HEGGIES

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Revision 0

Independent Print Media Group Pty Ltd
Warwick Farm Printing Project
Greenhouse Gas and Energy Assessment

PREPARED FOR

IPMG Pty Ltd
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Independent Print Media Group Pty Ltd
Warwick Farm Printing Project
Greenhouse Gas and Energy Assessment

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EXECUTIVE SUMMARY

Heggies has been commissioned by Independent Print Media Group Pty Ltd (IPMG) to provide a Greenhouse Gas and Energy Assessment including energy efficiency mitigation measures and recommendations during the development application stage of the proposed Warwick Farm printing project in Liverpool.

Independent Print Media Group Pty Ltd (IPMG) is proposing to expand its Sydney operations by refurbishing and extending the existing Kimberley Clark manufacturing plant at 23 Scrivener Street, Warwick Farm into a new facility for print production, warehousing and distribution. The plant will produce a variety of printed material including magazines, inserts, catalogues, brochures, books and the like.

The proposed site will comprise the following:

- A new press room with a raised roof and cylinder production area;
- The installation of a vapour recovery unit, link storage facility and associated boiler;
- The construction of a waste paper collection facility;
- The construction of a 4000 m^2 warehouse; and
- The renovation of the existing building.

The results of the greenhouse gas assessment for the project indicated that the combined Scope 1 and Scope 2 emissions total 44,743 tonnes of CO2-e which exceeds the above facility threshold for GHG emissions of 25 kilo tonnes. Accordingly, IPMG will be required to register and report GHG emissions and energy data from the project to the Greenhouse and Energy Data Officer in accordance with the NGER Act. Given this, the proponent will be pursuing or investigating the feasibility of several opportunities to increase energy efficiency in order to reduce associated Scope 1 and Scope 2 greenhouse gas emissions.

Overall, good Ecologically Sustainable Design (ESD) and energy efficiency features are currently in place for a number of areas, incorporating the following:

Energy

- IPMG propose to initially install 2 Roto gravure printing presses instead of the conventional Heat set Web offset printing. It is expected that the proposed printing process produces significantly less greenhouse gases per tonne of product.
- Continuous blowdown control system for the proposed boilers. Blowdown water has significant heat content which is recovered with a heat exchanger, or in a flash tank, and used to preheat incoming feed-water.
- Use an economizer to optimise outside air use and manage ventilation in the boilers.

Water

- A series of three water tanks with a total capacity of approximately 1.8 GL will be installed on the site for rainwater storage and reuse will greatly assist in achieving a high score for almost any energy rating scheme.
- Boilers water is recycled and all suspended and dissolved solids are removed by a recovery system.

Waste

- Dedicated storage area is provided for the separation, collection and paper recycling.

EXECUTIVE SUMMARY

The following additional recommendations have been made to significantly improve the sustainability of the proposed development:

- A feasibility study to investigate the use of cogeneration plant to provide electricity and steam on site. In general, conventional power stations have an efficiency of 30-45% whereas cogeneration systems have an efficiency of 80-85%. Therefore, cogeneration plant provides significant environmental benefits. Heggies recommends conducting this study during the design development stage when the average and instantaneous steam demand is reasonably well understood.
- Boilers be connected in series (boilers load sequentially). One of the boilers can then be used as a standby most of the time or to share the instantaneous steam demand when required.
- The use of a flue gas analyser to display percent oxygen, stack gas temperature, and boiler efficiency. Boiler efficiency can be increased by 1 % for each 15 % reduction in excess air or 4.4 °C reduction in stack gas temperature.
- Remove scale mechanically or by using an acid cleaner. A coating of scale one millimetre thick can result in a 5 % increase in fuel consumption.
- Removable insulation on uninsulated valves, pipes, and fittings to reduce losses in the process heat. Insulating pipes and process vessels can significantly reduce heat loss from surfaces by up 90 % for pipes carrying steam at high pressure.
- Power sub-metering to allow for effective monitoring and management of electricity consumption.
- Water sub-metering for different uses where appropriate.
- The use of LPG and/or a second generation electric forklift that utilises AC drive system and contributes to the widespread use of clean vehicles.

Heggies recommends conducting a detailed energy assessment of the proposed facility following 12 months of operations and IPMG to ensure fulfilment of the legislative requirements of the DEUS Energy Saving Action Plan.

Recommendations regarding the passive energy efficiency for the refurbished buildings have also been made within the body of the report.

These features will help to achieve significant reductions in the energy and water required by the development both in building and operation.

The ESD assessment prepared in the current report will be developed in greater detail as the site design progresses.

1 INTRODUCTION

Independent Print Media Group Pty Ltd (IPMG) is proposing to expand its Sydney operations by refurbishing and extending the existing Kimberley Clark manufacturing plant at 23 Scrivener Street, Warwick Farm into a new facility for print production, warehousing and distribution. The plant will produce a variety of printed material including magazines, inserts, catalogues, brochures, books and the like.

An Environmental Assessment Report (EAR) has been commissioned by IPMG, to assess the potential impacts of the proposed new operation.

Heggies Pty Ltd (Heggies) has been engaged by IPMG to prepare a Greenhouse Gas and Energy Assessment for the project. The scope of the assessment is to detail the Scope 1 and Scope 2 Greenhouse Gas emissions associated with the project and to outline a range of potential measures to achieve energy savings and reduce greenhouse gas emissions.

2 SITE LOCATION

The site is located at Warwick Farm as shown in **Figure 1**. The site is currently owned and operated by Kimberley Clark. The KCC facility has operated since the early 1970s for the manufacture, storage and distribution of paper products. Kimberley Clark are relocating and centralising their operations to another location.

Figure 1 Site Location

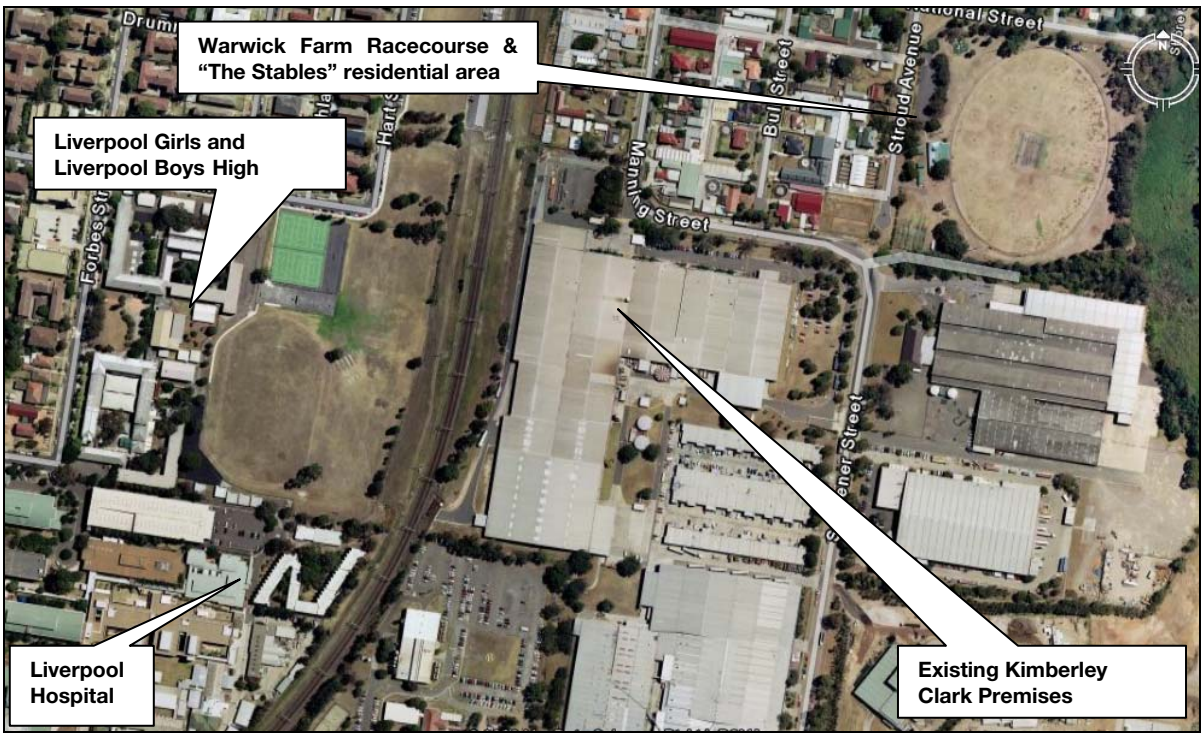


Image courtesy of Google Earth

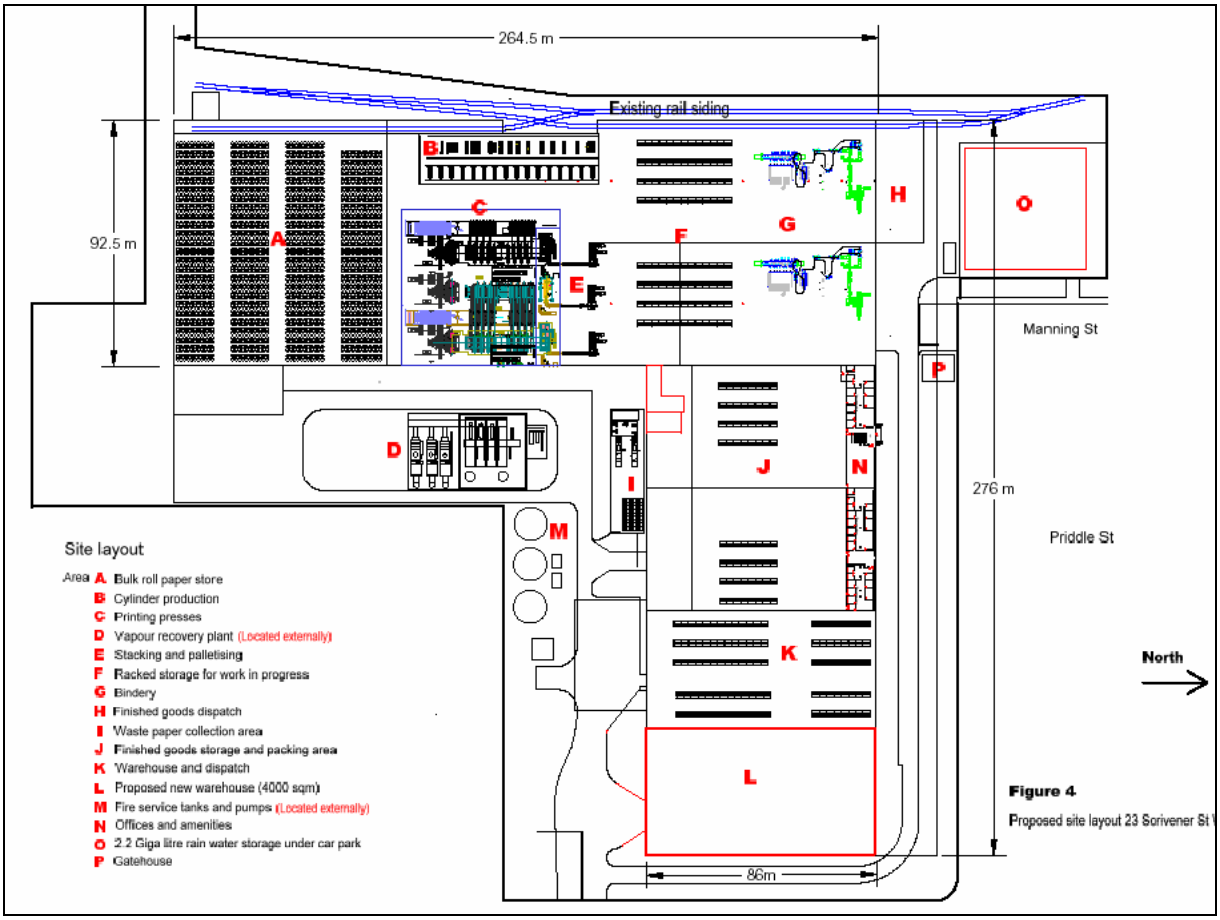
The site is located at the northern end of an established industrial precinct. It is bounded by the Main South Railway Line to the west, Priddle Street to the north and Scrivener Street and industrial units to the east and industrial premises and a Liverpool Hospital carpark to the south.

3 PROJECT DESCRIPTION

3.1 Proposed Development

The project involves modifying, extending and fitting out the existing industrial premises into a new plant for printing, warehousing and distribution. The proposed layout of the new development is shown in **Figure 2**.

Figure 2 Development Layout



The proposed facility will include a press room and bindery, materials storage and distribution areas and office and amenities. Part of the existing roof will be raised from the current 8 m to heights of 12 m and 14 m. The eastern end of the existing building will be extended to provide a new 4,000 m^2 warehouse area. A vapour recovery plant and ink supply system will be installed.

The staged renovation of the main areas (A, B, D, M and N) will commence in January 2009 with completion anticipated in September 2009. Warehouse construction will commence late 2010 with completion in May 2011.

3.2 Printing Production Process

The printing production process is as follows:

Paper receiving and storage

- Paper is stored within Area A (**Figure 2**). The paper rolls are delivered by semi-trailer to the south eastern factory apron and unloaded to the paper store by two (2) 10 t forklifts.

Cylinder preparation

- The images to be printed are electromechanically etched onto electroplated copper cylinders (Area B). The cylinders are hard chrome plated and stored prior to distribution to the press room.

Printing process

- Printing is carried out by three (3) 8 unit Rotogravure presses located within the enclosed Area C. The paper rolls are automatically delivered from the paper store to reel loaders at the rear of the press. They are mounted on a reel stand and the press unwinds the paper into the printing units at the back of the reel stand. The paper is printed in full colour in a continuous process.
- The folder slit cuts the printed web of paper into smaller widths and folds them into smaller sizes ready for stacking.

Vapour Recovery

- The vapour recovery system is located in Area D. The system removes the ink carrier solvent produced by the ink drying process at the presses.
- The plant consists of 5 vessels containing beds of activated carbon through which the solvent-laden air is sequentially pumped. The solvent is recovered and cleaned air is exhausted.
- After each cycle the carbon is cleaned and reactivated by pumping steam through the tank. The solvent is recovered from the steam by cooling and phase separation with the recovered water returned to the boiler.
- The recovered solvent is stored and reused in the print process or by ink manufacturers.

Stacking and Storage

- Folded product is conveyed to the stacking equipment (Area E).
- The stackers place the sheets of folded product one on top of the other to form a log of product which is strapped on pallets and stored to await collation with other magazine sections.
- Product not requiring collation is stitched/glued and trimmed at the press, they are then palletised at the stackers for dispatch.
- Product from the presses is stored in the racked storage (Area F) whilst other sections of the publication are printed.

Binding

- Two high speed collating and stitching lines (Area G) collate up to 7 printed sections together, stitch them and trim the folded edges away to create a magazine with 3 open sides and a stapled spine ready for distribution.

Waste Paper Management

- Paper waste and dust is exhausted to the waste paper system located next to the southern driveway (Area I). The equipment in this area separates the dust and bales the off-cuts ready for transport to external recycling.

Dispatch

- Finished product from the press room and binding section is stored and dispatched onto delivery trucks (Areas H, K and L).
- Publications which form mixed bundles are sent for collation to Area J where other magazines and materials are collated and packed with other items for distribution to newsagents and other suppliers.

4 GREENHOUSE GAS ASSESSMENT

4.1 National Greenhouse and Energy Reporting Act 2007

The *National Greenhouse and Energy Reporting Act 2007* (the NGER Act) is administrated by the Australian Government Department of Climate Change (DCC) and establishes a structure for corporations to report greenhouse gas emissions and energy consumption and production from 1 July 2008.

Under the NGER Act, corporations are required to apply for registration with the Greenhouse and Energy Data Officer if their associated greenhouse gas emissions or energy consumption levels are above defined thresholds for a financial reporting year. There are two threshold levels at which corporations are required to report - facility thresholds and corporate group thresholds. The facility thresholds apply to an individual operation while corporate thresholds are applicable to controlling corporations. The facility threshold - of 25 kilo tonnes of CO2-e per year - applies to this IPMG proposal.

The Director General Requirement (DGRs) require an assessment of the proposal's Scope 1 and Scope 2 greenhouse gas (GHG) emissions, defined as follows:

- Scope 1 emissions result from activities under a company's control or from sources which they own (eg on-site generation of electricity, on-site transportation emissions); and
- Scope 2 emissions relate to the generation of purchased electricity consumed in its owned or controlled equipment or operations.

The Scope 1 and Scope 2 greenhouse emissions associated with the project are detailed in the following sections.

4.2 Greenhouse Gas Emissions Estimation

Emissions of greenhouse gases generated by the project will be quantified in this assessment through the implementation of the DCC document *National Greenhouse Accounts (NGA) Factors* (DCC, 2008b).

4.2.1 Exclusions

It is noted that this assessment focuses on the project with regard to facility thresholds only, taking into account Scope 1 and Scope 2 emissions of the six major Kyoto Protocol greenhouse gases only, as discussed previously. Emissions of volatile organic compounds (VOCs) from the vapour recovery plant, which may include non-Kyoto Protocol greenhouse gases, and Scope 3 emissions associated with the project are not required for this project.

4.2.2 Scope 1 Emissions

Scope 1 emissions of greenhouse gases associated with the project are attributable to:

- Combustion of natural gas within the plant boilers; and
- Consumption of Liquid Petroleum Gas (LPG) by the on-site forklifts.

Plant Boiler Natural Gas Combustion

AGL Energy Ltd (AGL) have conducted a Gas and Electricity Requirements assessment for the project (report dated 21 August 2008), within which the supply levels of natural gas and electricity required by the project were discussed and the associated greenhouse gas emissions quantified. Emissions of greenhouse gases were calculated by AGL within this report using the NGA Factors in accordance with the NGER Act.

AGL calculated the hourly steam requirements of the printing press and vapour recovery components of the project in order to determine the necessary natural gas supply for the two 8 MW steam boilers. From this information, AGL calculated the potential greenhouse gas emissions associated with combustion of natural gas by the steam boilers at 75% of peak load capacity. Additionally, AGL provided maximum hourly and daily natural gas supply rates. The projected natural gas quantities and associated greenhouse gas emissions for the steam boilers are presented in **Table 1**.

Table 1 Natural Gas Requirements and Associated Greenhouse Gas Emissions

	Natural Gas Requirements (GJ)		Annual CO_2-e Emission (t)
	Calculated Requirement	Annual Requirement	
Actual Annual Quantity (75% Peak Load)	176,000	176,000	9,040
Maximum Hourly Quantity	72	630,720	32,356

Note: Greenhouse gas emissions calculated using the relevant emission factor of 51.3 kg CO_2-e/GJ for NSW and the ACT, as per Table 2 of the NGA Factors.

It can be seen from **Table 1** that for expected steam boiler operations, the project will generate approximately 9,040 t of CO_2-e annually through the combustion of natural gas.

Fork-Lift Fuel Consumption

The materials handling component of the project is expected to be conducted primarily by forklifts. IPMG propose to use liquefied petroleum gas (LPG) fuelled forklifts.

IPMG have indicated that a similar operational facility in Melbourne that produces 71,000 t of product annually, consumes approximately 48,540 Litres of LPG annually. This data has been applied against an assumed annual production rate of 92,000 t, as per AGL calculations, to derive an annual LPG consumption for the project.

The emission factors listed within Table 3 of the NGA Factors have been applied against the calculated annual LPG consumption rate to derive potential maximum greenhouse gas emissions. The results of these calculations are presented in **Table 2**.

Table 2 LPG Consumption Rates and Associated Greenhouse Gas Emissions

	Maximum Annual Consumption	Emission Factor (t CO_2-e/kL or m^3)	Greenhouse Gas Emissions (t CO_2-e/annum)
LPG	63,795	1.6	102

4.2.3 Scope 2 Emissions

As discussed in **Section 4.2.2**, AGL conducted a Gas and Electricity Requirements assessment for the project, detailing consumption rates of natural gas and electricity and associated greenhouse gas emissions.

Based on manufacturer's specifications and expected hours of operation, AGL have calculated the electricity requirements and associated greenhouse gas emissions of the project. Using Appendix C2: 1 of Australian Standard *AS 3000-2007: Wiring Rules Release* and a range of projected operating data, the required MWh/Tonne of product was derived. From these calculations, AGL then applied the relevant emission factor of 0.89 kg CO_2-e/kWh from Table 5 of the NGA Factors. **Table 3** presents the results of the electricity and greenhouse gas calculations conducted by AGL for the project.

Table 3 Electricity Requirements and Associated Greenhouse Gas Emissions

	Electricity Requirements (kW)	Annual Electricity Consumption (MWh)	Greenhouse Gas Emissions (t CO_2-e)
Maximum Demand	5,966	40,002	35,602

4.2.4 Combined Scope 1 and Scope 2 Emissions

Based on the calculations conducted in **Section 4.2.2** and **Section 4.2.3**, the total Scope 1 and Scope 2 greenhouse gas emissions from the project are presented in **Table 4**.

Table 4 Scope 1 and Scope 2 Greenhouse Gas Emissions

	Scope 1 Emissions (t CO_2-e)	Scope 2 Emissions (t CO_2-e)	Combined Emissions (t CO_2-e)
Expected Annual	9,142	35,602	44,744

It can be seen from the results listed in **Table 4** that Scope 1 and Scope 2 greenhouse gas emissions associated with the project could be expected to total 44.7 kt for an operational year. When this data is applied against the NGER thresholds, it is clear that the project meets the Facility threshold value of 25 kt for annual Scope 1 and Scope 2 greenhouse gas emissions.

It is noted that IPMG's national operations currently meet the Corporate threshold amount and have already applied for registration to report greenhouse gas emissions and energy data to the Greenhouse and Energy Data Officer, as per the requirements of the NGER Act.

5 ENERGY EFFICIENCY OPPORTUNITIES

The results of the greenhouse gas assessment for the project (**Section 4**) indicated that the greenhouse gas emissions and energy use would need to be reported under the NGER Act. The estimated project energy consumption is as follows:

- Annual electrical energy consumption = 40,002 MWh
- Annual natural gas requirements associated with combustion of natural gas by the steam boilers at 75% of peak load capacity is 176,000 GJ. AGL proposed to consider two 8 MW boilers to provide the energy demand. One of the boilers is used as a standby most of the time.

Given the high consumption of energy, the proponent will be pursuing or investigating the feasibility of several opportunities to increase energy efficiency in order to reduce associated Scope 1 and Scope 2 greenhouse gas emissions. These are described in the following section.

5.1 Management Plans

5.1.1 Energy Savings Action Plans (NSW)

The NSW water and energy savings initiatives were introduced by the NSW Government in May 2005. They are administered by the Department of Energy, Utilities and Sustainability (DEUS) and include a requirement for certain businesses, government agencies and local councils to prepare Energy Savings Action Plans. Plans must be prepared in accordance with the Guidelines for Energy Saving Action Plans, available from Department of Energy, Utilities and Sustainability (DEUS).

In accordance with NSW government (Department of Energy, Utilities and Sustainability) requirements, **Energy Savings Action Plans** must be completed by NSW businesses with sites using more than 10 GWh of electricity a year. The proposal is estimated to use 40.002 GWh. Preparation of the plan involves determining current energy use, undertaking management and detailed technical reviews, assessing energy savings measures and identifying actions to achieve savings. IPMG will conduct a detailed energy assessment of the proposed facility after 12 months of operations to fulfil the legislative requirements of the Energy Saving Action Plan.

5.1.2 Energy Efficiency Opportunities (Australia) administered by the Department of Industry, Tourism and Resources (DITR).

- The Australian Government's Energy Efficiency Opportunities program encourages large energy using business to improve their energy efficiency by implementing cost effective energy saving opportunities that exist for projects with a financial payback of up to four years. Participation in the program is mandatory for corporations that use more than 0.5 petajoules[(1)](PJ) of energy per year. Registration must be taken within nine months following the end of the financial year in which the energy use of a corporate group exceeds 0.5 PJ.

The preliminary energy consumption for the proposed development is approximately 0.32 PJ. However, IPMG will conduct a detailed energy assessment of the facility after 12 months of operations to establish actual energy consumption and to fulfil the legislative requirements if necessary.

(1) 0.5 PJ of energy per year is approximately equivalent to:
- 139,000 megawatt hours of electricity;
- 9000 tonnes of LNG or 10000 tonnes of LPG;
- 13 megalitres of diesel; or
- Spending of approximately $5-10 million on electricity, $1.5-2.5 million on gas or $11-13 million on diesel (depending on prices).

5.2 Ecologically Sustainable Design (ESD) and Energy Efficiency Features of the Proposed Site

Overall, good Ecologically Sustainable Design (ESD) and energy efficiency features are proposed in a number of areas, incorporating the following:

5.2.1 Energy

- IPMG propose to initially install 2 Roto gravure printing presses instead of the conventional Heat set Web offset printing. It is expected that the proposed printing process produces significantly less greenhouse gases per tonne of product.
- Continuous blowdown control system for the proposed boilers. Blowdown is the intentional release of water from a steam system to remove suspended and dissolved solids and prevent scale build-up. Blowdown rates typically range from 4 to 8% depending on purity of feed-water. Blowdown water has significant heat content which is recovered with a heat exchanger, or in a flash tank, and used to preheat incoming feed-water and then reduce energy consumption required to produce the steam.
- Use an economizer to optimise outside air use and manage ventilation in the boilers.

5.2.2 Water

- A series of three water tanks with a total capacity of approximately 1.8 GL will be installed on the site for rainwater storage and reuse will greatly assist in achieving a high score for almost any energy rating scheme.
- Boilers water is recycled and all suspended and dissolved solids are removed by a recovery system.

5.2.3 Waste

- Dedicated storage area is provided for the separation, collection and paper recycling.

5.3 Recommendations

The following additional recommendations have been made to significantly improve the sustainability of the proposed development:

5.3.1 Operational Energy Efficiency

- The average hourly steam requirement is 10.5 tonnes while an instantaneous steam demand of 28 tonnes may be required. AGL proposed to consider two 8 MW boilers to provide the energy demand. Heggies recommends that the boilers be connected in series (boilers load sequentially). One of the boilers can then be used as a standby most of the time or to share the instantaneous steam demand when required.
- Operating the proposed two boilers with an optimum amount of excess air will minimize heat loss up the stack and improve combustion efficiency. The correct amount of excess air is determined from analysing flue gas oxygen or carbon dioxide concentrations. Inadequate excess air results in unburned combustibles (fuel, soot, smoke, and carbon monoxide) while too much results in heat lost due to the increased flue gas flow—thus lowering the overall boiler fuel-to-steam efficiency. Heggies recommends the use of a flue gas analyser to display percent oxygen, stack gas temperature, and boiler efficiency. An often stated rule of thumb is that boiler efficiency can be increased by 1% for each 15% reduction in excess air or 4.4 °C (40°F) reduction in stack gas temperature.

- Remove scale mechanically or by using an acid cleaner. Scale build-up can be prevented by optimising boiler blowdown practices; pre-treating feed. Prevent scale accumulation by ensuring water treatment systems are operating effectively. Scale build-up in boiler feedwater tubes inhibits both throughput and heat transfer. A coating of scale one millimetre thick can result in a 5% increase in fuel consumption.
- Power sub-metering to allow for effective monitoring and management of electricity consumption.
- Water sub-metering for different uses where appropriate.
- Heggies recommend conducting a feasibility study to investigate the use of cogeneration plant to provide electricity and steam on site.

  Cogeneration works this way: A fuel, usually natural gas, is burned in a large gas turbine that generates electricity. The hot gases emitted from the turbine are typically routed to a unit called a heat-recovery steam generator and used to produce steam for use in the manufacturing process. Thermal energy may be used for heating as well for cooling if required.

  In general, conventional power stations have an efficiency of 30-45% whereas cogeneration systems have an efficiency of 80-85%. Therefore, cogeneration plant provides significant environmental benefits.

  Capital costs for cogeneration system typically vary from $ 1000 per kW for large systems to more than $ 3,000 per KW for the very small system.

  A cogeneration plant is sized based on the ratio of heat to power required by a site. A detailed study is required to select an optimal cogeneration electrical capacity for a site and to determine how the electrical power output from the cogeneration plant may be most effectively distributed.

  Heggies notes the following:

  - Although the existing 11 kV transformers supplying the site do not have the capacity to supply the required 7.5 MVA, AGL and Integral electricity proposed a new underground distribution feeder to provide sufficient electricity power to the site.
  - The average steam requirement is 10.5 tonnes/hr.
  - The instantaneous steam demand is 28 tonnes/hr.
  - The offices in the proposed site need to be air conditioned and additional thermal energy from the proposed cogeneration plant can be used to operate thermally operated air conditioning systems.
  - There is also a need for domestic hot water on site.

  One can conclude that the use of a cogeneration system to offset partially the electricity demand for the site might be a viable economical option for the proposed project.

  It is worth mentioning that AGL* has carried out a desktop study to determine the viability of a cogeneration system at the proposing printing site. The study concluded that the cogeneration system for the proposed site would not be commercially viable. The AGL study was based on forecast information to offset totally the electricity demand for the site.

  A cogeneration plant to offset partially the electricity demand for the site might be commercially viable. Heggies recommends conducting a detailed study during the design development stage when the average and instantaneous steam demand is reasonably well understood.

*Cogeneration Feasibility. AGL letter to IPMG dated 28 May 2008

- Heggies recommends using LPG forklift and/or electric forklifts for the proposed site. Heggies notes that a second generation forklift (developed by Toyota in 1999) utilises the world's first AC drive system designed especially for forklifts and boasts power comparable to that of an internal combustion engine forklift, displaying excellent power performance. The use of that vehicle contributes to the widespread use of clean vehicles

  Electric forklifts are fume free, have less moving parts, which means less overall maintenance, quiet and clean, and easy to use. Their drawback is an eight hour recharge time when it runs out of power and the forklift needs to be returned to a charger every time.

  If, however, forklifts are used outside where it could possibly rain, LPG is strongly recommended as an electric forklift can short out if it gets wet.

  The acquisition costs of an electric forklift fleet can be moderately to substantially higher than an LPG or diesel truck fleet. The operating and maintenance cost of an electric forklift is significantly lower than an LPG or diesel trucks. A study conducted by Jungheinrich Forklift Corp has shown that any significant differences in the truck acquisition cost can be greatly diminished within a year, especially for the high-hour applications.

5.3.2 Passive Energy Efficiency for the Proposed Development

- Light wells and rotor ventilators for the proposed new warehouses.
- Line the inside of the roof of air-conditioned areas with a minimum R3.0 insulation in accordance with BCA requirements.
- Provide external walls insulation with R1.5 for all air conditioned areas.
- Install removable insulation on uninsulated valves, pipes, and fittings to reduce losses in the process heat. Insulating pipes and process vessels can significantly reduce heat loss from surfaces by up 90% for pipes carrying steam at high pressure.
- Lighting system incorporating high frequency ballasts.
- Limiting electric lighting levels to 400 Lux to all office area.

These features will help to achieve significant reductions in the energy required by the development both in building and operation.

6 REFERENCES

- Commonwealth of Australia (2007), *National Greenhouse and Energy Reporting Act 2007.*
- Department of Climate Change, Australian Government (2008a), *National Greenhouse and Energy Reporting Guidelines.*
- Department of Climate Change, Australian Government (2008b), *National Greenhouse Accounts (NGA) Factors, January 2008*.
- Eberhardt, J. U.S. Department of Energy (2002), *Fuels of the Future for Cars and Trucks*. 2002 Diesel Engine Emissions Reduction Workshop, 2002.
- World Business Council for Sustainable Development and World Resources Institute (2005), *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard.*
- Bowles J., *Jungheinrich Forklift Corp., Cost of ownership considerations: Electric vs ICE Forklifts, see also http://www.forkliftaction.com*.

A1 THE GREENHOUSE GAS PROTOCOL INITIATIVE

The Greenhouse Gas Protocol Initiative (hereafter, "the GHG Protocol") is a multi-stakeholder partnership of businesses, non-governmental organizations (NGOs), governments, and others convened by the World Resources Institute (WRI), a U.S.-based environmental NGO, and the World Business Council for Sustainable Development (WBCSD), a Geneva-based coalition of 170 international companies. Launched in 1998, the Initiative's mission is to develop internationally accepted greenhouse gas (GHG) accounting and reporting standards for business and to promote their broad adoption. (WBCSD, 2005)

The GHG Protocol comprises two separate but linked standards:

- *GHG Protocol Corporate Accounting and Reporting Standard* (this document, which provides a step-by-step guide for companies to use in quantifying and reporting their greenhouse gas emissions).
- *GHG Protocol Project Quantification Standard* (forthcoming; a guide for quantifying reductions from greenhouse gas mitigation projects).

There are three scopes of emissions that are established for greenhouse gas accounting and reporting purposes, defined as follows.

A1.1 Scope 1 Emissions – Direct GHG Emissions

The GHG Protocol defines Scope 1 emissions as those which result from activities under the company's control or from sources which they own. They are principally a result of the following activities:

- generation of electricity, heat or steam. These emissions result from the combustion of fuels in stationary sources, e.g. boilers, furnaces or turbines;
- physical or chemical processing. The majority of these emissions result from the manufacture or processing of chemicals and materials e.g. the manufacture of cement, aluminium, adipic acid and ammonia, or waste processing;
- transportation of materials, products, waste, and employees. These emissions result from the combustion of fuels in company owned/controlled mobile combustion sources (e.g., trucks, trains, ships, airplanes, buses, and cars);
- tugitive emissions. These emissions result from intentional or unintentional releases, e.g., equipment leaks from joints, seals, packing, and gaskets; methane emissions from coal mines and venting; hydrofluorocarbon (HFC) emissions during the use of refrigeration and air conditioning equipment; and methane leakages from gas transport.

A1.2 Scope 2 Emissions – Electricity indirect GHG Emissions

Scope 2 emissions are those which relate to the generation of purchased electricity consumed in its owned or controlled equipment or operations. For many companies, purchased electricity represents one of the largest sources of GHG emissions and the most significant opportunity to reduce these emissions.

A1.3 Scope 3 Emissions – Other indirect GHG Emissions

The GHG protocol states that Scope 3 reporting is optional and covers all other indirect GHG emissions. Scope 3 emissions are defined as those which do not result from the activities of a company although arise from sources not owned or controlled by the company. Examples of Scope 3 emissions include the extraction and production of purchased materials, transportation of purchased fuels and the use of sold products and services.

The GHG protocol flags the issue that the reporting of Scope 3 emissions may result in the double counting of emissions. A second problem is that as their reporting is optional, comparisons between countries and / or projects may become difficult. The GHG protocol also states that compliance regimes are more likely to focus on the "point of release" of emissions (direct emissions) and / or indirect emissions from the use of electricity. However, for GHG risk management and voluntary reporting, double counting is less important.