated Planning Act*. However, the location of the pipeline and facilities will take into account the intent of the various Planning Schemes gazetted for the area.

If any water or sewerage connections to local authority facilities are required this would fall within the provisions of the *Local Government Act 1993*.

8.2 Australian Government Approvals

An Australian Government referral under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) will be undertaken prior to the commencement of the State EIS process. Due to the uncertainties related to the exact location of a 220 kilometre transmission pipeline at this early stage of the Project it is likely that the Project will be considered a controlled action by the Australian Government (as a result of potential listed threatened species of national environmental significant associated with the pipeline route). The EIS would then be carried out in accordance with the bilateral agreement between the State and Australian Government which ratifies the SDPWO Act (Qld) process allowing for a single EIS process.

Approvals will also need to be sought from the Civil Aviation Safety Authority (CASA) in terms of potential impacts arising from the emissions stack height and emissions plume.

8.3 Proposed Environmental Studies

Environmental investigations completed to date have been largely desktop. More detailed environmental and engineering investigations will be undertaken during the EIS (Table 8-1).

Table 8-1: List of Detailed Environmental Studies Proposed

Discipline	Topic
Engineering	• Engineering Detailed Design • Safety Case for the IGOC plant • Preliminary Hazard and Risk Assessment to AS2885 (pipeline)
Flora	• Identification of areas of conservation significance (including regional significance) • Rare and Endangered Plant Study • Vegetation Survey of Selected Pipeline Corridor
Fauna	• Identification of areas of conservation significance (including regional significance) • Rare and Endangered Fauna Study • Habitat and Fauna Survey of Selected Pipeline Corridor

Discipline	Topic
Geophysical	• Geology – including risk assessment for sequestration • Terrain and Soil Evaluation • Water Crossing Study
Cultural and Social	• Cultural Heritage and Native Title Studies • Social Impact Assessment • Economic Analysis
General Environmental	• Air Quality Assessment • Construction and Operations Noise impacts • Surface and Ground Water Impacts

8.4 Project Schedule

Providing all the approvals and funding is secured the expected project schedule is:

Test Drilling Commences	2Q 2006
Application for Significant Project Declaration	2Q 2006
Development of EIS Terms of Reference	2Q 2006
EIS Study Commences	3Q 2006
EIS Issued for Public Comment	4Q 2007
Regulatory Approvals Granted	2Q 2008
Construction Commences	2Q 2008
Construction Ends	2Q 2010
Plant Commissioning Ends	4Q 2010
Demonstration Commences	1Q 2011
Demonstration Ends	4Q 2020

APPENDIX