Climate Change - a global issue

Is a renewable energy target an effective response for the New Zealand electricity sector?

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Abstract

The main objective of this thesis is to investigate the effectiveness of a mandatory renewable energy target (MRET) in reducing greenhouse gas (GHG) emissions from the electricity sector. New Zealand's electricity sector emissions have grown at a rapid rate over the last decade (+19%) due to an increasing reliance on thermal generation plant.

Since the mid 1980's there has been increasing scientific evidence and acceptance that GHG emissions caused by human activity are reducing the amount of solar heat that would otherwise be radiated back out into space leading to climate change.

The Intergovernmental Panel on Climate Change (IPCC) has found new and stronger evidence that most of the observed warming of the past 50 years is attributable to human activities. The IPCC findings show potential for significant changes in temperature (1.4-5.8°C by 2100), rainfall patterns and sea level (9-88cm by 2100) and adverse weather events. This will impact on the global economy, the natural environment and the quality of life for present and future generations.

The Kyoto Protocol is the international vehicle for fighting anthropogenic climate change by reducing GHG emissions. Despite the US withdrawal from the Protocol in 2001, it could still enter into force and countries that ratify it could have legally binding GHG emission responsibilities by late 2002. Domestic policy and legislation presently under development will guide New Zealand's efforts to reduce GHGs and meet its future Kyoto Protocol commitments.

To assess the impact of a possible MRET, a tool was developed which evaluates the effect of five different MRET scenarios on the electricity sector's GHG emissions, the wholesale price of electricity and the level of renewable energy supply. It was found that an MRET is an effective method of reducing GHGs and increasing the level of renewable energy supply, however this effectiveness depends on the level of the target. The higher the target the higher the electricity price, which will also increase if inappropriate investment decisions lead to plant redundancy or oversupply of the market. Implementing energy efficiency measures with an MRET further reduces GHG emissions. If existing renewable generation was prioritised over thermal generation then environmental outcomes are further improved.

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Abbreviations

2MTT	Manapouri Second Tailrace Tunnel Project
AA	Assigned Amounts
AAUs	Assigned Amount Units
Annex A	Annex A to the UNFCCC.
Annex B	Annex B to the UNFCCC.
Annex I	Annex I to the Kyoto Protocol to the UNFCCC
Annex II	Annex II to the Kyoto Protocol to the UNFCCC
ARC	Automation and Remote Control (Manapouri)
BAU	Business as usual
CD	Corporate Delivery, Meridian Energy Ltd
CDM	Clean Development Mechanism
CEL	Contact Energy Limited
CERs	Certified Emission Reductions
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2-e	Carbon dioxide equivalent
COP	Conference of Parties
EC	Economic Community
ECNZ	Electricity Corporation of New Zealand
EECA	Energy Efficiency and Conservation Authority
EIA	Enhanced Industry Agreements
EIT	Economies in Transition
ERUs	Emission Reduction Units
EU	European Union
FCCC	Framework Convention on Climate Change
GEF	Global Environment Facility
GEL	Genesis Energy Limited
GEM	Green Electricity Market
GHG	Greenhouse gas
GHGs	Greenhouse gases
GWh	Gigawatt hours (10^9 watt hours)
GWP	Global Warming Potential
HFCs	Hydrofluorocarbons

IET	International Emissions Trading
INC	Intergovernmental Negotiating Committee for FCCC
IPCC	Intergovernmental Panel on Climate Change
IPCC WG I	IPCC Working Group One
IPCC WG II	IPCC Working Group Two
IPCC WG III	IPCC Working Group Three
JI	Joint Implementation
kWh	Kilowatt hours (10^3 watt hours)
LGNZ	Local Government New Zealand
LNI	Lower North Island
LULUCF	Land Use, Land Use Change and Forestry
MAF	Ministry of Agriculture and Fisheries
MED	Ministry of Economic Development, New Zealand
MEL	Meridian Energy Limited
MEPS	Minimum Energy Performance Standards
MFAT	Ministry of Foreign Affairs and Trade, NZ
MfE	Ministry for the Environment, New Zealand
MOC	Ministry of Commerce, New Zealand
MOT	Ministry of Transport
MRPL	Mighty River Power Limited
MRQ	Mandatory renewables quota
MS	Meridian Solutions, Meridian Energy Ltd
MW	Megawatt (10^6 watts)
N_2O	Nitrous Oxide
NA	Negotiated Agreement
NEC	National Environmental Standard
NEECS	National Energy Efficiency and Conservation Strategy
NI	North Island
NZ	New Zealand
NGA	Negotiated Greenhouse Agreements
NMVOCs	Non-methane volatile organic compounds
NO_x	Oxides of nitrogen
NPS	National Policy Statement
NSSCCC	National Science Strategy Committee for Climate Change
NZEM	New Zealand Electricity Market
OECD	Organisation for Economic Co-operation and Development
PFCs	Perfluorocarbons
PJ	Petajoule (10^9 joules)

R&D	Research and Development
REC	Renewable energy certificate
RE	Renewable Energy
SBI	Subsidiary Body for Implementation
SBSTA	Subsidiary Body for Scientific and Technological Advice
SF_6	Sulphur Hexafluoride
SG	Strategic Growth, Meridian Energy Ltd
SI	South Island
SOE	State Owned Enterprise
tC	Tonnes of carbon (to convert to tCO_2 multiply by 12/44)
tCO_2	Tonnes of carbon dioxide (to convert to tC multiply by 44/12)
tCO_2-e	Tonnes of carbon dioxide equivalent (multiply tGHG by GWP)
TAL	TranAlta Limited (renamed NGC in 2001)
TPK	Te Puni Kokere, Department of Maori Affairs
TRP	Trust Power Ltd
UK	United Kingdom of Great Britain
UN	United Nations
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention for Climate Change
UNI	Upper North Island
USA	United States of America
VA	Voluntary Agreement
VI	Vertical Integration Model
WEM	Wholesale Energy Market
WMO	World Meteorological Organisation
WOGOCOP	Working Group on CO_2 Policy

Units

k = 10^3	e.g. 1,000kg = 1t = 1,000,000 g = 1Mg
M = 10^6	e.g. 1 Mt = 1,000 kt
G = 10^9	e.g. 1 Gg = 1 kT
T = 10^{12}	
P = 10^{15}	

1 billion = 1,000 million = 10^9

See Appendix 26 for GHG units of measure.