Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 121 (2017) 300–307

Energy Procedia

www.elsevier.com/locate/procedia

International Conference on Improving Residential Energy Efficiency, IREE 2017

Benefits and challenges of energy efficient social housing.

Trivess Moore[a]*, Larissa Nicholls[b], Yolande Strengers[b], Cecily Maller[b], Ralph Horne[c]

[a]SBiLab, School of Property, Construction and Project Management, RMIT University, 124 LaTrobe Street, Melbourne, 3001, Australia
[b]Centre for Urban Research, School of Global, Urban and Social Studies, RMIT University, 124 LaTrobe Street, Melbourne, 3001, Australia
[c] College of Design and Social Context, RMIT University, 124 LaTrobe Street, Melbourne, 3001, Australia

Abstract

This paper presents a multi-method (interviews, cost-benefit analysis, technical monitoring) longitudinal evaluation of ten social housing dwellings in Horsham (Victoria, Australia), including four low-energy and six control houses. Occupants of the low-energy houses purchased 45-62% less electricity, had lower utility bills resulting in financial savings of $1,050/year, had improved thermal comfort, health and social outcomes. However, there were several challenges for the providing government department and tenants, including supporting tenants to use certain sustainability features of the house as designed. The paper concludes by providing discussion to help guide similar projects in the future to more sustainable outcomes.

Peer-review under responsibility of the scientific committee of the International Conference on Improving Residential Energy Efficiency.

Keywords: Low-energy housing; low-income households; social housing; energy efficiency; thermal comfort; health and wellbeing; cost-benefit analysis; interviews.

1. Introduction

Rising energy costs are an increasing concern for households across Australia and many developed countries. In the 10 years to mid-2013, electricity prices in Australia rose by an average of 72% and gas prices rose by an average of 54% [1]. Some analysts predict that the costs for energy in Australia will continue to increase beyond the rate of general inflation although not at the rate seen over the past decade [2].

* Corresponding author. Tel.: +613-9925-9071
E-mail address: trivess.moore@rmit.edu.au

1876-6102 © 2017 The Authors. Published by Elsevier Ltd.
Peer-review under responsibility of the scientific committee of the International Conference on Improving Residential Energy Efficiency.
10.1016/j.egypro.2017.08.031

Low-income households have been found to be most at risk from experiencing increasing energy prices [3-5]. There are three key reasons for why this is such a concern. Firstly, research has found that low-income households have greater difficulty in paying their energy bills, often resulting in involuntary disconnections when payments are not made one time [4, 6]. Secondly, to ensure payments can be made, some low-income households self-ration their energy consumption to an extent which compromises healthy thermal comfort levels [2, 6, 7]. For example, they may not use heating and cooling systems to maintain thermal comfort, which can lead to negative physical and mental health impacts during extreme weather conditions [8]. Thirdly, some low-income households trade off other things they require to be able to pay their energy bills [6]. For example, they may sacrifice healthcare, healthy food and education to pay energy bills.

The impact of rising energy costs on low-income households is often magnified by the fact that these households tend to have older and lower quality housing, less energy efficient heating and cooling equipment, other older appliances (e.g. fridge, TV), and are often unable to afford upgrading these appliances [3]. Improving the energy efficiency of dwellings can reduce reliance on mechanical heating and cooling, and improve financial and health outcomes for low-income households [7]. However, such improvements are often financially inaccessible to social housing tenants and there are several challenges for increasing energy efficiency in these households. These challenges include capital costs, split incentives and conflicting or complex information [3, 5].

The aim of this paper is to analyse the ways in which energy efficient housing can improve living conditions and thermal comfort for social housing tenants. In doing so it addresses the following research question:

What are the benefits and challenges of energy efficient social housing for tenants and providers?

The paper is organised as follows. In the following section, we briefly outline the methods employed for our evaluation of ten social housing dwellings. The next section provides the results of this evaluation, focusing on technical performance, thermal comfort, health, wellbeing, social outcomes and cost-benefit performance. We then discuss the benefits and challenges associated with this project for low-income tenants and housing providers, followed by conclusions for future social housing projects.

2. Methods

The Department of Health and Human Services (the department) engaged the research team to evaluate the costs and benefits of revising their minimum housing performance requirements for new low-income housing. The department decided to build four 9 Star NatHERS rated, low-energy houses (construction completed in 2012) and compare these to six control houses built to minimum department Standards (constructed from 2010-2012)[†]. All houses in the study were in climate zone 27[‡] as that climate experienced extremes in temperatures for both summer and winter allowing for improved testing and evaluation of the benefits and challenges of such housing design. The two-bedroom reverse brick veneer new detached low-energy houses were built to a higher building envelope thermal performance (predicted heating and cooling energy load of 25 MJ/m^2.annum) compared to their standard build (108 MJ/m^2.annum). All four of the low-energy houses had similar open plan modern designs and were built without the inclusion (or need) for air conditioning. The control houses were of similar size to the low-energy houses, but were built using only standard building materials. Additional key features of the low-energy housing include:

- passive solar design and optimum orientation
- advanced roof design (new material and improved design)
- improved levels of ceiling, wall and floor insulation
- external window shading
- natural ventilation and improved glazing

[†] The department Standards at the time of the research involved meeting the 6 star NatHERS minimum requirement and going beyond this with the inclusion of solar hot water and a rainwater tank (not plumbed into the house) where possible. These are the standards the control homes are built to, with department Standards theoretical model also used in the analysis based upon what these standards should mean for utility consumption.

[‡] Refer to http://apps.nowwhere.com.au/DCCEE/climatezonemaps for further information about the NatHERS climate zones.