Energy Audit
Dalrymple Road Depot

Inventory of Selected Facilities within Townsville City Council

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Director Date

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1.0 INTRODUCTION

In June 2001, C&B Group Consultants were contracted to undertake an energy and greenhouse gas emissions audit on behalf of Townsville City Council. The funding for this project came from federal monies from the Australian Greenhouse Office, through a project known as the Greenhouse Challenge. In Townsville, the Greenhouse Challenge is coordinated by Townsville Enterprise Limited.

The format of this report is that requested under the Greenhouse Challenge funding guidelines. Given the extent of the funding for this program, it has not been possible to extend this greenhouse gas emissions inventory to all of the council operations in detail.

Greenhouse gas emissions come from a variety of source under local authority control. These included landfill, tail pipe emissions, and are closely related to energy (electricity use) given the predominant source of power in Queensland is coal. It was therefore necessary to limit the scope of this document to a portion of the council's operations to The Dalrymple Road Works Depot. This facility can be viewed as being a pilot project that can be translated through to many of the other council's facilities.

This project introduces Council to the savings and the ease with which local governments can address current global problems such as global warming. It should also serve as a pilot project for the guidance of all future developmental proposals in the City. This is particularly important as ecological sustainability, of which reductions to global warming emissions is an integral part, is enshrined in the Integrated Planning Act.

1.1 EMISSIONS REDUCTION PLAN

The Reduction Plan section of this report will focus on strategies relating to the minimisation of energy consumption by the Townsville City Council, as carbon dioxide emissions related to energy use are a principal source of greenhouse gas emissions.

However, it is worth noting that detailed strategies can also be developed for the:

- Minimisation of energy consumption and related emissions from vehicles;
- Establishment of greenhouse gas sinks;

- Minimisation of emissions from waste products; and
- The development of management systems to measure, monitor and support energy reduction initiatives.

All of which can deliver considerable cost savings to your organisation in the long term.

1.2 SCOPE OF EMISSIONS PLAN

The Inventory focuses on the following buildings:

Works Depot (Dalrymple Road)

This Depot has been chosen because of the broad nature of the buildings within it. Therefore information can be extrapolated from this report to look at the possible problems that could be encountered and improvements that could be made to other buildings within the TCC's control.

1.3 OVERVIEW OF METHODOLOGY FOR EMISSIONS INVENTORY

The inventory is based on the collation of all energy bills relating to the individual buildings and business practices, in conjunction with a survey of the building structure and energy distribution within building. With these two approaches, it is possible to determine an "energy consumption and use" baseline by which we can:

- Determine where and in what manner energy is being used.
- Assess the existing building capabilities to reduce energy consumption.
- Assess the practices of the users of the building business, and suggest recommendations to improve energy efficiencies.
- Focus the recommendations to create the most cost effective reductions plan.

1.4 RECOMMENDATIONS

The Audits recommendations are based on three levels:

1. Management changes and refinements to the way the buildings existing facilities are used. These are designed to be carried out at no capital cost (although time will be required by the existing workforce to implement the strategies).

2. Minimal/low cost improvements. These are designed to be instigated at a low time and financial cost, taking into account working environment disruptions. Most of these recommendations would pay for themselves in no more than 2 years.

3. Major refurbishment projects. These are recommendations that are designed to be carried out at the *end* of the working life of the plant or structures. Payback periods for these items can be very long, so are generally only viable at refurbishment.

As an addendum to this, it should be noted that in most cases we are improving the working environment by involving the workforce in management of their own work space and making the building more responsive to the needs of the occupants. Where these audits have been carried out in other businesses, the ongoing monitoring of the project have indicated an improved productivity level and reduced absenteeism.

Although some recommendations repeat themselves in several of the buildings, we will approach them separately because of each building's individuality and relative practice. At the end of the report we will collate all data to provide an overall picture of the savings that can be made.

2.0 FACILITY DETAILS AND INVENTORIES

2.1 FACILITY DETAILS

Building 1:	Main Administration (cast in situ two stories)
Building 2:	Fleet Administration (concrete block single story)
Building 3:	Learning Centre (portal frame steel clad)
Building 4:	Storage Building (portal frame steel clad)

This represents the main energy consumers on the site. There is a total of 15 buildings, however they either have little or no electricity supply, or are currently not in service.

2.1.1 Building 1: Citiworks Central Administration

2.1.1.1 General Description

This building was constructed in the mid 1970s and was designed to be as energy efficient as possible for the time. The building was originally fitted with a solar airconditioning system, this was removed in the mid-80s when it proved to be impractical.

The main structure of the building is cast in situ concrete frame, with a cast in situ concrete wall infill panel. This provides a very high thermal mass[1] to the structure. Small openable windows are present to all but the west elevation. All windows are provided with awnings to reduce direct sunlight entering the building, which reduces heat gains attributed to solar radiation. The roof structure is of powder coated metal profiled sheets.

2.1.1.2 Building Uses

One Department (Citiworks) currently uses the building, the lower floor by the "road crew" management and the upper floor by Administration. The rear portion of the lower floor is used as a Cyclone Disaster Centre, at other times it serves as the canteen area for both floors.

[1] A High thermal mass absorbs heat during the day and expels heat during the cooler night. This prevents heat from passing into the building during the day, thus reducing the load on air conditioning systems.

2.1.1.3 Services

Lighting

Lighting to both floors is very similar so can be grouped together. All office areas are provided with fluorescent type recessed luminaries, these provide ample light for the work areas. The canteen area is also noted to have fluorescent lighting, although the room was not occupied whilst the survey was undertaken all lights had been left on. No problems were noted with the upper floor, however lighting to the ground floor is left on all day even though the occupancy levels drop off considerably throughout the middle part of the day.

Heating and cooling

Air Conditioning is present in this building, and is probably the single largest consumer of electricity on the site. It is provided by means of one main plant serving both the ground and first floors, and a number of stand-alone wall mounted units are also used. Distribution of outlets throughout the building is satisfactory. Controls for timing and thermostatic control also are well arranged to match the overall times when people are inside the building. The maintenance contract has recently changed. This has meant that it was not possible at time of survey to determine exact details of the systems used in these offices. It was also noted that the A/C system was overhauled a short time ago, therefore any major capital cost improvements would not be feasible at this stage. In general the A/C system is well maintained and well controlled, leaving little room for recommendations without considerable further detailed investigation into the plant and operation of the system. The only element worth noting is the fact that the water coolers are directly exposed to sunlight on the west elevation of the building. This increased thermal load increases the temperature difference between ambient and desired conditioned air temperature, therefore increasing the amount of energy used to drop the temperature of the coolant.

Natural ventilation and lighting

Currently natural ventilation is very limited to this building. Even though all the windows are operable to the building, very few are used. The main reason for this is to maintain efficiency of the A/C system, ie, it is very hard to ensure all windows are closed when the A/C system is in use, therefore all windows are kept closed.

With all the widows in these offices, natural light to the perimeter office space is of reasonable quality. However the lighting systems are not wired up in such a way as to exploit this. That is it is not possible to switch the outside rows of lights off during the day without affecting light nearer the center of the rooms.

Insulation

Insulation to the roof void was not checked at time of survey.

2.1.2 Building 2: Fleet Management Office

2.1.2.1 General Description

This building is also recent in construction. Walls are constructed from concrete blocks with a light coloured paint finish. Windows and doors are evident to all but the south elevation. The roof, as with all buildings on this site, is constructed from profiled metal sheeting, with large overhangs to the east and west elevations.

This building was renovated in the recent years and new internal layout introduced.

2.1.2.2 Building Uses

The Fleet Management Department currently uses the building. Again this building serves primarily as an administrative office, with toilet facilities for general workers located at the southern end of the building.

2.1.2.3 Services

Heating and cooling

A single cooling and heating unit currently provides Air Conditioning to this building. Insulated ducts distribute the conditioned air throughout the structure. Major problems have been identified with this system. Primarily the system is running 24 hours a day 7 days a week. This problem is exacerbated by the fact that during the winter months the heater is running during the night, increasing the ambient temperature of the building, this increases the load on the cooling system during the day. Secondly the duct layout within this building was not altered when the new internal layout was introduced. This has led to hot and cold spots throughout the office. With very little investment these problems could be rectified. Further to this an extremely large air extraction unit was evident at the toilet block. Investigation into the recent history of the building suggests that this fan was designed to extract air from the entire building. Therefore the motor rating and air extraction rates would be considerably in

excess of that required of the toilet block. It was not possible at time of survey to establish the exact capacity of the extraction unit.

Lighting

Ceiling mounted fluorescent tubes generally provides lighting within the building, although a minor amount of "task lighting"[2] was identified during the survey. As with the A/C system, the light switching in the offices was not altered when the new internal layout was constructed. Therefore only 2 light switches control the entire building (including the toilet block). This is not only causing excessive energy consumption by not being able to properly control the lighting requirements of the building, but is also causing problems with the utilisation of the building. For example it is impossible to turn the lights off in just the meeting room for presentation purposes unless you also turn off the lights in half the other offices along with it.

Hot and chilled water supplies

Hot water is provided by means of a wall mounted boiler in the kitchen. It was not established when or if this was turned off. No chilled water was evident to this building.

Natural lighting and ventilation

Windows to the building were mostly non-openable. However louvred windows were noted on the west elevation, although it was apparent that these are rarely used. Doors to the building are mostly kept closed. Natural light was used to an extent through the building, this is proving to be a hindrance in the meeting room due to solar heat gains from large windows to the east elevation of the room.

Insulation

It was not possible to established at time of survey what level of insulation was fitted to the roof or other elements of the building.

[2] Task lighting relates to desk or direct workspace lighting, rather than the overall lighting produced by ceiling mounted lights. The used of task lighting can reduce the amount of energy used on illumination by up to 25%.

2.1.3 Building 3: Storage / Offices

2.1.3.1 General Description

Profiled steel clad portal frame building. Approximately 120m x 20m. long axis running north south.

2.1.3.2 Building uses

This structure is used for several departments of the council

1. Learning Center
2. Catering storage
3. Citiworks storage
4. Workshop for repairing traffic meters

For the purposes of this audit they will be grouped into office and storage areas. There are currently plans to change the use of the building into a maintenance facility for Citiworks, therefore recommendations for this building will mostly focus on this proposed new use.

2.1.3.3 Services

Heating and cooling

The main offices (Learning Center) are serviced by an extremely old and inefficient A/C system. In addition to this there are several room A/C units fitted in this space. It was also noted that some of the outlet vents were covered up with office furniture reducing the efficiency further. No insulation was apparent to any of the ductwork to the main A/C system. Control of this A/C system is limited to a basic on/off switch.

For the size of the office this system is supporting, this is a very inefficient cooling system.

There is another A/C system within the building which has been "recommissioned" after several years of non use. Again, this in an inefficient system, that in this case, is rarely used.

The rest of the building area is provided with the occasional room A/C unit. This is an appropriate method of cooling as it targets only the areas that need A/C. All that needs to be watched in the management of these units is to ensure they are off when the rooms are unoccupied and that thermostats are set correctly, when fitted.

Lighting

Offices are provided with Fluorescent luminares, where as the storage areas are provided with a combination of fluorescent and metal halide luminares. Both these systems are energy efficient when used correctly. However, in the case of the storage areas between 20% and 30% of the lighting is left on during the day. It became apparent that the location of the light switches and which switch served which area was a problem area, as people cannot turn the lights off even if they wanted to. It was also noted that all the lighting was left on in the parking meter workshop which was both unoccupied and locked up.

Natural lighting and ventilation

This building was originally designed with high levels of natural ventilation louvred windows large open doorways and ridge ventilation allow for good convection currents throughout the storage area of the building. Office remains sealed and has very little natural ventilation.

Natural lighting was also considered when the building was originally constructed with many of the vents being fitted with glazed louvres, this in conjunction with the large overhangs reducing glare, has provided natural good quality natural light into the building.

Hot and chilled water

Hot water to this building is mostly provided by kettles in the kitchen area, and is not a high requirement within the building.

Insulation

When inspecting the building, insulation was found to be evident in some but not all areas of the portal frame.

2.1.4 Building 4: Storage

2.1.4.1 General Description

This building is of a steel portal-framed metal sheet clad construction. It is typical of many of the remaining structures on the site.

2.1.4.2 Building uses

Originally this building was used by the Council for its wood working operations. However these operations have been transferred to other sites. Current use is limited to general storage.

2.1.4.3 Services

Heating and cooling

No mechanical heating or cooling is evident in this building.

Lighting

Four (4) luminaries per bay, each being fitted with 2 fluorescent tubes, provide lighting. This equates to a total of 104 tubes. It has been noticed on several occasions that these lights have been left on during the day.

No hot or chilled water supply was evident to this building. Although a fire sprinkler system is evident.

Natural heating/cooling and ventilation

As with building No3, this structure is provided with good natural lighting and ventilation via high level glazed louvres. These were observed to be very dirty, limiting the amount of light entering the building. Also a hessian shade cloth had been fitted to the inside face of the louvres. This indicated that there was probably a high solar (heat) gain noted in the past.

Insulation

No Insulation was evident to the building.

3.0 ENERGY USAGE

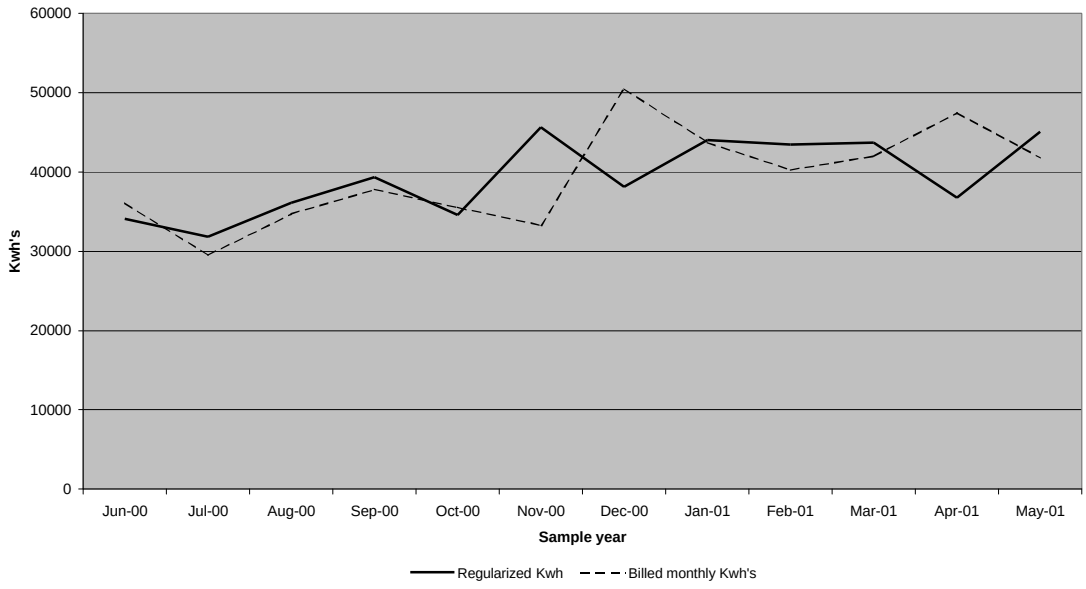
Monthly energy data is presented in **Figure 1** below.

Figure 1: Energy Consumption for Dalrymple Rd Works Depot

Period	tariff 20 kWh	service charge $	total charge $ inc GST	Tonnes CO2-e	Days in bill	Regularized Kwh
Jun-00	36070	8.14	3957.72	38	32	34041
Jul-00	29480	7.51	3523.18	31	28	31796
Aug-00	34690	8.78	4129.63	36	29	36125
Sep-00	37770	7.78	4476.14	39	29	39333
Oct-00	35510	7.78	4213.15	37	31	34594
Nov-00	33250	6.45	3921.07	35	22	45643
Dec-00	50468	11.72	5987.87	52	40	38103
Jan-01	43694	8.78	5158.69	45	30	43985
Feb-01	40248	8.19	4753.85	42	28	43410
Mar-01	41976	8.49	4956.85	44	29	43713
Apr-01	47444	11.41	5636.76	49	39	36739
May-01	41755	5.92	4960.85	43	28	45036
Totals	**472355**	**101**	**55676**	**491**	**365**	**472519**

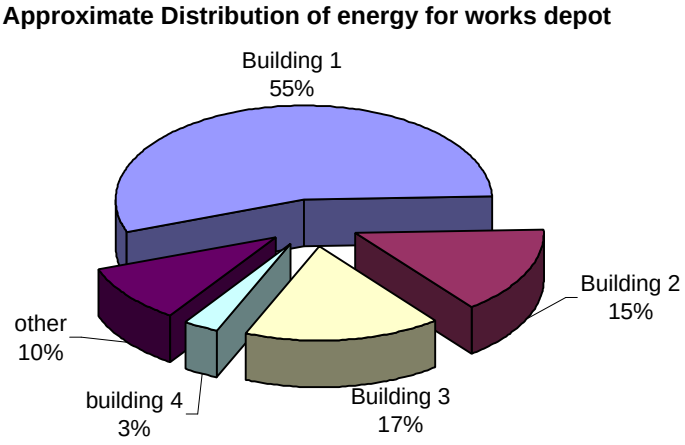
Firstly it should be noted that it was necessary to adjust the monthly figures to better indicate each months energy consumption, as billing duration's varied from 28 to 40 days. This distorts the yearly demand for electricity, thus making conclusions and recommendations more difficult. This distortion is indicated on the below chart for information only.

Figure 2: Energy distribution over year



Again the corrected line gives the indication of energy consumption increasing over the summer months, and increased use of A/C systems. Large drop offs during the December and April periods indicate that the majority of plant/equipment was turned of during this time.

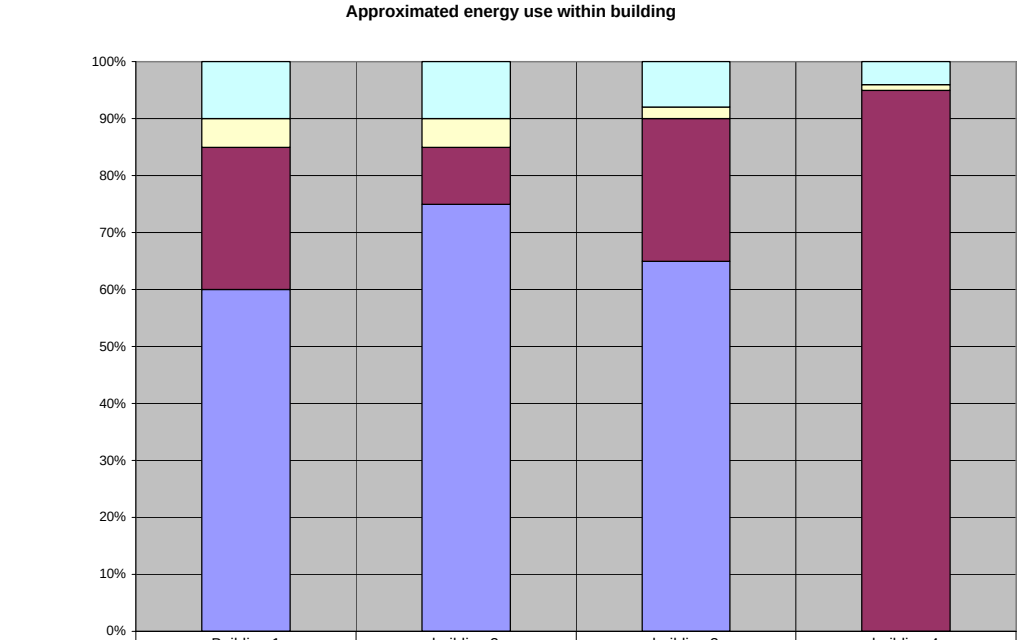
Figure 3: Approximate Energy distribution of Energy within Building



To indicate how recommendations will effect the overall energy bill,s it is necessary to identify how the energy is split between the facilities on the site. **Figure 3** indicates the approximate split in energy consumption for this site. As no direct metering information is available, and monitoring of this nature is beyond the scope of this audit, it is necessary to base these splits on site observations and previous audit work on similar facilities. Further to this, it is necessary to identify where the energy is consumed within each building to determine how long each recommendation would take to pay for itself (this only applies when capital investment is required). For accurate cost analysis to be carried out it would be necessary to firm these percentages up. Again these building demographics are based on site observations, standard data[3] and previous audits of similar buildings. These percentages are indicated in **Figure 4**.

[3] The Royal Australian Institutes Environmental design guide.

Figure 4: Approximate Energy use within each Building



	Building 1	building 2	building 3	building 4
gerneral power	10%	10%	8%	4%
hot/cold water	5%	5%	2%	1%
Lighting	25%	10%	25%	95%
Air conditioning	60%	75%	65%	0%

4.0 ACTION PLAN (ENERGY REDUCTIONS)

4.1 BUILDING 1

4.1.1 Introduction

Firstly, it should be noted that this building was designed to be as energy efficient as possible at the time of construction. Therefore there is now very limited room for major improvements to the system without spending considerable amounts of money on major plant alterations with extended payback times. Therefore, these recommendations are limited to no cost or low cost options only.

4.1.2 Stage One (Zero or very Low Cost)

There are no directly evident low cost savings to be made in this building.

4.1.3 Stage Two (Low to Medium Cost)

4.1.3.1 Strategy 1: Lighting

Current practice

It is noted that the ground floor has a definite occupancy level variation during the day. Initially the office is full whilst work supervisors sort paperwork out for the day, then as the morning progresses most of the supervisors leave for the day to check the field crews. As the afternoon progresses the supervisors return to complete office work for the day and prep are for next days workload.

Recommendation

- A detailed survey of how occupancy levels change through the day to determine the practicality of fitting movement sensors to parts of the office space that prove to be least occupied.
- Fit motion sensors to Canteen area. This room is 90% unoccupied, however lighting remains on throughout the day.
- Reduce the lighting level in non-work areas such as corridors and walkways. This can be done by removing one of the fluorescent tubes in the light fittings directly above these areas.

Capital cost of recommendation

Total cost of this recommendation is hard to establish until the survey is carried out to establish the occupancy levels.

However it can be assumed that the cost per movement detection device (fitted) will be in the region of $300 each. It Is suggested that two would be needed for the canteen area and up to three units for the office area giving a total cost of around $1500.

Savings from this form of modification to the lighting systems have been recorded between 15% and 30%. Therefore it is suggested that a saving of 20% of the total lighting expenditure is possible.

This equates to an annual saving of around $750. Therefore this recommendation would pay for itself in around two years.

4.1.3.2 Strategy 2: Air Conditioning

Current practice

The building is well shaded on three elevations. However, the West Elevation is still exposed to the full sun. The water coolers are also located to this elevation and provided with very little shade. Therefore during the summer months (the time of highest demand) the air con system has to work harder as the ambient temperature surrounding the plant is high.

Recommendation

- Shade Air Conditioning plant by installation of an awning from the wall of the building to the top of the surrounding wall.

Capital Cost for recommendation

For installation of awning:	
One awning 4m x 8m approx.	$2000
Labour to fix in place	$500
Total	**$2500**

By shading the plant, a saving of between 3% and 6% is possible. This would equate to a saving of around $900 per year therefore, payback for this recommendation can be expected in less than three years.

4.1.4 Stage Three (High Cost)

No high cost recommendations were identified at this time.

4.2 BUILDING 2

4.2.1 Introduction

This Building has the greatest potential for savings on the site. Extremely poor control of the air conditioning system and lighting is leading to gross over consumption of electricity. This also translates into hight maintenance costs as plant and lighting are being used at much higher rates. Below are listed the most obvious areas for improvement.

It is recommended that investigation be carried out into the extraction fan located on the exterior wall of the toilet block. It is suggested that this fan is in excess of the extraction rate for the toilet block. It is also unclear if the fan runs 24 hours or is turned off at night. It is recommended that if the investigations identify that the fan is indeed oversized then it may pay to change this to a lower capacity unit, fitted with an appropriate timer. Also, this part of the building has the potential for reasonable natural ventilation and with modifications to improve the natural ventilation levels, the fan may only need to be activated by a movement sensor fitted with a delay switch. A possible saving in energy is envisaged between 50% and 75% for this particular element.

4.2.2 Stage One Improvements (Zero or Low Cost)

No obvious savings could be made to this building without some form of investment.

4.2.3 Stage Two Improvements (Low To Medium Cost)

4.2.3.1 Strategy 1: Provide timer to air conditioning plant.

Recommendation

- By providing control to the A/C plant it should be possible to reduce the running time by up to 70%. This is equivalent to setting the timer from 7am to 5pm and not running at weekends.

Capital Investment

This represents a saving of up to **$6200** per year. Cost of timer fitted should not exceed **$300**. **This represents a payback period of less than three weeks.**

4.2.3.2 Strategy 2: Rewire lighting to office and toilet areas.

Current practice

Currently two light switches control the lights for the entire building. This is already affecting the performance of the building as discussed in Section 2.1.2.3.

Recommendation

Before rewiring takes place it is recommended that some of the ceiling lights to the individual offices be removed and either standard lamps or desk lams be provided. If this proves satisfactory this method of resolution would be considerably less expensive than the rewire. In some areas however this method may not be desirable, such as the meeting room. It should also be noted that this form of lighting will monopolise many more power sockets in the office, which is also undesirable. As mentioned before, the use of this form of "task lighting" is highly energy efficient when used correctly, it is also regarded as providing a more "intimate" working environment, which has the potential to increase work performance.

Capital Cost

An investment of 10 work and standard lamps should be sufficient to allow a fairly fluid use of lighting though the office. Allow a total cost of **$500** for all lamps. A Further cost of around **$350** for rewiring the toilet block so that it is lit independently should also be allowed for. As a guide it should be possible to reduce the lighting energy load by up to 30%. This would represent a saving of **$250** P/A and a payback period of less than four (4) years.

4.2.3.3 Strategy 3: Provide Solar film to Meeting room windows

Current practice

The meeting room faces east, therefore tends to be exposed to the entire mornings sun. The large windows in this room allow large quantities of solar (heat) radiation to enter it, thus making it uncomfortable to use and increasing the load on the air conditioning.

Recommendation

It is proposed that a "solar control film" be provided to these windows. Films are currently available that can reduce the solar gain by up to 50% and still allow the visible light spectrum to pass through.

Capital Cost

These films currently cost around $55 per m^2. This will improve the thermal comfort of this room considerably and greatly reduce the load placed on the A/C unit with relation to this room. A total cost of around $150 should be expected for this recommendation. It is however extremely difficult to attribute a savings figure in terms of energy reduction. However according to trade literature a payback period is usually around the 3 years.

4.2.4 Stage Three Improvements (High Cost)

No high level investment could be identified at this time that would provide any substantial savings, unless a total rewiring of the office to allow correct zoning of lighting is considered in preference to the option of utilisation of "task lighting".

4.3 BUILDING 3

4.3.1 Introduction

This building is earmarked for future renovation and utilisation possibly as a mechanical maintenance and training building. In light of this the recommendations have been given with regard to the possible future uses rather than providing savings to its current usage. Because these are suggestions with regard to the future rehabilitation of the building, the three levels of recommendations have not been applied.

4.3.1.1 Maintain the buildings existing positive characteristics.

This structure already has very good passive solar and ventilation characteristics. These should be utilised to their full affect when considering renovation proposals.

4.3.1.2 Provide New Skylights to workshop areas.

Currently there are no skylights fitted to any of the roof. At the time of the building's construction this was good practice, as large solar heat gains were the undesirable side affect of the materials (GRP) used for skylights at the time. However, materials are now available that reflect up to 60% of the solar heat radiation, whilst maintaining extremely good light transmittance to the areas below. It is therefore recommended that this would be a very cost effective method of providing a high level of natural light to the work areas, without the need for artificial light, except for early morning and late afternoon periods of the day.

4.3.1.3 Provide "Light Tubes" to office areas.

Light tubes are a relatively new concept in Australia. They consist of a standard dome skylight fitted with a highly reflective tube that projects down to the ceiling height of the room below, this provides a high quality natural light to corridors, common areas, receptions etc. Defusers are fitted to the light tube to bring glare to acceptable level. As with the new skylights these "light tubes do not allow the majority of the solar heat to reach the room. Using these fittings in the areas where natural light cannot reach within the building reduces (but not removes) the need for artificial light, thus greatly reducing the long-term energy costs associated with lighting these areas.

4.3.1.4 Appropriate zoning and choice of air conditioning systems.

It is appreciated that with Townsville's climate, during some parts of the year it will be necessary to use A/C to maintain thermal comfort. It is recommended therefore that careful thought go into the design and selection of the A/C system. Firstly the system should be "zoned" in such a way that conditioned air is only emitted where it is needed, and also that monitoring of ambient room temperatures includes humidity and CO^2 levels. These controls ensure that the plant only runs sufficiently to provide the comfort level required, unlike many of the existing systems that run at maximum on a constant basis. A building should be reactive to its occupants, not the other way round.

4.3.1.5 Shading of building.

As you enter the site a tree can be observed that shades the corner of building three nearest building one. This form of shading can provide many advantages.

- Natural cooling created by the "evaporative air conditioning" generated by vegetation.
- Reduced glare.
- Amenity and asthenic value of landscaped areas in the workplace.

4.4 BUILDING 4

Recommendation

There is only one basic recommendation for this building. That is to ensure that the lighting is turned off when not necessary.

Capital Cost

As noted earlier, a saving of at least $1500 is possible by carrying out this measure. However, consideration should also be given to the fact that the reduced usage of the lights should extend the working light of the Florescent tubes by up to 50%. Providing a reasonable cost saving in maintenance alone.

4.5 SUMMARY

Listed below are the recommendations given in this report. This provided a short overview of the nature of the recommendations, the possible cost, saving, payback and saving in $C0^2$ emissions. They are listed in the order of the most straight forward and lowest payback period first, finishing with the more complex recommendations that would require further study outside the scope of this particular audit. It should also be noted that the ease or difficulty in which the recommendations could be implemented has also been taken into account.

Figure 5: Summary of benefits for each strategy

No	Description	Savings $ P/A	Cost $ P/A	Payback	CO2 Reductions Tonnes P/A
1	**Building 4:** Better management of lighting.	1500	0	immediate	**13.5**
2	**Building 2:** Fit controller to air conditioning	6200	300	>3 weeks	**55.8**
3	**Building 2:** Use of Task lighting and rewiring of toilet blocks	250	850	>3.5 years	**2.25**
4	**Building 2:** Fitting of solar control film to meeting room.	?	150	Approx 3 years	**?**
5	**Building 1:** Fitting of light switches to ground floor offices and canteen area	750	1500	2 years	**6.75**
6	**Building 1:** Fitting of awning over air conditioning coolers to west elevation	900	2500	> 3 years	**8.1**
	Totals	**8100**	**6800**	**>1.5 years av.**	**86.4**

5.0 GENERAL NOTES FOR ENERGY EFFICIENCY AND CO2 REDUCTIONS

5.1 MINIMISATION OF EMISSIONS FROM WASTE PRODUCTS

Identify and utilise available recycling facilities and systems for existing waste such as paper, cardboard, plastics, glass, toner cartridges, oils etc.

5.2 GREENHOUSE GAS SINKS

Trees, shrubs and soil have the ability to absorb carbon dioxide, and planted in sufficient quantity have the potential to offset an organisation's emissions. In addition, the strategic planting of trees and shrubs to shield buildings and car parks can reduce the load, and hence the energy requirements, on building and car air-conditioners, as noted in the various action plans for the Council. The current thinking is to plant ten trees per vehicle fleet.

When considering these vegetative areas it is better to use local native species. This will reduce the amount of irrigation required, and also provide an appropriate habitat for native fauna.

5.3 MANAGEMENT SYSTEMS TO MEASURE, MONITOR AND SUPPORT ENERGY REDUCTION INITIATIVES

Key recommendations include:

- Make key staff accountable for energy management;
- Provide monthly reports on energy performance to senior management;
- Develop suitable indicators to assist in the reporting of energy performance data, including a suitable Performance Indicator;
- Install intermediate metering as required capturing energy costs for each business unit.
- Proper maintenance schedules to maximise the performance of existing plant and equipment, such as the annual cleaning of light fittings.

5.4 INDIRECT ACTIONS

Influencing external stakeholders such as suppliers, customers and subcontractors is a simple way of assisting increased awareness of greenhouse issues. Simple to implement actions include:

- Staff awareness programs to educate staff, their families and friends on greenhouse issues;
- Including energy/greenhouse information and issues in the monthly newsletter and the annual reports.
- Reviewing and modifying purchasing policies, where possible, to support environmentally responsible suppliers and to encourage all suppliers and potential suppliers to address greenhouse and environmental issues.
- When considering new projects “embedded energy” should be taken into account in terms of the construction materials and method of construction.

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