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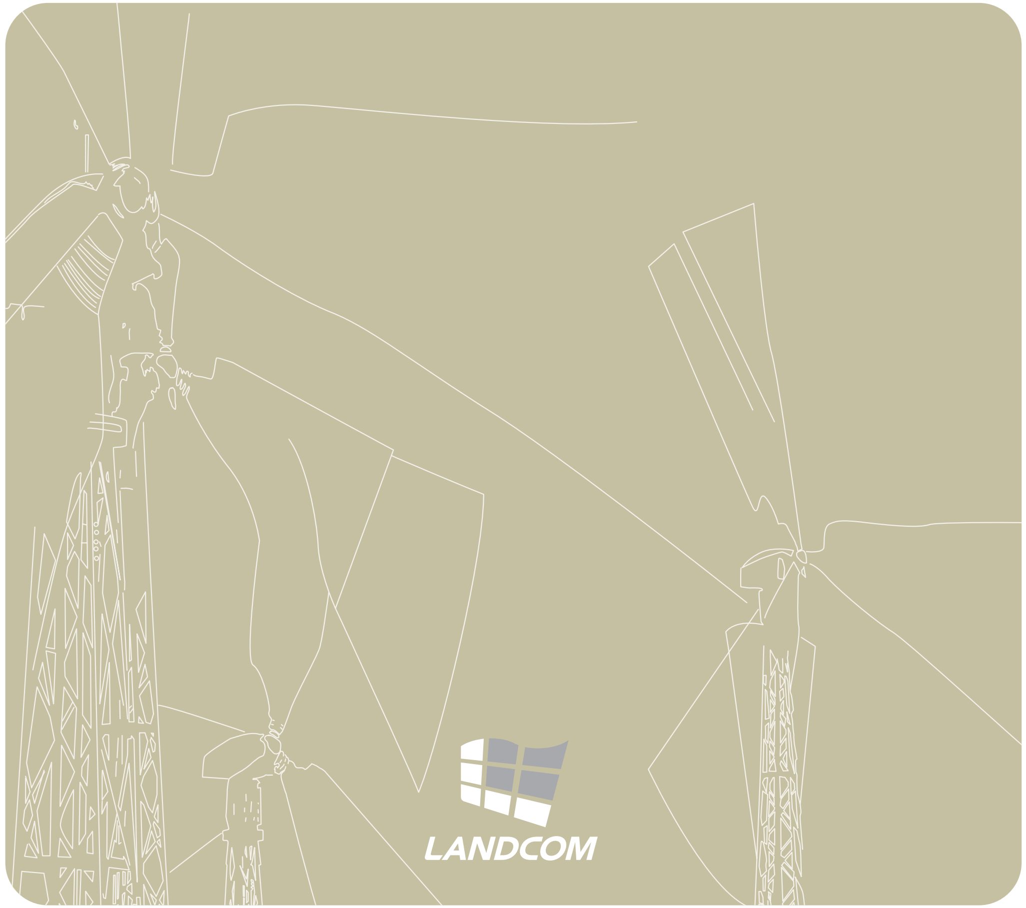
LANDCOM
Creating Better Communities

Energy Smart Communities Policy



LANDCOM

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1. Introduction

Residential buildings account for about 12% of national greenhouse emissions in Australia resulting in emissions of 63 million tonnes of carbon dioxide (CO_2)[1] in 1999. The thermal performance of the housing stock is significant, not only because of space heating and cooling requirements which comprise 15% of household greenhouse emissions, but also because of the relatively long life of buildings. The embodied energy contained in the building fabric of a new house may also equal up to 20 years of energy consumption of that house.

The dramatic increase in household electric appliance usage in Australia suggests that their share of household greenhouse emissions, currently at 52% is predicted to increase further. Water heating (28%) and cooking (5%) account for the remaining emissions.[2]

The current Commonwealth Government target is to achieve 108% of 1990 levels by 2008-12, equivalent to 55.3 million tonnes of CO_2 for residential buildings. Emissions are already above this threshold, and housing numbers and electricity usage are still rising. In order to improve the performance of the housing stock as a whole, new housing must begin to match the highest performance levels.

2. Objective

Landcom's Energy Smart Communities Policy (the Policy) has been developed to specifically address the energy and greenhouse management objectives contained in Landcom's Guidelines for Sustainable Design and Development (available on **http://www.landcom.nsw.gov.au**). It provides guidance to Landcom's consultants and private sector developer partners in preparation of their proposals and tender bids.

The Policy aims to achieve its objective of creating energy smart communities through appropriate demand side and supply side interventions - by facilitating energy efficient residential, commercial and industrial developments (demand side management) and providing renewable/sustainable energy sources (supply side management).

Most of the requirements outlined in the Policy have both mandatory and enhanced components. Mandatory requirements have been designed to raise the bar for minimum performance. However, if the mandatory requirements cannot be met for site-specific reasons, the tenderers should request exemptions, explaining reasons and provide alternative solutions where possible. The enhanced components are included to further encourage innovation and enable tenderers to differentiate their bids from those of their competitors.

3. Targets

The Policy targets to achieve a minimum of 40% reduction in total carbon dioxide (CO_2) emissions in all developments by 2007-2008, compared to the base case building envelope of 3.5★ as per National House Energy Rating Scheme (NatHERS) with gas water heating. See Appendix 1 for details of base case.

For major development projects (e.g. those exceeding 500 dwellings or including a commercial /retail precinct or town centre), a reduction of greater than 40% will be expected including a percentage of a renewable/sustainable energy source (on or off-site).

4. Exemptions

Sections 5 and 6 of this Policy document outline mandatory requirements and enhancements, which employ reasonably well-established and practical technologies. However, given the dynamic nature of technology evolution, alternative approaches that demonstrate equivalent or greater reductions in total CO_2 emissions from a development when compared to the base case will be considered as meeting the Policy requirements.

Note that variations in respect of individual dwellings are permissible provided the reduction target is met overall. In such an event, Landcom will expect a detailed description of how the CO_2 reduction will be achieved, and may ask for independent verification of methodology and approach.

Where developments include heritage buildings, the Policy requirements may have to be modified because of restrictions associated with the heritage conservation. Similarly, where there are genuine limitations to achieving the Policy requirements, deviations will be granted.

5. Energy Efficiency and Demand Management Criteria

5.1 Solar access, subdivision and lot design

Subdivisions must maximise solar access (see the NSW Sustainable Energy Development Authority's (SEDA's) revised Guidelines on Solar Access for Lots). All lots in a subdivision must indicate Solar Access Zones on an area plan of the subdivision to be submitted to Council. The Guidelines are available from SEDA's Energy Smart website - **www.energysmart.com.au**. See Appendix 3 for further details.

5.2 Building envelope

MANDATORY REQUIREMENTS

All dwellings must meet at least a 4.5★ NatHERS[3] rating. Independent of this requirement, particular attention must be paid to the following aspects:

- Apartment blocks should have a north/south aspect, with main living areas located to the north
- Apartment blocks should be designed to maximise cross flow ventilation
- A thermal performance study should be carried out at initial design stage and designs modified, where required, to minimise potential heating and cooling loads

Exemptions to mandatory requirements will be considered if there are genuine orientation constraints. Variations in respect of individual dwellings are also permissible subject to demonstration of compliance with the overall energy efficiency target.

Note that NatHERS does not apply to non-residential buildings. Landcom's target for commercial buildings is a minimum of 4.5★ rating in accordance with the Australian Building Greenhouse Rating (ABGR) tool.

In Australia, there are no widely accepted rating measures for retail buildings and hotels; however, the same principles of energy efficiency should be incorporated in design and construction of such buildings.

ENHANCEMENTS

It is suggested that:

- A majority of residential dwellings achieve 5★ NatHERS rating, particularly as Green Mortgages are available for such properties
- Commercial buildings are a minimum of 5★ ABGR rating

5.3 Shower roses and taps

MANDATORY REQUIREMENT

All shower roses must be of good quality and be at least AAA rated (as per Water Services Association Australia standards) for water efficiency.

ENHANCEMENT

Consideration should be given to the installation of flow-restrictors in basin and sink taps.

5.4 Water heating

MANDATORY REQUIREMENT

All dwellings are to be fitted with gas boosted solar water heaters sufficient to meet 60% of annual hot water requirements except where:

a) No gas supply is available, a heat pump hot water system should be fitted instead
b) Solar panels cannot be suitably positioned (for example because of orientation or overshadowing). In which case, single dwellings should be fitted with an Australian Gas Association (AGA) registered 5★ gas water heater
c) A cogeneration system is supplying the hot water.

Water heating with equivalent or better greenhouse gas performance may always be substituted for the heater specified; however, this is to be agreed in advance with Landcom's Environment Manager. Water heaters which are not suitable for use with AAA rated showers, such as gravity fed systems, should not be fitted. Some instantaneous water heaters come with their own flow/temperature regulators to overcome this issue.

5.5 Space cooling

A project-specific cooling strategy appropriate to the climate zone must be developed. As a general rule, Landcom does not support inefficient conventional whole house cooling in the Coastal NSW climate zone except for the upper storeys of high rise apartments where wind speeds hinder natural ventilation. Ceiling fans should generally be fitted in main living areas and main bedrooms. Where ducting for air conditioning is installed, one of the following should be provided:

- An evaporative cooling system (not suitable in coastal climate) or
- A reverse cycle unit with minimum rating of 4★ heating and 4★ cooling[4]
- Suitable controls for zoned regulation of air conditioning and provisions for future connection of remote switching for peak load control

Exterior shading must be provided for all north and west facing windows by means of either permanent overhangs (suitably dimensioned for the height of the glazing) or operable external blinds/shutters.

5.6 Space heating

MANDATORY REQUIREMENT

Bayonet(s) for gas heating must be provided in all living areas in developments where a gas supply is available, unless a cogeneration system supplies both heating and hot water.

ENHANCEMENT

A balanced flue gas heater fitted in the principal living area or provided as an option with property purchase (gas heaters must be 5★[4]. If suitable size 5★[4] heater is not available gas heaters must be at least 4★).

5.7 Lighting

ENHANCEMENTS

Natural lighting should receive the highest priority and any artificial lighting provided should minimise energy use. Low energy light fittings should be installed. Circuits should be designed to minimise standby power consumption with functional switching before any transformers.

Low voltage halogen lighting should be fitted with electronic ballasts in all cases. 240V light fittings installed in high use areas such as living rooms, kitchens, bathrooms, hallways, or exteriors should accept compact fluorescent lights (CFLs), not standard general lighting service (GLS) lamps. Linear fluorescent lighting, where fitted, should have electronic ballasts.

For communal areas and exterior lighting, automatic sensor switching should be considered to minimise operation while meeting safety requirements.

5.8 Appliances

MANDATORY REQUIREMENT

Where supplied, dishwashers and clothes dryers must have a minimum 3.5★ rating[4].

ENHANCEMENT

Include energy efficient appliance packages (in particular, 5★ refrigerators) as options with the sale of the property.

5.9 Cooking

MANDATORY REQUIREMENT

Gas cook tops must be installed wherever gas is available, except in apartments where electricity is provided by a cogeneration plant.

5.10 Clothes Drying

MANDATORY REQUIREMENT

Facilities for exterior drying (e.g. rotary hoist, clothes lines) must be provided in an area of the house with good solar access. Apartments are to be provided with low level pull out lines on balconies (or screened areas of balconies), which must be designed to accommodate these without adverse visual impact.

6. Supply of Renewable/Sustainable Energy

6.1 Cogeneration (sustainable energy supply)

In cogeneration, heat produced during electricity generation is not wasted as in conventional coal generation but instead salvaged to provide hot water and space heating or cooling. Cogeneration is only possible where heat or cooling can be used close to the source of the electricity generation.

All town centres and large apartment blocks with swimming pools, commercial or retail components should first consider the viability of cogeneration and provide reasons if it is not possible. Where cogeneration is installed, heat and hot water should be supplied from the cogeneration to apartments, and to any swimming pools.

Most cogeneration today (ie in 2003) is likely to use a reciprocating engine with natural or sewage gas as fuel although fuel cells or the use of bioenergy fuels may become available soon. Both fuel source and technology should be chosen to minimise greenhouse emissions while guaranteeing uninterrupted supply.

6.2 Renewable energy supply

Feasibility of renewable energy supply must be considered for all major development projects (e.g. those exceeding 500 dwellings or including a commercial, retail or town centre). See Appendix 5 for further information on various available technologies. Solar water heating has already been covered under point 5.4 of Energy Efficiency and Demand Management Criteria.

Photovoltaic (PV) panels

Where no other renewable energy source is available to supply electricity, single homes (including detached and semi detached houses, townhouses and villas) should be pre-wired to accept PV installation unless the dwelling is technically unsuitable for PV installation. Installation should be offered as an option at time of property sale. PV companies could be notified from time to time which dwellings have been pre-wired so that they can suitably approach residents without infringing on their privacy.

On-site Wind Turbines

Wind turbines should be considered in new developments where average wind speeds exceed 6m/s and suitable locations are available on site.

Sewage Gas

Energy generated from sewage gas should be considered as a source for cogeneration on sites where there is a sewage treatment plant nearby.

Off-site Renewable Energy

Off-site renewable energy generation sufficient to meet all or some of the electricity needs for that development can be considered for any project. The renewable energy source does not have to be physically linked to the development. Off-site wind turbines and bioenergy are currently (as of 2003) amongst the most cost effective renewable electricity options. See Appendices 6 and 7 for details of alternative technologies and a discussion of ownership and legal structures.

Abbreviations

AGA	Australian Gas Association
BCA	Building Code of Australia
CFL	Compact fluorescent lamp
CHP	Combined Heat and Power (also referred to as cogeneration)
CO_2	Carbon dioxide
COU	Coefficient of utilisation
GLS	General lighting service, standard tungsten filament incandescent lamps
kW	Kilowatt (1000 watts – a measure of electrical power, literally 1000 joules per second)
kWh	Kilowatt hour (the energy delivered by a 1000 W power source running for 1 hour)
kWp	Kilowatt peak (refers to the rating of photovoltaic panels; a 1 kWp panel operates at a power of 1 kW in full sunlight)
kWe	Kilowatt electrical (refers to the electrical rather than heating power)
kW_{th}	Kilowatt thermal (refers to the heating power)
m/s	Metres per second
MT	Mega tonnes (1,000,000 tonnes)
MW	Megawatt (1,000,000 watts – a measure of power)
MWh	Megawatt hour (the energy delivered by a 1 MW power source running for 1 hour)
NatHERS	National House Energy Rating Scheme
NO_X	Oxides of Nitrogen
PV	Photovoltaic
RDF	Refuse derived fuel
REC	Renewable Energy Certificate
RC	Reverse cycle (refers to air conditioning)
SEDA	Sustainable Energy Development Authority
SWH	Solar water heating

Appendix 1 - Base Case

The base case is assumed to be:

FEATURES	BASE CASE
Building envelope	3.5★ NatHERS rating
Shading	Shading on north facing windows
Shower	Standard
Lighting	Standard
Cooking	Gas hob, Electric oven
Water heating	Gas heating (centralised in apartments) unless there is no gas supply to the area
BCA Climate Zone 2, 4, 5 & 6 and NatHERS (2003) climate zones 28 & 17 Heating Cooling	**Houses:** reverse cycle air-conditioning COU 1.9 (50% of dwellings) **Apartments:** resistive electric space heaters Air-conditioning COU 2.3 (50% of dwellings)
BCA Climate Zone 7 Heating Cooling	 Electric space heating Not provided

Note: The climate zones above are from the Building Code of Australia (BCA) provisions for energy efficiency due to be adopted with NSW variations on May 1, 2004. The provisions include a map containing 8 zones. The measures proposed for each zone vary depending upon the severity of the climate. The zones are based on climatic data, alignment with local government boundaries where practical, and other adjustments where appropriate.

The zones relevant to NSW likely to be confirmed as applicable under the State Variations are as follows:

Zone 2: Coastal NSW from Kempsey North to Queensland border. Maritime climate with warm humid summers, requiring more attention to cooling than heating.

Zone 4: Western NSW. Hot dry summers and cool to cold, shorter winters.

Zone 5: Coastal NSW, (North to Kempsey) including Sydney, dominated by the population centres of eastern Sydney, Wollongong and Newcastle. Mild maritime climate, with an excess of winter heating over summer cooling requirements.

Zone 6: Northern highlands, Western Sydney and South Coast. A combined zone taking in approximately comparable heating and cooling loads, but significantly different climates.Generally dominated by winter heating requirements but with some potentially hot summer periods.

Zone 7: Highlands and Western Slopes south of Sydney. Higher winter heating needs with several months of potential frost and generally dry, warm summers.

Zone 8: Alpine.

Appendix 2 - Water Heating

Water heating accounts for approximately 45% of household energy consumption. This equates to about 16% of CO_2 emissions if a gas water heater is used or 50% if an electric water heater is used (consumption data is based on modelling of proposed Landcom developments).

The following table shows an example of annual CO_2 emissions from a single dwelling with different types of water heating:

Average CO_2 emissions from residential water heating[5]

TYPE OF WATER HEATER	TONNES PER YEAR OF CO_2 EMISSIONS
Co-generation[6]	0.18
Gas boosted solar	0.45
Gas	1.14
Heat pump	1.31
Electric boosted solar	1.75
Electric	4.37

Co-generation should be the first choice in developments where individual buildings or complexes have sufficient heat load. The next choice is gas boosted solar water heating.

The water heater should always be located as close as possible to points of major use (the bathroom and kitchen) to minimise losses from hot water pipes. Hot water pipes and storage tanks should be insulated.

Gas Water Heating

Using gas rather than electric water heater results in a significant reduction in CO_2 emissions because each unit of electricity gives out approximately four times more CO_2 emissions than an equivalent unit of gas. An instantaneous gas water heater is generally preferred as it avoids the losses associated with hot water standing in a tank, although there may be some situations where storage water heaters are more appropriate. 5★ models should be selected for both gas instantaneous and gas storage water heaters. Instantaneous water heaters that do not function properly with AAA rated shower roses should not be used.

Solar Water Heating

Solar water heating (SWH) is a well-established renewable energy technology which uses the sun to directly heat water. SWH is capable of meeting 60% of annual household hot water needs. Solar water heaters are available with either electric or gas boosting when the solar contribution cannot meet consumer requirements for hot water. Gas boosted solar should be used wherever gas is available as electric boosted solar water heating is more greenhouse intensive than gas water heating in most situations.

Two types of models are available – combined collector panel and storage units installed on the roof and 'split systems' in which the panel fits on the roof and the tank sits on the ground. Panels must be fitted on the north orientation of the roof, while giving due consideration to the design aspect of all dwellings.

Apartment blocks can have a major share of the hot water needs supplied by solar, by providing solar input to the centralised gas system. Care is needed in design of the apartments to facilitate roof installation. It should be specified that the solar system will provide a minimum of 60% of hot water needs unless constraints such as insufficient roof space for panels make this impractical.

It should be noted that the use of SWH will substantially reduce the feasibility of cogeneration systems as the hot water load will not be sufficient to make it viable.

Renewable Energy Credits are available for most models of SWH at point of sale, and significant discounts should be available for large developments (e.g. when more than 1000 systems are installed).

Sample solar water heating costs assuming discount for large release areas (approx. 5000 dwellings)

System Description	**Single dwelling:** 2 panel; 260 litre tank, integrated gas boost; frost protected	**15 apartment block:** 18 panels; 1700 litre storage; includes gas boost; frost protected	Centralised system (cost per apartment)
Retail cost	$2700	$23,000	–
Discounted cost	$1620 (40% discount)	$19,550 (15% discount)	–
Installation	+ $400	+ $1500	–
Renewable Energy Certification (REC)	- $780	- $7020	–
Off set for standard gas system	- $650	- $6000	–
Final cost	$590	$8,030	$535

Heat pump water heating

Heat pump water heating is more greenhouse intensive than gas water heating, and is not recommended when a gas supply is available.

If gas is not available, heat pumps are more efficient than standard electric storage systems, making a saving of 70% in the energy required. In terms of installation, heat pump water heating systems can exactly match and effectively replace an equivalent electrical system.

Heat pumps are priced very competitively, as shown below. A discount of 45% on retail cost was estimated for such a large order. The model recommended for individual houses would currently (in 2003) attract 25 Renewable Energy Credits (RECs).

Sample heat pump costs assuming discount for large release areas (approx. 5000 dwellings)

System Description	**Individual house:** Heat pump 270-T2-EC	**Apartments** (assuming 15 apartments) – Heat pump 5 x 340-T2-EC +50MJ gas boost	Centralised system (cost per apartment)
Retail cost	$2250	$12,750	–
Discounted cost	$1200 (45% discount)	$6,375 (50% discount)	–
REC	- $650	- $3120	–
Final cost	$650	$3255	$217

Appendix 3 - Space Heating and Cooling

In general, energy consumption for heating in NSW exceeds consumption for cooling. Priority should be given to providing north aspects to living areas. Winter heating requirements are significantly reduced in well insulated and favourably oriented houses, while living areas in apartments will need little if any supplementary heating if properly designed. The need for space heating and cooling should be minimised by:

- Good insulation (minimum R1.5 for wall and R3 for roof and ceiling insulation or equivalent)
- Design to maximise solar access during winter and minimise adverse sun exposure during summer
- Design to maximise potential for through ventilation in summer by fully opening windows
- Well sealed windows and doors to exclude draughts during winter
- Roof space ventilation

Solar Access for Lots

SEDA have guidelines for "Solar Access for Lots" available from their Energy Smart website (**www.energysmart.com.au**). These can be used throughout NSW.

The guidelines focus on the house and lot combination rather than addressing each separately. Thus allowing all dwellings in a subdivision to have reasonable solar access to their living room windows and private open space while preventing overshadowing of neighbours.

This is achieved by establishing Solar Access Zones on each lot at subdivision stage. They are located and sized by the subdivider according to their own business plan for developing the subdivision. Minimum dimensions are set for the Zones depending on height controls for the adjacent lot; however there are no minimum dimensions for the overall lot.

The subdivision plan indicating Solar Access Zones is submitted to Council. Council will verify at development approval (DA) stage that the proposed dwelling and the Minimum Solar Access Zone can be accommodated on each lot without overlap.

The guidelines allow flexibility for the subdivider to maintain overall yields. However, the subdivider is responsible for ensuring the lots are of a sufficient size to accommodate the range of house types that may be built on the lots.

Heating

Fuel substitution of gas for electric heating achieves a reduction in CO_2 emissions of approximately 25% compared to standard reverse cycle air conditioning, and 70% compared to resistive electric heaters. While the provision of gas points allows residents to install gas heating, fixed gas heating is better as it almost always ensures that gas will be used. Furthermore, balanced flue room heating appliances avoid the potential for adverse indoor air quality from portable heating appliances. In multi-storey apartments, fan-exhausted common flues are acceptable for flued appliances. However, in apartments, co-generation will usually provide the most environmentally beneficial heating.

Cooling

In the NSW coastal climate, adequate cooling can usually be achieved by the use of thermal mass and through ventilation, so that well designed dwellings need little if any cooling. Ceiling fans should satisfy any further cooling requirements.

For Sydney West climate zone[7] it is likely that some cooling will be required, although this should be minimised by incorporating the design measures described. The most extreme high temperatures are almost always accompanied by low humidity, and are therefore well suited to evaporative cooling. When high temperatures are accompanied by high humidity, some overheating may occur, although climate records for Sydney West suggest that these will generally amount to an average of only eight days in summer.

Evaporative Cooling

Evaporative cooling is an extremely energy efficient method of achieving cooling, with a typical Energy Efficiency Ratio of between 12 and 14. The equivalent measure for a good Reverse Cycle cooling system is 2.9, which makes evaporative coolers approximately 4 times more efficient. The resulting CO_2 emissions are also reduced by approximately 80%. Furthermore, capital costs are nearly half that of equivalent refrigerative cooling plants. However, evaporating cooling does not perform well in high humidity conditions and is not suitable for Sydney's coastal climate.

Ducting

Landcom strongly encourages alternatives to provision of whole house ducting for heating and cooling. Alternatives include ceiling fans and the provision of partial evaporative cooling in suitable climate zones. Provision of ducting effectively encourages the use of whole house cooling, as the cost of installing ducting is approximately 50% of the cost of cooling the whole house. In situations where whole house cooling is essential, a high efficiency model air-conditioning system should be used and ducting should be designed to allow maximum zoning of conditioned spaces.

Cooling System and Controls

A 5★ reverse cycle system is currently the most efficient form of whole house cooling after evaporative air cooling. Where fitted, models which have both efficient heating and cooling cycles should be chosen. Consideration should be given to control systems, in particular:

- Temperature settings should be relative to external temperatures, rather than cooling to a particular temperature
- Provision should be made for external switching that allows network managers control over demand peaks
- Controls should be to zoned areas and should operate separately at least for ground floor and first floor, and living areas and bedrooms.

Appendix 4 – Cogeneration or Combined Heat and Power (CHP)

Cogeneration (also called combined heat and power, or CHP) is a generic term for an energy conversion process where both electricity and useful heat are produced from the same fuel. All fossil-fuel power stations create heat as a by-product of electricity generation. In a CHP station, this heat is harnessed rather than being wasted.

CHP is used around the world in providing heat and power to residential, commercial and industrial customers.

CHP plants come in a very wide variety of sizes, from several thousands of MW's (providing steam and power to oil refineries) to a few hundreds of watts designed to fit quietly in a home kitchen (providing power, central heating and hot water). Cogeneration plants for small applications (i.e. less than 500 kW) will almost always use reciprocating engines.

Matching the system design to the application is crucial for cogeneration, and each project requires a feasibility analysis which considers end-uses for power and heat, fuel inputs, potential for export of power to the grid and costs. Generally, cogeneration plants cost between $1000 and $2000 per MW with overhead and maintenance costs being slightly higher than for conventional gas boilers.

Environmental gains will be greatest when the system is sized for the maximum heat load available.

Applications

CHP has been traditionally used in space heating applications in colder climates as well as in a range of industrial applications. In Australia, it is likely to be more suitable for large apartment buildings, commercial buildings and town centres.

In the early years of the last century, many towns and cities in Scandinavia and Eastern Europe built municipal "district heating" systems which operated in conjunction with CHP stations. Apart from supplying electricity to the area and the local power station, via a network of underground pipes, these also provided energy for space heating and water heating.

For decades, district heating with CHP has been an economically and environmentally efficient way of providing heat and power to millions of homes. In the European Union, 22 million people now use district heating and cooling.

Higher expectations of climate control and increasing demand for air-conditioning in commercial buildings has driven the relatively recent development of "district cooling" systems in Europe and parts of Asia. Good examples of district cooling systems powered by CHP are in the City of London and Southampton.

Fuel sources for CHP district heating in Europe are usually coal, natural gas or municipal waste. For smaller CHP schemes that provide power and cooling/heating to one or a few adjacent buildings, natural gas is the preferred fuel.

In Australia, it is estimated that over 2000 MW of cogeneration capacity is currently in operation. The majority of this is in the sugar industry where sugar mills use cane residue (bagasse) to produce electricity and steam.

In NSW, the State Parliament building currently uses cogeneration to provide electricity, heating and cooling. Further examples of large cogeneration schemes are listed on the following page. SEDA currently offers assistance with cogeneration feasibility studies as part of the Cogeneration Investment Program.

Macquarie University

- Two 760 kilowatt gas-fired generators have been installed to provide electricity for general use
- The waste heat powers an absorption chiller for air conditioning (with chilled water storage to even out peak air conditioning loads) and supplies heat for use in the University
- This is the first system in Australia to use combined power, heat and cooling with chilled water storage
- The system reduces carbon dioxide emissions by 5,400 tonnes per year

Sutherland Leisure Centre

- A 350 kilowatt gas-fired engine is being installed to provide energy for air-conditioning and pool heating
- Waste heat from the engine will heat the swimming pool
- The system reduces carbon dioxide emissions by 1,400 tonnes per year

Appendix 5 – Renewable Energy

Renewable energy generation should be considered for every site in Australia. Solar water heating (covered in Appendix 2) is almost always an option, as is solar electric (photovoltaics, or PV), although PV is currently (i.e. in 2003) very expensive. There is also the option of investing in off site renewables.

Where on site renewables are feasible, these are preferred as local generation avoids transmission and distribution charges and has advantages for network development. Local renewable generation is more straightforward than off site renewables in terms of administration and ownership and is an easier concept to 'sell'. However, off site renewable energy may be more cost competitive because of its ability to use optimum sites and a greater range of available technologies. Structures for enabling the linkage to residential development are currently being investigated (see Appendix 6).

Solar Photovoltaics (PV)

Solar photovoltaic (PV) panels directly convert sunlight falling on the panels into DC electricity which is generally transformed via an inverter to AC electricity at the normal voltage for domestic use. Houses are grid connected so that electricity from the PV is fed into the grid when panels generate more than is being used on site. When panels are not generating enough to meet demand, electricity is drawn from the grid. Some retailers offer nett metering arrangements so that customers are only charged for the difference between what they generate and what they consume in any particular period.

PV panels can be easily integrated onto buildings. On domestic buildings, they can be fitted on the roof in a comparable way to solar water heating panels or substituted for roofing or cladding materials. PV systems are modular, so any size may be installed up to the limit of the roof or wall area available. Since panels are very sensitive to both shading and orientation, roof areas should be unshaded and face as close to north as possible.

PV panels are rated according to their peak output, so that a 1 kWp panel would generate 1 kW in full sunlight. Annual output from a 1 kW panel in the Sydney region is approximately 1382 kWh. Average residential consumption in NSW is 7400 kWh per year, while consumption in a low energy house would range from 2000 - 5000 kWh per year. Measures to reduce demand are generally the most cost effective, so 2-3 kWp should be sufficient to meet domestic electricity consumption in most Landcom properties.

As compared to other measures to reduce greenhouse gas emission from the residential sector, PV is expensive with installed costs approximately $10,000 per kWp (before any subsidies). These costs are falling gradually and new products such as roof tiles with embedded PV cells will reduce overall costs further. There is currently a subsidy of $4 per Watt on residential systems (capped at $4000 per household), so the installed cost with subsidy is down to about $5000 per kWp. Subsidies are due to cease in June 2005, although these may be extended. Cost reductions may be available for large volume installations on the one development. Note that residential developers may not apply for the rebate on behalf of the future homeowner. The Australian Greenhouse Office has up to $1 million available to property developers who will include PV in new residential developments. Contact **1300 130 606** for more information.

The additional costs of pre-wiring houses to accept roof installation of PV at a later date are very small if carried out as part of the initial electrical installation. This would allow modular systems to be offered as an option to all individual householders, to be taken up either on purchase or later. It is important that householders are made aware of this option if included in the package. It may also be helpful to keep PV sales departments informed so that they can promote PV from time to time to the target houses, taking due care not to intrude into people's privacy.

Domestic PV systems are eligible for Renewable Energy Certificates (RECs). RECs for small solar power systems are determined according to location, and 5 years' worth are available up front. For example, a 1kWp PV system in Sydney would be eligible for 7 RECs on installation; then a further 7 in 5 years' time.

Wind

Wind turbines are one of the most cost effective means of providing renewable electricity, particularly with modern large turbines and high wind speed sites. Wind speed is the single most important factor in determining the viability of energy generation. Speeds of approximately 8.5 m/s are currently required for commercial development of wind farms in Australia. However, wind may be a cost effective method of introducing renewable energy supply into a development if annual average wind speeds are greater than 5 - 6 m/s. On site detailed wind monitoring will be necessary to determine feasibility.

The rating of a turbine (e.g. 1 MW) indicates generation under optimum conditions; however, wind is intermittent so the annual output is not the same as rated generation. The table below shows approximate annual output for a 1 MW turbine at different wind speeds and how this compares with the energy consumption in NSW homes.

Generation at different wind speeds

Wind speed m/s	Average generation (MWh/year)	Equivalent no. of homes with low energy consumption	Equivalent no. of homes with average energy consumption
5	1100	3,000	1,500
6	1900	5,400	2,600
7	2750	7,850	3,700
8	3500	10,000	4,700

Wind farms costs are approximately $1.8 million per MW, although this will rise considerably for smaller turbines or when only a small number are installed. Turbines are available from tens of kilowatts right up to 1.5 MW with price per MW reducing as the size of the turbine increases.

The development approval process for installation of a wind turbine is complex. It requires a thorough environmental impact assessment, including noise impact and effects on landscape, cultural heritage, archaeology, ecology, geology, aircraft safety, and television reception.

Turbines are large – a turbine of several hundred kW or greater will usually have tower heights of about 50m and a blade diameter of at least 25m. Visual impact is usually a major issue for the public – their size makes wind turbines visible over long distances thus provoking strong community feelings. However, this could have potential advantages with respect to 'branding' a development.

It may be possible to consider community ownership of wind turbines that form part of a residential development. In the UK and Denmark, where this has occurred, it has improved the perception of wind development, demonstrating that effective community involvement throughout the process is likely to be extremely important.

On site wind power generation is restricted to windy sites. However, investing in off site wind could be an option for any development, and may bring cost advantages, as the turbines may be located in areas with high wind speeds. The legal and administrative structures for such an approach are discussed further in Appendix 6.

Bioenergy

Bioenergy is the term used to describe energy production from a range of organically derived fuels including wood, straw and waste materials. Well designed bioenergy projects have the potential to be CO_2 neutral. This is either because they derive from waste materials that would be produced in any case and will decay, liberating their carbon content, or because bioenergy fuels are grown on a rotation so that the carbon released during energy production is re-absorbed during the next growth cycle.

Bioenergy fuel utilisation varies but usually relies on combustion at some stage in order to release the energy of the fuel. Fuels may either be burnt directly or converted to gas or liquid. Bioenergy is well suited to the combined production of heat and power (cogeneration) as well as providing only a source of heat. Commercial plants exist with capacities from 100kW to more than 100MW using a variety of technologies, although these may not be currently available in Australia. In some areas not all types of combustion plants may be appropriate because of concerns regarding air quality from emissions during the combustion process.

Wood

Bioenergy fuels derived from wood are likely to be a vital component of Australia's sustainable energy future. Sources include short rotation energy crops linked to rural diversification and/or salinity control and well managed plantation forests. Acceptance of these fuels in Australia has been controversial because of concerns over using wood derived from native forests. This was excluded from use for electricity generation in NSW in January 2003 by the Protection of the Environment Operations (General) Regulations, Chapter 3B. The development of the supply chain for wood chip fuels from energy crops is still in its infancy which does not currently make it feasible to install a bioenergy based generation plant linked to sustainably managed energy crops.

Waste

There are various technologies available to convert refuse to energy, ranging from old fashioned incineration to energy combustion plants with full emission control. In recent years, facilities that combine materials recovery (for recycling) with either production of refuse derived fuel (RDF) or direct energy have been developed. Energy may be produced by direct combustion or by gasification of the waste followed by burning of the resulting syngas (a mixture of methane, hydrogen, carbon monoxide and carbon dioxide) in a reciprocating engine.

Only a large plant can achieve adequate emission control and be financially viable, which would make it unsuitable on a subdivision scale. As a rule of thumb, a plant requires approximately 70,000 tonnes per year of waste for economic processing to yield approximately 5 MW of electricity export. For instance, at Edmondson Park, the waste production of approximately 30,000 tonnes per annum would require additional waste from surrounding suburbs in order to make the facilities viable.

Emissions from municipal waste combustion can be difficult to control because the fuel is extremely variable in content. However, stringent emission conditions can be met by employing excellent exhaust cleaning equipment. The gasification process is inherently likely to give better emission control, because the syngas produced by combustion is cleaned instead of the exhaust gases. This means a smaller volume of gas needs to be processed. The consistent gas quality required to achieve good performance in the plant also provides an economic imperative to achieve emission levels that are more stringent than normal consent conditions. However, NOx emissions from the engines are difficult to reduce although it is possible to remove them from the exhaust.

Sewage Gas

Methane (the major component of natural gas) may be derived from anaerobic digestion of sewage. If cogeneration is developed at the Edmondson Park release area, this option should certainly be explored further. Preliminary discussions with Sydney Water suggest that the Agency is currently examining the potential for local treatment which may yield gas supply on site. There is little difference in emissions from sewage and natural gas.

Appendix 6 - Ownership and Legal Structures

At present, there are few models for residential ownership of off site renewable energy generation plants. Appropriate administrative and ownership structures will need to be developed. There are two possible options to secure ownership of off site power generation by residential developments:

- Torrens Title with a covenant/encumbrance on individual dwellings, and
- Community Title

The renewable generating company must be constituted in a way that liabilities for plant operation and maintenance are not passed on to the community owners.

Traditional Title with Covenant/Encumbrance

Covenants are usually associated with restrictions on property use, and are often seen as a negative aspect of property title. This is a possibility for defining ownership but Community Title is preferable.

Community Title

In this option, formal ownership of a portion of the off site generator would be assumed by a dedicated Owners Corporation, in which residents would have an appropriate shareholding.

Returns from investment could go to the Community Title Company (for either subdivision among residents or to offset strata fees), or directly to residents if appropriate administrative arrangements are put in place.

Nett Metering for off-site generation

'Nett metering' is already in existence for photovoltaic (PV) systems installed on domestic roofs. PV panels generate energy only when the sun shines, while energy is consumed 24 hours a day with a peak around 6.30 pm. The result is that electricity usually feeds into the grid during the day (when the PV system is generating more than what is being consumed) whereas electricity is drawn from the grid when more is being used than the PV system is able to generate (for example, after sunset). In nett metering agreements, the retailer does reconciliation and only charges the consumer for the difference between consumption and generation over an agreed period of time.

Off-site generation could be linked to residential development using 'nett metering', with the difference that the renewable energy generation is now physically separated from its owner.

In the case of wind turbines, residents, probably grouped into a legal entity such as an Owners Corporation, would own a certain amount of generating capacity, via a lump sum investment at wind farm development stage. This ownership is bought and sold with the house, in a way similar to ownership of other communal assets (for example, communal swimming pools or central hot water boilers, in blocks of flats).

The output from their share of the wind farm is contracted to a retailer and attracts only a nominal charge from the wind farm operator to cover maintenance. If the resident chooses to buy electricity from that retailer, they are only charged 'nett', ie they are given a credit for the amount of electricity that their portion of the wind farm has generated during the billing period.

While reasonably simple in concept, there are practical and economic issues which need to be resolved. Landcom is currently engaged in discussions with utilities and other stakeholders on developing this model further.

Appendix 7 - Green Mortgages

The concept of "Green Mortgage" is now emerging with at least one financial institution offering a "Green Mortgage" to purchasers of a 5★ rated house. The Green Mortgage offers the advantage of a rate set below the standard variable home loan rate (e.g. 0.5% lower than the standard variable rate) for the life of a mortgage. On a loan of $300,000, a 0.5% reduction in the interest rate corresponds to a reduction of approximately $90 per month in mortgage payments (in 2003). It is hoped that other lenders will offer similar packages in the near future.

For more information, call SEDA on **02 9249 6100**.

1 All references to CO_2 emissions in this report are the total CO_2 equivalent of emissions, ie including the CO_2 of other greenhouse gases contained in emissions.

2 These percentages are from Australian Greenhouse Office (AGO) data for existing housing stock. An emissions breakdown relevant to new Landcom developments should be used in calculations to meet the requirements of this policy.

3 An alternative SEDA approved House Energy Rating Tool may be used after consultation with Landcom.

4 As defined by the Australian Government's energy rating program – see http://www.energyrating.gov.au/

5 Assuming 3 people live in a 4 bedroom detached house.

6 Co-generation emissions are low because electricity is assumed to displace coal generation, and are dependent on the specific characteristics of the co-generation set up.

7 Climate Zone 6 under BCA energy efficiency provisions due to come into force from May 1, 2004.