RMIT UNIVERSITY

School of Aerospace, Mechanical and Manufacturing Engineering

NIETL "ENTERPRISE NETWORKING"

NORTH Link Networking for Economic Development

RMIT University and NORTH Link Greenhouse Emission Reduction Program 2009

SUMMARY REPORT

December 2009

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- **Students**
  The eight final year Bachelor of Mechanical Engineering students, and the five Master of Engineering (Sustainable Energy) students from RMIT University who worked so enthusiastically to complete the projects and who presented their findings with such flair and confidence at the public presentation to industry.
- **Companies**
  The twelve companies that hosted the energy-reduction research projects for students and who provided the support and mentoring that helped achieve the outstanding results documented in this report. The many other companies who participated in the outreach support strategy program by attending seminars.
- **RMIT University**
  RMIT University staff from the School of Aerospace, Mechanical and Manufacturing Engineering who assisted in the development and implementation of the program especially:
  - Associate Professor John Andrews, Project Leader
  - Dr Andrea Bunting, Lecturer
  - Professor Aleksandar Subic, Head of School

  The assistance of Dr Biddyut Paul, Research Fellow in the school, in supervising number of students and preparing this final report is also gratefully acknowledged.

Mick Butera
Executive Director
NORTH Link

Executive Summary

NORTH Link and RMIT University have been actively engaged in greenhouse emission reduction activities, since 1998 and have achieved many successes over that period. These activities were supported by the Australian Greenhouse Office until the end of 2008 when this organisation was disbanded.

This year, 2009, the School of Aerospace, Mechanical and Manufacturing Engineering at RMIT University has once again set up and supervised undergraduate student projects involving fourth year Bachelor of Engineering (mechanical and aerospace) students, and postgraduate Master of Engineering (Sustainable Energy) students working with firms selected by NORTH Link, on the technical and financial evaluation, of the implementation of identified emission-reduction measures.

Hence, in total this year, fourteen RMIT engineering students have conducted projects with twelve firms located in Melbourne's north. The participating students comprised eight final-year Bachelor of Mechanical Engineering students, and six Master of Engineering (Sustainable Energy) students. Overall, the research conducted by the students has been a great success with all participating firms set to make large energy savings as well as cutting greenhouse gas emissions.

If all the measures recommended by the eight RMIT Bachelor of Engineering, and six Master of Engineering (Sustainable Energy) students involved are fully implemented by the twelve firms in this year's program, the total greenhouse gas emission reduction potential would be nearly 6 000 tonnes of carbon dioxide equivalent annually (Table E1).

In view of the continued success of the program in achieving emission reductions, financial savings to firms, and raising awareness and expertise among students in this area, we are very keen not only to run a similar program again next year in Melbourne's north, but participate in efforts set up similar programs in other cities and regions right around Australia.

Table E1: Summary of the estimated potential emission reduction, and the associated capital investment and savings in annual fuel bills, if all the measures recommended by the student projects in the 2009 program are fully implemented

Company	Project	Students	Projected emission reduction (tonnes/y)	Annual savings in fuel bills ($'000)	Capital costs ($'000)	Payback period (years)
Aisin	Energy Audit and Evaluation of Recommendations for Aisin Pty Ltd	Michael David Kidd (B Mech Eng)	80	9	11	>1
Armstrong World Industries	Emission Reductions for Furnace Used in Tile Production	Darrin Hunt (M Eng Sustainable Energy)	1406	81	256	3
Austin Hospital	Austin Hospital Steam Reticulation System	Thomas Ryan (B Mech Eng)	181	15	59	4
Austin Hospital	Emission Reduction for Austin Hospital tower	Gita Maruthayanar (M Eng Sustainable Energy)	170	130	350	>10
Capral	Energy Audit and Follow-up	Angus Medley (B Mech Eng)	840	58	275	5
Diecraft	Energy Audit and Follow-up	Sonia Bittelman (M Eng Sustainable Energy)	18	1.2	16	10
JAL Chemicals	Carbon Footprint Evaluation for the Operations at Peerless Jal Pty Ltd	Nritraj Kawshal Reebye (B Mech Eng)	85	3	17	5
Melbourne Airport Terminal	Lighting Efficiency Review at Melbourne Airport	Luke Evered (B Mech Eng)	770	76	74	<1
Melbourne Fire Brigade	Greenhouse Gas Reduction Recommendations for Melbourne Fire Brigade	Johnathon Jerrett (B Mech Eng)	308	22.5	88	2 to 5
One Steel	Level 2 Energy Audit of Onesteel's Profile and Tube Mill, Somerton Victoria	Ben Carmichael (M Eng Sustainable Energy)	1073	134	11	<1
RMIT University (Property Services)	Lighting Audit of Building 251 RMIT Bundoora East	Arsalan Shahlaee (M Eng Sustainable Energy)	140	50	342	7
RMIT University (Property Services)	Daylighting in RMIT Bundoora East Cafeteria	Rosemarie Evangelista (M Eng Sustainable Energy)	7	na	3	3
Ross Cosmetics	Energy Audit and Cogeneration System	James Kirk (B Mech Eng)	735	73	700	10
Securency	Emission Reductions at Securency International	Sachil Dilantha Meegama (B Mech Eng)	na	122	na	3
TOTAL			**5813**	**748**	**2202**	
Notes						
na: not available						

1 Introduction

Following the successes of its Greenhouse Challenge Support Programs over the period 2004-2008, NORTH Link and the School of Aerospace, Mechanical and Manufacturing Engineering (SAMME) at RMIT University have once again in 2009 set up student projects involving fourth-year Bachelor of Engineering (Mechanical and Aerospace) students, and postgraduate Master of Engineering (Sustainable Energy) students working with selected firms, on the technical and financial evaluation, and implementation of identified emission-reduction measures. As part of this work:

- Two seminars were held to:
  - Introduce firms, students and RMIT staff to the program
  - Allow students to present their findings and outcomes to invited representatives from Greenhouse reduction firms in the northern region of Melbourne
- Student reports and findings were also presented individually to firms

The activities conducted by RMIT University were as follows:

Activity/Outcome	**Date of Completion**
Establishing undergraduate engineering student projects involving students working with selected northern-region firms, on the technical and financial evaluation, and implementation of identified greenhouse-gas emission-reduction measures.	21 March 2009
Project Proposal, including definition of project scope, activities, and Gantt chart project schedule (15% marks – S1)	Friday 3 April 2009 (end of week 5, semester 1)
Seminar/training session 1: • For all potential and agreed participants in the student project program – students, RMIT academic staff supervisors, and company representatives • Provide background information on greenhouse issues and the Greenhouse reduction program • Outline projects to be conducted and procedures Deal with queries from participants	Friday 17 April 2009, 9-11 am
Progress report: draft to date of summary report, including introduction, methodology, findings to date (incorporating literature review), actual progress compared to planner, and projections to completion (15% of total marks – S1)	Friday 01 May 2009 (end of week 7)
Summary report: submission of summary report (covering progress to date) to go to company (note this will replace the Project Introduction as defined in the course guide for this course) (40% of marks – S1)	Friday 18 June 2009 (end of week 11)

Seminar/training session 2: • For all participants in the student project program, plus targeted/interested representatives from other firms • Overview and update on greenhouse issues, the Greenhouse reduction program • Short presentation of individual project outcomes by students, including (30% of total marks – S1) (replaces poster presentation) • Presentation by RMIT Program Leader on overall outcomes of the student project component of the program, including: o Overall abatement achieved by the projects to date and future abatement predicted o Potential for transferring actions/projects to other organisations and situations o Examples of interesting technical and other issues that arose, and achievements in addressing these o Commentary on significant greenhouse abatement actions more generally • Open discussion on lessons learnt from this program, greenhouse issues, and future opportunities for abatement	Friday 31 July 2009
Thesis progress report (15% of marks – S2)	14 August 2009 (end of week 4 semester 2)
Final project report in the form of a thesis for RMIT assessment (60% of marks – S2)	9 October 2009 (end of week 11, semester 2)
Oral presentation and examination (25% of marks – S2)	November 2009, during week 16, semester 2

The present report describes the activities conducted within and the outcomes from the RMIT-NORTH Link Greenhouse program in 2009.

2 Student projects on emission reduction

2.1 Setting up the projects

Selection of the firms to host student projects on emission reduction was accomplished as follows:

- Mick Butera, Executive Director of NORTH Link, made an initial selection of potential firms
- Associate Professor Andrews, and in some cases Dr Biddyut Paul, then visited all the short-listed firms to explain what would be involved in hosting a project and gaining provisional agreement for their participation in the program
- The list of twelve firms was then finalised, and a letter sent by NORTH Link to the firms for countersigning by the CEO, formally agreeing to host a student project.

RMIT Mechanical, Manufacturing, and Aerospace Engineering students have a choice as to topic selection for their final year project. The Greenhouse Emission Reduction Program was in competition with a range of other opportunities. In total there are over 100 students undertaking their final projects this year. The final year students to be involved in the Greenhouse Emission Reduction Program were thus selected through the following procedures:

- A presentation by Dr John Andrews of the opportunity at RMIT, in an information session to all (then) third year students in October 2008
- Advertisement of the opportunity at RMIT in February 2009
- Lecturers contacting students to encourage them to participate
- Eight B. Eng. students signed up to be involved with Greenhouse emission reduction projects
- Students were asked to sign confidentiality agreements so that no information confidential to their host firms is released in their project reports, while safeguarding their right to complete their theses for examination.

In 2009 postgraduate students undertaking the Master of Engineering (Sustainable Energy) program by coursework at RMIT were also given the opportunity to conduct course projects with firms in the Greenhouse Emission Reduction Program. Six mature-age students enthusiastically took up this option, but one master's student subsequently was unable to complete his project due to illness.

Thus in total 14 students participated in this year's program and completed their projects.

Students were assigned to particular companies taking into account so far as possible the preferences they expressed. Each of the twelve firms were then visited by Associate Professor Andrews with the assigned student(s), and Dr Biddyut Paul in the case of the projects he co-supervised, to introduce them to their company supervisor and agree on the ongoing working arrangements.

The final-year project component of the Bachelor of Mechanical Engineering and Bachelor of Aerospace Engineering at RMIT requires the submission of two milestone reports, with a final thesis due at the end of September. A special deadline of 30 June was set for the Greenhouse Emission Reduction Program students for completion of an overview report on their research and submission to the participating company and the Australian Greenhouse Office.

Students also committed to giving a presentation on their report at the final seminar in program held at RMIT at the beginning of semester 2 in July 2009. Students, however, continued their work with assigned companies until September to complete their theses giving a more detailed report on the research work done. The Master of Engineering (Sustainable Energy) students undertook their projects either as part of the course Sustainable Energy Systems and Design in semester 1 of the year, in which case their work on the program finished at the end of this semester in late June 2009; or for the course Energy Design Project (leading to a minor thesis), in which case their work was conducted over both semesters 1 and 2 and finished in November 2009.

The main RMIT staff involved with the program this year were Associate Professor John Andrews (Program Leader), Dr Andrea Bunting (Lecturer), Dr Biddyut Paul, Research Fellow, Energy CARE Group, and Professor Aleksandar Subic (Head of SAMME).

2.2 The projects initiated

Specifically the following projects were initiated within the program, involving fourteen students working with twelve firms from the northern region of Melbourne:

Company	**Project**	**Students**
Aisin	Energy Audit and Evaluation of Recommendations for Aisin Pty Ltd	Michael David Kidd (B Mech Eng)
Armstrong World Industries	Emission Reductions for Furnace Used in Tile Production	Darrin Hunt (M Eng Sustainable Energy)
Austin Hospital	Austin Hospital Steam Reticulation System	Thomas Ryan (B Mech Eng)
Austin Hospital	Emission Reduction for Austin Hospital tower	Gita Maruthayanar (M Eng Sustainable Energy)
Capral	Energy Audit and Follow-up	Angus Medley (B Mech Eng)
Diecraft	Energy Audit and Follow-up	Sonia Bittelman (M Eng Sustainable Energy)
JAL Chemicals	Carbon Footprint Evaluation for the Operations at Peerless Jal Pty Ltd	Nritraj Kawshal Reebye (B Mech Eng)
Melbourne Airport Terminal	Lighting Efficiency Review at Melbourne Airport	Luke Evered (B Mech Eng)
Melbourne Fire Brigade	Greenhouse Gas Reduction Recommendations for Melbourne Fire Brigade	Johnathon Jerrett (B Mech Eng)

One Steel	Level 2 Energy Audit of One Steel's Profile and Tube Mill, Somerton Victoria	Ben Carmichael (M Eng Sustainable Energy)
RMIT University (Property Services) RMIT University (Property Services)	Lighting Audit of Building 251 RMIT Bundoora East Daylighting in RMIT Bundoora East Cafeteria	Arsalan Shahlaee (M Eng Sustainable Energy) Rosemarie Evangelista (M Eng Sustainable Energy)
Ross Cosmetics	Energy Audit and Cogeneration System	James Kirk (B Mech Eng)
Securency	Emission Reductions at Securency International	Sachil Dilantha Meegama (B Mech Eng)

The first seminar in the student project component of the program was held on 4 April 2009 at RMIT's Bundoora East campus. This seminar provided an update on the climate change issue internationally and nationally, and an overview of the student project component of the overall program. It also allowed students and company representatives to meet as a whole group and swap ideas and contacts.

The invitation to this seminar is included in Appendix B.

2.3 Student presentations to companies

The fourteen student projects listed in the foregoing table have been completed as required in the contract with NORTH Link.

The students each made a five-minute PowerPoint presentation on their project and the main findings, including the emission reductions identified and the financial assessment of those measures, at a seminar held at RMIT on Friday 7 August 2009. The invitation and agenda for this seminar are included in Appendix B. The seminar was very successful, attended by representatives of the host firms, along with RMIT staff, and the fourteen students involved in projects. After each student presentation, their company supervisor gave a short comment on the company's experience with the program and their intentions with regard to implementation of the recommended emission-reduction measures. All spoke in a very positive way about the benefits of their project and commitments to putting into practice the recommendations. Associate Professor John Andrews offered comments and suggestions on the transferability of the findings to other firms.

2.4 Findings from research projects

The main findings from each of the research projects are presented in the following table. The estimated reduction in annual greenhouse gas emissions for each measure investigated is presented, together with its capital cost, estimated annual savings, and simple payback period.

Company	Project	Students	Projected emission reduction (tonnes/y)	Annual savings in fuel bills ($'000)	Capital costs ($'000)	Payback period (years)
Aisin	Energy Audit and Evaluation of Recommendations for Aisin Pty Ltd	Michael David Kidd (B Mech Eng)	80	9	11	>1
Armstrong World Industries	Emission Reductions for Furnace Used in Tile Production	Darrin Hunt (M Eng Sustainable Energy)	1406	81	256	3
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Capral	Energy Audit and Follow-up	Angus Medley (B Mech Eng)	840	58	275	5
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Ross Cosmetics	Energy Audit and Cogeneration System	James Kirk (B Mech Eng)	735	73	700	10
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TOTAL			**5813**	**748**	**2202**	
Notes						
na: not available						

Overall, the research conducted by the students this year has been a great success with all participating firms set to make large energy savings as well as reducing their greenhouse gas emissions.

If all the measures recommended by the eight RMIT Bachelor of Engineering, and six Master of Engineering (Sustainable Energy) students involved are fully implemented by the thirteen firms in this year's program, the total greenhouse gas emission reduction potential would be over 5 813 tonnes of carbon dioxide equivalent annually.

For the measures where financial figures are available, the total annual savings in energy bills would be $748 000 per year, for a total capital investment of just over $2.2 million. The average simple payback period for all these measures would thus be less than 3 years.

A short summary of each research project is provided in Appendix A, including the project aims, company profile, method, emission reduction and financial analysis.

3 Conclusions and recommendations

This program has once again provided the participating engineering students with highly valuable and practical career skills in improving the energy and cost efficiency of industrial processes and equipment, and in energy auditing, that will definitely enhance their employment prospects.

It has helped create a culture of environmental stewardship amongst both the students and within the participating firms that have hosted projects, making all parties more aware of the cost saving potential of greenhouse gas emission reduction measures. These effects will continue beyond the life of the program and will help achieve its capacity-building objective.

Overall, the program has provided the students with a great learning opportunity, through working directly with firms to identify new and practical energy-saving measures. The firms have also benefited from the new ideas and cost free research capacity, cutting their fuel bills and meeting their greenhouse emission reduction targets.

The twelve firms will also cut their carbon dioxide emissions by some 5 813 tonnes each year, if they implement all the measures proposed. Most firms indicated a high probability of implementation of the measures at the final seminar in the program.

The participating Greenhouse Emission Reduction Program firms based in Melbourne's north have the potential to achieve annual savings of nearly $748 000 upon implementation of the recommendations made by the students involved in the program. The total capital investment needed to implement these emission reduction measures would be $2.2 million so the package as a whole has provided a very attractive financial outcome for participating firms with an average simple payback period of less than 3 years.

In view of the continued success of the program in achieving emission reductions, financial savings to firms, and raising awareness and expertise among students in this area, we are very keen to run similar programs again in the future in Melbourne's north.

Discussions between NORTH Link and RMIT SAMME are therefore recommended to work out the best arrangements in the absence of Australian Greenhouse Office funding now that the Commonwealth Government's Greenhouse Challenge program itself has ended.

Appendix A: Summaries of Student Research Projects

The following projects were conducted in 2009. Summaries of each project follow this table.

Company	Project	Students
Aisin	Energy Audit and Evaluation of Recommendations for Aisin Pty Ltd	Michael David Kidd (B Mech Eng)
Armstrong World Industries	Emission Reductions for Furnace Used in Tile Production	Darrin Hunt (M Eng Sustainable Energy)
Austin Hospital	Austin Hospital Steam Reticulation System	Thomas Ryan (B Mech Eng)
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Ross Cosmetics	Energy Audit and Cogeneration System	James Kirk (B Mech Eng)
Securency	Emission Reductions at Securency International	Sachil Dilantha Meegama (B Mech Eng)

Project: **Energy Audit and Evaluation of Recommendations for Aisin Pty Ltd**

Company: **Aisin Pty Ltd**
Researcher: **Michael David Kidd**

Project aims

- Conduct an energy audit and estimate the annual energy consumption and the associated greenhouse gas emissions.
- Identify opportunities to reduce energy use and greenhouse gas emissions on site by recommending alternatives.
- Evaluate recommendations in terms of technical feasibility, emission reduction and net economic benefits.
- Review desired recommendation for potential implementation.

Brief company profile

- AISIN Australia was established in 1972 and is located in Melbourne's western suburbs at 593-599 Somerville Road, Sunshine. The production line in Melbourne specifically produces door frames for the Toyota Camry cars. AISIN procures parts and materials globally, supporting local economies as well as maintaining an active involvement in the local community. AISIN promotes technological exchanges and works to deepen mutual understanding through cultural exchanges.

Emission reduction measures investigated

- Reduce lighting consumption by using different type of bulbs.
- Reduce time between component placement within specific production line which in turn will produce a higher product output per unit of emission.
- Reduce the use of dust extractors by implementing a compressed air set up allowing the vacuum to be turned on only when need.

Method

- Determine baseline energy use.
- Conduct an energy review of major areas of power usage.
- Undertake a technical review, based on a level 2 energy audit in accordance with AS/NZS 3598:2000.
- Outline an energy savings action plan.

Potential emission reduction

Opportunities identified:

- Replacing 400 W Philips Powertone HPL-N E40 bulbs and 36 W Philips Fluoro tubes to more efficient bulbs.
- Replacing electrically driven dust extraction unit with a compressed air driven air mover.

Financial payback/net benefits

- If both recommended alternatives implemented with the investment of total $11 000, a saving of over $9 000 per year on energy bills with a corresponding emissions reduction of around 80 tonnes CO_2-e per year can be obtained.

Project: **Emission Reductions for Furnace Used in Tile Production**

Company: **Armstrong World Industries**
Researcher: **Darrin Hunt**

Project aims

- Make a thorough assessment of the PVC flooring consolidation processing facility at Armstrong World Industries.
- Identify opportunities to reduce greenhouse gas emissions.
- Present a proposal of identified opportunities for implementation.

Brief company profile

- Armstrong World Industries is a manufacturer of a diverse range of building products. They have 37 plants in 10 countries and employ about 11,000 people.
- The Braeside plant in Melbourne, Australia, manufactures, among other things, PVC flooring in a variety of colours and weights. Approximately 50% of their manufactured product is exported to China and Japan.

Emission reduction measures investigated

- Investigation was carried out on the feasibility of changing the heating regime used in the two ovens on the PVC flooring consolidation line with a view to reducing the overall energy consumption, thus leading to a reduction in greenhouse gas emissions.

Method

- Identify and quantify all the heat inputs used in the current production process.
- Data collection of energy inputs by direct measurements or supplied by Armstrong World Industries.
- Calculation of actual heat required for production of actual product.
- Submission of a proposal for a new heating regime with supporting detail.

Potential emission reduction

Opportunities identified:

- Replace the existing ceramic faced electric heaters with new, more efficient electric heaters.
- Replace the existing ceramic faced electric heaters with infrared catalytic heaters. Retain the steam heated platens and the Maxon burners
- Replace the existing ceramic faced electric heaters, Maxon burners and steam heated platens with infrared catalytic gas heaters both and above below the product.

Financial payback/net benefits

- Replacement of existing heaters with an infrared catalytic gas heater would costs capital investment of $256 000. Savings for the energy bills would about $81 000 per year with a payback period of 3 years.
- The annual reduction in greenhouse gas emissions would be about 1406 tonnes CO_2-e.

Project: **Austin Hospital Steam Reticulation System**

Company: **Austin Hospital**
Researcher: **Thomas Ryan**

Project aims

- Analyse the existing steam system at the Austin Hospital, and develop a mass energy flow chart for the system.
- Identify inefficiencies in the system and propose optimised solutions via design modification and controls, reducing energy expenditure and emissions of the system.
- Evaluate the options in terms of technical feasibility, emission reduction, potential and net economic benefits.
- Make recommendations about preferred options for implementation.

Brief company profile

- The Austin Hospital in Heidelberg is the main source of tertiary health services, health professional education and research in Melbourne's North East region. It is well known for high standard of hospital care, world renowned specialists research works in cancer, liver transplantation, spinal cord injuries, endocrinology, neurology, mental health and rehabilitation.

Emission reduction measures investigated

- Salvaging waste heat from the deaerator air/steam vent.
- Insulation of hot water/feed-water pipes in boiler room.
- Recovering heat from boiler blow down.
- Compact baffle hot water heat exchangers to replace DHW heat exchangers.

Method

- Sourcing out steam layout engineering drawings to identify the location of the components.
- Collection of data for energy usage and steam production of the system.
- Calculation of greenhouse gas emission from the amount of fuel required to maintain operation.
- Identify and investigation of potential areas of emission reduction.
- Make recommendation based on the detailed results from the different option investigated.

Potential emission reduction

Opportunities identified:

- Salvaging waste steam from the deaerator air/steam vent.
- Insulation of hot water/feed water pipes in boiler room.
- Boiler blow down heat recovery.

Financial payback/net benefits

- With the capital investment of total $59 000 for a deaerator steam recovery unit comprising of a condenser/heat exchanger system, a blow down recovery heat exchanger unit and the installation of insulation on hot fee water pipes, the Austin Hospital can save $15 000/yr on energy bills.
- The potential emission reduction associated with the chosen emission reduction measures translates to 181 tonnes of CO_2-e.

Project: **Emission Reduction for Austin Hospital tower**

Company: **Austin Hospital**
Researcher: **Gita Maruthayanar**

Project aims

- Highlight areas where energy is being consumed, in what form, quantity and cost.
- Determine areas that have to be improved in terms of energy use.
- Provide estimates, energy saving potentials and payback periods for the improvements and or recommendations.

Brief company profile

- Established in 1882, the Austin had five name changes that included the "Austin Hospital for Incurables" before becoming the Austin Hospital. The Austin Hospital is located in Heidelberg, 20 minutes north-east of Melbourne's city centre. The hospital was re-opened in 2005 after a major redevelopment (Austin Health, 2009). The redeveloped Austin Hospital now features: 400 acute beds, a 30-bed intensive care unit, one of the state's largest adult emergency units and a specialist six-bed unit for children a purpose-built, 26-bed high-tech spinal unit to serve all of Victoria and Tasmania infectious diseases.

Emission reduction measures investigated

- Identify the sub meters and electrical equipment serving the Austin Towers and the corresponding areas with the intent of reducing the hospital's electricity consumption and expenses.

Method

- Energy metering by wiring all the energy meters to the Siemens Building Management System (BMS) to actually predict the energy consumption for the whole Austin Tower.
- Setting up the KPI to meet the schemes that will be put in place by the State of Federal Governments.
- Analyse all sectors of energy usage like laundry, kitchen and lighting, and come up with recommendations for possible improvements.

Potential emission reduction

Opportunities identified:

- Staff awareness and education to turn off the equipment, especially in after hours and weekends.
- Setting up power save mode in computers.
- Sub metering for the energy usage in different floors, and cafeteria.
- Upgrading lighting system by replacing ELV's with compact fluorescent lights, installation of daylight sensors and C-Bus lighting control system with timer.
- Installation of roof mounted PV system to power the data centre or the main plant room.

Financial payback/net benefits

- Replacement of existing lighting system would cost - $350 000.
- Potential annual saving on electricity bill – $130 000 and greenhouse gas emission reduction 170 tonnes CO_2-e.
- Payback period is > 10 years.

Project: **Energy Audit and Follow-up**

Company: **Capral**
Researcher: **Angus Medley**

Project aims

- Prepare an emissions inventory for the whole Campbellfield plant.
- Conduct an energy audit and identify the options.
- Make recommendations into which of the options will work best for the business.

Brief company profile

- Capral is an Australian aluminum extrusion manufacturing company. They have five different manufacturing locations throughout Australia. The Campbellfield site employs around 120 people. This site usually operates 24 hours a day, five days a week. Each year this site can produce over 8500 tonnes of aluminum with over 3500 different cross sections (dies) to choose from customers. The aluminums extruded here is transported all over Australia and around world.

Emission reduction measures investigated

- The high bay lights were looked to find possible alternatives. Solar hot water system with gas booster also investigated. Improving the efficiency of the air compressor will also be an area where huge environmental and financial savings can be made.

Method

- Estimate the energy usage and make an emission inventory.
- Analyse the areas of interest where potential emission reduction can be achieved.
- Evaluate the options technically and workout which will have the greatest reduction on their greenhouse gas emissions and are economically viable.

Potential emission reduction

Opportunities identified:

- Replacement of high bay lights in AVA building and office lights by Solar Eluma lights and T5 fluorescent tubes with an ultra reflective background.
- Upgrading water heating system by solar hot water system.
- Improving the efficiency of the compressor by AirMetrix tool.

Financial payback/net benefits

- If all the recommended alternatives implemented with the investment of total $275 000, a saving of over $58 000 per year on energy bills with a corresponding emissions reduction of around 840 tonnes CO_2-e per year can be obtained.
- Payback period is in the order of 5 years.

Project: **Energy Audit and Follow-up**

Company: **Diecraft**
Researcher: **Sonia Bittelman**

Project aims

- Measure and assess the company's energy usage, patterns and trends to prepare for further energy efficiency opportunities.
- Assess the facility's reporting obligations under NGERS legislation.
- Examine opportunities for cost-effective energy and greenhouse gas emission reductions in Diecraft's lunch room.

Brief company profile

- The Reservoir factory of Diecraft manufactures plastic injection moulds (or dies) which are used to produce the Tupperware range of kitchenware products. The Diecraft Australia engineering company was originally established in 1965 as a tool and dies making business and has a long association with Tupperware. The factory is presently the main source of dies for Tupperware, supplying all the most complex dies, such as those designed for multi-colour parts, and about 50 to 70% of all Tupperware dies. Staff numbers are currently 86, including office staff.

Emission reduction measures investigated

- The energy analysis, inventory and lunch room audit to form the basis of continuing energy efficiency measures for the business.

Method

- Energy consumption and greenhouse gas emissions analysis.
- NGERS reporting-energy and emissions inventory (using OSCAR online sample).
- Recommendations for energy savings in the lunch room, using Triple Bottom Line analysis which will take into account environmental, social and economic considerations.

Potential emission reduction

Opportunities identified:

- Lunch room activities and facilities.
- Stop using second water boiler.
- Replacing more than 20 years old fridge with a new one.
- Installation of motion and light sensors.

Financial payback/net benefits

- Total greenhouse gas emissions savings of all above initiatives is 18 tonnes per annum.
- Total investment for all the initiatives would be around $16 000 with financial saving on energy bills $1 200 per annum.
- Average pay back period is grate than 10 but some options have much shorter payback period.

Project: **Carbon Footprint Evaluation for the Operations at Peerless Jal Pty Ltd**

Company: **JAL Chemicals**
Researcher: **Nritraj Kawshal Reebye**

Project aims

- Conduct an energy audit of the production site.
- Conduct a level 2 energy audit for the transport and delivery department.
- Estimate inefficiencies and wastages throughout manufacture and delivery.
- Investigate energy saving measures which need to be considered during the construction of forthcoming office area.

Brief company profile

- Established in 1947, Peerless Jal Pty Ltd currently has 77 employees throughout Australia. The Melbourne head office comprises of research and development, quality control, production and supply. It manufactures an average of 140 000 litres per month of various chemicals that is bottled and distributed to different organisations.

Emission reduction measures investigated

- The complete carbon footprint analysis, coupled with suggested recommendations will enable the Peerless Jal to optimise efficiency in areas such as air compression and water heating and hence reduce its impact on the environment.

Method

- Analysis of current situation.
- Estimation of losses in air compressor, excessive lighting and waste of natural gas.
- Calculation of the carbon footprint of the organisation in terms of annual tonnes of CO_2-e produced.
- An economic analysis of the proposed recommendations, including an estimate of the capital investment required and the payback period.
- Investigation of energy saving measures which need to be considered during the construction of a forthcoming office area.

Potential emission reduction

Opportunities identified:

- Maximising the use of natural lighting.
- Replacement of fluorescent tubes with LED.
- Sizing the air receiver such that the compressor idles more and hence uses less peak power.
- Boiler control box to turn off the system when not necessary.

Financial payback/net benefits

- Replacement of existing lighting with LED lights, maximisation of skylight by using Perspex sheet and the compressor receiver size modifications would attract capital investment of $17 000.
- Implementation of these measures potential emission reduction of JAL Chemicals is about 85 tonnes of CO_2-e and savings on annual fuel bills $3 000.

Project: **Lighting Efficiency Review at Melbourne Airport**

Company: **Melbourne Airport Terminal**
Researcher: **Luke Evered**

Project aims

- Identify options for improving lighting efficiency and hence reducing electricity usage and greenhouse emissions.
- Conduct an audit of the lighting at terminals 2, 3 and 4 at Melbourne Airport.
- Evaluate these options in terms of potential emission reduction and net economic benefits.
- Make recommendations regarding implementations of preferred options.

Brief company profile

- Melbourne Airport was opened in 1970 and since then has turned itself into the main transport hubs in Australia.
- It is currently to host around 24.3 million passengers per year, have around 193 000 aircrafts movement and are active participants in the Greenhouse Challenge Plus program.

Emission reduction measures investigated

- The energy consumption of the lighting in specific areas was investigated, then recommendations made on the ways to improve the situation.

Method

- The first step was to find the total emissions generated by the lighting, and to do this the total energy consumption was required.
- By doing this the areas where most savings could be made was easily found, and also areas where reductions would be of little or no significance.
- The next step was to evaluate the options shown above in terms of potential financial and environmental reductions made.
- Finally a recommendation as to which of the options to implement was required as well as some conclusions.

Potential emission reduction

Opportunities identified:

- Checking if areas are being over lt/under lit according to AS 1680.
- Changing the types of light used.
- Implementing photosensitive sensors and motion sensors.
- Consider opportunities associated with Passive Solar Design.

Financial payback/net benefits

- By implementing all options around 770 tonnes of CO_2-e emissions will be saved annually.
- With $74 000 of capital investment for implementing all the options, there will be financial saving of around $76 000 and the payback period is just under 1 year.

Project: **Greenhouse Gas Reduction Recommendations for Melbourne Fire Brigade**

Company: **Melbourne Fire Brigade**
Researcher: **Johnathon Jerrett**

Project aims

- Analyse energy consumption data for selected fire stations and identify usage trends, site characteristics and benchmark fire stations based on key performance indicators.
- Determine key usage patterns and to identify options for emission reduction by means of conducting energy audits of selected fire stations.
- Evaluate options in terms of potential emission reduction and net economic benefits and acceptability to fire station staff.
- Recommend energy efficient options for potential implementation for existing stations and for possible incorporation into new stations in the future.

Brief company profile

- The first known volunteer fire brigade operated in Melbourne in 1845. In 1890, the fire brigade act was introduced – leading to the establishment of the Melbourne Fire Brigade (MFB) in 1891. In 1893, the Eastern Hill fire station opened and today it is the MFB's headquarters. The MFB has established an Environmental Action Committee (EAC) to mange greenhouse gas emission reductions and other environmental improvements. MFB's target is to achieve 20% renewable energy by 2020 and 60% greenhouse gas emission reduction by 2050.

Emission reduction measures investigated

- Reducing Greenhouse Gas emissions associated with indoor lighting, hot water systems and heating and cooling systems in different fire stations.

Method

- Discussion of current stations and selection of stations for analysis.
- Conducting a level 3 energy audit using AS/NZS 3598:2000 for the four selected stations quantifying energy use by type.
- Conduct a comprehensive literature review to investigate the various types of greenhouse reduction method and renewable energy sources.
- Investigate the potential greenhouse gas reductions associated with the recommended alternatives in energy usage and greenhouse gas emissions reduction proposals.
- Complete a financial analysis, calculate payback period, and provide recommendations for the most suitable reduction methods.

Potential emission reduction

Opportunities identified:

- Using controlling strategies for lighting and efficient luminaries.
- Implementation of ground based geothermal heating and cooling system.

Financial payback/net benefits

- If all the measures are implemented the potential for annual reductions in greenhouse gas emissions to the selected four stations yields 308 tonnes of CO_2-e and potential cost savings ranging approximately $22 500 per year.
- Capital investment for these measures would be $88 000 and the payback period in between 2 and 5 years.

Project: **Level 2 Energy Audit of One Steel's Profile and Tube Mill, Somerton Victoria**

Company: **One Steel**
Researcher: **Ben Carmichael**

Project aims

- Assess several major energy efficiency opportunities at the Somerton plant in terms potential emission reduction and net economic benefits.
- Make recommendations to One Steel regarding implementation of preferred options.

Brief company profile

- One Steel's steel tube and profile plant in Somerton, is located at 235 Hume Hwy, and occupies a 27 864m^2 factory shell. The plant was established in 1998 and incorporates two steel mills – a profile mill which produces steel angles, channels and flats and a tube mill which produces steel tubes. Associated major equipment includes a steel splitter, three 260kW centrifugal air compressors, product bundling equipment and warehousing with overhead remote control cranes.

Emission reduction measures investigated

- An estimate of electricity end use was made by forming an inventory of electrical loads versus operational data. A number of energy efficiency opportunities were assessed during the audit, with an emphasis on the use of a high grade waste heat source from the galvanising bath exhausts.

Method

- Analyse monthly/annual energy demand and analyse the end-use energy demand at One Steel's manufacturing plant in Somerton.
- Establish a greenhouse emissions baseline annual inventory in accordance with the National Greenhouse and Energy Reporting System (NGERS), and a key performance indicator of emissions of CO_2-e per tonne of product
- Assess several major energy efficiency opportunities at the Somerton plant in terms of potential emission reduction and net economic benefits
- Make recommendations to One Steel regarding implementation of preferred options.

Potential emission reduction

Opportunities identified:

- Galvanising bath burner tune-up.
- Switch off security lighting at night/follow sign-out procedure.
- Fixing up compressed air leakage.
- Sub metering of shot blasters to reduce idle time.

Financial payback/net benefits

- Implementation of all these measures will incur the capital investment of only $11 000, and the financial payback period would be less than a year.
- The above measures are recommended as a means of annual energy costs savings of $134 000 and reducing greenhouse gas emissions 1 073 tonnes of CO_2-e at the Somerton plant.

Project: **Lighting Audit of Building 251 RMIT Bundoora East**

Company: **RMIT University Property Services**
Researcher: **Arsalan Shahlaee**

Project aims

- Make an audit the amount of electricity that is currently being used for the purpose of lighting.
- Find possible alternatives to reduce the electricity consumption in line with Australian standards and proposing replacement system where necessary with more energy efficient fixture.

Brief company profile

- RMIT University is a tertiary educational institution has multiple campuses in Melbourne, and is enthusiastic to participate in the Greenhouse Challenge Plus program. Building 251 is located in Bundoora east campus of RMIT University. It has three levels. In first level there are only plant rooms and storage rooms which are basically being used whenever there is a need for maintenance or accessing store rooms. The other 2 floors comprise of class rooms, offices, a cafeteria, a library and computer labs. Each of those categories has their own requirements in terms of lighting system, intensity of light (lux level) and lighting controls. Also currently there are 200 people working in this building.

Emission reduction measures investigated

- Reducing Greenhouse Gas emissions associated with new residential building or large renovation developments required investigating the opportunities for community education and training, Council support and advocacy to Government.

Method

- Analysis of the building energy usage by sectors.
- Identify current problem and issues in lighting system.
- Evaluate the options in terms of potential financial, environmental and social benefits.
- Make recommendations for implementation of preferred options.

Potential emission reduction

Opportunities identified:

- Replacing all T12 linear fluorescent tubes and fittings with T5 ones plus changing Halogen lamps with new IRC ones'.
- Installing occupancy sensors and daylight sensors.

Financial payback/net benefits

- By implementing the new lighting system and sensors, RMIT would benefit from reducing 140 tonnes of greenhouse gas emissions and can save $50 000 on electricity bills annually.
- Capital investment for these options is $342 000 and payback period is 7 years.

Project: **Daylighting in RMIT Bundoora East Cafeteria**

Company: **RMIT University Property Services**
Researcher: **Rosemarie Evangelista**

Project aims

- Determine the energy consumption of the cafeteria over its operating hours.
- Evaluate the possible sustainable technology options to achieve carbon reduction in conjunction with the RMIT-NORTH Link Greenhouse Emission Reduction Program 2009.
- Decide and design the most promising option based on triple bottom line evaluation and life-cycle assessment.
- Identify the possible applicability of the sustainable technology design to other buildings in RMIT and other commercial/industrial buildings.

Brief company profile

- RMIT University is one of the best engineering universities in Australia. RMIT University is concerned about global warming and is a member of Greenhouse Challenge Plus program. RMIT Property Services provide some projects every year to final-year undergraduate and Master of Engineering (Sustainable Energy) students on greenhouse gas reduction topics.

Emission reduction measures investigated

- This study focuses on the comparison between day lighting using TDD and T5's using the current lighting system in the cafeteria as the benchmark.

Method

- Actual inspection of the site (roof, mezzanine, inside the cafeteria, outside the cafeteria) and observation of the activities in the cafeteria.
- Physical audit of the light fixtures (quantity and wattage).
- Data gathering of the lux level inside and outside the cafeteria at different weather conditions. Review the weather pattern for Bundoora using 2008 data as the basis.
- Assess the project using Triple Bottom line evaluation and Life-Cycle assessment.

Potential emission reduction

Opportunities identified:

- Installation of Tubular Daylighting Device in the cafeteria alternative over artificial lighting.

Financial payback/net benefits

- Day lighting could potentially save the cafeteria emitting 7 tonnes of CO_2-e every year. Capital investment for this option would be $3 000 and payback period is three years.

Project: **Energy Audit and Cogeneration System**

Company: **Ross Cosmetics**
Researcher: **James Kirk**

Project aims

- Conduct an energy audit, and identify areas where improvements can be made to reduce energy consumptions and greenhouse gas emissions.
- Evaluate options in terms of potential reduction in emission with net economic benefits, and other factors valued to the company.

Brief company profile

- Ross Cosmetics was established in 1930, and is a family business. Ross Cosmetics is a leading Australian manufacturer of private level cosmetics, toiletries and therapeutic products. It manufactures approximately 2 000 cosmetic and medical products from the office, laboratory and manufacturing plant at Tullamarine.

Emission reduction measures investigated

- Investigation on cogeneration system to replace existing gas fired boiler.

Method

- Determine the processes, which have the highest energy demands, and the corresponding efficiency of the processes.
- Deliver a report recommending suitable solutions for Ross Cosmetics to implement.

Potential emission reduction

Opportunities identified:

- Installation of cogeneration system for heat and electricity.
- Replacement of current lighting with higher efficiency and longer life cycles.

Financial payback/net benefits

- Installation of cogeneration system and new lighting would cost $700 000 and save $73 000 annually on energy bills. The payback period is 10 years.
- Potential annual reduction of greenhouse gas would be 735 tonnes of CO_2-e.

Project: **Emission Reductions at Securency International**

Company: **Securency**
Researcher: **Sachil Dilantha Meegama**

Project aims

- Design a waste heat recovery system to heat a water stream for drying process in printing machines.
- Design of a PV/wind – battery backup system to supply power to the servers in the case of a blackout.

Brief company profile

- Securency International Pty Ltd was formed in 1996 as a joint venture between the Reserve Bank of Australia and Innova Films. Securency is recognised as world leader in producing secure polymer substrate and supply a range of unique substrates for printing banknotes and other security documents in various countries. The main manufacturing facility is located within the Note Printing Australia compound in Craigieburn Victoria.

Emission reduction measures investigated

- The main Greenhouse Gas Emissions reductions would be in the waste heat recovery system where the boiler to be completely shutdown. The PV/wind grid interactive backup power system for server will also provide reduction in greenhouse gas emissions.

Method

- Heat energy balance of the regenerative thermal oxidiser.
- Design of heat exchanger for the waste heat recovery system.
- Cost analysis of the heat recovery system.
- Analysis of both solar and wind data for feasibility study which system will be suitable for backup power.
- System design and financial analysis of the backup power system.

Potential emission reduction

Opportunities identified:

- Installation of a cross flow heat exchanger for waste heat recovery system.
- PV-battery back power system for servers.

Financial payback/net benefits

- With the investment of $10 000 for the cross flow heat exchanger in the heat recovery system, the annual energy cost saving would be about $122 000.
- Installation of PV-battery backup power system would costs $63 000. This system will be able to supply 5 299 kWh energy per year saving $530 of energy bill.

Appendix B: Seminar Invitations and Agendas

School of Aerospace, Mechanical and Manufacturing Engineering

INVITATION TO RMIT-NORTH Link Greenhouse Emission Reduction Program 2009
Seminar 1

Final year RMIT Bachelor of Engineering and Master of Engineering (Sustainable Energy) students will be completing a total of 13 projects with leading firms in the northern region of Melbourne during 2009.

NORTH Link and RMIT University have great pleasure in inviting you to join us to meet the participating firms and students, and a short presentation on the climate change issue and associated policy responses in Australia and internationally

Time: **9.00am – 10.30am, Friday 17 April 2009**

Location: **Building 251, Room 251.03.34**
RMIT University (Bundoora East Campus)
enter off McKimmies Rd (right turn from Plenty Rd heading north, at end of tram tracks. Take first left, then check with Security for directions. See map attached.

Agenda

9.00 am	Welcome **Mick Butera**, Executive Director, NORTH Link
9.10 am	*The greenhouse issue and policy responses in Australia and internationally* *Outcomes of the 2008 RMIT-NORTH Link/NIETL Greenhouse Challenge Plus program and introduction to Greenhouse Emission Reduction Program 2009* ***Dr John Andrews***, *Greenhouse Emission Reduction Program Leader, and Program Director, Master of Engineering (Sustainable Energy) program, RMIT University*
9.30 am	Firms hosting greenhouse projects for 2009 and participating students: introductions
10.00 am	Tour of RMIT University's Renewable Energy Laboratory and Centre ***Prof Aliakbar Akbarzadeh and Dr John Andrews***
10.30 am	Close

RSVP to Deb Redmond: d.redmond@latrobe.edu.au

RMIT UNIVERSITY
School of Aerospace, Mechanical and Manufacturing Engineering

NIETL "ENTERPRISE NETWORKING"

NORTH Link Networking for Economic Development

INVITATION

Case Study Presentations
How business reduce energy costs and emissions: RMIT-NORTH Link Greenhouse Emission Reduction Program 2009

Date: **Friday, 7 August 2009** **[rescheduled from 31 July]**
Time: **9.00am – 11.00am**

Venue: Building 251, room 253.02.06, RMIT University, **Bundoora East Campus**
Plenty Rd, Bundoora 3083 ***(See map attached)***
Entrance to campus off Plenty Rd, parking area marked. *Rm* 253.02.06 *is one floor up from ground level in Building 253.*

RMIT University Master of Engineering (Sustainable Energy) and final-year Bachelor of Engineering students will present fourteen energy and emission reduction case studies undertaken with twelve companies. These case studies will provide your organisation with a great opportunity to obtain and discuss new ideas on energy cost cutting and greenhouse gas abatement.

Company case studies include:
Aisin, Armstrong World Industries, Austin Hospital, Capral, Diecraft, JAL Chemicals, Melbourne Airport Terminal, Melbourne Fire Brigade, One Steel, RMIT Property Services, Ross Cosmetics and Securency

Why you should attend and what you will learn:
- Innovative strategies and practical measures to reduce your energy costs and emissions
- Update on the Commonwealth government greenhouse programs.

Seminar is hosted by RMIT University and NORTH Link

Agenda

8.45 am	Coffee and tea
9.00 am	Welcome and introduction **Mick Butera**, Executive Director, NORTH Link/NIETL
9.10 am	*Student - Industry Project Presentations* Chaired by **Dr John Andrews**, Senior Lecturer/Program Leader
10.55 am	*Concluding remarks* **Mick Butera**, Executive Director, NORTH Link/NIETL
11.00 am	Close

RSVP to Mick Butera by 3/8/08 on 03 9479 3337 or m.butera@latrobe.edu.au

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