Energy Study

Crawley Offices
Conservation and Land Management

Wednesday, March 05, 2003

Prepared
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065771

Energy Report

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Executive Summary

David Tiggerdine has compiled this study as a result of being asked by Richard MacKellar (Greenhouse Policy Officer) to assist the Crawley office of the Department of Conservation and Land Management to reach the 5% reduction target. He visited the building three times, two during the day, and one at night.

Two Objectives of this audit were to identify financially viable projects or operational procedures that when implemented, would reduce energy consumption and running costs. The other objective is to reduce the power consumption by 5% in accordance with the Energy Smart Government policy that is outlined in the Premier's Circular 2002/13.

An analysis of historical electrical use for the financial year 2001-2002 shows that a daily expenditure varied between $36.8 to $58.4 and averaged $46.55 per day. Electrical consumption ranged between 246 and 362 KW/h per day with a daily average of 289 KWh per day.

The cost for that period was $16922.95 and this equates to a consumption of 511 MJ/M^2. These offices are operating at about half Perth's average and according to the Federal Green House Office program gets a 4.5 star rating. See appendix 4 page 29. The consumption varies during the year; the highest use is during the summer months, with a marginally lower peak in winter.

The breakdown of loads uncovered that the air conditioning was the highest user at 43 %, light at 39 % and office equipment at 18 %. These portions vary as the air conditioning load changes.

Recommendations

Proposals are based on the investigation of the information available. A detailed description of the historical information and a lighting report can be found on page 12 of the study report.

The main uses of power in the building are air conditioning, lighting and general office equipment. It is the office staff that operates and controls this energy. It is the staff who will ultimately dictate through attitude and co-operation the amount of energy savings that is achievable.

- ***Energy Management Plan***

The introduction of an energy management plan to cultivate and validate a conservation ethos. This will include:

1. A vision and policy to make the plan official.
2. Appointment of an enthusiastic Energy Manager.
3. Staff training to encourage involvement.
4. A computer, office equipment practices policy.
5. An operational policy for the air conditioning plant.
6. An operational policy for the lighting system.

- ***Housekeeping***

Good house keeping will give a sustainable benefit in some instances of 20% or more. Importantly it promotes staff involvement and contributes to an organizational culture of efficiency and forward thinking. Good housekeeping means turning off lights and air conditioning when not needed. Computers and monitors need to have the energy saving features turned on and tuned to maximise energy efficiency.

This approach involves the lowest cost, with the quickest payback time of 0.5 to 1 year

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- ***Change Fluorescent Globes***

Replace the standard fluorescent globes with triphosphor globes and delamp where appropriate as per AS 1680 for interior lighting. This could provide approximately 9% reduction in annual energy use.

- ***Action Plan***

Create vision and policy.
Appoint Energy Manager.
Encourage better house keeping.
Delamp and replace existing fluorescent globes with triphosphor globes.

Energy Report

1 Introduction

This report results from day and night visits to the corporate headquarters of Conservation and Land Management and the Conservation Commission in Crawley. Visits were conducted on the 12^{th} at 11am and 14^{th} of February 2003 at 11am and 8:30pm, in order to ascertain a general picture of energy usage and a complete lighting audit.

This is the first step in an energy management program. This was to give an overview of the organisations operations and the determination for power efficiency gains.

2 Energy Study Objectives

To identify and develop any projects or operational procedures which would reduce energy use.

To reduce energy consumption by 5% as in accordance with the Energy Smart Government policy that is outlined in the Premier's Circular 2002/13.

3 Study Procedures

3.1 Historical

Analysis of past electricity usage, facility details and operational information: was used to identify any tendencies or patterns in energy consumption.

3.2 Field Survey

Three visits to the facility were conducted, the first to get a general overview of the building and surroundings. The next visit to acquire information on air conditioning and lighting systems and the third to ascertain how much power was being consumed at night.

Detailed information was collected on:

- Last Year 2001-2002 data on energy consumption.
- Percentage of Energy use by each purpose.
- Building structure.
- Insulation.
- Mechanical equipment installed.
- Plant maintenance and operation.
- Electrical equipment installed.
- Lighting installed.
- Control systems.
- Facility operation.

3.3 Post Audit Investigation

The data on past energy consumption and from the site survey were then analysed tabulated and charted. The results were used to determine what potential energy conservation and cost saving opportunities were available and economically viable.

3.4 Technical Report Documentation

Based on the information collected and the trends identified.
The recommendations here are presented for consideration and discussion.

4 Description Of Site And Services

4.1 Environment And Operating Conditions

The site under investigation is located at Hackett Drive Crawley near the City of Perth Western Australia, and the Corporate Headquarters of the Department of Conservation and Land Management and the Conservation Commission.

There are three buildings: one medium sized two storey brick office building, one new transportable with 7 offices and a brick building comprised of small storage areas. The brick building are situated near the Swan River with the long axis facing the river giving a north south orientation.

The main office building is constructed from red brick with concrete floors and an insulated asbestos roof. The ground floor has mostly wooden framed opening windows but some windows on the first floor are aluminum framed and does not open. The ground around the building is well treed, and shady with a lot of lawn. The building has had many alterations but these seem to marry well.

The building used to have three large commercial reverse cycle split air conditioners with two supplying the top floor and one for the ground floor. The ground floor air conditioner has been turned off and smaller single room air conditioners have been installed. This trend of fitting small split systems has continued with some offices on the first floor being fitted and still having some air coming from the main split systems.

The main building has two sections. The larger section houses the corporate headquarters of the Department of Conservation and Land Management and the smaller section is for the offices of the Conservation Commission.

Office hours are between 8 am and 5 pm Monday to Friday. However many of the staff work outside these times.

Average light levels throughout the offices showed a wide deviation from 202 lux to 1258 lux with the average value for the Conservation and Land Management offices being 522. The Conservation Commission offices averaged 365 Lux. The new transportable with new triphosphor globes 962 Lux. The Australian Standards require that a light level between 320 and 400 be maintained in an office environment dependent upon the tasks performed in the particular area.

4.2 Australian Standards

AS 1680 for interior lighting to be consulted for each situation before any trials or installations.

4.3 Other Equipment

As with any office environment the typical modern office equipment such as computers, faxes, photocopiers, phones and printers were present.

4.4 Electricity

The site is metered and billed at a Western Power L1 Tariff rate.

5 Observation On Operation Of Buildings Plant And Procedures

This site with 511 MJ/M^2 has a Federal Government Greenhouse Office program rating of 4.5 stars. This is better than average and shows that the staff is doing well at energy efficiency.

However housekeeping practices could be better and a coordinated approach to energy management / plant operation appears to be deficient.

The two remaining Carrier commercial split systems servicing the upper floor are used under a service contract filters seemed to be dirty and this showed in rooms furthest from the central heat exchanger with higher temperatures and less air flow from the vents.

Each of the newer small single room split systems on the ground floor has only enough capacity for the room in which it is installed.

The management of the old system where the conditioned air flows from the duct into the room and then out the doorway to be collected by the intake filter, is completely different from the small single system that needs to be in a confined space to work efficiently.

On the top floor the two systems condition the air from the intake near the centre of the building. One directs air north and the other south. There was a marked temperature 8° Celsius and airflow difference between the offices near the air handling rooms the offices particularly on the north end of the building.

The site survey showed that further savings could be obtained by better operational practices and maintenance. Regular cleaning of the main Carrier units and small split systems, condenser coils and filters is necessary to maintain efficiency.

Lighting systems and fittings in the main building are in general old and inefficient. The light fixtures have standard 36 W tubes and magnetic ballasts. The night visit revealed all the upstairs hallway lights were left on and a total of 19 globes approximate used 8 to 10 kilowatts. This figure would be even more if they were left on all weekend.

5.1 Summary Of Consumption Data

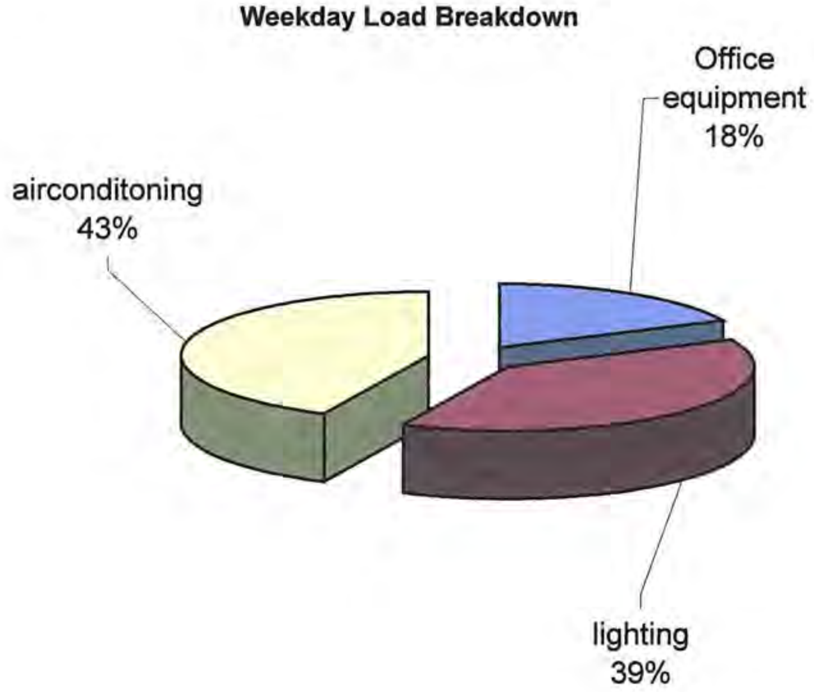
Data supplied dated 3/7/2001 to 3/7/2002 revealed the following: -

Annual Electricity consumption	
Billed (365 days)	105513 KWh (380 GJ)
Annual Electricity Cost July 2001-2	
Billed	$16922.95
Daily Electrical Consumption (annualised)	$46.55
Daily consumption for Normal office hours	$ 65.09 (260 days per year)
Annual Electricity cost per square metre 700 square metre	$24.20
Annual Energy use per person	14309 MJ/person/annum
Annual Energy use per square metre	511 MJ

Formula to convert Kilowatts to Mega Joules

This graph shows average percentages over the year. It shows that the greatest consumption is in air conditioning followed by lighting then office equipment. The proportion used in air conditioning is variable and will be significantly higher during times of higher or lower temperatures.

5.1.1 Graph 3: Load Breakdown Comparison



5.2 Historical

This is the record of the Electrical usage for the 365 days from 3 July 2001 to 3 July 2002. The total cost of that period was $16922.95.

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5.3 Energy Usage Table 1

Electrical Use of Conservation and land Management Crawley Office

Dates (Billing Periods)	Dates (Billing Periods)	Total units used	Days	Ave/ day	Cost	Unit Charge	Cost / day
3-Jul-2001	31-Jul-2001	9800	28	350.0	$1,556.24	0.1588	$55.58
31-Jul-2001	29-Aug-2001	8934	29	308.1	$1,418.72	0.1588	$48.92
29-Aug-2001	27-Sep-2001	8192	29	282.5	$1,300.89	0.1588	$44.86
27-Sep-2001	30-Oct-2001	7937	33	240.5	$1,260.40	0.1588	$38.19
30-Oct-2001	28-Nov-2001	9252	29	319.0	$1,469.22	0.1588	$50.66
28-Nov-2001	28-Dec-2001	8838	30	294.6	$1,427.58	0.1615	$47.59
28-Dec-2001	30-Jan-2002	10209	33	309.4	$1,649.03	0.1615	$49.97
30-Jan-2002	28-Feb-2002	10487	29	361.6	$1,693.94	0.1615	$58.41
28-Feb-2002	4-Apr-2002	9791	35	279.7	$1,581.54	0.1615	$45.19
4-Apr-2002	6-May-2002	7299	32	228.1	$1,178.99	0.1615	$36.84
6-May-2002	5-Jun-2002	7368	30	245.6	$1,190.13	0.1615	$39.67
5-Jun-2002	3-Jul-2002	7406	28	264.5	$1,196.27	0.1615	$42.72

Total units not adjusted for green power	105513 Kilowatts	379846.8MJ	
Days		365	
Average daily Units		289.08 Kilowatts	
Average daily cost		$46.55	
Average daily cost for normal office hours Monday to Friday		$65.09	for 260 days per year
Total cost		$16,922.95	
annual cost per square metre		$24.18	

5.4 Light Audit Table 2

Lighting Audit Crawley Offices

Room	Floor	Number of Fixtures	Lamps per fixture	Watts per lamp	Total lamps	Ballast loses	Wattage per day	Amount of light (lux) 1	Amount of light (lux) 2
Reception	Lower	6	1	36	6	63	2511	None	None
Office Diana	Lower	2	3	36	6	63	2511	205	225
Pax room	Lower	2	2	36	4	42	1674	202	None
Empty Office Aminya	Lower	2	2	36	4	42	1674	None	300
Office Simon	Lower	4	2	36	8	84	3348	524	559
Office John	Lower	2	2	36	4	42	1674	383	362
Office Kerry	Lower	2	2	36	4	42	1674	404	200
Office Alan	Lower	3	2	36	6	63	2511	231	309
Office Stella	Lower	2	2	36	4	42	1674	307	204
Office -----	Upper	4	2	36	8	84	3348	565	684
Meeting room Acacia	Upper	9	2	36	18	189	7533	784	702
Photocopy area	Upper	2	2	36	4	42	1674	531	None
Lounge	Upper	4	2	36	8	84	3348	455	None
Office Jan	Upper	2	2	36	4	42	1674	418	550

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Office Photocopier	Upper	2	2	36	4	42	1674	460	None
Office Keiran	Upper	6	2	36	12	126	5022	415	621
Office Jim Sharp	Upper	4	2	36	8	84	3348	555	511
Upstairs Hallway	Upper	9	2	36	18	189	7533	450	None
Office Kylie	Upper	4	2	36	8	84	3348	561	365
Office Gordon	Upper	4	2	36	8	84	3348	725	664
Office John	Upper	4	2	36	8	84	3348	918	880
Office Sharon	Upper	4	2	36	8	84	3348	817	605
Office Peter	Upper	4	2	36	8	84	3348	794	811
Office Caris	Upper	4	2	36	8	84	3348	881	653
Office Shadi	Upper	4	2	36	8	84	3348	642	786
Office Jeanette	Upper	4	2	36	8	84	3348	299	435
Meeting room karijini	Upper	8	2	36	16	168	6696	None	None
Lower hallway	Lower	3	1	36	3	31.5	1255.5	None	None
Commission meeting room	Lower	4	2	36	8	84	3348	414	437
Commission office	Lower	2	2	36	4	42	1674	479	422
Commission office end	Lower	2	2	36	4	42	1674	303	100
Commission office Christine	Lower	4	2	36	8	84	3348	426	369
Commission office chair	Lower	2	2	36	4	42	1674	237	241
Commission server room	Lower	2	2	36	4	42	1674	330	228
Transportable reception		3	2	36	6	36	2268	903	None
Transportable office 1		2	2	36	4	24	1512	720	None
Transportable office 2		4	2	36	8	48	3024	1258	None
Transportable office 3		2	2	36	4	24	1512	978	None
Transportable office 4		2	2	36	4	24	1512	1017	None
Transportable office 5		4	2	36	8	48	3024	1160	None
Transportable office 6		2	2	36	4	24	1512	700	None
3 strings of halogens		6	3	50	18		8100		
							110632.5	Total Watts per day	
		Total lamps			283		110.6325	Total Kilowatts per day	

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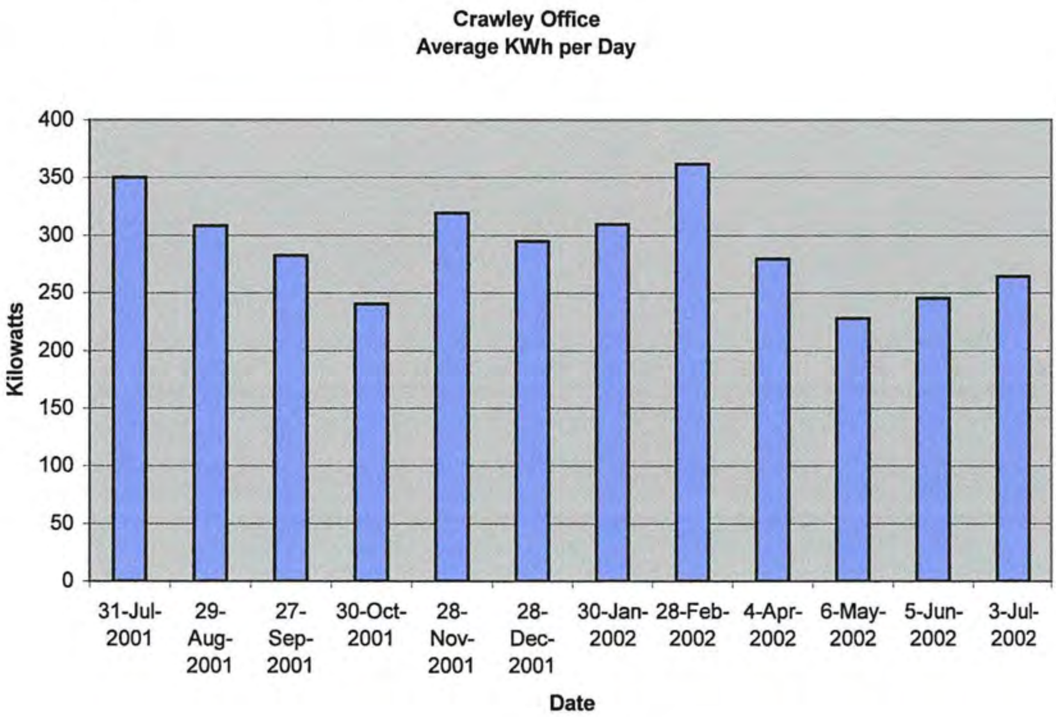
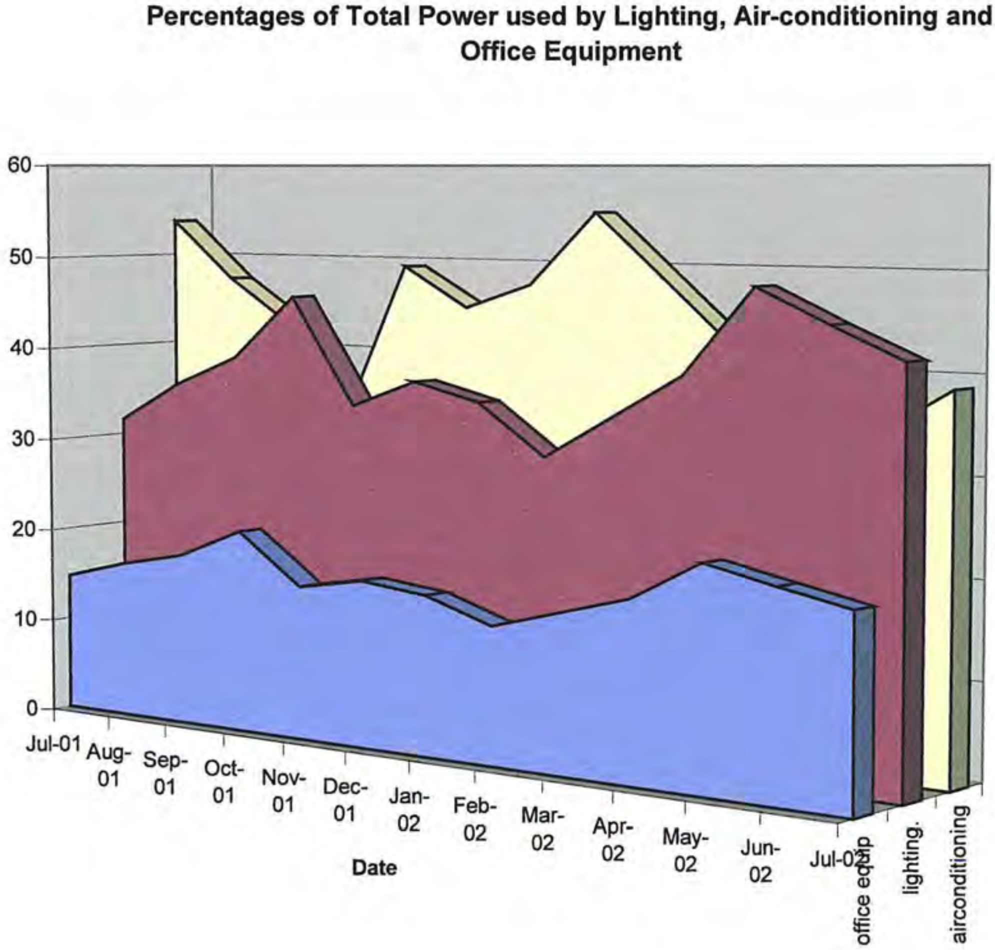
5.4.1 Graph 1 Average Daily Electrical Cost



5.4.2 Graph Two: The Different Percentages of Mains Power Used in Lighting, Air-Conditioning and General Power.



Comments

From this data we can deduce that the major spikes in the energy use are directly attributable to the air conditioners. Lighting and office equipment use varies due to Holiday's that staff takes and two peaks with end of financial year and in October for budgeting. The variability is partly due to poor building orientation, leaky building structure (poorly sealed windows, doors, window frames and other holes and cracks), lack of adequate insulation and ineffective and old air conditioning system.

6 Summary of Cost Saving Opportunities

All computations on estimated savings are based on equipment use, deduced from site observations and information gathered. All prices are conservative estimates and management should obtain firm quotes for prices and conduct equipment trials before any capital expenditure.

6.1 Energy Management

Energy must be treated as a consumable Resource rather than as so many businesses classing it as an OVERHEAD only then can it be managed. As a variable and not a fixed cost management decisions can influence the amount used and so need to take responsibility thus ensuring a minimisation of wastage.

For energy management to be successful it needs staff support. This is why it is so important to appoint an Energy Manager to gauge acceptance of proposed changes before a full installation goes ahead. It might be prudent to test new projects in a small area prior to full installation, to gauge acceptance and practicality of the proposal.

6.2 Saving Energy

The minimisation of energy usage in offices is usually achieved by studying three main areas: -

1. The efficiency, suitability and condition of plant and structure.
2. The efficiency, suitability and condition of the control systems and use of that plant.
3. To evaluate the need for any machine or energy using device or other measures that could be used to minimise the energy for the sustainment of services and conditions.

6.3 Introduction Of An Energy Management Program

To achieve any reduction and then maintaining the savings outlined in this report is by the application and maintenance of an Energy Management Plan. This will simply help to get the most out of any existing capital investment and those that are planed.

The appointment of an Energy Manager within the Crawley office or Department as a whole, would enable all energy-associated matters to be kept under reappraisal. In some circumstances a small staff representative team could also be appointed to report on different areas of the department and keep others informed.

Contractors should also be made aware of the Energy Program objectives and polices.

6.3.1 The Approach

1. In energy management the first determination to make is this energy being consumed is necessary. Requirements change over time so it is appropriate to building an ongoing review process.

   For example: Computers used to be very temperamental in high temperatures and needed air conditioning but now in most cases will run reliably under normal abient temperatures.

2. The second step is to find most effective method to achieve the wanted outcomes.

   For example in Crawley the fitting of small single room individually controlled reverse cycle split air conditioner instead of one centrally controlled system.

   In some circumstances the use of window spectral selectivity[1], tinting or openings in the building structure to allow natural ventilation could also reduce the load on these systems. Can cool air in summer or heated air in winter be recovered. Natural day lighting also reduces dependency on the lighting.

6.4 Housekeeping Measures

- Senior management need to make a clear commitment to accountability for energy management, with appropriate allocation of

[1] Spectral Selectivity refers to how the glass responds to different wave lengths of solar energy, e g to allow visible light but reject infrared heat

financial and staffing resources and the inclusion of reporting procedures.

- Turn of equipment and lights whenever its not being used.

- Staff encouraged turning off computers if being left for more than 30 minutes.

- Equipment needs to have energy-saving features enabled.

6.4.1 Staff Awareness Campaigns

Motivating, training and participation of staff

As mentioned before, only through staff involvement, will the greatest energy savings be made. Rasing awareness can bring benefits including:

- Support of the energy program and environmental responsibility.
- Dispelling the misconception that energy efficiency involves reduced light and comfort.
- Staff feels they are part of the solution.

6.4.1.1 Awareness Raising Techniques

There are many methods to raise staff awareness. It is important to keep the campaign dynamic and with the use of multiple techniques[2]. Some techniques are:

- Staff Incentives.
- Competitions.
- Training.
- Energy wardens.
- Publicity i.e. emails posters and newsletters.
- Awareness talks.
- Circulation of regular energy saving accomplishments.
- Talking to individuals.

[2] Ms Katrina Lyon Project Leader, Information and /training //services Australian CRC for renewable energy

6.5 Lighting

Lighting is the second biggest power user overall and at periods of the year becomes the biggest user. Lighting costs approximately $4609 for the brick building with the new transportable an extra $598.00 per annum. Therefore any reduction in operating hours, or amount of wattage of the light fittings and number of lamps will save energy. Possible measures include:

- Delamp the new transportable to reduce light to Australian standard 1680 for offices 320 to 400 Lux down from the average 960 Lux at present.

- Turn lights of when not in use.

- New switching circuits in the area where the Conservation Commission offices are situated. A single switch switches several rooms of and on at present.

- Have the lighting circuit for the building put onto a timer so that any lights left on would be automatically turned off say at eleven O'clock. The night I visited the upstairs hallway lights were on this is a total of 19 globes approximately used 8 to 10 kilowatts over night; even more if they were on all weekend.

- Motion switching in the kitchen and bathrooms and other irregularly used spaces.

6.5.1 Lighting Refit

Delamping and triphosphor replacement:

The Perth Observatory was able to reduce the number of lamps by 1/3 whilst the amount of light at the work surfaces actually rose. A replacement of the standard lamps with triphosphor tubes could allow a reduction of one in three lamps which would translate to a reduction of 94 lamps and a 9.1% reduction in overhaul in power. New tubes and fitting would cost approximately $1000 but the lighting power reduction would be paid back in about 6 months.

Additional there would be a reduction of heat from the ballasts and so a reduction in air conditioning power consumption.

6.5.2 Specular Reflectors

Highly reflective pieces of stainless steel are placed behind the florescent tube to direct more of the light on to the working surface. These reflectors boost fixture efficiency by 20 to 30%. These cost around 25 dollars plus fitting and this cost can be recovered in 18 to 24 months.

6.5.3 New Fittings Including Electronic Ballasts

Electronic ballasts give approximately an extra 20-30% light This happens because the electricity is boosted from cycling at 50 times per second to 40000 cycles per second so the light spends a lot more time on. Electronic ballasts also give power savings of 15-20% they are a lot more efficient than the standard magnetic ballast. Potentially the biggest saving of all, seem in many examples of office refits, is the rise in productivity of 6-15% and happier more comfortable staff. An electrician gave a verbal quote of $25 to $35 to remove and replace the ballast. Depending on the cost to have them fitted pay back period ranges from for 15months to 28 months.

6.5.4 Dimmable Electronic Ballasts With Day Lighting Controls

The Florida Solar Energy Centre ran a side -by-side test on two commercial office lighting systems. One office has the standard office lighting, similar to our system. The other had an advanced daytime lighting system consisting of a open parabolic troffer[3] with a reflector, two F32t8 lamps each driven by an electronic ballast and a ceiling mounted photometric sensor to provide continuous dimming in response to ambient light.

The dimmable system produced a 66% reduction in power consumption during daylight hours. This scheme has not been costed for our application and more research would need to be done. Dimmable electronic ballasts are about twice as expensive than non-dimmerable electronic ballasts. For a twin 32 watt fluorescent tube luminare the ballast is $100 plus switch gear.

[3] A Troffer is a recessed ceiling light fixture

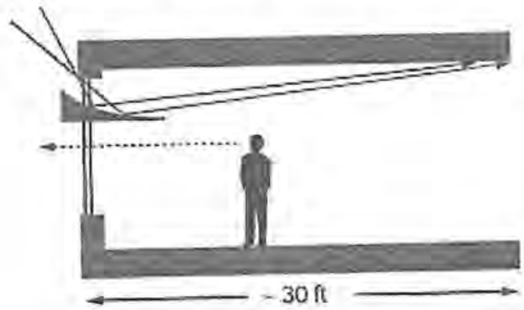
6.5.5 Lighting Power Reducers

This "electronic box" is hard wired into the lighting circuit and can work on up to 300+ lamps. The box reduces the power voltage to 90% but as more new lights are turned on raise the voltage back to 100%. Once the lights have ignited the voltage goes back to the 90% level. Where lights are left on for most of the day these devices can save up to 30%. See appendix 1

Conservation and Land Management offices at Kensington are just completing the installation of 6 units and their calculations show a payback time of around 4 years.

6.5.6 Day Lighting

Day lighting can take several forms. A skylight would be a good way to light the upper stairs reception area, first floor bathrooms and the hallway.
Also attachments can be put on or around windows to direct light into a room. The "light shelf" below reflects light onto the ceiling and so delivers more light at a greater depth in the room.



According to the U.S. Green Building Council's Sustainable Building Technical Manual, well-designed day lighting can reduce lighting energy use by 50% to 80% and increase worker productivity up to 15%.

6.6 Air Conditioning

Air conditioning is a very necessary part of any office building so that the staff can work well in Perth's seasonal extremes of temperature. Air conditioner load comes from two sources:

- External load conditions

- Internal load conditions

External conditions are the solar heating of the exterior entering; heat the building by conduction and radiation in summer through windows, walls and roof, and the hot air seeping in through cracks in the building fabric, e.g. unsealed windows and window frames, gaps in doors and unsealed orifice. Internal loads come from lighting, body heat, appliances and equipment inside the building.

The air conditioning load makes up around 43% of the Crawley offices electrical operating cost. It would be prudent to give consideration to any worthwhile effort to minimize these costs. A reduction in usage and maximum demand would give lower operating costs.
The major loads at Crawley are: -

- Infiltration of air and "fresh air make up" (e.g. when door are opened?).
- People – body heat.
- Lighting - tubes and ballasts produce heat.
- Electrical equipment e g computers photocopiers printers.
- Solar heating by radiation and conduction.

Air conditioning costs can be reduced by:

- External shutters, window treatments such as modern low–e glass that can reject 40% of the solar gain[4] but admit 90% of the light, upgrading of the roof insulation and a sealing up of the building fabric window and door seals and around window frames.

- Ensuring air conditioner inlet filters are cleaned regularly.

- Ensuring that condenser coils are cleaned regularly and not block by plants or rubbish this can increase efficiency by 15%.

[4] Solar gain is the amount of heat from the sun that infiltrates in to the building

- Correctly set temperature controls. Air conditioners should be set on heating or cooling, not automatic. In summer the automatic setting will cause the machine to heat the building in the early morning hours before then cool the building later in the day.

- For summer, cooling should be selected and temperature should be set between 22 and 24 degrees Celsius.

- For winter, heating should be selected and temperature set at between 18 and 20 degrees Celsius.

6.6.1 A heat recovery heat exchanger.

These machines will extract the heat or cool air leaving the building interior and transfer it into the fresh air drawn into the building. They could be fitted fit into the spaces along side the air handlers. These machines cost around $3000 dollars fitted and have typical pay back times of 2 to 3 years. One point to note is that the tighter the building fabric the more efficient they can be. See appendix 2

6.6.2 Night Time Ventilation

This is the drawing of cool air through the building at night in summer. It takes about 8 hours for the daytime heat to penetrate through the brickwork. Drawing cool air past the internal walls at night transfers heat from the brickwork to the moving air, which is then expelled. Extraction fans could possibly be hooked up to the ducting of the air handler's rooms. This reduces the load on the air conditioner system during the day and has the possibility of saving 20% of the current power consumption.

6.6.3 Altering the Air Conditioner Compound

The air conditioner compound could be altered to allow more cool air to reach the condensers. This small brick compound with one slatted wall restricts the amount of air flowing through the machines. Measurements taken on one of the machines showed 39.4° Celsius on the inlet side and 45.0° on the exhaust side when, the ambient temperature was 26.7° Celsius. I would suggest an air inlet grill on the outside of the compound to give a flow though effect.

6.6.4 New Split Systems For Upper Floor

Over the past thirty years air conditioners have become approximately 30% more efficient. Have had a talk to the suppliers Carrier's sales and service staff and they are going to give me a price on new machines of the same capacity.

6.6.5 Indirect Evaporative Air Conditioner

This sort of air conditioner is the same as a domestic evaporative air conditioner but has a heat exchanger <u>within</u> the unit so the machine cools the heat exchanger, which is drawing in the cool dry air. The moisture is not in the air stream that is entering the building. Enevac one company that make this type of air conditioner claim in tests that the machine reduces the temperature 3 to 5 degrees lower than a direct evaporative cooler. See Appendix 3.

6.6.6 Ground Source Heat Pump

This type of heat pump is simular to a standard air conditioner but instead of heat being released to the outside air the heat gets transferred into the ground through a buried pipe that forms a large loop. The loop can be horizontal or in a vertical bore. These systems are more efficient than the standard air conditioner and much quieter. At the Southern Cross Cosmos Centre near Gingin they have a similar system with two bores water is pumped and the pump water up one bore through the heat exchanger and back down the other bore. This allows a reduction in size of the plant by 33%. The USA Federal Energy Management Program claims they can have energy savings in the range 30 to 60% compared to conventional air conditioners. Payback time is 3 to 5 years

7 Switch Office Equipment Off When Not In Use

The easiest way of saving energy is to turn unused equipment off. In some Photocopiers and laser printing machines have heaters which unless machine is turned at the wall still can use up to 50 watts[5].

- Computers can be turned of during lunchtime, if left on $300 per annum or $75 for a working day.
- Air conditioners and lights turned off during space not being used.
- Laser printers turned of at night and weekends, $500 per year if left on and $230 for a 10 hour working day.
- Photocopiers turned of at night and weekends, if on continuously $980 a year or $450 for 10 hours a day/annum.

8 Purchase And Operate Energy Star Office Equipment

A lot of office equipment is getting more efficient and this efficiency needs to be taken into account when purchasing.

Example is that a laser printer use about three times more power than does a inkjet and for regular use these should be used.

Some monitors that were checked at Crawley used 80W and 20W in standby mode, Compare this with 30W and 3W for and LCD monitor. Here is a possible saving of 15kw per day As the price falls particularly for 15-inch LCD's the payback is getting shorter. This is approximately a 3.5% reduction in annual energy.

Office equipment that is energy star compliant has low power modes when standing by to be used. This equipment with the power conservation measures on can reduce the annual energy use by 33%.

[5] Figures collected from Green Office Guide 2001 produced by the Australian Greenhouse Office

9 Rationalize Excess Equipment

Equipment that has been used in the past but has been superseded by new equipment but is still connected to power just in case could be either stored or disposed of.

10 Action Plan

Create vision and policy.

Appoint Energy Manager.

Encourage better house keeping.

Delamp and replace existing fluorescent globes with triphosphor tubes.

11 Appendix 1 Light Dimmers

Dim the light fantastic

Gas discharge tubes are everywhere, and are most predominantly used in factory and street lighting. However, they are usually run at full power, even when this is not necessary.

The Autolux system is a fully electronic lighting controller for the regulation of single-compensated gas-discharge lamps. According to the manufacturers, the Autolux can save up to 60 per cent of lighting costs, most of this being electricity savings, and the rest in reduced maintenance due to longer lamp life.

The distributors of the Autolux are currently looking for dealers worldwide.

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Make fluoros even lower energy users

Lighting controllers for gas discharge lamps, such as fluoros and other similar lighting systems, seem to be quite common in many countries, but they are yet to take off in Australia. Yet there are considerable savings to be had with the use of these devices.

Essentially they reduce the voltage, and hence the power consumption, to the lamp once the lamps have started fully. These controllers are said to be able to reduce energy consumption by as much as 35 per cent, which can be a considerable amount of energy (and money) saved in buildings with large numbers of fluoro or similar light fittings.

We looked at one of these controllers a few issues back in *ReNew*, and have since found two others that perform a similar function. At right is the LEC lighting energy controller from Israel, with models capable of handling lighting loads of up to 160 amps, and at left is the Fluoresave controller, which is available in models up to 20 amps.

The LEC units are distributed by Lighting Energy Controllers (Aust) P/L, ph:0414 312 230 or 0417 474 144, while the Fluoresave units are available from Sustainable Solutions, 13 Brenda Crt, Croydon VIC 3136, ph:(03) 9733 5307, mobile:0422 105 638.

72 ReNew Issue 82 January-March, 2003 email: ata@ata.org.au WWW: http://www.ata.org.au/

12 Appendix 2 Heat Exchanger

Keeping the heat in

One of the best ways to reduce heating bills is to seal the house to eliminate draughts and the influx of cold air. But this creates the problem of providing adequate ventilation without losing that precious heat.

The Flair Duo energy recovery ventilator, from Australian Healthy Home and Workplace, is a heat exchange ventilation system that transfers the heat from the warm outgoing air to the cooler fresh air coming into the home, as well as cooling the incoming air in summer.

As well as heat, the unit can transfer moisture from the outgoing air to the incoming air in winter, and will do the reverse, dehumidifying the incoming air in summer.

There are three different models, capable of moving up to 85 litres of air per second, with a heat and humidity recovery efficiency of around 80 percent or more. The ventilators also feature filtering of the incoming air to reduce the level of airborne pollutants in the home.

The units can be installed by any ducted heating installer, and can even be incorporated into an existing system.

rrp $1750 for the 3060 Duo, $1870 for the 5590 Duo, and $1830 for the 3065 Duo high efficiency model. Installation cost will be extra. For further information, contact Australian Healthy Home and Workplace, 15 Dinah Parade, East Keilor VIC 3033, ph:(03)9331 3622.

13 Appendix 3 Enevac Indirect Evaporative Air conditioner

Introduction Technology Principles Comparison

PRINCIPLES OF OPERATION

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General Operating Principles

During operation, a blower supplies intake air to the Enevac heat exchanger. This intake air (Q°) is divided into 2 streams: primary and secondary air streams. The primary air stream (Q^1) passes through the dry channel and the secondary air stream passes through the wet channel (Q^2). As (Q^1) air passes through the dry channel, sensible heat is progressively removed from this stream of air by conduction of heat across the dry channel surface, across to the wet channel. In the wet channel, vaporization occurs and the latent heat of vaporization is exhausted as the secondary air stream (Q^2).

In Enevac, cooling is achieved through evaporation and saturation process which is non-adiabatic. The secondary air stream, Q^2, in the wet channels is saturated by water vapours and is flowing counter-flow to the intake air stream Q^1. The temperature of secondary stream Q^2 increases as it picks up heat, transferred across the wall separating the wet and dry channels, from the hot intake air. Not only does the moisture content increases in Q^2 but also its heat content. As a result, the equilibrium saturation takes place at a higher than wet bulb temperature. The warmer the saturated air in the wet channels, the more water is required to saturate it and hence, the more sensible heat can be removed from the hot intake air to be cooled.
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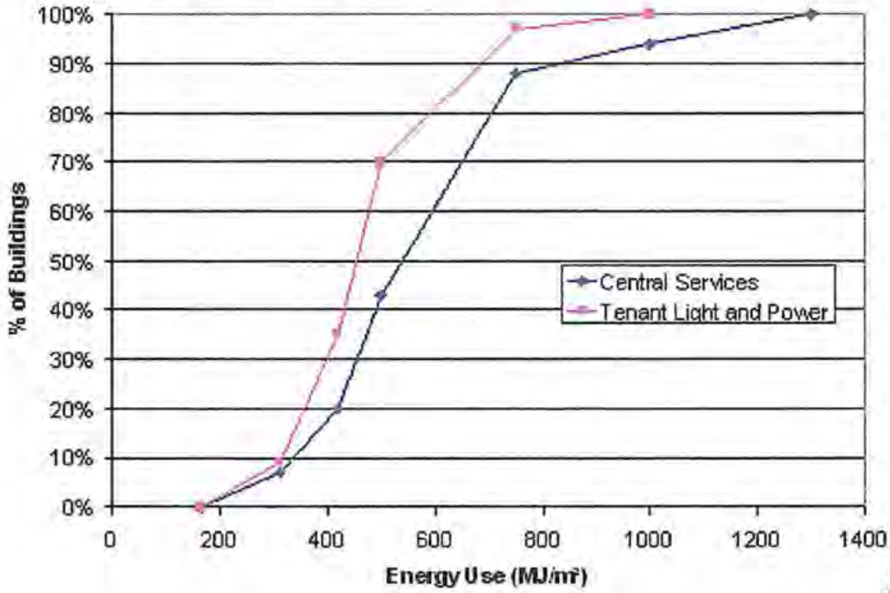
14 Appendix 4 Report Of Australian Office Energy Use

Buildings and energy
http://www.greenhouse.gov.au/lgmodules/wep/buildings/training/training6.html
2.1: Office building energy use

The graph below illustrates the statistical range of office building energy use in New South Wales. This distribution is generally valid throughout all of the non-tropical parts of Australia. It can be seen that both tenant light and power and central services energy consumption vary over an enormous range. In both cases, poor operation and design are the primary causes of this spread.

Distribution of energy use



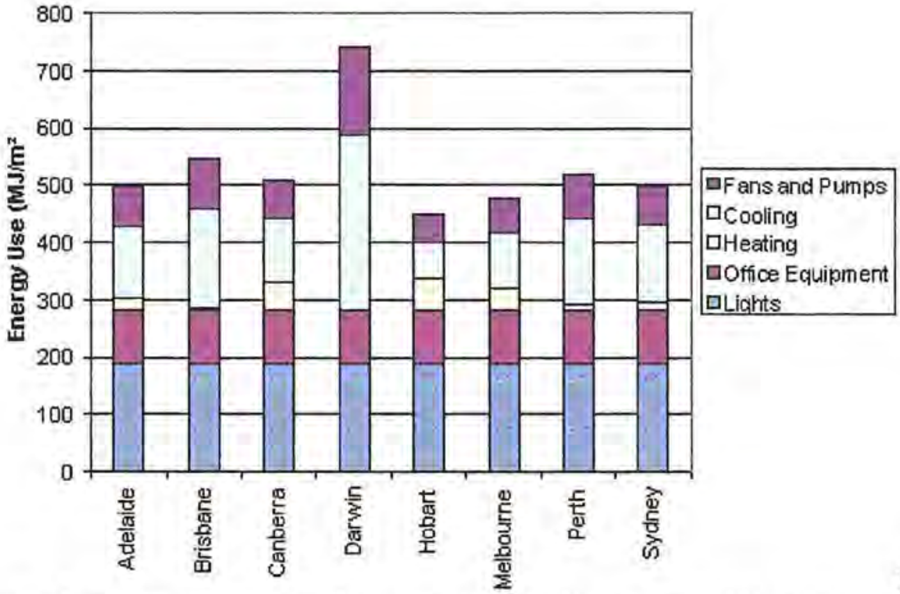
Approximate distribution of building energy use for central services and tenant light and power.

To read the chart for a given energy use figure, the corresponding percentage from the vertical axis is the % of the building population using that amount of energy or less for the given services.

From the figure you can see that an average building uses around 450 MJ/m2 for tenant light and power and 550 MJ/m2 for central services, giving a total of 1000 MJ/m2. It is interesting to compare these figures against how well a theoretical building can perform. In the next Figure, the energy use of a building has been estimated by computer simulation techniques for all of the capital cities around the country. The building model used represented average practice only and a conventional variable air-volume air-conditioning system.

Energy use in Australian buildings

Energy Report



Energy use for standard office buildings throughout Australia, estimated by computer simulation

The most significant observation to be made from the figure is that for most parts of the country total building energy use, including both tenant electricity and central services, can feasibly be around 500 MJ/m2. That's about half of the average energy use of actual office buildings, and is a dramatic demonstration of how much energy is wasted in the office building sector.

The figure demonstrates that throughout the temperate part of the country, climate is not a significant modifier to overall performance - scarcely 10%. Tropical climates have to be considered separately, as the energy use requirements for these areas are much higher.

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