Greenhouse Gas Management Plan

NewGen Power Kwinana Pty Ltd

Department: Health, Safety and Environment

NPK-HSE-PLN-009

Document History

Date	Document Number	Amended Section	Author	Approved By	Management Committee Approval
Dec 06	NPK GGAP	New Document	S. Welchman	M. Forrest	N/A
May 21	NPK-HSE-PLN-009-0	Conversion of GGAP to GGMP in accordance with DWER correspondence and in alignment with NGER reporting requirements. Updated GHG efficiency and intensity benchmarking	V. Yeo, Process & Chemical Engineer	M. Hammond, Station Manager	N/A

Contents

1. Introduction

NewGen Power Kwinana Pty Ltd (NPK) holds Ministerial Statement 0698 (MS698), approved on 7th November 2005 by Environmental Protection Authority (EPA) (amended on 15th August 2007 and 3rd November 2020 under Section 45C of the Environmental Protection Act 1986) for the construction, operation and maintenance of a combined cycle base load power plant in Kwinana (the premises).

The power plant has been in commercial operation since December 2008 and is part of the South West Interconnected System (SWIS). The power station comprises a 160MW combined-cycle gas turbine, with an 80MW heat recovery steam generator (HRSG) and steam turbine. An additional 80MW generation capacity is available from supplementary (or duct) firing, providing a total nominal capacity of 320MW. The premises are fired by natural gas supplied from the North-West Shelf and use low-NOx burners.

1.1 Scope/Purpose

This Greenhouse Gas Management Plan (GGMP) details the measures that are required to manage Greenhouse Gas (GHG) emissions from the power plant. This plan supersedes the Greenhouse Gas Abatement Programme (GGAP) management plan that was prepared in December 2006. The focus of this GGMP is carbon dioxide and other GHGs emitted from the combustion of gas in the power station including Nitrous Oxide and Methane. Other emissions to air are managed via the Stack Emission Management Plan.

1.2 Key Environmental Factors

This GGMP has considered the *Environmental Factor Guideline: Greenhouse Gas Emissions* (EPA, April 2020). The objective for this factor is:

'To reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change.'

Specifically, this is in relation to the minimising of emissions that are a direct result of an activity, or a series of activities, at a facility level (Scope 1) and emissions from the consumption of an energy product (Scope 2).

1.3 Rationale and Approach

This GGMP outlines how GHG emissions from the power station are monitored and managed to minimise the power station's contribution to global GHG emissions. This objective acknowledges that planned emissions to air from the power plant occur and that the impacts can be mitigated by implementing this GGMP.

The objectives of this GGMP are:

1) Through the use of best practice, to ensure that the GHG emissions from Scope 1 and Scope 2 activities are minimised;
2) Consider strategies for minimising GHG emissions to achieve interim and long-term targets and minimise the risk of environmental harm associated with climate change; and;
3) To manage and report GHG emissions in accordance with *National Greenhouse and Energy Reporting Act 2007*.

1.4 Relevant Ministerial Statement Conditions

This GGMP addresses the release of GHG emissions from the NPK power station in accordance with following conditions contained in MS698:

Table 1 Ministerial Statement Requirements and Reference

Condition number	Condition Text	GGMP Section
698:M7-1	Prior to commencement of construction, the proponent shall develop a Greenhouse Gas Abatement Programme to: • ensure that the plant is designed and operated in a manner which achieves reductions in "greenhouse gas" emissions as far as practicable • provide for ongoing "greenhouse gas" emissions reductions over time; • ensure that through the use of best practice, the total net "greenhouse gas" emissions and/or "greenhouse gas" emissions per unit of product from the project are minimised; and • manage "greenhouse gas" emissions in accordance with the *Framework Convention on Climate Change 1992*, and consistent with the National Greenhouse Strategy to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority. This Programme shall include:	- 1.3, 3, 2, 5, 7, 8, 9 3, 5 1.3, 3, 2, 5 1.3 -
698:M7-1(1)	calculation of the "greenhouse gas" emissions associated with the proposal, as advised by the Environmental Protection Authority;	2, 5, 6
698:M7-1(2)	specific measures to minimise the total net "greenhouse gas" emissions and/or the "greenhouse gas" emissions per unit of product associated with the proposal using a combination of "no regrets" and "beyond no regrets" measures;	3
698:M7-1(3)	consideration of the implementation of "greenhouse gas" offset strategies;	4
698:M7-1(4)	estimation of the "greenhouse gas" efficiency of the project (per unit of product and/or other agreed performance indicators) and comparison with the efficiencies of other comparable projects producing a similar product, both within Australia and overseas;	2, 5
698:M7-1(5)	implementation of thermal efficiency design and operating goals consistent with the Australian Greenhouse Office Technical Efficiency guidelines in design and operational management;	1.3, 3, 2, 5, 6, 8,
698:M7-1(6)	actions for the monitoring, regular auditing and annual reporting of "greenhouse gas" emissions and emission reduction strategies;	5, 6, 7
698:M7-1(7)	a target set by the proponent for the progressive reduction of total net "greenhouse gas" emissions and/or "greenhouse gas" emissions per unit of product and as a percentage of total emissions over time, and annual reporting of progress made in achieving this target. Consideration should be given to the use of renewable energy sources such as solar, wind or hydro power;	4, 5
698:M7-1(8)	a program to achieve reduction in "greenhouse gas" emissions, consistent with the target referred to in (7) above;	3, 5
698:M7-1(9)	entry, whether on a project-specific basis, company-wide arrangement or within an industrial grouping, as appropriate, into the Commonwealth Government's "Greenhouse Challenge" voluntary cooperative agreement program;	9
698:M7-1(10)	review of practices and available technology;	1.3, 3, 8
698:M7-1(11)	"Continuous improvement approach" so that advances in technology and potential operational improvements of plant performance are adopted.	3, 8
698:M7.2	The proponent shall implement the Greenhouse Gas Abatement Programme required by condition 7-1.	1.3, 6, 7, 8
698:M7.3	Prior to the commencement of construction, the proponent shall make the Greenhouse Gas Abatement Programme required by condition 7-1 publicly available	10

1.5 Regulatory Management Mechanisms Relevant to this GGMP

NPK and any contractors are obliged to comply with all relevant State and Commonwealth legislation. Legislation directly relevant to the management of GHG emissions in Western Australia is provided below.

1.5.1 Commonwealth

National Greenhouse and Energy Reporting (NGER)

The NGER Act was introduced in 2007 and is a single national framework for reporting and disseminating company information relating to GHG emissions, energy production, energy consumption and other information specified under the NGER Act.

The objectives of the NGER scheme are to:

- inform government policy and the Australian public.
- help meet Australia's international reporting obligations.
- assist Commonwealth, State and Territory government programs and activities.
- avoid duplicating reporting requirements in the states and territories.

The methods and criteria for calculating GHG emissions and energy data under the NGER Act are detailed in the National Greenhouse and Energy Reporting (Measurement) Determination 2008 (DoEE, 2008 updated 2020 - DAWE). NPK's emissions are reported annually under the NGER Scheme.

National Greenhouse and Energy Reporting (Measurement) Determination 2008

Describes the methods, standards and criteria to be applied when estimating GHG emissions, energy production and consumption.

Safeguarding Mechanism Baselines

The safeguard mechanism commenced on 1 July 2016 and applies to facilities that emit more than 100,000 tonnes carbon dioxide equivalent (CO_2-e) missions in a financial year. Emissions baselines represent the reference point against which emissions performance is measured under the safeguard mechanism. A safeguard facility must keep its net emissions levels at or below its baseline. Under the National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015, the Clean Energy Regulator (CER) can publish emission baseline determinations.

There are four types of emission baselines. These are:

- Reported baseline.
- Calculated baseline.
- Production-adjusted baseline.
- Benchmark baseline.

NPK was assigned a Reported Emissions Baseline by the CER in 2016 of 808,183 tCO_2-e. The power station is also covered under the sectoral baseline of 198 million tonnes CO_2-e. With the expiration of reported baselines on 1 July 2021, the sectoral baseline applies to NPK and is enforced until the sector's aggregated emissions exceed this amount.

Should the sum of reported emissions from each grid-connected electricity generator exceed the sectoral baseline for a financial year, the CER will publish a statement relevant to the financial reporting year stating that individual baseline applications will need to be applied. This would be relevant to the power station.

1.5.2 State

Environmental Protection Act 1986 (WA)

The state environmental impact assessment and Ministerial approval process.

1.6 Potential Emissions

CO_2 and small quantities of nitrous oxide (N_2O) and unburned methane (CH_4) are produced during the operations of the NPK Power Station and is also associated with Scope 1 emissions, which are the emissions released to the atmosphere as a direct result of an activity, or a series of activities at a facility level. NPK also purchase electricity from the grid to meet onsite requirements such as offices during a plant outage etc. The scope 2 emissions associated with generation of this electricity is also reported by NPK on an annual basis.

Emissions of greenhouse gases from the NPK power station have been estimated to be initially 746,000 tonnes per year (CO_2 equivalent) with an average degradation factor of 0.3% per year. The total greenhouse gas emissions from the plant has been estimated to be approximately 817,000 tonnes per year (CO_2 equivalent) in the 30th year of operation. Actual GHG emissions are reported each year as per Section 6.

2. Greenhouse Gas Efficiency

The efficiency with which useful energy can be generated by power stations from fuel is an important indicator of the relative importance of a GHG emission source. One means of reducing GHG emissions is to increase the efficiency of fuel conversion or adopt technology that is more efficient at converting fuel into electricity.

Combined cycle gas turbines (CCGT) are the most greenhouse efficient fossil fuelled power generation technology currently available. CCGTs are widely used throughout the world as a response to abate greenhouse gas production from power generation. CCGT technology achieves relatively low emissions of GHGs because it utilises natural gas, a fuel that has the least carbon intensity of the fossil fuels and utilises the waste heat from the operation of the gas turbine to raise steam and generate additional electricity in a steam turbine.

Traditional steam cycles using natural gas fuel, while having similar thermal efficiencies to equivalent sized coal fired plants have superior emissions performance due to the lower carbon intensity of the natural gas fuel when compared to coal.

The NPK power station is configured to deliver 320MW of base load capability through the combination of a 240MW CCGT plant and an 80MW conventional reheat steam cycle. The additional 80MW steam cycle is achieved through the addition of duct burners to direct fire natural gas into the heat recovery steam generator (HRSG), thus producing the effect of a conventional steam cycle.

The 240MW high-efficiency CCGT plant is designed to provide a thermal efficiency consistent with best practice. The additional 80MW of steam cycle is also designed to provide high efficiency output as it is generated through a high efficiency reheat cycle turbine as incremental load.

The GHG efficiency of the NPK power station has been calculated based as an average over a 5-year period on the High Heating Value (HHV) of the fuel. The efficiency of the power station as a whole is presented in *Table 2*. Due to the unique configuration of the facility, there is no other comparable Australian plant that can be used to directly compare or benchmark performance against, however comparisons against publicly available data for similar CCGT plants from across Australia from 2018/19 are also provided, demonstrating the high thermal efficiency of the NPK plant.

Table 2 Efficiency benchmarking (%, Higher Heating Value (HHV) Basis)

Plant	Efficiency (%) at ISO conditions (HHV)
NPK Base load Hybrid Plant 320 MW nominal (2015-2020 average)	46.5%
Yabulu CCGT 160MW, QLD (2018/19)*	47.4%
Osborne CCGT 118MW Power Station, SA (2018/19)*	44.1%

*Source: GHD 2019

2.1 GHD Intensity

As demonstrated by Table 3, the NPK power station operates at a significantly lower emissions intensity than the Default Emission Intensity for Electricity Generation defined in Schedule 2 of the National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015. The NPK power station also produces significantly less GHG emissions than similar existing and proposed power stations in Western Australia, such as FMG's PEG and Solomon Power Stations which utilise efficient reciprocating engines.

Table 3 Emission intensity benchmarking

Default Emission Intensity (Schedule 2, Safeguard Mechanism Rule) tCO_2-e/MWh	NPK base load hybrid plant (average 2015-2020) tCO_2-e/MWh	PEG Power Station Emission Intensity*[1] tCO_2-e/MWh	Existing Solomon Power Station (2018-19) tCO_2-e/MWh
0.539	0.416	0.464	0.628

3. Programme to Minimise Greenhouse Gas Emissions

NPK will implement the following "no regrets measures"[2] as per Condition 7-1 (2) of MS698:

- Minimise/reduce energy use through the following:
  - Installation of energy efficient lighting;
  - Installation of energy efficient air conditioning;
  - Routine monitoring of plant efficiency; and
  - Operate plant at optimum efficiency in accordance with manufacturer's operation and maintenance.
- Implement a routine preventative maintenance and cleaning regime to maintain operation of the power station at optimal efficiency; and
- Implement a "continuous improvement approach" so that advances in technology and potential operational improvements of plant performance are adopted where practicable.

NPK will implement the following "beyond no regrets measures"[3] as per Condition 7-1 (2) of MS698:

- Annual auditing and reporting of GHG emissions; and
- Undertake a review every five years, or sooner as directed by the Board, of state-of-the-art mitigation measures to identify advances in technology and potential operational improvements of plant performance that are relevant for CCGT plant; and
- Investigate the feasibility of implementing these technological or operational improvements at the NPK power station.

Power plant performance degradation is a major concern to power plants since degradation will have an impact on plant output levels and fuel consumption. This has a negative impact on the plant operational efficiency and environmental impact (AGO 2006).

Recoverable reductions are losses in efficiency that can be recovered by means of maintenance, repair, replacement, refurbishment of plant components or by correction of operational settings.

Non-recoverable degradation in efficiency is caused by build-up of scale and deposits, and by increased clearances, steam leakages etc. that cannot be recovered except by major refurbishment.

[1] Based on heat rate of 9 GJ/MWh and pipeline natural gas emission factor of 51.53 $kgCO_2$-e/GJ (National Greenhouse Accounts Factors, August 2019).

[2] "no regrets" measures are those that can be implemented by a proponent and which are effectively cost-neutral.

[3] "beyond no regrets" measures are those which can be implemented by a proponent and which involve additional costs that are not expected to be recovered.

At the time of design and construction of the NPK power station, the AGO Technical Efficiency Guidelines were considered, and thermal efficiency design and operating goals were implemented consistent with the AGO Guidelines. Throughout operation, NPK has worked towards successfully meeting these operating goals.

NPK is committed to minimising recoverable reductions for the operations. The minimising of recoverable reductions ensures that the most appropriate energy efficiency options are evaluated and implemented during the appropriate phases of the plant's design and operation life cycle. For example, design options are assessed during the design phase and maintenance options during the operation phase.

4. Greenhouse Gas Offset Strategies and Renewable Energy Sources

As shown in *Table 3*, the NPK power station has a GHG intensity less than the Default Emission Intensity for Electricity Generation defined in Schedule 2 of the National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015. That is, energy generated from the NPK power station has less GHG emissions than the industry baseline. *Table 2* shows the energy efficiency of the plant is better than similar plants and therefore has less emissions than that expected from best practice power stations.

The EPA's Bulletin 1190 states that:
The EPA understands that the proposed CCGT combination represents the best practicable means of meeting the additional base-load power demand required by the SWIS. While the efficiency of the combination is less than a wholly CCGT plant, the EPA is satisfied that it represents best practice for base-load power generation in consideration of the new capacity requirements of the SWIS. CCGT plants are more thermally efficient than coal-fired plants and the EPA does not require offsets to approve this proposal. However, the EPA would encourage the proponent to consider carbon sink projects during the life of the project.

Based on the above performance, GHG offsets and the use of renewable energy sources such as wind, solar or hydro are not required at this time. This may be reviewed as a response to operational amendments or as new technology becomes available.

5. Emissions Targets

The GHG emissions provided for the power station in Section 1.6 are estimates based on 7,500 hours of operation in the year. Total annual emissions are not considered a good comparative indicator of greenhouse performance over time. Accordingly, emission targets have been set on a per unit of production basis.

GHG emission targets for the power station are given in *Table 4***.** The targets will be achieved through the implementation of the actions identified in Section 3 of this GGMP. Over a 30-year timeframe, the target reduction in GHG emissions is 1.48%.

It should be noted that the targets in *Table 4* are estimates. The actual GHG intensity of the power station is determined and reported every year and compared with current best practice in accordance with the process and procedures specified by the National Greenhouse and Energy Reporting Act 2007 (NGER Act) and the NPK NGER Procedure (NPK-HSE-PRO-018). Actual plant performance and the extent of non-recoverable degradation can be determined from these reports.

Options for improving actual performance will be identified and discussed, and where deemed appropriate, these improvements will be implemented and reported through the Annual Environmental Report (AER) to DWER.

Table 4 Greenhouse Gas Emission Targets.

End of Year	Approved (tCO_2e/MW hr)	Target GHG (tCO_2e/MW hr)	Target change (%)	End of Year	Approved (tCO_2e/MW hr)	Target GHG (tCO_2e/MW hr)	Target change (%)
1	0.426	0.427	0.30	16	0.446	0.442	-0.79
2	0.427	0.428	0.20	17	0.447	0.443	-0.84
3	0.429	0.429	0.10	18	0.448	0.444	-0.89
4	0.430	0.430	-0.20	19	0.450	0.446	-0.94
5	0.431	0.430	-0.25	20	0.451	0.447	-0.99
6	0.433	0.431	-0.30	21	0.453	0.448	-1.04
7	0.434	0.432	-0.35	22	0.454	0.449	-1.09
8	0.435	0.434	-0.40	23	0.455	0.450	-1.14
9	0.437	0.435	-0.45	24	0.457	0.451	-1.19
10	0.438	0.436	-0.50	25	0.458	0.452	-1.24
11	0.439	0.437	-0.55	26	0.459	0.453	-1.29
12	0.440	0.438	-0.60	27	0.461	0.455	-1.34
13 (Oct 2021)	0.442	0.439	-0.65	28	0.462	0.456	-1.39
14	0.443	0.440	-0.70	29	0.463	0.457	-1.44
15	0.444	0.441	-0.75	30	0.465	0.458	-1.48

6. Monitoring and Reporting

GHG emissions will be monitored and reported in accordance with the requirements of the NGER Act 2007. In particular, the following information will be recorded and reported:

- Energy production;
- Energy consumption; and
- Scope 1 (Direct) and Scope 2 (Indirect) greenhouse gas emissions.

NPK have prepared and implemented a NGER procedure which outlines how to collect, calculate and govern the data for NGER. The annual review and update of NGER data and calculations (as required) is conducted by an independent expert (external consultant). The NGER data is reported to the Clean Energy Regulator (CER) each year.

A summary of the performance and compliance is discussed in the AER, which is submitted to DWER each year.

It should be noted that the energy sector is continually evolving in its approach and regulatory response. NPK has always endeavoured to achieve compliance with the current regulatory approaches to the energy market.

Previous operations have been undertaken in alignment with the then current AGO Technical Efficiency guidelines. Where applicable, NPK has retained operations in alignment with these guidelines, but have transitioned operations and performance to comply with current legislation, including the NGER Act.

7. Auditing

Annual audits will be conducted to assess compliance with this GGMP.

8. Review and Revision

Review of this GGMP will be undertaken by the Engineering Team every five years and updated where necessary or:

- following significant environmental incidents; and/or
- when there is a need to improve performance in a relevant area of environmental impact.

As mentioned in Section 3, available technology for mitigating GHG emissions from CCGT facilities will also be reviewed every five years, or as directed, and adopted where practicable. These changes shall immediately initiate a review of the GGMP, and the GGMP will be updated to reflect these changes with submission to the EPA for approval.

9. Greenhouse Challenge Plus

The Greenhouse Challenge Plus was a joint initiative between the Australian Government and industry. The key elements of the Greenhouse Challenge Plus Program were to assist companies in reducing their greenhouse emissions and provide for emissions inventory reporting. The Greenhouse Challenge Plus Program concluded in June 2009 and was replaced with the National Greenhouse and Energy Reporting System (NGERS).

NPK became a member of the Government's Greenhouse Challenge Plus Programme in 2008 and received a certificate from the Commonwealth Government upon completion of the programme (Appendix A).

10. Greenhouse Gas Management Plan Availability

This Greenhouse Gas Management Plan will be publicly available through the NPK website http://newgenpowerkwinana.com.au/.

11. References

Documents
Australian Greenhouse Office 2006 (AGO), Technical Guidelines: Generator Efficiency Standards.
Clean Energy Regulator (2020). Reported Baseline. http://www.cleanenergyregulator.gov.au/NGER/The-safeguard-mechanism/Baselines/Reported-baseline. Accessed 20 October 2020.
Department of Environment and Energy (DoEE) 2008. National Greenhouse and Energy Reporting (Measurement) Determination 2008. Australian Government, Canberra ACT.
GHD (2019). GHD AEMO Costs and Technical Parameters. GHD Pty Ltd.

12. Acronyms

Acronym	Definition
AER	Annual Environmental Report
AGO	Australian Greenhouse Office
CC	Combined Cycle
CCGT	Combined Cycle Gas Turbine
CER	Clean Energy Regulator
DWER	Department of Water and Environmental Regulation
GGMP	Greenhouse Gas Management Plan
GGAP	Greenhouse Gas Abatement Programme
GT	Gas Turbine

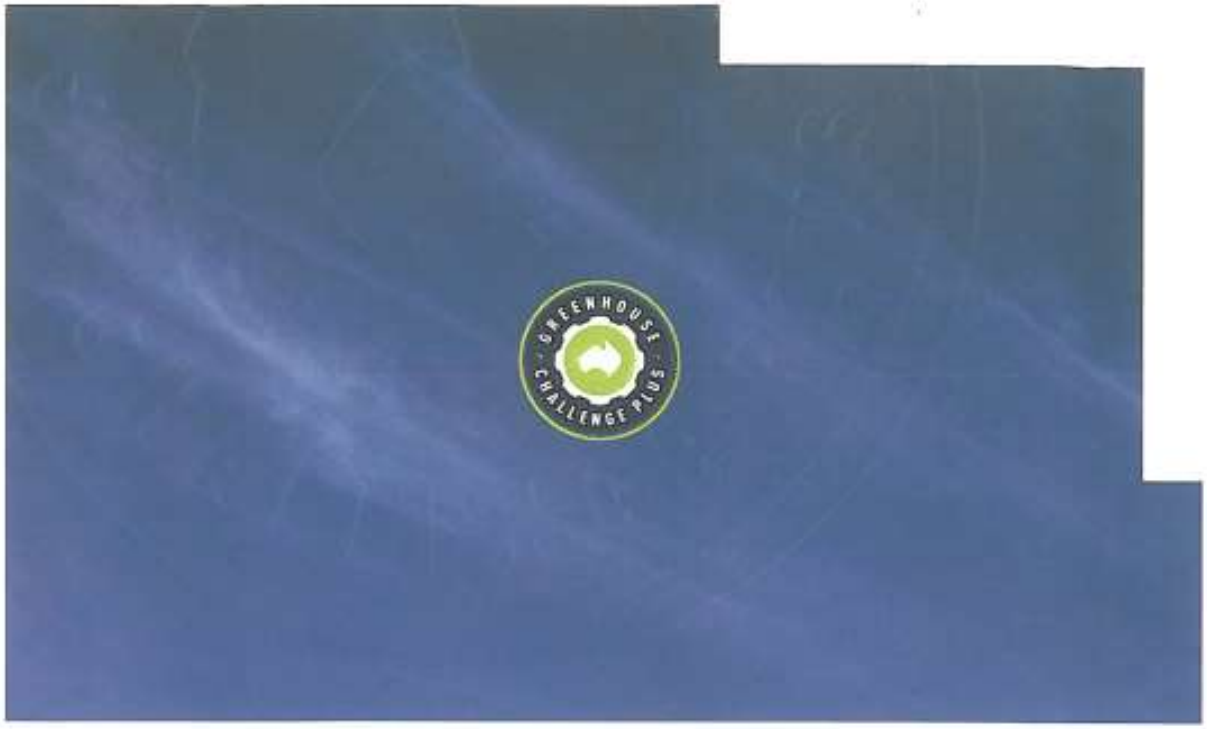
HRSG	Heat Recovery Steam Generator
MS698	Ministerial Statement 698
NGER Act	National Greenhouse and Energy Reporting Act 2007
NGERS	National Greenhouse and Energy Reporting Systems
SC	Simple Cycle
SWIS	South West Interconnected System

13. Resources and Supporting Documents

Document Title
National Greenhouse and Energy Reporting (NGER) Procedure
Stack Emission Monitoring Plan

14. Appendix A

Greenhouse Challenge Plus



The Australian Government extends its appreciation to

NewGen Kwinana Pty Ltd

for your participation in Australia's first voluntary greenhouse gas abatement program, **Greenhouse Challenge Plus**.

Your participation from 25/11/2008 assisted Australia in reducing greenhouse gas emissions by over 37 million tonnes of CO_2-e over the life of the Greenhouse Challenge Plus program.

Director
Greenhouse Challenge Plus
Department of the Environment, Water, Heritage and the Arts

Australian Government
Department of the Environment
Water, Heritage and the Arts