An initiative of the Cairns and
Far North Queensland Environment Centre

CAIRNS AND FAR NORTH ENVIRONMENT CENTRE

Retrofitting for Sustainability

A GUIDE FOR FAR NORTH QUEENSLAND











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Best Bang for your Buck – the top 10

Try these top ten retrofitting actions to reduce your bills, improve the comfort of your home and provide the biggest return on investment:

1. Start with a simple audit of your home to identify the most energy intensive areas and focus your attention on these areas first.
2. Work with nature by improving shading and ventilation. Start by enhancing air flow and breeze paths, use external shading or curtains and blinds to prevent heat from entering your home and use your fans instead of air conditioners. [Conduct a 'passive design' analysis of your home with our site template in the Passive Design Section, pg 2]
3. Install ceiling insulation (with a minimum R value of 3.5) in combination with ridge and eave vents.
4. Upgrade your halogen or older tube style fluorescent lighting to LED or energy efficient fluorescents with fast payback periods.
5. Hot water systems use up to 25% of your power so converting your system to off peak and consider putting it on a timer or turning it off over the summer months can save you money. If your system is old you may wish to upgrade to an energy efficient solar or heat pump.
6. Fridges and freezers use a lot of power so if you have a second fridge or freezer you're not using – turn it off - it could be costing you up to $250 per year. Check the seals to make sure they work properly, and replace them if needed. Next time you have to purchase a fridge buy one with the highest star rating you can afford – it will pay itself back in power savings.
7. Installing a rainwater tank can save up to 100,000L per annum and makes watering in winter guilt-free.
8. When you have to buy new appliances such as TVs, computers, fridges, air conditioners, and washing machines, buy the highest energy star rating you can afford for ongoing savings.
9. Retrofit your energy hungry pool for big savings by installing a pool cover, reducing filtering hours, converting to the off-peak tariff and upgrading your filter and pump.
10. After you have reduced your bills by following the steps in this guide, future proof your home by installing a solar power system to reduce your bills to $0. If you can't afford a larger system look at purchasing a smaller system with larger (5kW) inverter to allow you to upgrade later.

Publisher and Editor:
Cairns and Far North Environment Centre (CAFNEC)

This document should be cited as:
Cairns and Far North Environment Centre (CAFNEC) (2012) Retrofitting for Sustainability – A guide for far north Queensland, (Author: Sophie Barrett, Green at Heart), Cairns

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Acknowledgements:
The author and publisher would like to acknowledge the contribution of members of the Tropical Green Building Network including Beacon Lighting, BlueScope Water, Effective Energy Solutions, Enviromart, GreenBuild (Emma Thirkell), Naked Energy, NQ Solar, Placid Pools, RPM Environ, The Missing Link, Total Project Group Architects, Tropi-Cool Window Tinting, Geoff Anderson and Heather Fijol.

Cover Photos:
Solar power system (Naked Energy), bathroom by Tony Lawson Designs, rainwater tank (BlueScope Water), house by Chris Vandyke Designs (photo: Sean Reason).

Graphic Design: Suse Fewster
Printed on recycled paper
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Overview

Residential households account for around one fifth of Australia's greenhouse gas emissions (105 million tonnes annually).[1] This figure can be significantly reduced by improving the energy efficiency of our homes and appliances. Individually we can all make a difference by retrofitting our homes to reduce our energy use, water use and the amount of waste we produce.

Research shows that making your home more energy efficient can add to its value and make it more attractive to potential buyers.[2] Lower power bills are a very attractive feature.

This guide has been developed for the tropical climate of far north Queensland from Cardwell to Cape York, the northern gulf, and west to the Tablelands. It brings together advice and expertise from local designers, builders, installers and suppliers of energy efficient products in our region to provide you with specific ideas on how to retrofit your home for sustainability in the tropics.

We hope you enjoy your retrofitting journey, that you meet many interesting people on the way and increase your own knowledge of sustainability so that you can share your experiences with others. This guide is intended to be passed around and emailed to friends so if you have finished your renovation, please pass it on (along with notes of your experiences of course!).

There are a number of regulatory issues to consider when retrofitting your home for sustainability which will be referred to throughout this guide. However you should contact your local council for specific regulatory requirements. Always seek the advice of a professional before commencing any renovation work.

Before making any major purchases as part of your retrofit, we encourage you to make sure that the cost of disposing of a product is less than the cost of replacing it. Real sustainability means thinking about the whole cost of your decisions to the environment, society and the economy.



CA Architects

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1. Queensland Treasury (Office of Energy), 2004
2. Energy Efficiency Rating and House price in the ACT, National Framework for Energy Efficiency, DEHWA, 2008

The Local Environment

Coastal far north Queensland has a tropical climate characterised by hot, wet humid summers (the wet season, November to April) and milder dryer winters (the dry season, May to October). Higher altitude areas, such as the Atherton Tablelands, have variable rainfall and temperatures up to 5 degrees cooler all year round. Although the seasons are similar, areas get dryer the further you go inland (such as west of Mt Molloy and Ravenshoe). The climate can be extreme at times, with the risk of cyclones and heavy flooding in summer. In such an extreme environment it is important that our buildings provide us with a high level of safety and thermal comfort.

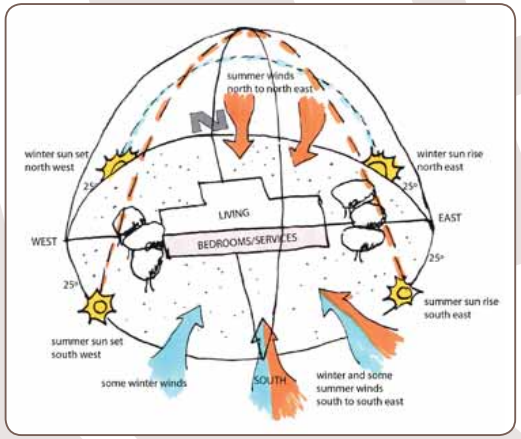
HIGH TEMPERATURES AND HUMIDITY

Far north Queensland has fairly uniform temperatures with a typical daytime range in Cairns of 23-31°C in mid-summer and 18-26°C in mid-winter.[1] We also experience high humidity during the summer months that creates uncomfortable conditions. It is often thought that due to humidity, a 32°C day in Cairns will often feel like a 37°C day in a drier climate.[2] Humidity on the Atherton Tablelands is annually at least 5% lower than Cairns.[3]

SUN PATH AND BREEZES

It is useful to know the sun path and wind directions to better understand the cooling and heating effects on your home. The predominant winds are east to south-easterly with the strongest winds occurring during the winter months. During the summer months prevailing afternoon sea breezes are experienced from the north to north east.

In winter the sun rises in the north east and sets in the north west. In summer the sun rises in the south east and sets in the south west.



Sun and wind paths in north Queensland

CYCLONES

The monsoon trough is close to far north Queensland from December to March and often brings rain, thunderstorms and the possibility of cyclones and associated storm surges.

ENERGY SOURCES

Current peak demand in the region is approximately 360 MW per annum.[4]

The majority of our electricity is from coal fired power stations and travels long distances from southern parts of the state. Significant transmission losses (up to 20-30%) occur across the distribution network to provide power to the regional and remote areas of north Queensland.

There are some sources of renewable energy currently in the Far North including two operational hydro power plants (Barron Gorge and Kareeya Hydro), Windy Hill wind farm, cogeneration at local sugar mills, and solar power systems on local businesses and residences. These power sources have the capacity to generate up to 50% of our current regional electricity demand, but in reality they are generating somewhere between 5-40%.[5]



WATER SOURCES

The coastal and hinterland areas of Far North Queensland are fortunate to have a high annual average rainfall of 1,992mm[6], most of which falls during the wet season. The region is also affected by the La Nina and El Nino cycles. In the early 2000's the El Nino cycle left the region very dry for several years with well below average rainfalls resulting in water shortages and bushfires in rainforest areas.

Water is sourced from various creeks and dams throughout the region. In times of extended dry periods these sources can sometimes struggle to meet the water demands of the community and also leave enough behind for healthy waterways. One area of concern is Rex Creek.

It is easy to be complacent about water use in an area of such high rainfall, but growing populations and climatic changes continue to put pressure on our water supplies. The cost of treating and transporting water to our homes and businesses is substantial, with up to 50% of Council's annual electricity use attributed to water pumping stations and water and wastewater treatment plants[7].

1. www.bom.gov.au/qld/cairns/climate.shtml 2. www.ecosavvy.com.au 3. Calculated from data provided by the Bureau of Meteorology (www.bom.gov.au)
4/5. Cairns and Far North Environment Centre (CAFNEC) (2011) Renewable Energy for Far North Queensland: A Discussion Paper, May 2011 (Ed. Sophie Allen), Cairns, (13pp).
6. www.bom.gov.au/qld/cairns/climate.shtml 7. Cairns Regional Council, Sustainable Building Design Guidelines (2011).

Passive Design

Understanding how to take advantage of natural climate conditions throughout the day, can make a big difference to your comfort and energy bills. "Manage your house like you'd sail a ship".

WHAT IS PASSIVE DESIGN?

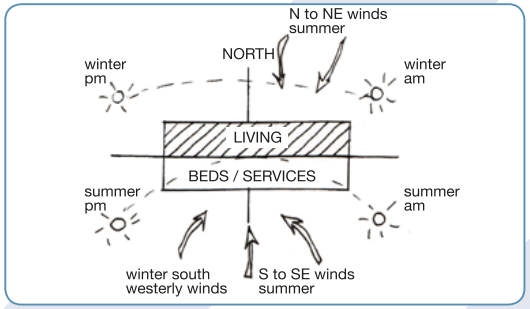
Passive design involves taking advantage of natural climate conditions to provide comfort within a building and reduce reliance on heating and cooling energy. When designing a new building, this can include orienting the building and shading windows and walls to exclude summer sun and capture seasonal breezes and the selection of building materials for best thermal performance.

For retrofitting, a good understanding of passive design can help you harness the benefits provided by nature through improving shading and ventilation to make your home comfortable all year round.



Total Project Group Architects

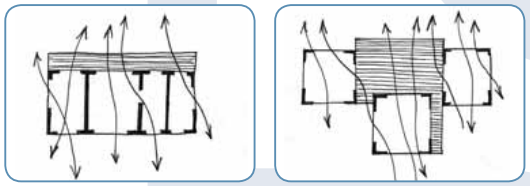
ORIENTATION & PLANNING



If possible, orient your building to cooling breezes and to minimise exposure of walls and windows to the summer sun. Ideally the long axis should be facing north (or within 45° of north) thereby minimising the length of east and west facing walls. In our region the summer sun is rarely in the northern sector, so north facing rooms are the coolest and ideal for daytime living. Services and bedrooms are best located in the southern sector. Where possible, avoid having rooms and hallways blocking breeze paths, open doors and consider removing non structural internal walls to allow for uninterrupted cross ventilation.

BUILDING SHAPE

Narrow buildings or separate pavilions (see diagrams below) are best suited to tropical climates as they minimise hallways and create larger areas of external walls allowing for more openings and easier natural cooling of surfaces in the evenings. Promoting the connection between indoors and outdoors through courtyard spaces and pavilions can create great shaded outdoor living areas.



Narrow Buildings and separate pavilions allow for more openings and better cross ventilation

BREEZES

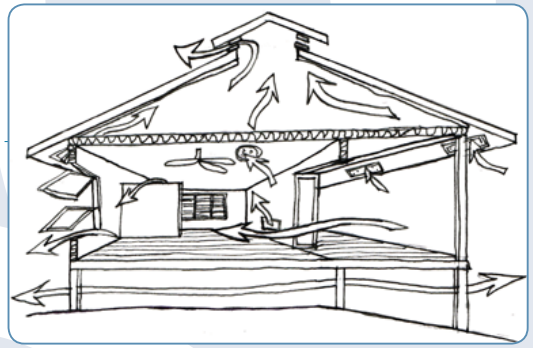
Even in hot humid weather a breeze can help you feel much cooler, with air speeds of up to 1m/s providing a cooling benefit of around 3 to 4°C.[1]

Ideally your home should have a minimum of two openings in each room to facilitate cross ventilation. Locate windows on the side of breeze paths to the south and south-east (winter and summer) and north and north-east (summer) and provide an opening on the opposite side to draw breezes through.

Commonly older homes have many internal walls and hallways that block breeze paths. Consider removing some of these walls and opening up living areas. This will encourage cross ventilation and allow more natural light into your rooms.

As a home user you can control the breezes in your home by opening windows on the windward side and making sure that internal doors are kept open. You can also utilise "night flushing" where doors and windows can be opened at night to draw in cooler air to flush out hot air and cool down internal surfaces.

Roof, eaves and floor vents can be easily installed to help cool your home. Passive roof ventilators or newer solar roof ventilators that use no power, are quiet and can move 14 times the volume of air than the old whirly bird ventilators both work well to reduce heat in the roof space.



Methods of achieving air movement in your home

Passive Design

SHADING

One of the best (and least expensive) ways to keep your home cool is by shading walls and windows. This prevents heat from entering the home, keeping your home naturally cool.

To avoid heat gain in your home it is important to have good overhangs. These should be a minimum of 600mm but ideally 900mm works best to prevent the sun heating up walls and entering windows, especially where your home is of concrete block or brick construction. In summer a 900mm overhang will completely shade the walls and windows in the middle of the day.

Where you have large areas of glazing or on walls facing south-east to east and south-west to west it is recommended to provide additional shading. Deep verandas and overhangs provide excellent shading. Other external shading devices which can be used include timber or aluminium external louvres, pergolas, window hoods, shade sails, vertical screens and trees and vegetation.

Within the home, shading windows with blinds or curtains will also help to reduce heat gain.

WALLS AND WINDOWS

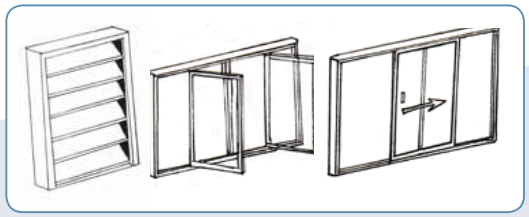
Lightweight well insulated walls perform best in the tropics as they cool quickly at night. Heavy weight concrete block or brick walls can act as a heat sink and retain heat during the day keeping the home warm during the night. Whilst in some inland areas such as the Tablelands this can be beneficial, in most situations in the tropics this is best avoided. If used, make sure they are light in colour and are well shaded by deep verandas and overhangs.

When renovating, select windows and doors with maximum openability to allow air flow, such as louvres, bi-folds or casements. These windows can open fully, unlike most double hung and sliding windows and doors, which only open from 30-50%. See windows and shading section for more details.

LEAST HOUSE NECESSARY

When renovating your home consider whether you really need that extra bedroom. Each bedroom can cost you up to $60,000 to construct and often adds to your ongoing electricity costs.

Window Types



Louvre	Casement window	Sliding window
100% openable	100% openable	50% openable

DESIGN FOR ACCESS

Design for change of lifestyle over time including adding an extra support in bathroom and toilet walls for future installation of grab rails, and installing larger door openings, slip resistant surfaces, and easy internal and external access ways.

Retrofitting tips

- Learn to open and close windows, curtains and doors to take advantage of natural heating and cooling throughout the day and night
- Shade walls and windows with external shading devices or vegetation
- Install roof and eaves vents
- Zone areas by positioning living to northern sector and bedrooms and services to the southern sector
- Remove obstacles to breeze paths such as walls and hallways to open up your home
- Minimise east and west facing walls
- Orientate to cooling breezes with a minimum of two openings per room
- Single room width buildings or pavilions work best in tropical climates
- Future proof your home by designing for access for future life stages



Verandas and good overhangs keep the home cool
Chris Vandyke Designs. Photo: Sean Reason

1. Sandy McCathie, Guide 2 - Harnessing Cooling Breezes, Planning Services Unit, City of Townsville

Passive Design Activity

The following site analysis exercise will help you analyse your home to identify areas that need to be addressed. Think about possible locations of external shading devices or vegetation to shade your windows and walls, making your home cooler and more comfortable. Ask a designer for help if needed.

Putting it all together

Conduct a passive design assessment of your home

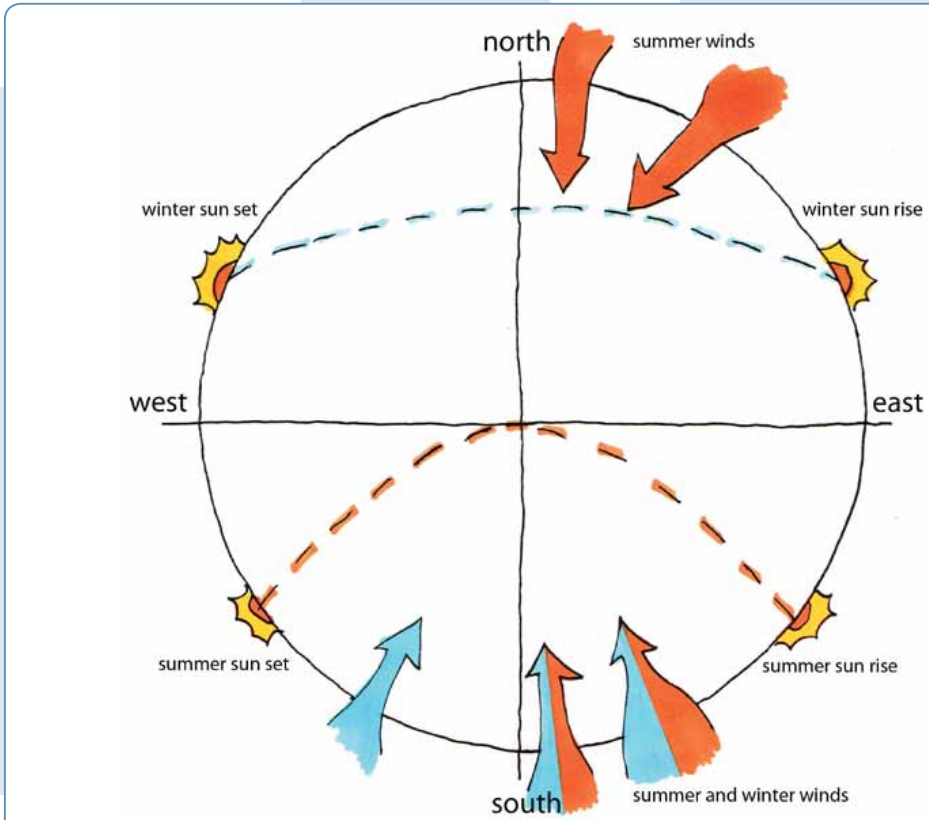
What you need: Tracing or greaseproof paper, ruler, pencil

Using tracing paper draw your house plan over the middle of the circle and orientate with north facing up the page. Note the summer and winter sun paths and any walls that may heat up in summer. Pay particular attention to walls in the south east to east (for summer morning sun) and south west to west (for summer afternoon sun). Note any issues in terms of excess heat due to lack of shading and large glazed areas.

Draw the breeze paths (taking these through the windows and doors and through your house) and note any internal and external obstructions. Do you have enough windows and are they large enough to capture breezes? Are they located in the right positions? Are your windows very openable? Mark your ideas on the plan.

This exercise should give you a good idea of what you can do to improve the comfort and sustainability of your home both in terms of how you use your home and some direction on the best retrofitting ideas for your home. Consider external shading to walls and windows, internal layout changes and wall removal and best placement of windows, doors and outdoor shaded areas. The rooms that you spend the most time in during the day should be in the coolest sector.

This exercise has been provided courtesy of Green at Heart © 2012



Planning and Finances

DIY or engage a contractor?

When looking at the scope of your project you need to make a decision about what work you can do yourself and what is legally required to be undertaken by a qualified contractor. You may be able to install light bulbs or external blinds yourself, but improvements such as changing light fittings or fans, extending eaves, window tinting or installing solar hot water systems will need a licensed contractor. Larger works and renovations should be undertaken by professionals.

PLANNING A RENOVATION

Once you have your ideas and suggested improvements in sketch or written form and a rough estimate of your budget, you can move on to planning your renovation.

There are a lot of factors to consider. You will need a good architect or building designer if the work is substantial, or a drafting service for minor works. You also may have to obtain approval from Council or a private certifier and access finance for your project. Some people may wish to undertake the project as an owner builder and co-ordinate their own contractors.



CA Architects

CHOOSING A DESIGNER

Architects, building designers and some builders can help you design and document your renovation. It is a good idea to do your research when choosing a designer.

Architects charge between 7-15% of the overall renovation budget for full service including tender and contract administration. Building designers typically charge around 5%. Services can include anything from design and documentation to tendering, contract administration and full supervision. Some builders offer a design service which is convenient. While this may seem a cheaper option, it is often factored in to their construction price.

When selecting a designer, ask to see examples of their work and check if they have any additional qualifications in environmental design. Architects and building designers vary in the quality of their work so choose one that you are comfortable with in terms of the work they can produce and your budget.

LICENSING REQUIREMENTS

Building designers and draftspersons must be licensed by the Building Services Authority (BSA) to undertake design and drafting work while architects are registered with the Board of Architects. Some builders also offer a build and construct service and are licensed to do so under the BSA. You can check if your designer is licensed on the BSA website **www.bsa.qld.gov.au.**

ENERGY EFFICIENCY CERTIFICATION

Some renovation work will require the services of an energy efficiency certifier. Your designer, private certifier or Council will let you know if this is required. When undertaking a large renovation you may also be required to upgrade the existing component of the home to current energy efficiency standards or obtain the minimum 'star rating' of six stars.

It is important to consider energy efficiency when purchasing a home to renovate as it may be costly to upgrade to current energy efficiency standards. Additionally it is a good investment to upgrade your home as it may be worth more if you increase the energy efficiency or install energy efficient features. Research in the ACT, where Mandatory Disclosure of a property's energy efficiency rating at point of sale is in place, shows that each star can add up to $10,000 to the value of the home[1]. A more energy efficient home also means lower running costs and improved comfort as well as a potential higher resale value.

SAFE DESIGN

New Work Health and Safety legislation introduced on 1 Jan 2012 requires all structures to be designed to meet safety requirements any time they are used as, or at, a workplace including during the construction, maintenance and demolition at the end of use. Your designer may also have to provide you with a safety report. As the client you may also have duties under the legislation and should consult your designer for more information.

STRUCTURAL ENGINEER

Your designer will need to consult with a structural engineer to certify or design the structural component of your renovation. If you are doing your own renovation work, you may also need to check with a structural engineer before commencing, particularly if you are looking at making changes to structural walls or windows and doors. In Far North Queensland it is particularly important to ensure that the structure is designed to withstand the wind speeds of the cyclone category applicable to your site.

CHOOSING A BUILDER

There are a number of factors to consider when selecting a builder such as price, availability, workmanship and whether they have an interest in helping you to source environmentally sustainable products. The HIA (Housing Industry Association) have GreenSmart accredited builders and the MBA (Master Builders Association) have a Green Living program. Check with the BSA that the builder is currently and appropriately licensed and obtain three quotes if possible.

A BSA Minor Works Contract should be signed with your builder for work valued between $3,100 and $40,000. For works over $40,000 you should sign a major works contract. Free advice is available by phoning BSA on 1300 272 272 or visiting BSA's website (**www.bsa.qld.gov.au**) and free Online Licence Search.

OWNER BUILDERS

You may consider undertaking your project as an owner builder. As an owner builder you will have full control over the project giving you the ability to select your own tradespersons, access builder's discounts, negotiate prices with tradespersons and create your own schedule which suits when you have the funds available. The satisfaction of creating your own home and saving money are factors that generally draw people to owner building.

It is important to be aware that you also take on many of the responsibilities of the builder including being personally responsible for dealing with individual contractors if problems in workmanship occur, for payments to rectify any defects in the building work or to complete any work left incomplete by an individual contractor as well as complying with the current Workplace Health and Safety legislation. Fortunately there are courses in owner building which provide participants with information on how to manage your owner builder project. On successful completion you can apply for an owner builder permit from the Building Services Authority.



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BUILDING CERTIFIERS AND COUNCIL APPROVALS

Some areas in North Queensland require a development application (DA) as well as a building approval (BA). These can include areas which are zoned multi residential, or classified in the planning scheme as hill slopes, bushfire prone, protected vegetation and waterways, airport or seaport zones or heritage-areas. Ask your designer or contact council prior to starting your renovation to find out if approval is required.

Some renovations require 'siting dispensation' approvals where additions and alterations encroach onto the required building setbacks from boundaries which is generally 6m from the front boundary or 1.5-2m from the side boundary to the eaves.

In many cases you will only require building approval (BA). To obtain approval of your renovation you may wish to lodge your plans with council or a private building certifier. Many people choose to use a private certifier as they can provide independent advice and support with your application. Make sure your certifier is licensed with the BSA. Your local council can also provide advice and building approvals and have an information desk where you can speak to the town planner or building department representative to have your questions answered.

GREEN HOME LOANS AND GOVERNMENT INCENTIVES

Many financial institutions offer a discount for Green Home loans with some offering a 0.5% discount on the standard rates. With a renovation of $150,000 this could mean savings of up to $50,000 over the life of the loan.

There are currently government incentives to assist with the purchase of solar power systems. Government incentives change regularly so ask your installer for more information.

LOCAL GREEN BUILDING SUPPORT

The Tropical Green Building Network (TGBN) is a network of people interested in sustainability and green building. Members include individuals and associations as well as architects, building designers, builders, product suppliers and installers. The monthly meetings are great to attend to find out information about other people's experiences and talk to professionals. More information on events and the online forum can be found at **www.tgbn.org.au**. There is also an online directory of professionals in the industry at **www.greenbuild.com.au**.

APPLICABLE WEBSITES

Building Designers Association of Queensland (BDAQ)
www.bdaq.com.au

Building Services Authority (BSA)
www.bsa.qld.gov.au

Board of Architects Queensland
www.boaq.qld.gov.au

Housing Industry Association (HSA)
www.hia.com.au

Master Builders Association (MBA)
www.masterbuilders.com.au

Tropical Green Building Network (TGBN)
www.tgbn.org.au

Retrofitting tips

- Choose a building designer, architect or builder who specialises in environmental design or construction and look at their industry accreditation
- Call your local council to check planning requirements and approvals
- Aim to exceed the minimum 6 star energy rating
- Consult with your designer on safe design
- It is a good idea to obtain three quotations for work
- Ask your designer or builder for details on current rebates.
- Join the local Tropical Green Building Network for some great networking and advice

1. http://www.nathers.gov.au/about/publications/eer-house-price-act.html

Building Materials

Selecting the right materials can make your home healthier and safer, as well as reduce the impact of your renovation on the environment.

SELECTING BUILDING MATERIALS

Lightweight versus heavy weight construction?

This is a question commonly asked in north Queensland. In general, lightweight structures that do not rely on air-conditioning are the most energy efficient option.

Lightweight structures, such as the 'Queenslander', are typically timber framed and clad, and elevated to release heat quickly. Heavy weight structures are typically made of brick or block and sit on a concrete slab on the ground. Both have their benefits and the efficiency and comfort of each can be improved through retrofitting.

Lightweight homes are ideal for natural ventilation as they do not store as much heat in their materials. Ideally lightweight homes should be elevated so breezes can be directed through the home and under the floor to keep it cool. To perform optimally they should have well ventilated and insulated roofs and walls and excellent cross ventilation.

Heavy weight structures can perform well if they are light coloured and have good overhangs/eaves (900mm ideal), roof ventilation and insulation. Slab-on-ground floor construction (with tiled surface) can perform well and can keep the home cool as long as the slab is not being heated by sun coming through glazed areas. In the tropics, concrete block homes with minimum overhangs and poorly ventilated roofs can be very hot as they store heat in the walls during the day. Retrofitting to shade walls and windows can greatly enhance the thermal comfort of these homes.



Lightweight elevated homes can cool easily
Tony Lawson

Lifecycle analysis and local products

Every product has environmental costs associated with the production of the materials, manufacture, transport and distribution – referred to as the Life Cycle Analysis (LCA). For example, Queensland grown plantation timber has a better LCA than concrete as it captures carbon during its growth, is lighter and easy to transport and can be recycled. Concrete has a poorer LCA, due to mining and environmental damage, as well as issues with production and transportation. Timbers from old growth forests (such as in Tasmania) and from countries like Malaysia and PNG can have environmental issues such as the loss of habitat for endangered species.

Do some research to find products that have a good life cycle and eco-footprint. Many manufacturers are now promoting theses features as part of their marketing. Sourcing products and suppliers locally helps support local businesses and reduces the number of carbon miles of that product. Timber products should be sourced from plantations or through legitimate sustainable timber certification schemes. (See the Forest Stewardship Council, **www.fscaustralia.org**).

Roofs

Using light coloured metal roof sheeting or roof paint will reflect heat and keep your home cooler. Metal sheeting also has the advantage of releasing heat quickly at night. Installing reflective foil insulation under the roof sheeting and bulk insulation on the ceiling with vented eaves and ridge vents can make this an effective system. Tiled roofs slowly absorb heat and re-radiate it into the home at night which can make it harder to cool your roof space.

Consider the use of a green roof such as soil filled plastic cells with plants or grass to keep your home cooler.

Walls

Lightweight insulated walls with breathable sarking (reflective foil or other flexible membranes for waterproofing, vapour proofing or thermal reflectance) are ideal in far north Queensland to keep your home cool and reduce condensation and mould growth. Well shaded concrete block can also perform well. Use light colours for best performance.

Floors

The earth maintains a constant temperature during the day, so slab-on-ground can help keep your home cool in summer if well shaded. Lightweight elevated timber floors can cool easily and release heat that has built up during the day.

Finishes & colours

Zero or low VOC paints and finishes (see hazardous substances below) are a good choice for your renovation. Not only do they have the benefit of improving the quality of your indoor environment but also are safer for the installers to apply.

Light colours work very well in far north Queensland for reflecting heat and can improve the energy efficiency rating and comfort of your home.

Recycled materials and reducing waste

Recycled materials reduce resource depletion and can be sourced in far north Queensland through various suppliers.

For housing there are many products available for internal or external use. Some options include insulation products made from recycled glass or plastic, plastic 'wood' products made from recycled plastic used for decking or landscaping, or recycled plasterboard. Many commonly used building products such as some particleboard and external cladding products contain recycled content. Visit local website **www.recyclebuild.com.au** to source recycled building products for your renovation.

Minimise construction waste by designing to suit material widths and sheet sizes. Some waste materials such as scrap metals (eg. steel and copper) can be recycled, although there are currently limited options in far north Queensland for recycling construction waste. Please contact your local council for more information.



Heavier mass homes can work well if well shaded and light coloured
Chris Vandyke Designs. Photo: Sean Reason

Mould and Mildew

Mould is a problem in far north Queensland, especially in the wet season. Make sure roofs and walls are breathable (eg. breathable sarking and roof/wall vents) to reduce the amount of mould and moisture accumulating. Condensation can occur outside air-conditioned zones in walls and insulation products. Good cross ventilation is a must. Ventilated shelving is also useful in linen cupboards and wardrobes.

There are a number of mould resistant products, paints and finishes, but make sure that they do not contain any harmful chemicals. Natural remedies such as clove oil and vinegar can be effective in preventing the growth of mould spores on walls and surfaces.

HAZARDOUS SUBSTANCES

When renovating your home you need to be aware of the possibility of hazardous substances including those shown below.

Asbestos

Asbestos is a naturally occurring fibrous silicate mineral that can be harmful when disturbed during activities which produce fibres or dust including maintenance or renovation. The importation or use of asbestos containing products has been prohibited since 2003 but was phased out from the mid 1980s. Some post-2003 buildings may still contain asbestos due to product stockpiling by distributors. It can be found in items such as cement sheeting, roof sheets, some texture paints, vinyl floor tiles, pipe lagging, fire resistant boards, and around ovens or heaters. It is important to always seek professional advice about managing or removing asbestos in your home.

Lead

Lead paint is most likely to be found in homes built before 1970, and lead can also be found in items such as old PVC pipes and flashing. Ingesting lead is harmful, particularly to children. When renovating, be particularly careful when stripping, sanding, abrasive blasting or burning paints containing lead. Some hardware stores have home test kits available. If you do find lead in or around your home, phone your state health unit for advice and use a qualified contractor.

Volatile Organic Compounds (VOCs)

Volatile Organic Compounds (VOCs) are chemicals that evaporate into the atmosphere at room temperature. They often have an odour and can be found in a wide range of household products, construction materials, new furnishings and also in paints, varnishes and adhesives. VOCs can be emitted from products for up to 7 years after application. Make sure the room is fully ventilated when applying these products and until the odour considerably disappears. Select paints and adhesives with a low or no VOC content. Ask your builder or supplier about the VOC content of any building construction materials selected for internal and external application.

OTHER HARMFUL SUBSTANCES

Treated timber

Timber can be treated to increase its longevity with pesticides and wood preservatives, including heavy metals and in some cases arsenic. Appropriate protective equipment should be used, and if in doubt consult an expert. Treated timber can be hazardous when sawing or sanding and hands should be washed after handling, children should not eat soil around treated timber. Treated timber should also never be burnt as it emits dangerous gases.

PVC

PVC is commonly used for pipes and can be hazardous. Avoid breathing dust and fumes and do not heat.

Termite treatments

When renovating it is preferable to use physical rather than chemical barriers termite treatments. Steel mesh products can be very effective and low toxicity chemical options are available.

Always seek the advice of a professional when dealing with hazardous substances.

Retrofitting tips

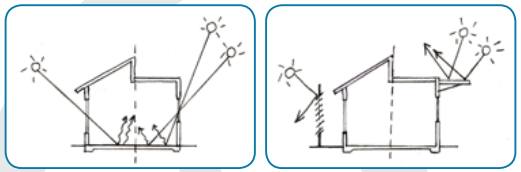
- Consider the lifecycle of materials before selecting
- Choose materials with recycled content
- Choose low or no VOC paints and finishes
- Shade heavy weight materials so they don't store heat
- Insulate and shade lightweight walls and use light colours
- Beware of hazardous materials when renovating
- Visit www.greenbuild.com.au for a directory of local sustainable building products and services

Windows and Shading

Windows are not only the eyes of your home but also one of the items that can best be adapted to help improve your thermal comfort and reduce your energy bills.

Heat enters your home when sunlight passes through the windows heating the air and surfaces inside. Effective management includes good cross ventilation with a minimum of two openings in each room and the installation of external shading devices.

In air-conditioned homes, you should first look at reducing heat entering the home as your air-conditioners will have to work harder to keep the occupants comfortable.



Heat entering through unshaded windows can be eliminated by appropriate shading devices

Factors influencing heat gain through windows are orientation, types of windows and glass, window coverings such as blinds and curtains, and shading.

ORIENTATION AND SHADING

Windows are best located to the north, while large glass windows to the east and west should be minimised. Windows should also be orientated to capture breezes, particularly summer breezes from the north to north-east. Overhangs should be designed to be at least 600mm, with 900mm being ideal.

For existing window retrofitting external awnings, internal curtains or blinds, and window tinting, can considerably reduce heat gain. For east and west facing windows consider rubber backed or double thickness curtains. Some external shading solutions include:

- Planting shade trees or shrubs
- External louvres
- Shade sails
- Increasing overhangs and adding verandas
- Window hoods and awnings
- Replacing glass windows with timber or aluminium louvres.

WINDOW AND GLASS TYPES

When selecting window styles for an extension or replacing existing windows, bi-folds, louvres, casement windows (100% opening) and triple sliders (66% opening) allow for the best ventilation for your home. You can also increase the size of your openings by replacing windows with sliding or bi-fold doors to allow more air into the home.

There are various types of glazing available. Clear glazing transmits around 83% of the solar radiation inside. Select tinted, toned or low-emissivity glass (thermal glass) to reduce the heat gain through your windows. Frames can also conduct heat into your home. Timber frames are best or aluminium frames with a thermal break which stops heat conducting through the frame.

WERS (Window Energy Rating Scheme)

You can check the thermal performance of different window products to see how they perform at www.wers.net much in the same way as appliance star ratings. For far north Queensland look for the highest number of cooling stars.

WINDOW TINTING

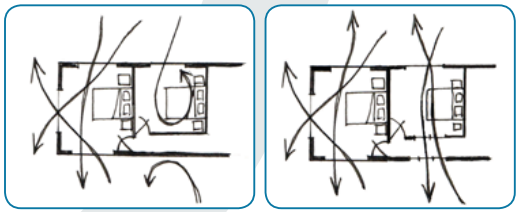
Applying tinted window films can greatly reduce the amount of summer solar heat gain for existing windows, in some cases by up to 75%, as well as reducing glare and the need for air conditioning.

Choose a film that is dark or reflective and has a low SHGC (Solar Heat Gain Coefficient, eg. a SHGC of 0.18 will allow 18% of the sun's heat through). Be aware that a very dark tint may increase your need for artificial lighting.

Silver reflective foils have excellent performance but the reflected light may be dangerous to passing motorists and flying birds and irritating to neighbours. Tints are available in silver, grey, green and blue for different effects and there is even a security tint that makes it hard for thieves to smash and remove windows. Most tinting installers offer a lifetime warranty (until the house is sold) against faults such as fading, peeling, bubbling and cracking.

CROSS VENTILATION

Installing windows on the windward size (north to north-east in summer, and south-west to south-east in winter and summer) and increasing opening sizes can promote cross ventilation. Make sure there are a minimum of two openings in each room and that you open windows and doors within your home to obtain maximum benefit.



Before After

Retrofitting windows can increase cross ventilations to rooms

Retrofitting tips

- Add external shading or tinting to windows to keep your home cool
- Install curtains or blinds for a cost effective way of reducing heat gain
- Replace window and doors with types that increase ventilation such as bi-fold, louvres, casements and triple sliders
- Add an extra opening to rooms to promote cross ventilation
- Make sure you have windows in the right location to capture breezes
- Check window and door seals to reduce load on your air-conditioning
- Purchase windows with a high WERs rating

Insulation

A good roof insulation system is typically the most cost effective way to improve a home's energy efficiency and could save you up to $200 each year on your electricity costs. Insulation creates a barrier to heat transferring through ceilings and walls and keeps your home cooler.. Although all newly-built homes must now be insulated, many older homes, up to 40% of Australia's housing stock, remain un-insulated.

HOW DO I KNOW IF I HAVE INSULATION ALREADY INSTALLED?

You can inspect your roof space to see if you have insulation installed. Bulk insulation will usually be fluffy, tan or pink, and be installed between your ceiling joists or as a blanket with a foil lining under your roof sheeting. Old insulation may not be effective and may need replacing.

TYPES OF INSULATION

Bulk insulation: includes materials such as glass fibre, cellulose fibre, polyester (made with a percentage of recycled PET bottles), polystyrene and wool. There are also recycled glass wool products and products that are free from formaldehyde, phenols, acrylics and dyes.



Wall insulation batts[2]

Reflective Insulation: includes reflective foil laminates (RFLs) or reflective bubble and polystyrene products that reflect up to 95% of heat entering a roof, and act as a vapour barrier and very important condensation combatant.[1] These are best installed directly under the roof sheeting at construction stage. It is possible to retrofit RFLs on existing homes but there are potential electrical hazards, so work should be only be undertaken by a professional contractor.

Loose-fill insulation: is best suited for flat or skillion roofs, and consists of shredded or granulated material (usually newspaper) supplied in a loose form and treated to make it pest and fire resistant. It may settle over time, reducing its effectiveness so ask your contractor to advise you of the "settled R-Value".

R VALUES

The R-Value is the most important thing to consider when choosing insulation and is a measure of the material's resistance to heat flow. The higher the R-Value, the greater the resistance and better the performance. Ask for a product R-Value (of the material itself) rather than a system R-Value (of the roof product, airspace and product) as this will make it easier for you to compare products.

THINGS TO WATCH OUT FOR:

Recessed downlights: In particular, halogen low voltage down-lights run very hot, are a fire hazard and should either be removed, or covered with a protector and the recommended clearance allowed.

Dust & Settling: A layer of dust on the reflective surface will greatly reduce performance of your reflective foil, so it should be regularly maintained. Insulation has a finite lifetime as it compresses over time.

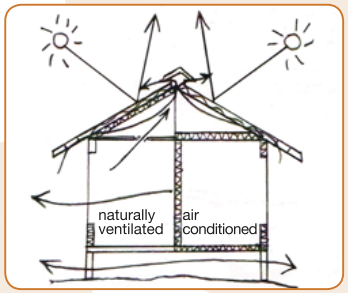
DIY

Check with your insulation supplier to see whether you are able to install your own ceiling batts and make sure you wear protective equipment and install as per manufacturer's instructions. VERY IMPORTANT - Turn off the power before entering the ceiling space and DO NOT work in the middle of the day as the space will be very hot. Maintain clearance around down lights or use down light covers.

INSULATION SYSTEMS

Homes with a pitched roof and flat ceiling can be easily retrofitted by installing batts with a minimum R-Value of 3.5 on the ceiling and a good roof ventilation system. Foil lined batts can help prevent condensation, particularly in air conditioned homes. Reflective foil can also be retrofitted under roof sheeting, however this can be costly and should only be undertaken by a licensed contractor.

For flat or skillion roofs the roof sheeting is often removed to install insulation batts although there are some loose fill insulation products that can be blown in to the roof cavity.



Block walls can have insulation installed on the wall exterior using polystyrene board or batts fixed between battens at 600mm centres and covered with a weatherproof cladding.

Natural and air-conditioned ventilation options

Retrofitting tips

- Insulate your veranda for comfortable outdoor living
- Insulate east and west facing walls
- Make sure your insulation has a high product R-Value
- Install insulation in conjunction with roof and eaves vents to further reduce roof temperatures and condensation

For naturally ventilated homes consider the following:

- Ceiling insulation with a minimum downward R Value of 3.5.
- Reflective foil under the roof with an air gap of at least 25mm.
- Ventilated roof, eaves and ceiling.
- Insulate walls with a minimum R1.5.

For air-conditioned homes consider the following:

- Insulate roof and floors with high upward and downward R value insulation, minimum of R3.5.
- Seal building well for maximum efficiency.
- Install a vapour barrier to prevent condensation.

1. Australian Standard AS1562.1 (1992) Appendix A - Roof Ventilation , water vapour and condensation
2. Earthwool insulation batts courtesy of Effective Energy Solutions

Lighting

Lighting can contribute significantly to your energy bill particularly if you have halogen or old-style tube fluorescent lighting installed. The good news is that upgrading your lighting is relatively inexpensive and will quickly pay back the investment.

TYPES OF LIGHTS

There are three main types of lights: incandescents (including halogens), fluorescents and LEDs (light emitting diodes). The incandescents have now been phased out.

Halogens

A type of incandescent often used in down lighting and are high energy users. A standard halogen uses 10% of its energy to generate light and 90% to generate heat (of up to 500°C), which will add significantly to your cooling costs. Halogens may also eventually be phased out. If you have a dimmer, a simple adjustment can save you over 50% of the energy use by decreasing the brightness of your halogens.

Fluorescent Lighting – CFL and tubes

Much more energy efficient and have a longer life that incandescent or halogen bulbs. Most fluorescents have a charge time using about 5 times the bulbs wattage for the first 5 minutes. Disposal is an issue as there is a small amount of mercury, a hazardous substance, in each globe. Contact your local council to see if there are any recycling options available. Fluorescent lights, including CFL and T5s, contain the rare metal Iridium in the electronic ballasts, which at current consumption rates may run out in the near future.[1]

Lighting Type	Cost of bulb (Approx)	Annual Power use (at 4 hrs/ day)	Annual running cost per bulb (at 21c/ kWh)	Lifetime
Replacing halogens or incandescent globes with CFL and LED				
Single Halogen 45W 240V or 12V	$10	65.7kW	$13.80	1,000 hrs
CFL 11W GU10 240V	$10-12	16.0kW	$3.36	10,000 hrs
LED 6W GU10 240V or 12V	$15-40	8.73kW	$1.83	50,000 hrs**
Replacing T8 Fluros (standard 1200mm long tube) with T5s tubes or LED				
Fluoro T8 with transducer 45W	$10	65.5kW	$13.75	10000 hrs
Fluoro T5 with transducer 28W	$10 + $35*	40.8kW	$8.57	20000 hrs
LED T8 equivalent 20W	Up to $100	29.1kW	$6.11	20000 hrs**

* You will need a kit to convert T8 to T5, at an additional cost of approx. $35.
** Rated lifetime is often much greater than actual lifetime. In reality a LED light degenerates by 10% over 8,000-10,000 years.[3]

Light Emitting Diodes (LEDs)

Convert most of their energy to light (not heat) and use up to 90% less energy than incandescents. They also produce more light per watt and have a rated lifespan of up to 80,000 hours. They reach full brightness instantly and operate at a low voltage making them cool to touch and safe to handle. They do not contain mercury or other harmful gases and are becoming more affordable.[2]

Retrofitting tips

- Utilise natural daylight by adding or increasing windows, opening curtains and having light coloured internal and external surfaces
- Install solar tubes or skylights for free lighting!
- Upgrade to energy efficient lighting to save hundreds
- Utilise dimmers to reduce use
- Halogens are not energy efficient but lower wattage halogens are available
- New homes are required to install minimum 80% energy efficient lighting.

RETROFITTING TO ENERGY EFFICIENT LIGHTING

To retrofit your halogens you must first determine whether they are 12V or 240V. To determine the voltage you can look at the pins. The thicker pins (approx 2-3mm Ø) are 240V and the thin pins (approx. 1mm Ø) are 12V.

Bulbs in 240V fittings can be directly replaced with GU10 CFL or LED. For 12V fittings it is possible to use 12V LED lamps, although you should check with your lighting suppliers as not all lamps will be compatible and it is often more cost effective in the longer term to replace the whole fitting.

REPLACE T12 AND T8 TUBE FLUOROS WITH T5 OR LED

T8 fluorescent tubes are not very efficient and can be adding to your power costs. Retrofitting these with the slimmer T5 fluoros which use 30% less energy is a good option. It can be expensive to retrofit T5s as an attachment is needed in addition to the globe. A recently available solution is the LED equivalent to the T8 which can be placed into the standard T8 fitting.



1. http://www.ecospecifier.com.au/knowledge-green/technical-guides/technical-guide-5-high-performance-fluorescent-lighting.aspx
2. www.led-lamps.net.au
3. Robert Finn, Beacon Lighting Cairns

Appliances

Appliances, including air-conditioning and refrigeration, can account for over 60% of your energy use. When buying new appliances make sure that you invest in the highest energy star rating that you can afford, as the energy savings will easily exceed the extra initial cost over the life of the appliance.

Calculating appliance energy use

Look for the watts rating on the plate on your appliance (eg. 600W - the watts per hour). Multiply this by the number of hours used per day and multiply this by 365 to obtain an annual energy use. For example:

Watts per hr	Hrs Used per day	Days Used p.a.	Total kW p.a.	$ per kW	Total
Fridge					
89	24	365	779	0.21	$164
Air-conditioner					
1800	8	250	3,600	0.21	$756

AIR-CONDITIONERS (ACs)

Air-conditioning accounts for up to 40% of your energy bills. A single unit can cost around $180 per quarter[1]. Older model air conditioners can be badly designed, noisy and expensive to run.

Energy Efficiency Ratios (EER) gives us a way of judging performance. In Queensland the EER has to be greater than 2.9. Good systems reach 4.

Consider replacing older box style and split system ACs with modern inverters and choose high star rated options. Outdoor units can be noisy so locate away from windows and outdoor living areas, at ground level for maintenance, and consider the distance from your neighbours. A well shaded location will improve the energy efficiency. Creating zones for AC use by closing areas off with doors can help ACs to work more efficiently.

Regular cleaning and maintenance of filters can make the AC units run more efficiently saving power. A ducted system may be more efficient if you are air-conditioning multiple rooms but make sure each room has individual controls. Ducted systems have a long life, are quieter and although more expensive initially they usually save money over time and work well with solar power systems. Ducts should be well insulated.

Solar Hybrid ACs are also available that can save up to 50% of your AC running costs.

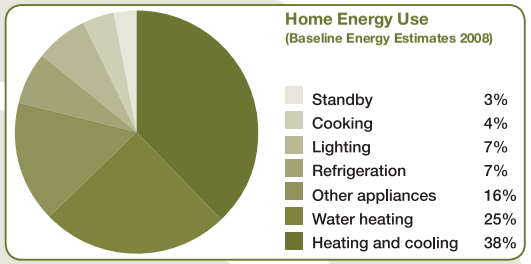
Set temperatures to 25°C in Summer. Each degree cooler can add up to 10% to the running costs.[2]

FANS

Fans can costs as little as 1c per hour to run[3], and work well with your natural ventilation system. They can also be used in conjunction with higher temperature settings on your AC. Choose longer blade options (1400mm) as they are more effective and can increase your homes energy rating by one or two stars.[4]

REFRIGERATION

Refrigeration accounts for around 7% of household energy use. When retrofitting your home consider upgrading to a more efficient model. A 4-star fridge/freezer uses $800 less electricity than a 1-star model over 10 years[5]. Set the thermostat between 3 to 5°C.



Fridges should be well shaded with at least 75mm of space around to ensure adequate ventilation. Make sure doors are well sealed and regularly maintain your fridge and clean condenser coils. Consider switching off your second fridge - it could be costing you as much as $250 each year.

OTHER APPLIANCES

Choose energy efficient appliances when upgrading. Check the watts per hour when selecting and comparing appliances as well as their star ratings.

Washing Machine and Dryer

Front loading washing machines are more energy efficient though most heat their own water, this is more efficient than an electrical hot water system but will not save you money if you already have a solar hot water system installed. Use cold wash and eco settings. Install an undercover line so you don't have to use a dryer.

Dishwasher

Selecting a high star rated dishwasher with low water use can be more water efficient than hand washing dishes (however uses more electricity). Consider using the dishwasher at night and switching to the cheaper night Tariff 33 and using economy settings.

STANDBY POWER

You could save up to $100 per annum by switching appliances off at the wall. Consider the purchase of remote power-off devices for your power points, or if you are renovating you can have your electrician wire power points so they can be switched off at a central point at the end of the day. Locate power points in easy to reach areas to allow them to be switched off when not in use.

Retrofitting tips

- Ask for running costs when you buy appliances
- Zone rooms for efficient AC operation
- Regularly maintain your appliances, clean coils and filters to reduce their energy use
- Turn off your second fridge
- Always use the energy efficient or eco settings on your appliances

1. Based on a 2400 watt input AC run at 6 hrs a day.
2. DERM ClimateSmart Program
3. www.tradesecrets.org.au
4. Based on BERs assessments from Green at Heart
5. www.energyratings.gov.au, for a 300-400L fridge/freezer at 19c/kWh.

Alternative Energy Sources

Solar Power

Our region has an ideal climate for solar power generation, with 9 months of sunny weather and 3 months of 50% sun.[1] Solar power systems have come down in price as a result of the strong Australian dollar, good government incentives and feed- in tariffs encouraging investment in solar. Reduce your energy by following recommendations in this guide to gain greater benefits from your system.

GRID CONNECT SYSTEM

1. Solar energy is converted by panels to DC power during daylight hours (mainly 9am-3pm)
2. An inverter converts DC power to AC power
3. Power is used by household appliances first
4. Any excess (not used) is sent to grid and credited to your account through the feed in tariff (see below)
5. At night, or if demand is greater than your system provides, electricity is drawn from the grid

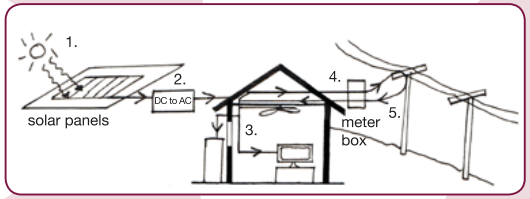


Figure: Solar Power Grid Connect System

STANDALONE SYSTEMS

Standalone systems are most often used in remote locations where there is unreliable power or no power supply lines. These systems are more expensive to install and store energy in a battery bank. Unlike grid connect systems they will work even if the power goes out.

SYSTEM SIZE

In far north Queensland the average daily production per 1kW of solar array is 4.2kWh per day. Refer to your electricity bill for your average daily use to help you determine what size system to select. Additional savings can be achieved by reducing your energy use by following the suggestions in this guide.

Eg. If you average daily use is 18Kwh, a 4kW system would provide approximately (4x4.2kWh) 16.8kWh of your power.[2]

LOCATION, ORIENTATION AND SHADING

Solar panels can be placed on the roof with the ideal orientation being north or 45 degrees from north, although good performance can still be achieved on other orientations. Optimally, they should be angled at the latitude of their location (eg. Cairns 16°) and in a sunny area. Partial shading of any of the panels from adjacent buildings, trees, roof ventilators, satellite dishes or sewer vents can result in a dramatic drop in performance. Also panels can provide shading to your roof helping to reduce internal temperatures.

CYCLONES

Make sure your system is installed to the cyclone standards of your location. If the power goes out during a cyclone, do not go on to your roof as your solar power system is still generating power and the roof may be 'live'. Follow the SHUT DOWN procedures attached to the inverter by your installer and have a qualified person check the system. Panels and their attachment systems must be designed for the cyclone region specific to your property.

FEED IN TARIFF AND GOVERNMENT INCENTIVES

The feed-in tariff applies to grid connect systems whereby the excess electricity (ie. net electricity, not gross) that you do not use during the day is fed back into the grid and credited to your bill. At the time of this guide the rate of income generated was 8c per kWh.[3] To achieve the maximum financial benefit from your feed-in tariff consider using your appliances outside the peak generation hours of 9am to 3pm.

The Federal Governments Solar Credits Scheme provides a discount off the cost of your system in the form of STCs (Small scale Technology Certificates) which represent a financial value based on the size of your system.

Generally solar power systems do not require council approval, but check with your installer.

Retrofitting tips

Solar Power

- North is the ideal orientation and angled at your latitude
- Beware of partial shading as this will dramatically effect output
- Grid connect systems won't work during a power outage
- Obtain 2-3 quotes for your solar power systems and look out for pushy sales people trying to get you to sign up on the day
- Use a local supplier with reputable products and good warranties, and ask around for a recommendation
- Install a large system or a larger inverter (eg.5kW) with a smaller system to future proof your home
- Maintain your panels following installers instructions to keep them working at their best
- Use a Clean Energy Council (CEC) Accredited installer

Wind power

Wind turbines are available for household use. These systems are useful where you have limited access to sun. They can be connected as standalone or to the grid and rebates are available.

Height is a big consideration for installation of a wind turbine. Wind speed increases as the height above the ground increases. A wind turbine also requires "clean" wind, wind that is steady and moving in a consistent direction. Areas that are subject to large obstacles creating turbulence may not be suitable. Check with your Council about any approvals that may be required prior to installation.

1. Naked Energy 2012. 2. Not taking into account the feed in tariff credits.
3. Rate of $0.44 ended July 2012. Tariffs locked in and paid until 2028, but subject to change as QLD is the last state remaining with a feed in tariff.

Hot Water Systems

Heating hot water can account for up to 25% of a household's average energy use. Retrofitting solar, heat pump or gas hot water systems can help future proof your home against rising energy costs. The cost of replacing your hot water system can pay for itself in around 5 years and over the life of the system can save you up to $12,000 and 60,000kg of greenhouse gases.

When building a new home it is compulsory to install a solar, heat pump or gas hot water system. Electrical systems will soon be phased out. The plumbing and wastewater code also require that the system be placed as close as possible to the main bathroom to improve efficiency.

Government incentives are available for eligible solar water heaters and heat pumps if you are replacing an existing electric hot water system. Ask your installer for the latest information.

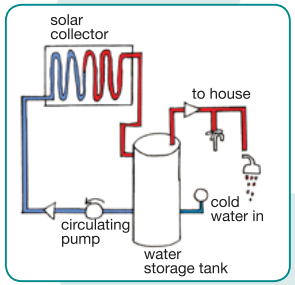
SOLAR HOT WATER SYSTEMS

Solar hot water systems use the sun's energy to heat water which is then either stored in a roof tank or ground level tank (called a 'split system').

Roof mounted tanks use the thermosiphon effect where heat rises naturally to circulate the water without a pump. Split systems have solar panels or evacuated tubes on the roof and the tank at ground level and use a pump to circulate the water from the tanks to roof. This is a good option when your roof may not be able to take the load of a roof mounted tank or for visual appearance.

Open circuit systems where water passes through the solar panels and then directly into the tank are most commonly used in tropical areas, while closed circuit systems that circulate a fluid (often containing an anti-freeze) through a heat exchanger to heat the water are used in areas where frost is possible.

A solar hot water system can save up to 4 tonnes of CO^2 per year (equivalent to a car)[1] and reduce the impact of ongoing electricity price increases.



Split System Solar Hot water system

A solar evacuator tube model with circular tubes is available that manufacturers' claim works better on cloudy days and are more efficient at heating water due to the circular shape of the tubes.

Solar panels are best placed in a sunny location facing north or 45 ° from north (without significant loss of efficiency) and at an angle as close to the latitude as possible.

Solar hot water systems are fitted with an electric or gas booster to increase the supply of hot water when it may otherwise be inadequate. Boosters can be operated manually or controlled by thermostat. Wiring your electric booster to the off-peak tariff and using a timer can save you hundreds of dollars per year.

Make sure your booster is switched off and used only when needed.

HEAT PUMP HOT WATER SYSTEMS

Heat pumps are energy efficient and can offer savings of up to 80% on your hot water bills and work well on cloudy days and in shady locations. Working like an air conditioner in reverse, they super heat a jacket of coolant surrounding the water to maintain the water temperature and expel cold air to the surrounds. The only electricity used is running the air-conditioning compressor utilising a fifth of the electricity used for normal electric hot water systems.[2] They are easier to install than solar hot water as they can directly replace an electric system with no additional plumbing required.



Heat Pump Hot Water System NQ Solar

GAS HOT WATER

Gas systems can be instantaneous or storage systems. Instantaneous systems just heat the amount of water being used and are quite efficient. New homes require a minimum 5 star system. In our region, as the majority of areas require bottled gas, these systems often prove more costly to run. The lifecycle emissions of gas are also very high due to the energy used in extraction and transportation.

Retrofitting tips

- Insulate hot water pipes
- Install your system near the main bathroom for maximum efficiency
- Choose the minimum size needed for your household to save heating water that you don't use
- More energy efficient systems attract higher rebates
- A system must be registered with Council once installed
- Check the energy efficiency of the booster and pump
- Install a timer and put your booster on an off peak tariff for further savings
- Install heat pumps away from bedroom windows as they produce a noise similar to an air-conditioner unit

1. www.ata.org.au/sustainability/solar-hot-water/ 2. Information provided by NQ Solar.

Water Saving Devices & Rainwater Tanks

Cairns residents individually use an average of 212 litres (L) per day with Port Douglas at 608L per day.[1] If each person in the city of Cairns reduced their water consumption by 50 litres per day the total saving would be almost 6.5 million litres per day or 2,400 million litres per annum[2].The cost of treating and transporting water to our homes and businesses is substantial with up to 50% of Cairns Regional Council's annual electricity use being attributed to water pumping stations and water and wastewater treatment plants.

Rainwater Tanks

In far north Queensland, annual rainfall exceeds 2,000L/ m2. For the average 200m2 roof this equates to 400,000 litres of water that ends up in stormwater - more than the annual water use for a household of 4 people[3]. Rainwater can be used for irrigation, indoor household use or drinking (with a suitable filtration device - check with your local council for requirements).

When building a new home it is now a mandatory requirement throughout most of Queensland to install a 5,000L rainwater tank plumbed for indoor use for laundry, toilets and the rear garden tap.



Rainwater tank, Bluescope Water

OUTDOOR USE

On average, up to 27% of potable drinking water is used outdoors and for irrigation so a rainwater tank can result in significant water savings. Consider raising your tank to use gravity rather than using a pump.

INDOOR USE

Retrofitting tanks for indoor water use for existing homes can be more difficult for concrete block and slab-on-ground construction where the plumbing is not easily accessible, but is still achievable.

To supply tank water for household use a pump may be needed. Choose a low energy model. There are several types, but a submersible pump is a better option from a noise, aesthetics and theft perspective. There are also pumps that work on a pressure cell that use less power, choose a minimum of a 20-50L pressure tank so that your pump will not have to start every time you flush the toilet or turn on the tap.

Other recommended components include a first flush diverter to divert contaminants off the roof, leaf and gutter guards and a strainer basket, mosquito cap and a drain near the base of your tank to allow for regular cleaning of any sediment. As these tanks must be connected to town water to ensure a continuous supply of water, a backflow prevention device to isolate from the mains supply is required.

OTHER CONSIDERATIONS

Roofs of corrugated steel and tiles are suitable to collect water but for health reasons you should not collect water from asbestos, bitumen or treated timber type roofs.

Tanks can be buried in the ground or above ground depending on the type. Poly tanks have to be located a minimum of 450mm from the boundary as they are a fire hazard. If you have limited space and access it is best to use a slimline steel tank which will also not create a fire hazard.

COUNCIL APPROVALS

For Council approval, all rainwater tanks require the completion of a Form 1 Development Application Parts A & B which must be accompanied by a site plan and cyclone tie down details. For tanks to be plumbed for household water use they must be connected to the mains water supply, so an Application for Compliance Assessment (Plumbing and Drainage) Form 1 and 2 must also be lodged.

Retrofitting Tips

Rainwater tanks

- Choose a larger tank if you have the room, as this can save you money and water (up to 100,000L per annum) in the long term.
- Always make the slab 200mm longer and wider than the tank footprint and above flooding levels. Cyclone tie downs are needed and cost effective details are available from all manufacturers.
- Install a gutter guard and/or first flush diverter to keep water free from leaves and contaminants.
- Ensure the overflow pipe diameter is equal or greater than the inlet downpipe diameter.
- Choose a light coloured tank to reflect heat, especially if it is located in the sun.
- A submersible pump is quieter and more secure.
- Maintain and inspect annually including checking of inlet, overflow and outlet pipes.
- Check access for tank delivery and height of gutters and location of downpipes.
- Direct overflow to the garden and avoid neighbouring properties.

Greywater and Stormwater

Greywater (waste water from fixtures such as showers, laundry and taps – but not the kitchen) can be recycled and reused. Check with Council before installing in your area as there are restrictions regarding distances from watercourses and approval is required. In the Cairns Region, the minimum distance required from a watercourse is 50 metres.

GREYWATER TREATMENT SYSTEMS

Greywater can be treated on site and used for toilet flushing and laundry use. This requires extensive treatment and is expensive to install.

GREYWATER DIVERTER

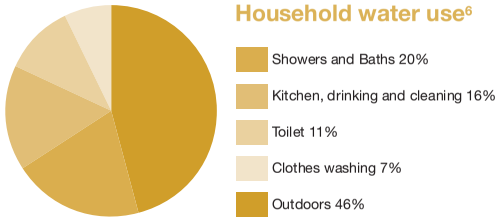
Another option is a grey water diverter which works by diverting greywater though a filtration device which is then connected to an underground drip irrigation system using the soil to filter out contaminants and odours. Spray irrigation is not allowed due to contaminants in the water. It is best to use the diverter in conjunction with grey water garden safe detergents and soap. A grey water diverter can save up to 150,000L per year[4].

If you are renovating and thinking of installing a greywater system at a later date, it is worth designing your plumbing to be accessible for future installation.

STORMWATER MANAGEMENT

On site water retention is important in urban areas as it is helps to replenish the water table, but also means that you use the water already falling on your property. Encourage onsite water retention by minimising non-porous areas and through the use of grass, landscaping, pebbles or stormwater management systems (eg. Atlantis cells) to construct driveways and paths. Stormwater can also be reused for watering gardens.

Saving water indoors



THE TOP THREE WATER USERS

In an average home, the three top indoor water users are the shower, toilet and washing machine. Replacing these with more efficient models (see table below) can save over 119,000 litres per annum for a 3 person household, representing a saving of around 50%.

If you are renovating your home, the Queensland Development Code Part MP4.1 requires that you upgrade toilets to 4 Star, showerheads and tapware to a minimum of 3 Star and install a hot water system that complies with the Queensland Plumbing and Wastewater Code.

Showerheads, tap aerators, toilets and appliances can be easily retrofitted. A cheap solution for reducing the water used in older toilets for flushing is placing a full water bottle in the cistern. When selecting new water appliances such as dishwashers or washing machines, choose High WELS (Water Efficient Labelling and Standards) rated appliances (see **www.waterrating.gov.au** for more details).

WATER LEAKS AND DRIPPING TAPS

Regular checking and maintenance can reduce the amount of water wasted through leaking pipes and dripping taps. A single dripping tap can waste up to 10,000 litres of water a year, while a visibly leaking toilet can waste more than 90,000 litres.[5] Toilets can be checked by putting food colouring in the cistern and checking if it appears in the bowl. Leaks in the pipes can be checked by turning off all the taps and reading the meter before and after one hour. If you notice a change you may have a leak.

Comparison	Efficient (kL/a)	Inefficient (kL/a)	Water Savings (kL/a)
Shower 3 star v's 18L	51	115	64
Toilet 3/4.5L v's 11L	13	46	33
Washing Machine 4 star v's 140L	25	47	22
Indicative savings in annual water for a 3 person household[7] kL/A = kilo litres (1,000L) per annum			

RETURN AND PRESSURE LIMITING VALVES AND COLLECTORS

Pressure limiting valves are now required in all new homes and can save up to 10,000L per annum[8]. These can be retrofitted at the boundary of a domestic installation to control supply pressure to a set maximum pressure across the whole installation.

Return valves can be installed at any point where hot water comes out (eg. shower, tap). If there is a long distance between your hot water system and the tap, the cold water in the pipes can be returned to the hot water system so the flow does not start until the water is a certain temperature, thus saving water. Other products collect the cooler water at the shower point until the hot water arrives and then release it with the flow. Insulating your hot water pipes can also mean less time to wait for hot water. Ask a licensed plumber for more details.

Retrofitting tips

Water devices

- Check for leaks
- Install a 4 star water efficient toilet
- Install a low flow showerhead
- Install tap aerators
- Install a pressure limiting device or return value
- Upgrade dishwasher or washing machines with water efficient models

1. Cairns Regional Council, Water Demand Strategy 2009 – 2012
2. www.ourcairnswater.com.au
3. BlueScope Water, Advice from Nick Skutenko at TGBN Retrofitting Forum, 2012
4. RPM Enviro, Advice from TGBN Retrofitting Forum, 2012
5. Waterwise Queensland, Being waterwise in bathroom, laundry and kitchen
6. Queensland Government (2003-2004) Research house- Analysis of annual water use
7. Based on 18mins total showering/day & 12 flushes
8. www.cabinet.qld.gov.au/MMS/StatementDisplaySingle.aspx?id=44721

Landscape and Surrounds

Creating a water efficient garden will save you thousands of litres of water per year and save money on your water bills.

WATER EFFICIENT GARDEN

When selecting plants and trees, choose native species which are adapted to our climate and hardier during the dry season, requiring minimal watering.

Deeper, less frequent irrigation can promote deep roots, and halve water use without changing any plants or reducing lawn area.[1] Gradually reducing the amount of watering will allow plants to become more resilient during dry periods.

Drip irrigation on a timer is more water efficient than above ground irrigation as the water will not evaporate. Mulching will also reduce the amount of water lost through evaporation.

Lawn areas are very water hungry, so consider replacing them with planted or pebbled areas or keep lawns long to reduce evaporation.

Greywater systems and rainwater tanks can also help with a water efficient garden. Grey water can be diverted to water hungry plants such as palms or fruit trees. Try a banana swale or circle where banana trees are planted in a circle with compost and mulch in the centre to absorb the water.



Growing your own food can save you money and help the environment

Stormwater management systems can encourage on-site water retention. Avoid the use of hard surfaces that divert water to stormwater drains, depleting the water table. Driveways can be constructed of permeable cells.

PASSIVE DESIGN

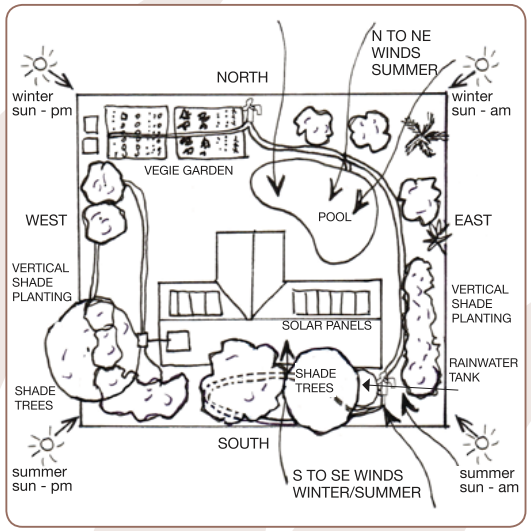
Landscaping can assist in cooling the home through shading and breeze filtering.

Landscaping for breezes

Summer breezes come predominantly from the north to north east with some from the south to south east. Winter breezes are predominantly from the south to south east with some south westerlies. Landscaping or strategically placed free standing walls can direct these cooling breezes into the home. When planting for shade be careful not to block breeze paths with dense planting.

Landscaping for shade

In far north Queensland the sun is at a high angle in summer so larger shade trees are a great option. The sun in summer rises in the south east and sets in the south west so is at a



Avoid dense planting to the north and north east as this will block summer breezes

low angle in the early morning and late afternoon. Shading at these times is essential as it will stop your home heating up during the day and cool quicker in the evenings. Vertical and dense planting are ideal on the east and west areas to avoid heat gain.



Landscaping can provide beneficial shading to the roofs and wall of your home for little cost. Consider shading east and west facades through planting of shade trees. If you are considering installing solar power avoid shading on northern side as shade effects the panels' performance. Consider the use of green roofs as an insulator which use recycled plastic cells to hold the earth and grass to your roof keeping the home cool.

Plants provide cooler shade than man-made structures due to the transpiration and evaporation from the leaves which provide up to 5°C temperature reduction.[2] Unshaded hard surfaces adjacent to your home can increase heat entering your home by heating the surrounding air.

FOOD GARDENS AND PERMACULTURE

Using your backyard to grow fruit and vegetables can save you a lot of money and provide you with fresh, healthy food.

Divide your garden into zones according to ease of access and how often you would visit to harvest and maintain. Zone 1 is the kitchen garden, an area where herbs, salad plants and vegies are harvested daily and should be located as close as possible to the kitchen. The best solar aspect for a kitchen garden is to the north which works well with a good north facing kitchen and living area. Consider permaculture principles such as companion planting to reduce pests and using natural fertilisers and pesticides.

COMPOSTING

Compost systems range from barrel or drum systems, anaerobic (bokashi style) bins, worm farms and tumblers to traditional garden composting. These can reduce the amount of waste going to landfill. Make sure that you locate them away from bedrooms and living areas and cover to avoid attracting pests. Compost is great fertiliser and ideal for improving soil structure.

Worm farms contain composting worms that are surface dwellers and are usually reds, blues and tigers that require large amounts



of organic matter to survive. Worm farms have a collector at the base to catch liquid to fertilise your garden and should be located in a shady area to protect them from drying out.

SWIMMING POOLS AND WATER FEATURES

Directing breezes across water provides a cooling effect. Locating your swimming pool to the north will mean that the water is warmer in winter (extending your swimming season) and will reduce evaporation of water and chemicals.

Install a pool cover

Installing a cover can reduce salt and chemical use by up to 50% and save up to 10,000L of water per month by reducing evaporation[3], particularly in the dry season. A cover will also reduce the need for maintenance and cleaning. Ideally use water from your rainwater tank for filling the pool. Many households put an extra dose of chemicals in the pool at the beginning of the dry season, cover it and turn off the pump all together. A pool cover will also pay for itself in as little as 3 years due to reduced electricity consumption in pumping the pool when it is not being used.[4]

Reduce pool filter hours and convert to off peak tariff

Reducing your pool filtering hours and converting your filter to the off peak tariff will reduce demand on the electricity grid, save you money on power and reduce the amount of chemicals needed. Filtration during the day creates water currents leading to greater evaporation of chemicals. Try reducing your filtering hours to work out the minimum needed for your system. In winter pools can run on as little as 4 hours a day but in summer, in the tropics, they may have to run longer due to the high water temperature and evaporation of chemicals.

Changing your pool filter from 8 hours to 4 hours a day on off peak could save you up to $500 per annum in electricity.[5]

Energy efficient pool pumps and chemical free pools

Installing a quieter, energy efficient pool pump or retrofitting your existing pool pump with an automatic variable speed model can save you up to $3,000 per annum over 5 years.[6]

Newer filters that use recycled glass instead of sand can last twice as long, but may have issues with disposal of materials at end of life. A new chemical free pool system which naturally filters the water is available locally and can be retrofitted to your existing pool with a payback period of around 2-3 years. This runs in conjunction with an energy efficient pool pump which will save up to 80% of your running costs.[7]

When looking to heat your pool try a cover that helps heat the water or use a solar roof heater or an energy efficient heat pump.

Retrofitting Tips

- Install an underground drip irrigation system connected to a rainwater tank
- Avoid large shade trees on the northern side if you want to install solar panels
- Dense planting and garages should be avoided to the north as they will block summer breezes
- Install a sail or pergola as an interim while your shade trees are reaching maturity
- Mature trees with good vertical shading such as golden cane palms or native options can be planted to quickly assist shading on east and west walls
- Wean plants off excess irrigation and use native and drought tolerant species
- Plant to direct breezes into the home and shade external walls and roofs
- Install a compost bin to divert up to 50% of your waste from landfill
- Grow food in a permaculture garden to reduce food miles and provide fresh, chemical free food for your family
- Install a pool cover, change to the off peak tariff and upgrade your pool filter for big energy savings

1. Centre for Sustainable Arid Towns (2008) Sustainable Housing in Central Australia
2. Guide 4: Landscaping: An integral aspect of sustainability, Sandy McCathie, Planning Services, Special Projects Unit, City of Townsville
3. www.daisypoolcovers.com.au 4. www.coolmob.org 5. Based on 1kWh/hr average pool pump energy use and 22c and 9c per kWh for peak and off peak.
6. www.coolmob.org/content/how-save-money-your-swimming-pool-electricity-costs 7. www.ecosplash.com.au

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About the Cairns and Far North Environment Centre

This guide has been produced by the Cairns and Far North Environment Centre to encourage improvements in energy and water efficiency in the home. We work with community, industry and government to promote awareness of and appropriate responses to environmental issues including sustainability and climate change.

We identified through our networks that there was no locally relevant, tropical resource available for residents wanting to address architectural design elements to improve energy and water efficiency of an existing house.

CAFNEC has been working closely with the Tropical Green Building Network (TGBN) and its members to encourage sustainable, climate-appropriate planning and building and have engaged with the TGBN, Green at Heart and the local community to bring local expertise to this guide that was made possible through the support of NRMA Insurance.

Our organisation has been involved in many initiatives to promote sustainability throughout far north Queensland over our 30 year history. If you would like more information on our work, visit our website **www.cafnec.org.au** or call our office on **(07) 4032 1746**.



