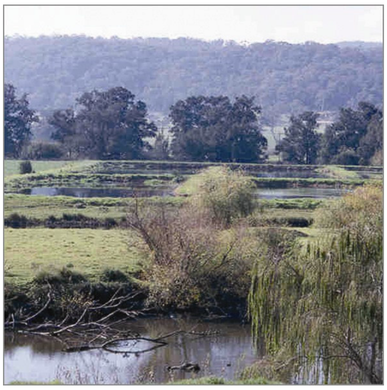
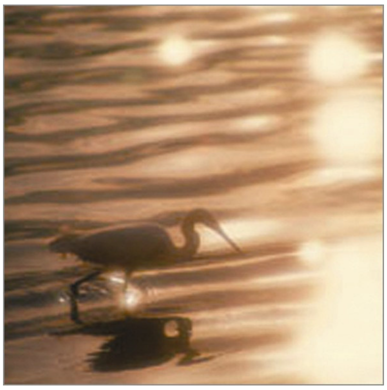
Prepared for

BlueScope Steel Limited

Greenhouse Gas Assessment

Illawarra Cogeneration Plant Project





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Abbreviations	
AGO	Australian Greenhouse Office
BFG	Blast Furnace Gas
BOS	Basic Oxygen Steelmaking
CHP	Combined Heat and Power
CH_4	Methane
COG	Coke Ovens Gas
CO_2	Carbon dioxide
DECC	Department of Environment and Climate Change
DoP	Department of Planning
EF	Emissions factor
FY 06/07	Refers to the financial year of 01 Jul 06 to 30 June 07.
GGAS	NSW Greenhouse Gas Reduction Scheme
GHG	Greenhouse Gas
GT	Gas Turbine
HRSG	Heat Recovery Steam Generator
ICP	Illawarra Cogeneration Plant
LDG	Linz-Donawitz Gas
NG	Natural Gas
NGA	National Greenhouse Accounts
NGAC	New South Wales Greenhouse Abatement Certificate
N_2O	Nitrous oxide
PKSW	Port Kembla Steelworks
STG	Steam Turbogenerator
WBCSD	World Business Council on Sustainable Development
WRI	World Resources Institute

Units	
tCO_2-e	Tonnes of carbon dioxide equivalent, defined as the combined amount of CO_2 and the global warming effect of other greenhouse gases such as CH_4 and N_2O.
kJ	Kilo joule, i.e. 1 x 10^3 Joules
MJ	Mega joule, i.e. 1 x 10^6 Joules
GJ	Giga joule, i.e. 1 x 10^9 Joules
TJ	Tera joule, i.e. 1 x 10^{12} Joules
PJ	Peta joule, i.e. 1 x 10^{15} Joules
kWh	Kilo watt hour
MWh, t and MWh e	Mega watt hour, thermal (relating to process steam), and mega watt hour, electrical (relating to electricity generation)
GWh, t and GWh e	Giga watt hour, thermal (relating to process steam), and giga watt hour, electrical (relating to electricity generation)
Mt	Million (10^6) tonnes
km	kilometres
p.a.	Per annum
kg	kilograms
kL	Kilo litre, i.e. 1000 litres
m^3	Cubic metre

1 Introduction

1.1 Background

The BlueScope Steel Limited Port Kembla Steelworks (PKSW) is a fully integrated iron and steel making plant located on a 742-hectare site within the Wollongong Local Government Area of New South Wales. The Port Kembla site is some 80 km south of Sydney and has direct access to the adjacent Port Kembla Harbour, rail transport systems and national highways. The PKSW has a nominal steelmaking capacity of 5 million tonnes and has a direct workforce of approximately 6,000 employees.

Primary iron production is undertaken in blast furnaces, six of which have been built and operated since the start of operations at Port Kembla. Today the PKSW operates two blast furnaces (Nos. 5 and 6), which have a combined daily production capacity in excess of 15,000 tonnes of iron per day. A by-product of this process is a gas mixture known as Blast Furnace Gas (BFG). The two blast furnaces produce approximately 27 PJ p.a. of BFG, which is used for process heating and for the raising of steam in boilers. Excess BFG is flared to atmosphere in onsite bleeders.

The production of iron in the blast furnaces is supported by other primary operations; namely, the coke ovens, sinter plant and ore handling facilities. The coke ovens are used to convert metallurgical coal into coke for use as the reducing agent in the blast furnaces. The conversion process involves heating the coal in ovens in the absence of air to drive off volatile compounds and gases leaving the residual carbon content as coke. The volatile constituents and gases are fed to a gas cleaning plant where many of the constituents such as coal tar are removed. The remaining Coke Ovens Gas (COG) is then fed into the inter-works gas reticulation system for distribution around the PKSW. Most of this gas is consumed within the PKSW with the balance flared. The Coke Ovens produce approximately 18 PJ p.a. of COG.

Secondary processing of the iron to form steel is undertaken in the Basic Oxygen Steelmaking (BOS) Plant. In simple terms this process involves burning out impurities from the iron by blowing oxygen into a molten mixture of iron, scrap steel and alloying agents. One of the main 'contaminants' in the iron is carbon and during the oxygen lancing process its presence results in the production of large quantities of carbon monoxide. The carbon monoxide, along with other gases, is collected in the dust collection system as BOS 'off gas', (also known as Linz-Donawitz Gas, or LDG). Due to the complexities in collecting the LDG, large volumes of which are produced in batches, this potentially useful by-product gas is currently flared. The portion of LDG which can be collected and utilised is approximately 4 PJ p.a.

Steel produced in the BOS process is then moved to one of three continuous casting machines where steel slabs, one of the main products of the PKSW, are produced.

The other main production area on the PKSW comprises hot rolling mills and cold rolling mills. These facilities convert the slabs from the slab caster into either coils of strip steel or flat plates of varying thickness. These facilities have no impact on the Illawarra Cogeneration Plant (ICP) design or implementation.

1.2 Current Steam and Electricity Supply Arrangements

The onsite production of steam is integral to the steel production process as it is the primary driving energy source for large rotating equipment including turbo blowers, air compressors and coke ovens exhausters. In addition it is used for internal power generation, process heating and other uses around the site.

The existing plant consists of five boilers, four of which, due to their size and age are planned to be shut down and decommissioned following commissioning of the ICP Project. The by-product fuels currently collected (BFG and COG) are consumed as fuels within the operating plant (for heating) and existing boilers (for steam raising). Surplus fuel currently flared (including LDG) makes up about 16% of the total by-product fuels produced.

Electrical power currently generated on site from steam is consumed within the site boundary and provides approximately 13% of total site electrical requirements.

Power is purchased via five (5) feeders from the Integral Energy distribution network and is distributed across the site to both internal and external customers via a network owned and operated by BlueScope Steel.

1.3 Project Objectives

The key objectives of the ICP Project are to:

- Improve the efficiency by which fuels generated at the PKSW are converted to electricity and steam;
- Put surplus fuels, produced at the PKSW and currently flared, to a useful purpose;
- Allow the decommissioning of old power and steam generating plants at BlueScope Steel's PKSW. These plants have relatively high operating and maintenance costs and have, by modern standards, poor efficiency and availability. The fuel used by these plants will be used by the ICP;
- Improve the reliability and security of steam supply to the PKSW; and
- Provide for overall greenhouse gas emission reductions and the associated benefits..

1.4 Project Description

Development of the ICP will guarantee the availability and reliability of steam for the PKSW.

The ICP has been designed to utilise surplus by-product fuels to generate steam under a wide range of operating scenarios such that as much as is practicable of the available by-product fuels produced on site are efficiently utilised. The steam produced will be used as a source of primary energy in equipment and to supply process heat with the surplus used to generate electricity.

The ICP will be integral to the operation of the PKSW and will make efficient use of all available by-product fuels produced on site, i.e., BFG, COG and LDG. The ICP will also be capable of peaking generation using natural gas as a supplement to by-product fuels. Under the peaking scenario, additional natural gas will be used by the ICP to generate electricity for export to the NSW grid at times when it is economical to do so based on NSW pool prices for electricity. The electricity generated under the peaking scenario is considered to be beneficial to the project as it makes use of the available ICP capacity and uses supplementary natural gas to produce additional electricity. This additional, or marginal electricity, is over and above the amount generated using predominantly byproduct fuels and can replace electricity from the NSW grid produced by coal-fired facilities.

The ICP will consist of three new high pressure boilers capable of burning BFG, COG and LDG with supplementary natural gas firing. LDG collection and distribution systems form a significant extension to the existing facilities required to enable utilisation of this fuel. Existing boilers 21 to 24 will be shut down and de-commissioned, however No. 25 Boiler will remain in service producing process steam for internal use supplemented with steam from the new ICP boilers. The remainder of the steam produced by ICP will be used to drive a new 225 MW Steam Turbogenerator (STG).

While the ICP is expected to generate electricity amounts which approach that of the total site requirements, due to the current physical electrical connection arrangements (including consideration of the cost to adjust the connection arrangements) the majority of the power generated will be exported to the grid. Power required by the Steelworks site will be purchased and supplied via existing incomers, retained internal generation, and a new sixth incomer.

1.5 Basis of Data Presented

The data presented within this report was developed from computational modelling of predicted performance based on design of new plant equipment. Historical data for the FY 06/07 year was used as the basis for the comparison of the pre-ICP (FY 06/07) and post-ICP cases as this is representative of historical performance and allows a direct comparison of the impact of ICP. The comparison is made on the basis that there will be no other changes on site which may affect greenhouse gas (GHG) emissions, such that any changes in emissions between these two sample periods can be directly attributable to the ICP.

The analysis involved the use of half hourly data for all steam and fuel consumption/production across the site. Hence the FY 06/07 data is a summary of the historical operation, whereas the post ICP results show what would be predicted to occur under the expected similar operational circumstances, following the commissioning of the ICP.

Two sets of data are provided for the post ICP operation – maximum generation and minimum generation.

The figures provided for the maximum generation scenario represent the case where the ICP is generating the expected amount of electricity. This figure is averaged over the life of the ICP facility such that short term variations in steelworks by-product fuel availability, as well as variations in available steam and electricity generation capacity due to scheduled boiler and STG maintenance outages, are taken into account.

Estimated electricity generation values are based on the results of completed feasibility design work. A number of factors could impact on these estimates, including:

- Process or equipment modifications during detailed design,
- The possibility of variation in boiler or STG performance,
- Changes to Steelworks output or equipment configurations which may impact on future fuel availability and steam demand, and
- Inaccuracies associated with metering large scale by-product fuel gas and steam flows

These potential variations lead to a range in estimated electricity generation values and the above factors are used to determine the post-ICP minimum generation scenario. As for the maximum generation figures, the post-ICP minimum generation figures also reflect the predicted long term average operation of the ICP. It should be noted that the actual values will not be confirmed until the completion of performance tests after the equipment is fully commissioned.

Throughout the GHG assessment, the differences between the pre-ICP, i.e. FY 06/07, case and the post-ICP case, which reflect the impact of the ICP, are calculated relative to the minimum generation scenario post-ICP as this represents the more conservative case.

It is also acknowledged that the NSW Pool Coefficient is likely to reduce over time as the proportion of lower greenhouse emission intensity generation sources increases in NSW. Such a reduction in the pool coefficient would reduce the calculated GHG emission reductions provided by the ICP.

The natural gas peaking data is based on modelling the use of additional natural gas for marginal electricity generation for a nominal 15% of the available time. During this period, generator output was assumed to increase from the average to the maximum generation rate. This data is provided for completeness within the GHG assessment, however, note that the typical or baseline change in GHG emissions resulting from the ICP is based on the change between the FY 06/07 and the predicted long-term post-ICP average without peaking for the minimum generation scenario (see **Section 8** for further discussion of the peak electricity generation scenarios).

1.6 Purpose of Report

This Greenhouse Gas Assessment Report has been prepared in accordance with the Director-General's Environmental Assessment Requirements (EARs). This assessment provides an estimation of the changes in GHG emissions associated with BlueScope Steel's PKSW site as a direct result of the ICP Project. In addition, emissions reductions associated with the reduced net consumption of electricity from the NSW electricity network, as well as the export of low emissions intensity electricity to the NSW electricity network are presented.

2 Methodology

This section presents the guidelines utilised in preparing this assessment, and the assessment criteria as stipulated in each guideline.

2.1 Guidelines

This GHG assessment has been completed in accordance with three guidelines:

1. The NSW Department of Planning *Draft Guidelines for Energy and Greenhouse in EIA* (DoP 2002);
2. The Australian Department of the Climate Change, National Greenhouse Accounts (NGA) Factors (NGA 2008); and
3. The World Business Council on Sustainable Development & World Resources Institute *The Greenhouse Gas Protocol* (WBCSD & WRI 2004).

This assessment is structured according to the recommendations of DoP 2002, NGA 2008 and WBCSD & WRI 2004.

2.2 Application of emission calculation guidelines

The following section discusses each of the three guidelines listed above and how they have been applied for this assessment.

2.2.1 NSW Department of Planning *Draft Guidelines for Energy and Greenhouse in EIA*

The objective of the Greenhouse and Energy Guideline in EIA is to provide guidance on the consideration of energy and greenhouse issues associated with developing projects and when undertaking environmental impact assessment (EIA) under the Environmental Planning and Assessment Act 1979 (EP&A Act).

The Draft NSW EIA Guidelines adopt the concept of reporting 'scopes' as follows:

- Scope 1 – Direct Energy Use Greenhouse Gas Emissions

  Within Scope 1 proponents consider energy use and greenhouse gas emissions that occur on-site or under the direct and immediate control of the proponents. Scope 1 principally consists of, but are not necessarily limited to, the energy use and greenhouse emissions produced by activities such as production of electricity, heat and steam and the combustion of fossil fuels for any other purpose.

- Scope 2 – Indirect Energy Use or Greenhouse Gas Emissions from Imports and Exports of Electricity, Heat or Steam

  Scope 2 principally focuses on the indirect emissions associated with the generation of purchased and imported electricity, heat or steam. Within

Scope 2 proponents are required to report all energy use and greenhouse emissions associated with the import and export of electricity, heat or steam. For many projects, the efficient use of imported electricity represents the most significant opportunity to reduce greenhouse gases. Scope 2 facilitates the transparent consideration of the use of Green Power or co-generation options which may enable some projects to use less greenhouse intensive power sources. The following points are noted in the Draft NSW EIA Guidelines:

- o All imports should be listed separately from exports. Imports and exports should not be netted.
- o Exports should be listed as negatives. In reporting the export of electricity, proponents are permitted to calculate "displacement" greenhouse gas emissions associated with low emissions intensity energy (e.g. for export of renewable electricity). Proponents can calculate the emissions intensity of the exported quantity and then take the difference between these factors as the associated displacement.

- Scope 3 - Other Indirect Energy Use or Greenhouse Gas Emissions

Within Scope 3 proponents are required to report other indirect energy use or greenhouse gas emissions that are a consequence of the proposal but do not occur on-site or are removed from the proponent's direct control.

- Scope 4 – Greenhouse Gas Emissions Abatement from Offset Opportunities

Within Scope 4 proponents could report any carbon offsets that have occurred as a direct result of the proposal. Proponents may report on the following activities:

- o Carbon sequestration performed by the proponent;
- o Community based energy use or emission reduction initiatives; and
- o The use of official government endorsed Kyoto Protocol flexibility mechanisms.

Greenhouse gas emissions associated with these activities are reported as negative values. Proponents are required to provide adequate supporting data and background information.

Section 4 and 5 of the Draft NSW EIA Guidelines deals with the framework for assessment and reporting boundaries for a particular project and establishes two levels of assessment. These levels of assessment are discussed in **Section 2.3.1.**

2.2.2 The Australian Department of the Climate Change, National Greenhouse Accounts (NGA) Factors

The National Greenhouse Accounts (NGA) Factors has been prepared by the Department of Climate Change and replaces the AGO Factors & Methods Workbook. This report uses the emissions factors and methodologies from the NGA Factors and from the Technical Guidelines for the Estimation of Greenhouse Emissions and Energy at Facility level.

The Technical Guidelines were designed to support reporting under the National Greenhouse and Energy Reporting Act 2007, once the first reporting period under the Act commences on 1 July 2008.

2.2.3 The World Business Council on Sustainable Development & World Resources Institute *The Greenhouse Gas Protocol*

The GHG Protocol established an international standard for accounting and reporting of GHG emissions by entities.

Chapter 4 of this Protocol deals with setting operational boundaries and is of particular relevance to this Project. The protocol describes how to set out operational boundaries by firstly identifying emissions associated with its operations, secondly involves categorising them as direct and indirect emissions, and finally choosing the scope of accounting and reporting for indirect emissions.

The protocol describes each scope as follows:

- Scope 1 – Direct GHG emissions

Direct GHG emissions occur from sources that are owned or controlled by the company, for example, emissions from combustion in owned or controlled boilers, furnaces and vehicles.

- Scope 2 – Electricity indirect emissions

Scope 2 emissions are a category of indirect emissions that accounts for GHG emissions from the generation of purchased electricity consumed by the company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organisational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated.

This definition of Scope 2 within the GHG Protocol guidelines does not include the displaced emissions arising from the export of electricity generated on site. However, the GHG Protocol guidelines do allow the reporting of displaced emissions arising from the export of electricity under Chapter 9 as additional information. The Draft NSW EIA Guidelines differ from this in that the Scope 2 definition enables the reporting of emissions from electricity imports and displaced emissions from electricity exports. For this assessment, electricity imports and exports are assessed within Scope 2 consistently with the Draft NSW EIA Guidelines.

- Scope 3 – Other indirect GHG emissions

Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are defined as a consequence of the activities of the company, but occur from sources not owned or controlled by the company. Some examples of Scope 3 activities provided in the GHG Protocol are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services.

At a minimum, companies are required to report on scopes 1 and 2.

2.3 Assessment structure

This section addresses the level of assessment according to NSW Department of Planning (DoP) recommendations, the reporting of emissions according to scopes, and the boundaries within the PKSW that are included in this assessment.

2.3.1 Assessment Level according to Draft NSW EIA Guidelines

The assessment of GHG emissions under the Draft NSW EIA Guidelines is broken down into the four 'scopes' discussed above in **Section 2.2.1**.

In addition to the four scopes, the Draft NSW EIA Guidelines establish two levels of assessment. A Level 1 assessment is a reduced assessment and is considered suitable for project proposals that will generate less that 20,000 tonnes of CO_2 equivalent (tCO_2-e) per annum. A higher degree of accuracy is required for projects approaching the 20,000 tCO_2-e per annum threshold.

Level 2 assessments are more in-depth and are required for projects with a significant level of GHG emissions and energy (in excess of 20,000 tCO_2-e or energy consumption in excess of 200 TJ). A Level 2 assessment need only be undertaken once a Level 1 assessment has been completed and one of the Level 2 trigger values has been met or exceeded.

The Draft NSW EIA guidelines describes the trigger levels mentioned above to determine whether a Level 1 or Level 2 assessment is required (as outlined in Table 12 of the guidelines). After a review of information contained in Table 12 pertaining to Level 1 and Level 2 assessments, a Level 2 assessment is considered to be required for the ICP Project (net GHG emissions from the PKSW will be reduced as a result of the ICP Project, but are expected to be greater than 20,000 tCO_2e per year).

The requirements for a Level 2 assessment are as follows:

- A more detailed description of the proposal;
- Establishment of the scope of assessment;
- Identification of energy sources and GHG emission sources; and
- Justification of proposed mitigation measures.

This report discusses the above requirements.

2.3.2 Reporting of emissions according to Scopes

This assessment reports GHG emissions within the following scopes:

Scope 1: GHG emissions arising from direct energy use or GHG emissions that occur on-site or those which are within the direct control of the proponent. In relation to the ICP Project, the primary sources of Scope 1 emissions are from the combustion of fuel in the ICP boilers.

This is reported according to:

- tCO_2e per MWh produced by the ICP
- total annual GHG emissions for two sample years: before the ICP is operating (FY06/07) and for a full year of operation post-ICP
- tCO_2-e on a fuel basis

Note that the GHG emissions generated on a fuel basis is only relevant for natural gas (rather than combined by-product gases and natural gas) for this assessment. This is because there is no change to the amount of combustion of by-product gases on site as a result of the ICP Project. There will only be changes to the amount of natural gas combusted on site. The GHG emissions on the basis of the natural gas combusted, i.e. in terms of kg CO_2-e/GJ will be the same as the emission factor used for natural gas (51.3 kg CO_2-e/GJ as provided by the NGA Factors workbook).

Scope 2: Indirect energy use or GHG emissions associated with the import and export of electricity, heat or steam at the PKSW.

Scope 3: Other indirect GHG emissions associated with:

- extraction of natural gas fuel imported by the BlueScope Steel PKSW
- fuel extraction (e.g. coal) associated with imported electricity reported under Scope 2
- line losses associated with imported electricity reported under Scope 2.

This GHG assessment for the ICP plant provides estimations of Scope 3 indirect emissions for the above activities, as well as estimations of emissions arising from the use of mobile sources and the production of steel and cement associated with the construction phase of the Project.

Note that BlueScope Steel's normal annual GHG reporting addresses Scopes 1 and 2 only.

2.3.3 Boundaries

This GHG assessment focuses on only the changes to equipment as part of the ICP Project. As discussed in the Introduction section, the main changes include the addition of three new high pressure boilers and a single STG as well as the decommissioning of existing boilers 21 to 24.

For the majority of the GHG assessment, changes to the consumption of natural gas and the generation of electricity are the primary considerations. Currently, the majority (84%) of the by-product gases produced on site are consumed as fuels for either heating or steam raising, and the remaining by-product gases produced (16%) are flared. Post-ICP, it is expected that a much higher proportion of the by-product gases produced will be efficiently utilised on site as process fuels and for the generation of steam in the boilers with a significant reduction in the amount of flaring. As a result, there are not expected to be any significant net changes in GHG emissions associated with the combustion of the by-product gases, and hence the GHG emissions calculations provided are based only on the changes in natural gas combustion. This is discussed further in **Section 3.1**.

2.4 GHG emission calculation methods

NGA Factors (2008) offers guidance on reporting, calculation methods and emissions factors that may be used to estimate GHG emissions from various sources. The NGA Factors has been used as the default guideline for the calculations undertaken.

Input data, data sources, algorithms and emission factors used in this assessment are presented within each Scope section **(Sections 3, 4, and 5**).

2.5 Comparisons to assess the Project's GHG mitigation performance

According to guidance provided by the DoP and NSW Department of Environment and Climate Change (DECC) for this Project, annual emissions should be compared against:

1. total annual NSW emissions (so the impact of the proposal on NSW emission reduction targets can be evaluated);
2. emissions from a coal fired facility producing an equivalent amount of electricity; and
3. 'best practice' emissions for peak electricity generation.

Items above are presented in **Section 9**.

3 Scope 1

The assessment of Scope 1 GHG emissions was carried out in relation to the ICP Project. As per the definitions provided in **Section 2.3.2**, Scope 1 emissions include direct energy use or direct GHG emissions. Direct emissions are those produced from sources within the boundary of the plant or facility. For this assessment, Scope 1 includes changes to emissions from the plant which are attributable to the ICP Project. In relation to BlueScope Steel's activities, direct sources that have potential to generate GHGs include:

- Combustion sources, or processes resulting in the generation of heat, steam or electricity, e.g. furnaces, incinerators, boilers and flares;
- Fugitive sources, e.g. emissions from fuel gas system leaks or equipment leaks;
- Other vents, including venting during equipment/process blow-downs, venting from emergency shut-downs, lifting of pressure relief valves.

In order to calculate the quantity of GHG generated from direct sources, emission factors are used. For various processes and fuel types, these are expressed in terms of the quantity of GHG generated per amount of energy consumed. For this assessment, emission factors were obtained from the NGA Factors 2008.

3.1 Identification of Scope 1 activities

This section details energy use and GHG emissions from the ICP Project.

3.1.1 Combustion of Fuel in ICP Boilers

The three new boilers as part of the ICP Project will use both by-product gases and natural gas as fuels for the generation of steam, with the predominant fuel being the by-product gases. The steam generated will be used in the ICP generator for the production of electricity and for process use on site (predominantly driving rotating equipment). A small amount of steam will be sent off-site to a neighbouring industry for process heating.

Currently by-product gases (surplus to PKSW process use requirements) are combusted in existing boilers on site, with the excess flared. With the introduction of the ICP Project, the majority of the surplus by-product gases will be redirected to the new boilers and burned. Combustion of the by-product gases in the new ICP boilers is expected to provide better air and gas mixing compared to the combustion at the flares. This is expected to result in higher overall combustion efficiencies and the reduction in the potential for releases of carbon monoxide to atmosphere. Any change in CO_2-e resulting from the combustion of by-product fuels in the ICP boilers compared to flares is not expected to be significant within the scale of the CO_2-e emissions reported. The change in GHG emissions resulting from the combustion of fuels in the ICP boilers will therefore only be considered to be attributable to the change in natural gas consumed in the new boilers for steam raising.

The primary GHG which will be released to atmosphere as a result of combustion of natural gas in the new boilers is CO_2. Other GHG pollutants emitted from stationary combustion activities include methane (CH_4) and nitrous oxide (N_2O). The rates of emission of CH_4 and N_2O are mainly dependent on fuel characteristics, type of combustion technology, operating and maintenance regimes, and the size and vintage of equipment. N_2O emissions are closely related to air to fuel mixes and combustion temperatures. CH_4 emissions from stationary combustion sources are primarily a function of the CH_4 content of the fuel and combustion efficiencies.

On a global warming potential weighted basis, emissions for CH_4 and N_2O from combustion in the ICP boilers are expected to be minor, and as such, the default emission factor from the NGA Factors 2008, which includes CO_2, CH_4 and N_2O, is adequate for this assessment.

3.1.2 Fugitive Losses

Due to the installation of additional natural gas piping systems as part of the ICP Project, fugitive losses of methane have been considered. However, as the piping system will all be new, the likelihood of leaks causing methane fugitive emissions initially, and over the life of the Project, is expected to be very low. In addition, any fugitive losses from leakages are expected to be insignificant in comparison to the GHG emissions resulting from combustion sources.

3.1.3 Venting Losses

During an emergency shut-down event of the ICP equipment, any surplus by-product gases would be directed to the existing flares instead of being combusted at the boilers. Small amounts of by-product gases and natural gas will be vented or purged from the safety shutdown system as part of any emergency shutdown sequence. Due to the small quantities of gases involved and the expected low frequency of emergency shutdowns, any contribution to GHG emissions from these conditions is expected to be insignificant.

In the event of a plant upset which results in incomplete or inefficient combustion of fuel gases at the ICP boilers, there would be an increase in the amount of methane and/or nitrous oxide at the boiler stacks. Due to advanced monitoring and control it is expected that such an event would be of very low frequency and short duration. As such, any contribution to GHG emissions from these conditions is expected to be insignificant.

3.2 Emissions calculations

For the activities and processes that were identified to be contributors to the generation of Scope 1 GHG emissions, emission factors were used, as discussed earlier, to calculate the CO_2-equivalent mass emission rate for the Project both before and after the ICP. The emission factors and other input data used in the calculations are provided in **Table 3.1.**

Note that, as discussed earlier, the figures provided for the Pre ICP (FY06/07) and Post ICP minimum generation case represent the changes expected as a result of the ICP.

Table 3.1 Scope 1 Input Data

Input data	Units	Value			Data source
Emissions Factor for Natural Gas NSW and ACT (Note 1)	kg CO_2-e/GJ	51.3			NGA Factors 2008
	Units	**Pre-ICP**	**Post-ICP, Min Gen**	**Post-ICP, Max Gen**	
Natural Gas unit purchases for total site (Note 2)	GJ/yr	3 257 040	2 534 220	2 534 220	BlueScope Steel
Natural Gas used for steam raising on site (Note 2)	TJ/yr	946	223	223	BlueScope Steel
Net electricity generated on site (from STG's) (Note 4)	MW	17.16	116.6	140.0	BlueScope Steel
Total steam raised on site	TJ/yr	13 834	24 866	25 551	BlueScope Steel
Total steam on site used for electricity generation	TJ/yr	3 236	14300	14963	BlueScope Steel
Total steam on site used as process steam	TJ/yr	10 598	10566	10588	BlueScope Steel

Notes:

1. *The emission factor for a large user has been used as BlueScope Steel has an annual usage of more than 100 000GJ.*
2. *The fuel consumption figures pre-ICP are based on the 2006/07 financial year and the figures post-ICP are based on the predicted long-term consumption figures following commissioning of the ICP.*
3. *As discussed in Section 1.5, the maximum and minimum post-ICP figures are a result of the range of electrical generation possible due to potential changes during detailed design, or actual performance of the proposed new boilers and/or steam turbine generator.*
4. *The net electricity generated on site is from steam related generation only and is less the power consumed by auxiliary loads.*

3.2.1 Total annual emissions for two sample years

Calculations of purchased natural gas Scope 1 emissions were completed in accordance with NGA Factors 2008.

The calculation based on gas consumed requires the quantity of natural gas consumed and a specific emissions factor. The following equation applies:

$$\text{GHG emissions } (tCO_2\text{-e}) = Q \times EF/1000$$

Where: Q is the quantity of natural gas consumed by BlueScope Steel expressed in GJ

EF is the relevant emissions factor for NSW expressed in kg CO_2-e/GJ identified in NGA Factors 2008.

3.2.2 GHG emissions per MWh produced

The CO_2–e emissions generated on the basis of the energy output streams before and after the ICP Project were calculated. The resulting emissions intensity figures were calculated in terms of net electricity generated, process steam generated, and also on the basis of the combined energy output streams, i.e. both electricity generated and process steam generated.

The following formulae were used to obtain these figures:-

(i) Net electricity generated basis

Emissions intensity = % of total steam raised used for electricity production x total emissions / MWh e of net electricity generated

(ii) Process steam generated basis

Emissions intensity = % of total steam raised used for process steam x total emissions / MWh t of process steam produced

(iii) Combined output energy stream basis

Emissions intensity = total emissions / (MWh t of process steam produced + MWh e of net electricity generated).

Note that the resulting energy intensity figure will change as the proportions of process steam and electricity generation are varied (e.g. from average loads to peaking loads) because of the different efficiencies associated with producing each output stream.

In all cases, the CO_2-e emissions are those arising from the combustion of natural gas (for steam raising activities).

3.2.3 Allocation of GHG Emissions based on energy output streams

Guidance within the GHG Protocol recommends that, for operations involving the sale of energy from a combined heat and power (CHP) plant, consideration needs to be given to the allocation of emissions for different output streams, i.e. electricity and process steam. This is specifically for cases where the process steam and electricity output streams are not sold in the same proportions as they are generated. This applies to the ICP Project because the majority of the electricity will be sold (based on the physical connection situation), but the excess steam generated will be used as process steam on site.

As such, the CO_2 equivalent emissions have been allocated to each of process steam generation and electricity generation on the basis of the energy content of the steam raised from the boiler for each application.

3.3 Results

Emissions arising from Scope 1 purchased natural gas are presented in **Table 3.2**.

Table 3.2 Results of Scope 1 purchased natural gas emissions calculations

	Units	Pre ICP	Post-ICP, Min Gen	Post-ICP, Max Gen	Change
GHG Emissions – for total site NG consumption	t CO_2-e / year	167 086	130 005	130 005	-37 081
GHG emissions on the basis of process steam energy	t CO_2-e / MWh t	0.0126	0.0017	0.0016	- 0.0110
GHG emissions on the basis of electricity (net) generated	t CO_2-e / MWh e	0.0755	0.0065	0.0055	- 0.0691
GHG emissions on the basis of combined output streams (process steam and net electricity)	t CO_2-e / MWh	0.0157	0.0029	0.0028	-0.0128
GHG emissions per fuel consumed (for natural gas only)	kg CO_2-e / GJ	51.3	51.3	51.3	0
GHG Emissions allocated to electricity production for the site	%	23.4	57.5	58.6	+34.1
GHG Emissions allocated to process steam production for the site	%	76.6	42.5	41.4	-34.1

Notes:

1. The change in emissions is based on the difference between the pre-ICP (FY06/07) and the post-ICP, Min generation data. Changes as a result of natural gas peaking are presented in Section 8.

2. GHG emissions on basis of electricity generated are based on net electricity, i.e. gross production minus consumption by auxiliaries.

3. All emissions intensity figures (i.e. t CO_2-e / MWh) are based on emissions attributable to, and consumption of, natural gas only.

4. GHG emissions on a fuel basis is the same as the NGA Factors 2008 emission factor. This is because the emissions are only related to natural gas, and hence by definition, will be the same as the emission factor used in the calculations of mass CO_2-e emissions.

3.4 Discussion of results

The major contributor to the change in generation of Scope 1 GHG emissions associated with the ICP Project is a result of the natural gas consumed in the boilers. The emissions resulting from natural gas combustion actually decrease post-ICP due to the ability to allow gas mixing in the new ICP boilers and hence the elimination of the need to run gas pilots in the boilers under most operating scenarios. The decrease in Scope 1 emissions resulting from the ICP will be approximately 22.2% of the emissions attributable to natural gas consumption on site prior to the ICP Project (i.e. based on the FY06/07 figures).

Post-ICP, the majority of the GHG emissions from natural gas combustion in the boilers will be attributable to the generation of electricity.

Other potential Scope 1 GHG emissions associated with the ICP Project such as fugitive emissions and vent releases are expected to be insignificant in comparison to the emissions arising from combustion within the ICP boilers.

4 Scope 2

In accordance with the relevant guidance documents outlined in **Section 2.1**, an assessment of Scope 2 emissions was completed for the existing imported energy usage of the site during the baseline year FY 06/07 as well as the expected imported and exported energy usage for the site once the ICP is operational. As for Scope 1, the Scope 2 assessment for post-ICP, was carried out for both the maximum and minimum generation cases to reflect the potential range of electrical generation from the ICP equipment. The change in emissions was calculated to be the difference between the pre-ICP FY 06/07 data and the minimum generation scenario for the post-ICP data.

As discussed earlier, although the PKSW purchases or imports electricity from the NSW grid, the ICP Project will also result in the generation and export of significant amounts of electricity to the NSW grid. Net imports from the NSW grid to the PKSW will reduce substantially through the implementation of the ICP. The emission reductions associated with the reduced volume of net electricity drawn from the NSW grid are included in the Scope 2 calculations.

4.1 Identification of Scope 2 activities

Scope 2 energy use and associated emissions are related to PKSW purchased (imported) and generated (exported) electricity.

Post-ICP, it is expected that there will be 1022 GWh/yr of net electricity generated by the ICP, 855 GWh/yr of electricity exported to the NSW grid, and 1130 GWh/yr of electricity purchased from the NSW grid. These figures represent the minimum generation scenario. Under the maximum generation scenario post ICP, there is no change to the electricity purchased, however the net electricity generated and exported increase to 1227 GWh/yr and 1060 GWh/yr, respectively. This translates to a relatively small net import of electricity post-ICP compared to a very large net import of electricity pre-ICP.

The amount of electricity purchased following the commissioning of the ICP is less than that purchased in the FY06/07 due to the partial flow of ICP generation to internal consumers. This flow is assumed in this analysis to be on average 35 MW, offsetting changes to site power demands resulting from ICP auxiliary power consumption and the decommissioning of the existing steam turbo generators which have reached the end of their economic service life.

Note that in addition to the export of electricity, there is a small amount of steam generated on the PKSW site which is exported to a neighbouring facility. This amount will not change as a result of the ICP, and will be approximately 0.47% of the total steam generated on site post-ICP. The GHG emissions associated with the generation of this steam are included within the Scope 1 calculations.

4.2 Emissions calculations

Scope 2 GHG emissions are estimated using the following equation adopted from NGA Factors 2008:

$$GHG\ emissions\ (t\ CO_2\ –e) = Q\ x\ EF/1000$$

Where: Q (activity) is the amount of imported or exported electricity consumed or generated by the proponent expressed in kWh.

EF is the relevant emissions factor expressed in kg CO_2 –e/kWh.

According to the NSW Energy and Greenhouse Guidelines for EIA, within Scope 2 calculations, proponents are permitted to calculate the “displacement” GHG emissions associated with low emission intensity energy. Proponents can calculate the emissions intensity of the exported quantity of electricity, compare this to the NSW grid’s marginal sent out GHG emissions intensity and then take the difference between these factors as the associated displacement.

For this assessment, the direct GHG emissions attributed to the generation of electricity at the ICP are calculated and included in the Scope 1 figures. As such, the emissions intensity of the exported electricity is not deducted from the NSW marginal sent out emissions intensity. Including the emissions intensity for the ICP electricity generation in this section would result in a ‘double-counting’ of emissions. To calculate the displaced emissions (from coal fired generation elsewhere in NSW), the exported quantity of electricity is multiplied by the NSW Pool Coefficient only, with no adjustment.

Note that the NSW Pool Coefficient is used as this is a recognised indicator of the average emissions intensity of electricity sourced from the electricity grid in NSW. It represents the emissions of GHG per MWh of electricity supplied from the ‘pool’ of major power stations servicing the NSW electricity grid. The most recent NSW Pool Coefficient figure, i.e. that from 2008, is used.

Scope 2 input data is presented in **Table 4.1**. FY06/07 PKSW purchased electricity (sourced from BlueScope Steel electricity purchasing records), estimates of post-ICP electricity import and export amounts, and the relevant emissions factors are presented below.

Table 4.1 Scope 2 Input Data

Input data	Units	Pre-ICP	Post-ICP, Min Gen	Post-ICP, Max Gen	Data source
Imported electricity into the site	MWh	1 146 211	1 129 773	1 129 773	BlueScope Steel
Exported electricity from the site	MWh	0	- 854 976	- 1 059 960	BlueScope Steel

NSW & ACT grid Scope 2 electricity emission factor for purchased electricity	kg CO_2-e/kWh	0.89	NGA Factors 2008
NSW Pool Coefficient, 2008	t CO_2-e/MWh e	0.954	GGAS Fact Sheet – The NSW Pool Coefficient

4.3 Results

Scope 2 emissions for FY 06/07 and for a full year of post-ICP operations are presented in **Table** 4.2.

Table 4.2 Scope 2 Emissions and Reductions

Scope 2 emissions	Units	Pre-ICP	Post-ICP, Min Gen	Post-ICP, Max Gen	Change
Emissions generated by imported electricity	t CO_2-e /yr	1 020 128	1 005 498	1 005 498	-14 629
Emissions displaced at NSW grid as result of electricity export from ICP	t CO_2-e /yr	0	- 815 647	-1 011 202	- 815 647

Notes:

1. The change in emissions is based on the difference between the pre-ICP (FY06/07) and the post-ICP minimum generation scenario data as this reflects a conservative case.

4.4 Discussion

Purchased electricity on the site will decrease slightly once the ICP is fully operational as discussed above. Scope 2 emissions relating to imported electricity for FY06/07 totalled 1 020 128 tCO_2-e and for post-ICP it is estimated that the emissions will decrease to 1 005 498 tCO_2-e. This means that there will be a decrease of 1.4% of Scope 2 emissions associated with the import of electricity.

The ICP is expected to generate a significant amount of electricity which will effectively reduce the net amount of electricity imported to the site. On a net electricity imports basis, the volume of electricity drawn from the NSW grid will reduce from 1,146,211 MWh to 274,797 MWh (minimum post-ICP generation scenario) with the introduction of the ICP. However, due to the physical electrical connection arrangements[1], the majority of the power will actually be exported to the grid while power required by the Steelworks site will be purchased and imported from the grid via existing feeders.

[1] The existing electricity connection configuration does not enable all of the electricity generated by the ICP to be used within the PKSW site, which means that significant quantities of electricity must be imported from the NSW grid. Changing the configuration such that only excess electricity is exported has been evaluated by BlueScope and is currently not considered to be an economical option.

The Scope 2 emissions which will be displaced from the NSW grid by the export of electricity is calculated as 815 647 t CO_2-e/year. Due to the large amount of electricity which is expected to be exported as a result of the ICP, and the fact that the electricity generated will be at a much lower emissions intensity compared to that supplied by the NSW electricity grid, the amount of GHG emissions displaced from the NSW grid are significant.

5 Scope 3

According to the international GHG accounting guideline *The GHG Protocol* (WRI & WBCSD, 2004) Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of a project or company, but occur from sources not owned or controlled by the company. Scope 3 can focus on activities that are relevant to the proposal, and for which reliable information is available.

5.1 Identification of Scope 3 activities

The ICP Scope 3 emissions in this assessment include:

- indirect emissions resulting from the extraction, production and transport of fuel associated with the supply of electricity to the Steelworks, and the indirect emissions attributable to the electricity lost in delivery in the transport and distribution network;
- indirect emissions from the extraction, production and transport of natural gas fuel which is consumed by the Steelworks;
- mobile sources not owned by BlueScope Steel, associated with the construction phase of the Project; and
- emissions generated from the production of steel and cement used in the construction phase of the Project.

Note that, as per the discussion included within Scope 1, there are not expected to be any changes in Scope 3 emissions with respect to the use of by-product gases on site. This is because the ICP Project is not expected to result in any changes to the amount of by-product gases combusted on site and hence, there will be no changes to the indirect emissions attributable to the generation and distribution of these gases on site.

5.2 Emissions calculations

5.2.1 Purchased Electricity and Natural Gas

Purchased Electricity

Calculations of purchased electricity Scope 3 emissions were completed in accordance with NGA Factors 2008.

The calculation based on electricity consumed requires the quantity of electricity used and a specific emissions factor. The following equation applies:

$$\text{GHG emissions } (tCO_2\text{-e}) = Q \times EF/1000$$

Where: Q is the electricity consumed by BlueScope Steel expressed in kWh.

EF is the relevant emissions factor expressed in kg CO_2-e/kWh identified in NGA Factors 2008.

Scope 3 input data is summarised in **Table 5.1.**

Table 5.1 Scope 3 Input Data for Purchased Electricity

Input data	Units	Value	Data source
Site wide electricity purchased pre ICP	kWh	1 146 211 000	BlueScope Steel
Site wide electricity purchased post-ICP, Min Gen scenario	kWh	1 129 773 000	BlueScope Steel
Site wide electricity purchased post-ICP, Max Gen scenario	kWh	1 129 773 000	BlueScope Steel
NSW & ACT grid electricity emission factor	kg CO_2-e/kWh	0.17	NGA Factors 2008

Note: As discussed in Section 4.1, the amount of electricity purchased following the commissioning of the ICP is less than that purchased in the FY06/07 due to the partial flow of ICP generation to internal consumers. .

Purchased Natural Gas

Calculations of purchased natural gas Scope 3 emissions were completed in accordance with NGA Factors 2008.

The calculation based on gas consumed requires the quantity of natural gas consumed and a specific emissions factor. The following equation applies:

$$\text{GHG emissions } (tCO_2\text{-e}) = Q \times EF/1000$$

Where: Q is the quantity of natural gas consumed by BlueScope Steel expressed in GJ

EF is the relevant emissions factor for NSW expressed in kg CO_2-e/GJ identified in NGA Factors 2008.

Scope 3 input data is summarised in **Table 5.2.**

Table 5.2 Scope 3 Input Data for Purchased Natural Gas

Input data	Units	Value	Data source
Site wide natural gas purchased pre ICP	GJ	3 257 040	BlueScope Steel
Site wide natural gas purchased post-ICP, Min Gen scenario	GJ	2 534 220	BlueScope Steel
Site wide natural gas purchased post-ICP, Max Gen scenario	GJ	2 534 220	BlueScope Steel
NSW & ACT grid natural gas emission factor	kg CO_2-e/GJ	14.2	NGA Factors 2008

Note: The emission factor for a large user has been used as BlueScope Steel has an annual usage of more than 100 000GJ.

5.2.2 Mobile Sources

As part of the Scope 3 emissions attributable to the ICP Project, contributions of mobile sources, road transport of equipment, sub-contractor employee travel and construction machinery to the total ICP GHG inventory emissions have been estimated.

Calculations of emissions from construction machinery and vehicles have been undertaken based on an average fuel efficiency of cars and trucks (10L/100km and 20L/100km respectively) and an average vehicle movement length of 15km. These assumptions may create unreliable mobile source estimation results, however, they enable a rough estimation of the magnitude of emissions from mobile sources to be made and therefore assist in determining whether further efforts in improving accuracy of figures is required. This, combined with the small portion of the total GHG inventory that construction mobile sources represent means the effort invested in quantifying an exact contribution adds little value to the GHG assessment process.

NGA Factors 2008 provides a methodology for the calculation of mobile source emissions by using estimations on fuel consumed.

The estimated fuel consumption is based on the type of fuel used for a particular vehicle. The calculation is undertaken using the following equation as outlined in NGA Factors 2008:

$$\text{GHG emissions} = Q \times EF$$

Where: Q is the quantity of fuel in thousands of litres (kL)

EF is the relevant emission factor for the particular fuel that is being used in t CO2-e/kL as identified in NGA Factors 2008 (**Table 5.3**).

Table 5.3 Scope 3 Emission Factors for Mobile Sources

Input data	Units	Value	Data source
Full fuel cycle emission factor - Diesel	tCO_2-e/kL	2.9	NGA Factors 2008
Full fuel cycle emission factor - Petrol	tCO_2-e/kL	2.5	NGA Factors 2008

Note: The full fuel cycle (Scope 1 and Scope 3) emission factor has been applied for this calculation. Refer to NGA Factors 2008.

Emissions arising from mobile sources have been estimated using the traffic data from the original Environmental Impact Statement (CH2M HILL, 2001). This data has been summarised in **Table 5.4** below.

Table 5.4 Traffic Estimations for Construction (adopted from CH2M HILL, 2001)

Type of Traffic	Typical Construction (movements/day)	Fuel Type
Truck Movements	50	Diesel
Car Movements	600	Petrol

Note: For the purpose of this estimation only typical construction traffic generation has been used, peak construction traffic generation has not been used.

Scope 3 input data for mobile sources is summarised in **Table 5.5.**

Table 5.5 Input data for Mobile Sources

Input Data	Units	Value - Truck	Value - Car
Average Vehicle Movement	km	15	15
Average fuel use	Litres per km	0.2	0.1
Average fuel use	Litres per movement	3	1.5
Fuel use	Kilo litres for construction	109.5	657

Note: The calculation above is based on the following assumptions:

- The construction period will last for a period of 2 years
- An average vehicle movement is 15km
- Average fuel efficiencies have been used to calculate average fuel use in litres, these values are 10L per 100km for cars and 20L per 100km for trucks.

5.2.3 Steel and Cement Production

The contribution of steel and cement production to the total ICP GHG inventory has been determined using the NGA Factors 2008 workbook. This section provides a methodology for the calculation of these emissions by using estimates of cement and steel to be used for the Project.

The calculation is undertaken using the following equation as outlined in NGA Factors 2008:

$$\text{GHG emissions} = Q \times EF$$

Where: Q is the production of steel and cement (tonnes)

EF is the relevant emission factor in t CO_2-e/t as identified in NGA Factors 2008 (**Table 5.6**).

Table 5.6 Scope 3 Emission Factors for Steel and Cement Production

Input data	Units	Value	Data source
Emission factor – Cement	tCO_2-e/tonne	0.534	NGA Factors 2008
Emission factor - Steel	tCO_2-e/ tonne	0.009	NGA Factors 2008

Scope 3 input data for steel and cement production is summarised in **Table 5.7.**

Table 5.7 Input data for Steel and Cement Production

Input Data	Units	Value
Approximate quantity of Cement to be used during construction of the ICP Project	tonnes	39 564
Approximate quantity of Steel to be used during construction of the ICP Project	tonnes	11 980

5.3 Results

5.3.1 Purchased Electricity and Natural Gas

Purchased Electricity

Emissions arising from Scope 3 purchased electricity are presented in **Table 5.8**.

Table 5.8 Results of Scope 3 purchased electricity emissions calculations

	Units	Pre-ICP	Post-ICP, Min Gen	Post-ICP, Max Gen	Change
Scope 3: Imported Electricity					
GHG Emissions	t CO_2-e	194 856	192 061	192 061	-2 794

Purchased Natural Gas

Emissions arising from Scope 3 purchased natural gas are presented in **Table 5.9**.

Table 5.9 Results of Scope 3 purchased natural gas emissions calculations

	Units	Pre-ICP	Post-ICP, Min Gen	Post-ICP, Max Gen	Change
Scope 3: Imported Natural Gas					
GHG Emissions	t CO_2-e	46 250	35 986	35 986	- 10 264

5.3.2 Mobile Sources

The input data in **Table 5.5**, the emissions factors in **Table 5.3** and the traffic estimations (**Table 5.4**) has been used to determine the approximate GHG emissions (t CO_2-e) for mobile sources during the construction period.

Table 5.10 Results of Scope 3 Mobile Sources Emissions Calculations

	Units	Construction
Scope 3: Mobile Sources		
GHG Emissions	t CO_2-e	1960

5.3.3 Steel and Cement Production

The input data in **Table 5.6** and the emissions factors in **Table 5.7** have been used to determine the approximate GHG emissions (t CO_2-e) for the production of steel and cement that will be used during the construction period.

Table 5.11 Results of Scope 3 Steel and Cement Production Calculations

	Units	Construction
Scope 3: Steel and Cement Production		
GHG Emissions - Cement	t CO_2-e	21 127
GHG Emissions - Steel	t CO_2-e	108

5.4 Discussion

The Scope 3 emissions associated with annual purchased electricity for the site have been calculated to be approximately 194,856 tCO_2–e using FY06/07 data (therefore under existing conditions prior to the ICP Project) and approximately 192 061 tCO_2–e for post construction. Note that no extra grid electricity use is expected during the construction phase.

There will be an estimated 1.4% decrease in Scope 3 emissions associated with the purchase of electricity on site as a result of this Project.

The Scope 3 emissions associated with the purchase of natural gas will decrease by 22.2% once the ICP is fully operational. That is, the Scope 3 emissions (associated with natural gas) under typical operating scenarios will be reduced by 10 264 t CO_2-e/year as a result of this Project. This is due to the elimination of the need to use natural gas pilots in the new boilers under most operating scenarios.

The Scope 3 emissions associated with the use of mobile construction sources have been estimated to be approximately 1960 t CO_2–e. This figure includes allowances for Scope 1 and Scope 3 transportation emissions as all transportation on site will be undertaken by sub-contractors. This is a once off value and is calculated for the 2 year construction period, for this reason it is not added to the other Scope 3 emissions which occur annually after commissioning of the plant.

The Scope 3 emissions associated with steel and cement production that will be brought onto the site during construction has been estimated to be 21 235 tCO_2–e. This figure has been calculated using approximate values for the tonnes of steel and cement that will be used during construction. This figure is a once off Scope 3 figure for construction only.

A summary of all Scope 3 emissions associated with the Project can be seen in **Table** 5.12 below.

As can be seen by the figures in **Table 5.12,** the Scope 3 emissions relating to on-going activities actually decrease (as a result of the reduction in both imported electricity and natural gas consumption). The Scope 3 emissions relating to construction are relatively minor when compared to total Scope 1, 2 and 3 emissions and considering that they are 'one-off' emissions created only during the construction phase which has a finite term, in this case 2 years.

Table 5.12 Summary of Scope 3 emissions for the ICP Project

	Units	GHG Change in emissions
Scope 3 Change in emissions		
Purchased Electricity	t CO_2-e/year	-2 794
Purchased Natural Gas	t CO_2-e/year	-10 264
Annual TOTAL	**t CO_2-e/year**	**- 13 058**
Mobile Sources	t CO_2-e	1 960
Steel and Cement Production	t CO_2-e	21 235
Construction TOTAL	**t CO_2-e**	**23 195**

6 Scope 4 or "Other"

Scope 4 emissions are defined in the Greenhouse and Energy Guideline in EIA as emission reductions which are associated with any carbon offsets that will occur as a direct result of the project. This Scope 4 concept is similar to the GHG Protocol which aims to capture GHG emission reductions that will occur as a result of the project and are sold or traded externally.

In terms of the ICP, this may relate to the reduced net import of electricity from the NSW Electricity Network and the creation of NSW Greenhouse Abatement Certificates or other environmental credits associated with energy efficiency.

The electricity generated post-ICP (displacing electricity from the NSW grid) will be produced at an effective emissions intensity of 0.0065 tCO_2-e per MWh,e (for the minimum generation scenario). This is significantly lower than the average GHG emissions intensity factor for NSW base-load generation, known as the "NSW Pool Coefficient", which in 2008 is 0.954 tCO_2-e per MWh.

BlueScope Steel is eligible to apply to the NSW Greenhouse Gas Reduction Scheme Administrator to become an accredited provider of NSW Greenhouse Gas Abatement Certificates (NGACs) and proposes to pursue recognition of this abatement activity.

However, these abatement activities are not assessed as a carbon offset and are not reported as Scope 4 or "Other" emissions for the purposes of this assessment. The emission reductions associated with the displaced electricity arising from the generation of electricity by the ICP have been estimated within the Scope 2 category in accordance with methods set out in the Greenhouse and Energy Guideline in EIA.

7 Summary Results

This section summarises the expected changes in GHG emissions arising from the ICP Project. Note that the change figures are based on the minimum generation scenario following the ICP start-up, which reflects the more conservative case.

Scope 1, 2 and 3 emissions will all reduce as a result of the ICP due to the decrease in both the natural gas consumption and the amount of electricity imported to site. On the basis of net electricity imports for a year, the volume of electricity drawn from the NSW grid will reduce from 1,146,211 MWh in FY06/07 to 274 797 MWh with the introduction of the ICP.

In conclusion, the ICP Project will result in a significant decrease in overall CO_2-e emissions. This is primarily a result of the ability of the ICP to generate significant quantities of electricity as well as its ability to generate electricity at an emissions intensity which is lower than that of the NSW pool coefficient.

The utilisation of existing by-product gases on site to generate electricity and process steam are considered to be significant beneficial measures to ensure PKSW is more energy efficient.

Table 7.1 presents summary results for Scopes 1, 2, and 3 both pre-ICP (FY06/07) and post-ICP (a full year of post-ICP operation).

Table 7.1 Summary: Scopes 1, 2, and 3 emissions

	Units	Pre-ICP	Post-ICP, Min Gen	Post-ICP, Max Gen	Change (see Note 1)
Scope 1 – direct emissions resulting from NG use	t CO_2-e/year	167 086	130 005	130 005	- 37 081
Scope 2 – imported electricity	t CO_2-e/year	1 020 128	1 005 498	1 005 498	-14 629
Scope 2 – exported electricity (displaced emissions from NSW grid)	t CO_2-e/year	0	- 815 647	- 1 011 202	- 815 647
Scope 3 Note 2 – indirect emissions	t CO_2-e/year	241 106	228 047	228 047	- 13 058
Total	t CO_2-e/year	1 428 320	547 904	352 349	**-880 415**

Notes:

1. The change figures are based on the difference between the pre-ICP (FY 06/07) and the post-ICP minimum generation scenario data as this reflects conservative base line operation.

2. This Scope 3 figure is excluding mobile sourced and other construction emissions, as these are only temporary in nature.

The summary table above shows that there will be a net reduction of 880 415 t CO_2-e/year as a result of the ICP Project under the minimum generation scenario. As noted earlier, the minimum generation scenario represents a conservative case, considering potential changes during detailed design and lower than expected output from the proposed new boilers and/or steam turbine generator. This reduction figure could increase up to 1 075 971 t CO_2-e/year under the maximum generation scenario.

It should be noted that these calculated values are quite sensitive to the "parasitic" electrical loads, i.e. the power required to operate equipment associated with power generation (the difference between gross and net generation). The final precise value for the proposed modification will not be known until detailed design is completed.

As discussed earlier, the figures in the above summary table for Scope 1 represent the emissions generated as a result of changes in natural gas consumption across the site. The Scope 2 figures are based on the total site electricity import and export amounts. To give further context to the Scope 1 and 2 changes in emissions shown above, the following table presents figures for Scope 1 and 2 for the entire site.

Table 7.2 PKSW site wide scope 1 and 2 emissions

	Units	Pre-ICP (FY 06/07)	Post-ICP, Min Gen	Post-ICP, Max Gen
Scope 1 and 2 – site wide direct and indirect emissions	Mt CO_2-e/year	11.0	10.1	9.9

Notes:-

1. The FY06/07 site emission figure of 11.0 Mt CO_2-e/yr is approximate only, however is expected to be in the range of 10.5 to 11.5 Mt CO_2-e/yr.

2. The site wide emission figures above are based on calculations using the NGA Factors. These emissions are dependent on the calculation methodology guidelines used and it should be acknowledged that these guidelines are currently in a state of flux and may change as the NGERS (National Greenhouse and Energy Reporting System) and the AETS (Australian Emissions Trading Scheme) are developed.

3. Note that the post-ICP data assumes that there are no other changes on the PKSW site which may affect emissions. This has been done to enable a direct evaluation of the impact of the ICP only.

8 Peak Electricity Generation

The ICP will be capable of generating peak electricity using natural gas as a supplement to by-product fuels. Under the peaking scenario, additional natural gas will be used to generate electricity at times when it is economical to do so based on NSW pool prices for electricity. The electricity generated under the peaking scenario is considered to be beneficial to the project as it makes use of the available ICP capacity and uses supplementary natural gas to produce additional electricity. This additional, or marginal electricity, is over and above the amount generated using predominantly byproduct fuels and can replace electricity from the NSW grid produced by coal-fired facilities.

As discussed in **Section 1.5**, the current economic modelling has shown that the optimal scenario for peaking using natural gas is for 15% of the time and this is used as the nominal value for this assessment. This means that for 15% of the time across the year, the ICP output capacity (over and above that used for firing byproduct fuels) is used for the production of electricity by the combustion of supplementary natural gas. As different parameters within the model change with time, the optimal amount of time for peaking may also vary.

It is expected that it will be possible for the ICP to peak at any time when there is boiler firing capacity greater than that required for the available by-product fuel. There would be periods where the available by-product fuel requires the full capacity of the boilers, and therefore peaking would not be possible. At other times, peaking would be possible whenever economically viable and this may well exceed the 15% peaking scenario. The maximum amount of peaking (i.e. hours per year) may, however, also be restricted by loss of boiler capacity due to boiler maintenance outages or annual NO_x mass emission limits.

Under the 15% peaking scenario, emissions calculations have been carried out for each scope to demonstrate the potential impact to emissions resulting from the ICP. Note that these emissions are not intended to represent the typical baseline range of emission reductions post the ICP, as shown in previous sections, but rather are provided for completeness of the assessment and to illustrate the significant benefits which can be achieved by providing the ability to provide peak electricity generation.

The methodology and emissions factor data used for the emissions calculation are the same as those described for each of the scopes above. As for the previous sections in the report, the 15% peaking scenario is applied to both the post-ICP minimum generation scenario as well as the post-ICP maximum generation scenario.

For the peaking generation case, the marginal emissions intensity factor was calculated and presented. This figure was calculated as follows:-

Marginal emissions intensity = (additional CO_2-e emissions resulting from the additional natural gas consumed during peaking) / (additional net electricity generated during peaking).

This emissions intensity figure is useful in providing a comparison with the NSW Pool Coefficient for the production of electricity.

8.1 Input Data

The following table provides the input data used in the calculations relating to the natural gas peaking generation scenario.

Table 8.1 Input Data for Peaking Generation Calculations

Input data	Units	Value			Data source
	Units	**Pre-ICP**	**Post-ICP, Min Gen** **15% NG peaking**	**Post-ICP, Max Gen** **15% NG peaking**	
Natural Gas unit purchases for total site	GJ/yr	3 257 040	3 581 040	3 581 040	BlueScope Steel
Natural Gas used for steam raising on site	TJ/yr	946	1 270	1 270	BlueScope Steel
Gross electricity generated by ICP	MW	0	143.3	168.6	BlueScope Steel
Net electricity generated on site (from STG's)	MW	17.16	126.4	151.6	BlueScope Steel
Exported electricity from site	MW	0	108.3	133.6	BlueScope Steel
Imported electricity to the site	MWh	1 146 211	1 138 465	1 138 465	BlueScope Steel
Total steam raised on site	TJ/yr	13 834	26 098	26 820	BlueScope Steel
Total steam on site used for electricity generation	TJ/yr	3 236	15 097	15 792	BlueScope Steel
Total steam on site used as process steam	TJ/yr	10 598	11 001	11 028	BlueScope Steel

8.2 Results

Emissions arising from the ICP as a result of generating peak electricity for 15% of the time using natural gas are presented in the table below. As per previous sections, the change figure is the difference between the pre-ICP figures and the post-ICP figures relating to the minimum generation scenario.

Table 8.2 Results of 15% peaking generation emissions calculations

	Units	Pre ICP	Post-ICP, Min Gen 15% NG peaking	Post-ICP, Max Gen 15% NG peaking	Change
Scope 1:- GHG Emissions – for total site NG consumption	t CO_2-e / year	167 086	183 707	183 707	16 621
Scope 2:- imported electricity	t CO_2-e / year	1 020 128	1 013 234	1 013 234	-6 894
Scope 2:- exported electricity (displaced emissions from NSW grid)	t CO_2-e / year	0	-905 151	-1 116 501	-905 151
Scope 3:- indirect emissions	t CO_2-e / year	241 106	244 390	244 390	3 284
Total	t CO_2-e / year	1 428 320	536 180	324 830	- 892 140

The GHG emissions intensity calculated on the basis of marginal electricity from natural gas peaking for 15% of the time (under the post ICP minimum generation scenario) is 0.572 t CO_2-e/MWh e. This figure represents the additional GHG emissions (over and above the 'non-peaking' case post the ICP) generated as a result of the use of additional natural gas per unit of additional net electricity (over and above the 'non-peaking' case past the ICP) generated during peaking.

8.3 Discussion

Scope 1 and Scope 3 emissions resulting from the ICP both increase slightly compared to FY06/07 figures under the 15% natural gas peaking scenario. This is different to the non-peaking scenario because of the use of additional natural gas to generate electricity. The results of the Scope 2 displaced emissions from the NSW grid show a benefit compared to that of the non-peaking scenario due to the larger amount of electricity generated by the ICP by the combustion of additional natural gas fuel, and hence an increase in the amount of emissions displaced at the NSW grid.

The ability of the ICP to generate peak electricity at a marginal emissions intensity of 0.572 t CO_2-e/MWh, which is less than the NSW Pool Coefficient of 0.954 t CO_2-e/MWh, demonstrates the significant greenhouse gas benefits of the ICP.

Overall, the results show a significant net decrease in emissions which demonstrates the ability of the ICP to generate peak electricity at a low emissions intensity.

9 Comparisons facilitating GHG mitigation performance

In order to assess the GHG mitigation performance of the ICP Project, this section presents a comparison of ICP GHG emissions (at first full year of operation) to:

1. total annual NSW emissions (so the impact of the proposal on NSW emission reduction targets can be evaluated)

2. emissions from a coal fired facility producing an equivalent amount of electricity

3. 'best practice' emissions for peak electricity generation

These comparisons are presented according to DECC Environmental Assessment Requirements.

9.1 Comparison with total annual NSW emissions

The total emissions for NSW in 2005 (AGO 2005) from the most recent State GHG inventory were 152 200 200 t CO_2-e. As shown in **Table 7.1**, the ICP (without peaking) will provide emission reductions to the total annual NSW emissions primarily of approximately 880 000 t CO_2-e per year due to its ability to reduce the net imports of electricity to PKSW from the NSW grid, as well as the reduction in natural gas consumption and purchased electricity. The reduced GHG emissions attributable to the ICP represent a decrease of approximately 0.6% of the total NSW emissions.

9.2 Comparison with emissions from a coal fired power facility

The net amount of electricity that the ICP Project will be generating under the minimum generation scenario is estimated at 1 021 735 MWh per annum. To produce this amount of electricity at a NSW based coal fired facility, approximately 974 735 t CO_2-e per annum of emissions would be generated. This compares to a reduction in emissions of -64 768 t CO_2-e/yr resulting from the ICP, excluding displacements associated with exporting electricity (from **Table 7.1**). The calculation method used for the emissions from a coal fired facility is based on the NSW Pool Coefficient for 2008, i.e. 0.954 t CO_2-e / MWh. The use of this figure is considered to be applicable because 90.5% of the electricity generated in NSW (in 2004 – 2005) was attributable to coal fired facilities (NSW State of Environment Report 2006, DECC).

9.3 Comparison with best practice emissions

In defining the best practice emissions from a cogeneration plant, the most important point to consider is the overall cycle efficiency of the plant, that is, the efficiency of burning fuel to produce optimum amounts of output energy. In this regard, emission reductions resulting from the generation of power from the combustion of fuel at the cogeneration plant (against emissions created from the generation of electricity at the local network grid) need to be considered, as well as the direct emissions from fuel combustion. The ICP will use a steam boiler in combination with a STG for the generation of both electricity and process steam. In terms of overall cycle efficiency, this configuration is not best practice for cogeneration. Current best practice configurations involve the use of a gas turbine (GT) to drive an electrical generator and heat recovery steam generators (HRSG) to produce useable process heat. The applications of the latter cogeneration technology have been more recent and the efficiency of this technology can be significantly higher than that of the more conventional boiler and steam turbine generator arrangement.

The use of modern high firing temperature GT and combined HRSG cogeneration technologies were considered in detail by BlueScope Steel. The key disadvantages associated with the adoption of this type of technology and hence the reasons for not selecting this cogeneration technology were as follows:-

- Operation and maintenance costs would be significantly higher for the GT and HRSG system due to the requirement for an electrostatic precipitator at the inlet of the gas compressor. The Steelworks by-product gases are dirty when compared to the requirements of GT/HRSG technology, which increases the operation and maintenance costs and increases the risk to operating regimes. In addition, the by-product gases are distributed throughout the Steelworks at very low pressure (around 5kpa) and a large compressor is needed to boost the pressure to that required by the gas turbine. This creates a huge parasitic load which considerably reduces the output of the gas turbine.
- Due to the single shaft concept, the GT and HRSG machine is much longer than a conventional gas turbine/steam turbine/generator plant. Site space restrictions mean that only one unit can be installed, meaning that it will not meet the required levels of redundancy on the ICP site. It is possible to install multiple units, but at a removed site from the supplies of gas and the consumers of steam, adding disproportionately to the project costs, potentially compromising the viability of the ICP Project.
- GT/HRSG plant has a significantly higher forced outage rate compared to conventional boilers. A key objective of ICP is to provide a secure supply of steam to the Steelworks. GT/HRSG plants do not currently offer the required reliability.

In summary, the final cogeneration technology selected by BlueScope Steel was constrained by the required reliability of steam production, economics associated with the use of technology and site constraints.

For purposes of comparison with respect to fuel efficiency, however, generation has been calculated for a plant such as the ISE power plant of ILVA's steelworks at Taranto, Italy.

This plant consists of three cogeneration combined cycles consisting of Steelworks gases firing Nuovo Pignone MS9001/E gas turbines/waste heat boilers. Steam from the waste heat boilers supplies steam to the Steelworks as well as generating additional power.

Taking the normal supply of Steelworks gases to ICP and feeding it to a plant such as this would result in net power generation of 200-210MW. By comparison, ICP will generate net 117-140 MWduring normal operation.

However the amount of gas available would mean that only two complete units would be required. Nuovo Pignone report that the availability of these gas turbine units is not high, citing 33 forced trips during a year resulting in 160 hours of forced outages for each gas turbine unit. As the security of the Steelworks processes relies on the supply of steam, the reliability of these units, plus only having two units, means that this would result in a considerable degradation of steam supply security to Port Kembla Steelworks.

The closest quantifiable comparison of emissions with that of the ICP that has been obtained is to use published data from the Australian Greenhouse Office Generator Efficiency Standards (Dec 2006). These technical guidelines provide efficiency benchmark figures and guideline values for the comparison and selection of new power plant.

The data available refers to a combined cycle gas turbine plant, i.e. a gas turbine and HRSG, using natural gas fuel. As discussed above, this is different technology than that of the ICP and uses natural gas only as the fuel, however it represents the closest comparison case data which can be found. The emissions intensity for this application is 0.355 t CO_2 / MWh of combined energy streams sent out. Although this represents CO_2 only, rather than CO_2-equivalent, this figure is significantly larger than the calculated emissions intensity figure of 0.003 t CO_2-e / MWh (see **Section 3**).

The main reason for the large difference is that the ICP uses predominantly by-product gases to generate energy, with natural gas being used in relatively minor amounts. There is no significant net change to the emissions attributable to the combustion of the by-product gases because they are already being combusted in either existing boilers or flared and hence there is no change to the pre-ICP case.

Overall, it can be said that in general terms, maximising the use of existing by-product gases on site (which are currently flared) for the generation of electricity and process steam is a major improvement on the current situation and is a major benefit of the ICP.

10 Comparison with Original Project GHG Assessment

As part of the Director-General's EARs, it is necessary to compare the emissions calculated for the current assessment with those presented in the original Project.

The GHG assessment as part of the approved development for the ICP (carried out in 2001) calculated emission reductions for each year from 2004 to 2018 inclusive. For this period, the average annual savings were calculated to be approximately 864,000 t CO_2-e/yr. The range of annual savings were between 663,700 and 961,100 t CO_2-e/yr.

It is not appropriate to directly compare estimated GHG emission reductions from the ICP Project in the 2001 assessment and the values included in this assessment. The original assessment was believed to be a conservative estimate based on a given ICP solution. The ICP scope has since been further defined and optimised to arrive at the current solution as presented within this report.

The key differences between the two assessments are a result of the following changes:-

- In terms of calculation methodologies, the original assessment was not separated into individual scopes, i.e. Scope 1, 2, and 3, which is the current standard methodology used, because this was not a requirement at the time of reporting. The original assessment included direct emissions (i.e. equivalent to Scope 1), and electricity purchases (Scope 2 emissions). The overall off-set amount was then calculated by also considering the benefit of the electricity exported to the NSW grid and displacing the power that would otherwise be generated by black coal-fired power stations in NSW. Indirect emissions resulting from the purchase of natural gas and electricity were not included in the original assessment.

- The current report uses recently published emission factors in the emission calculations, however these are different to the emission factors available at the time of the original assessment. For example, the original assessment used emission factors for the displacement of electricity from the NSW grid, i.e. for black-coal fired facilities, of 0.92 tCO_2-e/MWh. The figure used for the current assessment is 0.954 tCO_2-e/MWh, as representative of the emissions intensity for power generation in NSW in 2008.

- The net amount of electricity exported for the current ICP scope is different to that for the original ICP scope. This affects the Scope 2 and Scope 3 figures.

- The current ICP scope has a lower natural gas consumption compared to the original assessment due to the elimination of the need to use natural gas pilots. This affects both the Scope 1 and Scope 3 figures.

As a result of these differences, it is not meaningful to make a direct comparison between the final emission reduction figures given in the original and current ICP GHG assessments. As mentioned earlier, the calculated values are quite sensitive to the "parasitic" electrical loads i.e. the power required to operate equipment associated with power generation (the difference between gross and net generation). The final exact value for the proposed modification will not be known until detailed design is completed.

11 References

1. Department of Climate Change (2008) *National Greenhouse Accounts (NGA) Factors*. Australian Government, Canberra.

2. The NSW Department of Planning (2002) *Draft Guidelines for Energy and Greenhouse in EIA.*

3. The World Business Council on Sustainable Development & World Resources Institute (2004) *The Greenhouse Gas Protocol.*

4. DECC NSW State of the Environment Report, 2006

5. Australian Greenhouse Office, Department of the Environment and Heritage – Technical Guidelines, Generator Efficiency Standards (Dec 2006)

6. GGAS Fact Sheet – The NSW Pool Coefficient