ENERGY EFFICIENCY MEASURES IN LOW INCOME HOUSING

SUB-PROJECT ONE: LITERATURE REVIEW

A REPORT FOR THE TASMANIAN GOVERNMENT

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EXECUTIVE SUMMARY

The Tasmanian Government's Climate Change Office has commissioned the Sustainable Communities Research Group at the University of Tasmania to review the literature on the potential benefits of improving energy efficiency in the residential sector. Improving residential energy efficiency is one way of meeting the Government's objective of reducing greenhouse gas emissions by 60% of 1990 levels.

The aim of this literature review is to assist the Tasmanian Government to encourage Tasmanians to modify their dwellings to contribute to energy efficiency gains, and thus to greenhouse gas emissions abatement. The Government's focus on equity and social responsibility in its quest for Tasmanians to be energy smart means it is appropriate to focus on low income households in this review.

Two objectives are addressed in this report:

- to identify, summarize and critically review evidence for the financial, health and well-being benefits of implementing a range of energy efficiency measures in low income housing; and
- to identify, describe and report on evaluations and/or reported effects of energy efficiency programs in place in jurisdictions similar to Tasmania that may be implementable in the Tasmanian context.

These objectives relate to two other objectives that are the domain of the Tasmanian Climate Change Office in conjunction with agencies such as Housing Tasmania:

- to seek to improve the energy efficiency of a number of low income houses; and
- to increase awareness of, and encourage action on, energy efficiency amongst Tasmanians on low incomes.

In addressing the first two objectives listed above, this review is also informed by four years' of research on sustainable housing among members of the Sustainable Communities Research Group, as summarized in Stratford *et al*. (2008). The method of approach is standard to reviews. Various online databases have been searched according to several key terms. Information focused on the key terms set out in the brief or which dealt with case studies involving modifying low income houses in contexts similar to Tasmania was selected.

The interpretation of the research and the analysis presented in this study is informed by the authors' backgrounds in sustainable communities research. Their approach to this research is informed by an understanding of sustainable development: that the well-being of Tasmania's ecology, its communities, its people and its economies is interdependent. Such understandings require the authors to consider a diverse range of implications and benefits that may arise from improving household energy efficiency.

The research findings support the Tasmanian Climate Change Office focus on low income housing, as householders in such dwellings may have diminished options to change their living conditions. It is noteworthy that almost one third (27%) of Tasmanian's are classified as living in low income dwellings, so a focus on their needs

is a focus on the needs of a significant minority of people. In addition, while the focus on low income communities is apt, findings are likely to have much wider application given Tasmania's demographic profile, the age and standard of existing housing stock, climate, electricity use and – crucially – a history of innovation and self-reliance.

The review has established that householders in Australia, New Zealand, the UK, USA and Canada face serious health risks when living in inadequate housing and in conditions characterized by cold, damp, mould and a lack of natural light. Various researchers cited in this report have tracked energy efficiency programs of various kinds and have found that improving the condition of domestic dwellings will create a context for more comfortable, healthy and financially affordable living. In addition to the benefits to individual householders, improving low income housing has both direct and indirect implications for the householders' communities, society, environment and the wider economy. Programs already in place overseas and on the mainland provide useful examples of how dwellings in Tasmania could be improved and the measureable benefits which arise from those improvements could be better dispersed; nevertheless, laudable programs also exist *in situ* and there are many Tasmanians from whom much on this important subject could be learned.

A number of *material* interventions appear important in promoting energy efficiency in domestic dwellings. These are to seal the building envelope while ensuring air quality; insulate; use solar hot water; purchase energy smart appliances; and make the most of site or aspect where possible.

Additionally, a number of *social* conditions are key to successfully implementing domestic energy efficiency programs. These include engaging and recruiting householders; enacting and supporting behavioural change; promoting awarerness and understanding of the issue; lowering electricity consumption, improving household affordability and increasing comfort; up-skilling and sharing knowledge among trained professionals; and clarifying the role of government to be a primary facilitator and funder of programs.

Finally, evidence suggests that distributed leadership, supportive and supported champions, proper resourcing, and time are required for energy efficiency programs to gain purchase and give effect to change.

1. INTRODUCTION

1.1 BACKGROUND

Providing supplementary information on the Intergovernmental Panel on Climate Change scientific assessment, Houghton *et al*. (1992) underscored the point that the potential for uncontrolled increases in greenhouse gas emissions had prompted widespread interest in finding ways to improve residential energy efficiency. A decade later, Parker *et al*. (2003, p.169) remarked that the "residential sector is a major contributor to resource consumption and greenhouse gas production, as well as air pollution from coal-fired power stations, as it accounts for 22 per cent of global energy consumption".

In 2006, Australia's estimated greenhouse gas emissions by sector comprised waste (3%); land use, land use change and forestry (7%); agriculture (16%); industrial processes (5%); fugitive emissions (6%); transport (14%); and *stationary energy* (50%)[1]. The sum of these emissions representing a 1.5% share of the world's total (Australian Government Department of Climate Change, 2008). The generation of electricity is the largest single contributor to stationary energy emissions.

According to the Australian Government Department of the Environment, Water, Heritage and the Arts (2008a), residential sector energy use in 2008 was approximately 402 petajoules (PJ) and, under current predictions, may rise to 467 PJ by 2020, a 56% increase over the period from 1990. The Department predicts that, over the same decades, the number of occupied dwellings will shift from *circa* 6 million to *circa* 10 million, a 61% increase – and one experienced in response to various sub-elements of demographic change (among them regionally disparate population growth and increasing numbers of lone householders).

Floor area of residential dwellings may increase by 145% from 685 million squares to 1682 million squares if consumers continue to demand larger homes and new builds, and if local and state governments continue to supply land in periurban environments rather than focus on urban consolidation measures in inner and middle city areas. It is also forecast that electricity will be the energy source most likely to be used to meet residential energy demand; this observation holds for both new and existing dwellings. Without significant fiscal, infrastructural, cultural and political interventions *the net effect* of such predictions, if realized, *may be ongoing and increasing contributions to greenhouse gas emissions*.

A foundational premise of this report is that various modest but powerful and effective interventions for anthropogenic climate change mitigation and adaptation are possible among the vast majority of those who manage, own, rent or otherwise occupy the bulk of Australia's existing dwellings. This assertion also holds across different types of stock in diverse environments among diverse communities and local economies; dissimilar sub-cultures with assorted value sets; and various political contexts.

[1] In 2006 8.5Mt of greenhouse gas emissions were generated in Tasmania, stationary energy produced the largest proportion of emissions (Australian Government Department of Climate Change, 2008).

The possibility that action in the face of climate change represents hitherto unidentified opportunities underpins the Tasmanian Government's approach to policy on this complex matter. In response to environmental, social and economic risks and uncertainties over the medium- to long-term, the Tasmanian Government has identified eight priority areas for action under its *Framework for Action on Climate Change*:

- government leadership;
- consolidating the State's position *vis-a-vis* renewable energy;
- planning for change; protecting carbon stores;
- improving transportation systems;
- innovating in agriculture;
- *being energy smart*; and
- building communities that are resilient and adaptive

(Tasmanian Climate Change Office, 2008a).

Such priorities are underpinned by four practical objectives:

- by 2050, reducing greenhouse gas emissions to at least 60% below 1990 levels;
- adapting to climate change;
- realizing the opportunities inherent in climate change adaptation and mitigation; and
- demonstrating leadership as a low-carbon economy.

These priorities are also buttressed by six principles:

- exercising governmental and distributed leadership;
- recognizing equity and shared responsibility;
- observing best practice;
- accelerating outcomes by intelligent prioritization of effort;
- adhering to creative thinking and innovation; and
- being open and transparent and approaching evidence-based learning by carefully documenting 'mistakes' as positive elements in 'learning by doing'.

Being Energy Smart is one of eight priority areas of the Tasmanian Framework, and justified on the following grounds:

> Energy efficiency makes sense. There is significant potential for many energy efficiency measures to be cost-neutral or cost-positive … it will also ease the transitional and ongoing impacts on households and businesses from the national emissions trading scheme and from future climate change. Investing in energy efficiency for lower income households can provide them with houses that are more comfortable, affordable to operate and less susceptible to future electricity price rises (Tasmanian Climate Change Office, 2008a, p.27).

Among a number of actions determined in response to this priority, the Sustainable Communities Research Group at the University of Tasmania has been commissioned to conduct this literature review on the benefits of investing in energy efficiency measures in low income housing. The intent is that such work will "inform a new program which provides energy efficiency audits and insulation upgrades for selected low income housing in three 'test' areas across the State" (ibid, p.27).

A key impetus for this review is the Tasmanian Government's commitment to reducing the use of fossil fuels while respecting the need to care for local communities. The Government views smarter householder energy use as a chief component in reducing the State's energy consumption equitably.

1.2 AIMS, OBJECTIVES AND METHODS

In light of the foregoing, the aim of this literature review is to present evidence to help the Tasmanian Government address the question of how to encourage Tasmanians to modify their dwellings to contribute to energy efficiency gains, and thus to greenhouse gas emissions abatement. However, the Tasmanian Government's focus on equity and social responsibility in *being energy smart* means it is appropriate to focus on low income households in this review. Among the reasons for this focus, two are key: first, the occupants of low income households spend a larger proportion of their income on energy bills than other households; second, they also tend to live in poor quality housing without unrestrained capacity to change their living conditions either radically or rapidly (Bonnefoy *et al*., 2004).

Four objectives underpin this larger aim. These are to:

- identify, summaries and critically review evidence for the financial, health and well-being benefits of implementing a range of energy efficiency measures in low income housing;
- identify, describe and report on evaluations and/or reported effects of energy efficiency programs in place in jurisdictions similar to Tasmania that may be implementable in the Tasmanian context;
- seek to improve the energy efficiency of a number of low income houses; and
- increase awareness of, and encourage action on, energy efficiency amongst Tasmanians on low incomes.

This desktop study addresses the first two objectives listed above. It is informed by four years' of research on sustainable housing among members of the Sustainable Communities Research Group, as summarized in Stratford *et al*. (2008).

The method of approach used to prepare this study is standard to desktop research, and has involved locating scholarly and policy documents, as well as texts oriented to applied knowledge and from ephemera. Various online databases have been searched according to several key terms including *housing, ecohousing, energy efficiency, household energy, sustainable housing, low income housing, low income households, health and housing, climate change and housing* and *adaptation*. In particular these include ProQuest and the Australian Bureau of Statistics. Information which focused on the key terms set out in the brief or which dealt with case studies involving modifying low income houses in contexts similar to Tasmania was selected.

The interpretation of the research and the analysis presented in this study is informed by the authors' backgrounds in sustainable communities research. Their approach to this research is heavily informed by an understanding of sustainable development described by the World Commission on Environment and Development (WCED) in 1987 and

modified over several international commissions since: that the well-being of Tasmania's ecology, its communities, its people and its economies is interdependent. Such understandings require the authors to consider a diverse range of implications and benefits that may arise from improving household energy efficiency.

2. BASELINE INFORMATION

Housing stock is a term that describes *existing* dwellings which are available for a population's non-transitory occupancy. At the 2006 Census of Population and Housing, Tasmania had 189,000 occupied private dwellings, of which 86.2% were separate houses – above the national average. According to the Australian Bureau of Statistics (2006a, np), over the period between 1991-2 and 2003-4 "construction was completed on 145,000 new dwellings on average per year" in Australia. Construction rates fluctuated in Tasmania, with 2889 residential buildings approved in 2006-7, an increase of 11.1% on the 2005-6 estimates (Australian Bureau of Statistics, 2008a).

Access to adequate and affordable housing stock partly depends on *household income levels*. From 2001, for example, average weekly equivalized gross household incomes across Australia show that Tasmanians had incomes 17% lower than the national average (Australian Bureau of Statistics, 2006a). The State's regional and remote status intensifies that trend, and there has been little shift across intercensal periods between 1996 and 2006. In 2001, "the proportion of people in low income households[2] was highest in Tasmania (27%)" (Australian Bureau of Statistics, 2006b, np), and in more remote areas of the State that proportion was between 32% and 34% of households.

Tasmania had the "largest increases in the proportion of people in low income households between 1996 and 2001" (ibid, np). Income was largely composed of wages and salaries (52.8% of total household income), government pensions and allowances (31.5%) and other (6.5%). As a proportion of the total, government pensions and allowances declined between 2003-4 (36.6%) and 2005-6 (31.5%) but remained high relative to the national average. In the same period, expenditure was primarily upon food and non-alcoholic beverages (17.8% of total household expenditure), transport (16.9%) and housing costs (13%) (Australian Bureau of Statistics, 2008b).

In 2006, 36.8% of all occupied private dwellings in the State were fully owned (Australian Bureau of Statistics 2008b), and dwelling ownership was highest in the Tasman Local Government Area (52.1% of all dwellings in the LGA), and lowest in Brighton (20.8%). At the same Census, and among those still purchasing their dwelling, the median monthly home loan repayment for occupied private dwellings in Tasmania was $867; Hobart residents paying the highest median monthly costs ($1138) and West Coast residents the lowest ($500). Also in 2006, the median weekly rent in the private

[2] A low income household is defined as people who are in the bottom 20% on a scale of 'ranked ... average weekly equivalised gross household income' used by the Australian Bureau of Statistics (2006b), and refers to those in various forms of private and public rental accommodation as well as some home buyers.

sector in Tasmania was $135, with that figure as high as $180 in Hobart and Kingborough and as low as $50 in the Central Highlands LGA.

While various groups may choose to rent dwellings for reasons related to lifestyle (flexibility, job demands), finances (multiple residents) or other issues (retirement), according to the Australian Bureau of Statistics (2008c) renting is most common among young adults and low income households – especially single parent families (32% of all renter households in 2005-6). Approximately 74% of those low income householders were renting their accommodation from private landlords.

At 30 June 2007, the State's public housing rental properties numbered 11,672 in total, of which almost 50% were located in the Greater Hobart-Southern Statistical Division, and approximately 25% were located in either the Northern Statistical Division or the Mersey-Lyell Statistical Division (Australian Bureau of Statistics, 2008b). As with other jurisdictions, the proportion of households renting from Tasmania's housing authority remained stable over the decade from 1995-6 to 2005-6 at approximately 5% of households (Australian Bureau of Statistics, 2008c).

Housing Tasmania has other roles in the sector, however, not least among them policy around affordable housing and the protection of vulnerable groups. Among these groups are refugees, young children, elderly people, those with a physical or mental disability or illness, and indigenous people and, in this task, the Government's work is augmented by community sector organizations (Anglicare Tasmania *et al*., 2007; Australian Bureau of Statistics, 2008d). In other work increasingly related to questions of environmental management and asset management, Housing Tasmania also works in conjunction with other State Government bodies, such as the Tasmanian Climate Change Office. Such multilateral collaborations are important for climate change mitigation and adaptation, as we seek to make clear now.

Tasmania has a cool temperate climate – one characterized by mild to warm summers and cold winters, and comparable to highlands of Victoria and New South Wales (Australian Government Bureau of Meteorology (BOM), 2008a).

In a study for the World Health Organization, Bonnefoy *et al.* (2004) identify common conditions experienced in sub-standard housing, such as damp, mould, lack of insulation, excessive indoor temperature fluctuation, temperature extremes, lack of adequate heating, inability to afford heating.

Such conditions need not be the norm into the future. As the Australian Bureau of Meteorology (2008a)[3] notes, there are many accessible and relatively quick solutions to existing design faults that will contribute to thermal comfort, well-being and health (Box 1).

[3] The Australian Government's Your Home website also sets out recommendations for houses in such a climate.

BOX 1. DESIGN TIPS FOR A COOL TEMPERATE CLIMATE

In a cool temperate climate, we need …

- more north-facing glass than is required in the temperate zone. The area of north-facing windows should be 20 - 35% of the floor area of the room they are in - use 20% in buildings of low heat storage capacity and 35% in structures with high heat storage capacity.
- east-facing windows (with external shading to restrict summer sun) to provide morning sunlight during the cooler months;
- even more effort to block heat loss via drafts;
- all outer doors opening on to a small entry hall, which acts as an air-lock between inside and outside;
- edge insulation for concrete slabs;
- insulation for timber floors;
- thicker insulation for external walls and very thick ceiling insulation;
- thermal insulation of metal framing, if used;
- precautions against frost damage to water pipes and solar water heaters;
- pitched roofs where snow falls occur (a flat roof leaks, when melting snow collects on it);
- consider a sun-porch, glasshouse or conservatory, to trap the sun's heat and/or double-glazed windows, to reduce heat loss.

Condensation will be a problem in uninsulated houses in this climate. It occurs when moist air comes into contact with surfaces which are cold enough to cause water vapour to condense into liquid form. In well-insulated buildings, surfaces are warmer, so condensation is less likely.

(Adapted from BOM, 2008a, np)

Anecdotal evidence suggests that such design stipulations are not met in many Tasmanian households. Certainly, the overwhelming majority of houses in Tasmania were built prior to the advent of current building regulations which set minimum standards for various aspects of housing construction, not least among them standards related to insulating houses – *insulation* being one of two crucial elements of energy efficiency, the other being attention to *sealing the building envelope* while ensuring adequate and controllable ventilation (Australian Building Codes Board, 2008).

According to the Australian Bureau of Statistics (2005), 75% of Tasmanian houses have some form of insulation. However, the type and level of insulation is unknown, and the question of whether or not they would meet current regulation standards is unanswered. Even if houses do meet Tasmania's minimum insulation standards those standards fall behind requirements elsewhere in the world such as the United States (Schweitzer and Tonn, 2002) and the United Kingdom (Sustainable Development Commission, 2006).

Household energy consumption in such conditions becomes an important component in the mitigation of climate change (see tables and figures in Appendix 1).

Electricity was used in 99% of all Australian households in 2005 and is the most widely used source of residential energy. That electricity is generated almost entirely (92%) from fossil fuels, and especially (78%) from black and brown coal. Only 8% of energy is available from renewable resources. Solar energy was used in less than 5% of Australian households in 2005, and the majority of household electricity is used for space heating (39%), using appliances (30%) and heating hot water (27%) (Australian Bureau of Statistics, 2007).

The majority (60%) of the renewable energy produced in Australia exists in the form hydro power generated in Tasmania (Hydro Tasmania, nd). Tasmania's average annual energy consumption is around 10,000 GWh per annum (Hydro Tasmania, nd). Between April 2006 and 2007 Hydro Tasmania imported 1470 GWh of electricity from the mainland and generated 600GWh at the Bell Bay Power Station (Hydro Tasmania, 2007). Without the ability to source power from the mainland or from Bell Bay Power Station, Hydro Tasmania would have introduced power restrictions in 2007 (ibid). The cost of purchasing electricity from the mainland via Basslink and from Bell Bay Power Station was $100.6 million in 2006/7 (Hydro Tasmania, 2008b). Note, in this context, that Tasmania's energy requirements are expected to grow.

In 2006/7, the residential sector was the third largest consumer of electricity in Tasmania, requiring 16.3 % of energy consumed in the State (Australian Bureau of Agricultural and Resource Economics, 2006, np). The majority of household electricity demand comes from space heating and cooling and heating hot water.

However it is necessary to take an integrated approach to reducing household energy demand given the need for significant reductions in greenhouse gas emissions set out in the Tasmanian Framework for Action on Climate Change. Section 3 explores how current knowledge about energy efficiency could be used to holistically reduce the amount of electricity consumed by Tasmanian households.

3. WEIGHING THE BENEFITS OF IMPLEMENTING ENERGY EFFICIENCY MEASURES IN LOW INCOME HOUSING – MATERIAL CONCERNS

In fulfilment of the first objective of this study, outlined above, the purpose of this section is to identify, summarize and critically review evidence for the financial, health and well-being benefits of implementing a range of energy measures in low income households, such measures generally involving reasonably uncomplicated and relatively inexpensive renovations or retrofits that can contribute to energy efficiency (see, for example, Weaver, 2005). Hence the subtitle 'material concerns'. We undertake this work with reference to insulation, reducing air infiltration, solar hot water, appliances and aspect/siting, first elaborating upon one case study that illustrates the effects of retrofitting on low-income housing, and then making more general observations about various measures and their benefits. In Section 4, our focus turns to 'social concerns'

and the documented benefits and effects on people and communities of implementing energy efficiency measures.

Energy efficiency is defined here as actions (either electric or manual) that result in less energy consumed in a system to achieve the same performance outcome as alternative actions. For example, an energy efficient light will consume less energy to produce the same amount of light because it efficiently transforms electric energy to light.

In turn, *renovation or retrofitting for housing sustainability* is:

> the renewal and adjustment of the fabric, fixtures, fittings and landscape of any given residential dwelling in order to improve the dwelling's ability to sustain the occupants within the carrying capacity of the Earth. It may include, but is not confined to, insulating, sealing the building envelope, properly treating windows by the use of pelmets, curtains and appropriate glazing, fitting water tanks, solar panels, energy efficient light, heat and water systems, and planting native, productive and low-water gardens. Such renewal and adjustment avoids or minimises the depletion of natural, human, social, financial, physical and organizational capital, and is mindful of the scalar and temporal dimensions of our actions: it remains apposite rather than clichéd to think global, act local, and over the long-term. In an ideal world, [such renovation or retrofitting] would also move beyond site specificity and integrate with abutting and adjacent sites to effect a 'rippling' out of transformation and change (Stratford *et al*., 2008, pp.2-3).

In short, to reduce household energy consumption, increase energy efficiency in the residential sector, and ensure that low income households are not inequitably affected by such reforms, a holistic or integrative approach to renovation or retrofitting is necessary.

In practical terms, the performance of the building envelope[4], the design of the dwelling and its fixtures and fittings, the efficiency of heating and lighting, and householders' behaviours, attitudes, values and embodied practices are interdependent factors in whether or not a dwelling is comfortable, safe, healthy *and* environmentally more or less benign (Bonnefoy *et al*., 2004).

3.1 TAROONA CASE STUDY

During the winter of 2002, monitoring of the indoor climate of a heritage listed weatherboard house in Taroona of between 80 and 120 years recorded unheated daytime temperatures as low as 8 degrees Celsius (Figure 1). At the start of the following winter, and following an audit of the house and gardens, Hobart City Council, the owner of the property, made available $3000 in funds for the Sustainable Communities Research Group to purchase and have installed draft proofing, floor and ceiling insulation, and window pelmets and curtains as part of a Masters of Environmental Management thesis (Weaver, 2005; Table 1) and for the benefit of the low-income tenants occupying the dwelling.

[4] This term, also known as the building shell, refers to the exterior surface area of a building – its walls, windows, floors and roof.

Additional access to a 'curtain bank' was provided by Cool Communities and Sustainable Living Tasmania. Within a week after the completion of that retrofit the unheated temperature under equivalent conditions was recorded at 18 degrees Celsius.

Figure 1. Taroona house subject to retrofit (Weaver, 2005, p.86)

Table 1
Costs for retrofit of the Taroona house

Draught Reduction	Cost
* Weatherstripping materials for external doors and windows were purchased	92
* A kitchen door which had been removed was repaired and replaced	40
* Steel plates were purchased and sealed on top of the bedroom chimney and at the bottom of the kitchen chimney	72
* Silicone was purchased for application to gaps around skirting boards and in weatherboards	33
* Wages for HCC tradesman	512
Insulation	
* R3.8 pink batts were purchased and installed by the contractor in the ceiling, and R1.5 batts under the exposed elevated floor (and held in place with heavy-duty rodent-proof reflective foil)	1788
* To improve heat retention at night, pine pelmets were constructed for all windows (painted & installed by Council)	385
* Only 2 windows had curtains (thin ones) so a full set was obtained from the University curtain library (established	
* Cool Communities Tasmania) for a nominal bond	20
Total Cost of Retrofit	**2942**

Source: Weaver, 2005, p.93

Weaver's conclusions about the efficacy of the retrofit, noted below, should be read in context given a number of singularities to the case[5] – the presence of heritage restrictions on works and of large *macrocarpa* pines at the east of the house not least among them. However, he observes that:

> The retrofit of the Taroona House has yielded small reductions in overall energy consumption with attendant decrease in energy expenditure by the occupants. Due to the majority of reduction in energy consumption being in the amount of wood burnt, with a three per cent increase in electricity consumption there has been no decrease in greenhouse gas emissions, and if Tasmania had coal-fired electricity generation there would have been a slight increase in emissions (2005, p.105).

In addition, Weaver stresses the very significant point that the tenants reported experiencing health and well-being dividends from the retrofit (Box 2).

Box 2. Qualitative findings from the retrofit at the Taroona house, Hobart

One cold day, shortly after the retrofit had been completed in June 2003, I went to the house to ask the residents if they had noticed any changes in living conditions since the alterations. The woman resident commented that she had already noticed some changes which surprised her. She said that in the previous two winters, 2001 and 2002, she had chilblains on her feet for several months from May onwards. They had returned in May 2003 but were gone within days of the completion of the retrofit. Even more surprising, she said, was the children's health. Whereas they had sniffles and colds almost continuously through the winters of 2001 and 2002, and then they went on to have a chest cold and one had asthma, in the week after the retrofit the chest cold which the eldest already had cleared up, and the others lost their sniffles. Everyone had noticed almost immediately that when they talked to each other the 'vapour trails' they were used to seeing weren't there anymore …

Health gains continue to be noticeable, with less frequent sickness and anyone who gets sick recovering more quickly than they used to, without chest infections. The bedrooms are warmer at night than previously, and the house holds its temperature better in summer. The improvements are easier to notice in winter than in summer. The house used to be noticeably draughty, especially in the kitchen but isn't now. The vapour trails visible when they spoke in winter had disappeared for some time, but were now back when they were in the bedrooms. In winter they used to run the woodheater in the lounge and it heated the room quickly, but the room cooled fast too if the heater died down. The woodheater was not good for one child who had asthma.

After the retrofit they continued their pattern of going into the lounge after the evening meal and sitting by the fire. Some time later they felt that with the refitted door in the kitchen closing out the hallway they could stay in the kitchen. Now they spend most of their time in the evening in the kitchen, which heats up quickly with a little fan-heater. Often, after the children are in bed, the parents take the fan-heater into the lounge and it heats it well and the room holds its heat. There used to be a great deal of condensation on the windows in the mornings but now there is much less. It used to be difficult to dry towels and tea towels, but now tea towels dry overnight and only the thickest towels are not quite dry.

[5] Indeed, this point needs emphasizing: each retrofit will be different, and hence the widespread understanding of the desirability for professional auditing advice in advance of major modifications.

Mould previously appeared on items such as quilt covers and clothing in the clothes basket, but there has been no recurrence of mould on bedding or clothing. There had been mould on the bathroom ceiling and still is, but whereas there had been no mould in the bedrooms (apart from below a small roof leak above the children's ceiling), this last winter of 2004 there has been mould on the southern walls of both bedrooms.

Power bills do not seem to have changed, but they no longer have any expense for wood. Coming from Queensland where there were water meters, they considered they were quite environmentally conscious and owned a front-loading washing-machine. They were aware of the benefits of insulation as they had lived in an extreme climate with very hot summers and winters which were cold due to the altitude. Their house was not insulated and was unbearably hot in summer, so they had it done and noticed the benefits. In any house they may own in the future, the couple said they would definitely insulate the ceiling, and if they could afford it, the walls as well. They would recommend the retrofit changes done to the Taroona house to anyone for improved livability, and especially for the health benefits (Weaver, 2005, pp.94-5).

In general terms, inadequate housing impacts on householders' sense of well-being and their ability to perform day to day tasks, to work, go to school and interact with others. Householders who are dissatisfied with their dwelling, have poor natural lighting, cold indoor temperatures and noise were also found to have an increased rate of accidents (ibid). Comfort is a subjective feeling but, as the Bonnefoy *et al*. (2004) describe, it is dependent on several common foundations two of which are air temperature and relative humidity (ibid).

What, then, are the key measures for energy efficiency in existing housing stock and what evidence is there that they have financial, health and well-being benefits?

Certainly, the studies we reviewed suggest they include insulation, managing air infiltration and solar hot water, using particular appliances or using appliances in particular ways, and making the most of aspect or siting. These are dealt with in turn below.

3.2. INSULATION

More than one third (38%) of electricity used in Australian dwellings is used for space heating and cooling (Milne and Riedy, 2008). An insulating material is one which does not easily conduct heat. In a dwelling with insulation there is very little transfer of heat between the indoors and outdoors, and it is easier to maintain a steady temperature, save electricity and therefore money. It is important to reduce temperature variation because fluctuations and extremes can cause serious illness (Bonnefoy *et al*., 2004). Being unable to control indoor temperature also means that householders require more artificial heating and cooling. Insulating an existing dwelling means treating the ceiling, walls and potentially the floor, and it requires reducing the amount of air infiltration around joins, doors and windows (BOM, 2008a).

The insulating value of a material is measured using R-values: a higher R-value means a material has a high level of insulation (McGee and Mosher, 2008). Current regulations

require new Tasmanian dwellings (and major renovations) to have walls with an overall insulation value of R1.9 and ceilings to have an overall value of R3.8 (BCA, 2007).

In a standard house construction regulations can be met using insulation batts of R1.5 in the walls and R3.5 in the ceiling. The Building Code of Australia (BCA) sets minimum standards and the Australian Government recommends using higher value insulation (McGee and Mosher, 2008).

The performance of insulation batts is significantly affected by how well they are installed; for example if there are gaps around the batts or the batts are squashed too tightly together heat transfer will reduce the effectiveness of the insulation (Elliott, 2007). Although two major insulation suppliers in Tasmania recommend using R2 insulation batts in standard 90mm wall studs, there is some debate among builders as to whether they will fit (ibid). Whether or not wider wall studs are required for R2 batts and what the implications of that would be needs to be investigated.

A lack of adequate insulation poses a serious threat to the health and well-being of householders[6], and has been found to increase the mortality rate of the elderly in the United Kingdom (Bonnefoy *et al*., 2004). In poorly insulated housing, damp and mould can cause an increase in asthma, nasal allergies, and eczema as well as chronic bronchitis and cold throat illnesses. There can be a significant increase in incidents of depression, anxiety, fatigue, headaches, irritability and 'social misconduct' in houses with conditions such as cold, mould, draughts and damp (ibid). Being unable to change or improve living conditions can also affect householders' mental health.

Insulating a dwelling will often address these symptoms of ill-health, and may reduce noise levels which can sometimes also impact on householders' health. Attempts to rectify cold and damp conditions without such insulation treatments are often met by escalating electricity costs, which aggravate financial duress (ibid). In addition, the external costs to society of the aforementioned conditions of poor health and associated medical expenses or lack of productivity and meaningful engagement, and of financial strain, housing discomfort, and so on are exacerbated by increased and ineffective energy consumption (ibid). Certainly, European studies by the World Health Organization (2007) have found that insulation has more of an impact on improving people's health than other measures including removing damp from the dwelling or having an adequate artificial heating system.

In Tasmania, the majority of existing houses were built prior to the introduction of insulation regulation (Australian Building Codes Board, 2008). We have established that, in 2005, three quarters of Tasmanian houses had some form of insulation; however, that level and its adequacy are unknown and up to 51,000 houses may be uninsulated (Australian Bureau of Statistics, 2005, 2008f). One third of houses are also timber constructions which require more insulation that brick (ibid). The Australian Government recommends that houses occupied in a Tasmanian climate should have roof, ceiling, wall, underfloor and slab insulation (McGee and Mosher, 2008). Ceiling insulation alone can reduce space heating costs by 25% and wall insulation can reduce

[6] The World Health Organization (WHO) provides an overview of research into the relationships between poor quality housing and health, visit http://www.euro.who.int/Housing/20080319_3 for more information.

costs by a further 14% (Australian Bureau of Statistics, 2002). The Australian Government's recent Energy Efficient Homes Program is likely to have significantly positive impacts upon housing in Tasmania.

Householders can install ceiling insulation batts themselves by laying the batts in the ceiling cavity, this task is not technically difficult but householders may be discouraged from attempting it because of the upfront cost of purchasing ceiling insulation batts and because of the physicality, mess and inconvenience of doing so (Elliott, 2007; McGee and Mosher, 2008). The most common reason why householders have not installed insulation is the up-front purchasing cost (Australian Bureau of Statistics, 2008c).

When insulating existing walls the type construction (timber, double brick, brick veneer) and the age of the house will determine what type and level of insulation can be used. In some cases insulation batts or loose fill insulation can be fitted into existing wall studs. However, houses built prior to the imposition of current regulations may not have a vapor barrier (sisalation) installed to protect the insulation from moisture and moist insulation will not perform effectively (Elliott, 2007). If there is no vapor barrier either the external or internal cladding must be removed from the walls; this will be more expensive and require more labor than filling wall cavities with insulation but it will achieve a higher level of insulation performance (Elliott, 2007). An alternative option is to clad the exterior in an insulating polystyrene material; this is particularly recommended for brick veneer houses because insulating the bricks will allow them to act as thermal mass and store heat inside the house (McGee and Mosher, 2008).

Tasmanian dwellings with timber floors should have insulation under-floor wherever possible (BOM, 2008a). Although there are few professionals available to insulate under-floor areas in Tasmania, it is practical when the under-floor cavity is large enough. Insulating concrete slab edges in new dwellings is relatively easy and inexpensive; however it is not mandatory and few builders are aware of the benefits of doing this (Elliott, 2007).

This section has detailed how insulating a house has direct measurable benefits to householders by improving their health, well-being and by reducing their electricity bills. Insulation also offers indirect benefits to the community by reducing electricity consumption and reducing pressure on the health system and on work places through reducing the number of sick days off work and school (Howden-Chapman *et al.*, 2007).

3.3. REDUCING AIR INFILTRATION

Uncontrolled air infiltration (or drafts) will also create temperature fluctuations and increase the risk of damp and mould (Bonnefoy *et al*., 2004). To reduce air infiltration householders can seal around doors and windows, repair holes in doors and windows and seal unused fireplaces (Schweitzer and Tonn, 2002; Weaver, 2005). Metal pipes, window and door frames can also be insulated to reduce the transfer of heat. Many studies have shown that weatherproofing can have a positive impact on householders' health and comfort (see Bonnefoy *et al*., 2004; Weaver, 2005)

For some aspects of weatherproofing, such as sealing around doors and windows, it is not necessary to hire a skilled building professional. However, Schweitzer and Tonn (2002) argue that employing someone to weatherproof low income houses can save money because householders may not have the time or the capacity to access information about weatherproofing.

When weatherproofing a house, it is important to plan for ventilation. Without controlled ventilation, pollutants from gas appliances and damp or mould will build up, creating poor indoor air quality. Such pollutants can cause respiratory illnesses, disturbed sleep, arthritis and asthma, and affect householders' lungs (Bonnefoy *et al*., 2004).

> Besides the allergic and respiratory symptoms, in accordance with the literature data, *fatigue, headache, chronic anxiety and depression* were also significantly associated with mouldy homes. The observed increased risk for arthritis may be rather due to the dampness than to the mould growth. The odds ratios of *cerebral stroke, heart attack and hypertension* adjusted to age, sex, socioeconomic status, city, smoking and marital status indicated significantly increased risk associated with mouldy homes but these results require further confirmation because other studies did not mention (if investigated at all) such effects A possible link may be explained by the common link with depression (Bonnefoy *et al*., 2004).

A lack of ventilation coupled with a concentration of volatile organic compounds (VOCs) can also be carcinogenic (ibid). VOCs are emitted from paints, varnishes, carpets and furnishings in the home.

3.4 SOLAR HOT WATER

A quarter (25%) of household electricity is used by heating water (Milne and Riedy, 2008). Solar hot water systems can reduce greenhouse gas emissions by providing an alternative form of heating and reducing householders' dependence on electricity from burning fossil fuels. An average household's solar water heater can provide 75-100% of its hot water and would save 4 tonnes of greenhouse gas emissions annually (Low *et al*., 2005).

An average 4-person home with two bathrooms will require a 2-panel 300-litre solar water heater. In Tasmania, the initial purchasing price for that size is around $5000, with installation costs ranging between $700 to $1300 depending on the quote. Through savings in energy bills the payback period for a solar hot water system of that size is around 5 to 8 years, after which time there will be a net financial gain.

The Australian Government also offers Renewable Energy Certificates (RECs) for households replacing existing electric water heaters. RECs are tradeable certificates which householders can sell to their solar water heater supplier or another electricity company to reduce the purchasing price of the system by $1000 (Australian Government Department of Environment, Water Heritage and the Arts, 2008b). Although these systems work out to be financially viable in the long term the initial expense of purchasing this system remains a barrier for many households.

3.5 APPLIANCES

More than a third (37%) of household energy is used to run appliances (Milne and Riedy, 2008). Electricity bills can be reduced by using more energy efficient appliances and by planning to use energy efficiently (by placing sources of hot water close together and separating light switches) (ibid). Updating large appliances to ones with a high energy star rating will also reduce energy bills. Compact fluorescent lights use only one quarter of the energy of a normal light to produce the same amount of light (ibid). In terms of expense, the average fluorescent globe costs an additional $3.50 to purchase compared with the cheapest normal globe, but it will last 10 times longer.

Energy efficiency is also about deciding what is actually needed; the standby energy used to power the digital clock faces on many appliances such as radios, TVs, DVD players, ovens and microwaves when combined can contribute to 10% of household energy use (Milne and Riedy, 2008). Household energy use can be improved through choosing more energy efficient fixtures and appliances.

3.6 ASPECT / SITING

In a dwelling with a sound solar passive design, sunlight will light and heat the house, thereby reducing the need for artificial lighting, heating and cooling. Depending on design, site and location, a dwelling with a passive design will need minimal, if any, heating and cooling. In the southern hemisphere a dwelling should be designed with over 50% of the windows facing north (Boland *et al*., 2003). Windows facing south will not receive adequate sunlight and those facing north should be shaded in winter to prevent the dwelling overheating (Reardon, 2008).

When sunlight does enter a dwelling, it is either absorbed into materials or reflected back into the room, therefore the design and choice of building materials will also affect how the dwelling performs in summer. Floor surfaces such as carpet or cork coverings are insulators so they prevent heat being absorbed by reflecting it back into the room (ANZSES, 2006). In contrast, materials with greater thermals mass including water and floor surfaces such as concrete, terra cotta tiles or dark slate absorb heat. Dense wall materials such as earth, mud brick or straw bale will also have greater thermal mass than other forms of construction (ibid). By absorbing solar heat during the day these materials reduce the amount of heat inside the dwelling and prevent it from overheating, and when internal air cools down in the evening the heat rises warming the room (Low *et al*., 2005).

In dwellings designed to have solar access and thermal mass, it will be easier to maintain a steadier temperature for longer, there will be less temperature variation and temperature extremes and less dampness. Sunlight plays a major role not only in reducing the running costs of the house but also in creating a more comfortable environment and improving residents health and well-being (Bonnefoy *et al*., 2004). Insufficient natural light can affect householders' mental and physical well-being (ibid).

Although passive design is a low-cost option in new housing, it is difficult to achieve a sound solar passive design in an existing dwelling which has not been designed in that way (Elliott, 2007). Redesigning dwellings to incorporate passive design principles may involve major building work such as removing external or internal walls, purchasing new windows or changing the layout of the house (ibid).

Passive designs have been used elsewhere in the world for thousands of years but in 1999 only around half of Australian homes had been designed to take advantage of features such as allowing winter sunlight into living areas (Australian Bureau of Statistics, 2002). Although some passive design techniques are incorporated into the Australian Building Code (2007), building professionals require a more holistic and detailed understanding of how passive designs work if they are to use them (Elliott, 2007).

4. WEIGHING THE BENEFITS OF IMPLEMENTING ENERGY EFFICIENCY MEASURES IN LOW INCOME HOUSING – SOCIAL CONCERNS

In this section we document key recommendations from literature on low income energy efficiency programs in Australia, Canada, the United Kingdom and the United States. Where the focus in Section 3 was upon material concerns – that is, the fabric of a dwelling or physical interventions – attention here is upon social concerns related to, among other things, finances, health and well-being.

4.1 INSIGHTS ON LOW INCOME HOUSING AND ENERGY EFFICIENCY FROM ELSEWHERE

In discussions with the Tasmanian Climate Change Office which informed the brief for this desktop literature review, it was determined that it would be useful to identify, describe and report on evaluations and / or reported effects of energy efficiency programs in place in jurisdictions similar to Tasmania that may be implementable in the Tasmanian context (Tasmanian Climate Change Office, 2008b).

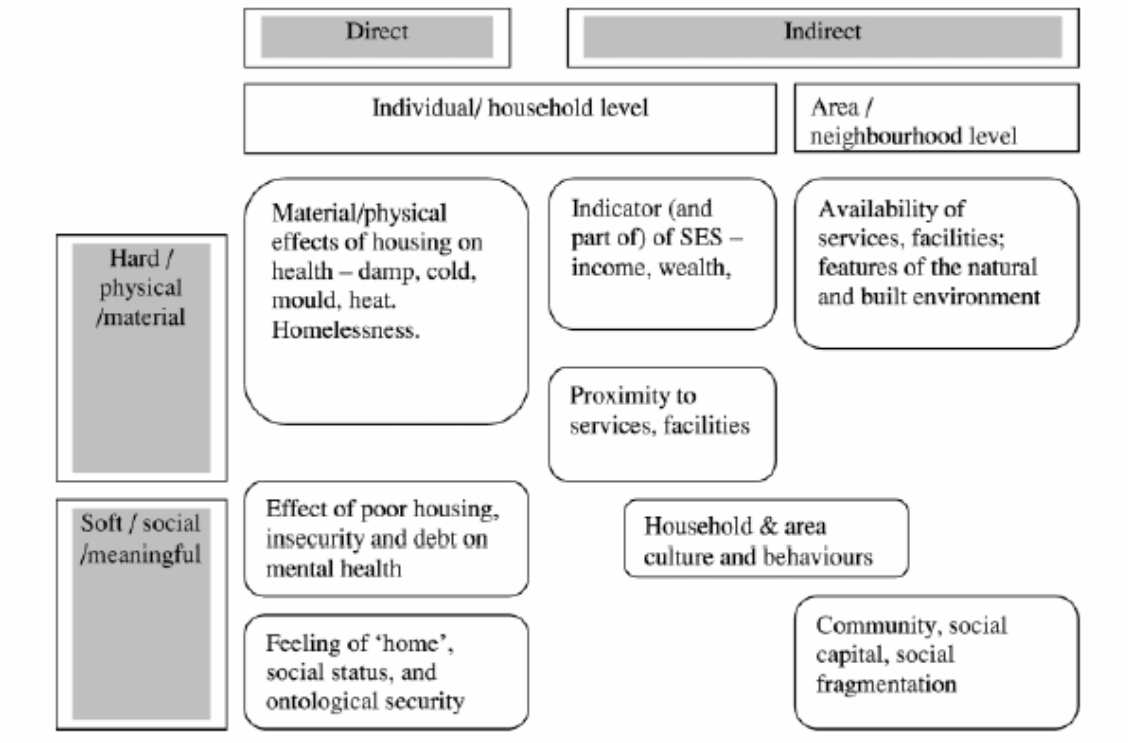
To that end, evidence from the World Health Organization (Bonnefoy *et al*., 2004), the United Kingdom (Sustainable Development Commission, 2006), the United States (Schweitzer and Tonn, 2002), New Zealand (Howden-Chapman *et al.*, 2007) and Australia (KPMG *et al.*, 2008) has been collected, read and analyzed, and is summarized below. Appendix 2 provides a list of additional literature of relevance to the subject area that has informed our analysis and interpretation.

According to researchers brought together by the World Health Organization to work on the question of what constitutes healthy housing, health "is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity … Healthy housing covers the provision of functional and adequate physical, social and mental conditions for health, safety, hygiene, comfort and privacy … a residential setting" (Bonnefoy *et al.*, 2004, p.1).

The relationship between health and housing, as modelled by Shaw (2004) (Figure 2) has been used by Bonnefoy and colleagues in an eight-city, Europe-wide, 3373 household study. Their work also reflects on a program of the Council of Europe Development Bank which, over the period of the late 1990s and early 2000s, distributed EU8 billion in loans for social projects related to housing (22% of funds), and health projects (10%) and environment (14%). They stress that these allocations represent half of the disbursements made by the Bank and argue that such financial programs are critical to the success of policy reforms *in action*.

Figure 2

Conceptual model for health and housing interactions



Source: Bonnefoy *et al.*, 2004, p.2

It is also useful to note that many of the elements of healthy housing cited by Bonnefoy and colleagues *do not* arise in conditions where houses are damp, excessively cold or hot, poorly ventilated or inefficiently insulated. In short, the European study leads us to conclude that there is a strong positive correlation between unhealthy dwellings and those exhibiting the 'symptoms' of being energy inefficient:

> It is critical that health authorities emphasize the importance of the housing environment on health and that environmental and housing authorities recognize that the built environment is a vital factor in human health. Poor housing increases rates of asthma, respiratory and skin allergies, and other lung diseases. It is linked to physical accidents and injuries, to social and mental effects including depression, isolation, anxiety or aggressions. Noise-related stress, exposure to toxins, lead, asbestos or carbon monoxide can have very severe health impact. Poor urban design, that lacks trees, parks and walking areas has been associated with lack of physical exercise, obesity, loss of ability to socialize, and increased motor transport. Some significant factors are difficult to influence as they relate mainly to occupant behaviour, how they "use" the building and its immediate environment, factors including window openings, door openings, cooking habits, use of extract fans, bathing habits, all influence indoor air quality, dampness and mouldiness and can either support or work against ventilation systems, heating systems and the insulation construct of the building fabric (Bonnefoy *et al*, 2004, p.17).

Put slightly differently, the health assessment program conducted by Bonnefoy and colleagues suggests that healthy residents are more likely to live in housing that are characterized by conditions which are also conducive to energy efficiency; a double dividend, in short.

The UK's Sustainable Development Commission (2006) refers to trends and patterns of household energy use that are not dissimilar from those cited above in Section 3 for Australia and Tasmania – expanding energy demand and especially electricity use, against a policy imperative for climate change mitigation and adaptation. The Commission notes that

> Energy efficiency, conservation and carbon displacement support the concept of sustainable development. Measures will result in a reduction in the damaging release of CO_2 into the atmosphere, and of other pollution released as a result of fuel combustion. Improved energy efficiency will contribute to reducing fuel poverty, and to delivering healthy homes. There is a significant evidence base suggesting many carbon reduction measures are cost effective currently, delivering economic benefits to householders. Household carbon savings are vital to delivering the Government's climate change targets (2006, p.26).

The Commission identifies four areas of change:

- enable householders to change,
- engage them in the process of change,
- encourage them to change and
- exemplify the change.

The Commission makes several recommendations for how changes to existing houses could be enacted (Table 2). Many of the barriers to change identified by the Commission are experienced in Tasmania and, after a more detailed examination, many of the recommendations noted in Table 2 could be useful in the Tasmanian context to encourage more widespread adoption of energy efficiency measures.

Table 2

Barrier to Energy Efficiency	Recommendation
A lack of insulation in existing houses	Use tax rebates to reduce the up-front cost burden for households.
Use of inefficient lights and appliances	Create a voluntary agreement for labeling entertainment appliances. Use financial incentives, such as tax rebates, to make purchasing efficient appliances easier. Create standards for lighting and appliance efficiency in the house. Use a product tax to increase the price of inefficient appliances such as incandescent lights.
Householders' behavior and awareness of how their household energy consumption contributes to greenhouse gas emissions	Informative energy bills. Installing smart meters in houses. Encourage estate agents, mortgage companies and landlords to assess energy performance when renting or selling houses.
Consumer confidence	Energy suppliers inform clients of energy efficiency standards and requirements
Costs (householders understanding of costs and benefits and being able to make informed choices)	Reduce tax on energy efficiency measures including insulation, glazing and draft proofing.
Landlords reluctant to invest in energy savings in rented houses	Landlord Energy Saving Allowance (LESA) designed to reduce the financial burden of large up front costs on landlords. Set minimum energy efficiency standards for private rentals and introduce tax incentive for homes that meet standard ('Green Landlord Scheme').

Adapted from the Sustainable Development Commission (2006)

Among such measures is a process known as weatherization.

Over the last 30 years, a Weatherization Assistance Program has been run by the US Department of Energy. The Program provides assistance to low-income households by helping them afford weather-proofing around doors and windows and other places of air infiltration, insulating floors, ceiling and walls, and insulating water heaters and pipes. The support provided by the Program assists householders who may not have access to information or time to improve their houses (Schweitzer and Tonn, 2002).

The benefits of the US program include indirect financial savings to communities: in 2001 an average of US$3346 per house could be saved in non-energy benefits by weatherizing low income houses. Indirect benefits identified by Schweitzer and Tonn (2002) include benefits to rate payers (payment-related and service-provision benefits) and payback to householders (affordable housing and safety, health and comfort benefits).

Importantly, weatherizing low income houses was found to have *most* benefit in terms of its wider implications for society (ibid). The *environmental* benefits of improving low income housing include enhancement of air quality – a corollary of reduced pollutants from electricity generation and reduced pressures on ecosystems. *Social* benefits include reduced unemployment, improved social equity and increased community pride (Schweitzer and Tonn, 2002). *Economic* benefits include job creation for implementing weatherization in low income communities and reducing the costs of importing energy into the community. Schweitzer and Tonn (2002) propose that

landlords also benefit from weatherization programs because of reduced financial pressure on tenants who are then more able to pay their rent.

As well as weatherization, it is clear that insulation remains a 'king hit' strategy for energy efficiency, health and well-being. One research project in New Zealand stands out as particularly relevant because it measures the benefits of retrofitting low income houses (Howden-Chapman *et al.*, 2007), with a particular emphasis on insulation. In 2001-2, over a thousand low income households, *where a member of the household had experienced respiratory illness*, were randomly selected for the study. Some of the dwellings were insulated and others were not, in order to measure the effects of insulation on health.

> The key research question was whether this intervention increased the indoor temperature and lowered the relative humidity, energy consumption and mould growth in the houses, as well as improved the health and well-being of the occupants and thereby lowered their utilisation of health care… Measures at baseline (2001) and follow-up (2002) included subjective measures of health, comfort and well-being and objective measures of house condition, temperature, relative humidity, mould (speciation and mass), endotoxin, beta glucans, house dust mite allergens, general practitioner and hospital visits, and energy or fuel usage (Howden-Chapman *et al.,* 2005).
>
> Insulating existing houses led to a significantly warmer, drier indoor environment and resulted in improved self rated health, self reported wheezing, days off school and work, and visits to general practitioners as well as a trend for fewer hospital admissions for respiratory conditions (Howden-Chapman *et al.*, 2007).

The study found that 'present gains' in terms of householder health, electricity and reduced greenhouse gas emissions were equivalent *to twice the costs of retrofitting the houses*. The cost of the retrofit was averaged at $1800 per house, whereas benefits were on average $3374 per house (Howden-Chapman *et al.*, 2007). The greatest benefits from the retrofits were found to be related to the health and well-being of householders (ibid). Although other benefits to householders' health were unable to be measured in the research time frame, it was assumed that there would be favorable long term effects on comfort and respiratory health as a result of the stabilization of indoor air temperatures. Although that research concentrated on 'present gains', significant long term financial and energy savings are expected, particularly because energy costs are forecast to rise (ibid) but demand in insulated houses has decreased.

In Australia, various domestic energy efficiency programs have been proposed or are in place in different jurisdictions, and increasingly these seem geared to offering residents energy audit packages and advice on how to improve their houses. The study most relevant to our analysis is one completed by KPMG *et al.* (2008) because it examines how the Australian Government could support low income householders to reduce their energy consumption. KPMG, the Brotherhood of St Laurence and Ecos Corporation (2008) have recently completed their national study of various possible impacts on low-income households of the Australian Government's (2008) Carbon Pollution Reduction Scheme (CPRS). The creation of such projects is likely to have been in response to the Government's announcements on carbon credit, predicted to have significant impact on energy costs for low income households.

The team was commissioned to investigate a range of options available to government to assist households contribute to greenhouse gas abatement and climate change mitigation and adaptation. Among its recommendations is one that the Australian Government executes a national energy efficiency program for an estimated 3.5 million low-income households over seven years – a period for which the Government has committed to CPI indexation and cash assistance – and provides between $2000 and $6000 per household on the basis of assessments conducting during specialist home visits (which will be costed as part of the dollar value per household that has been suggested). It has also been recommended that energy efficiency improvements may include "compact fluorescent light (CFL) light bulbs, efficient shower roses, weatherproofing, curtains, ceiling insulation and efficient refrigerators … energy efficient water heating or airconditioning" (KPMG *et al*., 2008, p.3).

These recommendations are made in light of predictions that the costs of energy will rise significantly, and that "an improvement in energy efficiency provides an opportunity for an effective demand side response by households that can shield households from the impact of rising energy costs through a reduction of energy consumption" (ibid, p.3).

Two important points need underscoring in relation to these recommendations. First, many householders are *reluctant to have strangers apparently representing government* entering their homes, and sense they are being surveyed. Therefore energy efficiency auditors should be provided with guidance about the particular needs and sensitivities of low income clients.

Second, unless auditors are to work for small sums of money, the inclusion of their fees in subsidies or grants for residential energy retrofits will *rapidly erode the amount of money actually available for the retrofits themselves, which appears counter-productive to the aims of the program.*

Experience in 2005 with the Taroona house discussed above showed that insulation alone was nearly $1800 for a three bedroom house; its absence from many Tasmanian houses suggests either that the Australian Government (minimum) grant of $2000 will need to be augmented by the Tasmanian Government for real gains to be experienced in residential energy retrofits or that householders will have to meet some of the costs, and some will not be in a position to do so.

Finally, research conducted by Stratford *et al.* (2008) provides a comprehensive overview of the barriers to improving the energy efficiency of existing Tasmanian houses. In that research the findings of three separate studies were combined to identify a variety of either individual, institutional or organizational barriers. Stakeholders from the community, private, non-government and government sectors were involved in interviews and/or focus groups. When their narratives were analyzed together five categories of barriers were identified: social values; socio-economic forces; physical constraints; deficits in capacity; and deficits in governance.

Although the focus of this report is on the implications of modifying low income housing, it is important to recognize the complex nature of barriers to energy efficient housing and understand how actions to improve low income housing could have ramifications for the wider community. For example, one barrier identified in the report is the lack of practical demonstration projects or models.

In this respect, the Tasmanian Government could use the case study houses it plans to modify for energy efficiency as examples of what can be achieved. It is important that the outcomes of that project are shared among stakeholders and that the community has access to information about them. Those projects could be one way of stimulating demand for energy efficient products, services and skills. The projects may also be a way for the Government to continue to show strong leadership on climate change mitigation and adaptation.

4.2 WHAT WORKS?

Research summarized in Appendix 3 suggests that six central challenges typify the impulse and drive to improve the energy efficiency of low income households:

- engaging and recruiting householders,
- enacting and supporting behavioural change,
- promoting awareness and understanding of the issue,
- lowering electricity consumption, improving household affordability and increasing comfort,
- up-skilling and sharing knowledge among trained professionals,
- clarifying the role of the Government: facilitating and funding programs.

Lessons from the literature review will be used to address each of those challenges.

4.2.1 ENGAGING AND RECRUITING HOUSEHOLDERS AND LANDLORDS

> ... one of the most important achievements of Cool Communities has been to test and successfully demonstrate the effectiveness and potential value of [the] partnership model as an approach to achieve cultural change on greenhouse in Australia (Laris and Gleave, 2003, p.7).

Partnerships with existing and trusted community organization networks is the key to the successful implementation of Government policy designed to improve household energy efficiency (Emerson, 1998; Spoehr *et al.,* 2006; TEA, 2006). Employing existing community organizations is particularly important when working with low income households. One challenge particular to working with such households is the difficulty in identifying and locating them (Toronto Environmental Alliance (TEA), 2006) – since the 'symptoms' of deprivation are not always overt; some community organizations will have existing contact with those households.

Community organizations appear central – first and foremost to householders and also to governments as mediating influences between their agencies and target populations. Householders of any income bracket may have a distrust of people visiting their houses,

especially if they do not understand why energy efficiency measures are needed, but this suspicion may be especially pronounced among low income households. Householders did not respond well to assistance from *welfare* organizations in South Australia because people were concerned that they were there to collect information about them that may affect their welfare payments (Spoehr *et al.,* 2006).

For this reason, representatives of *community* organizations and of energy suppliers who may have previously visited low income householders or who are known to them may be more likely to be accepted as advocates for energy efficiency programs (Spoehr *et al.,* 2006). In the case of the Water and Energy Savings in the Territory (WEST) initiative in the Australian Capital Territory, for example, success has been possible because "it is built on strong partnerships between the community sector (with its empathy for the client base), industry (with unmatched expertise in energy efficiency) and government (with funding responsibilities particularly directed to low income households)" (Sutherland, 2008, p.5).

The aforementioned research in South Australia parallels that done in the UK (Oxera, 2006) and Canada (TEA, 2006) in suggesting that an effective way of engaging with low income households is through energy suppliers: They appear able to engage with low income householders, inform them of programs and get them to make decisions about whether or not to be involved in an energy efficiency program. In South Australia, as in Canada, energy suppliers were set targets for the number of households to audit; this was an effective means of engaging with householders because it drew on existing networks of communication. In all jurisdictions reviewed, partnerships with *government* providing start up capital and *industry* organizing house audits and equipment, ensures the former is meeting social responsibilities, furnishes industry with meaningful publicity and reputational dividends, and assists energy suppliers to meet energy reduction targets (Emerson, 1998), reduce the incidence of unpaid or late energy bills, and log and deal with fewer complaints (TEA, 2006).

Evidence also suggests that it is important for community groups and/or local councils to be involved in household energy efficiency programs *from their advent*, and that all parties should have real choice in the design of such programs. One recommendation that arose from the South Australian experience is the need for more flexibility and autonomy at the local level. If community organizations are given the flexibility to design and plan their programs within a larger framework and to set goals for energy efficiency, this appears to result in strong longer term commitment from all parties (Spoehr *et al.,* 2006). Community organizations may also be aware of the location-specific challenges and opportunities which affect program success.

Supporting community as well as individual engagement with the process of transforming the domestic and residential sector for energy efficiency also builds shared awareness of environmental issues; people's behavioural practices are supported by those amongst whom they live and are reinforced on a day-to-day basis. In Tasmania, an evaluation of the Glenorchy Energy Rebate Program indicates that local councils can facilitate and support effective local programs when partnered by strong community

organizations which residents consider to be credible[7]. Whichever methods the Tasmanian Government selects evidence from elsewhere suggests the crucial need for ongoing communication to be nurtured and maintained via trusting working relationships (Laris and Gleave, 2003).

Cool Communities program newsletters have been found to be an effective way of distributing information in various jurisdictions (Laris and Gleave, 2003). The mass media is an additionally useful way to create awareness of energy efficiency, household benefits and related issues on a more widespread scale but it has not been found to be an effective means of recruiting householders to programs. Letter dropping was not found to be useful. Community workshops or seminars are seen as helpful in involving people giving them opportunities to share personal experiences, and providing a safety net for those not otherwise acquainted with one another to become so. In this respect, there is sense in creating occasions for multi-lingual and multi-cultural exchange.

In the final analysis, the most effective means of engaging and recruiting householders is *by word of mouth* (Laris and Gleave, 2003; Spoehr *et al.,* 2006). Once a first group of householders is enrolled, recruitment can be driven in part by recommendations from friends and family. Improving the quality of one house has broad (and possibly accelerating) implications because people can *experience* what can happen in their own dwelling or in like homes, and can begin to both 'teach' and 'learn' from their peers: in this way community capacity building becomes self-reinforcing.

In keeping with the idea that diversity is desirable in energy efficiency programs for householders, TEA (2006) recommends developing a program specifically for social housing to cooperate with state housing agencies, and a separate program for large landlords, one for small landlords and one for owner-occupied houses. Those four groups of stakeholders have different funding capacities and interests, and therefore different approaches may be needed to engage them in energy efficient measures.

Improving the energy efficiency of rented properties can improve the value of the property, can encourage rent to be paid on time, can increase the length of occupancy if low income tenants are better able to afford rent and their comfort is improved. Such action can also reduce the risk of accidents from faulty heating appliances. However, it is difficult to encourage landlords to improve the energy efficiency of rental properties when long term studies have yet to quantify the *direct* benefits for landlords; incentives or, indeed, constraints, in the form of government payments, subsidies or rent conditions may be desirable in this respect. In a Tasmanian Cool Communities program only substantial insulation subsidies were found to be effective for encouraging landlords to insulate their properties (Laris and Gleave, 2003).

It is important that low income tenants benefit from improvements to rental properties and are not adversely affected by subsequent rent increases. In the United States, the Weatherization Program places conditions on landlords to protect tenants after improvements have been made to the property, for example landlords cannot increase

[7] Phillipa Watson's doctoral work in the School of Geography and Environmental Studies at the University of Tasmania deals with this program (see http://fcms.its.utas.edu.au/scieng/geog/studentprofiledetails.asp?lStudentProfileId=465&lStartPage=5).

rent for a set period after weatherization. In order to address the issue of housing quality and energy efficiency in private rental accommodation in Tasmania, the State Government might consider working to improve the legislation for this tenure type and on drafting minimum acceptable standards for the lease of rental properties.

4.2.2 Enacting and Supporting Behavioural Change

Householders in the ACT and South Australia who had already implemented or attempted energy efficiency measures found that having an auditor visit their house was helpful in that it reinforced their ideas and provided them with support (Spoehr *et al.,* 2006). As Sutherland (2008, p.2) has noted in relation to the ACT "All respondents appreciated the face-to-face approach of the program and didn't believe they would have benefited so much if it was an information pack only. They specifically commented on the opportunity for the auditor to see the set up of the house and to provide tailored tips and information".

Personal contact, via energy audits, also encouraged people to change their behaviour. Having auditors return to a property to follow up on an audit and install energy efficient technologies is important; it appears to increase the up-take of recommendations and assists householders to address questions and problems that may have arisen between initial and subsequent visits. These insights rest on the back of data from a survey of 1000 properties, conducted in South Australia to assess the outcomes of energy audits (Spoehr *et al.,* 2006). It found that almost one third of survey participants had *not* installed the free shower heads provided as part of the program because they did not know how, were not physically capable of doing it, did not understand the benefit of doing it, or would have found it too expensive to hire a professional to undertake the work on their behalf.

A further impediment to people changing their behaviour is a lack of awareness of domestic energy use, and a lack of understanding that potential savings could be significant and relatively easily realized (Oxera, 2006). Providing people with personalized information about their own energy use and explaining energy labelling schemes is a useful way of tackling this impediment. Energy audits provide one opportunity for people to ask questions and learn about what energy savings are possible in their own house. The personal aspect of this 'intervention' is important because even when people have access to written information they still over- or under-estimate energy consumption and potential savings. The Australian Government's proposed energy labeling scheme for household appliances will also be an effective way of teaching people about energy consumption (Oxera, 2006), but may need to account for such estimation lags.

4.2.3 Promoting Awareness and Understanding of the Issue

Many householders appear not to fully understand why energy efficient measures are needed, how they work and how they save money (TEA, 2006). A multi-faceted approach to informing householders of energy efficiency is useful, and includes

producing written information, community seminars or workshops, and/or personalised energy audits of houses. Such an approach will provide people with information and involve them in the process of changing their houses and behaviours. Energy audits where householders walk through a house with auditors to discuss their energy use are a way of involving people in the process.

It is important to have a single point of contact for householders to access information and be directed to relevant local organizations who are implementing energy efficiency programs (Oxera, 2006; Spoehr *et al.,* 2006; TEA, 2006). Having one point of call makes access simple for householders and more cost effective for the providers of the program. That central person does not have to be part of the government, and the position could be contracted out in ways that create employment opportunities.

In addition, it seems that householders respond positively to a clear methodology. As Sutherland (2008, p.4) notes of the ACT experience, "WEST uses an interactive process of *audit* → *analysis* → *education* → *options* → *refit* → *evaluate* to ensure sustained reductions in energy use and cost savings for participants" – both of which are key desired outcomes of the course of action in the first place.

4.2.4 Reducing Energy Consumption, Improving Affordability and Comfort

In 2004 Spoehr *et al.* (2006) reviewed South Australia's $2.05 million Energy Efficiency Program for Low Income Households. The program was viewed as a success because it met the four aims to reduce energy bills, energy use, carbon emissions, and to improve householders' comfort. A survey of 1000 participants in the program found that most thought their comfort levels had increased as a result of the 'intervention'. A quarter of participants found it difficult to pay energy bills before the program began, but only 5% still had trouble after the program was implemented.

The South Australian review found that energy audits alone reduced energy consumption rates, and more significantly householders said that participating in the audit had encouraged them to investigate other energy saving options and to recommend energy saving measures to their friends and family. In the first year of the program the energy audits and retrofit kits alone saved the 1000 survey respondents $43,000 (in total). Another important finding of the review was that householders were satisfied with the program (Spoehr *et al.,* 2006).

Noting the existence of longitudinal data over 2005-2008, in the case of the WEST 2006 experience in the ACT findings for 23 electricity-only households were that 19 or 83% "reduced energy consumption in the one year period (4 bills) after the home energy audit date when compared to the one year period before the audit … 4 households (17%) showed little or now material change in energy consumption or the consumption patterns in the household were too variable to draw conclusions … [and no] households showed a pattern of strongly increasing consumption continuing unaffected after the WEST 2006 intervention" (Sutherland, 2008, p.3).

4.2.5 Up-skilling and Sharing Knowledge Among Trained Professionals

Training energy auditors creates a new skill base in the community; similar strategies have been used in the US Weatherization Program to drive market demand and create more jobs. Such training may also lead to demand for skilled tradespeople from amongst building and electricity suppliers. The WEST experience suggests the need for auditors with very specific sets of skills

> not limited to technical knowledge; they also include inner strength, firmness, compassion, foresight, adaptability, flexibility, persistence, and an overall non-judgmental point of view. These skills … make the WEST auditor a very special person. It also makes the audit process more expensive than in general energy efficiency home audit programs, and requires careful management attention to issues such as burn-out, personal safety, and appropriate feedback mechanisms for clients (Sutherland, 2008, p.4).

The South Australian program created 13 paid jobs and two voluntary positions (Spoehr *et al.,* 2006). However, it was was also characterized by a lack of follow-up training for auditors and there was nowhere for auditors to go for advice about, for example, unsafe buildings, evidence of child abuse in homes visited, animal cruelty and the householders hostility to outsiders. There was also an apparent inconsistency in the quality, length, information and follow-up service provided by auditors (which might have partly arisen from the limited support they, themselves, received). As part of the evaluation of the program it was also recommended that a baseline for the quality of the service be set to increase householder satisfaction. Findings indicate that it would also be beneficial to have a central hotline for people to call for information about the program.

Lessons from the Australian Cool Communities program (Laris and Gleave, 2003) suggest that the success of community-run programs depends on government funding for a facilitator or facilitators to oversee one or more projects. Such figures would have responsibility for administration, reporting and reviewing programs. Without government funding the role is filled – by default – by volunteers who may not have the time or capacity to do the work in an optimal fashion. Additionally, Cool Communities experience suggests the need for robust evaluation processes so that householders can be part of the adaptation and growth of programs to better suit their needs.

4.2.6 The Role of The Government: Facilitating and Funding the Programs

Evidence from the experience of energy efficiency programs in the residential sector in other sub-national jurisdictions suggests that Australian Government leadership will be important to the success of ongoing and more ambitious programs. Certainly, the emergent federal Green Loans Program will support the States' efforts to improve the energy efficiency of low income housing by training qualified energy auditors. However, for low income households, interest free loans will likely be insufficient given the age of housing stock and other expenses related to food and transport in particular. It also seems clear that such leadership needs to be augmented by local partnerships among authentically interested and skilled providers – non-government, government and industry – with existing and trusted working relationships in target communities.

In addition, and in light of evidence to suggest that programs which have been heavily centrally controlled have encountered significant implementation delays, mechanisms that maintain probity but allow for more autonomy at the local level are likely warranted. Engaging existing community organizations is also a way of strengthening, inspiring and reinforcing community networks to mobilize efficiently and effectively.

Although working at the local scale has been a key factor in program successes, it is important for people in different locales to have a clearly identifiable ways of accessing information about the program pertaining to their area, and for local community groups to network and share experiences with each other. Information exchange must be conceived at multiple scales, in other words. The Tasmanian Government may, in this regard, be able to foster strong ongoing communication networks between community organizations, energy suppliers, government bodies and tradespeople, by creating a central domestic energy efficiency contact point for people – Earn Your Stars could provide such a portal, and now enjoys wide community exposure and legibility; Service Tasmania is also set up to potentially provide such support.

The experiences of Cool Communities projects also highlight the need for government funding for community facilitators, working within local organizations or councils, who are responsible for the daily administration of programs, gathering information about the programs and writing about performance outcomes (Laris and Gleave, 2003).

The Tasmanian Government might, then, consider supporting domestic energy efficiency training for tradespeople, so they are able to offer accurate advice to clients and undertake energy efficient improvements on existing houses; our work reported in Elliott (2007) suggests there is significant need for such training and that the gap is recognized by members of the Housing Industry Association and Master Builders Association.

The Tasmanian Government might also support ongoing training of energy suppliers so that they are better able to offer coherent and easily understood advice to their clients about energy efficiency.

Given the numbers of people in low income housing in Tasmania who are also renting from others, the State Government might consider prioritizing new partnerships with private landlord and tenants organizations to find ways to protect tenants whose rental properties are improved and provide landlords with incentives to undertake those improvements.

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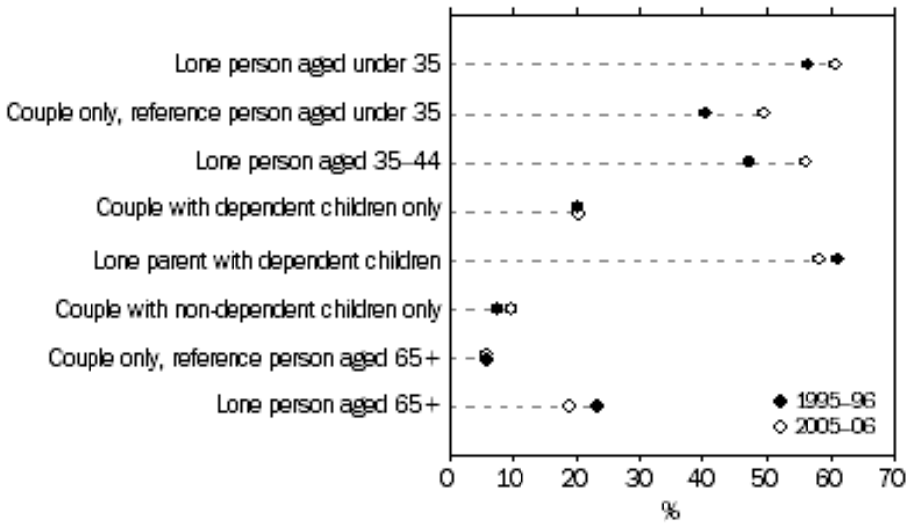
APPENDIX 1. BASELINE INFORMATION

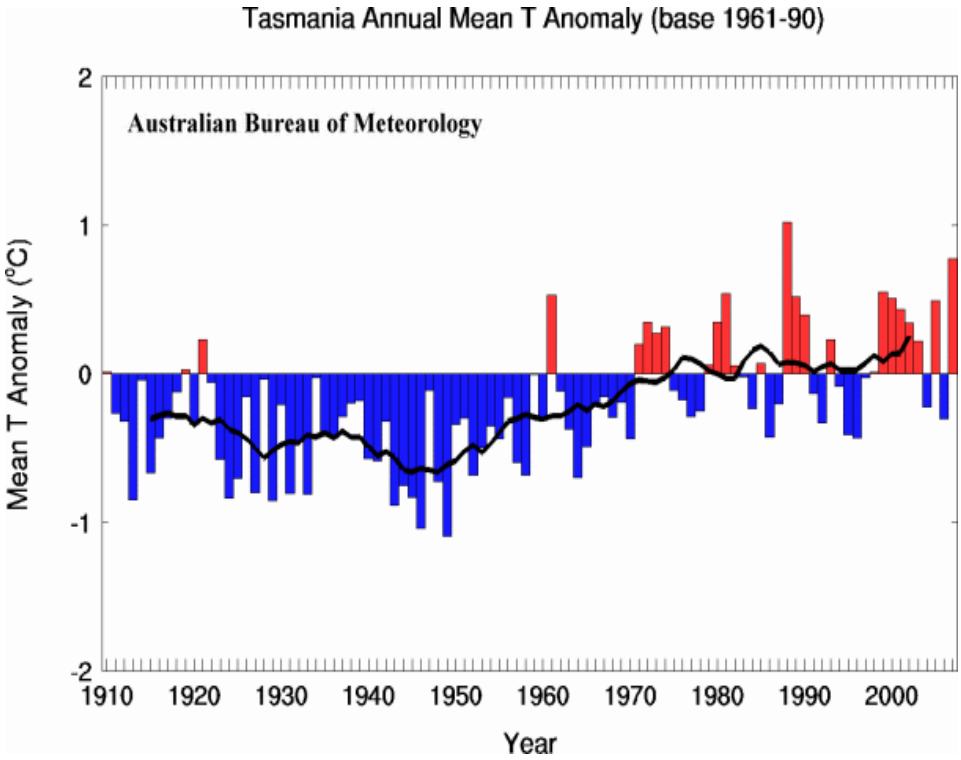
Figure A.1.1

RENTERS AS A PROPORTION OF ALL HOUSEHOLDS: SELECTED LIFE COURSE GROUPS



Source: http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4102.0Chapter9002008

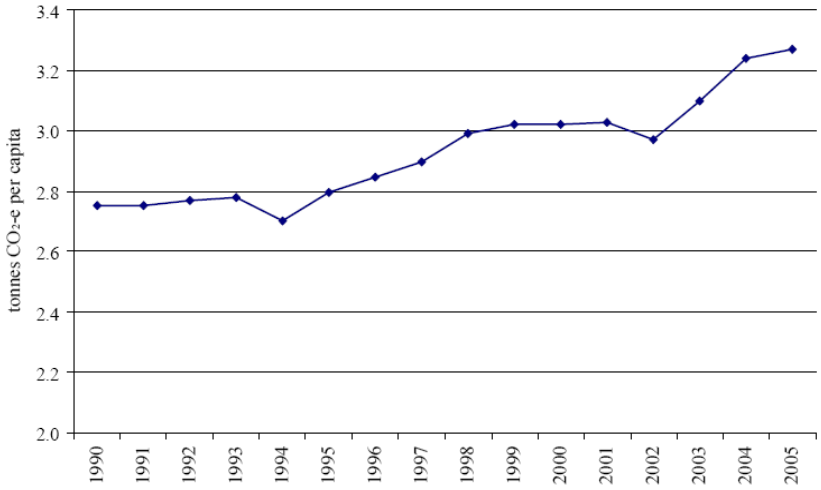
Figure A.1.2



Source: http://www.bom.gov.au/cgi-bin/silo/reg/cli_chg/timeseries.cgi?variable=tmean&region=tas&season=0112

Figure A.1.3

Emissions from household energy use per capita, 1990–2005



Source: Australian Greenhouse Office (2007, p.22)

Table A.1.1

RESIDENTIAL ENERGY CONSUMPTION

	1983–84	1993–94	2003–04	2029–30(a)
Energy source	**%**	**%**	**%**	**%**
Electricity	42.6	42.4	48.7	50.8
Natural gas	23.9	28.3	31.2	33.7
Wood(b)	25.1	23.7	15.9	10.4
Heating oil	2.5	1.1	0.0	0.0
Solar energy	0.7	0.7	0.6	0.7
LPG	2.1	2.6	2.7	3.2
Other(c)	3.0	1.1	1.0	1.2
Total	**100.0**	**100.0**	**100.0**	**100.0**
	PJ	PJ	PJ	PJ
Total	**276.0**	**344.4**	**420.8**	**650.8**
	GJ/person	GJ/person	GJ/person	GJ/person
Total	**17.7**	**19.3**	**20.9**	**26.3**

(a) Projected consumption.
(b) Includes bagasse and woodwaste.
(c) Mainly coal and petroleum products.
Source: ABARE, Australian Energy, national and state projections to 2029–30, 2005; ABARE electronic datasets.

Figure A.1.4
Primary energy consumption projections, Tasmania

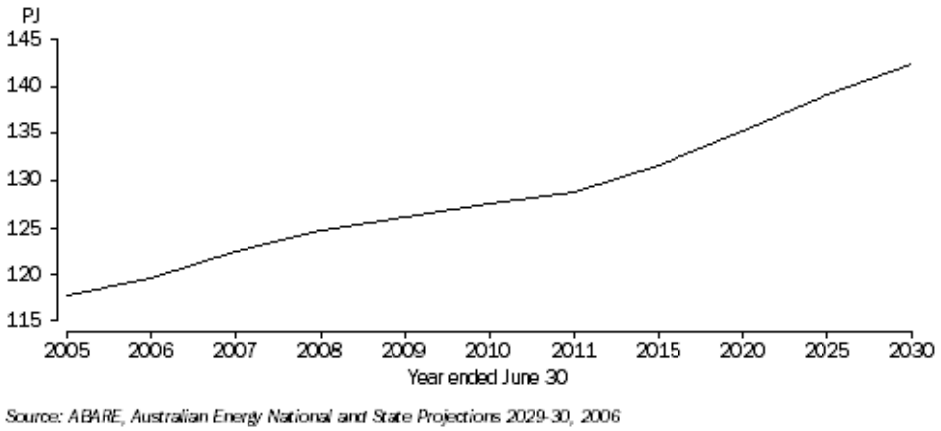
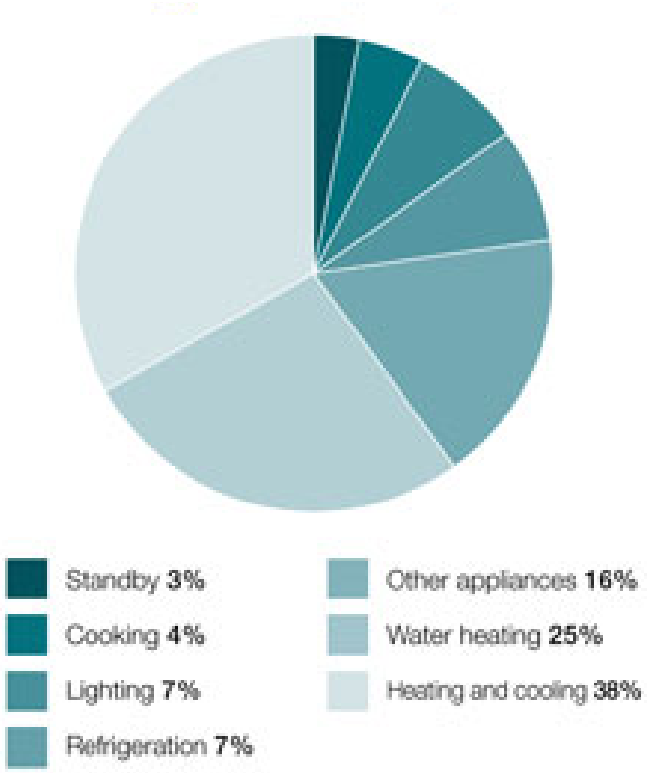


Figure A.1.5. Household energy use in Australia



Source Milne and Riedy (2008)

APPENDIX 2

SELECT BIBLIOGRAPHY OF LITERATURE ON ENERGY EFFICIENCY, HOUSING AND RETROFITTING

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APPENDIX 3 CENTRAL CHALLENGES AND RESPONSES TO ENERGY EFFICIENCY IN THE RESIDENTIAL SECTOR

Victoria

The Victorian Government's approach to climate change mitigation is multifaceted. Funding is directed at multiple challenges and approaches at once to encourage, support and facilitate the transition to more sustainable living practices. For the purposes of this review we only focus on low income housing support.

Program/policy name	Insulation Rebate	Climate Change Proofing Low Income Households	Energy and Water Taskforce	K2 and proposed development	Victorian Energy Efficiency Target Scheme (VEET) Energy Saver Initiative
Source	Sustainability Victoria, Victorian Government www.resourcesmart.vic.gov.au/	Victorian Government www.resourcesmart.vic.gov.au	Sustainability Victoria, Victorian Government www.sustainability.vic.gov.au	The Office of Housing, Victorian Government www.housing.vic.gov.au	Victorian Government www.esc.vic.gov.au/public/VEET
Date implemented	August 2007	A three year program with the first round funding offers closing in February 2009	2003	K2 was opened in May 2007	1 January 2009
Cost (to households and/or Government)	Rebate covers 30% off the cost of ceiling insulation (up to $300) or 50% of cost for low income households.	Government funding of $2million over 2 years	Government funding of $4million. Expected to reduce household water costs by $2.59 million across Victoria each year.		
Aims/objectives	To improve insulation in houses with none (only applies to houses which have never had ceiling insulation). Insulation must be installed by a qualified installer, not by a lay person.	Aims to reach up to 21,000 households, reduce emissions by 18, 000 tones and save $2.8 million. Work with local government and community groups to build their capacity to support low income households and offer advice about energy efficiency. Train unemployed members of the community to become Home Sustainability Assessors.	Water efficiency (AAA shower heads and dual flush toilets) in all public housing over the next four years. 4,700 houses in 25 disadvantaged communities have already been retrofitted. The $4 million contributed by Government in 2008 means expect to be able to retrofit 8,000 houses over 4 years.	K2: 96 environmentally sustainable public housing apartments. Proposed Development: 120 apartments for the long term unemployed with health and training facilities, designed using environmentally sustainable design principles.	Energy retailers in Victoria will be required to purchase energy certificates, the number of certificates they will require relates to the size of their share of the energy market. One certificate will be issued for each tone of household CO2 emissions which are abated through actions by accredited persons. For more details visit refer to source information above.

	Three funding priorities a) $1million over 3 years for existing community organizations to build capacity and offer advise, b) $750,000 for social housing improvements, c) $250,000 over 2 years for enterprise and jobs which support climate proofing houses.	

Australian Capital Territory

Program/policy name	Home Energy Advice Team (HEAT)	ACT Energy Wise Program
Source	Home Energy Advice Team (HEAT), ACT Government http://www.heat.net.au/	Home Energy Advice Team (HEAT), ACT Government http://www.heat.net.au/
Date implemented		
Cost (to households and/or Government)	Free for households	$30
Aims/objectives	To provide one place for householders to gather information about household energy efficiency	To improve household energy efficiency
Process/what is involved	Advisory service for residents to reduce energy use	A HEAT employee will conduct an audit and provide a written report with a plan for how those householders can reduce energy use. Households which spend over $2000 on energy efficient improvements get $500 refund and the cost of the program ($30) refunded.

New South Wales

Program/policy name	Low Income Household Refit Program	Rebates for solar hot water and insulation
Source	Department of Environment and Climate Change, New South Wales Government Climate Change Fund in partnership with Housing New South Wales http://www.environment.nsw.gov.au	Department of Environment and Climate Change, Government of New South Wales http://www.environment.nsw.gov.au
Date implemented	November-December 2008 pilot Home Energy Project to help inform state-wide implementation	
Cost (to households and/or Government)	$63 million program proposed savings to householders of $95 a year.	Solar hot water system rebate of up to $1200, ceiling insulation rebate of up to $300 (for half the cost of the insulation)
Aims/objectives	The pilot project involves 240 homes, energy auditors visit households to conduct audits and provide householders with information and advice The pilot project is estimate to save 173 tonnes of greenhouse gas emissions, 163.2 MWh of electricity and $22, 032 in energy costs per annum.	To improve the uptake of solar hot water systems and ceiling insulation
Process/what is involved	Energy assessments and energy saver kits provided to 220,000 low income households in New South Wales. Householders receive an energy saving kit including shower timers, thermometers, draught excluders, they also have incandescent lights replaced with compact fluorescent bulbs and water efficient shower heads will be installed.	

Northern Territory

Program/policy name	Cool mob Household Audits
Who is involved	Coolmob is run by the Northern Territory Environment Centre, with major funding from the Northern Territory Government and grant funding from Power and Water Corportation, Darwin City Council, and community based organizations. http://www.coolmob.org/noscript.php
Date implemented	June 2002
Cost (to households and/or Government)	Audits cost $10 or is free to those with a concession card
Aims/objectives	One of Coolmob's aims is to work with householders and community organizations to improve household energy efficiency
Process/what is involved	Householders have access to an energy audit, written information and links with energy efficient products and services

Queensland

Program/policy name	Home Energywise kits	Climate Smart Home Service
Source	Department of Mines and Energy, Queensland Government http://www.dme.qld.gov.au/Energy/home_energywise_kit_1.cfm	Queensland Government http://www.climatesmarthome.com/
Date implemented	2008	2008
Cost (to households and/or Government)	Free to householders	Households pay $50
Aims/objectives	Handy hints and tips to help low income earners and pensioners save money	Improve household energy efficiency
Process/what is involved		An electrician will complete an energy audit, including monitoring household and appliance energy consumption, providing up to 15 free energy efficiency lights and a free water efficient shower head. Households also receive a customized energy and water efficiency plan which sets out step by step procedures for households

South Australia

Program/policy name	Residential Energy Efficiency Scheme (REES)
Source	Department of Transport, Energy and Infrastructure, Government of South Australia http://www.dtei.sa.gov.au/energy/government_programs/rees
Date implemented	October 2008
Cost (to households and/or Government)	Free for low income households
Aims/objectives	To involve energy suppliers in reducing greenhouse gas emissions, and to support improving household energy efficiency. Although the program is aimed at all household types, energy providers must undertake 30% of their work in low income households. Overall 13,000 energy audits in low income houses are to be completed between 2009-11.
Process/what is involved	Under either the Greenhouse Gas Reduction Target (EGRT or GGRT) or the Priority Group Greenhouse Gas Reduction Target (PGGGRT) energy providers have been set targets to provide householders with incentives to improve energy efficiency. Householders who participate in the program will receive an energy audit and a written report based on that audit. The auditor will return for a follow up visit and to assist householders implement the recommendations in their report. Minimum requirements have been set for the audit. Auditors must asses the thermal performance of the house including insulation, draught proofing, shading as well as assessing large appliances and the householders energy use behaviour.

Tasmania

Program/policy name	Cool Communities	Glenorchy Energy Rebate Project
Source	This Federal Government program was run through the Australian Greenhouse Office (AGO) working with Australian Environmental Organizations (AEOs) in each state and territory. Laris, P. and Associates and Gleave, S. (2003) Cool Communities Evaluation,Learning from Success: Cool Considerations, Study Commissioned by the Australian Greenhouse Office, Australian Government.	Participants include Sustainable Living Tasmania, Australian Greenhouse Office, Glenorchy City Council and various businesses. Project is under review by Phillipa Watson at the University of Tasmania.
Date implemented	Round 1 in 2001, Round 2 in 2003	July 2007 – May 2008
Cost (to households and/ or Government)	Federal Government funding of $4million over 4 years	
Aims/objectives	To engage the community, to support behavioural change and to create measurable reductions to household greenhouse gas emissions	To support energy efficient home improvement in Glenorchy households
Process/what is involved	A range of approaches were employed by each community organization including information and support in the form of energy audits, community workshops and seminars, written information. Energy efficient items such as insulation or lights were also sometimes provided or offered at a subsidized rate. Participants in come projects also had access to demonstration projects.	After application process participating households were assessed by a trained professional. Rebates were provided to support the installation of fittings and fixtures for home owners and landlords. Heavily discounted energy saver packs were provided to householders. They included energy efficient lighting and draft proofing. Community information evenings on energy efficiency.

Western Australia	
Program/policy name	Sustainable Energy Development Office (SEDO) Grants program
Source	Sustainable Energy Development Office (SEDO), Government of Western Australia http://www1.sedo.energy.wa.gov.au/pages/grants.asp
Date implemented	February 2006
Cost (to households and/or Government)	Grants of between $5,000 to $50,000 are provided to community organizations to implement sustainable energy projects. Sustainable Energy Community Seminar Kit promote awareness and information sharing about energy efficiency and renewable energy
Aims/objectives	Provide support for community-based sustainable energy projects which assist householders reduce energy use, facilitate community awareness of that issue and of renewable energy options and reduce household greenhouse gas emissions.