Sustainability and Heritage

Improving the energy efficiency of existing and heritage houses

Introduction

Benefits of energy efficiency upgrades

House energy rating - star improvement

Cost saving

Reduction in global warming impacts

Background

This suite of seven Guidance Sheets presents findings from the study National Sustainability and Heritage Residential Buildings Project undertaken in 2011 by RMIT University for the Heritage Council of Victoria, the Building Commission of Victoria, the Office of the Victorian Government Architect, the Victorian Government's Department of Planning and Community Development and the Department of Sustainability and Environment.

Aims and Approach

The study calculated and compared the life cycle environmental impacts of a sample of existing and heritage buildings, both in their existing state and following a series of interventions to reduce energy used for heating and cooling.

A life cycle approach was used to calculate the impacts of the buildings in order to ensure that a fair and complete comparison was drawn. The simplified life cycle model used in the study is shown in Figure 1.

Only those elements of the building life cycle that directly related to the provision of climate controlled space were considered, such as the physical building itself and the operational elements needed to heat and cool it over its life.

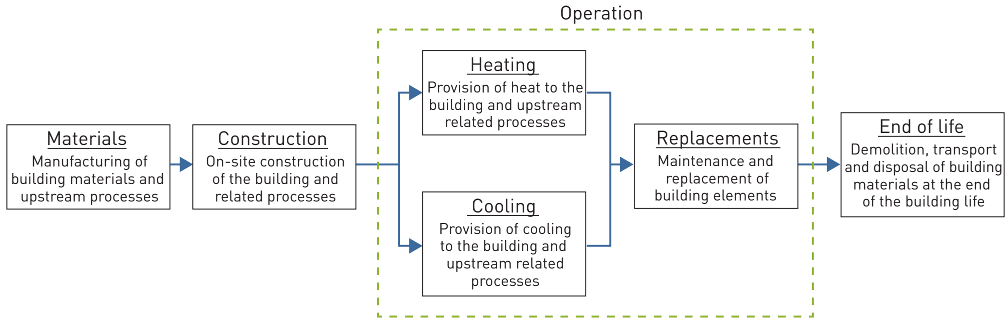

Figure 1: *Building life cycle model considered in the study.*

Houses Considered

The study considered a range of heritage house styles located in Victoria, and one reference house (a modern double storey home). A selection of these houses is presented in the Guidance Sheets, as described in Table 1.

Table 1: *Houses presented in the following Guidance Sheets.*

Style	Type	Size (m²)	Year
Contemporary	Double storey, brick veneer, detached	218	2000
1970s	Single storey, brick veneer, detached	171	1972
Post-war	Single storey, brick veneer, detached	154	c 1950
Bungalow	Single storey, weatherboard, detached	114	1926
Inter-war	Double storey, weatherboard, detached	280	1932
Edwardian	Single storey, weatherboard, detached	220	1911
Victorian	Double storey, solid brick, terrace	125	c 1880s

Measuring Impact

A suite of indicators was considered when determining the life cycle environmental impacts of the houses, however only one is presented here: Cumulative Energy Demand (CED). Although not strictly a measure of environmental impact, CED reflects the total primary energy input required by a system over its life, so is considered a precursor to impacts such as global warming. Primary energy for the house life cycles in this study is largely derived from fossil fuels, such as brown coal.

Building Commission
HERITAGE COUNCIL VICTORIA
HERITAGE VICTORIA
State Government Victoria
Department of Planning and Community Development

Life Cycle Impacts

The life cycle energy study tells us that the primary energy used to heat and cool the house is far greater than the energy used in other life cycle stages and should be the focus of attention when seeking to reduce life cycle energy use (Figure 2). The study also showed that if the house can be retained and improved, the primary energy associated with the construction and materials of a new, replacement house can be avoided

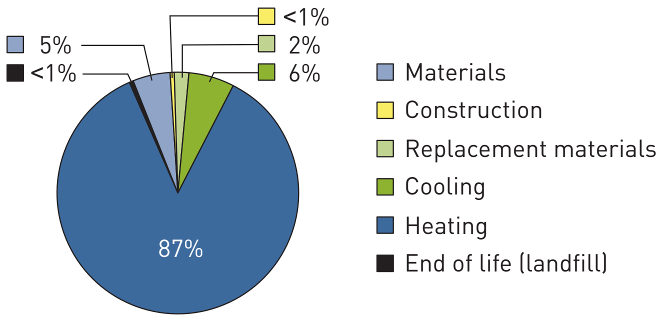

Figure 2: *Life Cycle Cumulative Energy Demand (Post-war)*

Extending the results to energy costs

RMIT University has undertaken to estimate the potential investment costs and energy savings associated with the interventions considered. This process involved making a series of assumptions regarding occupant behaviour, heater/cooler efficiency, energy prices and investment costs. As a result, the economic benefits shown in the Guidance Sheets should be used as a rough guide only. Energy prices assumed: 21c per kWh for electricity and 1.7c per MJ for natural gas.

Reducing Heating and Cooling Energy Use

In order to reduce heating and cooling related energy use, a range of interventions were considered that aimed to reduce heat flow into and out of the building, thereby reducing energy requirements. A selection of interventions considered is shown in Figure 3.

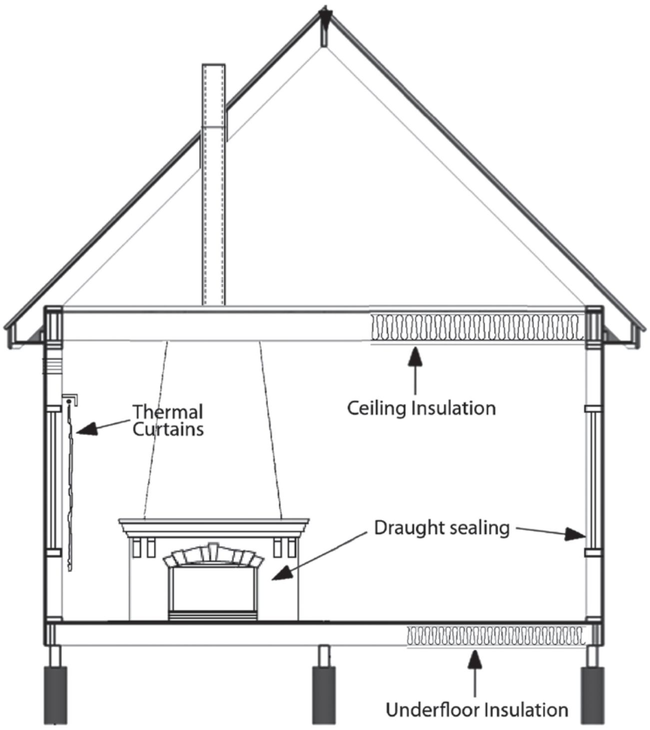

Figure 3: *Interventions considered.*

Key Findings

It was found that interventions were possible to reduce heating and cooling loads for each house; however the benefits achieved tended to vary considerably between the houses. Figure 4 illustrates the range of reductions in heating and cooling energy requirements for the interventions shown when applied to the heritage houses described in Table 1. Percentage reductions shown are relative to each house without insulation.

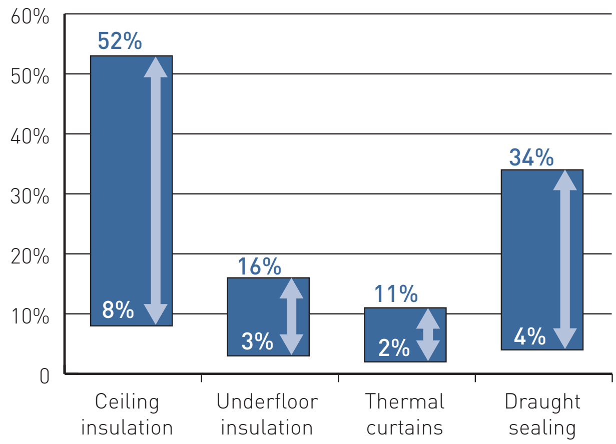

Figure 4: *Reductions in heating and cooling energy when selected interventions are applied.*

Study Limitations

- These results are based on desktop analysis and therefore represent a guide only.
- Results are specific to the houses considered, and may not reflect general outcomes.
- Upgrade costs shown in the Guidance Sheets are approximate.
- Energy cost savings shown in the Guidance sheets assume gas central heating and refrigerative cooling. Ranges of savings reflect alternative heater/cooler efficiencies and alternative householder behaviours.
- The heating and cooling energy requirements shown are based on thermal modelling undertaken using Accurate™ software.