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Energy efficiency within mid-rise residential buildings: A critical review of regulations in Australia

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Abstract

Within Australia, increasingly more people are choosing to live in cities. Due to a need for urban densification and more affordable housing, for the first time, development approvals for multi-residential developments have overtaken those for individual houses. The growing sector of mid-rise residential buildings in Australian cities has the potential to contribute significantly to improving the energy efficiency of the building stock. However, there is limited empirical research on this sector within the Australian context. The mandatory framework for the energy efficiency of mid-rise residential developments in Australia, with a focus on New South Wales with its distinct regulatory requirements, is critically reviewed and synthesised with the literature. The review provides an understanding of the regulatory context under which mid-rise residential developments are undertaken. The limitations of the current energy efficiency framework are highlighted. This study provides an understanding of the status quo in energy efficiency regulations for mid-rise residential buildings in Australia and demonstrates that there is both scope and an imperative for regulatory minima to be enhanced.

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1. Introduction

Concerns regarding scarcity of resources and the impacts of anthropogenic climate change are driving action around the world, at various levels, to move to a more sustainable future. Buildings represent over one third of final energy consumption, and related CO₂ emissions, globally [1]. In 2013-14, the residential sector accounted for approximately 11% of final energy consumption in Australia [2]. Around two thirds of the energy consumed in Australian homes relates to space heating/cooling and water heating [3]. Internationally, it has been stated that the building sector has the greatest potential to mitigate climate change using low-cost measures [4], [5]. Therefore, both voluntary and mandatory pathways to energy efficiency within residential buildings are of increasing importance.

After a decade and a half of consistent volumes of residential construction, from 2009 the number of dwellings being constructed in Australia has been increasing [6]. Driven by population growth within cities, demand for more affordable dwellings, and greater employment opportunities, apartment construction has been central to this increased residential construction activity [6]. Indeed, statistics at the time of writing suggest that for the first time, more apartments are being constructed in Australia than individual houses [7]. But worryingly, there is evidence that per capita energy consumption in apartments is higher than that of single-family houses [8].

Over 75% of the apartment developments constructed since 2011 have been within the larger capital cities of Sydney, Melbourne and Brisbane [6] and have been either centrally located or close to existing transport infrastructure. Many of these developments in central locations or close to transport infrastructure are mid-rise developments, which for the purposes of this paper are defined as between four and eight storeys.

Whilst concerns over energy security, rising energy prices and environmental impacts have started to drive policy change within the Australian context [9], it has been asserted that the regulatory standards for energy efficiency in homes in Australia fall well below the level of those in various countries with similar climatic conditions to the climate zones of Australia [10]. Therefore, the aim of this paper is to critically review the mandatory pathways to energy efficiency for mid-rise residential buildings in Australia, with a focus on the NSW context, thus highlighting the limitations of those regulations. The reason for the focus on NSW is that it has distinct regulatory requirements for the energy efficiency of homes and has been the state with the greatest level of building work (by current price) for the past four years [11]. The focus of this review paper is on mandatory instruments relating to energy efficiency in-use of mid-rise residential buildings. Therefore, although embodied energy and construction stage energy consumption are of increasing importance, these are beyond the scope of this paper. Similarly, whilst it is acknowledged that addressing the energy efficiency of the existing building stock is of great importance, this review focuses on new build mid-rise residential buildings due to the significant increase in new developments within this sector. The final limitation in scope is the focus on only mandatory pathways to energy efficiency; previous research has shown that legislation is the most significant driver in this respect [12]. In undertaking this review, academic journals, academic conference proceedings and books have been used as sources along with relevant grey literature from the Australian context.

Section 2 of this paper establishes the mandatory standards and regulations for residential energy efficiency in Australia, before an example of the design energy efficiency of a mid-rise residential building is presented in Section 3. Next the findings of the review are discussed in Section 4 before the paper concludes in Section 5.

2. Mandatory standards and regulations for energy efficiency

A variety of motivations drive the regulation of energy efficiency in buildings: countries with harsher winter climates have been quick to implement mandatory building energy efficiency standards; the energy crisis of the 1970s drove many European nations to consider the need to reduce their dependence on fossil fuels, and therefore improve the energy efficiency of their buildings, [13]; and more recently, mandatory energy efficiency regulations have become increasingly stringent as a result of concern over climate change and its potential impacts [14],[15]. Sweden has had national minimum building energy efficiency requirements since the early 1950s [16] and the Building Regulations in the UK have included standards for limiting heat loss since 1965 [17]. Whereas, in Australia, national energy efficiency regulations for homes were not introduced until 2003 [9]. Australia is the sixth largest country in the world by area. It is formed of six states and two territories, each with their own legislation.

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