DISCUSSION PAPER ON ALTERNATIVE ENERGY SOURCES FOR THE UNIVERSITY OF SYDNEY

October 2005

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Abstract

The world's climate is changing and warming through anthropogenic influences. Energy derived from the burning of coal has contributed to the enhanced Greenhouse Effect (Appendix A), through the release of an array of gases, the most common being carbon dioxide (CO_2). The University of Sydney's consumption of electricity has increased markedly over the last decade, also increasing its greenhouse gas emissions[1]. Across the globe, efforts are being made to reduce emissions in many ways, including using alternate renewable sources of power generation. Environmental organisations in Australia are pushing for greater uptake of renewable energy by all sectors of the economy. The University of Sydney is seeking to address its emissions and develop programs to reduce energy consumption.

Executive Summary

Energy management for a large institution such as the University of Sydney is an ongoing, costly and complex process. To date, the University has been proactive in understanding energy use on campus and in installing systems to reduce demand, primarily for economic reasons. Concern is raised however about the amounts of greenhouse gases emitted through the University's operations including electricity production and usage. For every kilowatt hour (kWh) of electricity from coal that is generated from a power station, 1kg of greenhouse gases are emitted, contributing to global warming, and climatic changes. The University cannot afford to ignore climate change. Environmental activism is strengthening with respect to uptake of alternative sources of energy, namely renewables such as solar and wind technologies. To continue to be a leader in the higher educational institution (HEI) field, the University of Sydney must address a range of energy management elements to reduce consumption and greenhouse gas emissions.

The consumption of electricity by the University of Sydney has almost doubled over the last 15 years from 34,000 megawatt hours to 56,000 megawatt hours, despite efficiency programs being in place. Increases in student numbers and gross floor space has contributed to this. In 2004, electricity charges amounted to over $4 million for the main campuses. It is anticipated that consumption will continue to increase at 2% annually, following similar trends in increased demand nationally.

[1] University of Sydney Ecological Footprint Report ISA. 2005

Electricity use and environmental charges rise each financial year, further raising costs. The cost of expanding infrastructure to cope with peak electricity loads is disproportionately high (10% of total costs for 1% peak load) and governments need to be doing more to reduce electricity demand, to alleviate the need for network expansion programs.

The University's greenhouse emissions amount to 56,000 tonnes of carbon dioxide (equivalent) from electricity, but are much higher when all activities are taken into consideration. To offset some of these emissions, national student environment networks are calling on their universities to undertake ambitious programs, including the purchase of 100% power from renewable sources (also known as green power), to reduce electricity consumption based on year 2000 levels, to adopt green building programs and to be able to generate large amounts of energy on campus. Throughout Australia, green power sources are expanding and able to supply greater quantities of power. The cost of green power is about 4c per kilowatt hour on top of black power and would thus increase the overall electricity bill.

Compared to some other HEIs, the University of Sydney's energy management initiatives have been to a large part economically driven. Many HEIs, for reasons associated with sustainability, already purchase green power and some have on-site generation facilities. By making efficiencies in many areas of energy consumption, a number of HEIs have used these savings to pay for green power. In the USA, it has been student and staff commitments to reduce consumption and increase their own student fees that have secured funds for green power purchases.

It is timely that discussion on greenhouse gas emission reductions and green power will begin, as the University's energy contract is up for renewal in July 2006. The fact that this is being addressed nationally could assist in securing better electricity rates for both black and green power and see many innovative technologies utilised.

Options for the University may include:

- Efficiency and demand reduction
- Investment in on-site generation
- Purchasing green power and
- Developing a transport strategy

A process of discussion with staff from Finance, Facilities Management, TASC, Academic staff, the Student Environment Collective and others will assist in furthering the University's energy management plans and improving its environmental performance.

Introduction

This paper has been developed to generate discussion about the University of Sydney's options for managing its energy usage with regards to reducing its greenhouse gas emissions. It provides a rough overview of various forms of energy production that are available in NSW and gives general consideration to environmental impacts of energy production. The reader should note that data in the graphs, while coming from the University's Utilities Information System (UIS), is accurate for the years up to 2004. Future trends in energy use are extrapolations based on estimates made by staff working on the Campus 2010 Building for the future program (C2010+). Data has been deliberately kept as raw as possible, to avoid masking trends or influencing the reader in any way.

The paper does not seek to find immediate solutions to energy management at the University of Sydney (USYD), but highlights what the general state of play is regarding energy and greenhouse issues and what several higher education institutions (HEIs) are doing in Australia and overseas. It does not include other elements of energy management, such as transport, and therefore further discussion will be required on this University's goals and commitments regarding its ecological footprint. It is timely that this discussion will begin as it will provide advice and direction to the development of the University's upcoming electricity tender process for 2005-2006.

Background

Student groups in the U.S.A. have successfully lobbied Universities to buy green power. The Australian Student Environment Network (ASEN) in association with Greenpeace is collectively lobbying Universities in Australia to buy green power as a first response to reducing climate change and global warming. The NSW and Victorian branches of ASEN have developed a list of resolutions to uniformly initiate discussions at Australian HEI's on this issue.

The Environmental Strategies Team (EST) met with the USYD Environment Collective and a representative from Greenpeace and explained the existing USYD Energy Program on April 6th 2005 (see Appendix B). The ASEN resolutions were accepted by the USYD Student Representative Council (SRC) in late July 2005 and will go to the University Senate in September 2005. This paper anticipates discussion on a USYD response to these resolutions.

Energy production and the environment in a global context

Ninety percent of Australia's energy comes from burning coal. It is now widely recognised that this practice is environmentally unsustainable, both as an extractive industry mining finite resources, as well as the long term consequences of releasing large amounts of carbon dioxide and other chemicals into the atmosphere with the burning of the coal. Carbon dioxide is a natural greenhouse gas, trapping heat in the atmosphere and maintaining the earth's temperature. Increased amounts of carbon dioxide and other 'greenhouse' gases, as emitted from anthropogenic sources, has contributed to global warming and atmospheric pollution. For every kilowatt hour of electricity from coal that is generated from the power station, 1kg of greenhouse gases (CO^{2-}) is emitted (Appendix A).

Our reliance on coal as an energy source means that Australia has the highest per capita greenhouse gas emissions in the developed world, according to recent OECD figures. Australia's environmental performance is poor. Out of 142 countries in OECD, Australia ranks 128th in efforts to reduce air pollution; 105th in eco-efficiency; 134th in its efforts to reduce greenhouse gas emissions.

Australia's population is expected to increase by 2-10 million over the next 50 years and there will be an increased demand for electricity to accommodate and service the population. The NSW Government predicts that the State's electricity maximum demand will increase by about 4% each year. A large percentage of networking infrastructure costs (around 10%) are needed to provide for only a small percentage of the maximum peak voltage load (approximately 1%), thus making electricity expansions a costly process.

There are alternative sources of energy that are currently available in Australia which do not release greenhouse gases into the atmosphere and as such are said to be 'green power'. Green power consumption in Australia is increasing as technologies become more available and the price reduces.

Summary of Energy Management at the University of Sydney

The University of Sydney was an early adopter of energy and water management and has a sophisticated monitoring system of power use that was developed in-house. Power is largely managed by the FMO's Energy and Water Manager. He is involved in tender preparation, negotiation with energy companies for both electricity and gas, watch dogging the billing systems and energy suppliers, and monitoring the UIS. He is also part of a network of other energy and water managers from UNSW, Newcastle and Australian National Universities.

Energy management covers a range of issues including, but not limited to the following areas:

- Negotiation for Tenders – In 1996 the University's electricity contract was up for renewal. The Energy and Water Manager successfully negotiated a favourable contract with Energy Australia which gave cheaper electricity resulting in a reduction in charges despite increased usage. This trend continued for about 6 years.

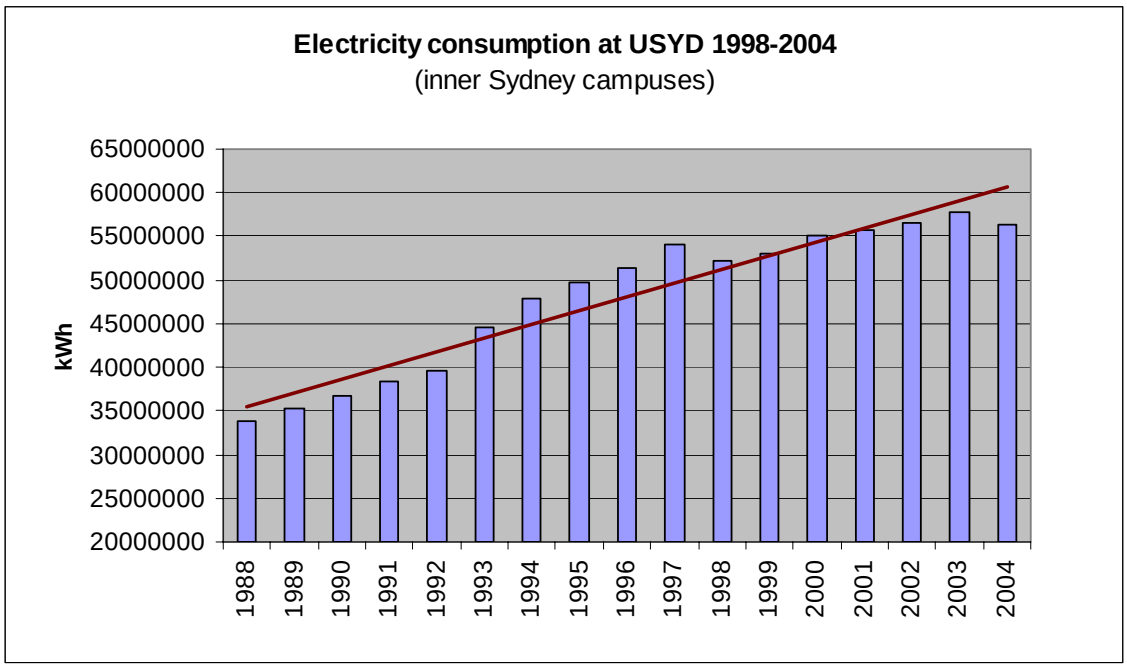
- The Utility Information System (UIS) - is a software product which analyses utility usage data and costs and provides sub-billing services. It was developed in 1997 and provides for the

analysis of information and establishment of benchmarks for maintenance needs. These range from tracking actual usage against benchmarks to close tracking of problematic or high-risk plant. Early warning of variances from historical or expected norms not only save direct usage costs but forestall functional problems, extend the life of plant and equipment and improve the operational environment for staff. The relatively aged and inefficient buildings of USYD make this ability to quickly identify variances very desirable.

Previous and current practices to reduce electricity demand on campus include[2]:

- housekeeping: metering and measurement to track consumption to recoup costs, identify high demand areas, and to highlight inefficient usage or waste;
- peak load shifting and power factor correlation;
- establishing and maintaining automated Building Management Control and switching across campus;
- occupancy sensors;
- services/plant retrofits and upgrades;
- equipment and fittings retrofits and upgrades;
- building passive solar design retrofits and upgrades;
- evaluating and providing comment on design and services for upcoming buildings;
- tracking the implementation of/responding to the Design Guidelines for new buildings; and
- building guidelines and maintenance procedures.

Figure 1.

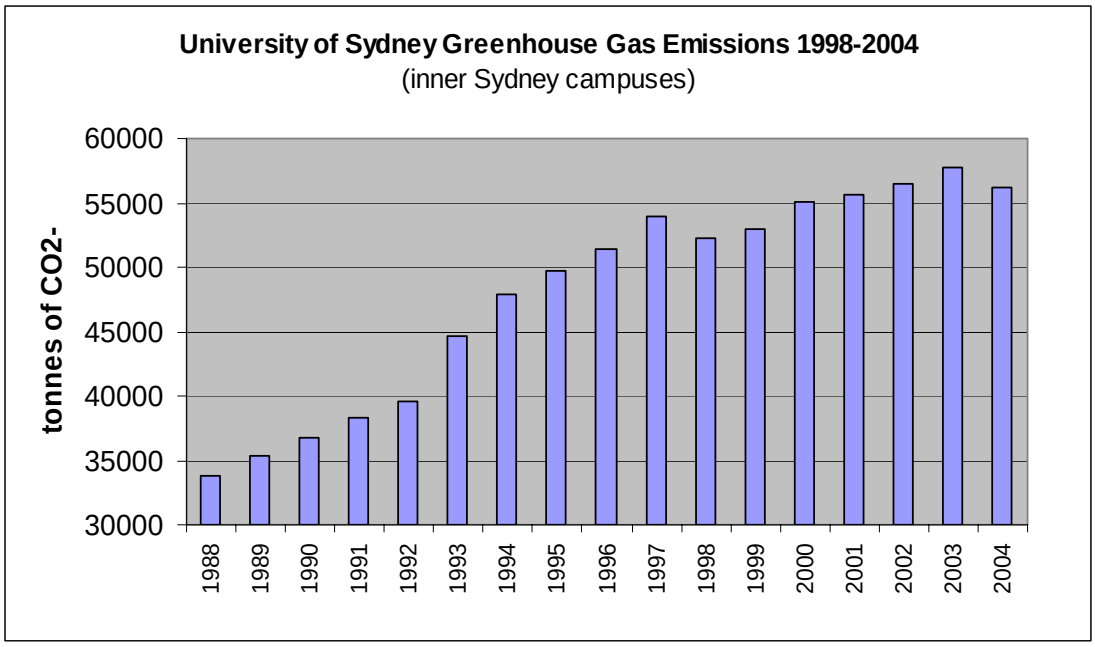


Source: USYD UIS

Despite the implementation of numerous energy efficiency projects across the campuses, the Figure 1 shows how over the last sixteen years, electricity consumption has steadily increased by over 60%, thus increasing the University's greenhouse gas emissions from 33,000 tonnes to over 50,000 tonnes of carbon dioxide (Figure 2 - Note: these figures do not include consumption from campuses at Camden, Narrabri, Orange and Camden PBI, therefore total emissions will be higher).

[2] *Pers comm*. Grahame Pepper, Energy and Water Manager, Facilities Management Office, University of Sydney 2005

Figure 2.



Source: USYD UIS

CONTEXT

Internationally, the main method for developed nations to cap and reduce greenhouse gas emissions is through the Kyoto Protocol which came into effect in March 2005. The last country to ratify the protocol was Russia. Australia, along with the USA, has not signed the Protocol due to differences of opinion as to its effectiveness. Instead, the Mandatory Renewable Energy Target (MRET) is Australia's most serious policy measure to reduce greenhouse emissions from the electricity sector. Arising from the Renewable Energy (Electricity) Act 2000, it has the goal of supplying an extra two per cent of our electricity from renewable sources by 2010.

The target was introduced by the Commonwealth Government primarily as an industry development mechanism for the emerging renewable energy industry. The target of two per cent has been translated into a fixed figure—9500 gigawatt hours—which, because of rapid growth in electricity consumption, means it will no longer be two per cent by 2010. Under the legislation, purchasers of wholesale electricity (electricity retailers) are obligated to source two per cent of their electricity from renewable sources by 2010, with proportional staggered targets to 12.5% leading up to 2010. In addition, under MRET legislation, organisations that generate renewable energy can have certificates (RECs) created for the amount of renewable energy they produce, which they can sell to energy retailers on the Green Electricity Market.

From July 2003, Full Retail Contestability (FRC) was introduced in the energy markets of NSW, Victoria, South Australia and the ACT. This means that households and businesses in these states are able to choose the supplier from whom they buy their energy. The aim is to allow all electricity and gas customers to have greater choice in their energy supply, and be able to compare prices and services. Electricity customers can also choose to buy various quantities of Green Power, based on the company's supply portfolio.

Demand management

Demand Management refers to measures that reduce the need for new generators and infrastructure. Demand management measures are important because in the past demand has been

met by more generation. Examples of demand management measures include energy audits, parity pricing to support 'embedded' generation (where a customer generates some or all of their requirements such as through on-site generation), load shifting, promotion of energy efficient appliances and discouragement of high-demand appliances such as air conditioners.

The Independent Pricing and Regulatory Tribunal of NSW (IPART) investigation into demand management found that there is very little being done in Australia to support demand management. The electricity industry has not really moved away from the 'build and supply' mentality of the 1970's which resulted in a large number of coal-fired power stations. Many states are now reaching supply constraints in peak periods and are looking to meet this by building more generating capacity, mostly from coal-fired power stations. IPART expressed strong comments on the role that demand management can play in responding to these challenges.

Greenhouse gas emissions abatement

From 2003 the NSW government introduced compulsory greenhouse benchmarks for electricity retailers to abate the emission of greenhouse gases from the consumption of electricity. The benchmark is expressed in tonnes of carbon dioxide equivalent (tCO_2-e) per capita. Each retailer is allocated a share of the electricity sector benchmark based on the level of their electricity sales as a proportion of the total State electricity demand. This allocation is used by retailers as their individual greenhouse gas benchmarks.

Energy retailers must reduce their emission of greenhouse gases to the level of their greenhouse gas benchmark by off-setting their excess emissions through the surrender of abatement certificates. These certificates are created by organisations which receive accreditation under the NSW Greenhouse Gas Abatement Scheme and can be traded to retailers. Failure to meet the benchmarks invokes a financial penalty. Retailers can achieve a reduction in greenhouse intensity via a number of mechanisms including reducing sales or sourcing less greenhouse-intensive energy. This policy initiative seeks to address the greenhouse intensity of electricity supply and impose financial penalties for failure to comply. Energy retailers pass on the costs of these certificates to customers, which is further explained below.

RENEWABLE ENERGY SOURCES

Green power, as discussed above, is that energy generated from renewable sources, including wind, solar, hydro, biogass, landfill gas and geothermal.

Hydro-electricity is generated through water turning a turbine feeding an electricity generator. About 8 percent of Australia's current power needs are met this way, mostly in mountainous areas of Tasmania and NSW where rivers can be dammed. Large hydro dams however cause enormous environmental problems including habitat destruction, social dislocation, deposition above dam and loss of silt deposit below dam. Smaller scale hydro projects are much more environmentally sensitive and use the energy of water already flowing along channels to generate electricity.

Wind power uses wind turbines to convert the wind's energy into electrical energy. Turbines are located in areas of known high wind. Wind energy use in Australia is rapidly growing as it is cheaper than other renewable energy options. A kilowatt hour of wind energy costs 7.5 cents [3].

Solar photovoltaic power converts the sun's energy directly into electrical energy, whilst solar thermal systems concentrate solar energy to heat liquids, solids or gases, such as the domestic application of solar hot water systems.

Biomass such as wood and crop waste can be burnt to generate large amounts of power, however this is not particularly sustainable if plants are grown simply to burn them, as soil nutrients are depleted. Biogas is given off during the natural decomposition of plant or animal matter. Gas from sewage works and methane generated from landfill sites is used as an alternative source of energy in many capital cities in Australia.

[3] http://www.futureenergy.org/infowindblmy.html

Geothermal energy is energy from the heat of the earth. It has been used for thousands of years in some countries for hot water, cooking and heating. It can also generate electricity using steam produced from heat found beneath the surface of the earth. It is not common in Australia, but is used in some parts of New Zealand and through Europe. Another form of geothermal energy is called "hot rock". This is where water is pumped below the surface to areas of hot rock. The water then turns to steam and is pumped back to the surface to drive a turbo-generator. Australia does not currently produce electricity from geothermal energy. However, tests are being carried out on a "hot rock" power station.

In 2005, the State government has broadened the energy debate into the issue of nuclear energy. Nuclear energy does not generate any greenhouse gases and so in this respect is seen to be more environmentally preferable than burning fossil fuels. However nuclear energy is not seen as a renewable source by most environmentalists. The most common definition of renewable energy is that energy sourced from a natural resource that is replaced rapidly by a natural, ongoing process. Under this definition, neither fossil fuels nor nuclear power are renewable. Some, notably nuclear power and coal advocates, dismiss the relevance of this definition, arguing that some renewable energy sources can have as great an impact on the environment as energy sources that don't technically meet this definition.[4]

Electricity suppliers can source energy from such renewable sources. Choosing a clean energy alternative is a simple way for energy users to reduce greenhouse gas emissions. To date, renewable energy has cost more than non-renewable energy per kWh to produce but if customers undertake other energy conservation measures to increase energy efficiency then signing on to Green Power may be cost neutral in many cases.

Green Power Accreditation Program

The Green Power Accreditation Program was launched in 1997 by the then NSW Sustainable Energy Development Authority (now Department of Energy, Utilities and Sustainability (DEUS)). It now runs nationally and aims to:

- facilitate the installation of new renewable energy generators across Australia and reduce greenhouse gas emissions.
- encourage consumer demand in greenhouse-free electricity.
- increase awareness of, and confidence in, renewable energy products.

It sets stringent environmental and reporting standards for renewable energy products offered by electricity suppliers to households and businesses across Australia. Green Power does not accredit biomass energy sourced from native-forest products or residue. Green Power accreditation criteria only allow electricity from Green Power–approved generators (solar, wind, biomass, hydro and geothermal). Eighty per cent of Green Power must come from 'new' renewable generators (generators commissioned or first selling energy after January 1, 1997) that decrease greenhouse gas emissions while actively contributing to the development of the renewable energy industry in Australia.

There are currently no regulatory guidelines or accreditation frameworks governing Non-Accredited Renewable Energy products (NAREs) and therefore there is no guarantee that the sources of generation or that sales of NAREs are driving investment in 'new' (ie. after 1997) renewable energy projects.

Table 1 shows the companies that are able to supply electricity from conventional and renewable sources to business customers in NSW:

[4] http://en.wikipedia.org/wiki/Renewable_energy

Table 1: Sources of energy for renewable energy providers

Energy Retailer	Energy Source			
	Wind	Solar	Hydro	Biomass
ActewAGL	✓			✓
AGL	✓			✓
Aus Power				✓
Ai R Energy	✓			✓
Country Energy	✓			
Energy Australia	✓	✓	✓	✓
Energex	✓	✓	✓	✓
Ergon Energy				✓
Integral Energy	✓	✓	✓	
Origin Energy	✓	✓	✓	✓
TXU			✓	✓

Source: National Green Power Accreditation Program Quarterly Status Report 1 Jan-31 Mar 2005

As of March 2005 Green Power supplied over 132,000 residences and 6,500 commercial customers throughout Australia, totalling 124,400 megawatt hours (MWh) of energy. In NSW alone, Green Power supplied almost 48,000MWh, equating to a reduction of greenhouse gases by 48 million tonnes.

Businesses can purchase Green Power in several ways, either as a chosen percentage, or in multiples of kWh. Most companies do not break down costs of Green Power based on demand, such as for peak, shoulder and off peak usages, however the NSW Government Contract with Energy Australia does. Green Power rates are more expensive than power generated by burning coal. From discussions with several retailers, this is roughly 4c a kWh on top of the cost of conventional energy.

Several companies can supply Green Power for specific events that businesses run, such as one off trade shows or supplying power for environmental lectures. Two recently held events that were powered by renewable energy were the Clean Air Forum in November 2004 and the Green Capital series of forums throughout 2004 and 2005.

Origin Energy's Green Earth Solar and Green Earth Plus and TXU's TXU Wind are said to be the leading renewable energy products. These products are sourced from 100 per cent new renewable generation. They are generated from wind and solar (photovoltaic) energy, said to be the cleanest forms of renewable energy.

DISCUSSION

What Other Australian Higher Educational Institutions [HEI's] Are Doing

Australian higher education institutions have had a range of experiences in energy conservation and management. As organisations which branch into teaching, learning, research and development, universities are strategically placed to be at the forefront of environmental influence.

A quick search of the Australian Campuses Towards Sustainability (ACTS) website database indicates the broad range of energy activities carried out by Australian HEIs (Table 2 - GO8 Universities are indicated by *). Note the database may have not been updated for some time by the individual HEI. For more detailed information on several universities, refer to Appendix C.

Table 2: Energy management initiatives in selected Australian HEIs

HEI	E. audits	E. mgt/min	E. mgt plan	E. Mgt Program	Efficient lighting	Solar panels	Co-gen	Green fleet	Alt fuels	Talloires	Greenhouse Challenge	E. Mgr	Buys Green Power
UNSW*	•	•	•	•	•	•	•		•	•	•	•	•
Flinders		•	•	•	•	•							
Nth Cst TAFE	•	•	•	•	•	•							•
S I TAFE	•	•	•	•	•	•							•
UWA	•	•	•	•	•	•					•		
U MQ		•					•					•	
Monash*	•	•		•	•	•		•			•		•
Tas Uni	•			•									
Vic UT	•												
ANU*	•	•	•	•				•	•	•	•	•	•
JCU				•									
Melb U*				•		•	•			•			•
USYD*		•			•							•	

Source: http://www.acts.unsw.edu.au/initiatives.htm

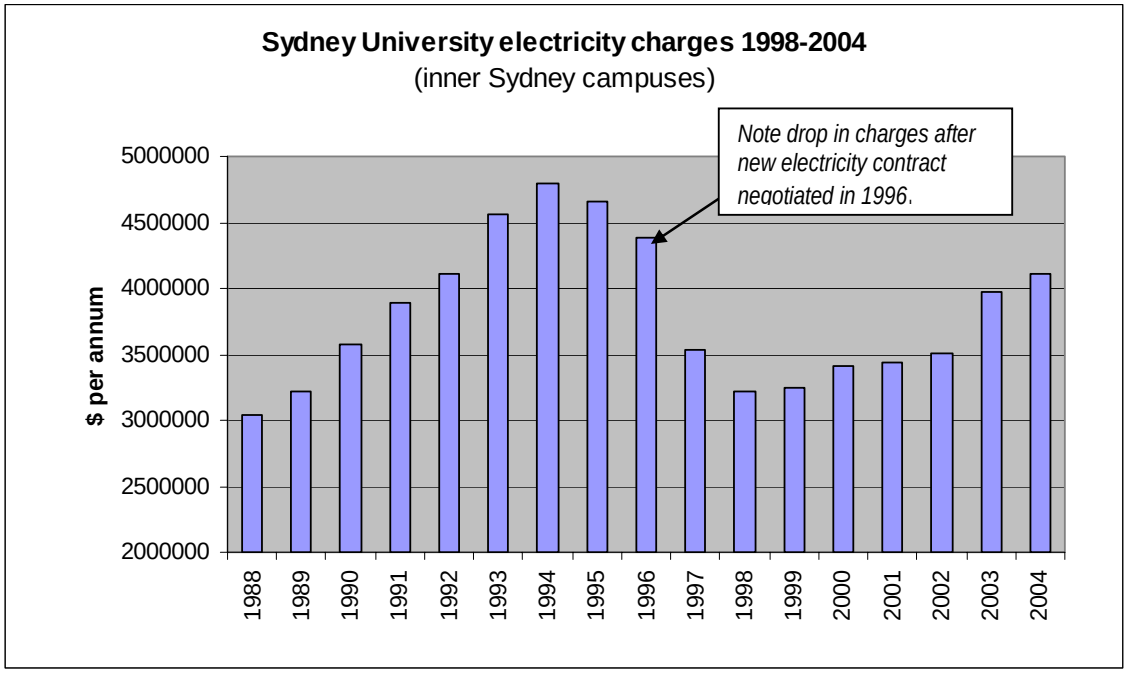
Strategic Implications for USYD

WHAT WE NEED TO BE AWARE OF

Future trends and costs for energy consumption @ USYD

Electricity charges for the University have been increasing over the last decade, as shown in Figure 3. The drop in price after 1996 is due to a new contract being negotiated with the current supplier, Energy Australia, and receiving very good rates. Since then, consumption has increased, resulting in increased charges.

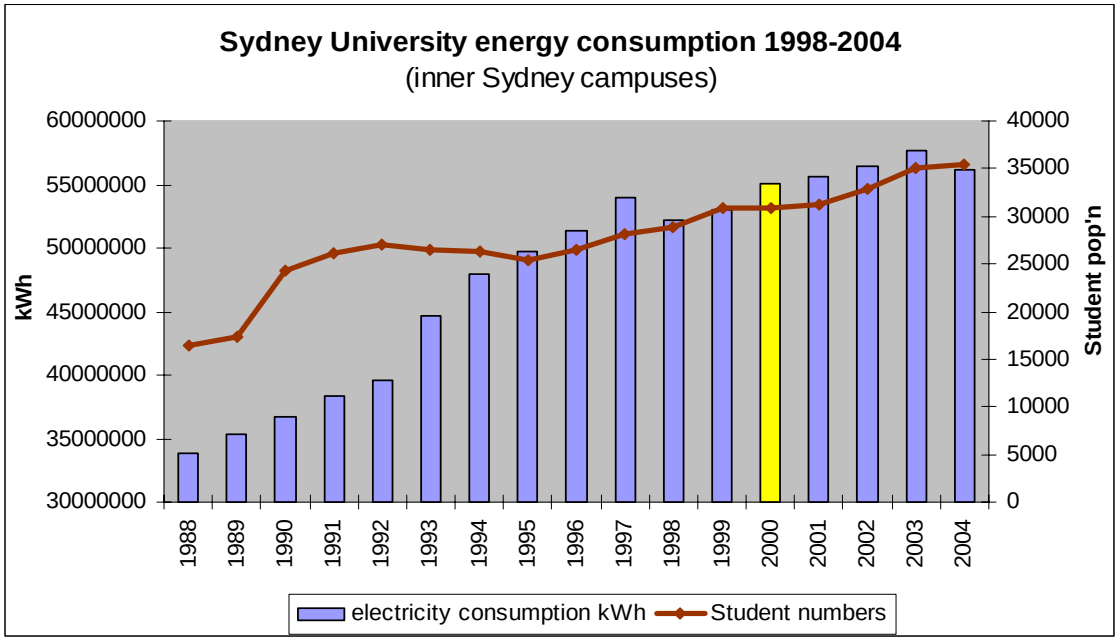
Figure 3.



Source: USYD UIS

In 2004, the University's total expenditure was projected at $898.1 million. Of this amount, $20.9 million was allocated to utilities and services (water, gas and electricity and other). University's total gross electricity consumption for 2004 was just over 56,000 MWh. This cost $4,113,000, and represents less than half a percent of the University's total budget. Ten percent of the $4m costs are spent on energy management initiatives and staff.

Figure 4

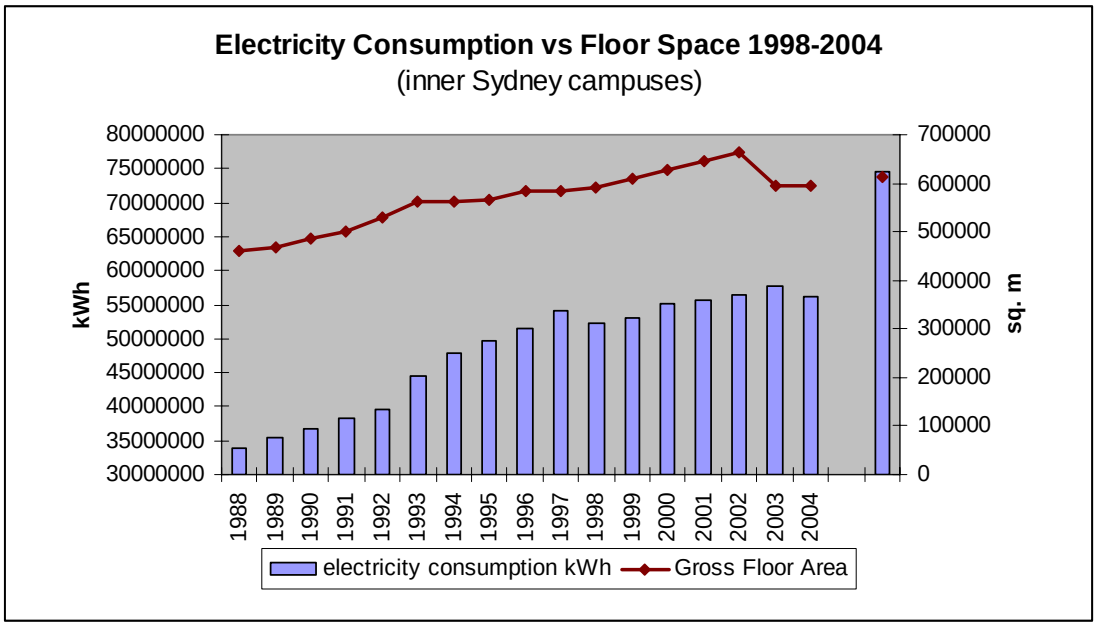


Source: USYD UIS

Figure 4 shows that student population has more than doubled since 1988. Energy consumption has also risen but at a lesser rate. Energy management started in 1997. Interestingly, when consumption is calculated with student population and floor space (Figure 5), the per capita KWh rate falls.

Floor space increases over the last 15 years have contributed to increased energy usage across the University. The Campus 2010 building for the future program will deliver approximately 19,000 square metres of increased gross floor space. By the time the project is completed, including a general annual increase of about 2 percent, the University's electricity consumption could be around 74,600 megawatt hours.

Figure 5

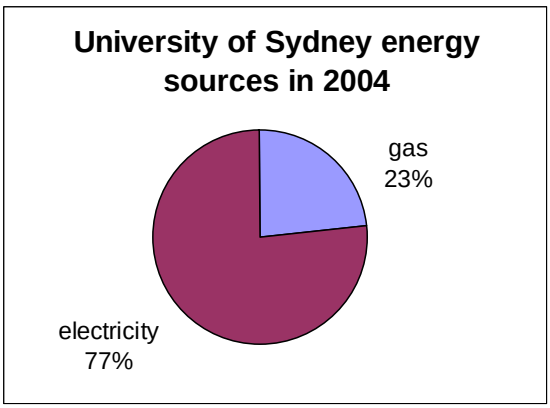


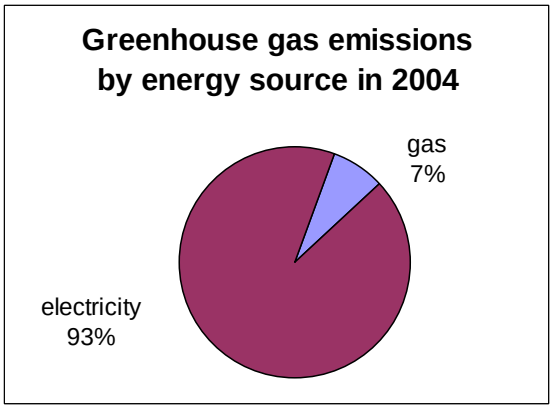
Source: USYD UIS

Through this consumption of electricity alone, 56,000 tonnes of greenhouse gas are emitted, the equivalent of that emitted by over 12,000 cars. Energy increases are expected to be approximately 2% per annum, however with the future building works as part of C2010+ there will be an energy increase in the order of around 10,000 megawatt hours. This is based on approximations of: Law- 3,640 MWh; Central – 2,800MWh; SIT- 4,000MWh

The University uses both gas and electricity as sources of energy. In 2004, as illustrated in Figure 6 below, over three quarters of our energy was supplied from electricity. The contributions to greenhouse gas emissions from electricity were 93%. Gas, by comparison only emits 7% of the emissions coming from energy. The university could reduce its energy emissions by increasing the percentage of gas utilised.

Figure 6





Electricity Charges and Rebates

The NSW government requires energy retailers to obtain Greenhouse Gas Abatement Certificates (NGACs) to quantify greenhouse gas emission reductions. The cost of these certificates is priced into the energy bills of their customers. Currently this stands at 1% of the bill and is benchmarked at 7 tonnes of CO^{2-} per capita. This scheme as it currently stands will end in 2012.

In addition to NGACs, our electricity bills also include the cost of Renewable Energy Certificates (RECs). The cost of one REC is equivalent to 1MWh of Green Power. In 2004 the percentage of RECs bought by energy retailers was 1.25%. These purchases were passed onto consumers as 0.1% of the bill, however some customers reported that the charges were not pre-informed of them nor were they explained on bills. For contracts currently under negotiation, customers should insist that the cost of RECs is included in energy rates and is firm for the term of the contract. Thus, the competitive sourcing of RECs is another factor making up the final energy price provided by retailers' traders.

Energy Australia's current billing rates for RECs and NGACs are outlined in Table 3, showing increases over the next few years. While the cost per kilowatt hour seems small in itself, when calculated against current and anticipated growth in usage (two percent per annum), the amounts are substantial. Energy Australia could not provide rates beyond 2007, however another University has reported that the rates will continue to rise over time, in addition to the anticipated electricity charges per kWh.

Table 3 Energy Australia fixed REC & NGAC prices as at 31st May 2005

Period	Darlington / Camperdown... campus (kWh)	RECs c/kWh	$ REC	NGACs c/kWh	$ NGAC	total (REC + NGAC)
Current billing	52,000,000	0.066	$34,320	0.136	$70,720	$105,040
1 Jan 06-31 Dec 06	53,040,000	0.089	$47,205	0.272	$144,268	$191,474
1 Jan 07 - 31 Dec 07	54,100,800	0.111	$60,051	0.3652	$197,576	$257,628

Source: Energy Australia

Linkages to Triple Bottom Line & environmental footprint reporting

According to Dr Christopher Dey, the University's total emissions (Greenhouse Footprint) for just the Camperdown/Darlington campuses are approximately 45,000 tonnes CO_2 equivalent. Current calculations show that electricity emissions account for 25% of total greenhouse emissions. Therefore a total of 180,000 tonnes of greenhouse gases are emitted from these campuses alone, including the two highest contributing commodities, electricity supply (25%) and air transport (20%).

If the University of Sydney were to buy 2.5% of Green Power (Department of Energy, Utilities and Sustainability recommendation), then this would reduce electricity greenhouse emissions from the inner Sydney campuses (Camperdown, Darlington, Dental, Rozelle, Mallet St, etc) by 2.5% (1,400 tonnes).

WHAT WE COULD DO

Green Power Accreditation Program – what USYD could do

The Department of Energy, Utilities and Sustainability mandated that all NSW State agencies source a minimum of 2.5% of their electricity from renewable sources. Because of its high usage, the University would be in a strong position to consider its suppliers and choice of renewable energy. According to another HEI in Sydney, the University is not bound to purchase both green and black power from the one energy retailer. It can buy 97.5% from one and the remaining 2.5% from a renewable energy producer for example.

University of Sydney Research and Development

Within the University, current and future research and development into energy production and efficiencies will add value to any energy programs that the University runs. The following areas of research are taken from the Rresearch Office and Department of Chemical Engineering webpages[5].

- *Integrated solar absorption* and thermal storage systems for application in low energy buildings. (Supervisor Mr B Forwood). Bruce Forwood's own work includes engaging architects in sustainability and architecture issues.
- *Solar thermal electricity* (School Physics, Solar Energy Group)
- Integrated Sustainability Analysis Group (www.isa.org.usyd.edu.au) is conducting research into areas such as: **ecological footprint analysis; triple bottom line reporting**; life cycle assessment; sustainability research; and environmental impact assessment.
- *Vacuum glazing* (Dr Nelson Ng and Professor Richard Collins) – a new type of glass (SPACIA Nippon Sheet Glass) with benefits including minimising heat flow, reducing transient heat movement, reducing building energy consumption by up to 15 percent, while also reducing air-conditioning energy load by up to 31 percent. This product is reported in the Sustainable Design Review for the Faculty of Law and USYD Central projects of Campus 2010. (University of Sydney Solar Science Pty/Ltd.)
- *Cogeneration:*A model of cogeneration of power and heat which analyses the economics of gas-engine and turbine-based cogeneration. Wider adoption of cogeneration is shown to lead to significant reductions in Australia's greenhouse gas emissions. A cogeneration system to meet the University's power, heating and cooling needs is being furthered. (Researcher: Rolf Prince)
- *Biomass gasification:* The development of biomass gasification to provide power to remote communities and to reduce greenhouse emissions (Researcher: Brian Haynes, Andrew Harris)
- *Adsorption behaviour of Multi-component CO_2, CH_4, and N_2 in the Porous Structure of Coals and Activated Carbon at Elevated Pressures.* Retention of CO_2 by adsorption on coal provides a sink for the long term geological storage of a principle greenhouse gas responsible for global warming. (Researcher: Marjorie Valix)
- *The development of zero emission coal technology.* A zero emission coal process is an integrated method of energy extraction, carbon dioxide separation and sequestration. The development of zero emission coal technologies is relevant because estimates suggest there are sufficient coal reserves to continue powering the global economy for several centuries to come, and technologies that substantially reduce the environmental impact of producing energy from fossil fuel resources will be required. (Researcher: Andrew Harris)

[5] http://www.usyd.edu.au/research/science_and_technology/our_research/

Green Power benefits to the University

By purchasing at least the minimum amount of green power as required by DEUS (2.5%), the University will be entitled to use and display the Green Tick logo to assist in marketing the University's green credentials. This would position the University as a good corporate citizen and contribute towards a leading 'green' edge over competitors.

The purchase of green power will also be in line with the University's Environmental Policy through a number of aspects including: improvement of environmental performance; implementing State regulations, and exceeding minimum requirements; raising public awareness of ecological sustainability; maximising long-range use of renewable energy sources; and purchasing energy from technologies that cause least harm to the environment and which generate fewest waste materials.

Further, as outlined above, the ecological footprint of the university would be improved, thus improving environmental performance ratings.

Green power purchases would also be seen as a tool to progress the University towards its goal of positioning itself for the 1:5:40 model of being the leader in Australia, ranked regionally in the top five and internationally in the top forty Universities. From the University's Draft Strategic Directions document it has set 'Environmental performance and sustainability' including physical, social and financial aspects as one of its standards of performance and benchmarks.

GOING THE EXTRA MILE

Funding opportunities

Appendix D highlights funding opportunities that the University could investigate relating to energy production, reduction and greenhouse gas emissions.

Other accreditation/reporting programs as administered by external bodies

Greenhouse Challenge Plus

Greenhouse Challenge Plus builds on the success of the Greenhouse Challenge programme (established in 1995), integrates two other industry focused measures (the Generator Efficiency Standards and Greenhouse Friendly initiative) and incorporates changes announced in the 2004 Energy White Paper 'Securing Australia's Energy Future'. Greenhouse Challenge Plus is designed to:

- reduce greenhouse gas emissions;
- accelerate the uptake of energy efficiency;
- integrate greenhouse issues into business decision-making; and
- provide more consistent reporting of greenhouse gas emissions levels.

The University of NSW and Monash University have joined this program and see it as a tool to gain leverage within the campus community towards greater energy efficiencies and greenhouse gas emission reductions. However negative aspects include the large amount of reporting and difficulties in meeting targets.

Talloires Declaration

Universities which have signed this Declaration agree, amongst many actions, to 'practice Institutional Ecology', including policy and practices of resource conservation, recycling, waste reduction and environmentally sound operations. The purchase of Green Power would fall under this action.

Case Studies from Higher Education Institutions and other organisations –

In the mid 1990's student environment movements in the United States and Canada began to focus on clean energy production and reductions in greenhouse gas emissions. Large scale demonstrations, protests, collection of signatures and financial contributions from students allowed for many campuses to reduce their reliance on coal and oil and support the development of the renewable energy industry through large scale purchases. Students were not only influential in the activities on campus but they directly targeted politicians leading up to elections, seeking political support for renewable energy in last year's Presidential elections.

Harvard University
Harvard Green Campus Initiative administers Green Campus Loan Fund, a US$3 million interest-free revolving loan fund made available for conservation projects with a 5 year payback period of less. This produced over $800,000 of annual savings, reducing greenhouse gas emissions by over 4.54 million kg. It offset 150% of annual electricity consumption at Uni's first Green Building. 3,990,000kWh of Green Power was supplied. A 2004 project called 'Go Cold Turkey' secured wind energy certificates to supply 15 buildings. Student and staff pledge to be more energy conscious for 1 year. Energy savings will offset cost of buying renewable energy. 3,600,000kWh was bought. School of Public Health purchased 50% of electrical load for entire campus from renewable sources.

University of Colorado-Boulder – a successful student campaign began in April 2000. By a 5 to 1 margin, students voted to increase their own fees by $1 per semester (raising $50,000) which covered the cost difference between conventional and green power. This sum purchased 2 megawatt hours annually or 1.5% of the total electricity needs, or 30% of the energy to run three student run buildings. 1,400 tons (American) of carbon dioxide was abated. CU-Boulder was the first university to vote with its money for wind energy.

University of Pennsylvania, Penn State University and Carnegie Mellon University (all in Pennsylvania) – these 3 schools buy 38 megawatt hours per year of wind energy purchases. The amount is only 5% of the total electricity consumed. Demand has lead to a doubling of wind turbines at the wind farm. Increased costs of Green Power (1.5-2 cents/KWh) is offset by programs to reduce consumption. This will provide not only conservation but education opportunities in teaching and learning for students, staff and faculty.

Other Universities –
- Unity College in Maine and Western Washington University made commitments in early 2005 to purchase 100% renewable electricity.
- The University of Tennessee became the largest purchaser of renewable energy in the region in March 2005.
- By 2001, 55 colleges in New Jersey had committed to reducing their greenhouse gas levels to 3.5% below 1990 levels to comply with the Kyoto Protocol.

Other NSW institutions
- AMP buildings – purchasing 2.5% green power across all common areas in shopping centres, using 5 separate electricity suppliers. Reduction of GHG emissions by 1600 tonnes per annum. Receive regular positive feedback on Green Power use after using logo on signage, which is good for business. Now promoting Green Power purchases to tenants, as well as promoting other environmental stewardship areas such as water and waste.

- North Sydney Council – uses 25% Green Power for approximately 90,000KWh per month (1,080 MWh per annum). Annually saving over 1,000 tonnes greenhouse gases. Council goal is to increase green Power percentage each year, to set an example to other Councils and local businesses. Use of Green Power logo and, in partnership with SEDA, is planning an energy star rating program for buildings in the Council area.

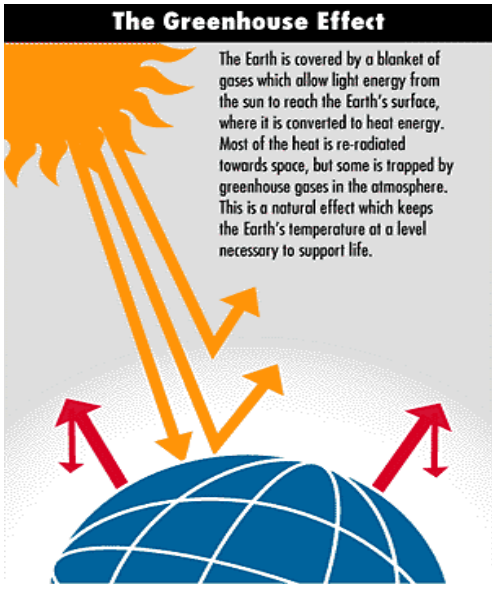
Options for University of Sydney [for discussion]

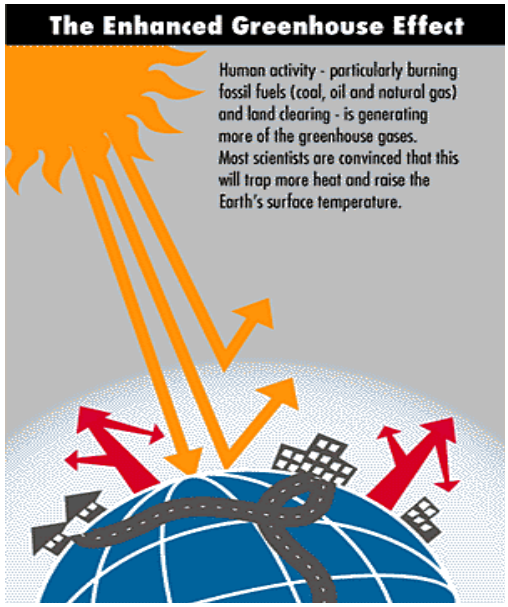
Greenhouse gas reduction Strategic elements*	Examples	Options	Current	Future	Advantages and disadvantages
Efficiency & demand reduction	Existing & New Buildings	Current practice of FMO	52,000 MWh electricity used	At least 2% annual increase in usage	Greenhouse emissions continue, at a slower rate
Invest in on-site generation (minimises grid losses)	Steam heat exchange. PV	Feasibility investigated as needs			Change to peak demand distribution could lower charges
Purchase green power	C2010 buildings	1. 2.5% GP source by 2007 2. 5% GP power source by 2010 3. GP for all C2010 buildings by x 4. GP for all public events/conferences by x	No green power bought by University	1. 5% increase in electricity charges 2. 10% increase in electricity charges 3. 10,000 MWh of electricity (30% increase in charges)	1. 1300 tonnes ghg emission reduced. 2. 2600 tonnes ghg e reduced. 3. 10,000 tonnes ghg e
NUS aspirational 10% reduction of 2000 electricity usage by 2014	Reduction comparative to greenhouse emissions	Purchase greenpower equivalent to 10% energy reduction		5500 tonnes of greenhouse gas abated. Offsets 5,500,000 kWh	
Other NUS aspirational resolution	Transport	Green fuel Hybrid vehicles Leasing of vehicles	Biofuel trials Vehicles with smaller engine sizes		

**More work is required following discussion paper with working group*

APPENDIX A – The Greenhouse Effect

The natural greenhouse effect: Greenhouse gases (water vapour, carbon dioxide, ozone, methane halocarbons and nitrous oxide) are a natural part of the earth's atmosphere. They trap the sun's warmth and maintain the surface temperature of the earth at a level necessary to support life. This is the natural greenhouse effect.





Graphics supplied by AGO

The enhanced greenhouse effect: Global warming is believed to be a result of: Human activities are increasing the level of greenhouse gases in the atmosphere. Prior to the industrial revolution, the levels of greenhouse gases in the atmosphere remained relatively stable. Since the industrial revolution however, the concentration of the greenhouse gases in the atmosphere has increased by approximately 30%. The main activities that increase the concentration of greenhouse gases are the burning of fossil fuels (coal, oil and natural gas) and land clearing (trees and plants absorb carbon dioxide from the atmosphere). Increased level of greenhouse gas emissions trap more heat in the atmosphere causing global warming and climate change. This is known as the enhanced greenhouse effect. The rate of greenhouse gas production continues to increase annually throughout the developed and developing world.

APPENDIX B - ASEN Resolutions

A RESOLUTION CALLING ON (Enter in name of student council) TO ADOPT A GREEN BUILDING AND CLEAN, RENEWABLE ENERGY POLICY

For the following reasons:

- There is a scientific consensus that carbon dioxide (CO2) and other greenhouse gas pollutants released into the atmosphere are causing global warming, leading to increased droughts, floods, heat waves, storms, beach erosion, diminished fresh water supplies and increased exposure to infectious diseases.
- Universities in Australia contribute greatly to Australia being one of the world's largest per capita emitters of greenhouse gas pollutants.
- Australia and its universities have an obligation to help protect its neighbours, such as Kiribati, which already suffer the impacts of global warming. Australia must reduce greenhouse gas emissions by 60-80% by 2050 to prevent low lying islands in the Pacific from disappearing.
- University students of our generation will experience many of the worst impacts of global warming in their lifetimes unless action is taken today to reduce energy use and promote clean energy sources like solar power and wind power.
- Each kilowatt of solar power generated reduces carbon dioxide (CO2) by 22,680 kilograms over the life of the system.
- It is imperative that universities set an example by implementing the best environmental and social practices that are taught on their campuses, to serve as a model for the rest of Australia to follow.
- Actions taken by universities to reduce greenhouse gas pollutants, to increase energy efficiency, and to purchase and install renewable energy, provide multiple local benefits by decreasing air pollution, creating jobs, reducing energy expenditure, and saving money in the long term.
- Increased energy efficiency and the use of solar energy systems will reduce annual operating expenditures for universities, resulting in increased annual funding for teaching and student resources.
- Universities have enormous purchasing power to support the solar and wind industries in Australia through providing a market for their products and therefore contributing in a significant way to reducing Australia's greenhouse emissions.
- Universities have enormous investment power to support endowment funds in ethical, renewable energy businesses rather than in companies which cause climate change and commit human rights abuses.
- Universities have the ability to gear all research, development and education towards renewable energy, energy efficiency, and conservation.

May it be resolved that ((Enter in name of student council) urges the Vice- Chancellor and all members of the University Senate to adopt a Green Building and Clean, Renewable Energy Policy, which will require that:

- the university purchases 100% renewable energy;
- electricity use is reduced to 10% below 1990 levels by 2014 in order to reduce consumption of non-renewable energy sources;

- all new and renovated campus buildings contain a photovoltaic solar generation system capable of producing at least 25 percent of the energy use of that building, or at least 1 MW of solar on-site on each campus;

- all new buildings constructed on campuses are designed according to stringent green building guidelines (still need to find out the best guideline/system) and include provisions to update lighting, HVAC systems, and other building components so that all renovated buildings reduce energy usage dramatically;

- that the university car fleet is phased into hybrid cars (eg Toyota Prius) and/or a car fleet that does not use petrol by 2010;

- that the university investment funds, if invested in oil, gas, or coal companies, are transferred to socially responsible investments, such as renewable energy funds, and the university, in conjunction with students, formulates an ethical investment policy and abides by this policy with all its investments; and

- that the university makes a concerted effort not to gear teaching or research in its engineering and science faculties to the needs of oil, coal, and gas companies, but rather focuses on renewable energy options.

APPENDIX C - Other Higher Education Institutions' Activities

University of NSW

- multi-faceted plan delivering individual projects that in combination would bring about major reductions in use of black coal and resulting greenhouse gas emissions.
- Purchase 2.5% renewable energy (1,800MWh) for nine main campuses from Ergon Energy.
- Uni has a revolving energy fund through cost savings from more accurate and efficient on-billing to commercial customers using Uni's resources. Energy efficiency projects recoup costs which are reinvested back into renewable energy purchases. The Fund has allowed for:
    - 42 kilowatts of photvoltaics on the Quad building ($0.5 million)
    - on-campus cogeneration to heat water from gas plant. (cost of >$0.5 million)
    - subsidised air-conditioning equipment $0.5 million
- Participants in Greenhouse Challenge. Reduction of greenhouse gases by over 1,600 tonnes.
- Long term plan to generate 10% of electrical load using renewable sources on-site, as well as a further 50% with equipment driven by natural gas within 10 years
- Targets to reduce emissions by 2 percent per year until zero emissions.
- Renewable energy research units such as Solarch and Centre for Energy and Environmental Markets

Australian National University

- Establish energy supply arrangements, which provide for a 2% increase in green power use per year based on commercial availability. ANU has purchased green energy since 1999 and in 2000 two million kWh were bought, costing $50,000. Energy contract is about to expire, and the uni is reconsidering its green power purchases in light of the rapidly increasing mandatory environmental charges (NGACs and MRETs) which by 2009 may be as high as $396,000 on top of the usage and networking bill.
- Develop and implement energy conservation & greenhouse awareness programs for staff and students, integrated with other environmental initiatives
- In 2005 won a Banksia Award for solar technology developed at the ANU Centre for Sustainable Services in conjunction with Origin Energy. Solar cells use silver to reduce the amount of silicon needed, reducing the cost of the finished product.

Melbourne University

- Began buying green power 3 years ago at 2.5%. It was the first University to buy Green Power in Australia, initially buying 1500MWh of energy to provide power to six campuses. About to sign next 3 year contract for 5% of electricity to be sourced from Green Power. Power from solar, wind and methane gas.
- In energy suppliers' contract, the supplier must show how they will reduce energy consumption. Recent report shows very good reduction in energy consumption over last 10 years, despite increasing floor space ratio by 10%. All new buildings designed for low energy usage. On Alan Gilbert Building (20,000 sq m) photovoltaic cells power 1 of 7 floors. Developed from project with AGO and Melb Uni at cost of $1.5 million.
- Will begin using small steam generation plants in scientific units for sterilisation processes.
- TBL and EF reporting-uni doesn't extract sustainability data. It is all embedded technology and these issues are not add-ons any more. Eg garbage contractor pays uni to take away garbage as fuel source for energy production.

Monash University

- 2002 initial purchase of 10% renewable energy for Clayton Campus only. From 2004 10% for all Campuses. Buys more than 400 megawatt hours which adds 3.5 percent to total electricity bill. Push came from students, academic staff and facilities. Articulated through Environment Policy Committee, and serviced through Facilities and Services department. Student group directly approached Vice Chancellor for consideration and positively received.
- Uni has over last five years, implemented many successful outcomes driven programs including Green office Program, purchasing agreements. Environmental considerations are now integrated into the language of the university.

- Energy audit on Clayton Campus revealed potential energy savings through operational changes to achieve the goals of greenhouse gas emissions as well as a reduction in energy consumption.
- No on-site generation of energy
- TBL reporting includes energy, water, emissions, recycling, waste to landfill.
- Signed onto Greenhouse Challenge to reduce emissions and highlight activities.

Macquarie University

- received grant from SEDA for $50,000 and $250,000 interest free loan to cover costs of installing cogeneration plant in 1999. Total cost almost $5 million. The library air-conditioning was aging and the library was expanding. 2 gas engines were installed to generate electricity and recover heat to power the absorption chillers for the library air-conditioning. Generator capacity 765 kilowatts and 1 megawatt of heat produced. Savings allowed for the aquatic centre water and undercover spaces to be heated. It is a high maintenance item but comes within allocated budget.
- University also has a geothermal field on the Vice Chancellors building which is a heat source ground pump used to source and store hot water as required. It was installed at a cost of $300,000 and had a payback period of 2 years. These systems have allowed for peak demand to be reduced and spread more evenly throughout the day, reducing costs.
- (Kerry Russell-Acting Building Services Manager 9850 7149)

APPENDIX D – Funding Opportunities

Current or upcoming funding in renewable energy and energy efficiency
FEDERAL:
Australian Greenhouse Office –

- *Photovoltaic Rebate program* (administered through DEUS). Rebates for systems on community use buildings providing that installation can be demonstrated to have educational and interpretative merit. Minimum size is 450ppW. Rebates paid at $4.00 per peak watt, capped at $8,000. Rebate is set to continue for 2 years.
- *Low Emissions Technology and Abatement* program (LETA). Large scale grant funding ($500 million) aimed at demonstrating technologies that are low greenhouse gas emitters. Technologies must be commercially viable by 2020 to 2030 and be able to reduce the energy sector's greenhouse gas emissions by at least 2 per cent per annum from 2030 (approximately 9.5Mt CO_2 equivalent). The fund will operate over the period 2005-06 to 2019-20 with first competitive funding round 2005-06. Applicants must, amongst others, demonstrate that they can match the grant money paid on the basis of two dollars for every one dollar provided by the fund. Minimum of $20 million grant funding (hence $40 million from applicant) (www.greenhouse.gov.au/demonstrationfund)

AusIndustry-

- *Renewable Energy Development Initiative (REDI*). REDI will provide matching competitive grants totalling up to $100 million over seven years for eligible applicants to undertake eligible activities which aim to produce, commercialise or establish the commercial or technical viability of a new, clearly-identified renewable energy technology-related product, process or service. REDI grants will range from $50,000 up to a limit of $5 million for R&D activities; proof-of-concept activities; and early-stage commercialisation activities. These activities must be carried out in Australia and have strong early-stage commercialisation and emissions reduction potential.

Australian Research Grants (ARC). encourages institutions to develop collaborative arrangements among themselves, across the higher education sector and with organisations outside the sector, in order to develop research infrastructure. Supports large-scale cooperative initiatives involving two or more institutions, thereby allowing expensive facilities to be shared. Enhances support for areas of research strength. Ensures that researchers in fields of recognised research potential have access to the support necessary for development

STATE:
Department of Energy Utilities and Sustainable Development

- *Energy Savings* fund $40million over 5 years on a contestable basis to support energy savings initiatives by large private users, government and research sectors. By 2010/11 the benefits from the fund will equate to savings of 900,000MWh per annum in electricity consumption. Further details announced in late 2005.
- *Innovation Fund* announced in budget $6 million for 4 years. This focuses more on research and development, than on ground installations. It is also covering land management and greenhouse gas abatement programs. (David Hemming NSW Greenhouse Office)

INDUSTRY
Business Council for Sustainable Energy
The Australian Business Council for Sustainable Energy is inviting expressions of interest from members for funding proposals related to Intellectual Property of Solar IP Funding. Funding may be available to members, subject to the following guidelines:

Funding must be for specific Intellectual Property (IP) expenses related to commercialisation of solar thermal or solar photovoltaic technologies

A limit of $10,000 per company will apply, subject to applications received and subsequent availability of funds

Funding is available for actual costs already incurred, or that will be incurred between 1 July 2004 and 30 June 2005.

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