WCC Long Term Council Community Plan:
Oil Price and Climate Change Challenges and Opportunities

Report prepared for Wellington City Council by

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EXECUTIVE SUMMARY

This report undertakes a summary of the challenges and opportunities associated with oil prices and climate change. In particular the report:

- Maps out the **threats and challenges** posed to the achievement of the strategic outcomes set out in Wellington City Council's current long term council community plan (LTCCP) by the advent of climate change and reduced availability of/access to oil.
- Comments on the need to **reprioritise actions** between and within strategic outcomes in the light of the potential impacts of climate change and reduced availability of/access to oil on the community and the additional or different demands this might place on Council services
- Explores the **opportunities** created by (the response to) climate change and reduced availability of/access to oil for the City Council to facilitate the development of a more sustainable city.

Oil Price

International oil prices are on an upward trajectory and are likely to remain so for the foreseeable future. This is likely to generate shifts in the demand for certain services and have an impact on economic activity in Wellington. The consumer cash flow available for non-essential goods and services is likely to contract to some extent due to the inelasticity in demand for goods and services linked to petroleum and petroleum products.

The causes of sustained increases in oil price are likely to include physical constraints on oil production as a consequence of oil discovery, and production dynamics, as well as political instability in key international oil supply regions.

It is well worth planning for a future where high oil prices are considered to be the norm. Such planning may include infrastructure investments in transport systems capable of operating with relatively low petroleum demand (including off-road freight options such as rail and sea), and a more comprehensive public transport system.

Urban design and planning may benefit from considering international best practice in mass transit systems and transit orientated design principles. The need for investment in mass transport systems is linked to the likely reduction in demand for private motor vehicle use.

Developing the details of such a plan are beyond the scope of this report, but it is recommended that WCC develop a strategic energy security plan to identify key oil price risks and planning responses associated with the seven themes in the Long Term Community Council Plan.

Climate Change Adaptation

Planning priorities for climate change adaptation have been gathered from national and local climate change impacts, adaptation and vulnerability assessments. They form the basis of a proposed Wellington Climate Change Adaptation Plan running on a decadal cycle of planning, implementation and evaluation.

Key priorities for adaptation risk assessment and planning include: An increased threat to lifelines and services coming from more frequent heavy rainfall events and associated floods; Increased drought risk particularly in the east of the Wellington region; Sea level rise making groundwater aquifers near the coastline vulnerable to saltwater intrusion; Changes in temperature and rainfall regimes brought about by climate change causing problems for plant and animal pest eradication programs.

Climate Change Mitigation

Several opportunities are identified for WCC to support the development of a voluntary carbon market as part of a WCC and Wellington city community carbon neutrality strategy.

The compliance carbon market will provide little scope for engaging WCC, SMEs, households and individuals in emission reduction activities because the compliance carbon market is structurally designed (at an international level) to deliver a different goal to carbon neutrality and emission reduction opportunities to those without a binding emission reduction obligation.

The voluntary carbon market on the other hand, provides an emission trading framework upon which to deliver a carbon neutrality program. In line with existing WCC documents it is recommended that WCC focus initial attention on carbon neutrality for WCC operations, and then support voluntary behaviour change through support for a voluntary carbon market mechanism.

WCC has the opportunity to use its green space as part of a net carbon accounting approach to its carbon neutrality efforts, and is able to use pre-1990 and post-1990 forests as internal carbon offsets in the calculation of its net operational carbon footprint.

WCC has the opportunity to potentially support the future development of a local grade of voluntary carbon unit following the initial development of a NZ voluntary carbon standard that will form the foundation of the NZ voluntary carbon market. WCC also has the opportunity to become a champion of the NZ voluntary carbon market.

INTRODUCTION

2008 has been characterized by a series of global resource trends that are significantly influencing national and local economies. The keystone issues that feature most prominently include food prices, oil prices, and climate change.

Rapidly rising grain prices are driving up the price of food globally, fuelling debates about the future direction of agricultural commodity prices and their impact on economies world wide. Oil prices have escalated at an unprecedented rate going from around US$100 a barrel at the beginning of 2008, to US$147 a barrel by mid July 2008[1]. Some experts project oil prices to reach US$200 a barrel by the end of 2008[2]. Meanwhile, the first commitment period of the Kyoto Protocol began on 1 January 2008 and with it the price of carbon entered the mainstream economy, whilst climate change impacts are accumulating (globally) at a faster rate than previously anticipated.

These three issues are interrelated, with the climate change impacts such as drought contributing to supply side shortages in food production. For example, the on-going drought in the Murray-Darling catchment is driving down Australia's grain production capacity (Australia being a leading grain exporter). The Australian Government's chief climate change adviser Ross Garnaut, warned in July 2008 that irrigated agricultural production in the Murray-Darling Basin would decline by 92% by 2100. At the same time oil prices also are contributing to increasing food production and distribution costs.

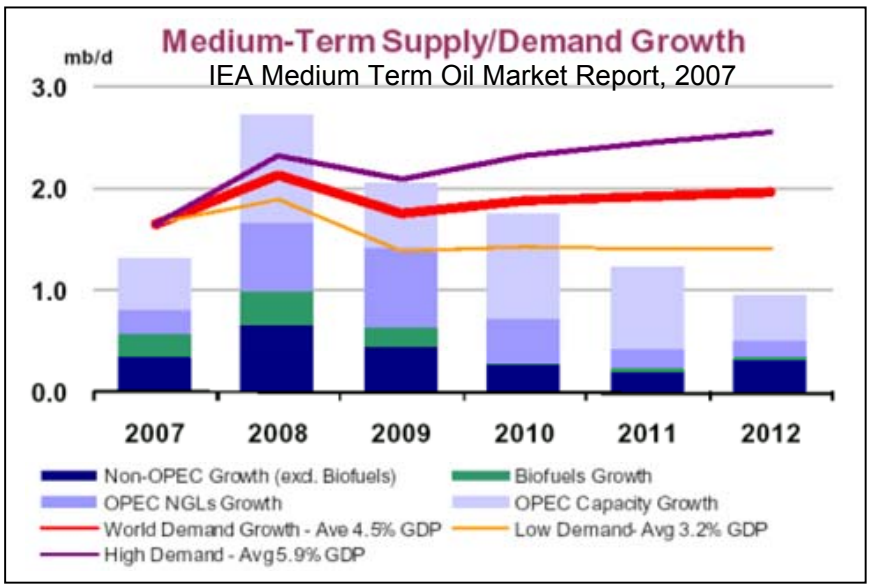
The challenge for the Wellington City Long Term Council Community Plan (LTCCP) is to understand the significance of these trends, and take sufficient account of these external forces in strategic planning in order to ensure a prosperous and sustainable future for the city and its inhabitants. These external factors are central to the well-being of the Wellington economy and community, which means that decisions capable of adequately responding to these challenges need to be located sufficiently upstream in the planning process to drive an effective strategic response.

OIL PRICE

The current rapid rise in oil prices has been forecast by different players globally for about a decade, with debate reaching new levels of intensity in the last two years. Publications such as Time Magazine, National Geographic, and the Economist have each released major feature articles and special editions converging on the notion that the age of cheap oil is over. An underlying driver of this analysis is the physical oil resource globally, its stage in the history of discovery and production, combined with the inelasticity of demand for petroleum as a fuel and a raw material (e.g. plastics), and the infrastructural commitments most countries have made during the 20th century for a petroleum-based economy.

[1] BBC News, "Oil hits new high on Iran fears", 11 July 2008 at http://news.bbc.co.uk/2/hi/business/7501939.stm
[2] BBC News, "Oil price 'may hit $200 a barrel'", 7 May 2008 at http://news.bbc.co.uk/2/hi/business/7387203.stm

The International Energy Agency Medium Term Oil Market Report (2007) signalled that even a low demand scenario for the coming years would have global oil supply failing to meet global demand by 2011.



> *"Despite four years of high oil prices, this report sees increasing market tightness beyond 2010, with OPEC spare capacity declining to minimal levels by 2012. A stronger demand outlook, together with project slippage and geopolitical problems has led to downward revisions of OPEC spare capacity…"* (IEA 2007 pg 5)[3].

This would produce a widening gap between supply (possibly associated with a production plateau), and demand (continuing to rise) thus generating a price gap that may continue to. The rise in demand globally is being driven by a rapid increase in energy intensity of rapidly industrialising developing country economies (particularly India and China) together with increases in energy demand associated with the uptake of electronics and appliances throughout the developed world.

The fact that oil is a stock resource means that at some stage supply must go into terminal decline (following a plateau phase) globally as it does for individual oil fields. Even though at peak production there is still several decades of geological supply, the changing supply-demand dynamic forces a continuing upward price trend. The inelasticity of demand for this commodity means that such price increases siphon cash flows from other parts of the economy to meet this demand.

This can have significant impacts on the money available to drive other parts of the economy with a steady decline in cash surpluses for Wellington businesses, consumers, and rate-payers. The consequences we can expect from continuing oil price rises in the

[3] Source or quote and figure: International Energy Agency Medium-Term Oil Market Report, 2007. Available at: http://omrpublic.iea.org/

coming decade include a number of trends – the steepness of which is difficult to foresee. These potential trends include, but are not restricted to:

- Price increases across several sectors (particularly food)
- Decline in growth in retail (particularly for non-essential products and amplified in lower socio-economic sectors)
- Decline in non-essential service demand (e.g. hospitality and tourism)
- Continued contraction of the housing market with implications for rate revenues and flow-on impacts on funds available for the provision of WCC services
- Increase in the cost of borrowing relating to the response of the banking sector to a decline in the capacity among borrowers to service interest payments on borrowed money
- Decline in economic growth with the usual flow-on effects
- On the other hand there is likely to be an increased demand for public transport services, localised retail services (within walking distance from communities), combined with a decline in private motor vehicle use.

All these possible impacts can be expected from a contraction in the economy as we (globally and locally) build a transition towards a lower reliance on petroleum energy. While there are alternatives to petroleum energy, few can compete with oil in terms of energy return on energy invested, and as such are less economically and energetically available as realistic alternatives for a rapid transition to other fuel sources.

Furthermore, many of our oil-based infrastructures are very expensive to develop and will take a long time to redesign and re-develop. For example, coal can be turned into liquid fuel and New Zealand has large coal resources, but building alternative fuel systems in the coming decades will necessitate significant R&D and infrastructural investments in the very near future if a smooth transition is to be logistically possible.

Any strategic initiatives in energy security in the face of steeply rising oil prices need to take adequate account of the international and domestic price of carbon. Therefore, the role of renewable energy, and local generation (where possible) is also central to any strategic planning for economic prosperity and sustainability.

These issues are at the forefront of national energy policy debate in this country, and are likely to drive local and national political debate for some time (intensifying in coming years). Fundamental to a prosperous and sustainable future for New Zealand in general and Wellington in particular is leadership in strategic energy policy and planning.

Developing the details of such a plan are beyond the scope of this report, but it is recommended that WCC develop a strategic energy security plan to identify key oil price risks associated with the seven themes in the Long Term Community Council Plan: urban development, transport, economic development, environment, cultural well-being, social and recreation, and governance. Because energy security and the influence of global oil price is a cross cutting issue, it is important that such a planning exercise identify risks, vulnerabilities, and adaptation/mitigation measures in an integrated fashion across the different planning sectors. This is particularly important for the ‘economic development’ theme given the way that energy forms such a keystone in any economic system.

CLIMATE CHANGE

One of the key drivers of demand for policy responses to the climate change challenge is built on what is now a broad consensus in the climate science community, together with recognition of this consensus in the global policy community, and the interests of a range of constituencies in civil society. This consensus is based on an understanding that:

1. Climate change in general is a natural feature of the global climate system and always has been,
2. Climate change is a function of the dynamic interrelationship between many components of the climate system (including greenhouse gas concentrations), and
3. If humans change any combination of those components we have the ability to influence the climate system.

The consensus can be boiled down to:

1. Climate change is currently happening
2. Humans are a significant causal factor
3. It poses a substantial threat to the economy and society
4. We will need to invest in strategies to cope with climate change (adaptation)
5. We can lower the scale of impacts by reducing greenhouse gas emissions (mitigation).

Policy makers need to have confidence in the information guiding their decisions. The source of confidence for this consensus is to be found in the peer-reviewed climate science literature. This literature is so vast that in 1988 the United Nations established a scientific review and advisory body on this topic: the Intergovernmental Panel on Climate Change (IPCC). Every 6 years the IPCC publishes an interdisciplinary scientific review and assessment that summarises the latest climate change research in three broad categories:

1. Scientific Basis (Working Group 1)
2. Impacts, Adaptation and Vulnerability (Working Group 2); and
3. Mitigation (Working Group 3).

The latest is the Fourth Assessment Report (AR4) published in 2007 - a summary by over 1,000 authors and expert reviewers, of over 10,000 peer-reviewed scientific studies. Many New Zealand scientists have contributed to the AR4 with some playing leading roles as Coordinating Lead Authors, and Lead Authors.

The following pages explore issues and planning options/priorities for addressing climate change adaptation and mitigation in Wellington. The adaptation section covers impacts and vulnerabilities from a global, national and then local perspective. It then explores adaptation planning priorities. The mitigation section focuses primarily on market mechanisms available to help implement a city wide carbon neutrality effort.

CLIMATE CHANGE ADAPTATION

Developing a strategic adaptive response to future climate change requires undertaking a risk assessment to identifying general and specific impacts and vulnerabilities. Climate change is a global issue and yet many global trends will manifest locally as changes in local conditions and local trends. This analysis of future climate change impacts and vulnerabilities draws on global, national and local scientific assessments. On this basis, a set of adaptation priorities are developed and framed in terms of a possible planning response for Wellington.

Global Scale: Impacts, Adaptation, Vulnerability

A global overview of impacts and vulnerabilities helps to provide a context for national and local level analysis. By way of introduction, key points relating to global climate change are presented below from the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment (AR4) published in 2007. The wording presented in italics is that off the IPCC AR4 Synthesis Report (2007)[4]:

Observed Changes

- *Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level.*

Causes of Change

- *Global GHG emissions due to human activities have grown since pre-industrial times, with an increase of 70% between 1970 and 2004.*

- *Global atmospheric concentrations of CO2, methane (CH4) and nitrous oxide (N2O) have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years.*

- *Global atmospheric concentrations of CO2, methane (CH4) and nitrous oxide (N2O) have increased markedly. Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations. It is likely that there has been significant anthropogenic warming over the past 50 years averaged over each continent (except Antarctica).*

Projected Climate Change and its Impacts

- *There is high agreement and much evidence that with current climate change mitigation policies and related sustainable development practices, global GHG emissions will continue to grow over the next few decades.*

[4] Intergovernmental Panel on Climate Change (IPCC) 2007. Climate Change 2007: Synthesis Report. Summary for Policy Makers. IPCC, November 2007.

- *Continued GHG emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century.*

    - *Altered frequencies and intensities of extreme weather, together with sea level rise, are expected to have mostly adverse effects on natural and human systems.*

    - *Anthropogenic warming and sea level rise would continue for centuries due to the time scales associated with climate processes and feedbacks, even if GHG concentrations were to be stabilised.*

Adaptation Options

- *A wide array of adaptation options is available, but more extensive adaptation than is currently occurring is required to reduce vulnerability to climate change. There are barriers, limits and costs, which are not fully understood.*

- *Many risks are identified [in the AR4] with higher confidence [than in the previous assessment report released in 2001]. Some risks are projected to be larger or to occur at lower increases in temperature.*

- *There is high confidence that neither adaptation nor mitigation alone can avoid all climate change impacts; however, they can complement each other and together can significantly reduce the risks of climate change.*

- *Responding to climate change involves an iterative risk management process that includes both adaptation and mitigation and takes into account climate change damages, co-benefits, sustainability, equity and attitudes to risk.*

National Scale: Impacts, Adaptation, and Vulnerabilities

The Australia and New Zealand chapter of the IPCC AR4 Working Group 2 report entitled "Impacts, Adaptation and Vulnerabilities" provides a valuable and timely summary of key issues relevant at a national scale in New Zealand. Those national issues relevant to Wellington are presented below. Each point listed here in italics uses the wording contained in the IPCC AR4 Working Group 2 report[5].

Overview

- *Regional climate change has occurred (very high confidence).*

- *Australia and New Zealand are already experiencing impacts from recent climate change (high confidence).*

[5] Hennessy, K., B. Fitzharris, B.C. Bates, N. Harvey, S.M. Howden, L. Hughes, J. Salinger and R. Warrick, 2007: Australia and New Zealand. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change,* M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 507-540.

- *The climate of the 21st century is virtually certain to be warmer, with changes in extreme events.*
    - *Large areas of mainland Australia and eastern New Zealand are likely to have less soil moisture, although western New Zealand is likely to receive more rain (medium confidence).*

- *Potential impacts of climate change are likely to be substantial without further adaptation.*
    - *As a result of reduced precipitation and increased evaporation, water security problems are projected to intensify by 2030 in southern and eastern Australia and, in New Zealand, in Northland and some eastern regions (high confidence).*
    - *Risks to major infrastructure are likely to increase. By 2030, design criteria for extreme events are very likely to be exceeded more frequently. Risks include failure of floodplain protection and urban drainage/ sewerage, increased storm and fire damage, and more heat waves, causing more deaths and more blackouts (high confidence).*
    - *Production from agriculture and forestry is projected to decline by 2030 over much of southern and eastern Australia, and over parts of eastern New Zealand, due to increased drought and fire. However, in New Zealand, initial benefits to agriculture and forestry are projected in western and southern areas and close to major rivers due to a longer growing season, less frost and increased rainfall (high confidence).*

- *Vulnerability is likely to increase in many sectors, but this depends on adaptive capacity.*
    - *Vulnerability is likely to rise due to an increase in extreme events: Economic damage from extreme weather is very likely to increase and provide major challenges for adaptation (high confidence).*

<u>Flood and Waste Water Management</u>

- *In New Zealand, rain events are likely to become more intense, leading to greater storm runoff, but with lower river levels between events. This is likely to cause greater erosion of land surfaces, more landslides …, redistribution of river sediments … and a decrease in the protection afforded by levees. Increased demands for enhancement of flood protection works are likely, as evidenced by the response to large floods in 2004.*

<u>Water Quality</u>

- *In New Zealand, lowland waterways in agricultural catchments are in a relatively poor state and these streams are under pressure from land-use intensification and increasing water abstraction demands. There is no literature on impacts of climate change on water quality in New Zealand.*

<u>Natural Ecosystems</u>

- *The flora and fauna of Australia and New Zealand have a high degree of endemism (80 to 100% in many taxa). Many species are at risk from rapid climate change because they are restricted in geographical and climatic range. Most species are*

well-adapted to short-term climate variability, but not to longer term shifts in mean climate and increased frequency or intensity of extreme events. Many reserved areas are small and isolated, particularly in the New Zealand lowlands and in the agricultural areas of Australia. Bioclimatic modelling studies generally project reductions and/or fragmentation of existing climatic ranges. Climate change will also interact with other stresses such as invasive species and habitat fragmentation.

- *There is little research on the impacts of climate change on New Zealand species or natural ecosystems, with the exception of the alpine zone and some forested areas.*

- *Major changes are expected in all vegetation communities.*

- *In New Zealand, fragmented native forests of drier lowland areas (Northland, Waikato, Manawatu) and in the east (from East Cape to Southland) are likely to be most vulnerable to drying and changes in fire regimes.*

Agriculture And Forestry

- *New Zealand is likely to be more susceptible to the establishment of new horticultural pests.*

- *In western, southern and higher-altitude areas of New Zealand, higher temperatures, a longer growing season, higher CO2 concentrations and less frost are very likely to increase annual pasture production by 10 to 20% by 2030, although gains may decline thereafter. In eastern New Zealand and Northland, pasture productivity is likely to decline by 2030 due to increased drought frequency.*

- *Climatic changes are likely to increase major land degradation problems such as erosion and salinisation. They are also likely to increase the potential distribution and abundance of exotic weeds.*

- *In New Zealand, the growth rates for plantation forestry (mainly P. radiata) are likely to increase in response to elevated CO2 and wetter conditions in the south and west. Studies of pine seedlings confirm that the growth and wood density of P. radiate are enhanced during the first two years of artificial CO2 fertilisation. Tree growth reductions are likely for the east of the North Island due to projected rainfall decreases and increased fire risk.*

Coasts

- *Sea-level rise is virtually certain to cause greater coastal inundation, erosion, loss of wetlands and salt-water intrusion into freshwater sources with impacts on infrastructure, coastal resources and existing coastal management programs.*

- *Many planning decisions for settlements and infrastructure need to account for new climatic conditions and higher sea-levels, but little research has been done on climate change impacts. The planning horizon for refurbishing major infrastructure is 10 to 30 years, while major upgrades or replacements have an expected lifetime of 50 to 100 years. Substantial infrastructure is at risk from projected climate change.*

- *Rises in sea level, together with changes to weather patterns, ocean currents, ocean temperature and storm surges are very likely to create differences in regional exposure. In New Zealand, there are likely to be more vigorous and regular swells on western coasts.*

- *Future effects on coastal erosion include climate-induced changes in coastal sediment supply and storminess.*

- *In New Zealand, emphasis has been placed on providing information, guidelines and tools such as zoning and setbacks to local authorities for risk-based planning and management of coastal hazards affected by climate change and variability.*

- *Investigations for metropolitan coasts reveal increased costs of protection for existing management systems.*

Property

- *Climate change is very likely to affect property values and investment through disclosure of increased hazards and risk, as well as affecting the price and availability of insurance.*

Migration

- *Climate change may contribute to destabilising unregulated population movements in the Asia-Pacific region, providing an additional challenge to national security. Population growth and a one-metre rise in sea-level are likely to affect 200-450 million people in the Asia-Pacific region. An increase in migrations from the Asia-Pacific region to surrounding nations such as New Zealand and Australia is possible.*

Tangata Whenua

- *Changes in New Zealand's climate over the next 50 to 100 years are likely to challenge the Māori economy and influence the social and cultural landscapes of Māori people. Some Māori have significant investment in fishing, agriculture and forestry and the downstream activities of processing and marketing, as well as being important stakeholders in New Zealand's growing tourist industry and in the energy sector.*

Energy

- *Energy consumption is projected to grow due to demographic and socio-economic factors. However, average and peak energy demands are also linked to climatic conditions.*

- *[We can expect] a likely reduction in winter heating demand counteracts the increasing summer demand, e.g., New Zealand electricity demand decreases by 3%/°C increase in mean winter temperature.*

- *Climate change is likely to affect energy infrastructure in Australia and New Zealand through impacts of severe weather events on wind power stations, electricity*

transmission and distribution networks, oil and gas product storage and transport facilities, and off-shore oil and gas production.

- *In New Zealand, increased westerly wind speed is very likely to enhance wind generation.*

Adaptation Response

Considering all sectors, four broad barriers to adaptation are evident.

1. *A lack of methods for integrated assessment of impacts and adaptation that can be applied on an area-wide basis. While sector-specific knowledge and tools have steadily progressed, the vulnerability of water resources, coasts, agriculture and ecosystems of local areas and regions are interconnected and need to be assessed accordingly*

2. *Lack of well-developed evaluation tools for assessing planned adaptation options, such as benefit-cost analysis, incorporating climate change and adapted for local and regional application.*

3. *Ongoing scepticism about climate change science, uncertainty in regional climate change projections, and a lack of knowledge about how to promote adaptation. This is despite 87% of Australians being more concerned about climate change impacts than terrorism. Application of risk-based approaches to adaptation (e.g., upgrading urban storm-water infrastructure design; Shaw et al., (2005) demonstrate how developments can be 'climate-proofed'. While a risk-based method for planned adaptation has been published for Australia there are few examples of where it has been applied.*

4. *Weak linkages between the various strata of government, from national to local, regarding adaptation policy, plans and requirements. Stronger guidance and support are required from state (in Australia) and central government The following case studies illustrate regions where climate change has already occurred, impacts are evident (in New Zealand) to underpin efforts to promote adaptation locally. For example, the New Zealand Coastal Policy Statement recommends that regional councils should take account of future sea-level rise. But there is a lack of guidance as to how this should be accomplished and little support for building capacity to undertake the necessary actions. As a consequence, regional and local responses have been limited, variable and inconsistent.*

Planning Issues

Australia and New Zealand have few integrated regional and sectoral assessments of impacts, adaptation and socio-economic risk. More are desirable, especially when set within the wider context of other multiple stresses. Methods to incorporate adaptation into environmental impact assessments and other regional planning and development schemes need to be developed.

Wellington Scale: Impacts, Adaptation, and Vulnerabilities

NIWA prepared a report for Greater Wellington Regional Council in 2002 entitled: 'Meteorological Hazards and the Potential Impacts of Climate Change in Wellington Region.'[6] It contains valuable information on future impacts of climate change, specific to the Wellington Region. Each point listed here uses the wording contained in the NIWA / GW report.

Flooding

- *These present a significant hazard to the Wellington Region. Climate change is expected to increase flooding risk, but science-based quantitative information on this is currently weak, with projected possible changes spanning a wide range. Interim projections are that the intensity of heavy rainfall could increase by up to about 7% by 2050. By 2030 the return period of heavy rainfall events and associated floods could be reduced by up to a factor of 2, and by 2070 by up to a factor of 4, but also the possibility cannot be ruled out that there will be no discernible reduction in return periods.*

Droughts

- *The part of the Wellington region most affected by droughts is the Wairarapa, where there are on average 15 days per year when soil moisture deficits exceed 130 mm. There is substantial year-to-year variability however, with up to 74 days of deficit exceeding this amount in some years. In the Kapiti, Wellington and Hutt Valley areas there are on average 10 days annually with a deficit exceeding 130 mm. Dry growing seasons (October – May) in the Wairarapa are frequently but not always associated with El Niño climate patterns. Projected temperature and rainfall changes suggest there will be a trend of increasing drought occurrence in the Wairarapa through the coming century, but no quantitative predictions are yet available.*

Landslides

- *The Wellington Regional Council has made a number of attempts to define the landslide hazards in the region, focusing on both rainfall and earthquake induced landslides. Maps of landslides resulting from specific storms [have been produced]. However, the current landslide hazard maps are not comprehensive or accurate enough to rely on solely for effective landuse management and planning strategies.*

Tides

- *The storm tide height reached in Wellington Harbour during the 1936 Cyclone event of approximately 1.7 m above the Wellington Vertical Datum–1953 is probably a useful benchmark for a 1% Annual Exceedance Probability (or 100-year return period). Also, wave heights of up to 8.1 m (Te Kaukau Pt) are possible around the Wellington Region coast, based on 20-year hindcast modelling.*

[6] Tait, A., Bell, R., Burgess, S., Gorman, R., Gray, W., Larsen, H., Mullan, B., Reid, S., Sansom, J., Thompson, C., Wratt, D., and Harkness, M. 2002. Meteorological Hazards and the Potential Impacts of Climate Change in Wellington Region. NIWA and Wellington Regional Council, 2002.

Sea Level Rise

- *"Most likely" estimates for sea-level rise around the Wellington region by 2050 and 2100 are 0.26–0.30 m above WVD-53 and 0.42–0.62 m above WVD-53, respectively. There is a small chance that sea level might rise by up to 1.0 m above WVD-53 in the year 2100. For tides, a level of 0.9 m above WVD–53 which would currently not be exceeded at all in 100 years, would be exceeded by up to 17% of all High Waters given the predicted rise in sea level by 2050.*

Wind Storms

- *The maximum 3-second gust speed (km/hr) at 10 m above the ground for low lying areas expected to be equaled or exceeded at an average interval of 142 years for most of the Wellington region is about 198 km/hr and at an average interval of 475 years is about 216 km/hr. These return period wind speeds are higher for escarpments, hills and ridges by between 1.04 and 1.54 times (see Table 6.1 for multiplication factors). Under global warming the mean westerly wind component across New Zealand is expected to increase by approximately 10% of its current value by 2050.*

Ex-Tropical Cyclones

- *These events pose a risk in that they bring both intense rainfall and wind, however the frequency of events is relatively low. Tropical cyclone track data suggest that central New Zealand, including the Wellington region is affected by cyclones of tropical origin once every three to six years. The most extreme ex-tropical cyclone to impact the Wellington region was the Wahine storm in which the strongest winds reached 110 km/h (gusting to 150) at the entrance to Wellington Harbour where the inter-island ferry Wahine was making its arrival.*

Wildfire

- *While the occurrence of four wildfires at the same time (January 2001) was an extremely rare event, the chances of similar fire seasons in the future are more likely due to easier access into forested areas, taller trees (more fuel) and a more blurred rural-urban interface. Wildfire frequency is closely related to drought frequency, as lower than normal rainfall is the main proponent for higher than normal fire outbreaks. It is possible that wildfire risk might increase in the future, based on climate change scenarios, particularly in the drier eastern parts of the Wellington region.*

Priorities for Adaptation Response

The need to address climate change impacts requires a planning framework capable of protecting existing investments and infrastructures, whilst guiding future developments in ways that protect those investments. One way to do this is to develop a strategic climate change adaptation planning program, perhaps in partnership with Greater Wellington. This program could be undertaken in different phases involving:

	Description	Duration	Year
First Management Period			
Phase 1	Develop 1st Wellington Climate Change Adaptation Plan	2 years	2009-2010
Phase 2	Implement 1st Wellington Climate Change Adaptation Plan	7 years	2011-2017
Phase 3	Review and evaluation of implementation	1 year	2018
Second Management Period			
Phase 1	Develop 2nd Wellington Climate Change Adaptation Plan	2 years	2019-2020
Phase 2	Implement 2nd Wellington Climate Change Adaptation Plan	7 years	2021-2027
Phase 3	Review and evaluation of implementation	1 year	2028
Third Management Period etc…			

Such a cyclic approach to planning and implementation enables the planning process to be adaptive to changing circumstances, which is so necessary in an area involving changing physical conditions and changing knowledge about the issue.

This program could then progress the planning requirements required in order to fully integrate climate change adaptation into the Long Term Community Council Plan. Moreover, such a program could also form an integral component of a much longer term strategic planning exercise (e.g. 100 years), designed to prepare Wellington for cross cutting global change influences that are very likely to affect the Wellington economy, and the well-being of the Wellington population.

A potential Terms of Reference for the first 'Wellington Climate Change Adaptation Plan' could be based on the framework of the NIWA and Wellington Regional Council (2002). This study identified four key areas of climate change impacts for Wellington as a consequence of meteorological hazards. It is important to note that this (2002) report pre-dated the IPCC AR4 (2007). This current report employs the framework of the NIWA/Wellington Regional Council report and integrates it with more recent IPCC AR4 information. Accordingly, the main impacts for consideration in a Wellington-based strategic planning exercise include, but are not limited to the following:

1. **An increased threat to lifelines and services coming from more frequent heavy rainfall events and associated floods.**
   Planning priorities arising from these vulnerabilities:
   a. Wellington landslide inventory on susceptibility, landslide triggers, and the frequency and magnitude of events.
   b. Risk and planning assessment of landslide vulnerability based on projected doubling of heavy rainfall and flood event frequency by 2030.
   c. Flood protection inventory and upgrade assessment, based on projected doubling of heavy rainfall and flood event frequency by 2030.
   d. Risk and planning assessment on wind gusts for areas identified as vulnerable to increased wind gust risk (north westerly exposed escarpments, hills, and ridges) under projections of increasing westerly air flow.

2. **Increased drought risk particularly in the east of the Wellington region.**
   Planning priorities arising from these vulnerabilities:
   a. Risk and planning assessment on wildfire threat for eastern Wellington based on projections of increased drought frequency.
   b. Risk and planning assessment on agriculture and forestry in the Wairarapa based on projections of increased drought frequency.

3. **Sea level rise making groundwater aquifers near the coastline vulnerable to saltwater intrusion.**
   Planning priorities arising from these vulnerabilities:
   a. Risk and planning assessment on sea level rise for vulnerable infrastructures and property for the Wellington south coast, Wairarapa coast and Kapiti coast areas.
   b. Risk and planning assessment on salt water intrusion to groundwater for coastal aquifers at Petone and Kapiti coast areas.

4. **Changes in temperature and rainfall regimes brought about by climate change causing problems for plant and animal pest eradication programs.**
   Planning priorities arising from these vulnerabilities:
   a. Risk and planning assessment on plant and animal pests for Wellington Region based on projected shifts in habitat preferences under a warming/changing climate.

For each risk assessment component listed above, it is recommended that they respond to the **risk assessment priorities** set by the IPCC AR4 Australia/NZ Working Group 2 Assessment (2007) which are:

- definition of the probabilities of exceeding critical biophysical and socio-economic thresholds
- assessment of consequent vulnerability or new opportunities
- assessment of net costs and benefits for key economic sectors
- better modelling of land-use change as climatic boundaries shift, and assessment of the implications for regional development, social change, food security and sustainability.

For the planning component of the assessments listed above, it is recommended that they respond to the **planning priorities** set by the IPCC AR4 Australia/NZ Working Group 2 Assessment (2007) which are:

- better understanding of societal preparedness and of the limitations and barriers to adaptation,
- better definition of costs and benefits of adaptation options, including benefits of impacts avoided, co-benefits, side effects, limits and better modelling,
- analyses of various options for social equity and fairness, the impacts of different discount rates, price incentives, delayed effects and inter-generational equity.

Subsequent Adaptation Plans would be able to prioritize planning issues on the basis of updates provided by the IPCC in its ongoing cycle of assessment reports (AR5, AR6 AR7 etc) in coming years/decades, together with information arising from any national and regional/local assessments of climate change impacts and vulnerability.

Because climate change adaptation is a cross cutting issue, it is relevant to several of the planning themes identified by Wellington City Council in the LTCCP:

LTCCP Theme	Climate Change Adaptation Issues
Urban Development	• Location and design considerations for new urban and suburban development in areas vulnerable to fire, landslide, flood, wind gust, and sea level rise. • Maintenance, upgrades, and design considerations for urban development infrastructures such as water supply, waste management, sewerage, and storm water systems to meet specifications capable of enduring future climate change impacts.
Transport	• Maintenance, upgrades, and design considerations for transport infrastructures to meet specifications capable of enduring future climate change impacts.
Economic Development	• Maintenance, upgrades, and design considerations for electricity, telecommunications infrastructures to meet specifications capable of enduring future climate change impacts. • Regional agriculture and forestry development in response to projected climate variability and change
Environmental	• Management of existing and future protected areas for fire and drought hazard (eastern Wellington), weed and pest control.
Cultural Well-Being	• Ensuring the rights of tangata whenua are fully integrated into climate change adaptation planning and implementation. • Ensuring cultural heritage assets are maintained, upgraded, and designed to take sufficient account of climate change adaptation requirements.
Social and Recreation	• Public health considerations associated with projections of future climate variability and change, including potential new vectors for vector-borne diseases. • Management of coastal and waterfront recreational areas in the light of future projections for sea level rise and storm surge impacts.
Governance	• Allocation of funds for the development and implementation of a Wellington Climate Change Adaptation Plan.

CLIMATE CHANGE MITIGATION OPPORTUNITIES

Climate change mitigation is primarily focused on the reduction of greenhouse gas emissions, as part of a strategy to stabilise atmospheric CO2 concentrations to levels that will prevent dangerous human-induced interference with the climate system. The development of a Wellington climate change mitigation strategy can be situated within the global climate change mitigation task in terms of:

- a Wellington contribution to a global solution, and
- the integration of Wellington-based climate change mitigation activity with global technologies, methodologies, and economic linkages.

Irrespective of any local interest in the global task of climate change mitigation, Wellington is currently, and will continue to be, affected by global and national climate change policy. Such policy relates primarily to international emission reduction targets (e.g. through the Kyoto Protocol) which have local implications (e.g. the effects of the NZ Emissions Trading Scheme).

New Zealand faces a big challenge to meet its international climate change commitments. These include NZ's commitments under the Kyoto Protocol's first period (2008-2012), and those it will take on post-2012. Wellington will play a role in this task one way or another, principally through the effect of energy prices increasing as a consequence of carbon price associated with the NZ ETS. But Wellington also has an opportunity to show leadership in the task of building an efficient, low carbon future.

The New Zealand challenge in terms of carbon emissions is set against the backdrop of the much larger challenge to reduce global emissions to 50% of 1990 levels by 2050, as now articulated by international science and policy leaders – even including the heads of state of the G8 countries at their recent 2008 meeting in Japan. As Lord Nicholas Stern has pointed out in his latest report[7], what this means "as a matter of arithmetic" is average global per capita emissions of about 2T CO_2e by 2050.

New Zealand's per capita emissions are about 18T CO_2e and growing (77.9 MT in 2006, 26% higher than in 1990). Given the deadline set by the Stern report - just four decades from now - it is clear that New Zealand, and many other countries, have a major mitigation challenge ahead.

Carbon Neutral Wellington

Wellington City Council has been very proactive in the climate change mitigation arena with its commitment to carbon neutrality. The wording of the WCC Strategy and Policy Committee Report 2 (7 June 2007) reflects an insightful position:

> *Irrespective of the actual medium to long-term climate impacts on Wellington, the city is going to be significantly affected in the short-term by:*
>
> - *current and future international treaties*
> - *a proposed cap-and-trade system in New Zealand that would place a price on carbon*

[7] *Elements of a Global Deal on Climate Change*, London School of Economics, April 2008.

- *increasing consumer demand for low-emissions products and destinations*
- *political and corporate positioning towards a climate-friendly stance.*

To future-proof the city against the environmental, social and economic threats of climate change, and to take advantage of emerging opportunities, the Council needs a highly visible, proactive approach to climate change. A leadership approach would position Wellington as a catalyst at the forefront of climate change action.

The above report identified three key steps in implementing its goal:

1. *Set an aspirational vision, **carbon neutrality**, for both Council operations and the city as a whole, to galvanise support and inspire action. This is consistent with the Government's aspiration for New Zealand to become carbon-neutral.*
2. *Set new short, medium and long-term emission reduction targets in line with both the Council's new vision and with what is required to keep global warming at a level which can be reasonably managed.*
3. *Scope a detailed work programme that is likely to achieve each target. This work programme will provide practical and quantifiable benefits to the Council and the city.*

At a global scale, some of the most innovative low carbon systems are being developed by cities and sub-national governments. In turn these innovations are able to influence climate policy further upstream at the national and even international level.

There are a number of policy frameworks available for the implementation of GHG emissions reduction strategies. These include:

Carbon Taxes	A **price-based mechanism** where you know the cost but you do not know the volume of emissions reductions you will achieve.
Project-based Schemes	Projects can be awarded credits for reductions (or sink removal enhancements) beyond a baseline that represents what would have happened anyway
Emissions Trading	A **quantitative cap-and-trade mechanism** where you know the volume of emissions reductions but you cannot know the final cost.
Other Policies and Measures	Incentive schemes, regulations and standards, voluntary programmes, subsidies, and penalties.

The intergovernmental climate policy community reviewed these options during the Kyoto Protocol negotiations. They eventually settled on emissions trading as the core instrument to assist countries meet their compliance obligations at least cost. This was also combined with project-based schemes linked to the emissions trading core.

Carbon Markets

Carbon markets and emissions trading now present a range of opportunities to engage the private sector in undertaking and financing the transition to a low carbon economy.

Carbon markets are currently transforming business investment decision-making in many countries throughout the world, and Wellington has the opportunity to embrace carbon markets as a significant step along the path of carbon neutrality.

Carbon markets are divided into two broad categories: 1 The 'Compliance Market' which is driven by binding emission reduction targets, and 2. the 'Voluntary Market' which is driven by carbon neutrality goals and corporate social responsibility (CSR). New Zealand is in the process of developing a domestic compliance market in the NZ Emissions Trading Scheme currently before parliament. This scheme is principally designed to help the Government meet its compliance obligations under the Kyoto Protocol.

The compliance carbon market applies only to those who have legally binding emissions reduction targets. These are called 'Points of Obligation' (POs) in the compliance system. Most businesses and all individuals and households do not fall into the category.

Therefore, WCC operations, most businesses and all individuals and households (hereafter called 'non-POs'), are excluded from any active participation in compliance carbon market activity. Non-POs are compelled to simply respond to the influence of Points of Obligation who impose a carbon-based price signal on everyone downstream in the system. Where there is inelastic demand (e.g. energy), those downstream in the supply chain are unlikely to change behaviour but instead simply pay more for this resource. Accordingly, compliance carbon markets offer little in the way of behaviour change incentives for non-POs.

Carbon Neutrality and the Voluntary Carbon Market

The voluntary carbon market presents an opportunity to engage non-POs (including WCC operations and Wellington businesses) in emissions trading. This, in turn, enables non-POs to voluntarily take advantage of a mechanism designed to help emission reductions to occur at least cost.

The compliance system, however, is not designed to deliver carbon neutrality and more importantly, is not capable of delivering carbon neutrality. This is because the quantitative environmental outcome of the compliance regime is already set in the form of the collective intergovernmental emissions cap. This cap does not equate with carbon neutrality because it is a cap that simply reduces collective emissions to about 5% less than 1990 levels for the compliance period (2008-2012). These emission levels are a long way from carbon neutrality and simply amount to a first step along the path of a low carbon economy. See Annex 1 for a further elaboration of carbon neutrality.

Accordingly, carbon neutrality can only be delivered through a different system to the compliance regime. This is where there is an important role for the voluntary carbon market. To understand how these two 'systems' (voluntary and compliance) can work independently, it is best to view them as happening in two separate 'universes' but where actions in one also occur and have 'value' in the other. So, for example, an emissions reduction action like energy efficiency in a New Zealand building taken as part of a carbon neutrality program will help that entity work towards their carbon neutral goal. This action will also help New Zealand meet its compliance commitments. But there is no other connection between this party's carbon neutral aspirations and New Zealand's compliance with Kyoto.

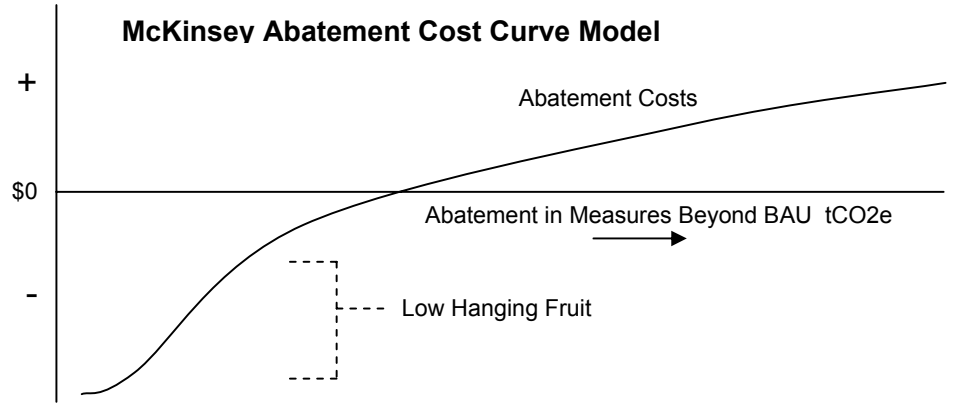
Beyond these big picture differences between compliance emissions trading and the voluntary carbon market, the other key difference is how individuals, households, and businesses are engaged in the practice of carbon trading. Carbon neutrality programs create a demand for voluntary offsets, because in reality no individual or firm is likely to be able to reduce their carbon footprint to zero.[8] This is partly a physical issue and partly a price issue. Physically it may be very difficult to eliminate all carbon emissions from an activity. This is not necessarily a problem because in nature carbon passes in and out of living and non-living systems. The issue is the net carbon balance – which can equate with carbon neutrality. From a cost point of view, many forms of emission reduction may be 'affordable' (some even with a negative cost) whilst some are prohibitively expensive.

One of the key features of emissions trading is that it recognises this situation and enables emission reductions (or enhancements of sink removals) to occur where they can do so at least cost. This creates a business opportunity for entrepreneurial 'action aggregators'. These, for example, may be groups delivering new additional energy efficiency programs at a community scale. Here entrepreneurial emission abatement activity is made financially viable by:-

a. Generating economies of scale for emission reduction activities and technologies, and charging a service fee, and

b. Generating emission reductions that can be turned into voluntary offset units for sale to those needing them for their carbon neutrality programs.

It is this 'bottom up' emissions trading activity that a cap and trade scheme like the NZ ETS fails to incentivise. It is not enough just to increase energy prices. There are significant cost barriers to successfully operating individual-scale projects even if they are theoretically cost effective (e.g. located in the negative cost portion of the McKinsey Abatement Cost Curve model below[9]). Furthermore, at the individual (one-off) project scale there is an absence of economies of scale and little bargaining power in dealing with contractors and product suppliers.



[8] However a carbon neutrality program by some organisations with growing forests within their program boundary could potentially get to zero or even be 'carbon negative'.

[9] Ekinvist, P., Naucler, t., and Rosander ,J. 2007. A cost curve for greenhouse gas emissions. McKinsey Quarterly No. 1 2007. Available at http://www.mckinseyquarterly.com/A_cost_curve_for_greenhouse_gas_reduction_1911_abstract

However, add entrepreneurial aggregators who can bring scale to this picture, and the economic situation quickly changes into a more favourable condition. This is the essence of why having a market in voluntary carbon offsets can make a key difference to increasing the uptake of abatement activity among non-POs.

The low hanging fruit in the above cost curve have negative costs in theory, but in practice may require aggregation to generate economies of scale sufficient to roll out in any significant volume.

Carbon neutrality involves three basic steps:

1. Measurement of carbon footprint

2. Abatement 'in house' (i.e. emission reductions through changing behaviour and/or investing in cleaner technologies)

3. Purchase of offsets for residual emissions (i.e. those that are more costly per tonne than the price of carbon)

WCC operations and Wellington businesses can then use marginal abatement cost curves and the carbon price to calculate how much in-house abatement to undertake and how many carbon units to purchase in order to move through to stage 3 and gain carbon neutrality status.

Double Beneficiaries and Double Counting

It is claimed by some that the separation of voluntary market activity from the 'compliance space' is necessary to avoid double counting of carbon units. This is because emission reduction activities generated through voluntary carbon market transactions will benefit the country by helping it meet its compliance obligation. This will potentially lower the number of international compliance units that the country will need to buy to be in compliance at the end of the commitment period.

The practical consequence of this approach to this perceived double counting problem, is that it would prohibit voluntary carbon market actions being undertaken in sectors and countries covered by any kind of compliance cap and trade scheme (e.g. the Kyoto Protocol).

There is a fundamental difference between 'double counting' and 'double beneficiaries'. Double beneficiaries refers to two beneficiaries from an action – but without double counting. Double counting refers, for example, to (a) the same emission units being sold twice, thereby duplicating the financial gains without duplicating the emission reductions. Or it could mean (b) the same party seeking compliance 'credits' (or deriving the equivalent financial benefit) and voluntary offset credits for the same action.

There are ways to prevent double counting, such as transparent credit registries, robust additionality methodologies, and ensuring that voluntary carbon units are non-fungible with compliance units. But it is clear that voluntary carbon market activity in countries and sectors covered by compliance accounting is a valuable tool in the emission reduction sector. Indeed without voluntary carbon market activities inside the compliance

space non-POs (the majority of businesses, local government, and all individuals and households) would be prevented from participating actively in carbon markets, which in turn would dramatically diminish the opportunities for emissions abatement from the bottom up.

WCC Operations & Wellington City Community

The WCC Climate Change Action Plan states that the carbon neutrality goal applies to WCC operations and also for the wider community. While carbon neutrality is clearly desirable for the wider Wellington community, the WCC has far greater capacity to deliver carbon neutrality for its operations.

From a practical point of view, a number of challenges confront those seeking a goal of carbon neutrality for a city compared with a more clearly defined entity like a city council, school, household, or business. For example, from carbon accounting point of view a city has a relatively diffuse boundary that is difficult to define. This is partly a result of a functioning city having the inward and outward movement of people, goods and services each with a carbon footprint. Furthermore, a city is made up of a wide variety of people and groups, some of which may not wish to contribute to carbon neutrality as they have other priorities. Unless a city council has a specific mandate from its constituents it may come across political difficulties when pursuing carbon neutrality on behalf of others. This does not mean that a community scale carbon neutrality goal is not valid. It has more to do with the staging of a carbon neutrality program and also the methodology for delivering it in different places.

In contrast the WCC has a lot of control over its own operation and can clearly define the boundary of this operation. As a single (complex but integrated) management entity WCC has a greater capacity to undertake steps 1-3 of a carbon neutrality exercise, which could be undertaken without the need for a broader mandate – because it is doing this for itself and not compelling others to do something. This is consistent with the WCC Climate Change Action Plan which states that *"the Council should first and foremost demonstrate leadership with its own activities through urgent and comprehensive actions to reduce emissions from its own activities."*

As for the wider community the WCC has an opportunity to support and incentivize voluntary participation in a community wide carbon neutrality goal. This is also consistent with the WCC Climate Change Action Plan: *"While the Council's actions for its own activities can provide leadership and direction to the community, the Council needs to work hard to change the behavior of both residents and businesses alike. This means engaging with the public on several levels and helping to stimulate change in the city and region."*

The key to the latter is voluntary behavior change, and one of the most useful mechanisms to stimulate this kind of action is a voluntary carbon market. This market approach is able to generate the conditions favorable to entrepreneur aggregators in the formation of a local emissions reduction and carbon neutrality service industry.

The early development stages of the New Zealand voluntary carbon market is focusing on establishing a set of modalities and quality assurance processes that will align the New Zealand voluntary market with the leading global voluntary carbon market standard

– the ‘Voluntary Carbon Standard’. This will help to build confidence at the buyer end of the market, and help to keep carbon prices high enough to stimulate significant voluntary abatement activity.

One of the key limitations of aligning a local scale carbon market with a global standard is that the transaction costs can become prohibitively high. This can have the effect of preventing the voluntary market from stimulating the scale of action desired in the community as part of a local carbon neutrality exercise. On the other hand, there may be scope for the development of a local grade of carbon credit designed and administered only for local trading, where quality can remain high but transaction costs are kept much lower. The WCC could potentially provide support in the development of the design and implementation of a local grade voluntary cap-and-trade system, to help stimulate local voluntary carbon market activity at a scale capable driving down Wellington emissions to a minimum.

Net Carbon Accounting and WCC Forests

In the measurement of the carbon footprint, WCC operations are well advised to pursue a net carbon accounting approach. Here the WCC would measure its net carbon balance to be the total emissions (reduced through abatement) minus total enhanced sink removals (carbon sequestration) through growing forests within the operational boundary.

As such, it may be strategically useful to define the operational boundary of WCC operations (and carbon neutrality management) to include all of its forests. This means that if WCC green space is a net sink, then this sink activity encompasses an internal offset mechanism which can reduce the net emissions total for WCC operations (as calculated in Step 1), and hence lower the number of emissions it needs to abate in-house, and/or lower the number of units it will need to buy to offset residual emissions to achieve carbon neutrality status.

The WCC green space is a carbon reservoir and probably also a net carbon sink. Determining this properly will require a carbon stock assessment using methodologies readily available to calculate above and below ground carbon stocks and the changes in those stocks through time.

The vegetation available for this WCC in-house offset service includes both its pre-1990 (non-Kyoto) and post-1990 (Kyoto) forests. This forest estate includes the natural vegetation and any plantation assets. The non-Kyoto (pre-1990) forest are eligible as carbon offsets in carbon neutrality programs for at least two reasons:

1. Carbon neutrality programs lie outside the compliance carbon market, because the compliance market is structurally unable to deliver carbon neutrality (for reasons elaborated above). Non-Kyoto forests are outside the compliance market.

2. Pre-1990 forests lie outside the New Zealand compliance carbon inventory because New Zealand elected to not undertake Article 3.4 of the Kyoto Protocol involving the management of pre-1990 forests (because it was an optional component of the Kyoto protocol and it feared that this category of forest would

be a net carbon source). Because these forests lie outside the NZ compliance carbon accounting system, they lie squarely inside the voluntary carbon market space. Furthermore, they also lie squarely inside the space most likely to be compatible with the generation of voluntary carbon offsets for emission activities not covered by the Kyoto Protocol (e.g. international aviation, international shipping).

The Kyoto forests (planted after 1990) in WCC green space is eligible for voluntary carbon market activity because the WCC is not a Point of Obligation in the NZ ETS (i.e. does not have any binding obligations), and because it is possible for voluntary carbon market activity to occur inside sectors covered by compliance accounting. The difference between voluntary market activity inside the compliance space and voluntary market activity outside the compliance space, is this: Inside the compliance space there is a double beneficiary for this voluntary activity (the carbon neutrality seeker and the government). This is because this voluntary emission abatement activity will help to drive down carbon emissions nationally, which will be measured in the national compliance carbon inventory, which in turn will help New Zealand meet its compliance obligations under the Kyoto Protocol.

WCC Champion of the Voluntary Carbon Market

The voluntary carbon market is still in early stages of development in New Zealand, and still needs champions to support its development. Wellington City Council could position itself as one of these champions and in the process provide leadership and support for domestic voluntary emissions trading activity. This leadership could also benefit other cities around the country (and potentially internationally) that could learn from the Wellington experience.

ANNEX 1. WORKING DEFINITION OF CARBON NEUTRALITY

A working definition of carbon neutrality is helpful in order to picture how it may be generated for WCC:

1. **Measurement:** Calculate all of the human induced GHG emissions and all the human induced carbon sequestration that occurs over a particular time period (e.g. a 5 year period).
2. **Abatement:** Take this net carbon balance and then implement a program to reduce net annual emissions where they can be reduced, through activities such as a) behaviour change, b) installation of clean technology, c) retrofitting efficient technologies to existing infrastructures, d) additional sequestration by planting new permanent forest, e) using products that reduce or avoid GHG emissions (e.g. nitrogen inhibitors). Then re-calculate the net carbon balance to find a volume of emissions that have not been eliminated.
3. **Offset Residual Emissions:** Then buy GHG emission reduction units (or carbon sink units) from a third party whose actions were real, verifiable, and additional, to offset the residual emissions remaining inside the project boundary.

This definition and 'the space and time' points above can be seen as helpful in clarifying some of the confusion about carbon neutrality and any situation that may apply under a government initiated compliance scheme such as the NZ ETS. So for example:

- Initial allocations of allowed emissions under a cap and trade compliance scheme have no relevance; nor do the actions or outcomes of anyone else in the same compliance scheme have any relevance.
- The actions of some upstream point of obligation in a compliance trading scheme to meet their commitments do not confer any "carbon neutral" status to fossil fuels consumed by the entity for whom carbon neutrality is being judged. By extension, then:
    - A litre of petrol used by New Zealand and Vanuatu consumers has exactly the same carbon emissions, and in New Zealand it will have the same emissions on 1 January 2011 – after liquid fuels are covered by the NZ ETS – as it does today. The same is true of stationary energy commodities after 1 January 2010.
    - So, for example, oil companies buying NZUs backed by NZ's initial allocation of Kyoto units, or buying Kyoto units in from overseas to help with New Zealand's compliance with its Kyoto commitments, has no bearing on the *carbon neutrality* of NZ individuals or firms or organisations or cities, or indeed of New Zealand.

The critical point is that the voluntary and compliance spaces should logically be seen as two different 'universes'.

The compliance space is one that is designed to deliver a pre-determined collective quantitative outcome (a global emissions cap), and no more. Any additional effort to over-comply with a binding obligation in a binding cap-and-trade system, will generate surplus units for sale to points of obligation that under-comply with their binding target – hence the quantitative outcome does not change as a result of over-compliance.

Moreover, this outcome is not a condition of carbon neutrality but a collective emission reduction target somewhere below business-as-usual.

The voluntary space delivers emission reductions and enhanced sink removals that are linked to voluntary actions to reduce a carbon footprint which can also align with a goal of carbon neutrality. If the voluntary activity takes place within a sector covered by compliance accounting, then voluntary abatement or sequestration activity will also make a voluntary contribution to a compliance target. If the voluntary activity takes place outside the compliance accounting system, then the emission reduction or sink removal is completely invisible to the compliance system, and simply has a direct relationship with the atmosphere.