CONFERENCE PAPER

No. 106 (2002)

Climate Change Mitigation & Adaptation Tools for Homes & Offices in New Zealand

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Presented at the Sustainable Building 2002 Conference,
Oslo, 23-25 September 2002.

This research was funded by the Foundation for Research, Science and Technology from the Research for Industry Fund and the Centre for Research, Evaluation and Social Assessment.

ISSN: 0111-7505

Climate Change Mitigation & Adaptation Tools for Homes & Offices in New Zealand

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1. INTRODUCTION

Since 1997, BRANZ has researched both the direct and indirect implications of climate change on homes and offices for the building industry in New Zealand. This involved studies into both the technical and social aspects of climate change and resulted in a number of technology transfer activities, e.g. reports, articles, seminars and other presentations. Concurrent with these activities was the need to provide easy-to-use information that demonstrated *practical solutions for individuals* to reduce both personal greenhouse gas emissions in, and to prepare for the impacts of climate change on, their homes and businesses.

Two paper-based publications were developed to achieve this; one focussing on mitigation based on the concept of 'Becoming a Climate-Friendly Citizen', the other focussing on adaptation called 'Coping with Climate Change'. The key objectives were to encourage individuals to think about the connections between their actions and impacts on the climate, and enable people to take action to prepare for the likely impacts. This paper discusses the background of the issue from New Zealand's perspective, describes the development and content of these two tools, along with their future directions.

2. CLIMATE CHANGE AND NEW ZEALAND

The climate is in a constant state of change. We know that Earth's climate has naturally varied over the past thousand years, and for millennia before that, for a variety of reasons (MfE, 1997). Climate change itself is not the concern; it is the current rate of change and the causative factors that are creating threats and opportunities for all communities around the world. Strong evidence from the scientific community is stating that the relatively rapid climate changes observed over the past hundred years are at least in part due to increasing greenhouse gas levels in the atmosphere[1]. Indeed most of the warming observed over the last 50 years is attributable to human activities, in particular, the burning of fossil fuels (IPCC, 2001).

New Zealand is experiencing changes consistent with global warming trends. In the last 50-100 years we have already warmed, on average, 0.7°C, the sea has risen 10-25 cm, and our glaciers are 40% shorter and cover 25% less area. In addition, there have been changes in rainfall averages and extremes, with shorter period rainfall fluctuations due to the counteracting, or reinforcing effects of the El Nino Southern Oscillation, and the Interdecadal

[1] Greenhouse gases include carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, perflurocarbons, and hydroflurocarbons.

Pacific Oscillation. (J. Salinger; cited in Wratt, 2002). Projections for New Zealand to the year 2080 include:

- Changes in average rainfall patterns, with very heavy rain more frequent;
- A 1°C to 2°C temperature increase;
- Fewer frosts;
- Sea level rise of 30-50 cm;
- UV and net solar radiation changes;
- Enhanced westerlies;
- Potentially more tropical cyclones; and
- Snow line rise and glacier shrinkage

(B. Mullan, cited in Wratt, 2002; Camilleri, 2000).

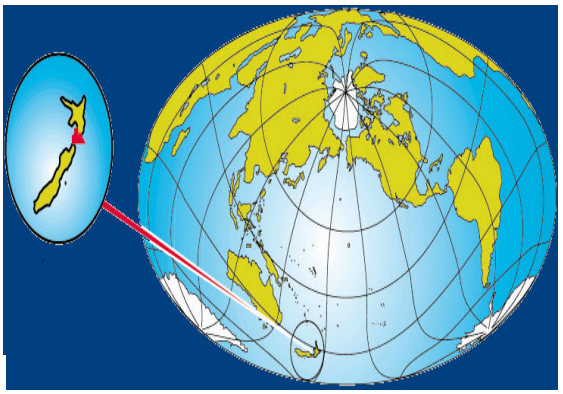

Figure 1. New Zealand in relation to the rest of the world

Within these projections there are regional variations. For example, the West of the country will become wetter, the East drier (Wratt, 2002), and temperatures in the North Island will increase faster than in the South Island (Kenny, 2002). For the built environment, the most significant risk is related to an increased incidence of heavy rainfall events and subsequent flooding (Minnery and Smith, 1996; cited in Camilleri 2000). How is New Zealand's built environment positioned to minimise these future climatic risks?

3. NEW ZEALAND'S BUILT ENVIRONMENT

New Zealand's population is around 3.8 million people (Statistics NZ, 2002). We live in about 1.3 million dwellings and work in around 67,000 commercial buildings (Page, 2002; Quotable Value, 2000). 85% of New Zealanders live in urban or suburban environments – one of the highest rates of urbanism in the world (PCE, 1998). Because the tools under discussion in this paper were developed with New Zealand's homes and offices in mind, an understanding of what an average home or office consists of, and how it may or may not cope with future climate risks, is of particular interest.

3.1 The Average House

1.3 million dwellings in a land area of 27 million hectares means that New Zealand's urban pattern is one of low density with relatively large geographical spread. Despite this spread and regional variations in climate across New Zealand, the housing stock is relatively similar in style and design (Saville-Smith, 1998). The average age of the housing stock (using 1999 figures) is 30-40 years, with an average floor area of 140m^2 (Clark et al, 2000). Most houses are detached and constructed with timber framing and weatherboard cladding.

The majority of New Zealand houses are not designed to deal with extremes of cold or heat (Saville-Smith, 1998), are rarely air-conditioned, and are only marginally heated (Camilleri and Jaques, 2001). For instance, a typical New Zealand house is only heated in the mornings and evenings often in a poorly controlled manner (Stoecklein et al, 2001). Furthermore, New Zealand homeowners do not appear to be strongly aware of ways to protect their houses from environmental risk, or how to reduce their environmental impacts in general (Saville-Smith, 2000).

3.2 The Average Office

Offices are commonly built of concrete and steel with a trend towards lower rise buildings (97% being less than or equal to three storeys), and floor areas of more than 300 m^2. In terms of office space requirements, the average area has decreased from about 34 m^2/person in 1988 to 18 m^2/person in 1998 (Bayleys Research, 1999; cited in Jaques et al, 2000). For new offices that are less than 300 m^2, mandatory thermal envelope requirements (the same as for housing) are required. Recent New Zealand Building Code (NZBC) revisions now require similar energy performance requirements for larger commercial buildings (Stoecklein, 2002).

Only 12% of office buildings have air-conditioning but most are heated (Royds Garden, 1992; cited in Camilleri and Jaques, 2001). In general terms, it is not known how New Zealand's offices will cope with climate change. There is research which summarises potential changes in comfort levels with buildings that are air-conditioned compared to those that area not (Camilleri and Jaques, 2001). But what is clear is that if a particular building does cope well, it will be by accident rather by intent (Saville-Smith, 2000). It would appear therefore, that both homes and offices in New Zealand are some way from being climatically responsive.

4. NEW ZEALAND'S POLITICAL CONTEXT

In global terms, New Zealand's greenhouse gas emissions are small. The economy is largely reliant on primary production and hence has much to lose (and gain) with climate change (MfE, 2001). The New Zealand Government has signalled its intention to ratify the Kyoto Protocol in September 2002. At the time this paper was written the preferred policy mechanisms to meet out obligations under the Protocol had yet to be released. However, it is reasonably clear from the supporting documentation and Government Strategies[2] released to date that there is a strong focus on mitigatory measures, particularly energy efficiency, to meet New Zealand's targets.

Whilst the focus on mitigation is important, equally important is clear, consistent advice on adaptation strategies. This is because even if all CO_2 emissions stopped today, New Zealand and the rest of the world will continue to have the effects of climate change to deal with for at least the next 100 years. Under the NZBC, buildings are designed and built to last 50 years (unless nominated a lesser life), with many buildings lasting up to 80-120 years or more. Future climatic risks must therefore be taken into account now as buildings built today will potentially still be functioning in 2100. The Government policies released to date do not provide adaptatory advice for built environments. The burden lies with the owners of buildings and associated infrastructure.

But as eluded to above, typical homes and offices in New Zealand are largely unprepared for climate change in general, or how to mitigate for, or adapt to, the likely impacts. The remainder of this paper describes two ways in which BRANZ has attempted to provide support and advice to the New Zealand building industry in this regard.

5. THE MITIGATION TOOL

The mitigation tool, based on the concept of *'Becoming a Climate-Friendly Citizen'* is a paper-based publication focussing on greenhouse gas reduction measures for homes and small- to medium-sized offices. In addition to providing a whole range of practical tips to

[2] Government Strategies released to date, which have greenhouse gas emissions reductions as a secondary goal, include the Energy Efficiency and Conservation Strategy (www.eeca.govt.nz), the Waste Minimisation Strategy (www.mfe.govt.nz), and the Land Transport Strategy (www.transport.govt.nz).

reduce greenhouse emissions, it includes a New Zealand-specific 'carbon calculator' so readers can work out their emissions on a monthly or yearly basis. The calculator was included as a 'measure to manage' instrument, based on the premise that you can't manage (or reduce) your emissions if you don't know what they are. Because the calculator is paper-based and thus highly simplistic, it only focuses on CO_2 emissions from energy, heating and transportation for homes, with paper use added for the office section.

The main objective is to support opportunities for the New Zealand public to actually do something about climate change in the areas where they spent the most of their time – at home and at work. The main output is a user-friendly, fully illustrated colour booklet. The reader is taken through what climate change is all about, and how it relates to them. It describes greenhouse gases and where they come from. From here the focus shifts to the emissions that the individual is directly responsible for, namely energy use.

Following this, the remainder of the booklet is dedicated to taking action to reduce emissions. For electricity use, tips are provided for lighting, appliances, water heating, insulation and windows. Tips are also provided for transport, reducing paper use and other recycling opportunities. To satisfy those readers who want to 'cut to the chase', a 'Quick Tips' section is provided along with lists of relevant web page links to further sources of information and web-based carbon calculators. The booklet is part of BRANZ's 'Easy Guide' series of publications and will be available for downloading from the BRANZ website in due course (see www.branz.co.nz under 'resources'). In summary, this tool is a timely publication that provides easy-to-use, practical information for individuals on how to reduce their greenhouse gas emissions on a day-to-day basis.

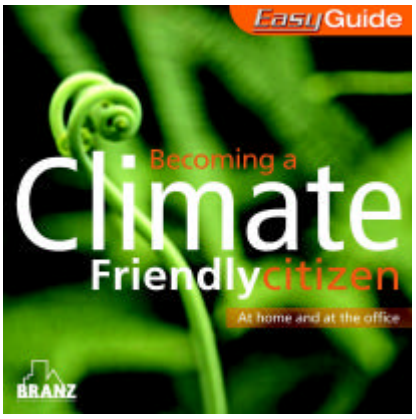

Figure 2. Front cover of the BRANZ mitigation tool

6. THE ADAPTATION TOOL

While mitigation refers to measures taken to reduce greenhouse gas emissions, adaptation refers to actions taken to minimise threats or risks and to maximise opportunities arising from the effects of climate change (Kenny, 2002). The *Coping with Climate Change* Bulletin (Hargreaves, 2001) is an adaptation tool produced by BRANZ that offers practical advice to the building industry, government and building owners for preparing for the challenges of climate change – both now and in the future.

BRANZ's Bulletins are a publication series that contain easily readable 'good practice' guidelines on a wide range of topics related to building and building performance. They are concise A4 sized, fold-out brochures with moderate technical focus. This particular Bulletin details the climate changes that are likely for New Zealand's built environment and what can

be done by the building industry. More precisely, it describes specific actions that home and office owners can take to future-proof their buildings against potentially more severe climatic events.

Before providing examples of what these actions are, the Bulletin quantifies some of the direct effects of climate change of interest to the New Zealand building industry. Of these, the most important effect is that any building with an existing flood risk may flood up to four times more often than before, and there may be increases in building damage from coastal flooding, erosion and rising water tables. In addition, there is a possibility that tropical cyclone activity could increase, increasing the likelihood and intensity of severe weather, primarily in the North Island.

After setting the scene, the Bulletin goes on to describe ways of dealing with these effects. Measures to future-proof for flood damage includes advice on building site location, building design including componentry, and references on how to recover after a flood event. For the increased risk of tropical cyclones, the Bulletin outlines actions to increase structural strength of buildings and pays attention to weathertightness. The advice covers what can be done in terms of both new and existing buildings, and consistent throughout is the need to consult with building professionals where appropriate. In summary, this tool, a first in New Zealand, offers people the means to respond to climate change in accordance with their circumstances.

Figure 3. Front cover of the BRANZ adaptation tool

7. SUMMARY & FUTURE DIRECTIONS

New Zealand is a small island nation in the South Pacific with much to lose (and gain) from climate change. It would appear that, in general, New Zealand's built environment is currently not well placed to minimise the identified risks or maximise benefits. The Government has indicated its intention to ratify the Kyoto Protocol in time for the World Summit on Sustainable Development in September this year. This sends a clear sign that climate change is an important issue for the New Zealand building industry to focus on.

As buildings have a relatively long life with slow turnover, tools that give specific advice on how to mitigate for, and adapt to, the predicted climate change impacts are both timely and relevant. Two such tools, one each on mitigation and adaptation, have been described. They aim to assist the public to reduce their greenhouse emissions at home and at the office, and to begin to prepare these buildings against future impacts.

While both tools are simple paper-based publications at present, possible future directions include the development of the carbon calculator in the mitigation tool for a web-based programme for enhanced ease of use and increased sophistication, e.g. under 'kilometres travelled by car', the type of car, number of passengers, type of fuel, etc could be included. There is also potential for a 'schools' version to be produced. The predictions and practical tips of the adaptation tool will need to be periodically revised as certainty in climate change scenarios and government policies evolve, and as new technologies emerge to help the adaptatory process. The same goes for the tips in the mitigation tool.

Whatever the final directions, the aim of these tools whether focussed on mitigation and/or adaptation, is to demonstrate practical solutions for the building industry so that New Zealand's built environment is climatically responsive in the years to come.

8. ACKNOWLEDGEMENTS

This work was funded by the Building Research Levy, and the Foundation for Research, Science and Technology from the Research for Industry Fund.

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