

Heritage **Solar Technology** **GUIDELINES**

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Foreword

Solar technology is a rapidly changing and evolving area. Home owners in Hobart are showing keen demand and interest in taking up new solar technologies. Council supports the use of solar technologies but recognises that guidance is needed in the siting of solar units on heritage listed properties and in heritage areas.

These guidelines are to help you plan for the installation of a solar system on your heritage listed property. Council’s aim is to ensure that new solar technologies are positively integrated into a home situation and that the visual impacts on the heritage qualities of places of historic and architectural merit are minimised.

They apply to all heritage listed properties and properties in heritage areas under [Schedule F of the City of Hobart Planning Scheme 1982](#) and [Schedule E of Battery Point Planning Scheme 1979](#) and any property adjacent to such a property.

These guidelines consider the current and most readily available solar technologies in Hobart.

Heritage buildings have always been capable of adaptation to include new and upgraded services and technologies and in most cases, it can be done without major compromises. Solar technology is no different.

However, each property presents a unique set of circumstances. Some may have limited roof space, roof angles are that too low, poor solar access, high inaccessible roof lines, plumbing or wiring constraints and so on. In most cases, special considerations and technical input will be required. In some instances, an alternative technology or approach may be required.

Anyone considering installing a solar unit should contact Hobart City Council to determine what permits are required. As part of that check, the heritage status of the building will be considered. A [checklist](#) is provided within these guidelines.

Solar collectors should be installed at an angle of between 48° and 53° from the horizontal for maximum winter performance in Hobart. In some instances

the existing roof angle may be adequate and a support frame is not necessary.



In general, the principal aim with heritage properties is to conceal the solar unit in order to reduce any negative visual impact on the streetscape and on the historic or architectural qualities of the property. This is particularly important if solar collectors and frames are part of the system. For those sites where the roof with the best solar access is highly visible, it is recommended that alternative solar technologies be considered.

The Council recognises that the role of solar technologies is not only to increase the energy efficiency of a building but also to act as an indicator of action on climate change. To that end the Council offers a [Solar and Heat Pump Hot Water Rebate](#) to encourage home owners to install a solar hot water system into their homes. Other rebates are available for other energy efficiency options.

The following solar guidelines are not exhaustive, but provide an illustration of some typical examples of simple and sustainable design and installation solutions that would be considered acceptable.

In some instances a planning permit may be required and the following documentation would also be required to be lodged with an application form and fees:

- Site plan
- Description of unit including size, brands, number of panels or units, details of framing, and
- Photographs or elevations of building showing the location of units on the roof or elsewhere.

Further information can be obtained on Council's website (http://www.hobartcity.com.au/content/InternetWebsite/Environment/Energy_Efficiency_Guidelines_and_Incentives/Energy_Efficient_Development_Rebate.aspx) or by calling Hobart City Council on 6238 2715.

To positively integrate solar technologies into our built heritage values the Council has developed a [Solar guidelines table](#).

1: Introduction: solar panels and heritage

Maintaining conservation values in heritage areas and for specific heritage listed properties requires a thorough evaluation of a development proposal.

In terms of development applications for installing solar panels and technologies, assessment of the potential cumulative effects of similar proposals in order to avoid progressive and gradual changes to the historical character that once defined the area's significance (or the place's heritage value) is also essential.

Buildings of heritage value have always been capable of adaptation: for gas, electricity, internal plumbing and contemporary use, colour combinations/styles and landscaping. And, in most cases, these adaptations have been completed without major compromise to aesthetics and structure.

In order for technology to be unobtrusive, functional and to ensure there is no permanent alteration to the heritage property or streetscape significance, it is considered desirable to mount solar panels on the rooftops of heritage buildings or on other buildings in significant streetscapes using concealing techniques such as 'hiding' them in [roof valleys](#) (refer to [Appendix A](#) for an explanation of terms), on rear roof planes or behind parapets. Alternatives to solar hot water systems, such as [solar heat pumps](#), should also be considered (refer to the explanation of terms for a more detailed analysis).

For anyone wanting to install solar developments, however, this document seeks to provide guidance as to what is acceptable in terms of meeting the current heritage requirements of Schedule F of the *City of Hobart Planning Scheme 1982* and Schedule E of *Battery Point Planning Scheme 1979*.

2: Solar technology systems and applications

Solar hot water systems generally consist of two basic components — an array of one or more solar collector panels and a tank for water storage.

Collectors generally appear as a flat panel containing a network of pipes which are glazed on both faces. The units are fixed on the roof 'plane' of the building which maximises exposure to the sun's rays.

Photovoltaic panels convert energy in the form of light from the sun into electrical energy. A panel contains a number of solar cells wired together to provide the required voltage and current ratings.

For additional information on the types and systems of solar hot water, collectors/tubes and solar panels, refer to [Appendix D: Additional Solar Technology Options](#).

SOLAR PANEL INSTALLATION SUITABLE FOR HOBART CLIMATE

To maximise the capture of the sun's energy in Hobart during winter, solar collectors should be installed at an angle of 5–10° greater than the angle of latitude at the site. In other words, the angle of the collectors should be 48–53° from the horizontal, for maximum winter performance.

A large proportion of buildings on heritage listed properties in Hobart contain steep roof pitches that would be considered satisfactory for winter solar gain. Some architectural designs of heritage value, however, employ slightly shallower pitches.

Accordingly, collectors for these sites may have to employ frames or other methods outlined in these guidelines.

The following table gives additional optimum performance for pitch of solar panels.

Evacuated tubes roof pitch				
Location	Latitude	Acceptable Range of Pitch	Optimum Pitch for Annual Performance	Optimum Winter Angle
Hobart	42.5°	20-67°	42.5°	67°

(AAE Manual)



Split system solar



Framing on ground



Flat roof on frames



Framing facing



North split solar system

(Conergy Manual:
Source Colin Mendoza)

Split systems pitch

To achieve optimum performance the collectors should be installed on a roof pitch of greater than 8° and less than 30°. If the roof pitch is less than 8°, the system will require a mounting frame to increase the pitch. Installations below 8° do not circulate effectively and the collector glass will not self-clean during rainy periods.

Where owners receive advice from independent solar consultants, such as the advice shown below, it is imperative that the guidelines are read in conjunction with the Council guidelines and any other statutory bodies' recommendations and practice notes, where applicable.

SOLAR PANELS FOR GRID CONNECTION OR HOT WATER GUIDELINES AS ADVISED BY INDEPENDENT SOLAR SPECIALIST

- Unless it can be successfully integrated into the design of the building, every effort should be made to minimise the visibility of a system from the street, and its impact on surrounding properties and public areas.
- As mentioned, permits may be needed to install units if visible from a street, public park or heritage listed property.
- Council typically does not support systems visible from the street where the existing building is deemed to be significant or contributory to local heritage.
- The historic fabric of a building should not be unnecessarily disturbed or destroyed, in line with minimum intervention and reversibility principles — i.e. when a system is removed the building should be able to be fully restored.
- Solar panels, tanks and other infrastructure should not display any form of private advertising or branding, visible from street level.
- Avoid placing the system on or near the property boundary without first obtaining consent from the adjoining owner(s).
- To ensure operational effectiveness, all panels should be positioned to avoid overshadowing from nearby buildings, trees, chimneys and power poles.
- The ideal placement for photovoltaic and solar hot water is 30°, however units can start from 20° with minimum loss of power gain.
- Consider other conservation and efficiency measures (additional insulation, energy-efficient light bulbs, low flow shower heads etc).

- Ensure that a qualified professional, accredited by the Clean Energy Council and Aurora Preferred Renewable Energy Suppliers, installs the system; they will guide you through installation at the site visit on obtaining a quote.
- Examples of different locations of photovoltaic panels in performance are attached and also pictures showing framing are available.
- Please note: satisfying these conditions does not guarantee approval of any planning application.

Extra cost of framing for 6 solar panels is between \$700 and \$1000 and for hot water \$300.

(Source: Colin Mendoza Solar Consultant/Australian PV Association)

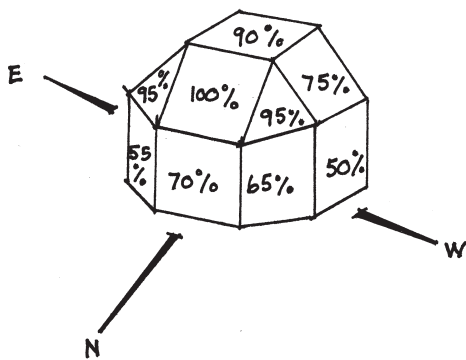
LOCATING THE SOLAR PANELS

In order to adequately conceal the panels from the street, a change in the optimum location of panels may be required, from north to north-east or west. This does not necessarily mean that the alternative installation would not be a viable and efficient option as the following diagram indicates.

What if the most suitable section of your roof to mount the solar modules does not face north?

For optimum performance a north facing roof is ideal, but power can still be generated in different directions away from north. The diagram shows the percentage of power theoretically generated by the solar arrays not facing north or not mounted at the optimum roof pitch.

The diagram shows that photo-voltaic (PV) panels do not have to be facing true north to be an effective solar unit. It also shows the degree that tilt will impact on solar efficiency.



Comparison of alternative solar location table				
System Size	Location	kW per year	Value (\$)	Difference (\$)
1kw 6 x 175w panels	North 180°	1337	256.70	
1kw 6 x 175w panels	West 90°	1146	220.03	36.67
1kw 6 x 175w panels	North /west 135°	1276	244.99	11.71
1kw 6 x 175w panels	North/east -135°	1263	242.50	14.21
1kw 6 x 175w panels	North 42° Tilt	1322	253.82	2.88
1kw 6 x 175w panels	North 60° Tilt	1205	231.36	25.34

A loss of approximately 8% efficiency from solar panels facing west as opposed to north would cost about \$36.67 each year in Hobart, for a typical 1kw installation. This is considered a minimal cost difference for greatly reducing the streetscape impact that solar panels may have on the historic environment, by simply considering alternative locations for the panel arrays.

Refer to [Appendix D](#) for additional, technical information on inverter yield comparisons for solar locations.

(Source: Colin Mendoza, Solar Power Brochure. BP Solar and Power Partners)

3: Energy retrofitting historic buildings and buildings in heritage areas

Before seeking to retrofit building with solar units, an evaluation of the building's features should be conducted to assess their inherent energy conserving potential.

If it is determined that sustainable retrofitting is likely to make an essential difference to a building's energy efficiency, then appropriate measures and works must be designed and carried out in a manner that ensures the building's character and contribution to the streetscape is maintained in the process of adaptation.

'Re-use, reduce, recycle and repair' — these are all key terms that sit well with the objectives and principles of heritage conservation and sustainable development. Sustainable design incorporates the re-use of existing buildings, providing adaptation and change as a means of extending a building's life.

Preferred **'Solar Gain' implementation strategies**, regardless of whether they are passive, primary, for power consumption, or for hot water, should be determined on the basis of the unique circumstances that each site can present. Planning Approval will be dependent on whether a proposal has addressed these and demonstrated that the outcomes are consistent with heritage outcomes by utilising the sort of sketches and photographic images shown as (acceptable) options in the guidelines.

'ACCEPTABLE SOLUTIONS' — GUIDELINES

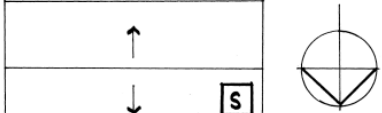
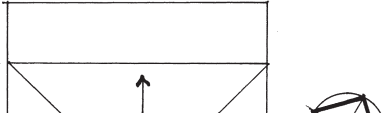
Application of the diagrammatic and photographic solutions and the accompanying principles in Section 4 for solar installations on properties listed as places of cultural heritage significance or properties in heritage areas will result in a reduced impact in terms of the heritage character of an individual property, streetscape aesthetics and the visual and aural amenity of neighbours.

The guidelines are not exhaustive in extent, and will undoubtedly be altered as future needs emerge and solar technology is improved. However, they provide simple, appropriate and sustainable solutions for current needs and current planning scheme provisions.

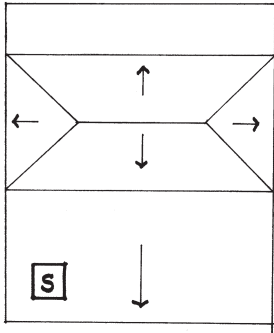
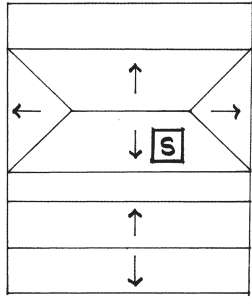
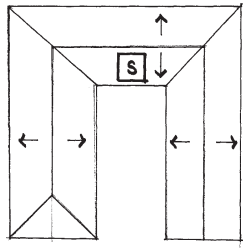
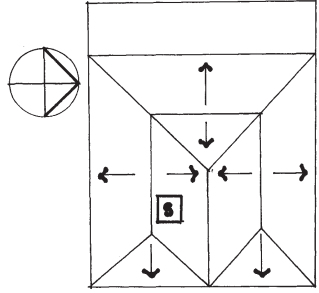
Concealment is the key word which will assist in the reduction of the potential negative aesthetic and visual impacts of a solar unit on the existing fabric and architectural design.

4: Solar guidelines table

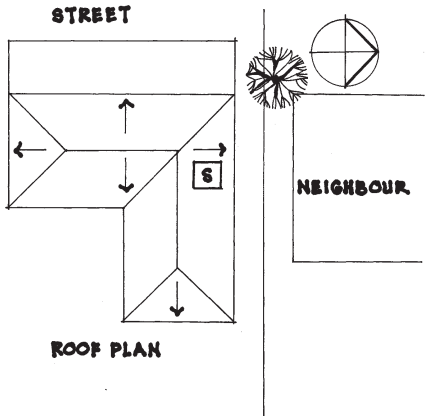
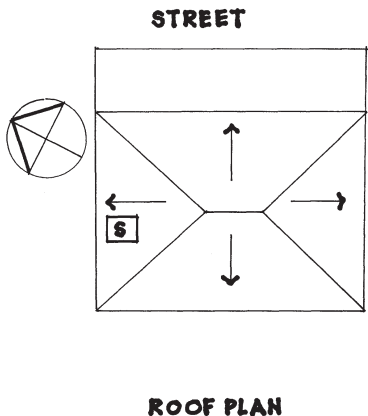
This includes buildings on an individually listed property and/or buildings in a heritage area.

GUIDELINE A	GUIDELINE B	GUIDELINE C
Solar units located on the main frontal roof plane are to be avoided as they may conflict with the heritage significance of the property and streetscape.  The panel array located on this historic building is located at the rear, invisible from the street and neighbouring sites. STREET  ROOF PLAN	Solar units to be located on outbuildings, carports, sheds and contemporary additions, where these are set back from the street front, as opposed to the main and original building. STREET  ROOF PLAN	Solar frames and units should not project beyond the existing ridge lines unless these are obscured from main public views.   Here the parapet on a two storey building may be high enough to conceal flat panels from the surrounding traditional streetscape. Collectors and units should not alter the historic roof line. Tubes located on the rear roof plane of buildings within heritage areas ensure subservience.

4: Solar guidelines table (continued)

GUIDELINE D	GUIDELINE E	GUIDELINE F
Solar units set on rear skillion roofs can often be supported by frames, provided they are not highly visible from the main street. STREET  ROOF PLAN 	Solar units to be located on concealed roof planes, such as internal valleys.  This is an excellent example of concealed tubes positioned within the internal roof valleys of a heritage listed property. STREET  ROOF PLAN	Split systems allow for alternative tank locations which could reduce impact.  This is a good example of a tank unit located on an internal roof plane, completely concealed from the street front where it would have detracted from the heritage character of the listed place. STREET  ROOF PLAN STREET  ROOF PLAN Solar units could be located in an internal roof valley and would be concealed from the street.

4: Solar guidelines table (continued)

GUIDELINE G	GUIDELINE H
Side elevations may allow for solar units, if they are minimal in size and number and have been set back from the front building line. This setback is determined individually as it depends on roof heights, surrounding features and streetscape visibility.  	In order for the units to be subservient, the extent of roofing material to be replaced with solar units should not exceed 15% for a visible roof plane.  This image shows that the side roof plane is not dominated by solar panels, and set towards the rear, the panels are less obvious.  The historic fabric of a building should not be unnecessarily disturbed, in line with minimum intervention and reversibility principles.

5: Checklist for solar installation proposals

Refer to [Appendix C: Scheme Requirements](#).

Required information	Description/examples	Diagrams/ photos	Additional written information	Check
Site plan	Site plan showing roof form and proposed location of units/panels/tubes/tank etc. Site plan must show the location of the street and the north point as per the guidelines in Section 4.	☐	☐	☐
Type and brand of solar unit	For example, <i>Apricus AE-250-22 Solar Tubes</i>	☐	☐	☐
Number and size of panels/tubes/tank	For example, <i>six panels/solar array approx 1.2m wide x 2.4m x 60mm thick.</i>	☐	☐	☐
Frame/support required	For example, <i>A frame as per attached brochure</i>	☐	☐	☐
Photographs of building (preferred)	Current photographic images/elevations showing proposed location as well as streetscape views of the building	☐	☐	☐
Heritage status	For example, <i>This place is within a Hobart City Council Heritage Area but is not individually listed</i>	☐	☐	☐

Appendix A: Explanation of terms

Solar Technology (refer **additional solar technology options** for a full definition)

Sustainable Design

Wikipedia describes Sustainable Design (also known as environmental design) as: the philosophy of designing physical objects, the built environment and services to comply with the principles of economic, social and ecological sustainability. The intention of sustainable design is to eliminate negative environmental impacts completely, through skilful, sensitive design. Manifestations of sustainable designs require no non-renewable resources, impact on the environment minimally and relate people to the natural environment.

Under Sustainable Architecture this attempts to reduce collective environmental impacts during the production of building components during the construction process, as well as during the lifecycle of the building (heating, electricity, carpet cleaning etc.) This design practice emphasises efficiency of heating and cooling systems, alternative energy sources such as solar hot water.

Roof Valleys

Roof valleys are the internal roof planes of a traditional hipped roof, or the inner planes of a returned gabled roof, that may fall to an internal gutter. Generally speaking, valleys are seen from the rear, or from above only.

Concealment

The Concise Oxford Dictionary describes conceal as: to keep secret, not allow to be seen, hide. The term ‘concealment’ (in this solar panels context) means to hide or disguise. In the solar panel context it suggests that whilst ideally a solar unit is hidden from view, a solar unit may not always be completely invisible to the general public, and should at least be located so that it is not highly visible or prominent.

Embodied Energy

Embodied Energy is the inherent energy that is found within the structure and site as the fabric of the place and exists as long term, well used and tested material.

Replacement of a structure with a new building is a loss of this existing energy and there is inadequate ‘green’ credit currently given for conservation and retention of historic buildings. In other words, not only do our historic places and areas contribute to our streetscapes and create a more visually appealing environment, but they also perform an inherently sustainable solution that many new buildings will not be able to match.

Installation of solar panels, in an effort to increase energy efficiency, may not be a practical or suitable solution for every heritage listed property or sites within heritage areas. This will depend on a number of interrelated factors:-

- the location and design of the solar proposal.
- the heritage significance of the site.
- the inherent character and embodied energy of the place.
- an analysis of alternative systems, both primary and secondary, and
- the relative costs associated with the task.

Solar Slate/Invisible Panels/Reversible Panels

Solar Slate is a recent product used in England, to resemble slate from Church roofs. It is essentially a solar panel that is cut the same size as the existing slate and coloured to match. (Refer to the bibliography for additional information here, under **Solar Design, Photo-voltaics for Old Buildings**).

Other future solar technologies to resemble corrugated iron and lead, even tiles, will also gradually assist in the concealment and appropriate integration of roof intrusions/solar units on the roof-scapes of our built heritage. It is anticipated that further development of thin film technology will lead to a proliferation of cost effective, PV coated building materials that can be integrated with the building fabric to reduce costs in a compatible way and not detract from the heritage value of the street or individual sites.

These guidelines have been written using the current and most readily available solar technology in Hobart as described. In time, however, they will need to be adapted to suit future technological improvements.

Solar Heat Pumps

These are a viable alternative to solar hot water systems that should be discreetly located where they will not be visible from the street and will not require unnecessary or irreversible works to the fabric of the building.

SOLAR HEAT PUMP EXPLAINED:

A solar heat pump is a system whereby heat from the ambient air is absorbed by a refrigerant gas (evaporator).

This refrigerant gas is then compressed using a small compressor which causes the gas's temperature and pressure to be raised.

This high temperature gas is then passed through special pipes wrapped around the outside of the water storage tank (condenser). This causes the heat to be transferred from the hot pipes to the water inside the storage tank.

Once the heat from the compressed gas has been transferred to the water storage tank, the gas becomes a liquid again as it has lost its heat.

This liquid gas then passes through an expansion device (TX valve) and back to the evaporator. The cycle is then repeated.

The Quantum Compact Solar Heat Pump is very efficient in that the only electricity required is for the compressor, fan and digital display panel. It will work in temperatures from as low as -10°C up to 40°C , both day and night, very efficiently without the need for boosting.



Quantum
Eco Hot Water

Appendix B: Hobart City Council rebates and initiatives

To encourage existing home owners and home builders to pursue energy efficient options, Hobart City Council offers rebate schemes. Go to the Council's web site at www.hobartcity.com.au or enquire at the Hobart Council Centre

SOLAR PANEL INSTALLATION SUITABLE FOR HOBART CLIMATE

To maximise the sun's beneficial energy in Hobart during winter, solar collectors should be installed at an angle of 5–10° greater than the angle of latitude at the site. In other words, the angle of the collectors should be 48–53° from the horizontal, for maximum winter performance.

For further advice on maximising your solar modules performance refer to *Your Home Technical Manual* at www.yourhome.gov.au

ADDITIONAL INFORMATION TO CONSIDER

Solar modules can be supplied with a frame, usually constructed of anodised aluminium, or as an unframed laminate.

More solar modules are being fabricated as building materials so that they can be integrated into the building fabric. They include solar roof tiles, wall materials and semi-transparent roof material for atriums and skylights.

For more information refer also to the following:

- Alternative Technology Association (2004), solar electricity: Plan your own solar electricity system www.shop.ata.org.au
- Australian Business Council for Sustainable Energy, Energy Use Technical Manual Home, 6.7 Photovoltaic Systems <http://www.yourhome.gov.au/technical/fs67.html>
- Clean Energy Council www.cleanenergycouncil.org.au
- Green M (2000), Power to the People: Sunlight to Electricity Using Solar Cells, UNSW Press, Sydney.
- Markvart T (ed) (2000), Solar Electricity, 2nd edition, John Wiley and Sons, QLD
- Photovoltaic Systems, Australian Government www.greenhouse.gov.au/renewable/pv
- ReNew, Solar Panels Buyers Guide, Issue 101 www.renew.org.au
- The Australia and New Zealand Solar Energy Society www.anzes.org
- The International Energy Agency Photovoltaic Power Systems Program www.iea-pvps.org

Appendix C: Key planning scheme provisions

CITY OF HOBART PLANNING SCHEME 1982

HERITAGE

Principle 20

The Council shall list parts of the Planning Area and specific buildings and sites to be of special significance; control of development through the Planning Area shall be exercised to require **conservation and enhancement of the significant characteristics of such areas, buildings and sites to the maximum degree the Council considers practicable.**

F.3.3

Any new development within or adjacent to a Heritage Area shall be in keeping with and shall not detract from those characteristics of the Area which contribute to its cultural significance.

F.3.4

Within any Heritage Area new development shall be in harmony with the height, bulk, setbacks, materials, colours and finishes of existing buildings but should not distort the cultural significance of the Area by attempting to imitate existing buildings or structures.

F.4.4

Any new development within or adjacent to a place listed on the Heritage Register shall be in keeping with and shall not detract from those characteristics of the place which contribute to its cultural significance.

BATTERY POINT PLANNING SCHEME 1979

E.2.6

Control of use and development must be exercised to require the conservation of places of cultural significance to the maximum degree Council considers practicable.

B.1 General Requirements

Where streetscape is an important component of the amenity and value of an area, the detailing of buildings and their visible curtilage shall be in conformity with the characteristic uses and forms of the area, in particular:

- (a) the factors of aesthetic historical, architectural and townscape value and significance, style, design, arrangement, texture, material and colour shall be taken into account;
- (b) unnecessary impairment to the visual characteristics of existing buildings or their neighbours shall be avoided;

B.2 (c) Conversion or Extensions to Existing Buildings

- (i) alterations visible from the street shall be kept to a minimum, and shall be in the style of the existing buildings as far as possible;
- (ii) irreversible changes visible from the street shall be kept to a minimum; specifically to be avoided are the removal of building elements based on earlier crafts and the painting of unpainted stone and brick.

ADDITIONAL CONSIDERATIONS/ADVICE TO ASSIST SOLAR GAIN

- Maintenance of existing landscape features which can moderate the effects of the climate on the property such as deciduous trees, evergreen wind blocks, lakes and ponds (removal of vegetation can accelerate deterioration of historic fabric).
- Planting and retaining landscape features (both natural and man-made) which perform passive solar energy functions such as sun shading and wind breaks.
- Consideration of passive solar devices other than panels, e.g. double and triple glazing (this will depend on the original glazing material), 'trombe' walls located inconspicuously etc (refer to sustainable guidance given in the bibliography).
- Reversible type solar panels and fixings will be preferred over intrusive structures depending on the site's significance and visibility of the panels.
- Internalised energy efficiency solutions will be preferred on sites of high significance prior to external sustainable options (such as thermal floor, roof and wall insulation) etc.
- Solar Gain Implementation Strategies may be required (in conjunction with development submission) as supporting evidence for sites of high significance (this would include an assessment of existing solar and sustainable qualities, embodied energy, costs, conformance with heritage provisions etc.) so that it can be determined whether the site is suitable and viable for solar technology.
- In order for solar development to be reversible (in particular on sites of significance) and re-assessed, existing roofing material that is considered significant should be retained on site.
- Choice of colours and finishes of the solar units may also reduce the potential impact of collectors.
- A small amount of shading early morning or late afternoon is a tolerable loss of solar/heat gain (either to panels, tubes or passively) but shading of an array during peak daylight hours should be avoided for optimum performance.

OTHER ROOF TOP ACCRETIONS

Roof top development accretions include satellite dishes, aerials/antennas, skylights/roof lights/clerestory windows, hot water service, heat pumps, air conditioning units, electrical conduits, lighting systems etc.

For places with a heritage discretion it is considered that all roof top accretions, as listed above, are considered building alterations and therefore require planning approval.

Should the proposed development follow the guidelines as outlined in Section 4 above for solar collectors, then it is likely that the accretion will be approved, and depending on the site's significance, may be exempt.

ADDITIONAL RESEARCH INFORMATION/ROOF INSTALLATIONS

Some buildings will not be able to support solar technology in a manner that would be considered acceptable and worthwhile, due to high visible access to relevant roof planes, such as corner sites, and will need to adopt other measures that will increase the energy efficiency of the building's operations and therefore reduce greenhouse gas emissions.

Recommended options for alternative heat sources include heat pump systems, passive cooling and heating technology. (Refer to 'Your Home Technical Manual' for additional information.)

Appendix D: Additional solar technology options

Most solar hot water systems use solar collectors or panels to absorb energy from the sun. Water is heated by the sun as it passes through the collectors. It then flows into an insulated storage tank for later use.

In passive systems, water flows due to a thermosiphon effect between the collectors and the tank. In active systems, water is pumped between the collectors and the tank.

PASSIVE SYSTEMS

In passive systems (or thermosiphon systems) the tank is placed above the solar collectors so that cold water sinks into the collectors, where it is warmed by the sun, and rises into the tank. A continuous flow of water through the collectors is created without the need for pumps.

Passive systems come in two types: close-coupled or gravity-feed.

In a close-coupled system the horizontal storage tank is mounted directly above the collector on the roof. Heated water is supplied at mains pressure. This arrangement is the most cost effective to install but efficiency is reduced in cool and cold climates by heat loss from the tank.

Additional insulation of tanks is desirable in these climates. Alternatively, tanks can be detached and moved inside the roof space, although this increases the cost.

In a gravity-feed system, the storage tank is installed in the roof cavity. These systems are cheapest to purchase but household plumbing must be suitable for gravity feeding, including larger diameter pipes between the water heater and the taps. A common alternative is to use a closed circuit gravity-feed system to heat mains pressure water using a heat exchanger.

ACTIVE SYSTEMS

In active systems (also known as pump systems or split systems), solar panels are installed on the roof and the storage tank is located on the ground or in another convenient location, which does not have to be above the solar collectors. Water (or another fluid) is pumped through the solar collectors using a small electric pump.

Because active systems do not require a roof-mounted tank they have less visual impact, particularly when the solar collectors are mounted flush with the roof.

Active systems are often used for solar conversions, when solar collectors are added to an existing hot water system or when the roof cannot support a passive system.

There are two main types of solar collectors available in Tasmania for solar hot water systems: flat-plate and evacuated tube collectors.

Flat-plate solar collectors

These are the most common type of collector. They consist of:

- An airtight box with a transparent cover.
- A dark coloured, metallic absorbing plate containing water pipes.
- Insulation to reduce heat loss from the back and sides of the absorber plate.

Solar evacuated tube hot water system

Evacuated tube solar collectors consist of:

- A series of transparent outer glass tubes that allow light rays to pass through with minimal reflection (the curved surface of the tubes allows the sun's rays to strike perpendicular to the water for a greater part of the day).
- Each tube contains an inner water pipe coated with a layer that absorbs the sun's rays, generating heat. Water runs through this inner tube and is heated.
- A vacuum (hence 'evacuated') exists between the outer tube and the water pipe, which acts as insulation, reducing heat loss.

(Source: *Your Home Technical Manual*)

SOLAR MODULES

Solar modules come in two distinct categories – crystalline silicon and amorphous silicon.

Crystalline solar modules are covered with tempered glass on top and a tough ethylene vinyl acetate (EVA) material at the back. The glass and backing material protect the solar cells from moisture.

The most efficient crystalline silicon cells are made from slices of a large single crystal ingot (hence known as mono-crystalline). Multi-crystalline or polycrystalline cells have a speckled appearance from multiple small crystals which slightly reduces their efficiency.

Crystalline modules need to be cool. The output efficiency of crystalline PV arrays decreases by 0.5 per cent per degree Celsius over the standard test temperature of 25°C. Good ventilation is required at the back of modules. Exposure to cool breezes when siting modules is an important consideration.

Amorphous silicon is one of a number of thin film technologies. This type of solar cell can be applied as a film to low cost substrates such as glass or plastic in a variety of module sizes.

Advantages of thin film cells include easier deposition and assembly, low cost of substrates or building materials, ease of production and suitability to large applications.

Efficiency of thin film modules is lower than that of crystalline modules but all the types of modules are price competitive. Those currently on the market degrade in output by up to 10 per cent when first exposed to sunlight but quickly stabilise to their rated output.

Thin film modules have various (often flexible) coating and mounting systems. Some are less susceptible to damage from hail and other impacts than those covered in glass.

(Source: *Your Home Technical Manual*)

INVERTER YIELD COMPARISONS FOR SOLAR LOCATIONS

SYSTEM OVERVIEW (AUSTRALIA / HOBART)

PV-module

Suntech STP175S-24/Ac

Angle of inclination: 25°

Azimuth angle: 180°

Module x String: 6 x 1

Inverter

1 x Sunny Boy SB 1100

Max. efficiency: 93 %; EU-efficiency: 91.6 %

Max. DC power: 1.21 kW; Max. AC power: 1.1 kW

Grid voltage/frequency: 240 V / 50 Hz

TECHNICAL DATA

PV peak power : 1.05 kW

Total number of modules : 6

Area of PV-generator : 7.8 m²

Number of inverters : 1

Max. DC power of inverter : 1.21 kW

Max. AC power of inverter : 1.10 kW

Inverter effectiveness : 91.6 %

Nominal power ratio : 115 %

Yearly en. yield * : 1337 kWh

Energy usability factor : 100.0 %

Performance Ratio * : 81 %

Spec. energy yield * : 1274 kWh/kWp

Cable losses (% in PV-Energy) : Not considered

Notes: 6 Panels with 1100 Inverter **Facing North**
6 X 175W V1.51

SYSTEM OVERVIEW (AUSTRALIA / HOBART)

PV-module

Suntech STP175S-24/Ac

Angle of inclination: 25°

Azimuth angle: 130°

Module x String: 6 x 1

Inverter

1 x Sunny Boy SB 1100

Max. efficiency: 93 %; EU-efficiency: 91.6 %

Max. DC power: 1.21 kW; Max. AC power: 1.1 kW

Grid voltage/frequency: 240 V / 50 Hz

TECHNICAL DATA

PV peak power : 1.05 kW

Total number of modules : 6

Area of PV-generator : 7.8 m²

Number of inverters : 1

Max. DC power of inverter : 1.21 kW

Max. AC power of inverter : 1.10 kW

Inverter effectiveness : 91.5 %

Nominal power ratio : 115 %

Yearly en. yield * : 1276 kWh

Energy usability factor : 100.0 %

Performance Ratio * : 81 %

Spec. energy yield * : 1216 kWh/kWp

Cable losses (% in PV-Energy) : Not considered

Notes: 6 Panels with 1100 Inverter **Facing North West**
130° 6 X 175W V1.51

(Source: Colin Mendoza)

Appendix E: Planning exemptions

The question of whether or not potential applications for solar units need planning approval under current planning scheme provisions has been raised and needs clarification.

Under the *Battery Point Planning Scheme 1979*, solar and PV panels aren't exempt and will need a planning application. For information, the only exemptions in that Scheme are as follows:

- 1.7.1 'development' carried out by 'Council' on a 'reservation';
- 1.7A(i) certain types of fences;
- 1.7A(ii) pergolas, etc;
- 4.2.2 signs defined by section 4.2.2

Like other proposals that constitute 'development', panels proposed upon a site that is either individually *heritage listed* or *within a heritage area*, or *adjacent* to a listed property or heritage area, require a planning application to be submitted to enable assessment. Following submission, the proposal will be assessed against these guidelines.

For non-heritage, non-heritage-area properties within the *City of Hobart Planning Scheme 1982*, if the panels (either solar or photovoltaic) would fit within the Building Envelope defined by Clause AS4.1, then they are exempt under Clause 1.6.1(k).

Furthermore, Clause AS4.2 states that cooling and heating appliances may project beyond the building envelope provided they aren't within 900 mm of a boundary. There is no qualification on the size or height of the panels. This clause covers solar panels but not photovoltaic panels.

So, for solar panels and appliances, they are exempt within the CHPS area, provided:

- they aren't within 900 mm of any boundary;
- they aren't on or adjacent to a heritage listed property;
- they aren't within or adjacent to a heritage area;

If they are within 900 mm of a boundary (and aren't on or adjacent to a heritage listed property or heritage area) they would need to fit within the building envelope to be exempt.

Most applications for proposed solar appliances will need to follow usual acceptable documentation as per the [checklist](#) in Section 5.

Prospective applicants should contact the Hobart City Council to determine whether planning and building approval is required for individual sites, regardless of the heritage status of their property.

For any solar hot water/heat pump installation that is not exempt from requiring a planning permit, and the normal application requirements do apply, then a completed application form, 3 sets of drawings (including site plan, and elevations of the panels in their proposed location) and 3 copies of title will be required.

http://www.hobartcity.com.au/content/InternetWebsite/Development/Building_Planning_and_Plumbing/Guidelines_and_Help/How_do_I_apply_for_a_Planning_Permit.aspx

Appendix F: Bibliography and useful web sites

Solar Design Photo-Voltaics For Old Buildings, Urban Space, Landscapes — Ingrid Hermannsdorfer

Google Wikipedia — Definition for Sustainable Design

Guidelines for Solar Technology installations in the City of Melbourne's residential areas — City of Melbourne

Solar Panels for Mosman Council — <http://www.mosman.nsw.gov.au/development/application/solar-panels>

Energy Conservation for Babergh — <http://www.babergh-south-suffolk.gov.uk/Babergh/Home/Planning+and+Building+C>

Guidelines for Rehabilitating Historic Buildings; Energy Retrofitting, US General Services Administration — <http://w3.gsa.gov/web/p/HPTP.NSF/gsaGovAllProceduresDisplay/0109118S>

Global Urban Development Magazine — Sustainable Urban Development Vol 2 Issues 1 March 2006 'Innovative Strategies for Urban Conservation, Sustainable Development and Renewable Energy' — <http://w3.gsa.gov/web/p/HPTP.NSF/gsaGovAllProceduresDisplay/0109118S>

Climate Change and the Historic Environment — English Heritage
www.english-heritage.org.uk www.helm.org.uk/climatechange

Small Scale solar thermal energy and traditional buildings — English Heritage
www.helm.org.uk/climatechange

Preservation Architect — Newsletter AIA
http://info.aia.org/nwsltr_hrc.cfm?pagename=hrc_a_200902_energy

Green Futures — 'Sustainable Heritage? : Rob Jarman of the UK National Trust
<http://www.forumforthefuture.org/greenfutures/articles/602482>

Welcome to the Centre for Design's quarterly e-newsletter Issue 12 — RMIT
www.rmit.edu.au/cfd

Submission Statements for Solar electric and Solar hot water panels in Heritage Conservation Area — Letter to Woollahra Council ex The Paddington Society Inc. For Community and Heritage.

Best Practice Guidelines for Local Government Approval of Solar Photovoltaic Installations — Australian PV Association June 2009 www.apva.org.au

Solar Power Brochure — BP Solar and Power Partners

