

BEFORE THE BOARD OF INQUIRY

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of a Board of Inquiry appointed under s 146 of the Resource Management Act 1991 to consider an application by Mighty River Power Limited for resource consents to construct, operate and maintain a wind farm at Turitea

REBUTTAL EVIDENCE OF RALPH ERNEST HARPER SIMS

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REBUTTAL EVIDENCE OF PROFESSOR RALPH E. H. SIMS

Introduction

1. My full name is Ralph Ernest Harper Sims. I am Professor of Sustainable Energy and Director of the Centre for Energy Research at Massey University, Palmerston North and am currently based with the Renewable Energy Unit of the International Energy Agency, Paris as a Senior Energy Analyst. When I am in New Zealand I reside in the Turitea Valley.
2. I hold the degrees of BSc (Ag Hons) Reading University and MSc (Ag Eng) Newcastle University. I am a Chartered Engineer, a Fellow of the Institute of Agricultural Engineering, an elected Fellow of the Institute of Professional Engineers of New Zealand and a Companion of the New Zealand Royal Society.
3. I have over 30 years experience in renewable energy systems and climate change. I was a Lead Author on renewable energy for the Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report – Mitigation (2001) and the Co-ordinating Lead Author for the Energy Supply chapter of the IPCC Fourth Assessment Report published in May 2007. The IPCC was awarded the Nobel Peace Prize jointly with ex US Vice President, Al Gore. I was a Board member of the New Zealand Energy Efficiency and Conservation Authority having been appointed by the Ministry of Energy for three terms from which I resigned in late 2006 due to international commitments. I was the Western Power Visiting Chair of Renewable Energy Engineering at Murdoch University, Western Australia in 2001 and am the New Zealand representative on the Renewable Energy Working Party of the International Energy Agency (IEA). Currently I am working with the renewable Energy Unit of the IEA in Paris on a series of projects relating to directives from the G8 Gleneagles Summit in 2005. I own a fifth shareholding in an 80 ha Kyoto plantation forest that offsets my greenhouse gas emissions from travel.
4. I am the author of two books and numerous other papers on climate change and renewable energy as listed in my curriculum vitae attached as Annexure 1.
5. I was an invited member of the Royal Society President's Energy Panel and was also an external reviewer on a report by the Parliamentary Commissioner of the Environment entitled "Future currents: Electricity scenarios for New Zealand 2005-2050", which

identified the social and environmental benefits from distributed renewable energy systems.

6. I have read the Code of Conduct for Expert Witnesses (Section 5 of the Environment Court Consolidated Practice Note 2006) and have complied with it in the preparation of my rebuttal evidence. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Scope of Evidence

7. This evidence rebuts the evidence in chief of Jeffrey Alan Baker and Marian Whitney Melhuish both of whom present their evidence on behalf of the Palmerston North City Council. Both of those witnesses have failed to assess or even acknowledge the benefits of renewable energy projects such as the Turitea Wind Farm Project with respect to mitigating the effects of climate change and securing progress toward meeting New Zealand's climate change objectives. Ms Melhuish provides an 'energy context' brief but does not address the very important issue of climate change mitigation in that energy context. Mr Baker at paragraph 80 acknowledges that the positive effects of the proposal must be properly weighed in the balancing of positive and negative effects of a proposal under part II of the RMA. However, he fails to even mention climate change and the reduction of carbon emissions as a positive effect of the Turitea Wind Farm Project, thus rendering his balancing of effects and his overall planning analysis defective.

Climate Change – the Science

8. "Climate change" is defined in the Resource Management Act 1991 (RMA) as:

"a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods."
9. Greenhouse gases (GHGs), most commonly carbon dioxide (CO₂), methane, nitrous oxide, occur naturally and are critical for life on Earth. Such gases prevent some of the sun's warmth from dissipating into space and thereby maintain the planet at a temperature suitable to sustain life. However, when a) the natural carbon cycle is disrupted by human activities; b) methane and nitrous oxide emissions are increased mainly by agricultural activities; c) hydrofluorocarbons and other synthetic industrial gases are released to the atmosphere; and d) reduced sequestration (absorption) of

carbon dioxide occurs in oceans, soils or vegetation; then the increase in total GHG emissions¹, result in the average global temperature rising to artificially high levels and disturbing natural climate and weather patterns.²

10. In 1988 the IPCC was established by the United Nations Environment Programme and the World Meteorological Organisation to examine the most current scientific information on global warming and climate change. The IPCC is the prime source of science and technological information for the Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC).
11. The IPCC's most recent report, *Climate Change 2007: The Fourth Assessment Report* drew on the expertise of hundreds of the world's leading climate change scientists, economists, and risk experts from over 100 countries. The Report remains the most comprehensive and authoritative evaluation of global climate change.³ Its key findings are summarized below. As a New Zealand government nominee, I was selected to lead the chapter on Energy Supply.
12. The *IPCC Third Assessment Report, 2001* took into account the most recent science concerning possible threshold effects (e.g. "tipping points"). *The Fourth Assessment Report 2007 – Climate Science* confirmed and strengthened the conclusions made in the earlier report. It made predictions on climate change risks more specific and projected impacts at a greater level of confidence.
13. Scientists have established that atmospheric carbon dioxide concentrations are currently at approximately 380 parts per million (ppm). Such concentrations are higher than any previous level able to be measured reliably over the past 650,000 years from ice cores. Previous levels able to be determined have ranged between 180 – 280ppm over four glacial and inter-glacial ages.⁴ The more recent rise in CO₂ is confirmed by world class New Zealand data collected by NIWA from Baring Head since the establishment of a measuring station there in 1972.

¹ The global warming potential of GHGs other than carbon dioxide is usually expressed in terms of the carbon dioxide equivalence of each gas. A molecule of methane, for example, has a global warming potential 21 times greater than a molecule of carbon dioxide over a 100 year time frame.

² http://unfccc.int/essential_background/feeling_the_heat/items/2917.php

³ The Summary for Policy Makers of the IPCC Fourth Assessment Report on Mitigation was published in May 2007 and is available at www.ipcc.ch

⁴ A joint statement by the science academies of 11 countries, including all the G8 nations (June 2005) Joint Science Academies' Statement: Global Response to Climate Change.

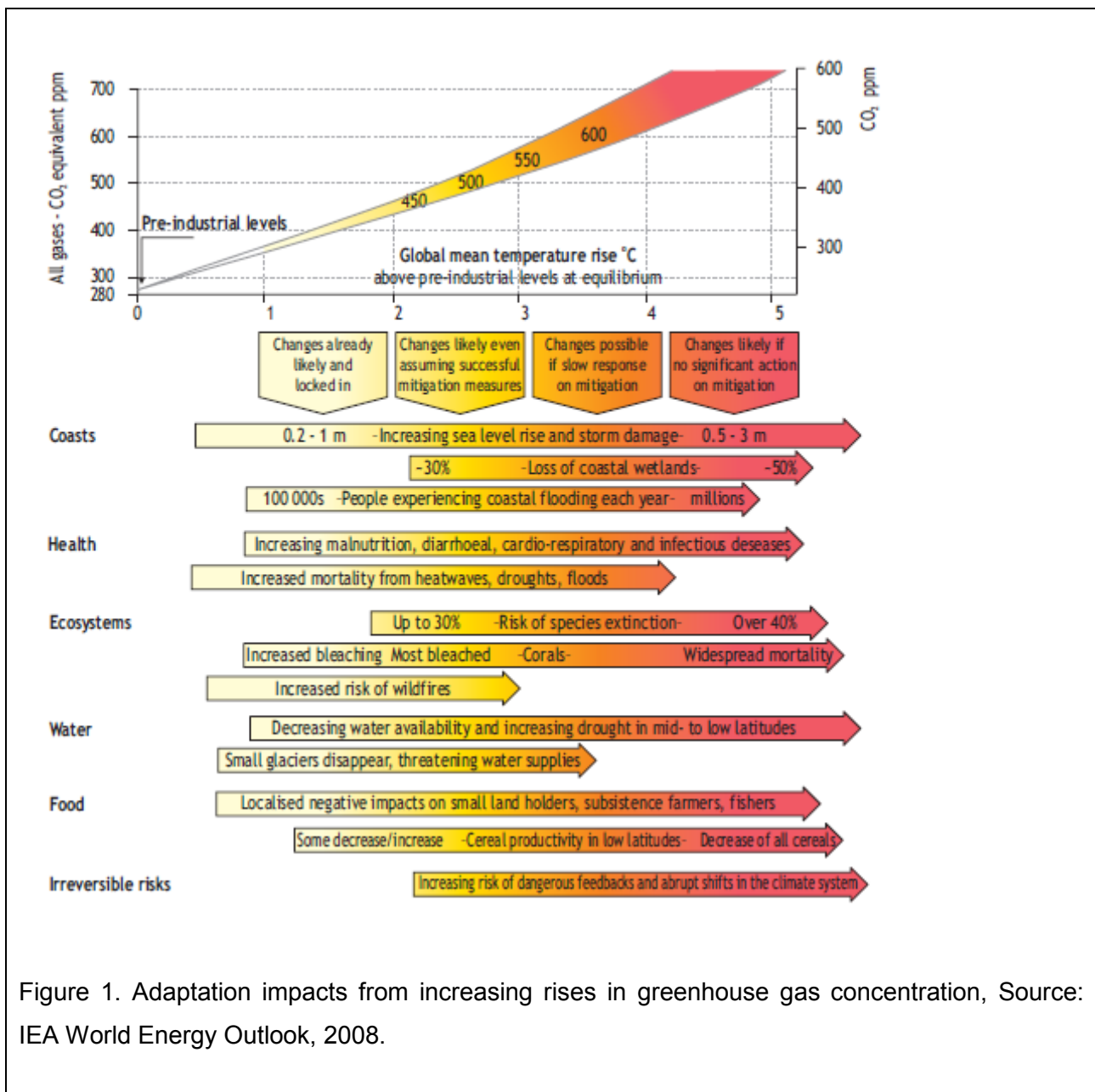
14. Since the late nineteenth century the average temperature of the earth's surface has risen by over 0.7°C. IPCC scenario computer models now suggest a mean annual global temperature rise of between 1.8 and 4°C will occur over the next century. This prediction is based on an increase of atmospheric concentrations of carbon dioxide and other greenhouse gases from the present level to between 550 and 950 ppm CO₂ equivalent.⁵ Even if the minimum temperature increase predicted takes place, it will be larger than any 100 year long trend ever experienced in the last 10,000 years.⁶
15. A 2°C average temperature increase towards the end of this century (as predicted by 21 models in various climate centres around the world⁷) is regarded by the IPCC as the threshold beyond which the risks to human societies and ecosystems increase significantly (Fig. 1). Contemporary societies will find the implications very difficult to cope with and adaptation measures will be significant and costly. Such a level of temperature increase is considered probable when atmospheric concentrations of carbon dioxide exceed 400 ppm and other greenhouse gases (offset by the cooling effects of aerosols) push this up to over 450 ppm equivalent. Achieving stabilisation of greenhouse gases to keep temperature increases below the 2°C threshold will be extremely difficult and adaptation will be unavoidable. Serious cuts in global greenhouse gas emissions are needed urgently so that global GHG emissions peak by around 2015 to minimize the 450 ppm equivalent overshoot that now appears to be inevitable. According to the IPCC Summary for Policymakers (2007), reductions of 60-80% below 1990 levels of annual global GHG emissions will be required by 2100 in order to stabilise atmospheric GHG concentrations at 450 ppm equivalent.⁸

⁵ Working Group I, Intergovernmental Panel on Climate Change (IPCC), Climate Change 2007: The Physical Science Basis, Summary for Policymakers (2007).

⁶ http://unfccc.int/essential_background/feeling_the_heat/items/2917.php

⁷ Sir John Houghton, 2009. Global Warming – the complete briefing, Fourth Edition, Figure 6.4. Cambridge Press.

⁸ IPCC Climate Change Synthesis Report, Summary for Policy Makers, 2007.



16. The Third Assessment Report observed that current levels of climate change have resulted from the release of only around 300 GtC (gigatonnes of carbon) and that there are sufficient remaining global reserves of hydrocarbons to last for centuries at current rates of usage (Fig.2). Accordingly the potential for escalation of climate change from fossil fuel use is significant.

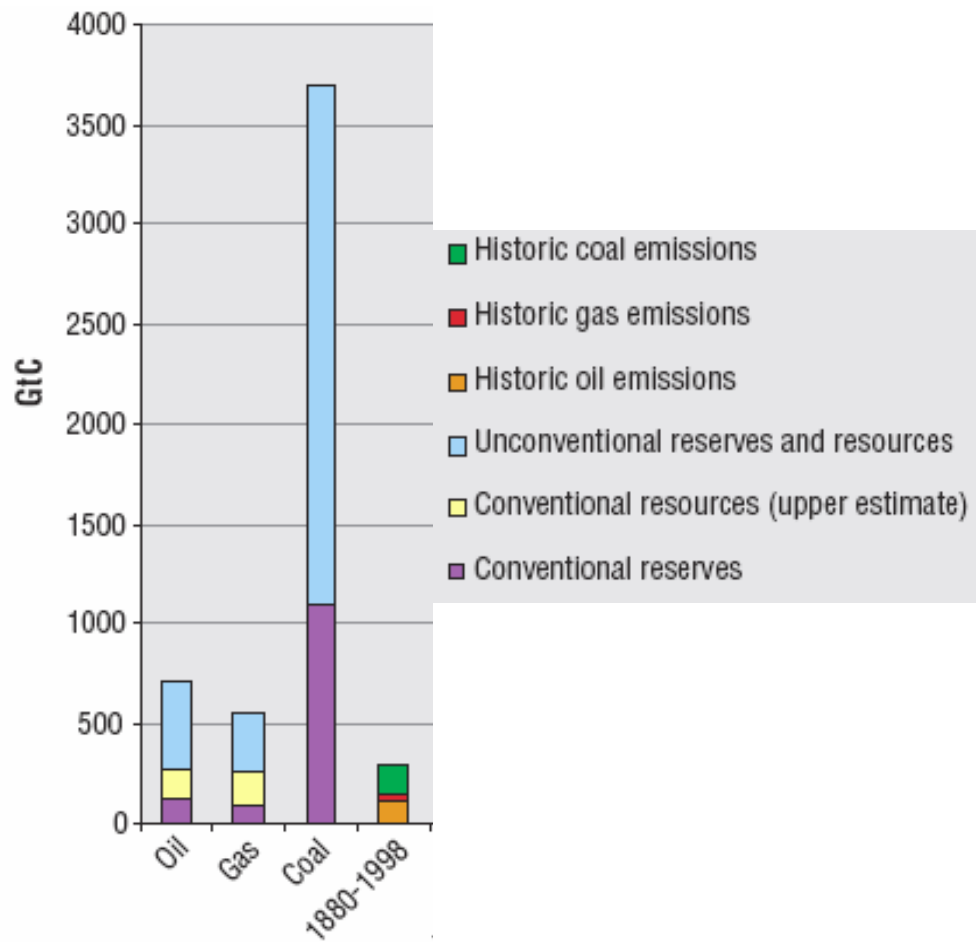


Figure 2: Expected emissions from fossil fuels used to 1998 and those projected from fossil fuels available for use based on data from IPCC 3rd Assessment Report, 2001 – Mitigation Chapter 3.

17. Climate change is associated with rising sea levels. The higher temperatures brought about by global warming cause the ocean volume to expand, and melting glaciers and ice caps on land add more water. The average sea level has risen by around 3mm per year during the last decade and an additional rise of up to 1m is expected by the year 2100.
18. Numerous plant and animal species, already weakened by pollution and loss of habitat, are not expected to survive the next 100 years due to the current warming trend. Further analysis was reported in the IPCC Fourth Assessment Report – Adaptation, Working Group II released in April 2007 after acceptance by around 150 governments during the international approval process.
19. Current global retreat and ice pack melting are clear indicators that climate change is having an impact on the environment now. Franz Joseph, Fox and many other glaciers are in an overall pattern of retreat (despite some fluctuations and short term advances),

which is expected to continue. The Fox Glacier has retreated 1500 metres since scientific observations began in 1860.⁹ Such indicators provide a clear imperative for governments and businesses to act. However in spite of all the low emission technologies available, the policies in place and the recent high energy prices GHG emissions continue to accelerate.

20. Human beings are also likely to face mounting difficulties. For example, in the Fourth Assessment Report, the IPCC Working Group II report stated “ongoing coastal development and population growth in areas such as ... Northland to Bay of Plenty (New Zealand) are projected to exacerbate risks from sea-level rise and increases in the severity and frequency of storms and coastal flooding by 2050”. As sea levels rise to the levels predicted, this could cause the disappearance of some island nations entirely (including some of New Zealand’s Pacific neighbours). Freshwater supplies could also be contaminated by seawater for billions of people and hence result in mass migration.¹⁰ For example a 50cm sea-level rise in Bangladesh would place about 6 million people at risk from flooding.¹¹ In the longer term, the Greenland ice sheet is expected to melt completely which would lead to a sea-level rise of as much as 6-7 metres. Indications are that the Greenland ice sheet is melting more swiftly than predicted and extensive sea-level rise could occur within centuries.¹² These scenarios are predictions based on no significant reductions in GHG emissions being achieved.
21. There remains a degree of uncertainty about the exact concentration of greenhouse gas emissions that would endanger human societies and eco-systems. Over time, advances in climate science and economic modeling of the costs of impacts and mitigation options can be expected to reduce the uncertainties associated with climate change projections and responses. However the first climate change driven migration, of 2600 inhabitants from the island of Carteret, off the cost of Papua New Guinea, has already begun with the first people moved in April 2009¹³.
22. According to the IPCC, significant global emission reductions will need to take place within the next 10 – 30 years if we are to avoid a level of warming that would be likely to

⁹ Working Group I, Intergovernmental Panel on Climate Change (IPCC), Climate Change 2007: The Physical Science Basis, Summary for Policymakers (2007).

¹⁰ http://unfccc.int/essential_background/feeling_the_heat/items/2917.php

¹¹ Joint Science Academies Statement: Global Response to Climate Change.

¹² E Rignot, P Kanagaratnam, Science 17 February 2006: Vol 311. No 5763, pp.986 – 990.

¹³ http://www.theecologist.org/pages/archive_detail.asp?content_id=2361

significantly increase the risks to human societies and ecosystems.¹⁴ The Stern Review (UK 2006) stated that any delay in taking action will be more costly in the long term and this was endorsed by the IPCC Fourth Assessment Report.

23. On a political level also, it is widely agreed that climate change is a serious global problem and action to mitigate its adverse effects is needed urgently. An example of recognition of this urgency is the agreement by the EU heads of state and government on 23 March 2005 that a 15 – 30% cut in GHG emissions by 2020 compared to 1990 levels “should be considered”.¹⁵ In March 2007, from the current 4%, a 20% renewable energy binding target by 2020 was passed into legislation to provide part of this mitigation objective.
24. The IPCC Fourth Assessment report was written in 2006/2007, but is already out of date. Further scientific analysis has since confirmed that climate change is happening at a rate faster than predicted. A congress of 2000 scientists held in Copenhagen in March 2009¹⁶ concluded with key messages for policy makers that:
- recent observations confirm that, given high rates of observed emissions, the worst-case IPCC scenario trajectories (or even worse) are being realised;
 - recent observations show that societies are highly vulnerable to even modest levels of climate change, with poor nations and communities particularly at risk;
 - rapid, sustained, and effective mitigation based on coordinated global and regional action is required to avoid “dangerous climate change” regardless of how it is defined;
 - an effective, well-funded adaptation safety net is required for those people least capable of coping with climate change impacts, and a common but differentiated mitigation strategy is needed to protect the poor and most vulnerable;
 - there is no excuse for inaction since we already have many tools and approaches – economic, technological, behavioural, management – to deal effectively with the climate change challenge, but they must be vigorously and widely implemented to achieve the societal transformation required to decarbonise economies; and
 - to achieve the societal transformation required to meet the climate change challenge, we must overcome a number of significant constraints and seize critical opportunities.

¹⁴ IPCC, Fourth Assessment Report, 2007, www.ipcc.ch

¹⁵ http://ue.eu.int/ueDocs/cms_Data/docs/pressData/en/ec/84335.pdf, Page 17

¹⁶ The International Scientific Congress on Climate Change, <http://climatecongress.ku.dk/>

25. For the foreseeable future, decision makers throughout the world need to work within a risk management framework comprising probabilities and uncertainties rather than absolute predictions concerning climate change and weather events.¹⁷ They must recognize that climate change is a reality and respond urgently.

Climate Change in New Zealand

26. The IPCC Fourth Assessment, Working Group I, *Climate Science*, forecast changes in New Zealand weather in its Regional Climate Projections report.¹⁸ Even modest climate change scenarios indicate New Zealand is likely to experience increased temperatures, increased sea levels, increased frequency of extreme weather events and changes in rainfall patterns (see Annexure 2).
25. Climate change therefore presents a real risk of economic harm to New Zealand. If extreme weather events become more frequent or severe, associated costs are also likely to increase. The financial consequences of stock losses, damaged roads, bridges, houses and storm water drains, soil erosion and loss of soil nutrients can be formidable. Recent events such as droughts and floods exemplify how vulnerable our society and economy is to extreme weather conditions.¹⁹
26. Flooding is expected to increase under climate change model scenarios. It is already the number one cause of civil defence action in New Zealand with current costs at about \$125 million per year (not counting money spent on increased flood protection). For example, the Manawatu floods in February 2004 caused \$355 million²⁰ of damage and repairs to roading and other infrastructure took several years to complete.
27. Similarly, the economic cost to New Zealand of climate change induced drought would be significant. The IPCC Fourth Assessment Report, Working Group II, *Adaptation*²¹ stated “Production from agriculture and forestry by 2030 is projected to decline in parts of eastern New Zealand due to increased droughts and fire.” The Canterbury drought of 1987/1988 cost the local agricultural community an estimated \$360 million in lost

¹⁷ Ministry for the Environment. Review of Climate Change Policies. 2 November 2005. Pg 223.

¹⁸ http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Pub_Ch11.pdf, page 896 to 901

¹⁹ <http://www.climatechange.govt.nz/resources/info-sheets/regional/wellington-kapiti-wairarapa.pdf>

²⁰ Storm: Civil Emergency – Storm and Flood Report, Horizons Regional Council (2204) p14.

²¹ IPCC Working Group II, Fourth Assessment Report, Summary for Policy Makers
www.ipcc.ch/SPM13apr07

earnings. Another drought in this region in 1997-99 caused a \$231 million loss at the farm gate (from decrease in value of product, additional expenditure on imported feed, and depletion of conserved feedstock reserves). Flow-on impacts to the local community cost additional millions of dollars, including lost income for processing industries and loss of employment.

28. There are also likely to be benefits and opportunities from a changing climate. The IPCC Working Group II report chapter covering New Zealand stated: “Initial benefits are projected in western and southern areas and close to major rivers due to a longer growing season, less frosts and increased rainfall”. This should benefit the reliability of hydro-power generation in these regions. However, it is uncertain whether such benefits to agricultural production would offset the potential disbenefits from extreme weather events.
29. Overall, if the rate and magnitude of climate change is not slowed down by GHG mitigation, any beneficial effects of climate change are expected to diminish and the adverse effects and long-term risks expected to increase.

Climate Change in the Manawatu Region

30. The Manawatu is vulnerable to the impacts of climate change on its coastline and associated infrastructure, on its agricultural based economy, and on its ecosystems.²² The Manawatu is similar to the Wellington region and is often windy because of its exposure to disturbed weather systems of the Tasman Sea. Otherwise it has relatively few climate extremes with warm summers and cool winters.²³
31. Predicted impacts on the region over the next 70 to 100 years from moderate climate change include a rise in average temperatures up to three degrees warmer on average and a rise in rainfall patterns. The region as a whole is likely to experience more varied rainfall patterns and flooding could become up to four times as frequent as today by 2070. Westerlies are expected to increase by 10 percent over the next 50 years and the sea level will rise.²⁴
32. The local effects of climate change are likely to cause significant costs to this community in combating extreme weather events and also in investments for adaptation to their

²² Ministry for the Environment. Review of Climate Change Policies. 2 November 2005, pg 410.

²³ <http://www.climatechange.govt.nz/resources/info-sheets/regional/>

²⁴ Climate Change Hazards, Greater Wellington Regional Council.

increased frequency and severity such as by necessary bridge strengthening and construction of raised stop banks, coastal protection systems and sea walls.

Climate Change – Global Policy Response

33. Recognition of the seriousness of climate change has prompted concerted international action. The UNFCCC was the first international response to scientific evidence linking greenhouse gas emissions from human activities with the risk of global climate change. It sets an overall framework for intergovernmental efforts to tackle the challenge posed and commits signatory states to taking action. The Convention enjoys nearly universal adherence with 189 countries having ratified including New Zealand, the United States and Australia.
34. The 1997 Kyoto Protocol to the Convention entered into force in 2005. It commits Annex I countries (predominantly developed OECD countries and economies in transition) to binding emission reduction targets during the 2008-2012 first commitment period. New Zealand is one of the 163 countries to have ratified the protocol, Australia having also done so in late 2007. The US has not signed, but with the new administration in place, it is set to take a leading role in Post-Kyoto negotiations.
35. Other countries with Kyoto Protocol commitments have implemented a range of measures to achieve the agreed emission reduction targets. These include wide ranging policies to encourage the uptake of renewable energy. Government support for renewable energy is growing rapidly (as evident from the IEA policies and measures database – www.iea.org/textbase/pamsdb). By the end of 2008, at least 73 countries had some type of renewable energy promotion policy in place including 18 developing countries²⁵ and many had renewable energy targets.
36. The United States has not ratified the Kyoto Protocol. However, the federal government has directed significant domestic resources to climate change solutions and around 12 individual states already have been taking independent action to reduce GHG emissions. Many of their policies focus on energy efficient improvements, energy-technology developments, and support for renewable energy projects.
37. Developing countries including China and India are also taking steps to reduce GHG emissions growth including through support for renewable energy deployment. China,

²⁵ Renewables global status report – 2008 update released in May 2009 (www.ren21.net).

for example, has a challenging target of 10% renewable electricity by 2010 and a 15% share of total consumer energy by 2015.

38. Technology development in achieving future emissions mitigation from renewable energy projects is imperative. Where an overall decline in energy intensity will be insufficient to significantly curb emissions growth, developing and transferring technologies that allow more efficient use of fossil fuels are likely to be a critical factor in curbing emissions growth, along with the sequestering of carbon dioxide, or the uptake of renewable energy for heat and power and nuclear power.

Emissions in New Zealand

39. In 1990, New Zealand's total GHG emissions were equivalent to 61.9 Mt CO₂. Total GHG emissions increased to 77.9 Mt CO₂ equivalent over the period 1990 to 2006 giving an average annual growth in overall emissions of 1.4 percent per year.²⁶
40. The New Zealand energy sector (including electricity generation and transport) comprised 43.9 percent of total emissions in 2006. In recent years, growth in emissions from the energy sector represented the highest sectoral growth (44.5% from 1990 to 2006)²⁷ and was one of the highest of all OECD countries. This growth is a consequence of increased population, strong economic growth and an associated increase in industrial and agricultural demand for electricity and transportation of produce.
41. Compared with 1990 levels, CO₂ emissions from electricity generation in 2007 had increased 91.3%²⁸ (in spite of a 17.9% reduction between 2006 and 2007 as a result of the commissioning of the Huntley combined cycle gas-fired power generation plant displacing the demand for coal-fired generation).²⁹ Although growth in energy demand, and thus supply, would significantly increase the emissions associated with electricity generation, the upward trend of emissions has been exacerbated by greater use of thermal stations to supplement hydro-electric generation in dry years. For example, in 2003, which was a drier year than usual, New Zealand relied more heavily on coal and natural gas for electricity generation. Emissions of CO₂ from Huntly, New Zealand's only power station able to run on coal (and also on gas), approximately doubled between

²⁶ <http://www.mfe.govt.nz/environmental-reporting/atmosphere/greenhouse-gases/emissions.html>

²⁷ <http://www.climatechange.govt.nz/resources/report/nir-apr05/html/page4.html>

²⁸ <http://www.med.govt.nz/upload/63349/GHG%20Report.pdf>

²⁹ <http://www.med.govt.nz/upload/63349/GHG%20Report.pdf>

- 2002-2003.³⁰ If more non-hydro renewable generation options were available, they would be used to mitigate dry year supply shortages without the need for greater output by existing thermal generation. Hence additional emissions would be avoided.
42. Low lake levels in the South Island in the past have also led to the increased operation of the Whirinaki (combusting light distillate) and Huntly plants. Genesis Energy, in its interim result in March 2007, registered a record coal consumption figure and power output for Huntly Power Station³¹ that had a resulting impact on 2006 emissions levels.
 43. New Zealand's target is to reduce its GHG emissions back to 1990 levels on average during the first commitment period of 2008-2012 or to take responsibility for emissions over this level. Data released by the UN Climate Change Secretariat in November 2008 showed that by the end of 2006 the national GHG emission levels had risen to 25.6% above 1990 levels, the fourth highest increase of 40 developed countries. New Zealand will receive some additional credits for carbon sequestration by some of its forest sinks. Under the Kyoto "mechanisms" it can also earn credits by investing in emission reduction projects overseas or buying credits from other participants in the Kyoto market. Treasury has estimated the national liabilities under Kyoto to be around NZ\$550 million as of January 2009³². Meeting the target in a more cost effective manner will require New Zealand to reduce its CO₂ emissions wherever possible at a cost per tonne that is less than the international market price. It is expected that more stringent reductions will be negotiated for future commitment periods post-Kyoto, which will mean that New Zealand will need to take actions at a progressively greater cost.
 44. Increasing New Zealand's supply of renewable energy will assist with mitigating the problem of increasing emissions in the electricity sector. New renewable power stations will reduce dry year demand for generation by existing thermal plants. Conversely, if growth in demand is not met by an increase in supply of renewable energy then that demand will cause growth in emission from thermal plant. This is why new renewable energy power stations are an essential part of New Zealand's emission management response.
 45. If opportunities are not taken to build renewable power stations at an appropriate rate, increasing electricity demand could encourage large scale thermal generation plants to

³⁰ <http://www.climatechange.govt.nz/resources/reports/nir-apr05/html/page4.html>

³¹ <http://www.genesispower.co.nz/genesis/index.cfm?00494901-05E1-4043-9075-3B9244BBBCE5&newsitem=77674A84-B63E-EE93-3A320687064860C4>

³² Reuters press release 11 March 2009. <http://www.treasury.govt.nz/government/liabilities/kyoto>

be built instead. This will then crowd out new renewable generation projects for the electricity market for years to come. Consequently, New Zealand's economy will incur the cost of GHG emission for the lifetime of these thermal generation plants that could have been avoided with appropriately staged building of renewable generation plant. It should also be noted that, carbon dioxide capture and storage technology is very unlikely to be retrofitted to any thermal power station or new plant built in New Zealand in the next 20 years or so. This is because the technology is largely unproven, costs remain uncertain, and international negotiations on regulatory mechanisms for long term monitoring and liability have not yet begun. Medium to large renewable energy projects are needed to keep up with the demand growth for the intervening period before more enhanced energy efficiency actions are able to slow the current rate of demand increase.

New Zealand Climate Change Policy

46. Reduction of GHG emissions is a policy priority for the New Zealand Government. I will not repeat the various policies that have been introduced as these are set out in the evidence of Mr Layton at paragraphs 4.4 to 4.12. However, amendments to the Resource Management Act in 2004 implemented a framework in which industrial emissions could be dealt with through the national policies described above. The same Amendment Act instigated other amendments designed to:
- (i) encourage energy efficiency;
 - (ii) ensure that the benefits of the use and development of renewable energy are given due weight in consent decisions; and
 - (iii) direct local authorities to consider the effects of climate change in their day-to-day activities.
47. If New Zealand is unable to meet its target through domestic action, emissions reductions will have to be purchased on the international market. It is therefore important that New Zealand captures every opportunity available to reduce emissions in order to avoid spending tax payers' money on purchasing off-shore credits. Wind-power projects are excellent examples as they contribute to meeting climate change goals without any associated economic growth trade-off.

Role of renewable energy as a climate change mitigation tool

48. New Zealand has substantial renewable energy resources that have not been developed, including an outstanding wind resource, hydro resource, extensive geothermal fields, high potential for woody biomass production, wave and ocean current energy, and a good solar resource. The proportion of New Zealand's consumer energy supply derived from renewable energy sources, at around 27% in 2004, is relatively high by international standards. Nonetheless this proportion has declined from 35% since 1990 mainly due to relatively higher growth in gas and coal use for electricity generation and in oil use for transportation. The global share of primary energy from renewable energy for 2007 was around 5% of total supply (excluding traditional biomass sources used in developing countries for cooking and heating). The current share of primary energy coming from renewable energy sources in OECD countries is 6.2%.³³
49. The relatively high market share in New Zealand is largely due to a high proportion of electricity generation from renewable sources, typically ranging between 65-70% of electricity supply.³⁴ However the proportion of New Zealand's electricity coming from renewable energy sources has been declining for decades because growth has been exceeded by growth in non-renewable energy power systems.
50. The key means of achieving emission reductions in the energy sector are through improvements to energy efficiency (in terms of both technologies and behaviour) and increasing the proportion of renewable energy in New Zealand's energy supply.³⁵
51. New renewable energy projects assist in meeting New Zealand's growing electricity demand without emitting GHGs. If an increasing share of New Zealand's energy production comes from renewable energy sources over time, then there is the potential for lower energy production from thermal energy sources, and hence reduced greenhouse gas emissions. In the absence of lower consumer demand for electricity, it is clear that reduced thermal energy production would require increased renewable energy generation unless nuclear power is to be deployed. Nuclear power is not a sensible option for New Zealand using existing commercial technologies.
52. In a progressively constrained carbon world (ie as the international cost of reducing GHGs increases) New Zealand's economy would be more resilient the lower its carbon

³³ Renewables Information 2008, IEA Statistics, International Energy Agency, OECD, Paris.

³⁴ <http://www.eeca.govt.nz/eeca-library/eeca-reports/report/situation-assessment-report-neecs-06.pdf> .

³⁵ Ministry of the Environment. Review of Climate Change Policies. 2 November 2005. pp425.

intensity. This means that new wind projects are likely to improve the economic resilience of New Zealand as they will help keep electricity GHG emission intensity low.

53. Existing regulation and support programmes to reduce emissions are generally more developed in the energy sector than in other sectors. Strong co-benefits (including economic, social, health and environmental benefits) have resulted in the Government acknowledging and committing to energy efficiency and renewable energy. Health benefits include the lack of local environmental pollutants such as NO_x and SO_x which are generated by thermal plants.
54. However, these policies to reduce GHG emissions do not make change happen. It is up to businesses like Mighty River Power and decision makers and influencers at all levels of central and local government such as the Palmerston North City Council to ensure that the uptake of new renewable energy becomes a reality.

Conclusions

55. Global action to reduce greenhouse gas emissions is required as a matter of urgency to prevent dangerous interference in the planet's climate and ecosystems and New Zealand must play its part.
56. There is no longer any doubt that anthropogenic activities have caused a rise in GHGs.³⁶ The question is how rapidly the effects on weather patterns will become clearly evident, and what will be the extent and impact of such changes?
57. Recognition of the magnitude of the climate change problem has prompted the international community to agree to emission reduction objectives. Mitigation of climate change is a policy priority for New Zealand.
58. Renewable energy is a very important part of the solution with benefits at the local, regional, national and international levels regardless of who directly uses the electricity generated. This is particularly so as New Zealand's demand for electricity continues to rise and the proportion of electricity derived from fossil fuel sources continues to increase.

³⁶ The Summary for Policymakers report of Working Group 1 of the IPCC Fourth Assessment includes the following conclusion "The understanding of anthropogenic warming and cooling influences on climate have improved since the TAR (Third Assessment Report), leading to a very high confidence that the average global net effect of human activities since 1750 has been one of warming, with radioactive forcing of +1.6 [+0.6 to + 2.4] W m⁻²." Page 3. 'Very high confidence' represents at least a 9 out of 10 chance of being correct.

59. Embracing new renewable energy technologies will help meet New Zealand's climate change objectives, and has a number of useful co-benefits relating to employment, health and air pollution in comparison with fossil fuel or nuclear power plants. Renewable energy developments can help meet New Zealand's emission reduction and target objectives without adverse economic tradeoffs.
60. Wind energy systems do not emit GHGs and should be evaluated as alternative options to fossil fuel use with all short and long term costs and benefits being taken into accounts including the impacts of carbon dioxide emissions.
61. New Zealand's continued growth in fossil fuel demand and the resultant GHG emissions will make it difficult to meet our international commitments under the Kyoto Protocol. The solution is to support the development of more renewable energy projects.
62. The key points of this evidence may be summarised as follows:
 - (i) New renewable energy projects assist in meeting New Zealand's growing electricity demand without emitting GHGs.
 - (ii) More renewable energy projects, including wind power, will assist New Zealand to meet its obligations under the Kyoto Protocol cost effectively, by helping to meet its growing electricity demand without increasing the use of thermal generation until this can be linked with carbon dioxide capture and storage.
 - (iii) If opportunities are not taken to build renewables at an appropriate rate, increasing electricity demand will require the building of large thermal generation plants which will crowd out future renewable plants. This could have a long term economic cost for New Zealand (and its tax payers) with regards to having to buy Kyoto credits to cover these emissions, potentially for the life of the power stations. Local emissions such as NO_x and SO_x that can cause health issues will also be higher.
 - (iv) Medium to large scale renewable energy projects are required to meet demand growth before enhanced energy efficiency actions can realistically be expected to slow the rate of demand increase.
 - (v) In a progressively constrained carbon world renewable energy projects are likely to improve the economic resilience of New Zealand as they help to keep New Zealand's electricity emission intensity low and for each year of the life of the

project. This will have an impact on tax payers as the cost of meeting on-going emission reduction obligations could increase.

- (vi) New Zealand needs to consider seriously every opportunity available to reduce GHG emissions. Mighty River Power's proposal for the Turitea wind farm development in the Manawatu is an excellent project in that it would contribute to meeting climate change goals without any associated economic growth trade-off, and with considerable cost management benefits and lower national risk.

Ralph E H Sims

5 June 2009

Annexure 1: Curriculum Vitae - Ralph E H Sims



Ralph E H Sims - Personal details:

Birth date: 9 September 1947.

Birth place: Hounslow, England

Professional Qualifications:

BSc (Ag Hons), Reading University. 1969

MSc (Ag Eng), Newcastle University. 1971

Chartered Engineer, UK. 1978

Present positions: **Senior Analyst,**
Renewable Energy Unit of the Energy Technology Office,
International Energy Agency, OECD.

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France

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Director, Centre for Energy Research,
Institute of Technology and Engineering,
Massey University
College of Sciences,
Massey University,
Palmerston North,
New Zealand

E-mail: R.E.Sims@massey.ac.nz

Awards and Memberships

- Royal Society Technology and Science Silver Medal, 2002
- Elected Fellow, Institute of Professional Engineers, NZ, 2003-
- Fellow, Institute of Agricultural Engineers, 1988-
- Member, N Z Institute of Directors, 2001- 2004
- Member, World Renewable Energy Network council
- Member and past convenor, NZ Sustainable Energy Forum Inc.
- Member, Solar Action and International Solar Energy Society.
- Member, Bioenergy Association of New Zealand.
- Companion, Royal Society of New Zealand.

Years as a practising energy researcher: 36

Professional appointments and relevant positions held since 1981

- 2005-2009 Senior Analyst, International Energy Agency
- 2007-2009 IPCC Special Report on Renewable Energy, appointed to Focus group as well as New Zealand representative. Lead Author for Chapter 8, Integration
- 2004-2007 Appointed as Co-ordinating Lead Author of “Energy Supply” chapter for Working Group III of the Fourth Assessment Report, Intergovernmental Panel on Climate Change (IPCC) under the United Nations Framework Convention on Climate Change.
- 2005 Official New Zealand delegate at the Beijing International Renewable Energy Conference “Renewables2005” on behalf of the Ministry of Economic Development www.BIREC2005.com
- 2005-2007 Invited member, Royal Society of New Zealand, President’s Energy Panel.
- 2005 Associate Editor, Renewable Energy, an International Journal, Elsevier and Science Direct.
- 2004 New Zealand government delegate/advisor at world summit conference “Renewables2004”, Bonn. www.renewables2004.de
- 2003-2004 Reviewer for the UK Energy Research Centre, a £20million initiative under the National Environment Research Council, Swindon, many government reports and several scientific journals including Energy Policy, Renewable Energy
- 2003 Appointed to Editorial Board of Elsevier scientific journal “Biomass and Bioenergy” having refereed numerous papers over several years.
- 2002 on-going New Zealand representative on International Energy Agency Renewable Energy Working Party (supported by the Ministry for Environment and Ministry for Economic Development).
- 1998 – 2001 Lead Author of Working Group III for the Third Assessment Report of the Intergovernmental Panel on Climate Change with responsibility for Energy supply, Renewable energy, Agriculture and contributions to sections on transport, forests, energy efficiency in industry and energy management
- 2000 -2007 Ministerial appointment as Member, Board of the Energy Efficiency and Conservation Authority (EECA). 2005 Reappointed for a third term.
- 2000 – 2001 Western Power Visitor of Renewable Energy Engineering, Murdoch University, Perth from October 2000 till March 2001.
- 2001 New Zealand negotiator for the approval of the Summary for Policy Makers, by 84 nations for the IPCC, Third Assessment Report -Mitigation under the UNFCCC. February. Accra, Ghana.
- 2001 Appointed Chair of the Expert Group on Energy Labeling, NZ Standards Association in association with Carter Holt Harvey Ltd.
- 2000–02 Member, Australian Co-operative Centre for Renewable Energy (ACRE).
- 2000-2001 Convenor, NZ Sustainable Energy Forum Inc.
- 2000 Reviewer of a suite of Energy reports for the Asian Pacific Energy Research Centre (APEREC).
- 1993 on-going New Zealand representative on the Council of the World Renewable Energy Network (www.wren.org.uk).
- 1997 - 2003 Representative on the International Energy Agency, Bioenergy Activity (Task 29) on Socio-Economic aspects of Renewable energy.
- 1991 – 2005 Convenor and organizer of several national and international conferences including those on Wind Energy Potential; Woody Biomass; Sustainable Production Methods; “Renewable Energy Research Showcase”; “Energy for our country” and a member of the “Asia Pacific Countries Energy and Environment Technologies” conference scientific and organizing committee of three held in Wellington, July 2005
- 1996-1997 Visiting Researcher, ETSU (Energy Technology Support Unit) of the Department of Trade and Industry, UK for 8 months.

1992-1998	Member, Editorial Board, Agriculture, Ecosystems & Environment, Elsevier.
1996	Project Manager, co-author, and technical editor for Centre for Advanced Engineering and Energy Efficiency and Conservation project and report New and Emerging Renewable Energy Opportunities in N Z.
1993-94	Task group leader for Energy Efficiency - Primary Production – a project and report commissioned by the NZ Centre for Advanced Engineering.
1991	Project leader for ECNZ research contract project on Wood-fired power generation.
1990-1996	Executive Secretary, Massey University Agricultural Research Foundation
1990	Project leader: Ministry of Energy contract; Wood fuel supplies and utilisation
1995- 1997	NZ representative, International Energy Agency CADDET project demonstration programme for energy efficiency and renewable energy technologies.
1979-1992	Member, Editorial Board, Soil and Tillage Research Elsevier
1985- 1986	Programme Manager, Biofuels Group, ETSU (Energy Technology Support Unit), UK on secondment for 15 months.
1983	Project leader: NZ Energy Research and Development Committee contract; On-Farm Energy Supply and Conservation
1981	Project leader: Liquid Fuels Trust Board contract; Natural oils/fats as diesel fuel substitutes

Consultancies and contracts

A wide range of sustainable energy consultancy projects have been undertaken. Those since 1998 include contracts with:

- Shell International Renewables; Shell Fiji; Shell Australia; Comalco /NZ Aluminium Smelters/ Rio Tinto; Scion (Forest Research Institute); Industrial Research Ltd.
- Energy Efficiency and Conservation Authority; Ministry for the Environment; Ministry of Economic Development; NZ Consumer Association; Standards Association of New Zealand; Foundation of Research Science and Technology.
- Rural Industries Research and Development Corporation, Australia; Enecon; State Forests of NSW; Western Power; Stanwell Power Corporation; Australian Co-operative Centre on Renewable Energy Research; Australian Greenhouse Office;
- Waitakere City Council; Lake Taupo Development Company; Go Wairarapa; Turanga Trust,
- Meridian Energy; Transpower; Main Power; WEL Networks; PowerCo; Orion Energy; Dunedin Electricity; Carter Holt Harvey; Agri-Genesis; Wrightsons; Dairy Insight; Wind Farm Developments Ltd; Genesis Ltd; ARS Ltd, Vector Energy Ltd
- Post-graduate student links through government schemes (e.g. Technology Industry Fellowships) with Meridian Energy, Power Flow Technologies, Richmond Meats Processors Ltd, Applied Research Services, ARS Ltd and Fisher & Paykel.

Industry experience:

2006-	Appointed to Advisory Board, Rio Tinto, NZ Aluminium Smelters
2002-	Co-organiser with Energy Management Association of a series of successful Energy Management 2 and 4 day courses for industry personnel.
2000/01/02/03/06	Judge, Energy Efficiency and Conservation Authority's Energy Wise Awards – Renewables and Energy supply categories
2004	Judge, Innovative Awards and Energy Efficient premier feature exhibitors, National Agricultural Fieldays, Hamilton.
2001 -	Appointed to Board of Bioenergy Industry Association of New Zealand
2001 -	Established a syndicate of 7 electricity industry companies as co-sponsors for a distributed generation research project for rural communities
1994 -	Director and partner, Tutukau Land Company Ltd., Rotorua.
1986 - 1989	Director, Coppice Fuelwoods NZ Ltd
1979-1982	Judge, Merit and Prototype Awards, National Agricultural Fieldays

1975-1998 Judge and technical advisor, National Tractor efficiency competitions at National Agricultural Fieldays with the aim to save fuel and improve performance.

University teaching programme contributions

- Chief supervisor of over 60 post-graduate student projects on agriculture engineering, sustainable energy and climate change topics.
- Internet papers: Negotiated in 2001 with Murdoch University, Western Australia for a series of nine post-graduate papers on Renewable Energy, Energy Policy, Energy Management and Climate Change to be offered under licence to New Zealand and international students enrolled at Massey University. Several new papers produced by Massey have since been added to the series.
- Produced a series of information leaflets on energy courses taught at Massey University.
- Developed the Sustainable Energy Systems paper (1992) and wrote and produced the study guide (1995) for the Massey University extramural version.
- Developed Renewable Energy Resource Engineering the more advanced, post-graduate paper and block course, in 1997.
- Developed course material under contract to Murdoch University, Perth for their new Bachelor of Renewable Energy degree (2000/2001). Material also used by University of New South Wales in their Bachelor of Solar Energy qualification.
- Managed since 1998 a series of well established Massey University qualifications on Energy Management including short courses for those working in industry.
- Produced in 1997 a series of 10 information leaflets for EECA (Energy Efficiency Conservation Authority) on: wind, solar thermal, PV, RAPS, biomass, tidal, wave and ocean currents, small hydro, biogas and landfill gas, woody biomass energy, energy crops.
- Organised, chaired and edited proceedings of the one day workshops, each attended by a wide range of 40 - 50 industry representatives, on:
 - Trees as carbon sinks. May 1995
 - Integrated land use planning. April 1994
 - Wind farming in New Zealand; potential and prospects. December 1992
 - Moving towards sustainable agriculture. June 1991
 - Renewable energy from woody biomass. May 1991

Recent professional activities

- Co-author and climate change analyst of International Energy Agency, World Energy Outlook, 2008. www.iea.org
- Co-author of International Energy Agency, Energy Technology Perspectives, 2008, www.iea.org
- Sweden's Energy Policies. Member, In-depth country review team, International Energy Agency/OECD Paris. 14-19 October, 2007. Report due for publication early 2008.
- IPCC Fourth Assessment Report, Working Group III – Mitigation. Summary for Policy Makers, Lead Authors meeting and government approval process, Bangkok, 27 April – 4 May 2007.
- Formal reviewer of many reports including: OECD Round Table on Sustainable Development “Energy technologies of the future” and Biofuels paper “Is the cure worse than the disease”; IEA “World Energy Outlook 2006”; IEA “World Energy Outlook 2007”; IEA “Energy Technology Perspectives 2006”; Danish Risø Energy Research Annual Report, 2006; Norwegian Energy Research applications; IISD reports on Biofuels.
- NZ representative at the IEA Renewable Energy Working Party meetings (unofficial whilst based at the IEA). Detailed meeting reports provided to Ministry of Economic Development.
- Chair, IEA selection committee of the Operating Agent for the Renewable Energy Technology Deployment Implementing Agreement

- February 27/28, 2007, IEA delegate, Global Bioenergy Partnership, Technology committee, United Nations, New York.
- Expert witness at Resource Consent hearings for wind farms (Meridian Energy, Palmerston North City Council, Trust Power, Windflow Technologies); hydro power (Meridian Energy); and opposing Marsden B coal-fired power station (Greenpeace).
- Facilitator, Panel discussion, “Biomass, Food or Fodder – best land use and tariffs,” 6th Bioenergy Australia 2006 Conference, 5-8 December, Perth, Western Australia.
- President’s Energy Panel member, Royal Society of New Zealand.
- Master of Ceremonies, EECA Energy Wise Rally Luncheon, Parliament Buildings, Wellington, 7 November, 2006. [and competitor in the Volkswagen team]
- Rapporteur, Policy status, innovative instruments and trends, Renewable energy heating and cooling IEA Seminar, 5 April 2006, International Energy Agency, Paris.
http://www.iea.org/Textbase/work/workshopdetail.asp?WS_ID=243
- Organiser and presenter of the World Renewable Energy Trophy jointly with Iceland at the World Renewable Energy Congress, Firenze. August 2006. (Winner – Cyprus).

Professional activities

- Sweden’s Energy Policies. Member, In-depth country review team, International Energy Agency/OECD Paris. 14-19 October, 2007. Report due for publication early 2008.
- Appointed to Focus group of IPCC Special Report on Renewable Energy – and NZ representative at discussion meeting.
- IPCC Fourth Assessment Report, Working Group III – Mitigation. Summary for Policy Makers, Lead Authors meeting and government approval process, Bangkok, 27 April – 4 May 2007.
- February 27/28, 2007, IEA delegate, Global Bioenergy Partnership, Technology committee, United Nations, New York.
- Sims R E H, 2006/07. Formal reviewer of several major publications including: IEA World Energy Outlook, 2006; IEA World Energy Outlook 2007; IEA Energy Technology Perspectives, 2006 all at www.iea.org. International Energy Agency, Paris IEA/OECD.
- NZ representative at the IEA Renewable Energy Working Party meetings (unofficial whilst based at the IEA). Detailed meeting reports provided to Ministry of Economic Development.
- Chair, IEA selection committee of the Operating Agent for the Renewable Energy Technology Deployment Implementing Agreement
- Expert witness at Resource Consent hearings for wind farms (Meridian Energy, Palmerston North City Council, Trust Power, Windflow Technologies); hydro power (Meridian Energy); and opposing Marsden B coal-fired power station (Greenpeace).
- Facilitator, Panel discussion, “Biomass, Food or Fodder – best land use and tariffs,” 6th Bioenergy Australia 2006 Conference, 5-8 December, Perth, Western Australia.
- President’s Energy Panel member, Royal Society of New Zealand.
- Master of Ceremonies, EECA Energy Wise Rally Luncheon, Parliament Buildings, Wellington, 7 November, 2006. [and competitor in the Volkswagen team]
- Organiser and presenter of the World Renewable Energy Trophy jointly with Iceland at the World Renewable Energy Congress, Firenze. August 2006. (Winner – Cyprus).
- Reviewed “Do we have the right R&D priorities and programmes to support the energy technologies of the future?” Paper by Richard Doornbosch and Simon Upton for OECD Round Table on Sustainable Development, Paris 14-15 June, 2006

Research and Extension Outputs

Numerous books, refereed scientific journal papers, contributions to books, refereed conference papers, research/technical publications

Annexure 2: Summary of possible climate change impacts in New Zealand – based on Climate Change Office information

Issue	Main Points
Electricity Supply	<p>Higher summer temperatures will increase the peak power demand for summer cooling and warmer winter temperatures will reduce the peak for winter heating.</p> <p>Reduced winter precipitation may reduce the mountain snow pack and affect hydro-power systems in the South Island that rely on snow melt in the spring.</p> <p>Lower rainfall could lead to more “dry year” events and could also affect run-of-river hydro-power systems in the North Island.</p> <p>If westerly winds strengthen as predicted more power will result from most existing and planned wind farms.</p>
Flooding	<p>More frequent intense rainfalls are expected to increase the likelihood of flooding by rivers, damage to crops, as well as flash flooding when urban drainage systems become overwhelmed.</p>
Water resources	<p>Water demand is expected to be heightened during hot, dry summers.</p> <p>Longer summers with higher temperatures and lower rainfall will reduce soil moisture and the chances to replenish groundwater supplies.</p> <p>River flows are likely to be lower in summer and higher in winter.</p> <p>Lower river flows in summer will raise water temperatures, make it more difficult to cool thermal power stations which may have to temporarily shut down, and aggravate water quality problems.</p>
Agriculture	<p>Redistribution of species and the appearance of new pests and diseases will affect horticulture, pastoral farming, and crop production.</p> <p>Flooding will occur in some regions and water shortages in others.</p> <p>Possible loss of production and revenue (for example loss of fruit from unseasonable winds/frosts in Hawkes Bay and a loss of lambs from unseasonable snows).</p>
Health	<p>Possible higher levels of human mortality relating to increased summer heat may result.</p> <p>Higher winter temperatures are likely to lead to a reduction in winter-related mortality and illnesses such as colds and flu.</p> <p>New diseases such as dengue fever will spread to New Zealand over</p>

	time.
Biodiversity	<p>Warmer weather would favour conditions for increased competition from exotic species as well as the spread of disease and pests, affecting both fauna and flora.</p> <p>Increased summer drought will cause stress to dry lowland forests.</p> <p>Earlier springs and longer frost-free seasons could affect the timing of bird egg-laying, as well as the emergence, first flowering and health of leafing and flowering plants.</p>
Built Environment	<p>Increased temperatures will reduce comfort of occupants in domestic, commercial and public buildings, and could lead to the disruption of business and schools.</p>
Transport	<p>Hotter summers may damage elements of transport infrastructure, causing buckled railway lines and rutted roads, with associated disruption and repair costs.</p> <p>Airport closures and ferry cancellations may also become more common if affected by extreme weather events.</p>
Business & Finance	<p>Lower income households may find it more difficult to access adequate insurance cover in the face of increased flood risk. New Zealand insurance companies are starting to closely question the risks of climate change-related claims following several extreme weather events in the past few years. Some properties along the River Thames in the United Kingdom have even had their cover withdrawn due to perceived higher risks of flooding. Following the 2007 Northland floods the Insurance Council Chief Executive Chris Ryan stated that individual properties and communities proven to be more prone to natural disasters such as floods would be targeted for higher premiums rather than national premium increases.³⁷</p> <p>Fruit and vegetable growers may find it more expensive to insure against weather related damage such as hail.</p> <p>The risk management of potential climate change impacts may provide significant opportunities for business.</p>

³⁷ "Insurers Count Cost of Winter" Dominion Post, 16 July 2007, p A1.