The Impact of Physical Planning Policy on Household Energy Use and Greenhouse Emissions

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Thesis originality

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

(Peter Rickwood)

Thanks

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Publications related to this thesis

Four peer-reviewed papers have been published (or accepted) that summarize some of the research carried out for this doctorate, with one additional paper currently in review. This thesis draws heavily on these published accounts.

Published Rickwood, P., Giurco, D., Glazebrook, G., Kazaglis, A., Thomas, L., Zeibots, M., Boydell, S., White, S., Caprarelli, G., and McDougal, J. (2007). Integrating population, land-use, transport, water and energy-use models to improve the sustainability of urban systems. *2007 State of Australian Cities Conference*.

Published Rickwood, P., Glazebrook, G., and Searle, G. (2008). Urban structure and energy – a review. *Urban Policy and Research*, 26(1):57–81.

Published Rickwood, P. and Glazebrook, G. (2009). Urban structure and commuting in Australian cities. *Urban Policy and Research*, 27(2).

Published Rickwood, P. (2009). Residential operational energy use. *Urban Policy and Research*, 27(2).

Contents

Abstract

This thesis investigates the impact of physical planning policy on combined transport and dwelling-related energy use by households. Separate analyses and reviews are conducted into dwelling-related and transport-related energy use by households, before a model is developed to investigate the city-wide implications of different land-use scenarios in Sydney, Australia.

The analysis of household energy use in Chapter 3 suggests that medium density housing (i.e. lose-rise apartments, townhouses, and terraces) is likely to result in the lowest per-capita energy use, while also allowing for sufficient densities to make frequent public transport service viable.

The analysis of transport energy in Chapter 4 confirms that increasing urban density is associated with decreased car ownership and use, independent of other factors. However, land use changes alone are likely to result in modest changes to travel behaviour.

The results of the scenario modelling in Chapters 7-9 support the view that changes to land use alone can reduce household energy consumption, but the changes, even over a long time period (25 years) are small ($\approx 0-10\%$) for all but the most extreme land-use policies. Instead, a coordinated (land-use/transport and other policy levers) approach is much more effective. The results confirm that it is transport energy that is most sensitive to planning policy, but that a combined consideration of dwelling-related and transport-related energy use is still useful. The micro-simulation model developed to assess the impact of different land-use planning scenarios allows the establishment of a lower-bound estimate of the effect that housing policy has on household energy use, assuming 'business as usual' transport policy, household behaviour, and technology.