Maroochy Shire's Guide to

Green Building

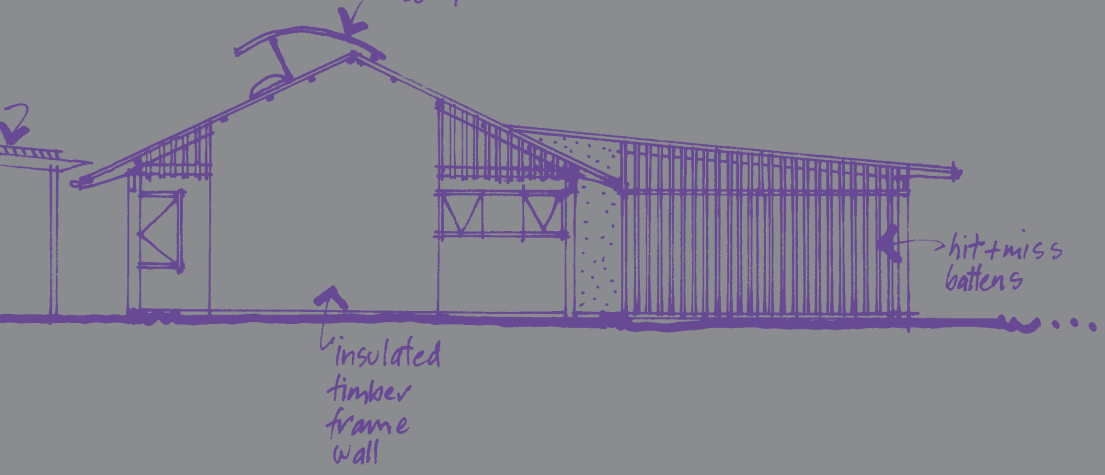
Maroochy Shire Council

Introduction

This booklet aims to help you design and build energy efficient and environmentally friendly houses. It provides detailed information about how to save money and greenhouse gases at the same time by making your home more comfortable and energy efficient.

It is for people who are just at the design stage of their new home, and for those who want to renovate their existing home. The information for those at the design stage will often be extremely useful for those of you looking to renovate, because all the same principles apply.

Often there are benefits for more than one aspect of the environment with some of these initiatives but sometimes there are also compromises between environmental issues. **Just do the best you can.**



Glossary

Biodiversity — is the variety of life; all the plants and animals, the genes they contain, and the ecosystems of which they are a part.

Climate Change — When humans add greenhouse gases, such as carbon dioxide and methane, to the atmosphere, it adds to the natural greenhouse gas layer and we trap more of the sun's heat. This is the enhanced greenhouse effect and the result of that is climate change — changes in temperature, rainfall, etc. Greenhouse gas emissions mostly come from burning fossil fuels like coal, oil and petrol, as well as land clearing and livestock.

Ecological Sustainability — A complex concept which, in it's simplest terms, means meeting today's needs without compromising the ability of future generations to meet their needs.

Embodied Energy — The amount of energy that goes into the manufacture of a product. It considers the energy that goes into the extraction of the primary resources, the processing of those resources, the transporting of those resources, the conversion of those resources into a product and the transport of that product to its end user.

Work with nature, not against it, and $ave

1. Energy Efficient Design

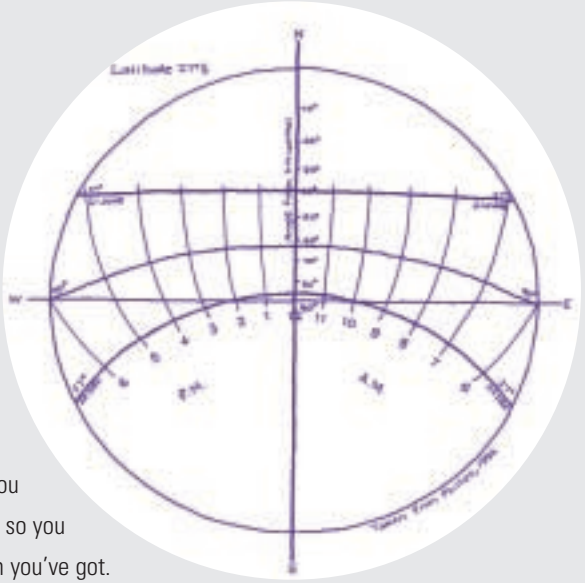
Energy efficient design means designing with nature: using natural elements to our advantage but with minimal or no environmental impacts. For homes, energy efficient design relates primarily (but not only) to natural temperature control and lighting. It helps us save money, be more comfortable and reduce greenhouse gas emissions, as most of the electricity used at home comes from burning fossil fuels like coal and gas which is causing climate change.

Savings in an Energy Efficient Home: The savings below were worked out from a real example of a 5-star energy efficient house. Note that these savings do not account for further savings that were made by choosing energy efficient appliances such as the stove top, fridge, washing machine and others. This is therefore a conservative estimate of annual savings.

Item	Annual Costs in a 3½-star Home	Annual Costs in a 5-star Home	
Climate control	$480	$84	$396
Hot Water	$430	$110	$320
Lighting	$40	$8	$30
Water Conservation	$250	$100	$150
TOTAL	$1,200	$303	$896

Energy efficient design has some basic principles that will provide good energy savings. After that, there are plenty of smaller things that may require more effort and/or more money but they will still add to improving your home's energy performance. We'll start with the basics which, if done right, will make the biggest improvements.

1.1. Orientation



Orientation is the most fundamental element of energy efficient design. The rule is **face the sun, not the street**. With proper orientation, we can keep the sun out during summer but get it in during winter. But even if your property doesn't allow you to face north, you need to know the same principles so you can make the best of the situation you've got.

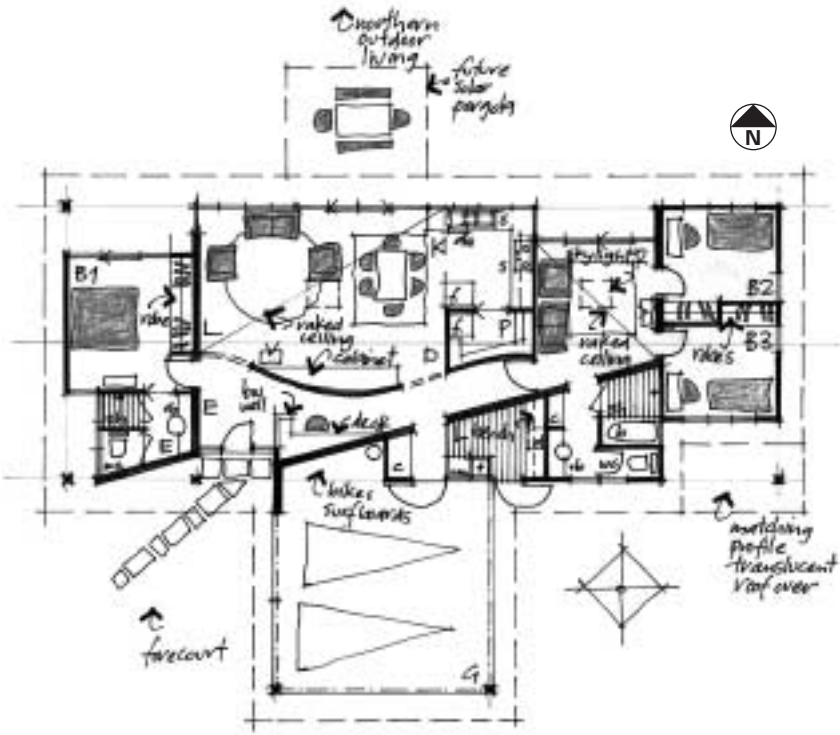
Firstly, you need to have a good idea of the sun's movements throughout the year. You can see in the diagram above that, on the Sunshine Coast, the sun's movements are as follows:

- On 22 December, the summer sun rises at around 27˚ south of east, goes almost directly overhead at noon (86˚ from horizontal) and sets at 27˚ south of west.
- On 21 March and 23 September, the sun rises and sets due east and west and is at an angle of about 63˚ from horizontal at noon.
- On 21 June, the winter sun rises and sets at 27˚ north of east and west and goes across the sky to the north at less than 40˚ from horizontal.

Remember when you are thinking about these angles that they are based on true north, not magnetic north. So, to find true north, look at your compass and true north is 10.5˚ east of where the compass is actually pointing.

Face the sun,

For the Sunshine Coast, the long sides of a building are best kept facing north and south. It's good to keep the walls facing east and west short and well shaded with no or few, small windows. You can see how this works in the sample floor plans below. Orientating the house this way keeps out a lot of hot morning and afternoon sun. Also, the sun is at a low angle to the north during winter, so facing north allows plenty of sun in during the cooler part of the year.



not the street

naturally cool
naturally warm

To add to the benefits of orientation, **eaves and other overhangs** can be designed to shade the house from the direct sun during summer but allow the sun to enter the house during winter when the sun's angle is low enough to come in through the north windows. The most sun comes in right in the middle of winter. You can see these angles in the illustration on page 7. For windows facing true north, measure from the bottom of the window sill to the bottom of the fascia. Half that height should be the minimum width of your north eave. That will keep the sun out from late September through to late March, but will allow the sun in during winter. But if your north eave is too wide, you will block out the winter sun completely and make the house cold. Maybe you can use a solar pergola on the north, as shown on page 14.

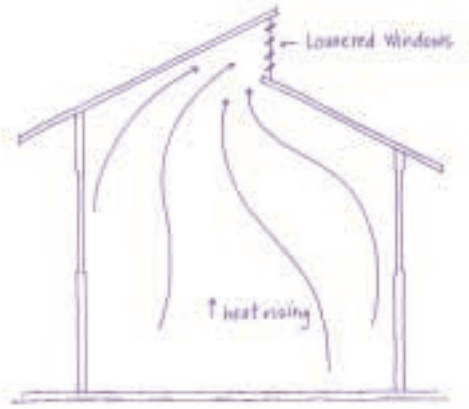
To compliment good orientation and overhangs, we consider the **location of rooms** within a house. The spaces that we spend the most of our waking hours in — the kitchen, dining and living rooms — should be the most comfortable. Rooms that we don't spend a lot of time in — the garage, laundry and bathroom — should take the worst of the summer sun. So, if we put the kitchen and living rooms on the north, they will get the benefit of the winter sun and if we have a garage on the west or southwest, it's taking the brunt of the afternoon summer sun.
These are just some suggestions, but you can work out what would be the best arrangement for your lifestyle.

1.2. Ventilation

The sun isn't the only freely available climate control. Passive design should make the most of prevailing breezes. The other advantage of a long, thin house (where your long sides face north and south to keep the hot morning and afternoon sun off the east and west, see above) is that it allows breezes to come right through the house without too many obstructing walls.

Openings (doors and/or windows) in opposite or adjacent walls allow for cross-ventilation. Have a look at the sample floor plans on pages 5 and 7 to see how easily breezes can be brought through these homes. Ceiling fans are an energy efficient way of assisting air movement, especially when it is humid.

Also with ventilation, remember that heat rises. Work with that. During summer, let the heat rise out of and away from the house. A good way of letting the heat escape from the house during summer is to have windows that open up high, such as celestorey windows. Also, although it's good to have big eaves to keep the sun off the house, eaves can trap heat close to it. To reduce the amount of heat that they trap, don't have eaves that angle downwards. It's best if they have a flat ceiling or, even better, face upwards.



Verandah roofs can also trap heat next to the house the same way that eaves can. Consider raising the roof above the roof line so that heat can rise up and way through a gap between the bottom of the roof and the top of the verandah.

1.3. Insulation

To help moderate temperature year-round, the external walls and the ceiling should be insulated. Heat moves into cooler spaces so there is a need to resist that natural movement to keep warmth in when it's cold and keep it out in summer, and that's what insulation does.

Insulation is given an R-value, which is basically a measure of how well it resists that heat flow. Higher R-values mean better resistance. For the Sunshine Coast, we recommend — as a minimum — that walls are insulated to R1 and the ceiling or roof to R2.5. But you can never over-insulate a house that is designed for energy efficiency.

One way of achieving bulk insulation for external walls is to construct with straw bales. Straw bale construction provides extremely high insulation. It's not R1 or R2, but an incredible R47. Also, because the bales are made of a waste product, they are very environmentally friendly.

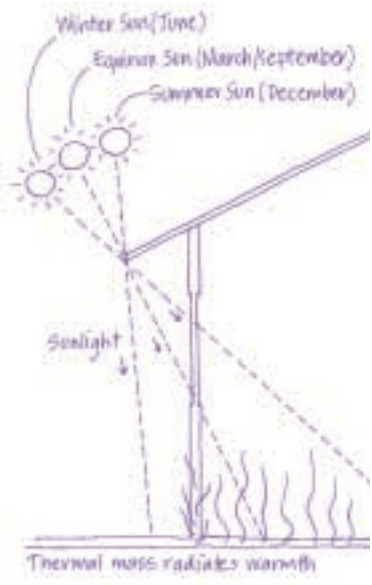
To find out more about straw bale construction, look it up on the internet or in your local library. Straw bale construction is permitted in Maroochy Shire.

1.4. Thermal Mass

Another way of controlling internal temperature naturally is using **thermal mass** inside the house. Thermal mass refers to heavy, earthy materials such as concrete, brick, and stone. These types of materials are able to store thermal energy for extended periods of time.

In summer, when the sun is kept off thermal mass materials, they stay cool.
In winter, when the sun shines on to the concrete and brick, the heat is absorbed and then released as the atmosphere starts to cool down — they release the heat gained during the day at night when the air is cooler.

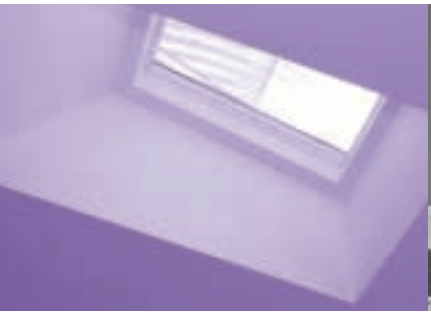
One of the best thermal mass elements for an energy efficient home is **concrete slab flooring**. Slab-on-ground flooring also has the benefit of connectivity to the earth. On Queensland's Sunshine Coast, the earth stays at a temperature of around 22˚C all year round. In summer, with the direct sun kept of the floor, the earth's coolness comes into the house. Alternatively in winter, if the sun comes in from the north, it warms the floor up more than it does with other types of flooring. You can see this illustrated to the left. Carpet decreases the thermal mass benefits of concrete ground slab, but tiles and other similar finishes do not.

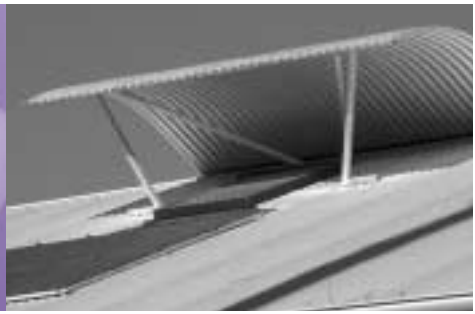


In addition to the slab-on-ground construction, you may choose **thermal mass internal walls**, for example rammed earth, concrete block, or rock walls. Rammed earth and rock walls have the additional benefit of requiring less energy to manufacture than, for example, standard concrete or brick walls.

Standard bricks require firing and therefore have high *embodied energy*.
See the section on Building Materials on page 16 for more on embodied energy.

It is good to minimise areas of thermal mass on the outside of the house, such as cement or paved footpaths and driveways. Having large areas of exposed concrete and paving radiates heat into the house.





1.5. Natural Lighting

Skylights provide great passive, natural lighting. If they are not correctly designed or installed, however, they can let in heat when it's not wanted. But there are skylights available which only let in diffused light, to keep the heat out, and you can also use shading devices for skylights which allow reflected light in during summer but not the direct sun. Such shading devices can also be designed, like the overhangs for windows and doors, to allow direct sun to enter during winter.

Think globally. Take it personally!!

1.6. Other Measures for Energy Efficiency

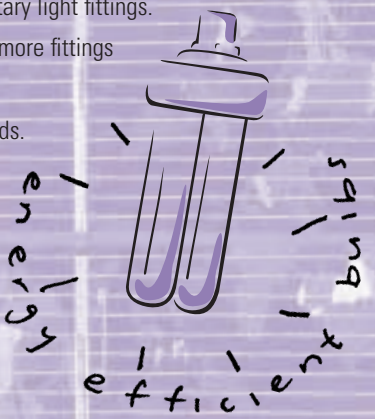
As explained above, there are a few simple things that you can do to reduce your dependence on electricity that comes from burning fossil fuels which create greenhouse gas emissions — orientate the house to the north; insulate well; include internal thermal mass; have a good ventilation strategy and use natural light. But there are plenty of other smaller things you can do too.

In design and construction...

- Use light colours on the exterior walls and roof to reflect the heat. Dark colours might seem stylish at first but they absorb the heat and they'll soon lose their appeal.
- Use louvres or casement windows so you can open up whole windows rather than half.
- Cathedral ceilings with openings at the top allow heat to rise and escape naturally during summer but can be closed in winter.
- Locate your fridge where it will be the coolest — not where the sun, stove or oven will heat it up; surround it by thermal mass; and where the warm air it generates can get away naturally.
- Apply weather stripping on doors and windows to control unwanted air movement.
- Use locally made materials to reduce transport needs.
- Have your electrician locate switches and power points where they can be easily turned on and off.

In fit out of your new home...

- **Install a solar hot water system or a heat pump hot water system** (pictured). Hot water makes up 40 to 60% of your electricity bill, so this is probably the single biggest thing you can do to cut your electricity bill and greenhouse gas emissions at home.
- Install a solar, wind or other renewable energy electricity generation system.
- Purchase your power from a "green energy scheme" — ask your electricity provider about this.
- Choose gas appliances over electric.
- Choose energy efficient white goods.
- Choose energy efficient lighting and complimentary light fittings.
- Install lighting strategically so that there aren't more fittings than necessary for tasks.
- Use locally made goods to reduce transport needs.

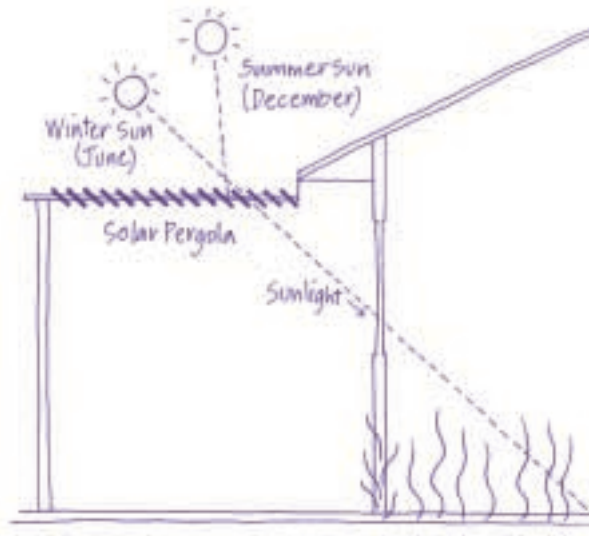


2. Renovating Your Existing Home

2.1. Orientation *when Renovating*

If you are in an existing home, rather than building new, you may not have the best orientation. However you will still be able to make adjustments to make your house more comfortable, relative to the movements of the sun. Have a look at the diagram on page 4 and compare the sun's movements to your home. Are there ways you can keep out the sun during summer and, if possible, also let the sun in during winter? You might be able to plant shrubs or trees to the east and west, or put up a solar pergola on the north, as shown below. Thick curtains can also work well, especially if there is white lining on the window side of the curtain to reflect the sun back out.

Alternatively, if your house is cold during winter, see if there is some way you can expose the north side of the house to more sun. Maybe there are trees or shrubs in the way which you can remove or replace with deciduous species; maybe you just need to open the blinds in the morning to let the sun in whilst you're at work. If you have a raised timber floor, you may be able to enclose the area under your house with a timber or brick skirt or you may be able to install insulation under the floor. These things help to cut the drafts and cold air coming in through the floor.



2.2. Ventilation when Renovating

To increase the amount of ventilation in an existing home, you might need to take more radical measures, such as installing new windows. If so, be sure to account for how the sun will come in through that window at different times of the year.

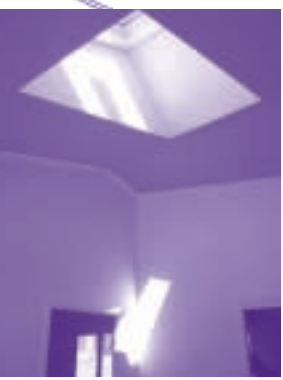
Some other, easier ways of circulating air might include installing ceiling fans and extractor fans, just to get the hot air out of the roof space. But look for models which can be closed off in winter, as you don't want to lose the warmth of the house then.

2.3. Insulation when Renovating

Of all the ways to renovate a house, installing insulation into the ceiling must be one of the easiest options, and it can cut your heating and cooling bills in half! By installing insulation (at least R2.5), you can save up to $50 a year off your electricity bill.

2.4. Thermal Mass when Renovating

Getting thermal mass into an existing home might be quite easy. If you have a slab-on-ground house, you might just need to remove carpet and have the concrete slab polished, tiled or some other nice finish. However, if you have a timber floor, there's really not much you can do. You might be able to have a thermal mass wall constructed inside the house if it is possible to tail the load down the foundation on the ground, but you would probably achieve bigger gains by focussing on other energy efficiency measures.



2.5. Natural Lighting with Renovations

Skylights can be added to most homes with stunning effects. Just consider the type of skylight you use. Be sure that it's not going to let in too much heat during summer, either directly from the sun or from the roof space, and that it won't release too much heat during winter.

3. Green Building

As you can see, energy efficiency is easy to achieve. However, to be *ecologically sustainable*, there are other environmental issues to consider and respond to as well as the greenhouse effect.

3.1. Building Materials

Increasingly, as people become more aware of environmental issues, we are looking more at the **life cycle impact** of things we buy. For example, some people buy organic food because they are concerned with the impacts of fertilisers and pesticides on the environment. This is a very simple example of thinking about the life cycle impact of a product. With building materials, it can be far more complex. Life cycle considerations include:

- Where resources have come from (for example, tree clearing, etc.), and
- Embodied energy.

The source of materials is important for protecting the environment. When using timber, ask your builder to choose Australian plantation timbers or recycled timbers and to avoid using timbers from native forests overseas where good forest management practices may be lacking. Recommended plantation timbers include radiata, slash and hoop pine. (Cypress pine is generally not plantation grown.) When using timbers that require treatment, such as radiata pine, use ACQ preservatives if at all possible because they are effective but contain no high toxicity arsenic / chromium compounds and can be safely burnt and mulched. For more information on timber products, go to www.timbershop.org.

It is good to try and use locally-sourced materials. This helps reduce greenhouse gas emissions from transport. Products imported from interstate or overseas have high environmental impact just from their travels!

Embodied energy is the amount of energy that goes into the manufacture of a product. It considers the energy that goes into the extraction of the primary resource, the processing of that resource, the transporting of the resource, the conversion of the resource into a product and the transport of that product to its end user.

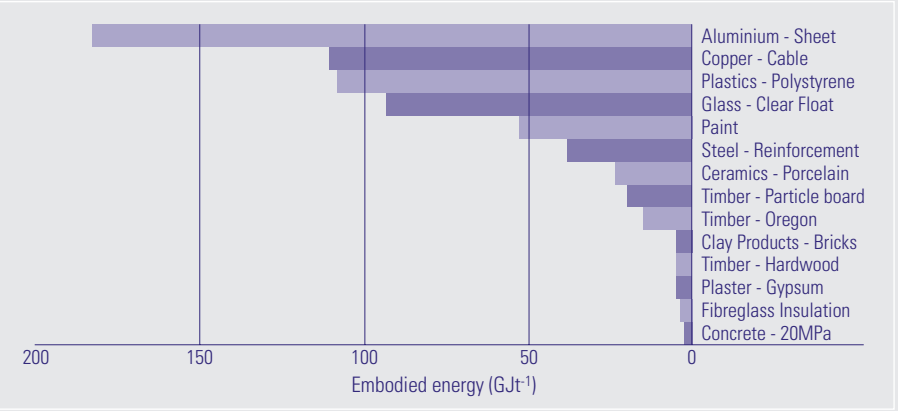


Figure. Embodied Energy of some building products (gigajoules per tonne). Ref. CSIRO.

Increasingly, embodied energy is being recognised as a major consideration for construction materials as well as other products. For example, although a concrete floor is excellent for passive heating and cooling of the house, concrete has a high embodied energy and therefore a high impact on climate change. By comparison, a timber floor may not have the same benefits with heating and cooling but they often have a much lower embodied energy. But, again, although timber floors have a lower embodied energy, they may mean you need more artificial heating and cooling, which has an impact on climate change, and the harvesting of the timber has other environmental impacts. Weighing up such costs can be a complicated and intimidating process. But don't worry about it too much. Just do the best you can. The graph above might help, but note that it compares the embodied energy of different materials per tonne. For some materials, their embodied energy may look low, but they actually weigh a great deal more than products which seem to have a high embodied energy but weigh very little.

3.2. Water and Sewage

Water conservation programs in the Maroochy Shire have already reduced water consumption by 24% per capita in just a few years. In today's terms, that's about 4,400 million litres per annum and about $3.5 million. Our water conservation programs have included:

- universal water metering with a user pays pricing structure
- water efficient appliances and garden watering systems
- reticulation pressure reduction
- public awareness/education
- water supply system leak detection
- effluent re-use
- regulation of water use

By reducing demand we postpone the need to build new dams and new water and sewage treatment plants. Furthermore, saving water may not directly save you energy (it can if you're using hot water) but it does save energy elsewhere. It takes a lot of energy to treat and transport water and sewage — nearly half of Maroochy Shire Council's greenhouse gas emissions are from the water sector alone.

To reduce water use, here are some things you can do.

- Install water-efficient plumbing fittings. AAA-rated taps and showerheads can save you between $100 and $200 a year from water and water heating bills.
- A water efficient shower rose will cut your water use in half (Maroochy Shire Council currently offers residents rebates on AAA-rated shower roses) and with some of the new types on the market, you can't even tell that they are efficient because they're no longer just a dribble of water!
- Install a double-bowl kitchen sink so you can rinse dishes in a sink without the tap running.
- Install 6/3 litre dual flush toilets, which will save you around $20 a year.

- Plant *locally* native trees, shrubs and flowers which can survive on less water than exotic species. Plants that are native to other parts of Australia can become weeds here in Maroochy, for example the Umbrella Tree (Schefflera actinophylla), Cadagi (Corymbia torreliana) and the Queensland Maple (Flindersia brayleyana). To get a full list of weeds for Maroochy Shire, contact Council on 1300 366 695 or 07 5475 8501

3.3. Runoff and Rainwater Tanks

Another water issue that you can address during the design, construction and landscaping of your home is **runoff**. What goes down the gutters goes into creeks and other waterways. As we increase the amount of hard surface area with roofs, footpaths, driveways and roads, and we reduce the amount of trees, we increase the amount of water running off into our waterways therefore increasing erosion and pollution. Design your landscaping to maximise infiltration and uptake of rainfall. This may include installing a **rainwater tank**.

Using a rainwater tank reduces runoff and also saves water from the mains system saving you money (at the time of publication, Maroochy Shire Council offer rebates of up to $250 for installing rainwater tanks on properties that are on town water). Also, make your driveway and footpaths out of materials like pebbles and rocks which allow rain to soak into the earth rather than run off into the gutter and ultimately into creeks and rivers.

3.4. Biodiversity

In construction of new buildings, protecting biodiversity is best achieved by using recycled materials. This prevents the harvesting of forest timbers and the extraction of other primary resources for products such as cement, aluminium and steel. See section 3.1 above for more information on the choice of construction materials.

When locating a building on a site, consider wildlife habitat. For example, many native animals use hollows in old trees as homes so if you have an old tree with one or more hollows, it's likely that something lives there. For biodiversity conservation, it is best if you can avoid removing such trees.

It is also beneficial to native wildlife if you can re-plant using locally native flora. Even in highly suburbanised areas there are still benefits for using native flora over exotics, including plants native to other areas of Australia. Using species native to the Sunshine Coast helps to prevent the spread of weeds and provides food and habitat for native animals. With your landscaping, you can attract wildlife by planting particular species which attract butterflies or birds, or you might want to build a frog pond. If you want to plant exotic species then make sure that they are not environmental weeds. Phone Maroochy Shire Council for a full list of weeds to avoid.

Another option for minimising your impact on biodiversity is to grow your own food. Our diets can have a considerable environmental impact because of the land clearing, pesticides and fertilisers. If we grow at least some of our own food, we would decrease our environmental impact significantly.

Summary

We hope that this booklet leads you to take more actions to reduce your environmental impact.

If you want to find out more about Maroochy Shire Council and some of our environmental initiatives, check out our web site **www.maroochy.qld.gov.au** or contact us on telephone 1300 366 695 [or (07) 5475 8501 from outside the Shire or on mobiles] or at PO Box 76 Nambour Qld 4560

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Maroochy Shire's Guide to Green Building is a detailed introduction to thedesign and construction of energy efficient and environmentally friendlyhomes tailored for the new home builder and renovator."

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