Carbon Neutral

Our lifestyles and homes have a significant impact on the environment. To balance and reduce this trend there is a growing interest in carbon neutral, zero energy and carbon positive homes. This fact sheet outlines key considerations for designing such homes.

Steps for moving towards a carbon neutral home:

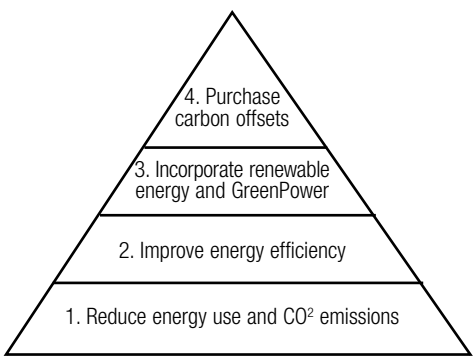
> Calculate the amount of emissions and energy being used.

> Reduce the demand for energy and activities that produce greenhouse gas emissions.

> Improve energy efficiency technologies.

> Incorporate renewable energy and use GreenPower.

> Offset the equivalent amount of emissions in other areas and activities.



WHAT IS CARBON NEUTRAL?

The term 'carbon neutral' aims to balance the overall amount of CO_2 being emitted into the atmosphere, by calculating how much CO_2 is being emitted from an activity and reducing the equivalent amount of CO_2 in another activity.

Carbon dioxide (CO_2) is a naturally occurring gas in the atmosphere. Before the industrial revolution CO_2 levels in the atmosphere were consistently between 260 and 280 parts per million (ppm). Since the industrial revolution human society has become increasingly dependent on burning the fossil fuels of coal and oil and as a result human activities have increased the concentration of CO_2 in the atmosphere to more than 380ppm.

For example:

CO_2 EMISSIONS ARE CALCULATED FOR AN ACTIVITY		OFFSET CREDITS ARE PURCHASED THROUGH AN ACCREDITED SCHEME		OVERALL CO_2 IN THE SYSTEM IS NEUTRAL
If 1 tonne of CO_2 is emitted each year, eg. through transportation or the burning of fossil fuels for electricity generation	+	1 tonne of CO_2 is absorbed by planting trees or other sequestration measures	=	the net result of CO_2 being emitted by the activity is deemed to be carbon neutral

Activities that we think of as quite ordinary, like driving a car or heating a house with a gas or electric heater, continue to contribute to the release of CO_2.

Although CO_2 is a small part of the atmosphere's composition it plays a major role in creating the greenhouse effect, which enables the atmosphere to trap solar energy and make the planet hospitable to life as we know it. Increased levels of CO_2 have been shown to relate to global warming and climate change, and while reduction of CO_2 to pre-industrial levels is considered difficult to achieve, any reduction is likely to help slow down climate change and every householder can contribute.

The goal of becoming carbon neutral may be achieved by carbon offsets. By purchasing offset credits that reduce CO_2 by an amount equal to that being produced, the overall amount of CO_2 being emitted into the atmosphere can be effectively zero, hence carbon neutral.

There are many carbon neutral or carbon offset schemes available in the market that offer to balance or offset the CO_2 emissions created by our lifestyles and homes. These schemes generally involve three steps:

1. The off-set scheme attaches a cost to emissions by working out how much it will cost them to carry out a project that is specifically set up to provide a greenhouse savings or benefit. (eg new tree plantings or stopping greenhouse gases from landfills).
2. The off-set scheme calculates the amount of CO_2 emissions produced by an activity.
3. The cost calculated in step 1 is applied to step 2 to give a cost to offset the activity.

In the following example, a cost is attached to carbon to show how an off-set scheme determines a dollar figure to offset the CO_2 emissions of a domestic flight.

For example:

1. If one tonne of carbon costs $13.75.
2. And one seat on the average short domestic return flight (up to 2600km) generates 0.399 tonnes of CO_2 emissions.
3. Then 0.399 tonnes of CO_2 emissions from the domestic flight would therefore cost $5.50 to offset.

Carbon offsets need to sequester carbon and take it out of the atmosphere to contribute to a carbon neutral result. They may also have other benefits, eg. trees not only absorb carbon dioxide while they grow and trap it for years to come, they can also help to combat salinity, reduce soil erosion, clean underground water systems and provide habitat for wildlife.

Reducing energy use is not the same as taking carbon out of the atmosphere – it only reduces the amount of CO_2 released.

Before considering a carbon offset scheme, ensure that the offset scheme is credible, and has undergone independent auditing.

Although carbon offsetting can provide a way to assist in balancing the amounts of CO_2 being emitted into the atmosphere as a whole, a long-term sustainable solution to environmental problems requires reductions in the amount of CO_2 being emitted in our homes and appropriate changes to our lifestyles.

BECOMING CARBON NEUTRAL

The first step in becoming carbon neutral is to reduce the demand for energy and the amount of CO_2 being emitted. After reductions have been made offset credits can be purchased equivalent to the remaining emissions.

Reducing CO_2 emissions from our homes can be achieved by adopting many of the techniques and procedures described in the *Your Home* Technical Manual, eg.

> Reducing the use of electrical appliances and switching off lights, appliances and equipment at the plug when they are not needed – especially a second refrigerator. [See: 6.4 Appliances]

> Selecting smaller energy efficient appliances with low standby power use and avoiding unnecessary purchases. [See: 6.4 Appliances; 6.10 Home Automation]

> Reducing water use (it takes energy to treat and pump water to a home) and reducing hot water heating by installing water efficient showerheads, taking shorter showers and using cold water for washing clothes. [See: 7.2 Reducing Water Demand]

> Draught-sealing and weather-stripping to reduce unnecessary heat loss and heat gain and setting thermostats appropriately. [See: 4.7 Insulation]

> Installing curtains and pelmets, external blinds and shading to reduce the need for additional heating and cooling. [See: 4.4 Shading]

> Changing the fuel source of hot water systems and home heating. For example switching from electric hot water systems to gas or solar hot water systems. [See: 6.2 Heating and Cooling; 6.5 Hot Water Service]

> Improving the energy efficiency of the home when building, renovating, renting or buying through methods such as:

  – ensuring effective orientation and layout to maximise solar-passive strategies [See: 4.2 Design for Climate]

  – adding or increasing insulation [See: 4.7 Insulation]

  – sizing and orientating windows appropriately [See: 4.10 Glazing]

  – providing double-glazing to windows [See: 4.10 Glazing]

  – using materials that enhance passive solar strategies [See: 5.0 Material Use]

> Adopting and developing a zero energy home – *see next section*.

Reducing CO_2 emissions in our lifestyles can be achieved by:

> Switching to low greenhouse impact transport options like walking, cycling or public transport – or use the telephone or email. If a car is essential, use a fuel-efficient one.

> Considering the time and cost of travel from your home location to work, school, shops and leisure activities. [See: 2.6 Transport]

> Diverting food and garden wastes from landfill to composting – when food and garden wastes break down without fresh air they create a mixture of gases including the very damaging greenhouse gas, methane.

> Purchasing food, products and other services that have not travelled long distances.

> Minimising waste of packaging and materials – 'refuse, reduce, re-use, recycle'.

> Reducing the purchase of non-essential products – ask "do I really need it?"

> Holidaying closer to home rather than flying to distant destinations.

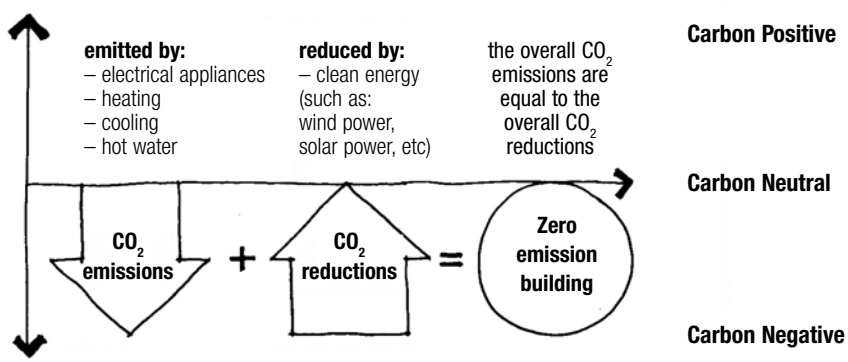
WHAT IS A ZERO ENERGY HOME?

The terms 'zero energy', 'zero carbon' or 'zero emission' are applied to buildings that use renewable energy sources on-site to generate energy for their operation, so that over a year the net amount of energy generated on-site equals the net amount of energy required by the building.

For example, a home that uses 5000kWh of electricity for a year may incorporate photovoltaic panels that generate 2160kWh of electricity in winter. This may not be enough electricity for what is needed during winter, but in summer 2840kWh of electricity could be generated, which would be more electricity than is needed at this time. If the combined result of electricity generated on-site for the year is equal to the amount of energy used for the year (2160 + 2840 = 5000kWh), the building can be considered to be zero energy. Nevertheless, it should be noted that in winter the additional energy needed would still result in carbon dioxide being released to the atmosphere unless it is also sourced from renewables.

Zero energy homes set out to use renewable electricity generated on-site. Although obtaining electricity from the grid through accredited green electricity providers should be used and could be considered as having net zero CO_2 emissions, the intention of zero energy homes is that they are relatively self-contained. This provides occupants with a full understanding of how much space and cost is required to provide renewable energy solutions on-site and the benefits of energy efficiency.

Stricter definitions of 'zero energy' buildings also take into account the energy used in their construction and eventual decommissioning.



Limitations of zero energy homes as described here, are that they only include the energy to operate the home and not other CO_2 emitting areas associated with our homes, such as the manufacture and transportation of building materials and energy used during construction.

Major benefits of creating zero energy, zero carbon or zero emission homes come from the increased energy efficiency strategies that are necessary to make on-site renewable energy sources viable and the immediate awareness and better understanding of energy use they encourage for their occupants.

DESIGNING A ZERO ENERGY HOME

Designing a zero energy, zero carbon or zero emission home can be complex, as each design solution must be tailored to the specific location.

This includes designing to the features and qualities of the site, designing for the requirements of the building's use, designing with an understanding of how to incorporate renewable energy sources on-site and designing with consideration of actual energy use – which is affected by occupant behaviour.

The basic principles that can be followed for designing zero energy homes are described in the *Your Home* fact sheets and include:

> Incorporating energy efficiency strategies with renewable energy options from the outset of the project. **[See: 6.0 Energy Use]**

> Choosing a site or location that allows for renewable energy opportunities and reduces transportation and food production needs. **[See: 2.0 Sustainable Communities]**

> Maximising passive design strategies in the design of the home to reduce energy demand. **[See: 4.0 Passive Design]**

> Reducing water use in conjunction with reducing the demand for hot water. **[See: 7.0 Water Use]**

> Selecting materials use appropriately, by incorporating materials that enhance the passive design strategy and have a low embodied energy. **[See: 5.0 Material Use]**

> Reducing energy use in all areas of the home. **[See: 6.0 Energy Use]**

Maximising energy efficiency allows energy needs to be met with reduced amounts of energy needing to be supplied. Renewable energy opportunities then become:

> Physically viable with reduced space requirements.

> Economically viable with a reduced amount of renewable energy source being required; and

> Environmentally viable with less resources being used to manufacture the renewable energy source.

For example:
In the early 21st century a typical Sydney household uses about 5,000kWh of electricity per year. Table 1 indicates the types of reductions that could be made to a typical home to reduce energy demand based on an all-electric household with a 2 star rating.

There are a range of opportunities for reducing the energy demand of a home, but these depend on the specific household. The energy efficiency measures in Table 1 are indicative only.

After reducing the energy use of the home, renewable energy opportunities can be reviewed as seen in Table 2.

Table 1

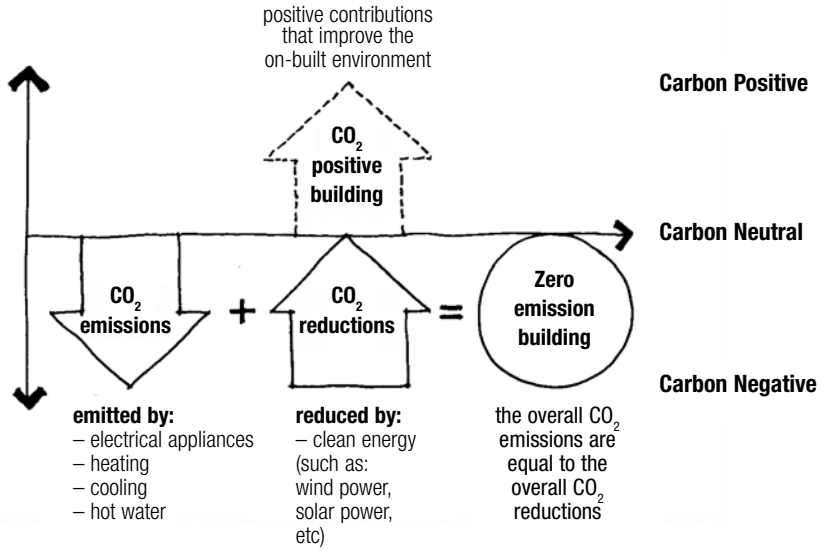
REDUCING DEMAND							
ENERGY USE OF AN AVERAGE AUSTRALIAN HOME EACH YEAR	INITIAL LOAD (kWh)	APPROX COST ASSUMING $0.15c/kWh	CARBON EMISSIONS	ENERGY EFFICIENCY MEASURES	APPROX. ENERGY EFFICIENCY SAVINGS	NEW LOAD (kWh)	APPROX. SAVINGS ASSUMING $0.15c/kWh
Heating / cooling 38%	1900	$285.00	20%	Improve house energy rating from 2 to 5 star	35%	1235	$99.75
Water heating 25%	1250	$187.50	23%	Change to solar hot water system	50%	625	$93.75
Other electrical appliances 16%	800	$120.00	24%	Improve efficiency and reduce use	10%	720	$12.00
Lighting 7%	350	$52.50	11%	Change to compact fluorescent lighting	75%	88	$39.38
Cooking 4%	200	$30.00	5%	Improve efficiency by using a microwave	30%	140	$9.00
Refrigeration 7%	350	$52.50	12%	Improve efficiency by 2 stars	30%	245	$15.75
Standby 3%	150	$22.50	5%	Turn off most appliances at the plug	90%	15	$20.25
Total	**5000**	**$750.00**				**3068**	**$209.88**

Note: This example is based on a typical Sydney household which is situated in a temperate climate. These prices are indicative only and will vary depending on location, price and use of electricity.
Source: Global Warming Cool it, (Australian Greenhouse Office, 2007). Baseline Energy Estimates, 2008. www.nathers.gov.au

Table 2

INCORPORATING RENEWABLE ENERGY SOURCES (APPROXIMATE AMOUNT OF RENEWABLES REQUIRED)				
RENEWABLE OPPORTUNITIES	INITIAL LOAD OF 5000kWh	APPROX. COST ($)	NEW LOAD OF 3068kWh	APPROX. COST ($)
Photovoltaics – Grid connected	32m^2	$38,265.00	20m^2	$23,480.00
Photovoltaics – Stand alone	44m^2	$52,887.00	27m^2	$32,451.00
RENEWABLE OPPORTUNITIES	5000KWH = APPROX. 3500kWh	APPROX. COST ($)	3068kWh = APPROX. 7900kWh	APPROX. COST ($)
Wind – Average wind speed = 7m/s	2 x 1kW turbines	$14,000	1 x 1kW turbines	$7,000

Note: Costs are indicative only and provide a comparison for the base renewable source only. They do not include installation, inverter (which may cost $3,000 or more), batteries, connections etc. Costs are based on a 165W panel costing $1,800 and 6 panels being required to produce 1kW peak. Obtain advice from accredited designers for actual amounts of renewable energy required and costs.



The incorporation of renewable energy is site specific and as the tables highlight, the more energy that can be reduced from the outset, the more viable incorporating renewable energy sources become. To determine actual amounts and costs for any system, advice from accredited designers should be obtained.

If a zero energy home is achieved and the net amount of operating energy is reduced to zero, measures to become carbon positive could be considered and incorporated.

WHAT IS CARBON POSITIVE?

Carbon positive aims to move beyond carbon neutral or zero energy and use human activities to improve the environment by making additional 'positive' contributions.

For example, this could be achieved by:

> Producing more energy on site than the building itself requires and feeding this back into the power grid.

> Improving a damaged environment and leaving it in a better condition.

> Releasing water or air from a building that is cleaner than when it entered.

> Planting on or over a building to a greater amount than was removed by the building itself due to its construction.

The contributions that carbon positive projects can make for the built environment as a whole are significant, especially because there will often be situations where zero carbon or carbon neutral homes are not possible.

Carbon positive projects can also help to address the carbon intensity and damaging impacts of past building practices and our lifestyles up to this point.

Becoming carbon neutral and achieving zero energy and carbon positive homes would reduce some of the impact from our homes and lifestyles and significantly reduce greenhouse gas emissions. However it is only part of the solution. Other sustainability aspects – social, economic and environmental – along with other impacts in the building process need to be considered in a holistic way, if a progression toward a sustainable future is to be achieved.

ADDITIONAL READING

Beddington Zero Energy Development, UK
www.peabody.org.uk/bedZED
www.bioregional.com/programme_projects/ecohous_prog/bedzed/bedzed_hpg.htm

Carbon Neutral Emissions Calculator
www.australia.gov.au/climateclever

Department of Climate Change, Australian Government
www.greenhouse.gov.au/greenhousefriendly

Global Warming Cool It
www.greenhouse.gov.au/gwci

Lazarus, N (2003), *Toolkit for Carbon Neutral Developments*, BioRegional Development Group, London.

Vale, B and Vale R (2000), *The New Autonomous House*, Thames and Hudson, London.

NAHB Research Center (2006), *Final Report: Zero Energy Home, Amory Park Del Sol Tuscon, Arizona*
www.toolbase.org/PDF/CaseStudies
TucsonZEH1Report.pdf

Mobbs, M (1998), *Sustainable House: Living for Our Future*, Choice Books, Australian Consumer's Association, NSW.

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