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ENVIRONMENTAL ASSESSMENT REPORT: ANGLICAN CHURCH PROPERTY TRUST

PARISH PILOT ENVIRONMENTAL ASSESSMENT (08/026)

FINAL (PUBLIC) REPORT

ISSUES

Issue	Date	Reason for Issue	Comment	Checked	Approved
1	21 July 08	Client request for review	Incomplete draft	NB	GNE
2	9 Sept 08	Further review	Final draft	NB	GNE
3	15 Sept 08	Final	Final report – ACPT	NB	GNE
4	29 Sept 08	Public/generic report	Identifying parish information excised	NB	GNE
5	2 Oct 08	Public/generic report	Amended report	NB	GNE
6	10 Oct 08	Public/generic report	Further excisions	NB	GNE

CONTENTS

1.0 Executive summary

There is now widespread scientific evidence and increasing consensus that accelerated climate change is happening, associated with everyday human activities. A renewed concern has entered the debate about reducing greenhouse gas (GHG) emissions. The federal Government has announced the start of a *Carbon Pollution Reduction Scheme* from mid 2010, which will add economic incentives to reduce carbon pollution. This will affect the cost of all energy-intensive processes, from petrol to electricity, from services to food. This era has been characterized as a time of consequences, requiring some fundamental changes within our everyday world.

For the Anglican Church, energy efficiency and environmental concern flows through to matters of good stewardship, education and organizational example. Hence the policy decision of the Anglican Church Property Trust Diocese of Sydney to respond to a Synod resolution on the matter, auditing representative church properties as a first step in mitigating greenhouse gas emissions associated with climate change.

Section 1 is the executive summary presented here.

Section 2 outlines the project brief, rationale, audit criteria, methodology and terminology. It sets the context for the study as a whole.

Section 3 systematically introduces each of the selected five parishes and the buildings to be audited. These represent five typologies that have broader relevance within the Sydney Anglican Diocese so that the results can be more widely and usefully disseminated:

- Historic church building (large), with church hall and rectory,
- Historic church building (small), with church hall and rectory,
- Post WW2 church (large), with church hall and rectory,
- Post WW2 church (small), with church hall and rectory,
- Modern church (recent years), with church hall and rectory.

These properties have been individually assessed and presented against the criteria established, including comments upon the findings of electrical, gas and water consumption, possible savings in priority order, suggested building improvements with cost implications. They typically show some simple no or low cost improvements, but that much of the building stock has inherent energy in-efficiencies that have consequential operational cost and greenhouse gas implications not so easily remedied without $ cost.

Section 4 brings together the key findings and compares this with benchmark for the rectories (the only one available). For the churches, it finds a direct correlation between building age, size, type of construction and the hours of usage. Basically, the older the church the less energy efficient it is (typically cold throughout winter) and the harder /impossible it is to improve. For the church halls and associated facilities, it finds a wide variation in energy consumption with size, heating source (gas having less overall impact) and construction type being key determinants. It finds that little attention has been paid to solar design or energy efficiency at any time up to the present. For the rectories, the older they are the more below average (benchmarked) they are, from zero to three stars (out of five), suggesting they are all energy in-efficient and often uncomfortable, inspite of high energy inputs. They are all capable of improvement, from no /low cost up to considerable cost.

Section 5 gives conclusions and recommendations, including suggested future steps at parish and Property Trust level, outlines the limited funding assistance available and finalises the range of suggested improvements.

Section 6 provides key references for this report in this constantly expanding field.

Section 7 provides useful web-based links, where an enormous amount of helpful information is available to follow-up on many areas identified within this report.

Section 8 Appendix is the audit pro-forma developed for this study (but not fully used).

2.0 PROJECT OVERVIEW

2.1 Background

In 2007, the Synod of the Anglican Church Diocese of Sydney passed Resolution *17/07 about Climate Change,* which stated:

Synod accepts the emerging scientific consensus that climate change is occurring and supports the need for Christian responses to the potential problems and opportunities that arise from climate change including-

(a) Praying for our world and using every opportunity to speak of the Lordship of Jesus Christ;
(b) Christian ministry to those most vulnerable to the effects of climate change such as farmers, rural communities, the homeless and refugees;
(c) The setting of a godly example of good stewardship in our personal and communal lives;
(d) Education of our children about a biblical understanding creation and our role as its stewards and carers;
(e) The development and implementation of an environmental policy within each Parish and Diocesan organisation which expresses principles of good environmental stewardship and care; and
(f) Encouraging governments at all levels to take climate change seriously and to make wise policy decisions to deal with its effects.

2.2 The Property Trust 'Brief'

Following the passing of this Synod Resolution, the Anglican Church Property Trust Diocese of Sydney determined that it would be desirable to assess the environmental performance and energy effectiveness of parish properties. It was decided that this could be most cost-effectively achieved via a trial audit based on five or six representative parish properties within the Diocese of Sydney. It was anticipated that these properties might typically include a church, hall and rectory, and other buildings such as toilet blocks, garages, etc. For the trial audit, properties were selected to also represent a range of buildings in type, age and construction within the Diocese. The trial was anticipated to provide performance indicators and benchmarks to assess existing building performance, the direction for improvements, plus inform the Property Trust's on-going development of environmental and operational policies and building practices.

A number of firms were approached for quotations to undertake this work, with AJ+C selected as the successful tenderer.

An initial discussion about 'Level 1' or 'Level 2' (of three) energy audits to AS/NZS 3598:2000 was broadened to capture a fuller range of essential sustainability criteria, applicable to these building types. The Australian Standard defines 'Level 2' (for energy alone) as:

'A Level 2 audit identifies the sources of energy to a site, the amount of energy supplied, and what the energy is used for. It also identifies areas where savings may be made, recommends measures to be taken, and provides a statement of costs and potential savings.'

The wider environmental criteria to be captured by this audit comprise:

1. LOCATION, TRANSPORT, MANAGEMENT FACTORS
2. OPERATIONAL ENERGY USE
3. WATER USE
4. THERMAL COMFORT
5. MATERIAL FACTORS
6. WASTE & EMISSIONS
7. GREENHOUSE GAS CONSEQUENCES

The justification and criteria for including these criteria is detailed below. It must be remembered however that this audit is dealing with existing buildings that physically limits many strategies for environmental improvement /enhancement. Consequently, the audit criteria below have been tailored for this situation.

Confidentiality was requested for each Parish buildings/site response, and consequently, with this composite Report. Individual Parish reports are created from the relevant part of Section 3 to also include attachments relevant to the particular issues for that parish.

2.3 Rationale for the audit

A comprehensive audit of relevant environmental factors pertaining to a particular Parish property identifies the potential for energy, water and other costs savings, consistent with developing notions of social responsibility, plus earth (resource) stewardship. It is justified in pragmatic terms plus as a pastoral and scriptural responsibility.

A 'walk-though' audit allows an over-view of consumption /over-consumption over a range of criteria – so that improvements and/or stronger corrective action can be made in timely manner. Collecting, aggregating and analysing this data can then lead to establishing and comparing performance against newly established benchmarks, with a number of potential direct benefits:

- Establishing new shared environmental goals through, say, an annual review,
- Development of an action plan that outlines, tasks, timetable, costs and responsibilities,
- Financial savings through greater efficiencies, without compromising effectiveness,
- Possible tracking of savings, plus greenhouse gas (global warming) consequences,
- Annual reporting of energy, water and greenhouse gas emissions is increasingly seen as a standard 'corporate' responsibility for any organisation,
- Potential for identifying no or low cost building and equipment improvements at Parish level,
- Increased morale where environmental responsibilities are incorporated into ethical and spiritual values,
- 'Future proofing' church assets, commensurate with rapidly changing needs and expectations,
- Appropriate organisational and Parish risk management and due diligence.

Hence this audit has the potential to improve the efficiency and effectiveness of church property assets and lift Parish satisfaction that the Anglican Church Property Trust Diocese of Sydney is responding and/or leading in meetings its wider obligations.

A comprehensive audit is the first step, then a technical report indicating the potential for savings /improvements, followed by an implementation plan, following through the recommended actions plus methods for testing the savings/improvements made. In sustainability terms, 'closing the loop' between potential and performance.

2.4 Audit criteria

The range of criteria developed for this commission is broadly pertinent to assessing the wider range of environmental performances for church building stock. The criteria and project checklist has been developed with cognizance of other 'rating tools' and energy/greenhouse management guidelines. These include BASIX –the NSW State Sustainability Index; (national) Green Star 'Office Design' Technical Manual; 'Every Drop Counts' campaign of Sydney Water; the 'Greenhouse Challenge Plus' of the Australian Government's (then) Australian Greenhouse Office of the Department of the Environment and Heritage; plus the Victorian 'Energy & Greenhouse Management Toolkit'. Specific references are cited where appropriate and fully listed at end of the Report.

2.4.1 LOCATION /TRANSPORT /MANAGEMENT FACTORS

Transport is responsible for nearly 14% of Australia's Greenhouse Gas (GHG) emissions. With rapidly increasing petrol (oil) prices, access to church properties without public transport availability may become an increasingly common problem. Similarly, assessing access for those differently-abled, where specific measures should be provided. Furthermore, we briefly look at noise, daylight and similar factors that impact on effective operation.

Public transport proximity	We examine how easy it is to access the site by walking, bicycle, bus or train.
Car-parking provision	Whilst this remains a common concern for many and has been seen as a limitation on usage/growth, we assess it here more in terms of open land that might be better utilized in future years.
Private vehicle incentives	Are motor vehicles, maintenance and/or petrol subsidized - encouraged?
Disabled access (AS 1530.1), and Adaptable Housing (AS 4299)	Apply initial sieve to AS 1530.1: access/egress, hearing augmentation, toilets, signage.
Landscaping, local ecology	Waterwise gardens? Drip irrigation? Mulch? Hard/soft/permeable paving?
Noise factors	Noise transfer inside/out and vice versa, eg. noise disturbance and source
Daylight factors	Effective natural light saves on energy use, gives preferred (visual) colour rendering, and lifts the spirits.

2.4.2 OPERATIONAL ENERGY USE

As part of 'stationary energy' producing nearly 50% of Australia's energy consumption (and higher figure for Greenhouse gas emissions - GHG), this is the area most easily and directly addressed by users /consumers. We compare results for Rectory's with housing benchmarks for the same postcode area through 'NABERS Home' energy and water assessment, giving some conversion to tonnes /CO_2 emissions – which will likely develop into an over-riding concern in future years.

Supply and metering	Supply single /three phase? Central or individual meters? Important to differentiate when seeking energy reductions. Tariff?
Lighting /lamps	Lamp types – as each type has different capacity, efficiency, colour rendering, ability to dim
Lux (illumination) levels?	Adequate – not excessive – light levels are important for different building usage. We test against AS 1680
Lighting power density	Establish how efficient the lighting layout is compared to benchmarks (watts per lux)
Lighting controls	Manual, automatic, sensors, timers, dimmers?
Natural illumination	Maximised? How could it be simply improved (ie. energy savings)? Glare?
Heating source	Medium, type, rating, likely operational efficiency
Refrigeration	Capacity, rating, seals, likely efficiency
Cooking	Medium, type, rating, likely operational efficiency
Mechanical ventilation	Fan, mechanical, conditioned? Rating? Maintained?
Air-conditioning	Reverse-cycle, refrigerated, packaged, evaporative, central AC? Rating? Maintained? Controls, vents, efficient?
Office & household equipment	May be 15 – 30% of total electricity consumption. Equipment types, ratings, energy-saver options, sleep-mode/switched off, waterboilers?
Hot water system(s)	Electrical , solar, gas? Age, thermostat, energy-star rating, switching, location, insulated? Serviced/maintained? Showers
BASIX energy target	Residential targets, from 25 to 40% better than local (postcode) average required

2.4.3 WATER USE

Water is a much under-valued resource that has been in record short supply. Conserving energy generally will help conserve water usage – as well as a series of other measures.

Supply and metering	Water ratings (WELS)
Fitments and WELS ratings	Shower, taps, WC, basins, sinks, WM, DW, reducers?
Rainwater collection	Rainwater tanks, storage, pumping, connected to..? Size, type.
Wastewater reuse	Greywater system? Blackwater system? Type, connections.
Leakage	Test for obvious leaks, bleed valves?
Stormwater	Used or discharged? Captured, treated?
Outdoor water use	Irrigation, other?

2.4.4 THERMALCOMFORT

A primary purpose of all buildings is thermal comfort for occupants – a matter which has often been overlooked. Hence BASIX Sustainability Index for example, draws other data together and won't permit a 'pass' unless Thermal Comfort is adequately addressed (for housing). Here we make observation, without numerical assessment.

Ventilation adequacy	Natural, assisted, conditioned? Comfortable? To AS 1668.2?
Insulation	Type, location, adequate and to Standard? Seals to windows, doors?
Thermal mass	Material density affects retention of warmth/coolth
Heating /cooling adequacy	Depends upon use as comfort conditions vary with age and activity levels
Shading	Orientation, Avoid excess heat gain in summer and better comfort conditions.
Air leakage (infiltration)	Reduced/controlled ventilation can save up to 20% heating/cooling costs. Recessed lighting, door/window seals, gaps/cracks, draught-proofing, permanent ventilation

2.4.5 MATERIAL FACTORS

The nature and materials of building enclosure markedly affect all the other factors discussed here. Assessing material type gives a 'short-hand' response to concerns and areas for possible improvement.

Building fabric	Types, contribution to energy-efficiency?
Insulation	Type (visible), likely rating and adequacy
Glazing	Types, shaded/screened?
Durable & low maintenance	Material types, embodied energy, longevity, maintenance
Potentially hazardous materials	Visual assessment (only) of potential for lead, asbestos, material off-gassing and PCBs.

2.4.6 WASTE & EMISSIONS

To reduce our earth-impacts we need to assess our wastes and greenhouse gas emissions generally to aim towards better performance. Some of these matters also have a significant effect upon health and safety issues that are of local and wider significance.

Waste volume	Collected weekly? Measured? Stored?
Recyclables	Collection weekly? Separated? Stored?
Mould & indoor air quality	Potential for toxicity IAQ concern?
Light pollution	External light spill (wasted)
Refrigerants – ozone depleting potential (ODP)	Visual assessment of refrigerant labeling (including air-conditioning) for gases with ozone depleting potential that markedly contributes to global warming.

2.4.7 GREENHOUSE GAS EMISSIONS

With commencement of carbon emissions trading due to start within 2010 (the federal Government's *Carbon Pollution Reduction Scheme*), most other environmental issues will be subsumed by this single indicator. Hence where possible, we convert the operational energy and water usage to this single indicator, using current conversion factors - noting that the conversion rates are under national re-assessment and are changing.

Carbon consequences	Conversion of operational energy and water data to Green House Gas (GHG) emissions rate (aggregated) and 'carbon footprint'

2.5 Research methodology

The methodology is of necessity pragmatic, through assessing buildings and data that is most readily available, and in situations that may be considered representative of the wider Church building stock. The methodology is based on requirements for AS/NZS 3598:2000, but again with broadened criteria.

2.5.1 Consultant invitation, offer, selection,
2.5.2 Head office briefing, including priorities, policies, agreement on audit criteria, protocols, contacts, timeline, reporting methodology,
2.5.3 Draft research over-view and audit criteria for comment

2.5.4 Desk-top research on likely benchmark figures to guide performance targets and indicators,
2.5.5 Test and review audit criteria in-house,
2.5.6 Receipt of appropriate drawings, services accounts for 2 (+) years from Parish and usage schedule for individual buildings.
2.5.7 Individual site audits, including introductions, observe /inspect (noting) building location, layout, fabric, plant & equipment, usage patterns, public and disability access and the like,
2.5.8 Analysis and tabulation of the sites/buildings, including operational inputs of energy and water, plus outputs of wastes and emissions.
2.5.9 Data entry tabulation and analysis for each site, including itemized recommendations and action steps,
2.5.10 Comparison of individual and overall benchmark indicators and targets for property types,
2.5.11 Individual property audit Reports (confidential),
2.5.12 Action steps with suggested capital works program per site/building to include suggested works in order of priority: predicted annual energy and water cost savings, predicted cost of implementation (bearing in mind that we are not cost-consultants and cannot warrant accuracy.)
2.5.12 Draft Report for review and finalization, including incorporation of individual site audits, comparisons, benchmarks, leading to recommendations of (site) action steps and overall action plan.
2.5.13 Development of a resource guide including pointers towards further information, research and subsidies and/or rebates.
2.5.14 The extent of follow-up feedback, briefings and action plans for individual Parishes is yet to be determined.

Recommendations shall be listed in priority order using simple payback to cost ratio as follows:

- Those easily implemented at little or no cost;
- Those requiring capital expenditure with a payback period of less than 3 years;
- Those requiring capital expenditure with a payback period of 3 years or more.

2.6 Data limitations

Aggregated services data for whole sites – rather than individual buildings: Collective metering limits the Auditor's ability to provide more detailed itemized responses for individual buildings, necessitating a higher level of assumption regarding individual buildings. We do not feel this significantly affects the accuracy of the results, other than in the distribution of issues or concerns to particular buildings. The substance, directions and conclusions of this Report and individual Parish Reports still stands.

Limitations on available drawings and documents: Some sites required additional consultant input to obtain the required data. In other instances there were gaps in the record of service bills requiring (reasonable) assumptions for missing data, which obviously affects the numerical certainty of the results. In one case the 'summary' data helpfully provided was inconsistent, leading to additional consultant time and enquiry in trying to sheet home a reasonable approximation of actual services use. Again, accuracy and certainty suffered as a result.

Assumptions on fittings and fixtures: Close inspection of each and every (elevated) light fitting or gaining access to every energy-rating panel was not possible – too many have been removed or are hidden behind the fixture. Hence in many cases, reasonable assumptions based on knowledge of comparable fittings have had to be made.

Observed non-measured assessment: The audit and assessment is based upon what has been provided (eg. service bills, drawings), what is readily visible and/or discernable onsite and/or what can be discovered by reasonable enquiries of relevant persons on the day.

Time restrictions: This is not a fully comprehensive audit (ie. Level 3 to AS 3598), but a cost and time effective assessment without physical intervention such as opening up or removal, plant or equipment testing, detailed mathematical or scientific test or analysis.

Indicative cost advice: This is provided to give a general 'order of magnitude' (± 20%) rather than specific reliable costing advice. Hence professional advice and/or trade quotations should be obtained prior to proceeding on the basis of this first cost advice.

Calculating greenhouse emissions: As this is a new and developing science, the methodologies and conversion factors (greenhouse coefficient) are not definitive. For example, no reliable figures are yet available for the energy costs associated with water supply (eg. pumping, or future de-salination). Integral Energy changed its calculation measures in mid 2007 which almost doubled the reported greenhouse gas emissions per unit of electricity consumed (from 0.53 to 1.068 tonnes /kWh). Furthermore, there are large discrepancies between the 'very approximate' figures associated with NABERS 'Energy Explorer' and figures arising purely from energy bills (which in some cases were double). Obviously the GHG from measured energy use are more persuasive than NABERS estimates based on lifestyle estimates (eg. lighting, cooking, laundry usage).

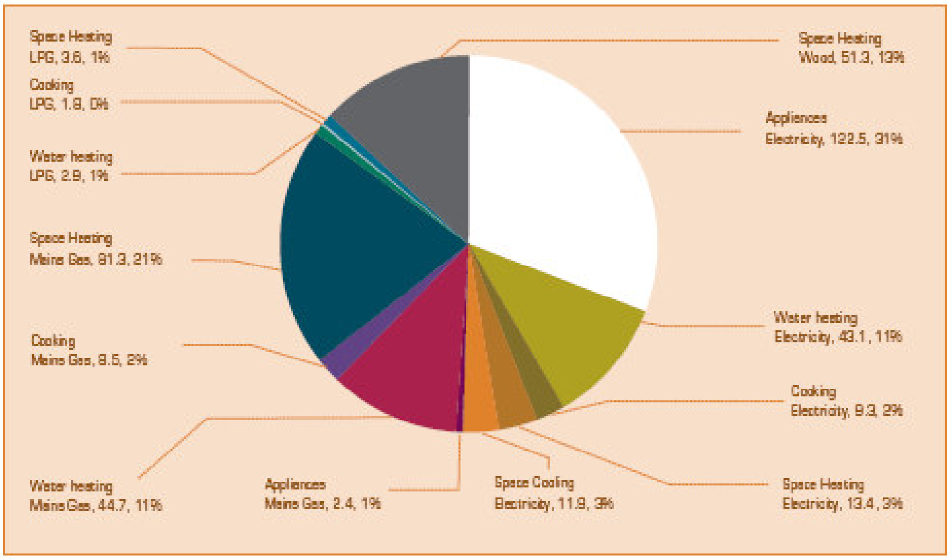
Hence we are not able to fully approximate the 'carbon consequences' ('carbon footprint') that currently arise from use of these Parish facilities. Of relevance is the extent of travel associated with car use and especially flying – both of which can immediately double or treble the annual greenhouse gas emissions per person. It was determined that assessing 'transport' is outside of the concerns of this audit as it is more a personal than parish matter.

2.7 Service bills & greenhouse gas consequences

Improvements to energy, water and environmental performance generally, will only occur where we can demonstrate and quantify problems, improvements and savings. Hence an understanding of energy and water use and the conversion of these units to equivalent emissions is very important. Hence we use data obtained from service bills (electricity, gas, water) to quantify consumption and associated greenhouse gas ('carbon' or its equivalent) emissions.

Electricity:

Electricity charges may be based upon 'peak' and/or 'off-peak' consumption (metered), network charges (eg. minimum standing charge) and/or other charges from different energy retailers. The actual rate per kilowatt hour (kWh) varies according to your selected retailer and the various incentives and discounts provided and accepted. The greenhouse gas emissions associated with (black) coal-fired power stations in NSW are very high and are a major contributor to overall emissions. Hence any savings through energy-efficiency will flow on to savings in GHG. One 'kilowatt hour' means one kW of power (eg. small radiator) being used for one hour.



Note: Energy consumption shown in PJ followed by % share of total

Figure 1: Australian residential energy use 2007
(www.environment.gov.au/settlements/energyefficiency/buildings/publications/energyuse.html)

Green Power:
Green Power is an alternative to coal-generated electricity. It is generated from clean and renewable energy sources such as solar, wind, biomass, wave and hydro power. By agreeing to pay a small additional amount on every electricity bill (typically from 2 – 4¢ per kWh) the greenhouse gas emission impact of electricity is wholly or partially reduced. See current 2008 comparisons at www.greenpower.gov.au/choice-report.aspx and www.greenelectricitywatch.org.au

Natural gas /LPG:
Some parish facilities have access to reticulated natural gas. Natural gas is commonly regarded as a cleaner fuel with respect to greenhouse gas emissions. Natural gas is measured in cubic metres (m^3) but billed in megajoules (MJ). To convert from MJ to kWh a factor of 3.6 is applied. Thus 1 kWh = 3.6 MJ. The conversion is used within this report to compare overall energy consumption between facilities.

Energy consequences of water usage:
Whilst Sydney Water charges (commercially) for potable water based on the number of 'fixtures' (eg. wc's, basins) rather than actual water use, there is little or no incentive for water savings. This is different for domestic (eg. rectory) use which is based on charges for (metered) water usage. Recycled water from central plant is available to some parts of western Sydney, provided and metered at a slight discount rate from potable water. At present, the energy and GHG-consequences of obtaining, purifying, pumping and distributing water across Sydney is not measured. This work is under way, with energy and GHG costs likely to significantly rise when the desalination plant becomes operational.

Calculating greenhouse gas emissions:
Buildings directly contribute to 23% of Australia's total greenhouse gas emissions, with savings of 30 – 40% easily achieved through everyday efficiencies (ASBEC, 2007). Calculating such GHG emissions is a rapidly evolving science following Australia's ratification of the Kyoto Protocol. All signatory countries have to account annually for all emissions from all sources - to demonstrate compliance internationally. Australia is currently well behind in meeting its 2012 Kyoto Protocol commitments, suggesting that more intensive efforts for energy-efficiency and GHG reductions will be required very shortly. Whatever targets (limits) set by governments (following the *Garnaut Climate Change Review*), 'business as usual' will not be an option. And further research is showing that GHG reductions through the building sector (McKinsey & Company, 2008) is the easiest and most cost-effective strategy for governments to follow. The pressure is on for buildings to reduce their energy and environmental impacts.

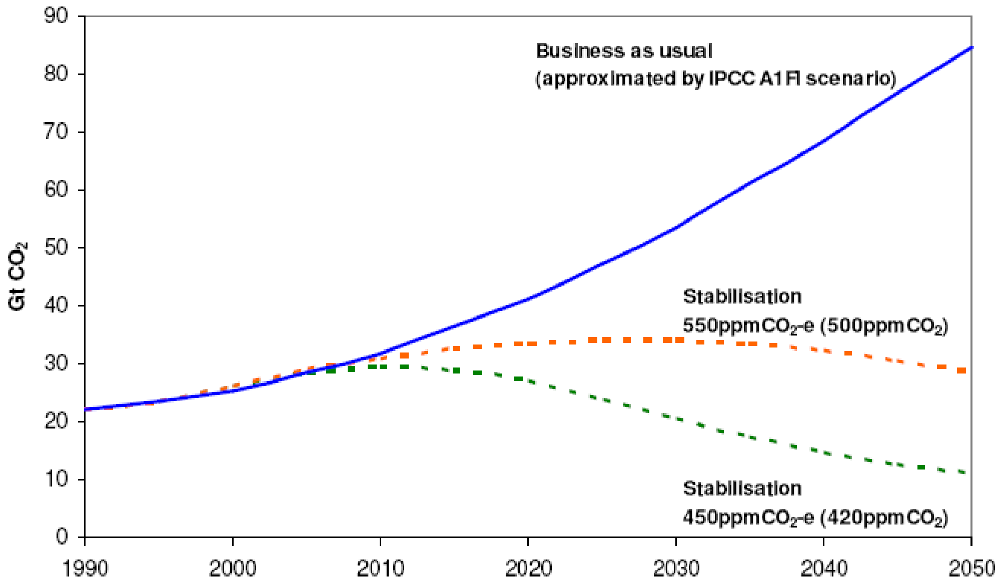


Figure 2: Garnaut review (February 2008) Annual global emissions under a 'business as usual' emissions growth scenario… (Figure 4)

Performance targets:
There are no known benchmarks for assessing energy consumption and/or efficiency for churches or church halls – presumably because there are many variables, distinctive (faith-based) requirements, plus (until now) little financial incentive to do so. Most other building types have been subject to research and analysis - including housing.

The national 'NABERS' program plus NSW's 'BASIX' (see below) are rating tools that seek to measure, assess and improve building performance. We use aspects of both in the following assessments, although neither is a perfect fit for these audit needs. 'NABERS Home' and 'Energy Explorer' has proven to be significantly inaccurate in the following audits (comparing measured energy use with 'lifestyle' modeling based upon broad assumptions). The BASIX measure is a comparative tool normally applied at time a residence is being designed and submitted for Approval. It requires detailed construction input not appropriate (or known) here, but does give a useful point of comparison – comparing performance of 'like with like' – eg. comparing performance of a three bedroom home with others in the same postcode area.

2.8 Terminology

As there are many new words and acronyms relevant to this report within this growing field, we provide a short outline here to assist.

BASIX	The NSW government Building Sustainability Index that is now required for all new and most altered residential buildings, requiring a marked improvement in energy and water consumption plus enhanced thermal comfort before a building can get Development Approval.
Benchmarking	The process of identifying the best performing product, service, function, process or activity… and using this to set or judge performance.
Carbon emissions	CO_2 is a greenhouse gas that is released when fossil fuels are burnt (eg. coal, oil, gas or electricity generated by fossil fuels). Green house gases act like a blanket around the earth, effectively over-heating it in ways that cause irreversible changes to the climate. Heating, cooling, electronic devices and vehicle usage all add carbon dioxide to the atmosphere.
Carbon footprint	The total amount of carbon dioxide and other greenhouse gases emitted over thew life cycle of a product or service.
Carbon neutral	CO_2 can be off-set by contributing to projects that reduce CO_2 in the atmosphere by the same amount that your activities add. This could be by investing in re-afforestation or renewable energy systems for example.
Carbon off-sets	Carbon offsets are a way of compensating for emissions by investing in emission reductions elsewhere, ie. purchasing 'credits' from projects that have prevented or removed an equivalent amount of carbon. However they are a deferring action rather than being a solution to demand reduction.
Carbon Pollution Reduction Scheme (CPRS)	The 'emissions trading' policy announced by the federal government that is to commence in 2010.
Climate change	Now attributed to human activity that alters the composition of global atmosphere that is additional to natural climate variability over time, the consequences of which are of grave concern to all.
Compost	The natural biological breakdown of organic materials into stable useful humus.
Consumption	All the goods and services used, which relates to energy, water and resources consumed. Australian society has continuously increased its consumption since first settlement.
Daylight design	The use of controlled natural illumination through skylights, windows and/or reflected light – so as to reduce or eliminate the need for artificial illumination during daytime. A primary means of reducing electrical loads and consequent environmental (carbon) consequences.
Emissions trading	Putting a market cost on carbon pollution through adding these costs into

	production and consumption. See *CPRS* above.
Energy audit	An analysis of building elements, environmental support systems, fuel and operational factors that utilise energy – with view to identifying opportunities for improvement.
Energy Performance Contract (EPC)	A commercial means of improved energy performance, through measured performance and guaranteed performance improvements with the upgrading costs paid by and energy service company (ESCO).
Environmentally preferable purchasing	The purchase of goods or services that have the least negative effect upon the environment and human health.
Formaldehyde	An effective but toxic compound widely used in glues, particleboard, MDF, carpets, wallpapers and the like that can off-gas at room temperature. Low or no emission products are coming onto the market.
Global warming	The increase in the Earth's temperature, in part due to emissions of greenhouse gases.
Global warming potential (GWP)	A numerical index that shows the relative effect on global warming based on CO_2 as 1 unit. This shows methane as 21 times worse, nitrous oxides 310 times, HFC's 140 – 11,700 times, etc. Hence refrigerant gases commonly used in fridges and air conditioning are of enormous concern.
Greenhouse gas (GHG)	Gases which contribute to the greenhouse effect, with the problem now being the 'enhanced' effect through increased concentrations in the atmosphere including GWP.
Greenpower	The national government's accreditation scheme for electricity generated from renewable resources (ie, solar, wind, wave, wastes).
Green Star	A voluntary building rating scheme of the Green Building Council of Australia that is having increasing impact across government and commercial development.
Kilowatt-hour (kWh)	A measure of electrical energy equivalent to 1,000 watts for one hour.
Kyoto Protocol	A United Nations agreement ratified by Australia in late 2007 that legally binds us to meeting agreed international carbon reduction targets.
Megajoule (MJ)	The unit of energy commonly used for measuring gas consumption.
NABERS (National Australian Built Environment Scheme)	A national 'benchmark' rating scheme that compares building performance on a number of criteria over 12 months of usage.
Off-gassing	The emittance of gas from a material, product or equipment that may have irritating, toxic or carcinogenic effects on human health, particularly volatile organic compounds (VOCs) and formaldehydes.
Operational energy	Energy used in the day to day operation of a building , including heating and cooling, cooking, refrigeration, lighting and appliances.
Peak oil	A term referring to the idea that we have reached the peak of oil production and following this oil will be more difficult and expensive to extract, with many possible consequences.
R-value	A measure of the thermal resistance of a building element or material. Sydney climate now requires a minimum of R1.0 to floors, R1.5 to walls and typically R3.0 + to ceilings/roofs.
Renewable energy	Any source of energy that can be made without depleting its reserves, such as sunlight, wind, wave, biomass and hydro-energy.
Recyclable	Having the potential to be collected, processed and reused.
Sick Building Syndrome (SBS)	Discomfort or illness caused by the indoor environmental quality (IEQ) that may be caused by VOCs, dust, fibres, microbes and the like. A matter of increasing concern and litigation.
Solar power	Energy obtained by converting solar energy to electricity (photo-voltaic – solar panels) or solar hot water systems.
Transport energy	The energy content and costs of moving people and goods. When related back to GHG and carbon consequences, this shows that motor vehicle usage and flying have enormous impacts on each person's ecological /carbon footprint.
Volatile Organic Compounds (VOCs)	Chemicals that contain carbon molecules that evaporate ('off-gas') at normal air temperatures that can cause irritation through to cancers in humans.

	Materials of possible concern include paints, glues, curtains, upholstery, carpets and the like.
Waste	A useful resource in the wrong place and/or at the wrong time.
Water harvesting	Collection and use of rainwater and runoff.
Weather stripping	This strips of foam, rubber or the like around windows and doors to prevent air infiltration and often reduce noise intrusion at the same time.

3.0 AUDIT FIELDWORK

3.1 Introduction

Five parishes where invited by the Property Trust to take part, being representative of church properties more widely. Thus whilst identifying information is contained in this CONFIDENTIAL compilation report, each participating parish will receive its own (confidential) report upon its own property. More publicly, it is anticipated that the generic information will be made fully available to other parishes by generic type, so that all parishes may benefit:

3.2 Historic church building (large), Church hall and Rectory,
3.3 Historic church building (small), Church hall and Rectory,
3.4 Post WW2 church (large), Church hall and Rectory,
3.5 Post WW2 church (small), Church hall and Rectory,
3.6 Modern church, Church hall and Rectory.

3.2 Historic Church building (large), Hall & Rectory

Site audit, 10 July 2008.

3.2.1 Locational factors

Parishioner catchment is local, usually within walking distance, but with maybe 50% driving. There is limited (but adequate) carparking on site. Railway station and bus routes are nearby. The congregation is generally younger than many other parishes, reflecting the demographics of the area.

	CHURCH	CHURCH HALL	RECTORY
Facilities	Large traditional heritage-listed church, surrounded by cemetery.	Freestanding large hall adjacent, modified at rear for offices, toilets and more meeting rooms.	Old two-storey rectory of 6 bedrooms and multiple formal rooms adjacent.
Construction	Sandstone and slate church, copper gutters & downpipes, attached sandstone steeple.	Double brick, raised timber floor with entry steps and porch, concrete roof tiles + metal roof to rear additions	Double brick two-storey architect-designed rectory with distinctive wrap-around verandahs.
Usage	Two Sunday services, Saturday weddings, weekday two evenings /week.	Main hall (160 m^2) and back hall (50 m^2) and storeroom, with church and parish offices and toilets, all over two floors.*	Family home for 5 people.
Daylight - natural	Limited natural light due to leadlight windows, hence effective reliance upon electric lighting.	Good natural light from windows each side (east & west) to Hall, with lesser natural illumination for the newly renovated rooms, requiring lighting.	Generous windows to most rooms but light reduced by verandah, size of rooms and ineffective skylight over the stairs.
Ventilation - natural	Minimal – but large building volume precludes this from	Good cross-ventilation possible – but restricted in use due to	Limited but adequate.

	being an issue.	proximity of neighbour (south-east).	
Insulation (assumed)	Minimal, reflective foil sarking under roof (renewed) slate roofing.	Minimal, reflective foil sarking under roof (renewed) slate roofing.	Nil, or at best, malthoid bitumen paper under concrete roof tiles.
Heat loss	Considerable, with no insulation, high roofs, single glazing but high thermal mass evens out temperature variations.	Considerable, high ceiling with ventilation holes leaking warmth straight out, single glazing with metal frames, timber floors with moderate thermal mass generally.	Considerable, no insulation, heavy construction and 'leaky' old window/door construction.
Thermal comfort	Pleasant in summer, cold in winter.	Pleasant in summer, cool /cold in winter.	More pleasant in summer than winter – cold & uncomfortable.
Disabled access	Front sandstone steps, step-up to pews, lack of disabled toilet and other provisions makes disabled (wheelchair) access currently impossible. No auditory loop for hearing enhancement.	Currently impossible due to porch steps, lack of accessible toilets, etc. No auditory loop for hearing enhancement. Rear meeting rooms, offices and toilets require use of steps.	Entry steps currently preclude access, including to more 'public' visitor areas.
Services /meters separated?	No	No	Yes
Electricity	3 meters	2 phase, single meter	2 meters
Gas	Nil	Nil	Yes, cooking, some heating
Water	Shared meter	Shared meter	Shared meter
WCs, basins	Nil	4 full flush, 2 basins	3 full flush WCs, 3 basins, bath, 2 showers, laundry tub
Rainwater	Wasted to street	Wasted to street	Wasted to street
Hot water system	35 L under-sink electric storage water heater.	Rheem electric storage 50 L to Kitchen , Bosch 4star instantaneous gas to bathrooms.	???
Space heating	Suspended THS 5 x 2.4kW radiators (total 12kW); Heatstrip under pews (?), say 12 kW, total 24,000 watts. Heating power density (very high)around 120 kW /m^2	4 x 4.8 kW (?) electrical fan heaters. Heating power density around 20 kW /m^2	Original open fireplaces extant, some with (flued) gas heaters installed. Mostly reliant on in-effective electric heaters, oil-column heaters or fan blower. Open chimneys extract whatever warm air is available giving enormous heat loss.
Space cool	Nil required	Nil. Domestic fans	Nil. Domestic fans.
Lighting – electrical, internal	Galleries 10 x 50w, Narthex 10 x 50w TH, Choir above 2 x 36 fluoro, Altar 3 x 150w floods, Nave up/downlights 10 x 650w MH(?), others say 700w Total say 8,700 watts Lighting power density around 42w /m^2 (mainly from floodlights).	Office: 2 x 50w TH Ministers office: 6 x 50w TH Corridor: 2 x 50w TH Stairs: 3 x 15w CFL Stores: 4 x 36w fluoro Mini-hall: 4 x 50wTH, 4 x 36w fluoro, 4 x 18w fluoro, 2 x 100w incandescent. Lower hall: 4 x 36w fluoro Main hall: 30 x 36w fluoro Others, say 300w Total say 2,760 watts Lighting power density (low) at around 16w /m^2.	30 Incandescent say 75w ave., 2 compact fluorescent say 30w Total 2,280 watts
Lighting – electrical, external	5 x 300w floods (?) 2 x 100w (?) floods – timer Total say 1700w	Porch, 75w (?)	3 floodlights x 150 w (?) Total 450w.
Appliances - electrical	Urn, Zip boiling water unit (only turned on when	Birko urn, Microwave (Sharp) Stove (Westinghouse),	Kitchen: Gas stove, Dishlex range-hood, large fridge, MW,

	necessary), bar fridge, 2 burner electric hotplates, Sammic dishwasher, coffee maker. Projector, speakers, pa, sound-board	refrigerator 600L (Westinghouse) 2.5 star.	Dishwasher. Living: TV (medium), DVD, Playstation, projector. Household generally: 2 desktops, 3 laptops, 2 printers, Bathroom ceiling extractor fan
Potentially hazardous materials	Lead-based paints, lead flashings, possibility of asbestos as insulation or in older sheet linings (ie. c.1912 to c.1980).	Lead-based paints, lead flashings, asbestos-cement sheeting linings (walls, ceilings) to back rooms.	Lead-based paints, possibly of some old asbestos-cement sheeting.
Wastes	3 x 240 L /week mainly from cemetery; recycling 1 x 240 L /week; greenwaste 9 x 240 L /week (grounds).	1 x 240 L /week; recycling 1 x 240 L /week.	1 x 240 L /week

3.2.2 Church

This heritage significant church is set within wider grounds and heritage cemetery, with the other parish facilities adjacent. The Rectory is an imposing architect designed structure of its day, with the adjacent hall the least distinguished building of the group. The rear of the hall has been recently partially renovated over two levels.

Electricity consumption

DATES	COST	DAYS	ENERGY USE/	AVERAGE/DAY	CO2 (kg)
March 08	$584.45	92 days	3,707 kWh	40 kWh /day	3,772.6 kg
December 07	$732.48	94 days	4,574 kWh	49 kWh /day	4,304.1 kg
September 07	$1,259.42	90 days	7,174 kWh	85 kWh /day	7,284.3 kg
June 07	$797.59	90 days	5,381 kWh	60 kWh /day	5,063.5 kg
March 07	$399.78	93 days	2,822 kWh	30 kWh /day	2,655.5 kg
				47 kWh /day	
June 06	$582.46	88 days	4,416 kWh	50 kWh /day	4,102.5 kg

The most recent years electricity accounts shows the use of 20,836 kWh of electricity at a cost of $3,373.94, producing 16,655 kg (16.6 tonnes) of greenhouse gas – using the changing conversion rates offered by Integral Energy. Due to the nature of this heritage building, only minor improvements can be made. We note however that there has been a gradual and persistent rise in energy consumption, this year compared to previous. Whether this reflects greater usage, installation of the pa/sound system, lights or heaters left on we do not know. Certainly whilst the 'Heatstrip' electrical (under-pew, overhead) heating is relatively expensive to operate (around $1.80 /hour for overhead, plus same again for under-pew heaters), it delivers heat for only a few hours per week and as effectively as possible (where people are) rather than trying to heat a large volume.

Possible improvements

Improvements are highly constrained by the nature of the building's heritage listing – visible changes to building fabric are possibly not acceptable. Nevertheless, improvements to illumination and heating could be examined, along with creating double glazing over existing lead-lights (if not already done) and draft-proofing of doors would all offer some energy, thermal and greenhouse gas reduction benefits. The older style 'discharge' flood lights may be upgraded (without necessarily changing the fitting) to more energy-efficient lamps, that should also be of the same 'colour-temperature' for even visual effect.

Cost implications

Compatible with heritage significance, installation of (stick-on) weather-stripping around doors would cost commercially up to $100 per door (or $15 per door if you do it yourselves). But the overall benefit in terms of air leakage plus energy costs would be very limited, due to the church volume. Up-grading the lighting (lamp efficiency rather than the light fittings) may be possible from specialist supplier (eg. Webs Lighting, 9418 1444), with the opportunity taken to also address /rationalise the external floodlighting at the same time. This could costs from say $500 for the lamps alone, through to many $1,000 if fittings are changed. But this will become known if and when you obtain appropriate technical advice.

Greenhouse gas performance (carbon footprint)

Whilst the historic church is not energy efficient, its high thermal mass means that it is pleasant throughout summer, with parishioners suffering throughout winter. Timing the use of heating (as happens now) is the most effective way of minimizing the buildings 'carbon footprint', along with investigating the possibilities for upgrading lighting efficiency.

3.2.3 Parish Hall

This cavity-brick building with high ceiling and timber floor has been extended at the rear over two (split) levels. This portion has been recently renovated with offices, smaller meeting rooms and toilets (not disabled accessible – an important matter lacking for the property).

Electricity consumption

DATES	COST	DAYS	ENERGY USE/DAYS	AVERAGE/DAY	CO2 (kg)
June 08	$298.95	88 days	2,316 kWh	26 kWh /day	2,151.6 kg
March 08	$194.24	93 days	1,410 kWh	15 kWh /day	1,330.6 kg
June 07	$285.53	183 days	3,604 kWh	20 kWh /day	3,391.4 kg
September 07	$355.37	75 days	2,400 kWh	26 kWh /day	2,258.4 kg
December 07	$341.58	94 days	2,303 kWh	25 kWh /day	2,167.1 kg
March 07	$324.71	92 days	2,198 kWh	24 kWh /day	2,236.9 kg

Energy use for a full year shows the (anticipated) use of 8,429 kWh of electricity at a cost of $1,190 producing 6,874kg (6.9 tonnes) of greenhouse gas. There is not a significant difference between summer and winter or any clear trend in usage. This reflects that the main electrical use is lighting, with minimal heating within the building. The fairly recent installation of recessed tungsten-halogen down-lights to the rear alterations will unfortunately contribute to un-necessarily high energy bills, with considerable energy (heat) losses through the electronic transformers. The main hall has low-level illumination (low power density) and may utilize older-style in-efficient ballast (some of which could be of toxicity concern) as well as poor illumination. As above, we recommend that a lighting specialist be engaged to assess appropriate improvements and applicable costs.

Possible improvements

New technology LED lights are becoming available (www.cree.com) that fit in the socket for Tungsten-Halogen, last 50,000 hours whilst reducing energy consumption for each such light by 80 – 90%. Aside from better light output per lamp and per fitting with new fluorescents, consideration could also be given to improving ambience and light level (to 240 'lux') in the main and secondary halls.

We note reported noise from the Hall. Up-grading the acoustic separation could be achieved by installing a secondary window of suitable appearance (toughened glazing required). This requires a 100+ mm air space between new and old windows (using the wall thickness) and will also enhance energy performance somewhat. This will remove any possibility of easy cross-ventilation air-flow – but possibly you don't open those windows anyway(?)

Some benefit would be obtained from insulating the (limited) roof space above the ceiling as well as effectively closing off the open vents. Insulation of R3.0 + is suggested. Because of the roof/ceiling shape, complete insulation cover is not possible until major re-roofing (but should be done at some stage).

Cost implications

This could be from $0 to tens of thousands $, depending upon advice received on lighting and/or window upgrade. Neither action alone will significantly reduce energy bills or greenhouse gas emissions, but they would improve ambience and usability overall. Only at the time of any major Hall upgrade could major improvements be to made significantly improve the situation, including installing double-glazed roof windows (natural light), full insulation (only possible with re-roofing) etc.

Greenhouse Gas performance (carbon footprint)

Only minor improvements (ie. upgrading lights and lamps) are possible without major and relatively expensive building works.

3.2.4 Rectory

This large two-storey heritage building with southern and western verandah, lines the street. Being of full brick construction with (former) reliance upon open fireplaces to all principle rooms, throughout winter it is a cold and uncomfortable residence, very capable of improvement but at some expense and with heritage difficulties.

Electricity consumption

DATES	COST	DAYS	ENERGY USE	AVERAGE/DAY	COST/DAY	CO2 (kg)
March 08	$308.79	92 days	2,964 kWh	32 kWh /day	$3.57	3,016.5 kg
December 07	$335.70	94 days	3,306 kWh	35 kWh /day	$3.69	3,110.9 kg
September 07	$723.13	91 days*	5,567 kWh	62 kWh /day	$7.95	5,323.2 kg
June 07	$379.91	90 days	3,625 kWh	40 kWh /day	$4.22	3,411.1 kg
March 07	$289.32	93 days	2,920 kWh	31 kWh /day	$3.11	2,747.7 kg
June 06	$568.12	88 days	5,350 kWh	61 kWh /day	$6.46	4,970.1 kg

* Includes off-peak electricity rates from previous electric storage water heater now replaced by gas instantaneous.

Gas consumption

DATES - quarter	COST	DAYS	GAS USAGE	AVERAGE/DAY	COST/DAY	CO2 (kg)+
March 08	$324.71	92 days	2,198 MJ	24 MJ	$3.53	2,236.9 kg
December 07	$341.58	94 days	2,303 MJ	25 MJ	$2.57	2,167.1 kg
September 07	$355.37	75 days	2,400 MJ	26 MJ	$4.74	2,258.4 kg
June 07	$285.53	183 days ?	3,604 MJ	20 MJ	$1.56	3,391.4 kg
June 06	$298.95	88 days	2,316 MJ	26 MJ	$3.40	2,151.6 kg

The above figures show a very high energy use year-round, no doubt because of the size of the building, the lack of orientation for the sun, the lack of insulation and it's draftiness, all leading to occupant discomfort, especially in winter. Electricity use goes up around 40% in winter, whilst the gas account is remarkably similar year-round as it's mainly used for cooking and water heating. Annual electricity consumption was 15,462 kWh, which when added to gas consumption (10,505 MJ) and converted to kWh equals 18,380 per annum.

NABERS Home online assessment on energy use was applied for comparative purposes. As water usage could not be separated from that of the whole property, it was not assessed. This simple assessment showed that the Rectory energy rating at 0.5 stars (out of 5) was highly *energy in-efficient* – a very poor performer compared to all other similar-sized houses in the same postcode. This is largely due to the lack of solar orientation, heavy-weight (brick) construction, lack of insulation, poor (almost non-existent) heating, so typical for the period. Whilst some improvements can be made, serious rectifications would require serious expenditure that would need to be considered in light of heritage listing as well as other Parish priorities.

We suggest that you investigate energy and greenhouse gas emission savings by going to NABERS on-line *Energy Explorer* for interactive self-assessment, www.nabers.com.au/home.aspx

RECTORY: 0.5 star energy performance – a poor performer. (NABERS Home rating calculator)	RECTORY: energy-efficiency improvements (least cost to $$)
About your home: Postcode - People in home 5 Weeks unoccupied 2 Electricity 15,762 kWh pa Natural Gas 10,505 MJ pa Greenhouse gas emissions 16,274 kgCO_2 pa **What the rating means:** The average NABERS Rating is 2.5 stars More stars indicate better environmental performance. A 3 star home is above average, 4 stars is excellent and 5 stars is exceptional.	1. Install water-efficient shower head (AAAAA), 2. Minimise (eliminate?) use of electric clothes dryer, 3. Use cold water only for washing machine, 4. Replace ordinary incandescent light bulbs with compact fluorescent globes (CFLs) or LEDs, 5. Close off un-used chimney flues (even temporarily) to eliminate major heat leakage through winter, 6. Minimise or eliminate 'standby' power by disabling electronic timers etc not used and turning equipment off at powerpoint, 7. Draft-proof the Rectory with seals around outside doors and windows, 8. Install heavier close-fitting curtains or blinds to form still air-space (equivalent to 'decorative double-glazing') 9. Switch electricity supply to accredited GreenPower supplier (www.greenpower.gov.au) 10. Install R 3.0 (or better) insulation across ceiling in roof space, 11. Upgrade skylight over stairs (minimally through polycarbonate double/triple glazed panel at ceiling, more optimally with insulated constructed shaft, and perfectly with double-glazed roof window – which affects the roofing). 12. Consider installing more efficient ('balanced flue') gas space heater to living spaces – to take moisture and gasses outside, 13. When replacing appliances, select more energy-efficient models and gas for cooktop, 14. Improve light levels and energy efficiency more generally through installation of 'Velux' double-glazed roof windows strategically located (and heritage appropriate), 15. Consider double glaze all *southern, eastern* and *western* windows with additional window /acrylic over the existing (creating a still air-gap) – and/or install heavy curtains with pelmet for still-air space. 16. Consider installing rainwater tanks with pump connected to WCs and laundry.

Rectory: cost implications of suggested improvements

This substantial heritage building has unfortunately had energy-inefficiency built into the fabric of the building due to orientation, thermal mass, lack of insulation, extent of glazing facing the 'wrong' direction and the like. Past restraints on user behaviour (minor matters – 1, 2, 3, 6 above) or future selection of appliances and equipment, real improvements have attendant costs as indicated generally below:

4. Install compact fluorescents	$100 - $200	5 Close off disused flues	$400 - $800
7 Draft proof seals (number, type?)	$600 - $2,000	10 Ceiling insulation	$2,000 - $3,000
11 Upgrade skylight – 3 steps	$200, $1,500, $3,000	12 New gas heater(s) (flued) each	$1,600 efficient, $2,400 appearance
13 Energy-efficient appliances	Varies	14 New roof windows	$3,000 each
15 Create double-glazing	Varies	16 Water tank, some re-plumbing	$4,000 - $8,000

NOTE: 'Costs' are approximations only to give a commercial 'order of magnitude'. Note also that work that significantly affects the building fabric may require a heritage impact assessment and/or Authority approvals.

Greenhouse Gas performance (carbon footprint)

The no /low cost options above will make a small but worthwhile GHG improvement. But to substantially tackle the bigger issues will require detailed investigation and costing, but almost certainly will be a minimum of $6,000 - $8,000+. Generally, heating from gas has substantially less greenhouse gas impact than electrical use, whilst effectively being comparable in operating costs. Hence we suggest 'passive' upgrading, followed by minimizing electrical consumption and wherever possible, heater replacement using gas.

3.2.5 Water

All facilities on the site are connected through one water meter, so analyzing the contribution of all the component parts is not possible.

Water consumption – all facilities (fixed charge based on 8 fixture units)

DATES	COST	DAYS	AVERAGE/DAY	CO_2 (kg)
June 08	$175.10	75 days	-	-
March 08	$175.10	82 days	-	-
June 07	175.25	86 days	-	-
June 06	$164.70	88 days	-	-

With water and sewerage rates connected purely to the number of wc's and fixture units, there was no metering of actual water use. Hence we cannot comment upon this matter other than to note the increasing desirability of installing water tanks for garden and domestic use – although care is needed when rainwater run-off may be contaminated (un-suitable for potable use) by old lead flashings and pipes for some of these buildings. Should a decision be taken to install for say garden use, then security (non-operable without special key) taps would be required to ensure passer's by cannot drink this water.

3.2.6 Smart meters

A new generation of time and load-based metering of electrical energy is now available. That is, electrical meters that have a constant visual display of energy use and costs, so as to encourage people not to waste energy. Greenhouse gas emissions are typically also displayed. Cost and energy savings can be up to 10%, therefore paying for themselves often within a year, with on-going savings.

3.3 Historic Church building (small), Hall and Rectory

Audit: 29 July 2008

3.3.1 Locational Factors

This extensive heritage property was originally donated. There has been a number of subdivisions since, with a further one being enacted to pay for needed restoration work. The group consists of an early chapel, then church (architect designed) with surrounding cemetery, the (architect designed) Rectory and late nineteenth century hall which has been much modified since. Parishioner catchment relies largely upon cars, with effectively no public transport available.

	CHURCH	CHURCH HALL	RECTORY
Facilities	Small rural church with Vestry and later porch.	Adjacent old chapel, now much utilized as a hall.	Residence, 4 bedroom.
Construction	Sandstone church with leadlights, timber ceilings with scissor truss, (replacement) asbestos-cement shingle roof, copper gutters and downpipes with attached steeple. Porch	Oldest building on site of full brick construction and corrugated metal roofing. Previous extensive additions were demolished in the early 1990's.	Large two-storey sandstone house with asbestos-cement shingle roof, dormer windows and small verandah. Rear additions.

	was a 1920's addition.		
Usage	Church services weekly, baptisms (say 20 pa), weddings (12 pa), funerals (15 pa), say 120 hours use per annum	Morning teas each Sunday (1 hour), and other groups plus congregational and other meetings. Total usage around 550 hours pa.	Residence for Minister and family including teenagers. Prayer meetings held twice monthly in the Rectory. Study used as church office, although most work is done at the Parish Office nearby.
Daylight - natural	Large leadlight windows giving good natural light.	Good with light on two + sides.	Varies according to orientation, generally reasonable.
Ventilation - natural	Very limited.	Good cross flow if windows opened.	Very average. Drafty building. Bathroom extractor (into ceiling space – contributing to mould problem).
Insulation (assumed)	Nil.	Nil.	Nil. Mould visible on upstairs walls and ceilings from condensation (moisture) on cold surfaces.
Heat loss	Considerable, with no insulation, high roof, single glazing, but high thermal mass evens out temperature variations.	Considerable, through ceiling /roof, large windows, gaps and cracks everywhere, but most especially the open ventilation into the roof-space (for previous gas lighting?).	Considerable, with no insulation, single glazing and unfortunate developing condensation /mould problem.
Thermal comfort	Pleasant in summer, very cold in winter.	Hot in summer, cold in winter	Generally pleasant in summer (except for sunroom and rear additions overheating), very cold and uncomfortable through winter
Disabled access	Currently not possible, several steps or more everywhere. Should be addressed.	Currently possible to upgrade chapel access, but not to kitchen (or toilets?).	Threshold and verandah steps.
Services /meters separated?	Church and chapel	Church and chapel	Separately
Electricity	Single phase	Single phase	Single phase
Gas	Nil	Nil	Nil
Water	Church and chapel	Church and chapel	Separately
WCs, basins	Nil	Not inspected	Dual flush, flow restrictors
Rainwater	Wasted (but asbestos roof and lead flashings not suitable for collecting potable water).	Wasted.	Wasted (but asbestos roof and lead flashings not suitable for collecting potable water).
Hot water system	Nil	Zip boiling water unit (Sundays only)	Vulcan 250 L electric off-peak storage heater.
Space heating	Under-pew electric strip heaters 20 x 2.4m (?) + ? w (auto control 3.5 hours Sundays)	Open fireplace (disused), oil-column (electric) heater, small electric fan heater.	Open fireplaces (highly in-efficient with constant heat loss up flue). 2 oil-column heaters, 1 ceramic, 1 radiator, Daiken air-conditioning (single phase, split-system).
Space cooling	Five pedestal fans	Two pedestal fans	Ceiling fan (upstairs)
Lighting – electrical, internal	10 x 18w CFL, 3 x 11w CFL, 2 x 150w PAR38, 2 x 300w(?) discharge lamps, choirs stalls 2 x 150w discharge lamps = 1,430w. Approximately 96 m^2. Power density 14.7w /m^2. Foyer 3 x 9w CFL.	2 x 75w incandescent, 1 x 18w CFL, Kitchen 1 x 75w. Hall approximately 58 m^2. Power density 2.9 w /m^2 (poor light levels).	Mixture of incandescent, compact fluorescents, tungsten-halogen (Kitchen), bathroom light /heat /extractor unit (2000w?). Total around 3,000w.
Lighting –	Floodlighting Friday + Saturday nights, timer (costing 3 – 4 ¢	1 x 13w CFL	Unknown

electrical, **external**	/hour).		
Appliances - electrical	Amplified sound system, organ,	Bar refrigerator, two pedestal fans, microwave, 2-bar radiator, 2 oil-electric heaters.	Refrigerators 423 L + 335 L, dishwasher, microwave, griller, 7kg top-loader washing machine, 5 kg clothes dryer, plasma + mid and small-size CRT TV, DVD, music amp + speakers, electric blankets (4 ?) 3 desktop computers + laptop, 2 printers, 1 copier.
Potentially hazardous materials	Asbestos-cement roof cladding, lead flashings.	Lead flashings (?)	Mould is hazardous to human health, associated with asthma and respiratory difficulties. It arises from moisture collecting on cold surfaces. Asbestos-cement roof cladding, lead flashings.
Disabled access	Not possible to conform to AS 1428.1, sandstone steps. Removable ramp possible.	Possible, minor threshold issue. No disable access toilet.	Verandah and threshold step.

3.3.2 Church + Chapel adjacent

These two older buildings are metered together. Obviously the buildings originally used oil or spirit lamps, before gas conversion, then electrical conversion and the more recent upgrading.

Electrical consumption

DATES paid	COST	DAYS	ENERGY USE	AVERAGE/DAY	CO2 (kg)
April 08	$264.24	187days	1,243 kWh	6.7 kWh /day	1,327.5 kg*
January 08	$243.85	93 days	1,385 kWh	14.9 kWh /day	1,479.2 kg*
October 07	$276.45	89 days	1,621 kWh	18.2 kWh /day	1,731.2 kg*
July 07	$279.86	95 days	1,774 kWh	18.7 kWh /day	940.2 kg
April 07	$133.39	98 days	686 kWh	7.0 kWh /day	363.6 kg
January 07	$125.46	84 days	670 kWh	8.0 kWh /day	355.1 kg
October 06	$438.46	89 days	2,868 kWh	32.2 kWh /day	1,520.0 kg
July 06	$223.81	96 days	1,420 kWh	14.8 kWh /day	752.6 kg
April 06	$94.06	93 days	441 kWh	4.7 kWh /day	233.7 kg
January 06	$107.93	90 days	554 kWh	6.2 kWh /day	293.6 kg

* *Integral Energy's* assigned greenhouse gas emissions (from 2001) were rated at 0.53 kg of carbon dioxide per kilowatt hour. From October 2007 Integral Energy used the Australian Greenhouse Office's *Factors and Methods Workbook, December 2006* for calculations, which almost doubles the GHG figures to 1.068 kg of carbon dioxide per kilowatt hour. The above figures reflect this change.

Church and chapel electricity energy consumption per annum show little change in *winter* use, but effectively a doubling in *summer* energy use in recent years. The reasons for this is not apparent, but could in part related to church and chapel usage and the (high-intensity) external flood-lighting. Nevertheless, actual consumption is not high and could be reduced with a few simple steps outlined below.

Water consumption

DATES	COST	WATER USAGE	DAYS	AVERAGE/DAY	CO2 (kg)
June 08	$5.35	4,000 Litres	90 days	44 Litres	
March 08	$8.00	6,000 litres	96 days	62 Litres	
December 07	$8.00	7,000 Litres	85 days	82 Litres	
September 07	$3.85	3,000 Litres	90 days	33 Litres	
June 07	$5.05	4,000 Litres	91 days	44 Litres	
March 07	$5.05	4,000 Litres	90 days	44 Litres	
December 06	$5.05	4,000 Litres	93 days	43 Litres	
September 06	$3.65	3,000 Litres	90 days	33 Litres	
June 06	$7.20	6,000 Litres	86 days	70 Litres	

March 06	$3.60	3,000 Litres	97 days	31 Litres	

Again, water usage is very modest with biggest consumption likely to be from full-flushing of toilets (11 – 12 litres). Restricting the water flush through simple cistern conversion is suggested.

Greenhouse gas consequences
Aside from the changed GHG accounting from Integral Energy which almost doubles emissions per kilowatt hour, total contribution is not high (total nearly 5.5 tonnes) and will be improved with the measures suggested below.

Suggested improvements
CHURCH: Because of heritage considerations, little can be done regarding upgrading of insulation (until time of re-roofing). New technology for floodlighting gives equal or better light output with reduced energy consumption. But replacing the existing floodlights is not presently warranted until system failure, because of the low level of usage generally.

CHAPEL: Because of heritage considerations any improvements most be cognizant of not affecting the heritage fabric and/or be reversible. The easiest steps are blocking the chimney flue (non-destructively within the flue and out of sight); installing ceiling insulation (R3.0 +) including over the open ceiling ventilators (spray-paint black the batts where otherwise visible?); installing stick-on door and window weather-stripping; and replacing incandescent light bulbs consistently with compact fluorescents – which typically last 10 times longer and use just 20% of the energy. Only buy better quality CFL with 'warm white' colour quality.

3.3.3 The Rectory

This two-storey heritage building is very problematic in terms of energy conservation and human comfort – yet there are a numbers of steps that can be taken to improve the situation.

Electricity consumption

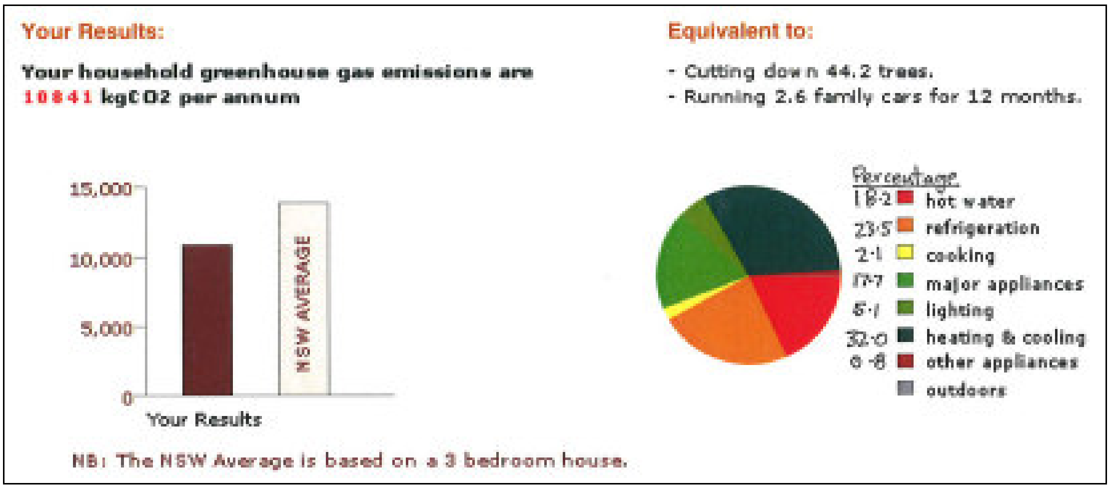
DATES	COST	DAYS	ENERGY USE Domestic	COST /DAY Domestic	ENERGY USE Off peak	COST /DAY Off peak	CO2 (kg) *
April 08	$555.22	94	2,372 kWh	25.2 ¢	1,920 kWh	20.4 ¢	4,583.8 kg*
January 08	$550.32	93	2,536 kWh	27.3 ¢	1,546 kWh	16.9 ¢	4,359.6 kg*
October 07	$812.69	89	4,203 kWh	47.2¢	1,543 kWh	17.3 ¢	6,136.7 kg*
July 07	$804.43	-	-	-	-	-	-
April 07	$420.33	98	2,100 kWh	21.4 ¢	1,188 kWh	12.1 ¢	1,742.6 kg
January 07	$534.45	84	3,266 kWh	38.9 ¢	1,388 kWh	16.5 ¢	2,466.6 kg
October 06	$915.67	89	5,777 kWh	64.9 ¢	2,098 kWh	23.5 ¢	4,173.7 kg
July 06	$772.53	96	5,077 kWh	52.9 ¢	1,850 kWh	19.3 ¢	3,671.3 kg
April 06	$393.41	93	2,542 kWh	27.3¢	878 kWh	9.4 ¢	598.9 kg
January 06	$251.59	90	1,415 kWh	15.7 ¢	875 kWh	9.7 ¢	524.7 kg

* *Integral Energy's* assigned greenhouse gas emissions (from 2001) were rated at 0.53 kg of carbon dioxide per kilowatt hour. From October 2007 Integral Energy used the Australian Greenhouse Office's *Factors and Methods Workbook, December 2006* for calculations, which almost doubles the GHG figures to 1.068 kg of carbon dioxide per kilowatt hour. The above figures reflect this change.

The above figures show the high cost of heating and cooling this building ($2,722.66) per annum. Winter consumption (heating needs) almost doubles from that of summer (air-conditioning), yet with open chimneys plus ceiling mold, the lack of thermal comfort is apparent. The fairly recent renovations have added pleasant light-filled space but have largely ignored the need for energy efficiency

The *NABERS Home* rating assessment scheme plus *Energy Explorer* indicates that the Rectory utilised excessive energy ('0 stars' out of a possible 5), meaning it's also being quite un-comfortable to live in for much of the year. Primarily this is due to the building orientation, heritage fabric and construction – all deficient by current standards. The indicative *Energy Explorer* results shown immediately below are also half of those deduced from the actual energy bills and assessed in *NABERS Home* within the box (over).

This illustrates the problem is 'built-in' within the building fabric, rather than occupant behaviour. Unfortunately the additions of some years ago have not assisted thermal performance



RECTORY: 0 star energy performance – an extremely poor performer, well below the normal range.

About your home:

Postcode	-
People in home	5
Weeks unoccupied	3
Electricity	20,503 kWh pa
Water	284 kL pa
Greenhouse gas emissions	20,195 kgCO_2 pa

What the rating means:
The average NABERS Rating is 2.5 stars

More stars indicate better environmental performance.

A 3 star home is above average, 4 stars is excellent and 5 stars is exceptional.

RECTORY: energy-efficiency improvements (least cost to $$)

1. Take shorter showers,
2. Minimise (eliminate?) use of electric clothes dryer,
3. Use cold water only for washing machine,
4. Use cold water to rinse dishes before dishwasher and use 'economy' cycles,
5. Replace ordinary incandescent light bulbs with compact fluorescent globes (CFLs) or LEDs throughout,
6. Replace halogen downlights with new LED's, or replace the whole fitting,
7. Close off un-used chimney flues (even temporarily) to eliminate major heat leakage through winter,
8. Consider whether you can rationalise refrigerators /freezers – and turn one off,
9. Minimise or eliminate 'standby' power by disabling electronic timers etc not used and turning equipment off at powerpoint or switchable electrical energy-board,
10. Draft-proof the Rectory with (non-destructive, removable) seals around outside doors and windows,
11. Switch electricity supply to accredited GreenPower supplier (www.greenpower.gov.au)
12. Consider installing more efficient ('balanced flue') gas space heater to living spaces (to take moisture and gasses outside) located near glass on external wall (to efficiently circulate heat),
13. When replacing appliances, select more energy-efficient models,
14. Install R 3.5 (or better) insulation across ceiling in roof space (although this is hard /impossible to fully do without rebuilding roof or ceiling linings) which requires further investigation.
15. Consider double glazing all *southern, eastern* and *western* windows with additional window /acrylic ("Magnatite') over the existing (creating a still air-gap) – and/or install heavy curtains with pelmet for still-air space – wherever possible.

Water consumption

DATES	COST	WATER USAGE	DAYS	AVERAGE/DAY	CO_2 (kg)
June 08	$68.25	51,000 Litres	90	566 Litres	
March 08	$73.60	55,000 L	96	573 L	
December 08	$73.60	55,000 L	85	647 L	
September 07	$76.80	59,000 L	90	655 L	
June 07	$87.20	69,000 L	91	758 L	
March 07	$82.15	65,000 L	90	722 L	
December 06	$97.30	77,000 L	93	828 L	
September 06	$96.15	78,000 L	90	867 L	
June 06	$87.60	73,000 L	86	849 L	
March 06	$67.20	56,000 L	97	577 L	

Water conservation is 3 stars which is better than the Sydney average (2.5 stars) and trending downwards. Well done! Presumably this is achieved by not watering gardens or the like, plus being conscious of water use more generally.

Greenhouse gas consequences

At nearly 19 tonnes of greenhouse gas emissions per annum just from the use of electricity alone, this building is highly energy in-efficient and therefore producing an excessive amount of GHG. This pattern is exacerbated if other household travel emissions were added.

Suggested improvements

The Rectory requires building attention over and above the improvements suggested above. The building at present will be exceedingly uncomfortable for a substantial part of the year plus the developing mould issue is a cause of health concern that needs to be remedied (see below).

The mould problems indicate cold and damp internal conditions upstairs throughout winter, reflecting a lack of ventilation and/or warm dry air inside. It arises from the lack of ceiling insulation, bathroom extractor fan blowing warm humid air into the roof space, and maybe small failures in the roof tiling (eg. cracks). We suggest that It needs to be rectified for the benefit of the occupants, but also to protect the building fabric from further deterioration and allied costs.

Cost implications of improvements

Its hard to be precise with building costs for improvements from only a short inspection and assumptions about constructional matters. Closing off flues (neatly within the flue – point 7 above) can be temporary or more permanent and cost from several hundred dollars each, to considerably more if closed off near the top. The flue covering should be insulated at the same time. Draft-proofing can cost from $50 per door (do-it-yourself installation) to several hundred if paid for commercially – especially as care is needed to avoid damage to heritage timberwork. Efficient (balanced-flue) gas space heating system typically cost from $2,500 installed on an external wall. Because of the more rambling nature of the house (old and new), several heaters may need to be installed with consideration of heating upstairs and closing off different sections.

Additional insulation (14 above) (typically costing from $2,000 installed) may need to be undertaken in conjunction with roof repairs and elimination of the moisture /mould problem. Certainly a closer investigation of the cause and remedy to this problem is suggested.

Creating double-glazing is an expensive option that would need to be carefully evaluated for the older part of the house. The additions are easier to deal with. Cost of this work would start at $5,000 and upwards ($400 /m^2 ?) so even heavier close-fitting curtains may be a preferable option.

3.3.4 Church Hall

This older building has been several times renovated, with only the building form plus front porch illustrating its heritage provenance. Ground level has built up alongside its northern (street) façade indicating incipient problems of increasing seriousness.

Facilities	Open hall with raised stage. Adjacent kitchen and toilets (non disabled). Can accommodate 120 seated. Hall and stage approximately 135 m^2.
Construction	Timber frame, weatherboard clad, corrugated metal roof, two porches – all now set too low to the ground such that regular stormwater flow against the timber structure will create rot and encourage termite attack. New posts to porch non-resistant timbers and in ground contact. These matters should be rectified before it's too late.* 1960's alterations and additions including toilets and kitchen, accessed off steps, all of average quality.
Usage	Congregations for large meetings and social events (4 times a year), Dance group four evenings/week for 40 weeks/year; one day exams per year; Sewing group twice/month : junior youth group Friday evenings; Senior Youth Group Sunday's; Sunday School Sunday mornings; art exhibitions etc four times per year; casual use (ie. birthday parties) four times year.
Daylight - natural	Fair, lights mostly required.
Ventilation – natural	Some (limited) cross ventilation
Insulation(assumed)	Nil
Heat loss	Considerable, through ceiling/roof, walls and floor, windows, gaps and cracks.
Thermal comfort	Hot in summer and cold in winter, with temperature variations closely linked with variations in outdoor temperature due to lightweight construction. Ceiling fans will assist in warmer months.
Disabled access	Not accessible at present (threshold step at porch and inside to kitchen) but could be modified. NO disabled access toilet. No auditory loop.
Electricity	Separately metered.
Water	Separately metered.
Toilets	MENS: 1 wc (full flush), 1 urinal, I basin (cold water only); WOMENS: 2 wc (full flush), I basin (cold water only)
Rainwater	Wasted (but old roof not suitable for collecting potable water)
Hot water system	Zip boiling water unit, urn used for bigger events 5 to 6 time par year.
Space heating	Electric fan heaters wall-mounted 6 off ('Autohot Prestige Turbo') x 48 00w (?)
Space cooling	Three ceiling fans.
Lighting – electrical, internal	Old style 'EXIT' signs need faceplate replaced. Fluro 4 x 36w, Fluro 12 x 36w, 3 x 60w incandescent = 756 w. Hall power density approximately 4.3w /m^2.
Lighting – electrical, external	Fluro's 4 x 18w manually switched.
Appliances - electrical	Old refrigerator 250 L, old dishwasher, old upright stove, microwave. Three ceiling fans, manual control.
Potentially hazardous materials	It is likely that asbestos-cement cladding has been used at some time, plus roof-cavity dusts, all requiring care and specialized equipment should anything be disturbed releasing fibres and/or dust.
Wastes	Council collection weekly,

* Driveway water needs to be effectively diverted away from the building, the earth against the building (porch, floors) pulled back to permit air-flow and termite /pest inspection. This may also require repairs and changes including bridging the gap at the entries. Full disabled access should be investigated at this time.

Electrical consumption

DATES	AMOUNT	DAYS	ENERGY USE	COST/DAY	kWh /DAY	CO_2 (kg) *
April 08	$116.51	94	534 kWh	$1.23	2.9 kWh	570.3 kg*
January 08	$102.51	93	434 kWh	$1.10	3.1 kWh	463.5 kg*
October 07	$184.28	88	1,053 kWh	$2.09	12.0 kWh	1,124.6 kg*
July 07	$152.95	95	882 kWh	$1.61	16.2 kWh	476.5 kg
April 07	$93.27	98	398 kWh	$0.95	6.4 kWh	210.9 kg
January 07	$80.57	-	-	-	-	-
October 06	$184.58	89	1,440 kWh	$2.07	9.3 kWh	763.2 kg

July 06	$151.16	96	1,156 kWh	$1.57	11.8 kWh	612.7 kg
April 06	$52.94	93	289 kWh	$0.57	4.7 kWh	153.2 kg
January 06	$49.12	90	261 kWh	$0.55	5.7 kWh	138.3 kg

* *Integral Energy's* assigned greenhouse gas emissions (from 2001) were rated at 0.53 kg of carbon dioxide per kilowatt hour. From October 2007 Integral Energy used the Australian Greenhouse Office's *Factors and Methods Workbook, December 2006* for calculations, which almost doubles the GHG figures to 1.068 kg of carbon dioxide per kilowatt hour. The above figures reflect this change.

Consumption of electrical energy varies considerably according to season (doubling in winter months), time of use (day or evenings) and no doubt, changeable patterns of usage over the year(s). Greatest consumption of energy will be the wall-mounted electric blow-heaters costing maybe 36¢ per hour or more each, costing $2 to $3 per hour depending upon numbers turned on. Internal lighting will be costing around 40¢ /hour. The Zip water heater running cost is around 30¢ /hour, compared to using an urn at 14¢ /hour (whilst for smaller volumes an electric jug costs around 15¢ /hour). Obviously the urn and jug tend to be used only on demand, whilst it's too easy for Zip type heaters to be left on indefinitely ($7.20 per day). Refrigeration (especially older in-efficient models) costs around 80¢ /day or nearly $300 per annum – which is possibly about 2/3 of the annual running costs of the Hall. The cost of running 3 ceiling fans (4 - 5¢ /hour) is negligible.

Water consumption

DATES	AMOUNT	WATER USAGE	DAYS	AVERAGE/DAY	CO2 (kg)
June 08	$68.25	51,000 L	90	560 L	
March 08	$73.60	55,000 L	96	570 L	
December 08	$73.60	55,000 L	85	640 L	
September 07	$76.80	59,000 L	90	650 L	
June 07	$87.20	69,000 L	91	750 L	
March 07	$82.15	65,000 L	90	720 L	
December 06	$97.30	77,000 L	93	820 L	
September 06	$96.15	78,000 L	90	860 L	
June 06	$87.60	73,000 L	86	840 L	
March 06	$67.20	56,000 L	97	570 L	

Whilst water remains a subsidized low-cost resource, economic rationalism suggests little improvement is warranted. However, substituting full-flush (11 litres) with dual flush (6, 3 litres) will halve water usage overall, but at some cost as the whole toilet suite will need replacing (typically $700 - $900). A worthwhile and in-expensive option is the adoption of Sydney Waters' kit to modify standard cisterns to flush only whilst the button is depressed, thereby saving water at negligible cost. We cannot recommend rainwater tanks for water reuse when roofing is old and with painted corrugated iron (contaminants, lead flashings). When re-roofing takes place, this is the time to insulate and capture all available rainwater for at least toilet flushing and garden usage.

Greenhouse gas consequences

Greenhouse gas emissions from electricity use amounts to around 2.63 tonnes per annum. Even allowing for the changed method of calculation from October 2007, it shows a significant increase - at a time in which we should all be reducing.

Suggested Improvements

The most cost-effective means of reducing greenhouse gas emissions whilst improving energy-efficiency and human comfort is installing insulation, followed by weather-stripping around doors and windows (anticipate up to $100 each when done professionally). Ceiling insulation to the Hall (R3.0 or better) would give a noticeable improvement at a cost of around $1,600 - $2,000. The payback period could be reduced to as little as 5 years should electricity prices rise by the predicted 30% within a few years. A smaller and/or more efficient refrigerator would further reduce energy consumption at a cost, whilst usage, cost and GHG consequences of the electric fan heaters could be reduced with installation of the insulation.

Consideration should be given to replacing the old refrigerator with smaller more energy-efficient unit – and/or being more selective in what is stored within from week to week, turning it off whenever possible.

Other measures would make an improvement (ie. wall insulation, underfloor insulation, double glazing) but all at significantly higher construction cost that would be hard to justify at present. We re-state the note above however, that eliminating ground-water problems with associated rot and potential termite problems is urgent and essential for the longevity of the Hall, and this could cost $10,000 or more, depending upon the findings and solutions developed.

3.3.5 Smart meters

A new generation of time and load-based metering of electrical energy is now available. That is, electrical meters that have a constant visual display of energy use and costs, so as to encourage people not to waste energy. Greenhouse gas emissions are typically also displayed. Cost and energy savings can be up to 10%, therefore paying for themselves often within a year, with on-going savings.

Typical 'Smart Meter'

3.3.6 APPENDIX NOTE: Mould and its treatment

Adapted from: www.health.vic.gov.au/environment/emeregency_mgmt/flood_mould.htm

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What is mould?

Moulds are fungi (like mushrooms), which are present at low levels virtually everywhere, indoors and outdoors. People are exposed to mould on a daily basis without harm.

Moulds need organic materials (eg. leaves, wood, paper or dirt) and moisture to grow. Mould is often green, grey, brown or black, and produces a musty smell. The most common indoor moulds are Alternaria, Cladosporium, Penicillium and Aspergillus.

Moulds release countless tiny, lightweight spores, which travel through the air. This occurs when moulds are actively disturbed (during cleanup) or in dry conditions (when the house is being dried out). If mouldy materials and items are not removed or properly cleaned, high levels of airborne mould spores may be a health risk for mould-sensitive family members.

Who may be sensitive to moulds?

Moulds can trigger asthma attacks and aggravate other respiratory and allergic conditions. Symptoms depend on the amount of airborne spores a person is exposed to and how sensitive they are to moulds.

The following people should avoid being present during cleaning or repair works:

- *Children (under 12 years, particularly infants)*
- *Pregnant women*
- *People over 65 years*
- *Those with weakened immune systems; allergies; severe asthma; chronic, obstructive, or allergic lung diseases.*

Possible health effects of mould exposure

- *People can be exposed by eating, breathing in or touching mould spores.*
- *People sensitive to mould may experience stuffy nose, irritated eyes, wheezing, or skin irritation.*
- *People allergic to mould may have difficulty breathing and shortness of breath.*
- *People with weakened immune systems and with chronic lung diseases, such as obstructive lung disease, may develop mould infections in their lungs.*
- *If anyone develops health problems after exposure to mould, seek medical advice.*

Do I need to test for moulds?

No. It is better to assume that the building's interior is contaminated with moulds when:

- *Visible mould growth is extensive.*
- *Visible water damage is present or mildew odours are strong.*
- *The key to preventing mould growth is to clean up and dry out the house.*

Cleaning up mould

If you plan to clean up mouldy areas, wear a shower cap, goggles and a particulate respirator to prevent breathing in mould spores.

If you are asthmatic and intend to do the clean up work, keep your asthma medication with you at all times. If you show any signs of an asthma attack, seek immediate medical treatment.

What about wearing a respirator?

Special respirators (called 'P1' or 'P2') are suitable for filtering out airborne mould spores. They are available at most hardware stores.

Ordinary paper dust masks, handkerchiefs or bandannas are generally not useful in filtering out airborne mould spores.

Before deciding to wear a particulate respirator consider the following:

- *They can be hot and uncomfortable to wear.*
- *If the seal around the face and mouth is poor (eg. people with beards cannot get a good seal), the respirator is much less effective.*
- *The respirator does not filter out gases such as carbon monoxide.*
- *They can make it harder for you to breath normally, so anyone with a pre-existing heart or lung condition should seek medical advice before using them.*

Steps to minimise mould

Mould removal efforts should focus on:

1. *Removing all sources of excessive moisture from the home.*

2. *Removing all porous (ie. soft or absorbent) materials with mould growth.*
3. *Cleaning and disinfecting all affected surfaces inside the house, including floors, walls, the kitchen, bathroom and laundry.*
4. *Allowing the house to dry throughout by airing or active drying (eg. fans or dehumidifiers).*

Removing mould

Step 1 - clean

In many cases household cleaning products can do the job if used correctly. Check the product's label to see how much to use, which surfaces they can be used on, as well as cautionary advice about mixing with other chemicals.

Tackle one room at a time. A two-bucket approach is most efficient: use one bucket for rinse water and the other for the cleaner. Rinse out your sponge, mop, or cleaning cloth in the rinse bucket. Wring it as dry as possible and keep it rolled up tight as you put it in the cleaner bucket. Using two buckets keeps most of the dirty rinse water out of your cleaning solution. Replace the rinse water frequently.

Apply cleaner and give it time to work before you mop or sponge it up. After cleaning a room or item, go over it again with a disinfectant to kill the germs and remove the smell.

If the cleaner you are using does not remove the mould, try a solution of:

- *1.5 cups of household chlorine bleach in 10 Litres of water (the volume of a household bucket).*

Never mix bleach with ammonia, or any other cleaning product or detergent.

Do not use a bleach-based solution on aluminium, stainless steel surfaces or linoleum. Use a household detergent.

Step 2 Disinfect

Disinfect surfaces with a disinfectant product. Alternatively, use:

- *0.5 cups of household chlorine bleach in 10 Litres of water (the volume of a household bucket).*

Drying out the house

Open doors and windows to let the house air for as long as possible.

3.4 Church building (large), Hall & Rectory (1945 – 1980)

Site audit: 24th July 2008.

3.4.1 Locational Factors

The parishioner catchment is generally within 2 - 5 km, and hence are car reliant. Some informal car-pooling and/or collection occurs. There is adequate but limited carparking on site. There is little garden planting of note other than a magnificent eucalypt to the street frontage, grass and a few shrubs. Disabled access is very limited (front steps, ramp too steep, no disabled toilets) and hence is very capable of improvement.

	CHURCH	CHURCH HALL	RECTORY	COTTAGE
Facilities	Modern brick and tile Church attached to heritage sand-stone church (not audited) , with offices, conference room and hall subsequently attached.	Attached to church with low-roofed foyer in between including toilets, kitchen, stores, small hall and conference room.	Adjacent rectory with glazed family/dining room additions to rear (west). Three bedrooms & bathroom upstairs (in-roof).	Adjacent residence integrated into Hall for Associate and family. Three bedrooms & bathroom upstairs.
Construction	Double brick rendered internally, suspended timber floor, high roof with good natural light, tiled roof, all on sloping site. Imposing steps at street frontage.	Double brick, raised timber /concrete floor, clerestory windows (fixed), roof tiles, minimal insulation. Flimsy carport is structurally under-sized and of concern.	Double brick, concrete slab + timber floors, timber windows (single glazed) and green roof tiles all with minimal insulation.	Double brick, tiled concrete slab + timber first floor, timber windows (single glazed) and metal roofing, all with minimal insulation.
Usage	Regularly 8.5 hours /week.	Hall regularly 29 hours /week, plus other uses.	Family, 4 adults	Family, 2 adults + 3 children
Daylight - natural	Good natural light from side windows and end highlights (east, west) with vertical venetians used for light and glare control.	More limited natural light from glazed clerestories. Single-glazing (and plastic skylight to toilets) winter heat loss.	Adequate generally, with excessive light and heat gain from rear (western) additions.	Adequate generally, but plastic dome skylight (heat loss issue) to hall.
Ventilation - natural	Adequate.	Limited.	Limited.	Limited.
Insulation	Unknown, but minimal Reflective foil sarking under tiles only?	Unknown, but minimal. Reflective foil sarking only?	Unknown, but minimal. Reflective foil sarking only?	Unknown, but minimal. Reflective foil sarking only?
Heat loss	Considerable with high ceilings, high dormer windows, timber floors.	Considerable, extensive high single-glazing to all orientations, heavy-weight construction, no /poor insulation	Considerable, single-glazing to all orientations, heavy construction, no /poor insulation	Considerable, single-glazing to all orientations, heavy-weight construction, poor insulation.
Thermal comfort	Moderate in summer, cool /cold in winter.	Moderate in summer, cool /cold in winter.	Hot in summer, cold in winter.	Moderate in summer, cool /cold in winter.
Disabled access	Inadequate. Many steps to front door, side ramp too steep, etc. No accessible toilets.	Good level access to public areas but shortcomings on door clearances, handles etc. No accessible toilets.	Not possible – threshold entry steps	Hardly possible, cramped study and access.
Services /meters separated?	With Hall	With church	Yes	Yes
Electricity	Single phase	Single phase	Single phase	Single phase
Gas	Wall-mounted gas radiators	Gas space heating, gas BBQ.	Space heating	Hot water (gas storage), cook-top.
Water	One meter	One meter	One meter	One meter
WCs	Adjacent	3 full flush, 3 person urinal.		2 full flush
Rainwater	Wasted to street	Wasted to street	Wasted to ground	Wasted to street
Hot water system	Nil	Rheem electric storage 50 L (2006) 3.6 kW	Gas storage 200 L.	Vulcan gas storage, 185 L (older)
Space heating	Six flue-less gas radiators, wall-	Eight un-flued school-type, large - capacity	Single-phase air-conditioning.	Electric blow heater (1.2 /2.4kW), unflued

	mounted, separate controls; Flueless gas radiators (floor mounted) to crèche (?), Vestry	gas space heaters. Conference: un-flued gas heater,	Several un-flued gas heaters, electric blow heater, bathroom IXL 1100w heater/light/extractor.	gas space heater 25 MJ.
Space cooling	domestic fan over Chancel, three domestic floor-mounted.	Conference: two ceiling mounted 900mm fans (not reversible)	Domestic room fans	Domestic room fans
Lighting – electrical, internal	Chancel 2 x 150w floods, 2 x 100w suspended, 8 x 36w, 2 x 6 x 9w CFL teardrop; Nave: 20 x 36w fluorescents, Foyer: 4 x 75w, 2 x 9w Choir: 1 x 9w, 4 x 36w. **Total** approximately 2,100 watts.	32 x 36w fluoro's hall, 7 x 36w stage, 350w flood, **Second Hall** 20 x 36w fuoro, 4 x 18w CFL, 100w. **Foyer** 10 x 50w recessed TH DL, 3 x 7w, **Store** 6 x 36w, 3 x 36w **Kitchen** 4 x 36w, 1 x 18w, Paper storage 15w. **Total** about 3,600 watts	Living: 2 x 20w sconces, 3 x 30w TH (recessed), 7 x 20w, 1 x 15w, Office 2 x 36w, Bathroom 20W TH + 1,100 w, 3 x 25w wall, Hall 2 x 11w CFL, Bedrooms 6 x 30w TH recessed, 3 x 40w bedside, 3 x 30w TH downlights. **Total** around 2,000 watts	Study 9w + 11w CFL, Bath 7w, c'p'd 7w, Family 32w fluro Kitchen 4 x 100w spots, Laundry 60w, Dining 2 x 7w, Lounge 2 x 7w Bedrooms 5 x 11w, Bath 775 exhaust-light, WC 7w. 2 x 20 TH recessed. **Total** about 1,420 watts
Lighting – electrical, external	2 x 150w (PAR 38) 2 x 300w (?) floods – timer. Total 900w.	75w incandescent +	Not checked.	Not checked.
Appliances - electrical	Sound system ,PC, CRT monitor, mixer, amplifier. Electric keyboard, projector.	Two Linda urns, Zip Econoboil 2000 unit, MW, old commercial oven + 4 hotplates, Fridge 300 L (Kelvinator)empty, Ricoh Copier (all church documents, (half double sided?)	Dishwasher, fridge side by side 300 + 300L, Kitchen appliances. Gas stove top and oven. Desktop computers (2), laser printer, mid-sized CRT TV.	**Bath** ceiling extractor (no shutters), **Kitchen** fridge (520L), MW, DW, wall oven, domestic appliances, **Laundry**: 7kg front-loader), 4kg Dryer, **Computers:** 2 desktops, 2 laser printers.
Potentially hazardous materials	Non observed, but original paints of this vintage still had high lead content. Probably lead roof flashings.	Non observed, but original paints of this vintage still had high lead content. Un-flued gas heaters considered a health hazard within restricted space	Non observed, but original paints of this vintage still had high lead content, probably lead roof flashings. Un-flued gas heaters considered a health hazard within restricted space.	Non observed. Un-flued gas heaters considered a health hazard. Existing carport structure under-sized and potentially dangerous.
Wastes	Not known	Bins 3 x 240L	Not known	Weekly Council collection, 240L + recycling 120L bins

3.4.2 Church + Hall

One electricity meter covers the large church, large and small halls, foyer, offices, kitchen and toilets, etc. Hence allocating consumption to constituent parts is near impossible.

Electrical consumption

DATES	AMOUNT	DAYS	ENERGY USE	AVERAGE/DAY	CO2 (kg)
Ist quarter 2008*	$772	90 days	4,192 kWh	47 kWh /day	4,266.2 kg
4th quarter 2007*	$702	93 days	4,624 kWh	50 kWh /day	4,351.2 kg
August 2007*	$849	83 days	1,623 kWh	17 kWh /day	1,572.2 kg
July 2007	$734.45	90 days	4,736 kWh	53 kWh /day	4,456.6 kg
May 2007	$637.05	91 days	4,239 kWh	47 kWh /day	3,988.9 kg

January 2007	$563.80	91 days	4,271 kWh	47 kWh /day	3,967.8 kg
October 2006	$697.27	92 days	4,554 kWh	50 kWh /day	4,230.7 kg
July 2006	$503.04	89 days	3,668 kWh	41 kWh /day	3,407.6 kg
May 2006	$485.60	92 days	3,590 kWh	39 kWh /day	3,335.1 kg
January 2006	$525.10	91 days	3,847 kWh	42 kWh /day	3,462.3 kg

* Not sighted – but figures provided.

Gas consumption

DATES - quarter	COST	DAYS	GAS USAGE	AVERAGE/DAY	COST/DAY	CO2 (kg)+
1st quarter 2008*	$106	96 days	1,536 MJ	16 MJ	23 ¢	99 kg
4th quarter 2007*	$104	90 days	1,442 MJ	16 MJ	23 ¢	193 kg
August 2007	$699.21	91 days	42,976 MJ	472 MJ	$6.54	2,759 kg
May 2007	$104.84	92 days	1,051 MJ	12 MJ	17 ¢	67 kg
February 2007	$119.23	92 days	1,999 MJ	21 MJ	31 ¢	128 kg
November 2006	$653.57	92 days	37,021 MJ	402 MJ	$5.59	2,377 kg
August 2006	$909.38	91 days	54,938 MJ	604 MJ	$8.22	3,527 kg
May 2006	$125.25	90 days	2,534 MJ	28 MJ	39 ¢	162 kg
February 2006	$126.99		2,365 MJ	26 MJ	37 ¢	152 kg

* Not sighted – but figures provided. + Conversion factor 64.2 kg /CO_2/MJ

Energy consumption

These extensive buildings use considerable energy including much gas for winter space heating. At some point the church and hall were separately metered, but since early 2007 they appear to be linked to one service meter. Hence we present here the joint figures, whilst the later summary and comment uses the separated figures. For reasons unknown the most recent year's electricity billing period is slightly less than a calendar year. We have added 10% as an approximate allowance for this where we have summarised.

Electrical consumption is very even at something between 4,000 and 5,000 kWh each quarter, producing a total of around 15.9 tonnes of greenhouse gas emissions per annum. However energy consumption increases enormously with the winter season where gas is used for space heating. Actual gas consumption of 47,005 MJ in the last year is equal to 13,057 kWh which produces just 838 kg of greenhouse gas emissions. This clearly illustrates the greenhouse gas emission benefits of reticulated gas as an energy source, rather than the GHG intensive electrical generation based upon burning coal.

Being typical 1970's construction, this building has fairly high thermal mass (brick and concrete) with too little insulation and in-efficient single glazing to many orientations (where *north* is preferable). Furthermore, the replacement fluorescent lighting has left holes across the ceiling where heat flows immediately out into the ceiling/roof void. Whilst it has good natural light levels due to the clerestory windows, these also leaks warm air in winter. Heating from over-head radiators is crudely effective for the church and probably less so for the Hall – but users are possibly more active here. Having cold feet and warm head (overhead radiators) when sitting, is a most uncomfortable combination. Ideally heating could/should come from the floor (not easily done here) or from under the pews.

Of note is the security concerns that lead to window blinds being drawn most of the time thereby precluding natural winter warmth, plus windows not being opened in summer for natural ventilation. The consequence in both cases is higher electricity bills and greater greenhouse gas impact.

Upgraded toilets and enhanced disabled access are also suggested.

Energy-efficiency improvements (least to more expensive options)

1 Ensure double-sided photocopying and equipment turned off at powerpoint whenever possible,
2 Open windows in summer for cross-ventilation (especially the higher windows) installing winding mechanisms (pull cord or mechanical) if necessary,
3 Replace all incandescent bulbs (downlights) with more energy-efficient (compact fluorescents, LEDs),
4 Rationalise and down-rate all external lighting to more energy-efficient (compact fluorescents, LEDs),
5 Rationalise internal electric lighting generally, and over the chancel in particular,
6 Install small fridge for 'everyday' use, leaving the existing large one for occasional use only when required,

7 Fill all holes in the ceilings from previous light fittings to eliminate heat loss,
8 Install insulation (R 3.0 or better) across suspended ceiling,
9 Depending upon frequency of use of Vestry and Office, consider installing fixed high windows in the wall to 'borrow' light and warmth from the Church high windows (double-glaze if sound reduction is a concern),
10 Consider upgrading horizontal clerestory windows to Church and Hall with winding mechanism (pullcord or mechanical) Note that making windows double-glazed is desirable too – but not as essential as elsewhere,
11 Consider upgrading highlight windows above Chancel and Kitchen/Group Rooms with double-glazing (additional windows or 'Magnetite') whilst installing a panel of tight-fitting operable louver windows (for enhanced natural airflow in summer),
12 Consider replacing existing ground-level windows (of security concern) with new glass block panels (retains light, more secure, energy-efficient, recycled glass), possibly integrated with operable metal louvres,

Other improvements (least to more expensive options)
13 Update 'exit' signs to new Australian Standard requirement (now the international standard applies showing a running figure + arrow),
14 Implement enhanced disable access provisions such as entry doors to Hall, handle heights, wheelchair turning circles (1.5 m diameters) etc,
15 Consider installing rainwater tanks connected to WCs and/or garden use,
16 Consider how to obtain disabled access toilet /bathroom to AS 1530.1 or better (avoid possible issues with the *Disability Discrimination Act 1994*),

3.4.3 The Rectory

Being a free-standing two-storey building with its own street address, this building is separately metered. It is of full cavity brick construction with most windows either east or west which is a poor solar aspect (north is ideal). The summer over-heating or winter cold problems have been exacerbated with the rear glazed additions that offer plenty of (afternoon) light but enormous thermal problems. Evidence of this is seen from the canvas awning erected over the glass roof to try and shade it.

Electrical consumption

DATE	COST	DAYS	ENERGY USE	AVERAGE/DAY	CO2 (kg)
July 2007	$288.57	90 days	2,121 kWh	22kWh /day	1,902.7 kg
May 2007	$247.35	91 days	1,785 kWh	20 kWh /day	1,679.7 kg
January 2007	$298.32	91 days	2,099 kWh	23 kWh /day	1,950.0 kg
October 2006	$321.09	92 days	2,237 kWh	24 kWh /day	2,078.2 kg
July 2006	$387.32	89 days	2,835 kWh	32 kWh /day	2,633.7 kg
May 2006	$272.66	92 days	2,020 kWh	22 kWh /day	1,876.6 kg
January 2006	$255.34	93 days	1,858 kWh	20 KWh /day	1,672.2 kg

Gas consumption

DATES	COST	DAYS	GAS USAGE	AVERAGE/DAY	COST/DAY	CO2 (kg)
August 2007	$310.12	91 days	17,354 MJ	191 MJ	$2.61	1,114 kg
May 2007	$157.27	90 days	7,360 MJ	8 MJ	$1.08	472 kg
February 2007	$163.17	92 days	7,755 MJ	84 MJ	$1.12	498 kg
November 2006	$369.10	92 days	21,551 MJ	234 MJ	$3.15	1,384 kg
August 2006	$425.69	91 days	26,287 MJ	289 MJ	$3.74	1,688 kg
May 2006	$204.16	90 days	11,006 MJ	122 MJ	$1.54	646 kg
February 2006	$198.72	90 days	10,622 MJ	118 MJ	$1.48	614 kg

Energy consumption consists of gas and electricity. Electricity is consistent year round at something over 2,000 kWh per quarter (total 8,242 kWh per annum) creating approximately 7.6 tonnes of greenhouse gas emissions and costing $1,155.33 per annum. With gas heating required through-out winter, consumption trebles to an annual amount of 54,020 MJ costing $900. These accounts are higher than they should be for a compact apartment.

'NABERS Home' online assessment on energy use was applied for comparative purposes. As water usage could not be separated form that of the whole property it was not assessed. This simple assessment showed that the Rectory energy use at one and a half stars was *worse* than the average for that postcode area (2.5 stars), but could readily be improved.

We suggest that you investigate energy and greenhouse gas emissions savings by going to NABERS on-line *Energy Explorer* for interactive self-assessment, www.nabers.com.au/home.aspx

RECTORY: 1.5 star energy performance – below average performer.	RECTORY: energy-efficiency improvements (least cost to $$)
About your home: Postcode - People in home 4 Weeks unoccupied 3 Electricity 8,242 kWh pa Natural Gas 54,020 MJ pa Greenhouse gas emissions 11,969 $kgCO_2$ pa **What the rating means:** The average NABERS Rating is 2.5 stars More stars indicate better environmental performance. A 3 star home is above average, 4 stars is excellent and 5 stars is exceptional.	1 Install water-efficient shower head (AAAAA), plus take shorter showers, 2 Minimise (eliminate?) use of electric clothes dryer, 3 Use cold water only for washing machine, 4 Open doors /windows in summer for cross-ventilation, close doors between heated parts of the home in winter, 5 Minimise or eliminate 'standby' power by disabling electronic timers etc not used and turning equipment off at powerpoint, 6 Minimise use of the air-conditioner and/or turn settings up a degree or two, 7 Draft-proof the rectory with seals around outside doors, 8 Switch electricity supply to accredited GreenPower supplier (www.greenpower.gov.au) 9 Replace halogen downlights with more efficient lamps (eg. compact fluorescents, LEDs), 10 Install R 3.0 (or better) insulation across ceiling in roof space to fullest extent possible, 11 Consider installing more efficient ('balanced flue') gas space heater to living space – to take moisture and gasses outside, 12 When replacing appliances, select more energy-efficient models and gas for cooktop, 13 Consider installing rainwater tanks for connection to WC, laundry, 15 Consider retro-fitting the Family Room glazing by adding another glass /acrylic ('Magnatite') layer to create double glazing for western window-wall (creating a still air-gap).

Cost implications of improvements

Points 1 to 7 above are matters which occupants can control at no cost. Certainly energy consumption has come down in the most recent year compared to the previous, presumably due to such factors. Draft-proofing the home commercially may cost from $500 to $1,000, but a fraction of this cost if the main simple work was done by a handyman. Light bulb replacement with energy-efficient compact fluorescents or LED lights may cost $100 - $200 and quickly repay for themselves. Upgrading ceiling insulation is necessary but more problematical due to the 'rooms in roof' building form. There too is little easy-access ceiling compared to sloping walls – but improving insulation generally is important. At the same time, it is important to modify the Bathroom ceiling extractor fan that sends moisture-laden air into a restricted air-space – that then condenses into water droplets when it hits a cold surface. The upstairs of this building is starting to develop mould problems as a result. The cost of undertaking these improvements requires greater investigation of the existing construction before a satisfactory solution can be developed.

3.4.4 Cottage - Assistant Minister

This apartment is a connected part of the adjacent Hall. In fact, so connected that 'structure-born' sound transfers clearly through the party from adjacent Hall. The apartment is a compact two-storey brick structure, with collapsing carport outside that merits demolition. There is no notion of solar design built-in, for winter warmth or summer coolth. Hence the structure does little to contribute to thermal comfort, minimized service accounts or greenhouse gas emissions.

Electrical consumption

DATES due	COST	DAYS	ENERGY USE	AVERAGE/DAY	CO2 (kg)
First quarter 2008	$112*	91 days	1,681 kWh	18 kWh /day	1,710.8 kg
Fourth quarter 2007	$112*	91 days	1,681 kWh	18 kWh /day	1,710.8 kg
Third quarter 2008	$164*	84 days	2,121 kWh	25 kWh /day	1,572.2 kg
July 2007	$225.71	90 days	1,605 kWh	18 kWh /day	1,714.1 kg
May 2007	$183.73	91 days	1,306 kWh	14 kWh/day	1,394.8 kg
January 2007	$187.89	91 days	2,099 kWh	23 kWh /day	1,950.0 kg
October 2006	$231.18	92 days	1,659 kWh	19 kWh /day	1,541.2 kg
July 2006	$218.56	89 days	1,655 kWh	18 kWh /day	1,489.2 kg
May 2006	$198.22	92 days	1,425 kWh	15 kWh /day	1,328.8 kg

* Not sighted – but cost figures provided

Gas consumption

DATES - quarter	COST	DAYS	USAGE	AVERAGE/DAY	COST/DAY	CO2 (kg)
First quarter 2008*	$109	92 days	3,565 MJ	37 MJ	57 ¢	229 kg
Second quarter 2007*	$66	91 days	1,211 MJ	13 MJ	20 ¢	78 kg
August 2007	$190.84	91 days	9,783 MJ	109 MJ	$2.10	628 kg
May 2007	$101.16	90 days	3,576 MJ	40 MJ	58 ¢	230 kg
February 2007	$104.03	92 days	3,746 MJ	41 MJ	59 ¢	240 kg
November 2006	$163.86	92 days	7,620 MJ	83 MJ	$1.18	489 kg
August 2006	$202.16	92 days	10,468 MJ	115 MJ	$1.58	672 kg
May 2006	$134.76	90 days	5,976 MJ	66 MJ	92 ¢	384 kg
February 2006	$79.77	91 days	2,365 MJ	26 MJ	37 ¢	152 kg

* Not sighted – but cost figures provided

In this instance, energy performance covers both gas and electricity. Electricity consumption rises 20 – 30% or more during winter months (electric fan heaters), totaling 7,085 kWh in the past year with consequent 6.7 tonnes of greenhouse gas emissions. Gas usage has been most variable over several years (different occupants?) with peak consumption from winter space heating (un-flued gas heaters). Gas consumption reduced by one-third within the last year to 18,135 MJ.

We suggest that you investigate energy and greenhouse gas emission savings by going to NABERS on-line *Energy Explorer* for interactive self-assessment, www.nabers.com.au/home.aspx

COTTAGE: 3.0 star energy performance – better than average performer	COTTAGE: energy-efficiency improvements (least cost to $$)
About your home: Postcode: - People in home: 5 Weeks unoccupied: 3 Electricity: 7,088 kWh pa Natural Gas: 18,135 MJ pa Greenhouse gas emissions: 8,274 kgCO_2 pa **What the rating means:** The average NABERS Rating is 2.5 stars More stars indicate better environmental performance. A 3 star home is above average, 4 stars is excellent and 5 stars is exceptional.	1 Install water-efficient shower head (AAAAA), plus take shorter showers, 2 Minimise (eliminate?) use of electric clothes dryer, 3 Use cold water only for washing machine, 4 Open doors /windows in summer for cross-ventilation, close doors between heated parts of the home in winter, 5 Minimise or eliminate 'standby' power by disabling electronic timers etc not used and turning equipment off at powerpoint, 6 Minimise use of electric fan heater, 7 Minimise use of un-flued gas heater (leaving window slightly open for ventilation), 8 Draft-proof the cottage with seals around outside doors, 9 Switch electricity supply to accredited GreenPower supplier (www.greenpower.gov.au) 10 Replace halogen downlights and incandescents with more efficient lamps (eg. compact fluorescents, LEDs), 11 Install R 3.0 (or better) insulation across ceiling in roof space to fullest extent possible, 12 Consider installing more efficient ('balanced flue') gas space heater to living space – to take moisture and gasses outside, 13 Consider installing instantaneous gas water heater with electronic thermostatic control when existing storage water heater needs replacement, 14 When replacing appliances generally, select more energy-efficient models, 15 Consider installing rainwater tanks for connection to WC, laundry.

Cost implications of improvements

About half of the above suggestions relate directly to 'lifestyle' choices about household energy efficiency which can easily lead to a 20% or more reduction. Draft-proofing can be done for as little as $15 per door if done yourself, or from $100 if paid and including a threshold (bottom) seal. Replacing light fittings may cost from $7 and upwards per fitting – with the cost recouped within a year. Changing the space heating is a bigger investment of probably $2,000+, but could include a thermostat and timer to become more efficient as well as healthier and more comfortable. Rainwater tank installations (size dependent) start at around $2,000 and can double or treble if connected to WC and laundry – depending upon degree of difficulty for additional plumbing.

3.4.5 Water performance and greenhouse gas

The greenhouse gas consequences of water supply and use are not yet reliably defined. Obviously all infrastructure requires energy use and therefore creates greenhouse gas consequences. When the Sydney desalination plant is operational in future years, GHG emissions from pumping and treating water will increase significantly.

Water consumption – all facilities

DATES	COST	DAYS	WATER USAGE	AVERAGE/DAY	CO2 (kg)
First quarter 2008*	$300*				
Fourth quarter 2007*	$367*				
Third quarter 2007*	$350*			2,010 Litres	
July 2007	$309.00			1,530 L	
April 2007	$346.95	91 days	174 kL	1,910 L	
January 2007	$412.40	86 days	191 kL	2,220 L	
October 2006	$389.65	92 days	209 kL	2,270 L	

July 2006	$353.90	89 days	192 kL	2,150 L	
First quarter 2006*	$382*				

* Not sighted – but cost figures provided

The above figures give no real guidance to water consumption or means of reduction. Observation suggests that at minimum, installing flow-restrictors though-out, installing dual flush toilets will have a small but significant impact at minimal cost. The further step is to capture rainwater off some roofs (not where there are lead flashings) and install in rainwater tanks for at minimum garden use – but preferably (at additional cost) for flushing toilets.

3.5 Church building (small), Hall and Rectory (1945 – 1980)

Site audit: 3 July 2008.

3.5.1 Locational Factors

Parishioner catchment is generally within 2 - 5 km, with some informal car-pooling /collection. The railway station is nearby, but there is no Sunday bus service available. The congregation tends to be older, within a socially and ethnically changing demographic. Adequate but limited carparking is available on-site. Garden planting is limited to grass, a few shrubs and an old eucalypt, not requiring much additional water use. There is an outside toilet block with 2 wc's (full flush only) and one basin for each gender, both supplied with cold water only. These toilets are not disabled accessible.

	CHURCH connected to Hall	CHURCH HALL connected to Church	OLD HALL	RECTORY with additions
Facilities	Modern Church attached to hall, with vestry, office and hall	Attached to church with dividing concertina doors, stage, kitchen, group room, hall.	Original weatherboard Church relocated, with vestry removed and hall extended.	Brick veneer and tile home set (too) low, with northern additions to become 4 bedroom + study
Construction	Double brick, concrete floor, clerestory windows (fixed), roof tiles + metal roof.	Double brick, raised timber floor, clerestory windows (fixed), roof tiles + metal roof	Weatherboard, steep tiled roof, porch, elevated timber floor	Brick veneer and tile house, Hardiplank additions, upgraded services, plastic skylight.
Usage	Sunday services x 2, monthly evening service.	Morning teas 1 /week, childcare group 2hrs /week, Friday evening kids night, ladies group fortnightly, Seniors Fellowship Fridays.	Occasional.	Residence for family of five.
Daylight - natural	Good natural light from clerestories and windows – but blinds used for security and glare control – hence artificial lights used more than needed.	Good natural light from clerestories and windows – but blinds used for security and glare control – hence artificial lights used more than needed.	Large windows to east and west.	Generally adequate/ good, but plastic dome (heat loss issue)to Lounge.
Ventilation - natural	Security concerns keeps building more enclosed	Security concerns keeps building more enclosed	Good, although old sash-cords a risk	Adequate.

	than necessary. Hence use of fans etc.	than necessary. Hence use of fans etc.	with double-hung windows.	
Insulation	Minimal, reflective foil + minimal fiberglass (?) under roof sheeting.	Minimal, reflective foil + minimal fiberglass (?) under roof sheeting.	Nil	Minimal, sarking, + cellulose fibre.
Heat loss	Considerable, ceiling holes (previous lights), little insulation, high roofs, single glazing.	Considerable, ceiling holes (previous lights), little insulation, high roofs, single glazing.	Considerable, no insulation and 'leaky' lightweight construction.	Considerable, too little insulation and (partially) lightweight construction.
Thermal comfort	Moderate in summer, cool /cold in winter.	Moderate in summer, cool /cold in winter.	Hot in summer, cold in winter. Little used?	Moderate in summer, cool /cold in winter.
Disabled access	Good level access to public areas. Has auditory loop for hearing enhancement. No accessible toilets.	Good level access to public areas but shortcomings on door clearances, handles etc. No accessible toilets.	Not possible – entry steps	Possible from private entrance – not public entrance (steps). Limited access internally.
Services /meters separated?	No	No	No	No
Electricity	Single phase	Single phase	Very limited (wiring not currently legal)	Single phase
Gas	Nil	Nil	Nil	Reticulated, heating, hot water, cooking.
Water	One meter	One meter	One meter	One meter
WCs	-	4 dual flush external toilet block	-	2 dual flush
Rainwater	Wasted to street	Wasted to street	Wasted to ground	Wasted to street
Hot water system	Nil	Electric storage 50 L (1999)	Nil	Rinnai 24 instantan-eous gas, no temp-erature controller
Space heating	Four x 1200 w suspended radiators, separate controls; two x 600w strip radiators, Vestry fan heater 2400w, Office radiator 1000w + fan heater 1200w. Total 10,600w	Hall six x 1200w suspended radaiators; Kitchen and group room 2 x 600w radiators Total 8,400w	Nil	Two un-flued gas heaters; four oil column radiators to Bedrooms; Fujitsu AC (2.5 kW?) through Study wall.
Space cooling	Two ceiling mounted 900mm fans (reversible), domestic fan over Chancel, three domestic floor-mounted.	Four ceiling mounted 900mm fans, NOT reversible.	Nil	Fujitsu AC through Study wall; 4-blade ceiling fan to Master Bedroom; 3 (wind-driven) roof ventilators
Lighting – electrical, internal	8 x 36w fluoro's chancel, 11 x 36w fluro's church, 12 x 75w recessed DL 3 x 75w recessed DL foyer, PAR38 (150w) to altar. Vestry 2 x 36w, Study 36w fluoro. Total 2,067 watts. Lighting power density approx. 12w /m^2.	6 x 36w fluoro's hall, 2 x 36w kitchen, 3 x 36w Group room Stage ? Total 396 watts + Lighting power density approximately 3w /m^2	10 x 36w (total 360 watts) Lighting power density approx-imately 4w /m^2	Study 4 x 50w TH Bath 2 x 50 TH Family 2 x 32w fluro Kitchen 1 x 32w fluro Bedrooms 4 x 15wCF 5 x 20w (?) TH bedside. Total 556 watts
Lighting – electrical, external	4 x 150w (PAR 38) 1 x 250w & 1 x 250w floods – timer, 6 x 15w CFL. Total 1,200w	4 x 150w (PAR 38) 1 x 18w CFL Total 680w	75w incandescent	?
Appliances -	Ricoh Copier (all church documents, (half double	Birko urn, Microwave (Sharp), Stove	1 energetic possum	Bath ceiling extractor (no shutters), TV,

electrical	sided?)	(Westinghouse), Fridge 600L (Westinghouse) 2.5 star		Kitchen fridge (519L F&P), MW (Panasonic), Dishwasher, Stove (chef), Laundry: 8kg top-loader(Hoover), 5kg Dryer, Computers: 2 desktops, 2 laptops, 2 laser printers, 1 ink-jet.
Potentially hazardous materials	Non observed, but original paints of this vintage still had high lead content	Non observed, but original paints of this vintage still had high lead content	Asbestos-cement sheeting, Lead paints - flaking	Non observed. Un-flued gas heaters considered a health hazard.
Wastes	Fortnightly Council 240L commercial collection			Weekly Council collection, 240L + recycling 120L bins

3.5.2 Church + Hall

This combined facility has the church at one end and the hall at the other separated by bi-fold doors, both with a shared entrance foyer. Of cavity brick construction with concrete floor and several roof types (pitched tiles for effect, remainder a double flat metallic roof permitting highlight windows), this building can be thermally improved. Of note also is the traditional outside toilet block (cold water only, inaccessible to the lesser-abled) that is less than desirable.

Electricity consumption – Church, halls, toilets

DATES	COST	DAYS	ENERGY USE	AVERAGE/DAY	CO_2 (kg)
May 2008	$218.72	90 days	1,613 kWh	18 kWh /day	1,093.0 kg
February 2008	$259.41	97 days	1,011 kWh	10.4 kWh /day	1,028.9 kg
November 2007	$222.56	83 days	1,623 kWh	17 kWh /day	1,572.2 kg
July 2007	$403.49	53 days	2,717 kWh	32 kWh /day	2,556.7 kg
May 2007	$135.26	90 days	970 kWh	11 kWh /day	916.5 kg
February 2007	$144.85	93 days	929 kWh	10 kWh /day	863.0 kg
November 2006	$193.48	94 days	1,499 kWh	16 kWh /day	2,517.6 kg
August 2007	$344.94	87 days	2,710 kWh	31 kWh /day	2,758.0 kg
	$151.52	90 days	1,160 kWh	13 kWh /day	1,077.6 kg
December 2006	$110.68	90 days	670 kWh	9 kWh /day	709.2 kg
August 2006	$206.97	94 days	1,672 kWh	18 kWh /day	1,508.8 kg
May 2006	$113.10	90 days	858 kWh	10 kWh /day	772.7 kg
February 2006	$114.76	93 days	866 kWh	9 kWh /day	779.4 kg

Electrical energy consumption

These buildings show an increased energy use in recent years, possibly related to increased hours of usage. Winter heating and lighting nearly doubles electrical consumption. Inspite of replacing the recessed downlights with more efficient (but reduced ambience) fluorescent strip lighting, the holes left in the ceiling has probably nullified the energy improvements. With 6,425 kWh of electricity used in the last year at a cost of $932.04, this has produced 6.8 tonnes of greenhouse gas emissions.

Being typical 1970's construction, this building has fairly high thermal mass (brick and concrete) with too little insulation and in-efficient single glazing to many orientations (where *north* is preferable). Furthermore, the replacement fluorescent lighting has left holes across the ceiling where heat flows immediately out into the ceiling/roof void. Whilst it has good natural light levels due to the clerestory windows, these also leaks warm air in winter. Heating from over-head radiators is crudely effective for the church and probably less so for the Hall – where users are probably more physically active. Having cold feet and warm head (overhead radiators) when sitting, is a most uncomfortable combination. Ideally heating could/should come from the floor (not easily done here) or from under the pews.

Of note is the security concerns that lead to window blinds being drawn most of the time thereby precluding natural winter warmth, plus windows not being opened in summer for natural ventilation. The consequence in both cases is higher electricity bills and greater greenhouse gas impact.

Upgraded toilets with enhanced disabled access is also suggested.

Energy-efficiency improvements (least to more expensive options)
1. Ensure double-sided photocopying and equipment turned off at powerpoint whenever possible,
2. Open windows in summer for cross-ventilation (especially the higher windows) installing winding mechanisms (pull cord or mechanical) if necessary,
3. Replace all incandescent bulbs (downlights) with more energy-efficient (compact fluorescents, LEDs),
4. Rationalise and down-rate all external lighting to more energy-efficient (compact fluorescents, LEDs),
5. Rationalise internal electric lighting generally, and over the chancel in particular,
6. Install small fridge for 'everyday' use, leaving the existing large one for occasional use only when required,
7. Fill all holes in the ceilings from previous light fittings to eliminate heat loss,
8. Install insulation (R 3.0 or better) across suspended ceiling,
9. Depending upon frequency of use of Vestry and Office, consider installing fixed high windows in the wall to 'borrow' light and warmth from the Church high windows (double-glaze if sound reduction is a concern),
10. Consider upgrading horizontal clerestory windows to Church and Hall with winding mechanism (pullcord or mechanical) Note that making windows double-glazed is desirable too – but not as essential as elsewhere,
11. Consider upgrading highlight windows above Chancel and Kitchen/Group Rooms with double-glazing (additional windows or 'Magnetite') whilst installing a panel of tight-fitting operable louver windows (for enhanced natural airflow in summer),
12. Consider replacing existing ground-level windows (of security concern) with new glass block panels (retains light, more secure, energy-efficient, recycled glass), possibly integrated with operable metal louvres,

Other improvements (least to more expensive options)
13. Update 'exit' signs to new Australian Standard requirement (now the international standard applies showing a running figure + arrow),
14. Implement enhanced disable access provisions such as entry doors to Hall, handle heights, wheelchair turning circles (1.5 m diameters) etc,
15. Consider installing rainwater tanks connected to WCs and/or garden use,
16. Consider how to obtain disabled access toilet /bathroom to AS 1530.1 or better (avoid possible issues with the *Disability Discrimination Act 1994*),

3.5.3 The Rectory

This brick veneer and tile home is set behind the church hall, giving reasonable solar aspect along its length. This, plus the more recent additions, makes the house pleasant and livable even though it lacks good insulation and efficient heating. Of note is that the building was built too low on the land, such that it can flood after heavy rain. Excavation along the southern side and a more permanent means of diverting stormwater away from the building is needed.

Electrical consumption

DATES due	COST	DAYS	ENERGY USE	AVERAGE/DAY	CO2 (kg)
May 2008	$155.69	91 days	1,074 kWh	12 kWh /day	1,093.0 kg
November 2007	$218.75	99 days	1,927 kWh	18 kWh /day	1,028.9 kg
August 2007	$285.50	84 days	2,121 kWh	25 kWh /day	1,572.2 kg
May 2007	$225.71	90 days	1,793 kWh	20 kWh /day	2,556.7 kg
November 2005	$219.04		1,781 kWh	19 kWh /day	863.0 kg
May 2005	$201.89		1,720 kWh	19 kWh /day	2,517.6 kg
February 2005	$196.03	87 days	1,655 kWh	18 kWh /day	2,758.0 kg

Electricity use has reduced in recent years, with winter electricity consumption rising presumably due to use of electric oil-column heaters which typically cost from 20 to 35¢ /h our. Nevertheless, overall electrical consumption is modest. Gas is sued for cooking (burners), hot water and through winter, un-flued gas heating. Winter usage for heating nearly doubles overall consumption. We have no explanation for the spike in winter quarter gas consumption (three-times higher) in mid 2006.

Gas consumption

DATES - quarter	COST	DAYS	GAS USAGE	AVERAGE/DAY	COST/DAY	CO2 (kg) +
June 2008	$110.05	92 days	4,272 MJ	46 MJ	74 ¢	2,742.6 kg
April 2008	$80.96	90 days	2,135 MJ	24 MJ	36 ¢	1,370.7 kg
December 2007	$84.33	93 days	2,847 MJ	31 MJ	46 ¢	1,827.8 kg
September 2007*	$281.62		17,260 MJ*			18,433.7 kg
June 2007	$93.97	89 days	3,704 MJ	42 MJ	61 ¢	2,378.0 kg
March 2007	$74.15	92 days	2,344 MJ	24 MJ	37 ¢	1,504.8 kg
August 06	$253.62	90 days	15,552 MJ	173 MJ	$2.39	9,984.0 kg
April 06	$65.99	95 days	1,896 MJ	20 MJ	28 ¢	1,217.2 kg
Jan 06	$68.41	85 days	2,257 MJ	27 MJ	37 ¢	1,448.9 kg

* Not sighted – but figures extrapolated from known costs paid. + Conversion factor 64.2 kg /CO_2/MJ

Gas consumption peaks sharply in winter when un-flued gas heaters are used – increasing everyday consumption (from cooking) by a factor of seven or eight. This illustrates the desirability of installing a fuel-efficient balanced flue gas heater (meaning it takes the products of combustion away) on an external wall. It will quickly save money and have benefits for indoor air quality too.

The 'NABERS Home' online assessment on overall energy use was applied for comparative purposes. As water usage could not be separated form that of the whole property it was not assessed. This simple assessment showed that the Rectory energy use at three stars was slightly better than the average for that postcode area (2.5 stars), but could readily be improved.

We suggest that you investigate energy and greenhouse gas emission savings by going to NABERS on-line *Energy Explorer* for interactive self-assessment, www.nabers.com.au/home.aspx

RECTORY: <u>three star</u> energy performance	RECTORY: **energy-efficiency improvements** (least cost to $$)
About your home: Postcode - People in home 5.8 Weeks unoccupied 3 Electricity 6,915 kWh pa Natural Gas 24,806 MJ pa Greenhouse gas emissions 8,579 kgCO_2 pa **What the rating means:** The average NABERS Rating is 2.5 stars More stars indicate better environmental performance. A 3 star home is above average, 4 stars is excellent and 5 stars is exceptional.	1. Install water-efficient shower head (AAAAA), plus take shorter showers, 2. Minimise (eliminate?) use of electric clothes dryer, 3. Use cold water only for washing machine, 4. Open doors /windows in summer for cross-ventilation during cooler parts of the day, close doors between heated parts of the home in winter, 5. Minimise or eliminate 'standby' power by disabling electronic timers etc not used and turning equipment off at powerpoint, 6. Minimise use of the air-conditioner and /or turn settings up a degree or two (ie. it works less hard, saving energy, 7. Draft-proof the rectory with seals around outside doors, 8. Switch electricity supply to accredited GreenPower supplier (www.greenpower.gov.au) 9. Replace halogen downlights with more efficient lamps (eg. compact fluorescents, LEDs), 10. Install R 3.0 (or better) insulation across ceiling in roof space, 11. Consider installing more efficient ('balanced flue') gas space heater to living space – to take moisture and gasses outside, 12. When replacing appliances, select more energy-efficient

	models and gas for cooktop, 13. Improve light levels and energy efficiency for Lounge with either installing plastic panel at ceiling level below plastic skylight (ie. double glazed) or replace with operable 'Velux' roof window, 14. Consider installing rainwater tanks connected to WC, laundry, 15. Double glaze all *southern* windows with additional window over the existing (creating a still air-gap).

Cost implications of improvements
Our initial cost appraisal above suggests you could invest from a few hundred dollars to $20,000 or more in upgrading this building. The greatest tangible benefit (following changed behaviour) would arise from 7 to 11 above, plus (minimally) sealing off the light-well shaft with plastic sheet at ceiling level in the Dining Room.

7 Draft proofing doors	$500 - $700	9 Replace tungstenhalogen lamps	$300 - $400
10 Install insulation across ceiling	$2000 - $2500	11 Install efficient gas heater	$1,500 - $2,500
13 Replace plastic domelight	$200, $2,000	14 Install rainwater tank + pump	$4,000 - $5000
15 Double glazed southern & western windows (additional sash?)	$7,000 - $10,000		

3.5.4 Old Church Hall

This original church now modified to become a little-used back hall, represents all the common difficulties of such facilities. Its materials are deteriorating from lack of maintenance leading to concerns about security (highly flammable construction), lack of disabled access, unsafe electrical cables and the like. Obviously it does not conform to contemporary building and safety regulations, but nor can it be easily or inexpensively upgraded.

3.5.5 Water – all facilities

One water meter controls all the facilities on site. Hence we cannot separate out individual facilities with any reliability.

Water consumption – all facilities

DATES	COST	DAYS	WATER USAGE	AVERAGE/DAY	CO_2 (kg)
June 2008	$202.30	84 days	53 kL	631 Litres	
March 2008	$204.95	85 days	55 kL	647 L	
December 2007	$217.03	95 days	64 kL	674 L	
September 2007	$200.55	86 days	53 kL	616 L	
June 2007	$207.55	91 days	63 kL	692 L	
March 2007	$128.25	92 days	1* kL	- *	
December 2006	$204.70	92 days	63 kL	685 L	
September 2006	$197.90	85 days	62 kL	729 L	
June 2006	$202.70	97 days	66 kL	680 L	
March 2006	$187.45	91 days	63 kL	692 L	
December 2006	$185.35	92 days	64 kL	696 L	
September 2005	$182.30	88 days	61 kL	693 L	

- In-explicable low water use as billed by Sydney Water

Water usage is highly consistent throughout the year, with (pleasingly) a slight reduction apparent. At a minimum, retrofitting the toilet cisterns for reduced flow will drive down water usage further.

3.5.6 Conclusions

This 1970's church represents a fairly typical combination of issues for parish properties. Energy and water use are not high overall, although energy consumption doubles in winter due to very average building construction. Thermal comfort is not good in the extremes of the seasons, but can be upgraded at a cost. Because the facilties (other than Rectory) are mostly used for a limited number of hours per week, the current cost-effectiveness of spending money on building improvements is limited. However gains can be made at no or low cost through improved building usage. But as shown below, energy and water-intensive facilities will be subject to marked price increases in future years.

3.6 Church building (modern) with Hall and separate Rectory, plus Minister's house

Audit: Thursday 21st August 2008.

3.6.1 Locational Factors

Parishioner catchment is predominantly local within this region, with most parishioners reliant upon car access. Hence there is a large carpark (for 62 + disabled on-site). Limited bus routes are nearby with railway station too distant to be useful. The congregation is generally younger than many other parishes, reflecting the demographics of this newly established area.

	CHURCH	CHURCH HALL
Facilities	Modern church (440 m2) with associated Vestry, Musician's Store, Crying and Infants rooms, plus several Offices and Meeting room – with shared Foyer (330 m^2).	Attached Hall (160 m2) with several Meeting Rooms, Furniture Store, Toilets and commercial grade Kitchen, all connected by the shared Foyer (330 m^2).
Construction	Full brick (rendered) construction externally, with curved portal-frame metal roof and flatter roof to (joining) Foyer. Plasterboard stud frames to some internal walls.	Full brick (rendered) construction, with curved portal-frame metal roof and flatter roof to (joining) Foyer. Plasterboard stud frames to some internal walls. Extensive outdoor covered area.
Usage	Three Sunday services, Saturday weddings, occasional funerals. Office 15 – 20 hours /week, band twice /week. Some overlap (extent unknown) with 'hall' usage.	Three play groups, Tiny Tots Saturdays, Prayer group monthly, weekly Kids Club, weekly Youth Group, new mothers training weekly, Anglicare twice /term, Parents Support, Parish Council monthly, High School training weekly.
Daylight - natural	Limited natural light due to high ceiling and building volume to Church. Crying and Infants rooms mainly borrowed light. Offices rely on artificial lighting. Foyer has skylights with reasonable light spread with perimeter glazing.	Main hall has limited natural light due to high ceiling, building volume and southern windows. Meetings rooms have natural light from two sides. Toilets, Kitchen and Stores are all internal.
Ventilation - natural	Nil.	Some cross-ventilation possible to perimeter spaces – but generally restricted.
Insulation (assumed)	Unknown, reflective foil sarking plus fibreglass under metal roofing. Probably not a high R value.	Unknown, reflective foil sarking plus fibreglass under metal roofing. Probably not a high R value.
Heat loss /heat gain	Some, with single glazing and probably too little insulation.	Some, with single glazing and probably too little insulation.
Thermal comfort	Mostly reliant on air conditioning for comfort.	Mostly reliant on air conditioning for comfort.
Disabled	Generally accessible.	Generally accessible.

access		
Services /meters separated?	No – together.	No – together.
Electricity	3 phase, single meter	3 phase, single meter
Gas	Nil	Nil
Water	Shared meter.	Shared meter.
Recycled water	Recycled water as part of development area, metered.	Recycled water as part of development area, metered. Used for lawns and toilet flushing. Big variation in amounts used – see below.
WCs, basins	Nil.	10 dual flush, disabled, kids, 8 basins, Cleaners sink.
Rainwater	Wasted to street	Wasted to street
Hot water system	35 L under-sink electric storage water heater.	Rheem electric (4.8 kW) storage 400 L to Kitchen + Rheem 50 L electric storage, + 400 L (?) electric storage for Bathrooms & Meeting room.
Space heating Space cooling	Air conditioning 4 x 11 kW units plus two further package units on roof (say 4 kW each?). Aside from 7.5 hours programmed church use weekly, reportedly there has been marked a reduction in consumption following installation of 2-hour timer-switch for automatic turn-off. The whole building is mostly reliant on air-conditioning throughout the seasons and year. Natural ventilation is not currently an option.	
Lighting – electrical, internal	Foyer (entire): 53 off recessed CFL say 26w; Creche: 10 off 8CFL say 26w. Church: 20 off 250w metal halide (?), 3 off recessed CFL say 26w, 5 off recessed PAR 38 150w DL over Sanctuary. Total 5850w. Vestry: 4 off 2 x 36w, Music: 4 off 2 x 36w. Office: 3 of 2 x 36w; Copier room: 3 of 2 x 36w + 15w paper store; Meeting room 6 off 2 x 36w + 4 off recessed TH 50w; Total say 7,500w Special theatre lighting 16 'barn-door' spots say 150w = 2,400 w (assuming occasionally used) Lighting power density around 13.3w /m^2 (to church if 250w or 20 w/m^2 if 400w lamps) and 4.2w /m^2 to Foyer.	Corridor: 3 off 2 x 36w; Men's: 3 off 2 x 36w + 2 x 18w + 2 x 12w; Women's: 3 off 2 x 36w + 2 x 18w + 2 x 12w; Disabled 2 x 36w; Kids 2 x 18w; Cleaner 2 x 18w; Total 650w. Meeting Room: 9 off 2 x 36w; Meeting 2: 9 off 2 x 36w; Furniture Store: 4 off 2 x 36w; Upstairs (2 off): 12 off 2 x 36w, 2 off 2 x 18w; Kitchen: 6 off 2 x 36w; Total 1,480 watts Hall: 6 off high-bay HID say 250w, 4 off 2 x 36w, Total 1790w Lighting power density around 13.2w /m^2.
Lighting – electrical, external	Steeple uplights: 2 x 35w HIT, External floods: 2 x 70w HIT, Floods to leadlights: 2 x 36w, Total 212w. Timer	Bunker lights around whole building 8 x 26w CFL, Total 208w.
Appliances - electrical	Overhead projector, pa system, major sound system with amplifier, Canon photocopier, desktop computer + domestic laser-jet printer,	Kitchen: Meiko commercial dishwasher, domestic microwave, domestic Chef upright stove, coffee machine (2.1kW), Turbofan (3.1 kW) professional oven, commercial overhead extractor hood and fan, two (Danish) commercial fridge-freezer units (370 L + 332 L), boiling water unit (2.4 kW), water filter, Kambrook 8 L urn.
Potentially hazardous materials	Non apparent.	Non apparent.
Wastes	Not recorded	Not recorded

3.6.2 Church + Hall

Electrical consumption – Church & Hall

DATES	COST	DAYS	ENERGY USE/	AVERAGE/DAY	CO_2 (kg)
June 08	$1,286.01	84 days	8,800 kWh	104.8 kWh /day	9,398 kg
March 08	$1,766.49	96 days	12,120 kWh	126.3 kWh /day	12,944 kg

December 07	$1,494.62	90 days	10,240 kWh	113.8 kWh /day	10,936 kg
September 07	$955.21	87 days	10,960 kWh	126.0 kWh /day	11,705 kg
June 07	$1,144.93	90 days	9,320 kWh	103.6 kWh /day	9,954 kg
March 07	$1,871.69	98 days	13,880 kWh	141.6 kWh /day	14,824 kg
December 06	$1,318.38	89 days	9,720 kWh	109.2 kWh /day	10,380 kg
September 06	$1,432.65	85 days	10,760 kWh	126.6 kWh /day	11,492 kg

Electrical consumption

With just one meter covering all facilities we have assumed a split between church (one-quarter) and all other occupants (three-quarters), loosely based on anticipated hours of use and relative floor space. The facility as a whole is heavily utilized by a range of church and community groups, plus has part time administrative staff. Energy use is high (42,120 kWh), due to its almost total reliance upon electric illumination and air-conditioning for nearly every room and every space. There are no marked trends in consumption other than a winter dip, indicating that summer cooling is the biggest energy load.

This facility was built fairly recently, so it reflects better performance norms than that of earlier decades or centuries. The whole church and hall building is metered as one. Only the Foyer has much natural light, whilst less desirably, almost everything else is reliant upon electrical lighting and air conditioning. Whilst this might be good for containment (security) and with manageable bills in the meantime, it will provide a cost and greenhouse gas burden that increases in future years. There is little seasonal or other discernable variation in consumption other than a most recent dip which may be related to the installation of timer /switch-off button. If so, it's made a measurable difference!

Doubtless the air conditioning is the biggest user of electrical energy – especially because of the less than desirable insulation standard anticipated. As a result, the air conditioning has to work harder than is desirable or necessary. Insulation regulations have lifted requirements in recent years, to be at least R1.5 in the walls and R3.5 in the ceiling /roof for that climatic zone. We believe that the (un-insulated) cavity brick and rendered walls are less than R0.5 (ie. one-third today's minimum) whilst the roof may be R1.8 (ie. around half today's standards). 'Cost savings' like these during construction have enormous cost and performance implications for the life of the building. The opportunity to upgrade insulation is now effectively limited to areas above flat ceilings – the service areas - which will have little impact overall.

The other major area of heat loss or gain is in the single-glazing everywhere, other than for the glass blocks facing east. There is no 'passive solar' design using the free natural warmth from the sun (ie. northern orientation) but significant glazing east, west and south which are the least desirable orientations. As these orientations have significant eaves overhang for summer shading, the main problem becomes lack of natural light and warmth through winter. Hence in a location which has some 'temperate climate' extremes (hot in summer, cold in winter) plus high natural light levels, reliance is entirely upon electrical energy for lighting and thermal comfort. Whilst understandable, this is not sustainable. All buildings need to become better attuned to the pattern of sun, wind, rain and the like to minimize energy (and water) consumption.

Possible improvements

1 We suggest that blanket insulation (R2.5+) be laid over existing ceilings wherever possible, with care required around electrical cables and transformers (to avoid trapping excess heat).

2 We suggest investigation of removing the existing aluminum (north-facing) louvers high over the Youth Activities Hall to be replaced with toughened 'high-performance' glass. This relatively easy modification would significantly enhance natural light but also the pleasantness of this hall, whilst decreasing the need for electrical lighting. At the same time, sun-shading should be investigated for these potential windows to ensure that only winter sun penetrates deeply, and excessive summer sun is excluded.

Cost implications

1 Insulation installed over existing ceilings (around 330m^2) likely cost around $3,000 - $4,000.

2 Replace louvers with glass to existing frames (3 sets) say $3,000, plus additional external sun control (?) say further $3,000.

Greenhouse gas (GHG) performance
These buildings have a large GHG 'footprint' due to the air-conditioning and lighting components. And the more the building is used, of necessity, the higher the electrical use and greenhouse gas consequence. In the last year, GHG has been around 45 tonnes, a slight improvement on the previous year at 46.5 tonnes. A future modification may be 'green retro-fitting' with multiple further skylight installation (eg. double-glazed and venting roof windows) so 'internal' rooms then receive predominantly natural light and ventilation.

3.6.3 Water issues

This area receives reticulated recycled water from Sydney Water, separately metered from potable water. The supply cost of fresh potable (ie. drinking, cooking) water is $1.61 /kL. Supply cost of recycled water (for toilets, air-conditioning, lawns, etc) is cheaper at $1.29 /kL.

Water consumption

DATES	COST	DAYS	POTABLE WATER	AVERAGE /DAY	RECYCLED	RECYCLED /DAY	CO2 (kg)
July 08	$612.30	91 days	17 kL	180 L	273 kL	3.00 kL	
April 08	$577.80	92 days	10 kL	100 L	432 kL	4.69 kL	
January 08	$850.85	90 days	15 kL	160 L	645 kL	7.17 kL	
October 07	$385.05	92 days	11 kL	110 L	177 kL	1.92 kL	
July 07	$460.15	90 days	7 kL	78 L	239 kL	2.65 kL	
May 07	$1,017.30	92 days	8 kL	80 L	658 kL	7.15 kL	
January 07	$890.75	92 days	7 kL	70 L	663 kL	7.21 kL	

* Note this includes for 'trade waste' from coffee shop through a pump-out grease-trap.

Noteworthy from the above table is that potable water use has doubled in the last year (more active Kitchen and facility use?), whilst recycled water use has varied most erratically. This lead to the Parish questioning Sydney Water on likely causes (February 2008), with faulty meters or obvious leaks being possible culprits. Subsequent investigations by Sydney Water were unable to determine the cause, with suggestion that the Parish engage its own plumber to investigate further.

The greenhouse gas emission (CO_2) consequences of water supply and use are not yet reliably defined. Obviously all infrastructure requires energy use and therefore creates greenhouse gas consequences. When the Sydney desalination plant is operational in future years, GHG emissions from pumping and treating water will increase significantly.

3.6.4 Ministry residences

	RECTORY	Minister's residence
Construction & Facilities	Four bedrooms plus study, two-story brick-veneer and tile home, with two car garage.	Three bedroom plus study single storey brick-veneer and tile home with two car garage.
Usage	Two adults and three teenagers.	Two adults and four young children.
Daylight - natural	Adequate, but too few windows facing north and two many facing east and particularly west – with too little shading.	Adequate, with greater ratio of public areas facing north, yet still too many (bedroom) windows facing south. Glazed pergola has extended effective and usable living area.
Ventilation - natural	Limited possibility of cross-ventilation.	Limited possibility of cross-ventilation.
Insulation (assumed)	Low installed standard, leading to discomfort (upstairs) especially through summer.	Low standard installed, leading to discomfort (upstairs) especially through summer.
Heat loss	High, with aluminium-framed glazing, single (ordinary) glass mostly with poor orientation, and (presumably) no wall insulation.	High, with aluminum-framed glazing, single (ordinary) glass mostly with poor orientation, and (presumably) no wall insulation.
Thermal comfort	Uncomfortably hot on summer afternoons especially – completely reliant on air-	Uncomfortably warm on summer afternoons especially – mostly reliant on air-conditioning.

	conditioning – but still not comfortable.	
Disabled access	Threshold step precludes full access.	Threshold step precludes full access.
Services /meters separated?	Separate meter.	Separate meter.
Electricity	Three (3) phase domestic.	Three (3) phase domestic.
Gas	Connected. Cooktop, hot water, m	Connected.
Water	Potable and recycled (for wc's, laundry and garden?).	Potable and recycled (for wc's, laundry and garden?).
WCs, basins	3 off dual flush (recycled water?).	2 off dual flush (recycled water?).
Rainwater	Wasted to street.	Wasted to street.
Hot water system	Gas 250 L storage tank outside. Can run short of hot water. Flow restrictors installed	Gas 250 L storage tank outside. Likely to run short of hot water as children grow. Flow restrictors installed.
Space heating	Carrier 3 phase, rated 85,000 Btu's. Three zones. Bathroom HPM extractor /light /heat say 1240w., Ensuite HPM extractor /light /heat 890w.	Carrier 3 phase, rated 65,000 Btu's, zones. Two off electric oil heaters, say1kW and 1.5kW Bathroom IXL extractor /light /heat say 890w.
Space cooling	Ditto AC	Ditto AC
Lighting – electrical, internal	Recent local conversion offer to replace standard incandescent bulbs with compact fluorescents wherever possible. 17 off CFL say 15w, 3 off 60w uplights, 4 off 50w TH downlights, 4 off bedside (say 30w). Total 605w.	Recent local conversion offer to replace standard incandescent bulbs with compact fluorescents wherever possible. 14 off CFL say 15w, 2 off 60w uplights, 3 off 50w TH downlights, 4 off bedside (say 30w). Total 500w.
Lighting – electrical, external	2x 26w CFL. Total 52w.	1 x 26w CFL, 2 off 120w PAR38 with Infrascan. Total 266w.
Appliances - electrical	Study: Laptop + printer. Living: medium sized CRT TV, DVD, sound system. Kitchen: 450 L fridge-freezer, fgan-forced electric wall oven, 1000w microwave, canopy extractor fan, dishwasher, kettle, toaster etc. Laundry: Top-loader (2 star), dryer (5kg). Bathroom: see heating above Upstairs Living: larger CRT TV, 3 computers, 2 printers, scanner, laptop.	Study: Laptop + printer, radio, fan, Garage: 300 L fridge, 282 L freezer, Kitchen: 400 L fridge-freezer, electric wall oven, 1000w microwave, canopy extractor fan, dishwasher, kettle, toaster etc. Living: medium-size CRT TV, DVD, sound-system. Desktop computer + printer. Laundry: Top-loader washing machine (3.5 stars) 6 kg, electric dryer 5 kg (used less than outside clothes line). Bathroom: ceiling extractor.
Appliances – gas	4-burner gas cooker, gas (storage) hot water.	4-burner gas cooker, gas (storage) hot water.
Potentially hazardous materials	No apparent.	Non apparent.
Wastes	Not recorded.	Not recorded.

3.6.5 The Rectory

As a two-storey brick veneer and tile project home with poor insulation and poor orientation, high energy use is to be anticipated due to reliance on air-conditioning in an attempt to obtain thermal comfort. It still fails to be comfortable due to excessive (un-shaded) glass facing west.

Electrical consumption *

DATES	COST	DAYS	ENERGY USE	AVERAGE/DAY	CO2 (kg)
June 08	$286.37	95 days	1,669 kWh	17.6 kWh /day	1,782.5 kg
March 08	$311.82	94 days	1,842 kWh	19.6 kWh/day	1,967.3 kg

assume+			1,842 kWh+		1,967.3 kg+
September 07	$328.08	84 days	1,989 kWh	23.7 kWh /day	2,124.3 kg
July 07	$216.58	92 days	1,317 kWh	14.3 kWh /day	1,406.6 kg
April 07	$424.40	98 days	2,757 kWh	28.1 kWh /day	2,944.5 kg

+ Assumption based upon following summer quarter

Gas consumption *

DATES	COST	DAYS	USAGE/DAYS	AVERAGE/DAY	COST/DAY	CO2 (kg)
March 2008	$167.11	94 days	3,712 MJ	41 MJ	62 ¢	238.3 kg

* Unfortunately not all records were available to allow a more complete analysis.

With very incomplete accounts to work from, it is hard to make projections or predictions with confidence. Assuming a similar energy consumption in the pre-Christmas period as after (March account), this shows 5,350 kWh of electrical energy producing 7,841 kg of greenhouse gas emissions. The annual gas consumption is more a matter of conjecture than hard data – but it possibly could be around 22,000 MJ or 6,100 kWh, producing just 280 kg of greenhouse gas. This well illustrates the greenhouse gas emission advantages of using reticulated gas as a fuel, compared to electricity.

A 'NABERS Home' online assessment on energy use was applied for comparative purposes. As there was inadequate historical data, the water usage could not be assessed. The simple 'Home' assessment showed that the Cottage energy rating at 2.5 stars (out of 5) was average compared to all other similar-sized houses in the same postcode. Improvements can be made as outlined below.

We suggest that you investigate energy and greenhouse gas savings by going to NABERS on-line *Energy Explorer* for interactive self-assessment, www.nabers.com.au/home.aspx

RECTORY: 2.5 star energy rating – average for the area

About your home:

Postcode	-
People in home	4
Weeks unoccupied	3
Electricity	8,287 kWh pa
Natural Gas	14,848 MJ pa
Water - potable	232 kL
Water - recycled	44 kL
Greenhouse gas emissions	9,221 kgCO_2 pa

What the rating means:

The average NABERS Rating is 2.5 stars

More stars indicate better environmental performance.

A 3 star home is above average, 4 stars is excellent and 5 stars is exceptional.

Water rating: 3.5 stars – above average performer (due largely to recycled water use)

RECTORY: energy-efficiency improvements (least cost to $$)

1 Install water-efficient shower head (AAAAA), plus take shorter showers,
2 Minimise (eliminate?) use of electric clothes dryer,
3 Use cold water only for washing machine,
2 Replace remaining ordinary incandescent light bulbs with compact fluorescent globes (CFLs) or LEDs,
3 Minimise or eliminate 'standby' power by disabling electronic timers etc not used and turning equipment off at powerpoint,
4 Draft-proof the Rectory with seals around outside doors and windows,
5 Install close-fitting curtains or blinds to form still air-space (equivalent to 'decorative double-glazing') in winter,
6 Switch electricity supply to accredited GreenPower supplier (www.greenpower.gov.au),
7 Install R 3.5 (or better) insulation across ceiling in roof space,
8 When replacing appliances, select more energy-efficient models and gas for cooktop,
9 Consider what is involved in providing better sun protection to eastern and western windows to reduce heat loss /gain.
10 Consider installing gas instantaneous hot water system with electronic thermostat when the existing gas storage unit needs replacing.
11 Consider double glazing all *eastern* and *western* windows with additional window /acrylic over the existing (creating a still air-gap) – and/or install heavy curtains with pelmet for

	still-air space. 12 Consider installing rainwater tanks for garden watering and/or pump connected to WCs and laundry.

Cost implications of improvements
Actual costs will vary considerably depending upon how you obtain quotations and the extent of genuine interest and price competition. Please obtain actual quotations before proceeding with any of the suggested improvements.

4. Install compact fluorescents	?		
6 Draft proof seals	$100 - $500 if professionally installed	10 Ceiling insulation (R3.5 +) professionally installed	$2,500 - $3,500
11 Better sun protection	?	12 Replace Bathroom fan etc	$500 - $800
13 Instantaneous gas hot water	$1,800 - $2,400	15 Create double-glazing	$1,000 - $4,000
16 Water tank, some re-plumbing	$2,500 - $6,000		

Water consumption *

DATES	COST	DAYS	POTABLE WATER	AVERAGE /DAY	RECYCLED	RECYCLED /DAY	CO2 (kg)
August 2008	$141.90	94 days	47 kL	500 Litres	11 kL	117 Litres	

* Unfortunately not enough records were available to allow a more complete analysis.

With only one account to review, the only observation that can be made is that for this home, recycled water usage (used for flushing toilets, laundry and garden) is under one-quarter that of potable (cooking, drinking, washing).

Greenhouse gas performance (carbon footprint)
Due largely to energy in-efficient building construction with windows to less than ideal orientations, this house relies on air-conditioning for thermal comfort in summer. Where gas is used for cook-top and water heating, the use is far more greenhouse friendly than electricity.

3.6.6 Ministry residence

Electricity consumption

DATES	COST	DAYS	ENERGY USE	AVERAGE/DAY	COST/DAY	CO_2 (kg)
June 08	$405.55	95 days	2,432 kWh	25.6 kWh /day	$4.27	2,597.4 kg
March 08	$588.13	94 days	3,396 kWh	36.1 kWh /day	$6.26	3,626.9 kg
December 07	$463.45	90 days	2,804 kWh	31.2 kWh /day	$5.15	2,994.7 kg
September 07	$273.50	84 days	2,442 kWh	29.1 kWh /day	$3.25	2,608.0 kg
June 07	$125.33	92 days	2,436 kWh	26.5 kWh /day	$1.36	2,601.6 kg
April 07	$506.82	88 days	3,331 kWh	37.9 kWh /day	$5.76	3,557.5 kg

Gas consumption

DATES	COST	DAYS	ENERGY USE	AVERAGE/DAY	COST/DAY	CO2 (kg)
June 2008	$155.55	92 days	5,778 MJ	63 MJ	$1.00	4.0 kg
April 2008	$133.85	90 days	4,794 MJ	53 MJ	79 ¢	3.4 kg
January 2008	$144.35					
October 2007	$154.65	92 days	6,704 MJ	73 MJ	$1.08	4.7 kg
July 2007	$150.29					

Energy performance

This single storey brick veneer and tile project home suffers from poor insulation and poor orientation. Like the rectory nearby, it requires considerable energy in trying to maintain thermal comfort, especially in summer. Electricity use rises by one-third in summer in an attempt to cool the house. Arguably, simple devices like the pergola that shades the back door glazing saves it's capital cost within a few years, and makes the home more livable immediately. Electrical use is moderately high at 11,074 kWh in the last year (costing $1,730.63), similar to the previous period and producing 11.8 tonnes of greenhouse gas emissions. Gas consumption (assumed at 242 MJ) adds around 871 kWh, producing just 15.5 kg of CO_2.

'NABERS Home' online assessment on energy use was applied for comparative purposes. As water usage could not be separated from that of the whole property, it was not assessed. This simple assessment showed that the Cottage energy rating at 2.0 stars (out of 5) was slightly worse than average compared to all other similar-sized houses in the same postcode. This is largely due to the lack of solar orientation (windows to east and west), brick-veneer construction with little insulation, lack of ceiling/roof insulation, and extent of electrical lights and appliances. Some of these matters can be addressed as outlined below.

We suggest that you investigate energy and greenhouse gas savings by going to NABERS on-line *Energy Explorer* for interactive self-assessment, www.nabers.com.au/home.aspx

<table>
<tr>
<td>
Ministry residence: 2 star energy performance – below average performer

About your home:

Postcode: -
People in home: 6
Weeks unoccupied: 3
Electricity: 11,074 kWh pa
Natural Gas: 22,070 MJ pa
Water – potable: 244 kL
Water - recycled: 46 kL
Greenhouse gas emissions: 12,481 kgCO2 pa

What the rating means:
The average NABERS Rating is 2.5 stars

More stars indicate better environmental performance.

A 3 star home is above average, 4 stars is excellent and 5 stars is exceptional.

Water rating: 4.5 stars – excellent performer (due largely to recycled water use)
</td>
<td>
Ministry residence: energy-efficiency improvements (least cost to $$)

1 Install water-efficient shower head (AAAAA), plus take shorter showers,
2 Minimise (eliminate?) use of electric clothes dryer,
3 Use cold water only for washing machine,
4 Replace remaining ordinary incandescent light bulbs with compact fluorescent globes (CFLs) or LEDs,
5 Minimise or eliminate 'standby' power by disabling electronic timers etc not used and turning equipment off at powerpoint,
6 Draft-proof the building with seals around outside doors and windows,
7 Install heavier close-fitting curtains or blinds to form still air-space (equivalent to 'decorative double-glazing')
8 Try to rationalise refrigerator storage so the garage fridge isn't normally required.
9 Switch electricity supply to accredited GreenPower supplier (www.greenpower.gov.au)
10 Install R 3.5 (or better) insulation across ceiling in roof space,
11 Consider what is involved in providing better sun protection to eastern and western windows to reduce heat loss /gain.
12 Consider replacing the electric heating/ventilating unit in Bathroom ceiling (energy in-efficient) and substituting with other means.
13 When replacing appliances, select more energy-efficient models and gas for cooktop,
14 Consider installing gas instantaneous hot water system with electronic thermostat when the existing gas storage unit needs replacing.
15 Consider double glazing all southern, eastern and western windows with additional window /acrylic ('Magentite') over the existing windows (creating a still air-gap) – and/or install curtains with pelmet for still-air space.
16 Consider installing rainwater tanks for garden watering, and/or with pump connected to WCs and laundry.
</td>
</tr>
</table>

Cost implications of improvements

Actual costs will vary considerably depending upon how you obtain quotations and the extent of genuine interest and price competition. Please obtain actual quotations before proceeding with any of the suggested improvements.

4. Install compact fluorescents			
6 Draft proof seals	$100 - $500 if professionally installed	10 Ceiling insulation (R3.5 +) professionally installed	$2,500 - $3,500
11 Better sun protection	?	12 Replace Bathroom fan etc	$500 - $800
13 Instantaneous gas hot water	$1,800 - $2,400	15 Create double-glazing	$1,000 - $4,000
16 Water tank, some re-plumbing	$2,500 - $6,000		

Water consumption

DATES	COST	DAYS	POTABLE WATER	AVERAGE/DAY	RECYCLED	CO2 (kg)
August 2008	$141.90	94 days	47 kL	500 Litres	11 kL	

With only one account to review, the only observation that can be made is that for this home is that recycled water usage (used for flushing toilets, laundry and garden) is just one-quarter that of potable (cooking, drinking, washing). Potable water usage is less than the Sydney average per person (185 L).

Greenhouse Gas performance (carbon footprint)

This home produces 11.8 tonnes of greenhouse gas within the last year, mainly from electrical use – lighting, appliances – but particularly air-conditioning. Any and all steps indicated above that improves the energy performance of the building envelope (eg. insulation, sun-shading) will reduce demands upon the air-conditioning and therefore greenhouse gas emissions. Savings of 20 – 30% could be easily achieved

4.0 BENCHMARKS and FINDINGS

The only external benchmarks found for these building types are for the rectories – which essentially are family homes with a study. Hence this study sets out to define new benchmarks based upon the audit review. It should be noted at the outset, that energy reductions of 30 – 40% are commonly possible for *houses* at relatively low cost – often just by behavioral change (e, shorter showers, turning down thermostats). Operational cost savings (eg. improved insulation, weather sealing, more efficient windows) accrue for the rest of the buildings life.

4.1 CHURCHES

Energy consumption varied markedly between the different properties, related most directly to size, age and construction type.

Property	Electricity consumption	Gas consumption	Gas – convert ed to kWh	Energy total	COST pa	CO2 emissions
Heritage - large	20,836 kWh	Nil	NA	20,836 kWh	$3,373.94	16,655 kg
Heritage - small	3,012 kWh[1]	Nil	NA	3,012 kWh[1]	$1,064.40	2,739 kg
Post WW2 - large	5,564 kWh[2]	15,668 MJ	4,352 kWh	9,916 kWh[2]	$1,121.06	5,317 kg
Post WW2 - small	2,140 kWh[3]	Nil	NA	2,140 kWh[3]	$310.66	2,284 kg
Modern - large	10,530kWh[4]	Nil	NA	10,530kWh[4]	$1,375.60	11,245 kg

1 Church + chapel metered together.
2 Assuming one third of combined church + hall consumption (jointly metered)
3 Assuming one-third of combined church + hall consumption (jointly metered)
4 Assuming one-quarter of combined church + hall consumption (jointly metered)

Heritage - large: This large and traditional sandstone and slate building has all the glories plus energy and comfort deficit's typical of its age. Lighting is relatively in-efficient, whilst the mains-electricity strip heating (overhead and under-pew) whilst essential, consumes considerable energy. It has by far the highest energy consumption and operating costs of all the properties we examined.

Heritage - small: This smaller sandstone church is relatively modest in its energy use, probably reflecting its more limited hours of use. Doubtless it is less than comfortable throughout winter months.

Post WW 2 - large: This building is fairly in-efficient in electrical use due largely to its size, but a major part of operating costs is in the radiant gas heating.

Post WW 2 - small: This smaller church of the 1970's is connected to the hall (bi-fold doors separate the two) – so construction and energy issues are similar for both. A past retrofit for fluorescent lighting has increased the energy-efficiency but the holes left in the ceilings offers immediate loss of comfort – with minimal insulation above. Because of its limited hours of usage each week, the energy in-efficiency is masked.

Modern - large: This large and modern church is connected by foyer to a much-used hall and community facilities. But it is almost totally reliant upon artificial illumination and air-conditioning through-out. Hence electrical use and operating costs are relatively high.

4.2 HALLS

Energy consumption varied markedly between the different properties, related to size, age and construction type, but most particularly, the extent of usage.

Property	Electricity consumption	Gas consumption	Gas converted to kWh	Energy total	COST per annum	CO2 emission
Heritage - large	8,429 kWh	Nil	NA	8,429 kWh	$1,190.00	6,874 kg

Heritage - small	2,903 kWh[1]	Nil	NA	2,903 kWh[1]	$456.25	2,635 kg
Post WW2 - large	11,128 kWh[2]	31,337 MJ	8,705 kWh	19,833 kWh[2]	$2,918.00	10,632 kg
Post WW2 - small	4,280 kWh[3]	Nil	NA	4,280 kWh[3]	$621.33	4,570 kg
Modern - large	31,590 kWh[4]	Nil	NA	31,590 kWh[4]	$4,125.75	33,737kg

1 Separate Hall
2 Assuming two-thirds of combined church + hall consumption
3 Assuming two-thirds of combined church + hall consumption
4 Assuming three-quarters of combined church + hall consumption

Heritage - large: This 1950's hall with more recent two-level rear additions is large, cold in winter, and fairly energy in-efficient. Improvements will mostly have to await other major construction works in order to insert insulation, improve heating and the like.

Heritage - small: This older hall is the least expensive to run, but possibly because it's the least used.

Post WW2 - large: These extensive halls, foyers, offices, toilets, conference room etc illustrate typically high energy use from the 1960's. The space is large but poorly insulated, meaning that gas space heating is needed plus extensive electrical lighting. Retrofitting improvements are more easily made here than other parish properties.

Post WW2 - small: The main Hall is really a continuation of the church building - separated by bi-fold doors. The 1970's construction did not consider energy-efficiency, nor the renovations since. Consequently there are a number of cost-effective improvements that can be made as finances permit.

Modern - large: This community facility is connected by foyer to the church, with everything metered as one. It is almost totally reliant upon artificial illumination and air-conditioning through-out, even when there are low-cost options for improvement. Hence this building is unfortunate in that without more extensive expenditure of improved insulation and natural lighting, little improvement can be inexpensively made.

4.3 RECTORIES

Energy consumption was most directly associated with size and age of building, followed by family size.

Property – all figures are per annum	Electricity consumption	Gas consumption	Gas converted to kWh	Total energy consumption	COST per annum	CO2 emissions
Heritage - large	15,462 kWh	10,505 MJ	2,918 kWh	18,380 kWh	$1,447.52	14,861 kg
Heritage - small	14,188 kWh	Nil	NA	14,188 kWh	$2,722.66	18,751kg
Post WW2 large						
Rectory	8,242 kWh	54,020 MJ	15,005 kWh	23,247 kWh	$2,154.99	11,079 kg
Minister	7,088 kWh	18,135 MJ	5,038 kWh	12,126 kWh	$1,080.67	7,873 kg
Post WW2 small	7,454 kWh	26,500 MJ	7,361 kWh	14,815 kWh	$1,489.00	8,555 kg
Modern – large						
Rectory	5,344 kWh	18,000 MJ[1]	5,000 kWh[1]	10,340 kWh[1]	$1,739.00	8,121 kg
Minister	11,074 kWh	22,970 MJ[1]	6,380 kWh[1]	17,454 kWh[1]	$2,319.03	11,842 kg

1 Assumed figure from limited evidence

These buildings are rated from zero, to three star energy efficient (out of five), as assessed by the NABERS housing benchmark. That is, the older parish rectories are extremely energy-in-efficient (0 or 0.5 stars), whilst the more recent rectories are performing at or below average houses for their area (2.5 stars). Hence there is considerable scope for improvement.

Heritage - large: The rectory is large, early twentieth century, poorly oriented for sun, un-insulated, and especially energy-inefficient. Doubtless it's an uncomfortable building through colder months. Because of the heritage significance, only small matters can be improved – but they will make a noticeable difference.

Heritage - small: The rectory shares similar problems with above, with the newer building additions doing little to alleviate the additional summer discomfort (too much poorly oriented glass). The original rectory building (first floor) suffers from a mould problem that needs to be addressed. Electricity costs are high, plus this heating source is far more greenhouse gas emission costly (in-efficient coal-fired electricity generation) than piped gas.

Post WW 2 - large: This rectory is a two-storey 1950's building adjacent to the church. It is fairly uncomfortable due to lack of insulation generally and the more recent (single) glazed family room addition which is a source of large heat gain or less – depending upon the season. The nearby 'cottage' is an attached part of the church hall which suffers from high thermal mass and poor window orientation. Hence it is cool to cold throughout winter and requires excessive energy to maintain some comfort.

Post WW 2 - small: This rectory is a more recent brick-veneer and tile building that has a larger and younger family in occupation, yet with relatively modest energy consumption. The additions have added some solar gain and connected efficient gas hot water heating. The leading concern here is the use of un-flued gas heating, which ideally should be replaced by a 'balanced-flue' fixed heater(s) for better health and economy.

Modern: The main rectory suffers from excessive summer afternoon heat gain (large, un-shaded windows) and relies on air-conditioning both for cooling and partially for heating. These issues are shared with the Assistant Minister's house nearby which has higher energy costs directly related to family size and age (four young children). Both buildings could be improved with additional insulation and shading of glass to east (and especially) western facades.

4.4 FINDINGS in COMMON

Building age: Essentially, the older the church, hall or rectory building the higher the thermal mass (eg. sandstone, full cavity brick); the poorer the orientation (eg. they face the street rather than the sun); the lesser the amount of insulation (if any at all); the draftier the building whether from open chimneys or poorly fitting doors/windows/floorboards - and the greater the discomfort for anyone using the building.

Such findings are not so unusual for heritage properties from the 1800's, but unfortunately the trend has continued almost to this day. The buildings of the 1950's right up to the past few years (including the alterations and additions) all display the same limitations: a lack of concern for solar orientation, natural illumination, a marked lack of insulation, single (energy in-efficient) glazing and the like. Instead, all these buildings have relied upon cheap electricity or gas to buy their way out of energy-inefficiency, with attendant higher operational costs and building-user discomfort. Unfortunately, with electricity prices likely to rise 30+ % in the next few years (through the *Carbon Pollution Reduction Scheme* plus other cost drivers) plus concerns about rising greenhouse gas emissions, electricity costs and energy efficiency will be of increasing concern.

Building construction: Cost 'savings' made at time of original construction (typically insulation, in-efficient glazing) will now cost vastly more to improve. The single most cost-effective measure for building upgrading is better insulation, starting with the roof cavity, thence walls, then under-floor insulat5ion (where possible). In the next few years, retro-fitting existing buildings for human comfort and reduced impacts will become an increasingly essential norm. Each building needs to be assed individually, with starting observations regarding directions for improvement made earlier within the body of this report.

Alterations and additions: Those properties that have been altered or extended in recent years (rectories) display an unfortunate lack of awareness of energy and thermal comfort. Too much single glazing facing east or west means major heat loss or gain depending upon the season. In some cases they may not be a 'safety glass' as is now required within the Building Code of Australia, which could become a problem should an accident happen. Appropriate assessment and up-grading should be considered at earliest opportunity.

Lighting: Most parish buildings have older-style (in-efficient) lamps within whatever light fitting is installed. There has been a quiet revolution in lighting efficiencies (lumens per watt of energy) which means that substantial operational and greenhouse gas savings can be made. Most especially these include replacing incandescent bulbs with compact fluorescents (typically 6 times more efficient and lasting ten times longer), and now replacing these with LED (light emitting diode) lamps (3 – 4 times further efficient and lasting 50 times longer!). Maintaining light quality (eg. 'warm white' and flicker-free) is important, so more expert advise for the individual buildings should be sought.

Heating: Whilst Sydney generally is a 'temperate' climate which allows much passive warmth and 'coolth' from the sun and controlled ventilation, this largely depends upon building orientation and construction. All the parish buildings audited fall short in one or more seasons – some excessively so. Hence the higher heating and cooling bills than otherwise necessary, and too often without overcoming the basic (built-in) problem that determines human comfort (or otherwise). Church buildings or halls that require people to passively sit are especially demanding, as people's comfort tolerance is reduced. Hence whilst limited means exist to address these issues in the buildings studied (without considerable expense), improved performance of the building fabric should be considered as well as /before heating upgrading.

Disabled access: Under the *Disability Discrimination Act 1993* it is un-lawful for public buildings to discriminate or set barriers for lesser-abled people. As a 'complaints-based' procedure it is difficult for building owners to insulate themselves against possible claims even if the building does /did conform at the time of construction. Building regulations are commonly behind public and the disabled expectations.

These parish buildings reflect a range of disability concerns. The heritage /older buildings usually have steps to front /all points of access, let alone the spatial niceties required within Australian Standards. Whilst arguably not complying is discriminatory, most people will accept that full compliance will deleteriously affect building fabric and suggest alternative means of (ramped) access. The newer the parish building the better the response and disabled access compliance (although front door /threshold steps precluding disabled access are too common). More recent attempts to provide access ramps do not now comply (too steep, no turning circle, no rail, etc).

Perhaps of greater concern are those properties where wheelchair users may enter the buildings but then have no access to an appropriately sized and fitted disabled-access toilet. This creates a major impediment ('discrimination') that should be remedied at earliest opportunity.

Constructional issues and BCA compliance: Several matters of building, health and safety concern where found during the course of the audit investigation which require further investigation and assessment so as to develop appropriate remedies. These matters are mentioned in the body of this report.

Directions for improvements: Individual comments have been made for each building within the study. Below are some observations and suggestions for general improvement previously provided to the *Property Trust*, from low cost to higher cost.

'Button-Up'	Weather-strip doors and windows, gaps and cracks – all of which markedly affect comfort and energy-efficiency.
Insulate water heaters	Old-style hot-water storage heaters lose enormous energy, especially if hardly used. At minimum, add an insulation blanket and install temperature thermostat (50^0 max. so no-one gets burned). Preferably, replace.
Install low-flow taps and showers	New low-flow fittings can reduce water use by two-thirds at little cost and still do the job pleasantly. This also reduces the energy costs from hot water.
'Harvest' rainwater - install water tanks	Connect gutters to 'first-flush' device, collect in appropriate tanks and use water for toilet flushing, laundries (both uses requiring a pump), gardens. Do NOT use for drinking /cooking if runoff is from old roofs with lead flashings.
Replace incandescent	Before they're banned! Compact fluorescents and new(er) LED lamps provide the same output at a fraction of the running costs and last 8 to 20 times longer!

light-bulbs	This means the cost of replacement is usually repaid within the first year. Use task lighting, rather than full illumination everywhere.
Install lighting controls	These may include dimmers, time-switches (avoid burning lights all night!), passive infra-red ('Infra-scan') sensors (only switch on when necessary),
Install fans	Where cooling is necessary, install fans with speed controller and reverse (for gently spreading warmth in winter). This has much less environmental impact than AC.
Replace old inefficient refrigerators /appliances	Modern appliances can be three times more energy-efficient than the old (check the 'star-rating'). Don't just dump the old (fridges, air-conditioners), find out where they can be drained of operational gas which are highly damaging greenhouse gas emissions (eg. CFCs are 140 – 11,700 times worse than carbon dioxide).
Tune heating, cooling, air-conditioning	Service all mechanical equipment, tune up and replace filters, pumps and the like. Install electronic thermostats with timers ('set and forget') appropriately regulated. Use the least-impact space heating – sun, gas, electric…
Insulate everywhere	Starting with roof/ceiling, walls and then underfloor (last). Fill every gap and crack.
Efficient hot water systems	Install energy-efficient hot water systems with minimal greenhouse gas emissions. For low/occasional water use this may be instantaneous gas (with temperature control); otherwise consider 'heat-pump' (on roof or walls not necessarily facing the sun); 'evacuated tube' technology; or solar panels (roof-top facing sun) with gas boost (NOT electric boost). Government subsidies give around $2,000 rebate (2008).
Commit to renewable energy	NSW conventionally uses (in-efficient) coal-fired electricity generation. By paying somewhat more per kWh for 'green energy', you pay for and support renewable energy (with much reduced environmental and carbon impacts).
Maximise natural light – minimise heat gain	Creative retrofitting can often add value and opportunity for natural light deep within buildings, through double-glazed roof windows, solar-tubes and the like. At the same time ensure this doesn't lead to excessive heat gain from un-shaded windows.
Use trees and landscape	Not only are they pleasant, they lock up carbon and give off oxygen, they can provide energy-efficiency and cost savings (eg. shade from excess sun or wind. Design for sun /wind protection, to minimise maintenance, to attract birds, for fragrance and aesthetics, using hardy stock of species suitable for that place ('native', 'endemic').
Photo-voltaics (PV) solar cells	These generate electricity, sitting on rooftops. 'Grid-connect' systems generate (usually spare) electricity during the day, which is drawn back at night-time – with a meter that flows both ways (providing or drawing electricity). Currently (2008) there are government rebates of $8,000.

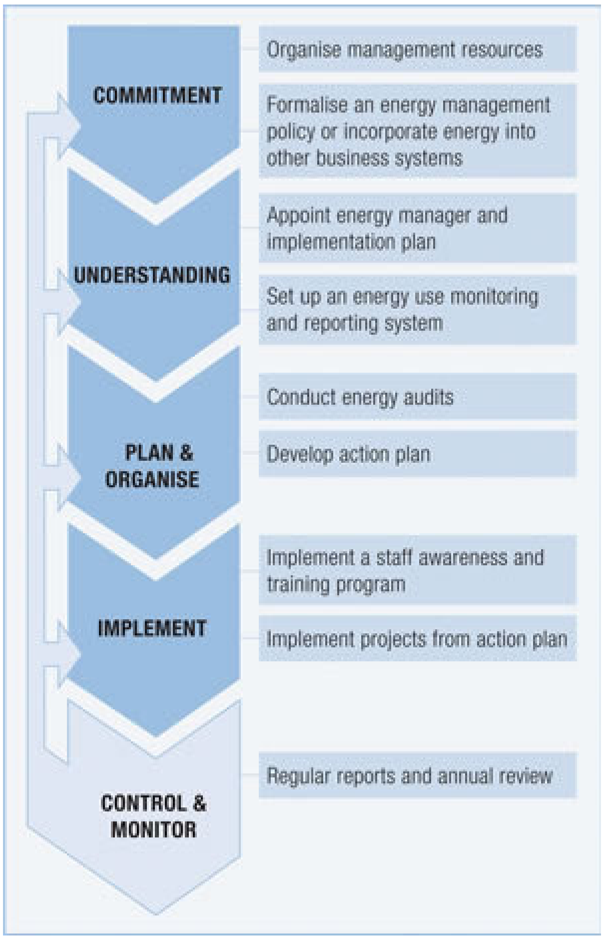
5 CONCLUSIONS and RECOMMENDATIONS

The evidence shows that whilst Australia is doing well in some areas of reduction, overall energy use and greenhouse gas emissions are continuing to rise. This is directly related to our extensive travel (motor vehicles, aeroplanes); larger houses and buildings generally; insufficient insulation and in-efficient lighting /heating /cooling leading to poor overall building performance; imported goods and services generally; ‘food miles’ (eg. food travelling considerable distances to our tables); as well as continued land clearance and degradation.

Hence if improved environmental and greenhouse gas emission impacts are accepted as essential, all bodies including the Anglican Church and it’s properties will need to take action to minimize building, site and individual impacts, so as to reduce overall environmental and carbon ’footprint’.

5.1 SYSTEMIC IMPROVEMENT

Improved performance at local and regional level requires all the following steps, from the broad to the particular, and at every level of organisation.



Achieved (by commissioning this audit and study).

Required.

Required (at Property Trust level)?

Required (at Parish level)?

Generic audit study done.

Generic action plan done.

Required as part of implementation plan by Trust and individual Parish’s.

Individual Parish action plans for improvements.

Annual returns for composite reporting through the Anglican Church Property Trust, Diocese of Sydney.

Figure 3: Continuous improvement feedback loop.

5.2 RECOMMENDATIONS

We suggest that the Anglican Church Property Trust, Diocese of Sydney, consider the following opportunities that arise from this audit in conjunction with the wider issue of climate change as follows:

5.2.1 That, noting that the results of climate change and global warming falls dis-proportionally upon the most vulnerable people of our community and the world, that it commits to improved environmental and energy performance across it's entire jurisdiction.

5.2.2 That in the spirit of setting godly example and good stewardship, it encourages and facilitates reductions in energy and greenhouse gas emissions across all parish properties and buildings to reduce overall environmental and carbon 'footprint'.

5.2.3 That to encourage education, care and stewardship, the Property Trust develops an effective environmental /sustainability policy within each Parish and Diocesan organization that offers practical directions and results in reducing our individual and collective earth-impacts.

5.2.4 That local training and involvement be sought for improved energy/water management practices across all parish properties.

5.2.5 That the Anglican Church Property Trust Diocese of Sydney commits to meeting or bettering the climate change trajectory agreed by our federal government.

5.2.6 That whenever building work is required, passive solar and ventilation design be firstly considered, plus sustainable low-impact methods and materials, so as to reduce overall earth impacts.

5.2.7 That life-cycle costing be considered when commissioning building work – rather than just initial first (construction) cost – to save on dis-economies being built-in to the structure that remain for the life of the building.

5.2.8 That noting the anticipated rise in energy and fuel costs, the Anglican Church Property Trust Diocese of Sydney seeks development where better served by public transport, rather than continued reliance on private transport. Where private transport is the only option, that car-sharing be encouraged.

5.2.9 That alternative /renewable energy sources and /or tariff structures be adopted through committing to 'green power' energy supply as an immediate way of reducing environmental and carbon 'footprint'.

5.2.10 That this audit and report, arising from Synod Resolution 17/07, be accepted as the starting point for a wider Sydney Anglican Diocese commitment and response to the problems and opportunities that arise from climate change.

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7 USEFUL LINKS

ABC	abc.com.au/greenatwork/GreenYourWork/
BASIX NSW Government Sustainability Index	www.basix.nsw.gov.au
Energy smart (Dept. Energy, Utilities & Sustainability	www.energyratings.gov.au
Energy Star program (appliances, electronics)	www.energystar.gov.au
The GreenHome Guide	www.acfonline.org.au
Guide to energy-efficient white goods	www.energyrating.gov.au www.gas.asn.au
Guide to energy-efficient gas appliances	www.gas.asn.au
Global Warming- cool it!	www.environment.gov.au/settlements/gwci
Green Electricity Watch (rates providers)	www.greenelectricitywatch.org.au
Green Power (electricity)	wwgreenpower.org.au
Green Plumbers (Ph. 1800 133 871)	www.greenplumbers.com.au
Enviro Plumbers (Ph. 8789 7000)	www.enviroplumbers.com.au
NABERS home audit (National Australian Built Environment Rating System)	www.nabers.com.au
WaterFix	www.sydneywater.com.au/savingwater/inyourhome/waterfix
Water for life	www.waterforlife.nsw.gov.au
Window energy rating scheme	www.wers.net
Water rating of products (WELS)	www.waterrating.gov.au/
Your building (commercial buildings)	www.yourbuilding.org
Your Home (technical manual)	www.greenhouse.gov.au/yourhome www.yourhome.gov.au/tools/lighting.html www.yourhome.gov.au/tools/water-savings.html www.yourhome.gov.au/tools/white-goods.html

8 APPENDICES

Audit pro-forma

Note that the following comprehensive pro-forma was developed specifically for this project. In practice, it proved too cumbersome and time consuming to use it for assessing three or four buildings in half a day, and so a simplified format was used.

CONFIDENTIAL

ENVIRONMENTAL AUDIT: ANGLICAN CHURCH PROPERTY TRUST

PROPERTY: BUILDING
ADDRESS:
CONTACT PERSON generally:
CONTACT for service/technical enquiries:
DATE of Audit inspection:
INSPECTION limitations (eg. access, heights, weather?

LOCATION /TRANSPORT /MANAGEMENT FACTORS		Note
Parishioner catchment Catchment distances Car pooling		
Other user groups & frequency? Catchment distances Car pooling		
Public transport availability ? Train station(s) distance Bus stop distance from church Bicycle ease of access, parking Walking catchment, ease		
Carpark size, configuration ?		
Church usage of motor vehicles encouraged ? Ownership /leasing Petrol, maintenance subsidised Usage policies		
Site coverage (%) Buildings Paving (types) Grass, vegetation Permeable		
Noise factors ? Proximity to noise sources (eg. road, rail) Shielding (how) ? Shielding effectiveness of building fabric		

Need for ventilation /other openings cal complaints ?		
Daylight factors ? Does the building maximise daylight Are solar obstructions significant Orientation issues Improvement possibilities		
Disabled /accessible access ? Ramps/steps Doors, handles WC, bathrooms Tactile indicators Hearing augmentation Carparking		
Need for enhanced Standards ? Adolescents Severely disabled		
Service supply Electricity, 1 or 3 phase Overhead, underground Reticulated, bottled gas Single or multiple metering 'Green energy'		
Improvement notes		

OPERATIONAL ENERGY – HOT WATER		Note
Type of system ? Gas instantaneous Gas storage Electricity Instantaneous Electric storage - mains Electric storage (gravity – in roof) Solar storage Solar storage (gas boosted) Solar storage (electric boosted) Heat pump –storage Location (inside, outside) Timers Other	No. Age: Energy rating: Star rating:	
Adjustable thermostat ?		
Temperature setting ?		
HWS turned off at all ?		
Outlets connected ? Hot water taps Urn, boiling water unit Dishwasher Washing machine Other		
Showers ? Number available for use		

Frequency of use Approximate shower times Bath, usage		
Pipe runs minimised from HWS ? Proximity of fixtures Insulated thickness & materials		
Hot water saving features ? AAA rated taps, showerhead Automatic tap off Spring-loaded taps Electronic sensor		
Taps Separate hot and cold Single lever mixer taps Other		
How often checked for drips, leaks? Leaking now – test		
System maintenance ?		
Improvement notes		

OPERATIONAL ENERGY – HEATING /COOLING		Note
Air conditioning ? Reverse cycle Refrigerative wall unit Refrig. central system (split, packaged) Evaporative system Single or three-phase Other	No. Type: Rating:	
AC controls ? Auto or manual switching Control location (easy?) Control functions temperature (thermostat), Time, Zones, Air-flow speed Air-vent direction Other		
Fixed heaters ? Electric – radiant (bar) heater Electric – oil-column heater Electric – fan blower heater Electric – in/on floor (fixed, u/carpet) Electric storage (off peak?) Gas – fixed and flued Gas – radiator (flued, unflued) Gas portable (unflued) Gas – hydronic (in-slab, radiators) Oil heater Other	No: Type: Rating:	
Heater controls ?		
Age, use of heater system ?		

Economy cycle /setting ?		
Times of usage ? Who controls?		
Thermostat settings ?		
Zonings ?		
Controls accessible, clearly labelled ?		
Manufacture's instructions available ?		
Maintenance, cleaning ?		
Windows, doors left open ?		
Improvement comments		

OPERATIONAL ENERGY – VENTILATION		Note
Mechanical ventilation system ? Ceiling fan(s) Exhaust fans(s) Wall vents Ducts Other	No. Type: Rating:	
Controls manual /auto?		
Maintenance, cleaning ?		
Natural ventilation maximised? Cross ventilation Comment on opening locations Prevailing winds? Other		
Any heaters requiring external air supplies ? Solid fuel (slow combustion) heaters Gas space heaters (un-flued) Water heaters Traditional cooker Other		
Improvement notes		

OPERATIONAL ENERGY – LIGHTING		Note
Types & numbers of lights used ? Incandescent Fluorescent tubes (type, ballast, age) Compact fluorescents Tungsten halogen (12v) Sodium vapour (outdoors) Mercury discharge (outdoors) Spot/flood lights LEDs Other (detail) Improvement notes	No. indoors No. outdoors	
Lighting power intensity (W/m2)		
Lights left on, unoccupied areas?: Weekdays, Weekends Nights Other Switching (manual, sensors, timers) Improvement notes		
Lighting levels appropriate, to AS 1680.1 or 1680.2 ? Offices, music, reading 320 Lux General purpose 240 Lux Halls, classrooms 240 Lux Assembly, corridors 160 Lux Storerooms 80 lux Toilets 80 Lux Stairs 80 Lux Walkways, carparks 40 Lux Other		
Lights in obscured /useless locations ?		
Lighting controls ? Programmable Time switches Photo-sensor devices Occupancy /motion sensors Dimmers Understandable switching (ie. named)		
Signage to remind turn-off ?		
Emergency, exit lights ?	No. Type(s): Rating:	
Contribution of natural light ? Window location /orientation Skylights, light tubes Light coloured interiors Other		
Maintenance, cleaning ?		
Improvement notes		

OPERATIONAL ENERGY – GAS /OTHER		Note
Reticulated, LPG		
Plant /equipment connected ? Space heating Water heating Cooking Other		
Electronic ignition, pilot flame ?		
Flued ? Standard flued Balanced Other		
Controls ? Timer Thermostat		
Improvement notes		

OPERATIONAL ENERGY – OFFICE /HOUSEHOLD EQUIPMENT		Note
Office equipment? Computers Monitors Photocopiers Printers Fax machines Scanners Multifunction devices Urn, Water boiler /chiller Instantaneous water heater Other	Type:: Usage: Rating: Energy Saver:	
Equipment switched off ? How often, regularly At wall Sleep mode after ? minutes		
What type of printers are used, for what, how frequently ? Laser Ink-jet Dot-matrix		

High-end colour Other		
Signage, training for energy efficiency ?		
Maintenance, cleaning ?		
'Household' equipment? Refrigerator(s) Microwave oven Oven - electric Oven - gas Hotplates – electric Hotplates - gas Range hood Dishwasher (hot or cold connection) Clothes dryer Outdoor/indoor clothes line Other	Type: Usage: Rating: Energy Rating:	
Refrigerator location ? Out of sunlight Clear of the wall Well ventilated Away from heat sources Other		
Improvement notes		

WATER		Note
Supply, metering ? Size Materials Location		
Fitments (WELS Ratings?) Taps Shower nozzles Baths Basins WC cisterns (single flush) WC cisterns (dual flush) Urinals Cleaners sinks Washing machines Dish washer Other	No: Type: Rating:	
Leakages, drips ? Tested Bleed valves tested		
Stormwater ? Runoff from where? Discharged to street ,other Collected, held (how, where) Pumped		

Treated Connected to ? Other		
Rainwater Discharged Collected, held (how, where) Pumped First flush Connected to? Other		
Wastewater Sewer connection Septic /in-ground Other treatment system Blackwater /greywater Other		
Outdoor water reuse Mains, Stored Sprinklers Hose Hose (trigger grip) Drip system Timer Controls Other	No: Location:	
Improvement notes		

THERMAL COMFORT		Note
Climate region – BASIX notes		
Insulation – types, locations, rating or thickness Bulk Reflective Composite EPS Other None	Floor: Walls: Ceiling: Roof:	
Suspended floors ? Insulated ?		
Ground slab ? Insulated ?		
Obvious gaps in insulation cover?		
Roof ventilation ?		
Are all gaps sealed ? Building structure		

Door frames Window frames Architraves Skirting boards Ceiling cornices Construction joins Floor boards Plumbing pipes Exposed beams and rafters Heaters and air-conditioners Gaps between walls Other		
Air leakage ? Open fireplaces, flues Obvious cracks and gaps Ceiling, wall ventilators Exhaust air fans (no shutters) Other		
Any recessed downlights ?	No. Types:	
External doors draught-proofed ?		
Windows draught-proofed ?		
Doors left 'permanently' open		
Windows 'permanently' open ?		
Window curtains or blinds installed ?	Type: Location:	
Any external windbreaks ?		
Glass shading ? North East South West Other		
Improvement notes		

MATERIALS		Note
Building fabric Walls Floors Roofing Other	Material type: Extent: Condition:	
Glass, glazing Single Double	Extent: Ratio: Condition:	

Safety, tempered Toned High performance Leadlight Other Framing material Seals		
Thermal mass ? Light Heavy Mixture Other		
Insulation standards (see above)		
Durability, maintenance ?		
Hazardous materials ? Asbestos lagging Asbestos-cement sheets Lead sheet Lead paints PCB's (old fluorescent s) Other		
Improvement notes		

WASTE & EMISSIONS		Note
'Household' wastes ? Minimised? Recycling Sorting method Compost Other	Collection: Method: Frequency: Volume:	
'Commercial' wastes ? Minimised? Recycling Sorting method Compost Other		
Indoor air quality ? Problem areas Paints Carpets Unflued heaters Poor ventilation Cleaning products Accumulated dust Other		
External lighting - pollution? Extent Types Light spread Uplights Other		

Legionella potential ? (Church property only) Water-based heat-rejection AC system Other		
Volatile Organic Compounds (VOC) NOTE: Not tested Formaldehyde likely? Possible sources Other		
Ozone sources Copiers, printers Other		
Improvement notes		

GREENHOUSE GAS CALCULATIONS		Note
Carbon footprint assessment Gas Electricity Water supply	Consumption: Period: Rate:	
Indirect contribution		
Improvement notes		
TOTAL		