Global warming and its implication to emission reduction strategies for residential buildings

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1. Introduction

The residential building sector contributed around 13% of the total Australia national greenhouse gas (GHG) emissions in 2005–2006 [1]. It is anticipated that the projected population growth, the trend of smaller family sizes, and the desire for more comfortable indoor environment and larger houses will increase the energy demands, and subsequent GHG emissions from the residential building sector. Consequently, residential building energy performance has been one of the major target areas of emission reduction schemes and regulations.

Building energy performance depends not only on building designs but also on local climate conditions including ambient temperature, humidity, solar radiation and wind. Changes in the local climate may alter building energy consumption. For example, a warming climate reduces the heating energy requirement in relatively cold climates [2–4]. However, a warming climate may increase the cooling energy requirement for buildings during a warm season [5]. The increase in cooling energy consumption may eventually offset or exceed the benefit from the saving of heating energy [6], especially in tropical and subtropical regions [7].

Local climate in Australia can vary considerably. The northern states of Australia are typically warm all the time, with the southern states experiencing cool winters but rarely sub-zero temperatures. In Australia [8], the average temperature has increased by 0.9 °C since 1950 with significant regional variations. The frequency of hot nights has also increased and the frequency of cool nights has declined. By 2030, the best estimation of annual average warming relative to the climate of 1990 is approximately 1.0 °C, with warming of around 0.7–0.9 °C in coastal areas and 1.0–1.2 °C inland. Climate change trends from 2050 will depend in part on greenhouse gas emission scenarios. For the high emission scenario (A1FI), the best estimation of the average annual temperature increase is 2.2 °C by 2050 and 3.4 °C by 2070. Consequently, changing climate may significantly alter the energy consumption of a building during its service life.