Selected solar design tools for sustainable residential land development

A thesis presented in fulfilment of the requirements for the degree

of

Master of Engineering

At Massey University, Palmerston North, New Zealand

Andrew Duncan

2005

Abstract

As New Zealand's natural gas reserves decline and electricity demand growth exceeds the building of new generation plants, greater focus needs to be applied to energy efficient design in domestic buildings and land developments.

A case study of residential land development was analysed in terms of its potential for energy efficiency gains and optimisation of solar resources. A design tool was developed to rapidly assess the solar energy loss of a specific building site due to existing land features. 'Solar obstruction contours' were produced that define the maximum permissible height of obstructions before solar shading occurs. These contours were produced based on a minimum percentage solar energy capture.

Thermal energy demand for the development case study was calculated by specification of a Building Performance Index relative to floor area. The demand was then balanced against on-site thermal energy production from biomass to give a percentage thermal energy self sufficiency.

The tools developed can be used to optimise the design of a residential land development resulting in an increase in renewable energy use above that of standard residential developments. The study concluded that incorporation of the tools as standard practice by municipalities is viable, and if implemented would increase the energy efficiency and renewable energy use of the New Zealand housing stock.

Acknowledgements

This work is the result of my planting a seed in the thought processes of land development three or four years ago. I would like to thank those around me who helped to nurture this seed into a full-blown development.

It goes without saying that I owe much thanks to my partner, Dolly, without whose understanding this work would not have been possible.The assistance of my family investors is very much appreciated, and being able to bounce mathematical ideas off Alan Duncan, invaluable.Last, but in no way least, I would like to thank Building Research (formerly BRANZ), who provided funding for this research.

Table of Contents

List of Figures

List of Tables