NIWA
Taihoro Nukurangi

Climate-Energy Matters

a quarterly newsletter from the National Centre for Climate-Energy Solutions

The Climate–Energy Challenge

Welcome to the first issue of *Climate–Energy Matters*, the quarterly newsletter of NIWA's new Centre for Climate–Energy Solutions. The Centre has been established to help create new economic, social, and environmental opportunities for New Zealand by finding national, regional, and local solutions to issues associated with climate change and energy reform.

While most public attention to date has focused on climate change, there is a growing realisation that two of the world's dominant sources of energy supply, oil and gas, will become increasingly restricted during the century ahead. Hence, unless more oil and gas are found, most countries will have to reduce their dependency on these energy sources, even if global warming does not turn out to be as threatening as currently thought.

The fact that the globe is warming, and that this warming is largely attributable to greenhouse gas emissions emanating from human activities, means that the world can not keep meeting its demands for energy with fossil fuels.

It is not surprising therefore that choices about, and investments in, energy over the years immediately ahead will have a dramatic effect on our economic well-being, environmental sustainability, and international relations for much of the 21st century.

Providing the energy to maintain and expand global economic prosperity without undermining the environmental foundations of well-being forms the heart of what I like to call the "Climate–Energy Challenge". I use the word "challenge" because there are solutions. The word also implies competition, and there is no doubt in my mind that those countries which meet this challenge well will be the big winners in the century ahead.

It is important therefore that we get moving. Our new Centre for Climate–Energy Solutions will provide a focal point for collaborative research, services, and information which will help individuals, businesses, organisations, and Government agencies:

- monitor and reduce emissions of greenhouse gases;
- ensure national greenhouse gas inventories are well formulated and defensible;
- increase understanding of the human dimensions of climate change and energy reform;
- make better use of energy sources emanating from, and imported into, New Zealand;
- foster the development and use of new and emerging emission reduction and energy technologies;
- develop optimal response strategies based on climate, emission, and energy opportunities;
- mitigate undesirable environmental and human health effects associated with energy use and climate change;
- identify and develop business opportunities, both nationally and internationally, associated with climate change and energy reform.

In addition to this newsletter, the Centre will also be establishing a website and fronting a public lecture series.

I hope you find the Centre valuable and, when possible, contribute to it. We look forward to working with you to make a better New Zealand.

Dr Rick Pridmore, NIWA
Deputy Chief Executive (Strategic Development)

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How do motor vehicle emissions affect our cities?

Motor vehicles have long been acknowledged as a major source of air pollution worldwide. In New Zealand, our experience has been no different. Air quality impacts have been highlighted as key issues in central Government investigations, such as the Land Transport Pricing Study and the Vehicle Fleet Emissions Control Strategy. Increasingly, however, the focus is broadening to other pathways in which transport adversely affects the environment. Vehicles are major contributors of greenhouse gas emissions. Cars and trucks also deposit emissions on and around roadways, some of which end up in road run-off which affects life in urban aquatic and estuarine environments.

NIWA is directly involved in studies of urban air pollution and in developing tools to aid both central Government and local authorities in their efforts to generate effective environmental policy to better manage vehicle emissions. Recent research shows that some 250 people over the age of 30 die prematurely each year in Auckland through exposure to vehicle emissions alone. Traffic delays in Auckland also have a substantial negative effect on the economy. We will be sharing the results in future issues of *Climate–Energy Matters* and will provide details of the effects motor vehicle emissions are currently having on New Zealand cities.

Dr Gerda Kuschel (g.kuschel@niwa.co.nz)

Alternative energy supply

One of the keys to New Zealand diversifying its energy supply mix and moving to a sustainable supply will be applying new technological developments to wave, wind, or small hydroelectricity generating schemes. We have really only just begun the challenge to harness the energy in our winds and waves. Although wind generators are becoming a feature of our landscape, wave generation has not taken off. Yet there is substantial interest in wave power both locally and worldwide, and there are systems under trial in North America and Europe.

How much wave energy is out there? NIWA's research indicates a resource exceeding 20 kW per metre of wave front around much of our coastline. This suggests that an 11 km length of coastline is impacted on average by as much wave energy as that produced by the Benmore hydroelectric power station. Offshore, the resource is much greater, but much less accessible. NIWA's measurements are supported by a 20-year study which simulates wave conditions for the entire coastline, and we have identified the most likely sites for future exploitation. There are real opportunities for New Zealand here.

Wind and wave generators are seen as part of local energy solutions which may be integrated with other forms of generation. Over the next 2 years NIWA will be working with energy suppliers and wave technologists to identify suitable sites for wave power generation and trial new wave-power generators.

Dr Andrew Laing (a.laing@niwa.co.nz)

Greenhouse gas emissions

NIWA has considerable experience and expertise in quantifying New Zealand's greenhouse gas emissions. In particular, we have been measuring methane emitted (belched) by farmed livestock – New Zealand's single biggest greenhouse gas source – since 1995 in a joint collaboration with AgResearch. This ongoing research aims to more precisely estimate the national annual livestock emissions and to help develop strategies to reduce them.

As methane is an unburned hydrocarbon, its production and release by livestock represents a loss of energy that might otherwise be converted to animal product. The loss comprises about 5–10% of the animal's gross energy intake, or about 6–12% of its metabolised energy. Thus, both the farmer and the environment would benefit from a reduction in emission. A typical dairy cow belches about 0.3 kg of methane each day, enough to power a car equipped to run on compressed natural gas for about 5 km. NIWA's current research focus includes developing new technologies to verify greenhouse gas emissions at source and being involved in new satellite experiments to quantify emissions at the country-to-country scale.

Dr Keith Lassey (k.lassey@niwa.co.nz)

Climate change – how science and policy interact

Climate change will provide one of the most complex scientific, social, and political challenges of the 21st century. Addressing this challenge has already led to the establishment of new processes and structures within science and policy communities, and to a recognition that science must remain separate from policy.

This distinction is clear in the work of the Intergovernmental Panel on Climate Change, which provides regular assessments of scientific information for policymakers, but plays no other role in the policy process. NIWA adheres strictly to this distinction between science and policy on all environmental issues. It is not the business of scientists to argue for or against ratification of the Kyoto Protocol. In fact, one should be suspicious of any scientists who take such a stance. However, it is the business of scientists to make sure that all stakeholders in policy decisions have equal access to all the relevant scientific information we can provide.

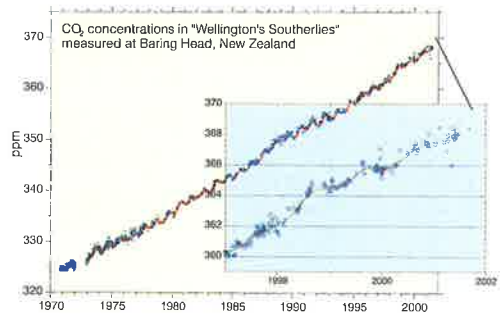
As New Zealand considers its response to the Kyoto Protocol, equity in access to scientific information and its accuracy take on special importance. NIWA's climate scientists spend a great deal of time preparing and presenting summaries of climate change issues to stakeholder groups. In doing so, it has become apparent that not everyone has the same level of awareness of the science behind climate change, the potential effects of climate change, and the range of adaptation and mitigation options.

An important aim of *Climate–Energy Matters* will be to address such information gaps and foster approaches to climate change issues which are analytical and objective. We will provide plain language answers to some of the questions that we encounter frequently, such as: How are different greenhouse gases compared? Why does an apparently natural process such as pastoral agriculture have an effect on climate? and How do New Zealand's current and projected emissions stack up against those of other developed countries?

Policy decisions require an understanding of our options for reducing greenhouse gas emissions as well as the implications of doing nothing. New Zealand's mix of greenhouse gas emissions is unique among developed countries with relatively high non-CO_2 emissions and potentially large forest carbon credits. We also have significant renewable energy resources both established (hydro, geothermal) and potential (wind, wave, biofuels). At the same time, we have an energy-intensive economy, are dependent on transport due to geographic factors beyond our control, and import much of the energy-related technology that we rely on.

The complexity of climate change issues makes it difficult for a small country with limited research capacity to produce a detailed response strategy quickly. New Zealand lags behind most developed countries in analysis of the socio-economic implications both of adaptation and mitigation options. However, the National Centre for Climate–Energy Solutions will bring a new focus among researchers to deal with this situation. NIWA does not have the breadth of expertise to address all the necessary areas, so we will invite experts from collaborating organisations to contribute to this newsletter in areas such as agricultural science, forestry, land use, economics, and social sciences. In all areas we intend to provide relevant information and analysis in a policy-neutral way.

Dr Martin Manning



Martin Manning

Martin Manning is one of New Zealand's leading experts on the atmosphere. After graduating from Victoria University and completing his doctorate in Canada, Martin has led and developed New Zealand's carbon dioxide measurement programme over the last 30 years. It is now the most significant record in the Southern Hemisphere and is proving vital in assessing changes in greenhouse gases. Martin is a member of the Bureau of the Intergovernmental Panel for Climate Change (IPCC) and will be providing his specialist advice on greenhouse gas emissions to the new Centre for Climate–Energy Solutions.

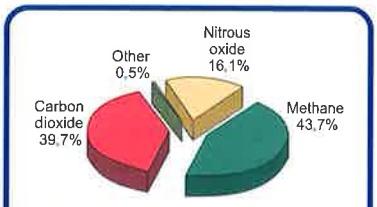
If we do have carbon trading, what will a unit cost?

There are hugely complex social, political, and economic factors behind ratification of the Kyoto Protocol. There is also little information on just what the costs might be to the nation or to individuals.

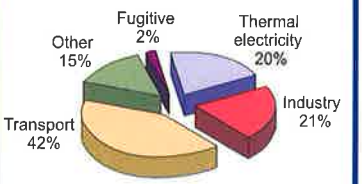
New Zealand's greenhouse gas emissions are not large in global terms (0.2% of international emissions), but they have an unusual mix. Unusually high portions of our total greenhouse gas emissions are due to methane and nitrous oxide. These emissions are a consequence of our pastoral-based economy: the main source of methane is ruminants (sheep and cows), the main source of nitrous oxide is animal urea and nitrogen fertilisers.

How do we value discharges?

As we move to an emission target, we need accurate information on the current emissions, and there is a strong case for having a value put on these emissions. The World Business Council for Sustainable Development argues that we don't protect what we don't value, and high levels of waste and emissions are signs of poor technology, low efficiency, and bad use of resources. So, various forms of economic instruments, such as carbon taxing or trading, will need to be implemented.



New Zealand's greenhouse gas emissions



New Zealand's carbon dioxide emissions by sector

The "value" of 1 t of CO_2 has been estimated at anything between US$0.15 and US$100 (NZ$0.35 to NZ$240), and the current best estimate assessed informally by New Zealand Government officials is NZ$30. Whatever value is finally established, the important point is that it is a defined value; that way it can be incorporated into investment decisions.

Even at NZ$15 a tonne, emissions of CO_2 in New Zealand (more than 32 million tonnes annually) translate into a "value" of $480 million; and nitrous oxide and methane emissions are greater.

Power generation in south Auckland

What is the scale of emissions?

A large discharger, such as a 400 MW plant generating electricity by burning natural gas, might emit 1 Mt of CO_2 each year, at a value of NZ$15 million. These dischargers will generally have good information on processes and on fuel use and in most cases will have emission monitoring systems. At the other end of the scale are the small dischargers like motor vehicles. A 2 litre sedan travelling 10 000 km per year and using a litre of petrol per 11 km will emit 2.1 t of CO_2 each year, at a value of NZ$31.5. But New Zealander's own a lot of cars (more than 3 million), and the total value of discharges from them is a staggering NZ$87 million.

How might we offset emissions?

The two main options are the "Clean Development Mechanism" (which we discuss in a future issue) and sequestration, particularly through trees – the so-called "Kyoto forests".

New Zealand has a lot of trees, we can plant a lot more, and they grow fast. The Forest Research Institute estimates that the average CO_2 uptake by 30-year-rotation *Pinus radiata* (our most commonly planted exotic species) is about 26 tonnes per hectare per year. We would need to plant a new forest of 1.2 million hectares to account for our total CO_2 emissions of 32 Mt per year, and this would last for only 25 years or so, while the forest is growing. We would then need another 1.2 million hectares.

This is clearly a useful sink, and if widely adopted could delay the rise of CO_2 in the atmosphere, but it is a one-off effect. The only real way to reduce greenhouse gas levels is to reduce emissions. There is a more subtle economic concern within the New Zealand forestry industry. If any significant value were placed on forests through a carbon trading regime, this would skew the global market. It would become attractive for other countries to plant trees, the global supply of forest products would grow, and the market for our products would suffer.

Where to from here?

The world is moving into a phase with international agreements on reducing greenhouse gas emissions. They will be some of the most significant treaties ever signed by New Zealand, with far-reaching implications. The costs and benefits of any one measure will need to be carefully appraised by governments, industries, and individuals. Future issues of *Climate–Energy Matters* will present the sort of information needed as a basis for these business and planning decisions.

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Climate–Energy Matters is a quarterly newsletter from NIWA's National Centre for Climate–Energy Solutions.
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