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SUSTAINABLE ENERGY MANAGEMENT  
FOR A SMALL RURAL SUBDIVISION  
IN NEW ZEALAND

A thesis presented in fulfilment of the requirements for the degree of

Master of Technology

In

Energy Management

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## ABSTRACT

An eight-lot residential subdivision in central Wairarapa is being developed to demonstrate the principles of sustainable resource management. Local energy sources for low and high grade use, including electricity sourced from proposed grid-integrated, on-site, distributed generation will supplement imported network electricity. A unique component is an internal loop grid for lot connection that interfaces with the local network through a single connection point.

A decision model was designed as a decision-support tool for the development based on the annual supply-demand electrical energy balance, site infrastructure covenants and a range of economic and technology criteria. Solar and wind resources were assessed for potential supply of electricity to the community energy system. Three demand profiles were developed using supplied and estimated electrical demand data; and included assumptions on thermal performance of the houses, the use of low-grade heat, user behaviour, and appliance use. Supply and demand were analysed as daily average profiles by hour for each month of the year.

The decision model outputs were designed to give a graphic view of the system options. The accompanying output datasets also enabled a number of scenarios for connection configurations, load management, and economic sensitivity to be explored for their impact on the communal approach to managing energy.

The viability of the community energy system is significantly influenced by managing demand level in conjunction with system size, capital cost management, and tariffs for electricity import and export. Energy requirements could be best met in the short term by installing a site-wide mixed generation system of sized capacity between 5 and 11kW, supported by metering and information technology to deliver management data to the residents.

Future research opportunities exist to continue monitoring technical, economic and social outcomes from this unique community development. Incentivising private investment in user-focussed energy innovations is an option for New Zealand to consider in the current climate of market-driven large scale electricity developments.

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There were a number of unexpected challenges during the course of this work. One source of inspiration that encapsulated these rocky periods came from the late Sir Edmund Hillary's 1952 crossing of the Nup La Pass in a storm:

*"Often I'd come to an impossible drop or a gaping crevasse and know I was on the wrong route. And then I would climb wearily back to the last piece of track I knew and try again. Many of the crevasses had widened and many of our snow bridges had gone. But we found a way down."*

Excerpt from High Adventure, (Hillary, 1955)

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## LIST OF ABBREVIATIONS

BANANA	Build Absolutely Nothing Anywhere Near Anyone
CHP	Combined Heat and Power
DM	Decision Model
EDF	Energy Data File
EECA	Energy Efficiency and Conservation Authority
HEEP	Household Energy End-use Project
ICP	Individual Connection Point (to the electricity network)
kWh	Kilo watt hour
LRMC	Long Run Marginal Cost
MED	Ministry of Economic Development
NIMBY	Not In My Back Yard
NREL	National Renewable Energy Laboratory (US Department of Energy)
NPV	Net Present Value
PCE	Parliamentary Commissioner for the Environment
PV	Photovoltaic
RE	Renewable Energy