



# Long-Term Challenges and Opportunities in the Natural Resource Sector: Three Case Studies

New Zealand Treasury

BACKGROUND PAPER FOR THE  
2013 STATEMENT ON THE LONG-TERM FISCAL POSITION

JULY 2013



**THE TREASURY**  
Kaitohutohu Kaupapa Rawa

New Zealand Government

**BACKGROUND PAPER  
FOR THE 2013  
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# Long-term challenges and opportunities in the natural resource sector

## 1 Introduction

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### 1.1 New Zealand's natural capital

New Zealand's cultural, social, and economic prospects are inextricably intertwined with the health and sustenance of our natural capital.

#### **What is natural capital?**

Natural capital includes both non-renewable natural resources (such as land, coal, oil, gas, and minerals) and renewable or recyclable resources (such as forests, fish, and water flows). Natural resources have biophysical limits, either because they are finite in quantity or because the biophysical processes for their renewal restrict the rate of replenishment.

Natural capital provides a flow of goods and services that have both an instrumental value, to the extent that they contribute directly to economic production and wealth creation, and an intrinsic value, to the extent that they contribute to cultural values, national identity, and non-market uses. In addition, nature's ecosystems and other natural systems provide essential services, eg, absorption of waste products.

New Zealand is wealthy in natural resources. We have plentiful, clean water; clean air; fertile soil and a climate well-suited to humans, trees, livestock, and agriculture; long coastlines and significant aquaculture resources; significant mineral and petroleum reserves; and extraordinary biodiversity on our land and in our water bodies. The World Bank estimates that New Zealand ranks eighth out of 120 countries and second out of OECD countries in natural capital per capita; we are outranked only by petroleum-exporting countries.<sup>1</sup>

Our natural resources are central to New Zealand's cultural heritage, both for Pakeha and Māori. Māori draw identity and *whakapapa* from the environment and exercise *kaitiaki* responsibilities over land and resources. We have a responsibility to recognise this cultural relationship in accordance with the principles of the Treaty of Waitangi.

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<sup>1</sup> World Bank. "The Changing Wealth of Nations: Measuring Sustainable Development in the New Millennium." (2011.) Retrieved from <http://data.worldbank.org/data-catalog/wealth-of-nations>

Natural resources such as land, water, and fish provide a large proportion of the inputs to our economic system:

- In 2011, export revenue from the primary industries amounted to over \$31.5 billion or over 70 percent of total merchandise export revenue.<sup>2</sup>
- Agriculture and primary industries contribute over 17 percent to our Gross Domestic Product (GDP).<sup>3</sup>
- Over 70 percent of our electricity is generated by renewable energies.<sup>4</sup>

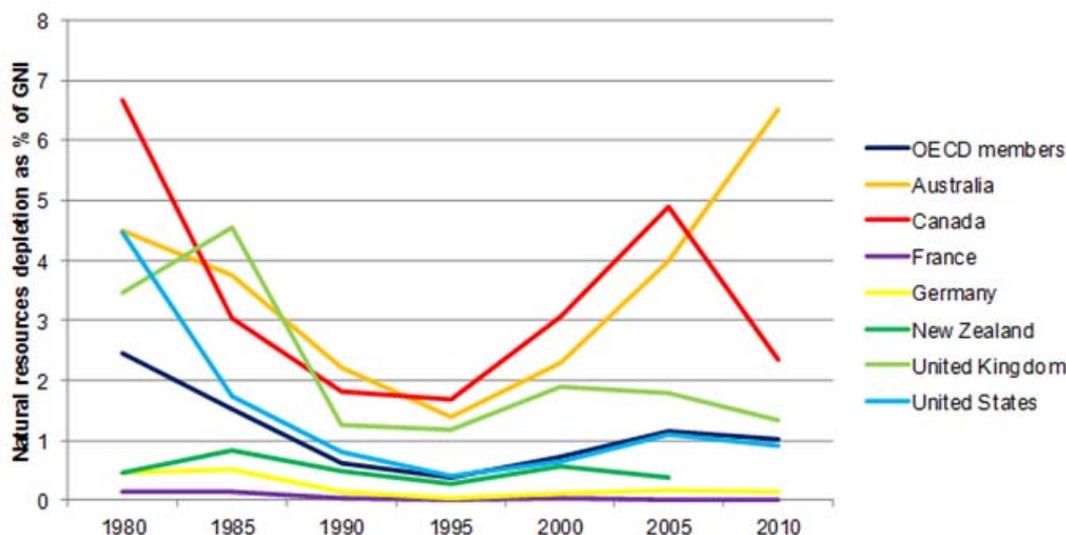
The New Zealand economy has grown on the basis of its natural capital stocks and flows and our ability to generate wealth will be dependent on this stock for the foreseeable future. According to the OECD:

The sustainability of economic growth depends on the importance of non-renewable natural resource extraction for overall income generation and the rate at which environmental capital is permanently degraded in the process.<sup>5</sup>

Strong income growth in emerging markets will support demand for natural resources in the short- to mid-term, underpinning demand for New Zealand's exports and further entrenching our reliance on the productive sectors for our growth, wealth, and living standards. Should we fail to plan for and manage within biophysical resource limits we will undermine the productivity of our primary sector in the long term and limit our growth potential. This in turn constrains the Government's ability to provide for the needs of a growing and ageing population.

Figure 1 shows forest, energy, and mineral resource depletion as a percent of Gross National Income (GNI) for a number of OECD countries.

**Figure 1 – Forest, energy, and mineral depletion as a percent of GNI**



Source: World Bank.<sup>6</sup>

<sup>2</sup> Ministry for Primary Industries. "International Trade: Agricultural and forestry exports from New Zealand: 2011 June year end highlights." (2011.) Retrieved from <http://www.mpi.govt.nz/agriculture/statistics-forecasting/international-trade.aspx>

<sup>3</sup> Statistics New Zealand. "National Accounts: Year ended March 2011." (2011.) Retrieved from [http://www.stats.govt.nz/browse\\_for\\_stats/economic\\_indicators/NationalAccounts/NationalAccounts\\_HOTPYeMar11.aspx](http://www.stats.govt.nz/browse_for_stats/economic_indicators/NationalAccounts/NationalAccounts_HOTPYeMar11.aspx)

<sup>4</sup> Ministry for Business, Innovation, and Employment. "Summary of 2011 Modelling Results – Electricity Generation and Build, New Zealand's Energy Outlook 2011." (2012.) Retrieved from <http://www.med.govt.nz/sectors-industries/energy/energy-modelling/modelling/new-zealands-energy-outlook>. Assumes \$100 per tonne carbon dioxide (CO<sub>2</sub>e).

<sup>5</sup> OECD. (2013.) "2013 Economic Review – New Zealand."

Unlike GDP, GNI is reduced by foreign indebtedness and sale of domestic resources abroad. Using this metric, New Zealand's natural resource depletion in these areas relative to income has consistently stayed below the OECD average in recent decades, indicating that we are relatively efficient at using our resource base to realise improvements in our living standards.

## 1.2 Natural capital in the Crown accounts

In New Zealand, natural resource stocks and flows impact both directly and indirectly on the Government's revenues, expenses, assets, and liabilities.

### 1.2.1 Direct impacts

The Crown incurs expenses for natural resource management and regulation, including the cost of managing public conservation areas, regulating fisheries, cleaning up lakes and rivers with deteriorating water quality, and free allocation of New Zealand Units (NZUs) to Emissions Trading Scheme (ETS) participants. In limited cases, the Crown collects revenues from natural resources, including royalties for petroleum and minerals extraction, proceeds from radio spectrum auctions, direct payments of NZUs and other carbon units for obligations under the ETS, and taxes on petrol and diesel fuels. In these instances, the Crown has asserted a right to manage a resource or regime on behalf of all New Zealanders, including the redistribution of any accrued economic benefits.

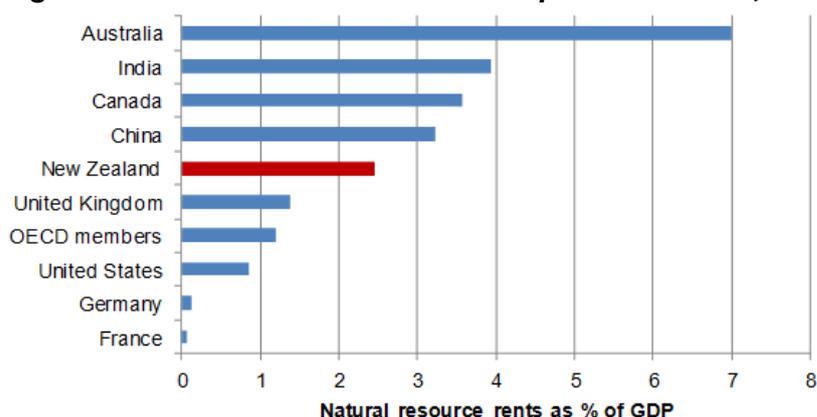
The Crown carries liabilities associated with natural resources, including contingent liabilities for our current obligation under the Kyoto Protocol. The Crown also possesses a number of natural resource-related assets, including physical assets such as the conservation estate, Crown-owned forestry and agricultural assets, and non-physical assets such as the stock of international carbon units collected through the ETS.

Figure 2 shows natural resource rents as a percentage of GDP for a number of OECD countries. Economic rent of a natural resource equals the value of capital services flows rendered by the natural resources, or the difference between the price at which an output from a resource can be sold and its respective extraction and production costs, including normal return. Countries with historically high natural resource depletion per unit GNI (as shown in Figure 1), like Australia and Canada, and the emerging economies tend toward more significant natural resource rent collection per unit of GDP.

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<sup>6</sup> Natural resource depletion is the sum of net forest depletion, energy depletion, and mineral depletion. Net forest depletion is unit resource rents times the excess of roundwood harvest over natural growth. Energy depletion is the ratio of the value of the stock of energy resources to the remaining reserve lifetime (capped at 25 years). It covers coal, crude oil, and natural gas. Mineral depletion is the ratio of the value of the stock of mineral resources to the remaining reserve lifetime (capped at 25 years). It covers tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate.

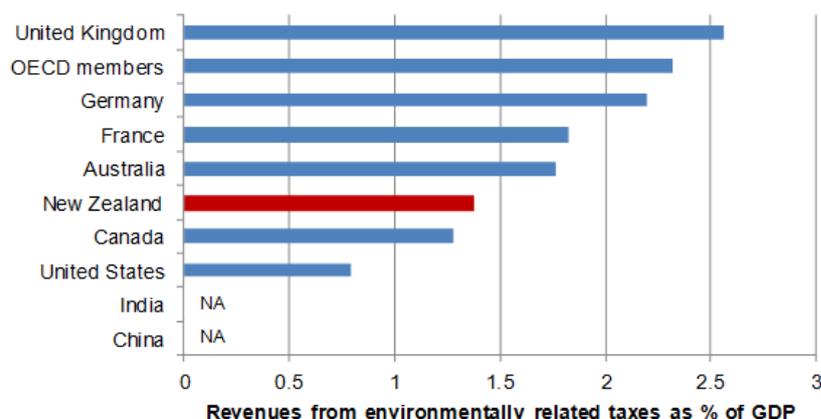
**Figure 2 – Natural resource rents as a percent of GDP, 2009**



Source: World Bank.<sup>7</sup>

Figure 3 shows revenues from environmentally related taxes as a percent of GDP. Relative to both GDP and total tax revenue, New Zealand's environmentally related tax revenues are approximately half of the UK's and significantly below the OECD average. While broader environmental taxation aimed at, for example, curbing pollution and managing demand for resources like effluent taxes and water charges, is relatively lower in New Zealand than other developed countries, most of this gap results from New Zealand's lower petrol taxes.

**Figure 3 – Environmental tax revenue as a percent of GDP, 2010**



Source: OECD.<sup>8</sup>

The revenues from environmentally related taxes declined on average in OECD countries over 1994 to 2010, largely driven by a decline in the use of petrol per unit of GDP; this decline indicates that price changes in resources, including environmental taxes, impact on behaviour and efficiency.<sup>9</sup> In New Zealand, total fuel consumption per unit GDP remained nearly flat over 1994 to 2009 while petrol prices and petrol tax rates increased. However, the composition of this consumption shifted away from petrol and toward diesel fuel, on which taxes have increased only slightly over the same period, indicating that consumers have responded to taxation with substitution.

<sup>7</sup> Total natural resources rents are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents.

<sup>8</sup> Tax bases covered include energy products, transport equipment and transport services, measured or estimated emissions to air and water, ozone depleting substances, certain non-point sources of water pollution, waste management and noise, in addition to the management of water, land, soil, forests, biodiversity, wildlife and fish stocks. Revenues from fees and charges are not included. The figure for Canada is from 2009.

<sup>9</sup> OECD. (2013.) "More information on environmentally related taxes, fees and charges." Retrieved from <http://www2.oecd.org/econst/queries/>

## 1.2.2 Indirect impacts

Given the dependence of our economy on natural resources, changes in the availability or quality of natural resources for extraction and use will have a significant impact on New Zealand's economic performance, which, commodity prices and all else being equal, will impact on Government tax revenue. For the same reason, changes to resource management and conservation policies may have indirect impacts on the Government's finances insofar as they impact on the productivity or profitability of resource-dependent sectors.

## 1.3 Policy options

Some of New Zealand's resources are non-renewable, or finite; in some cases, the benefits of extracting these resources and the risks associated with their extraction may be best managed by the Crown on behalf of all New Zealanders, including future generations. These resources represent wealth that New Zealand already holds and policies should be aimed at realising those assets at a rate and in a manner that will provide the greatest return to the economy as a whole, over time.

Some of our resources are renewable but can become degraded, scarce, or extinct if they are not valued and managed appropriately. If the aim is to manage within biophysical limits and protect ecosystem values, renewable resource management should aim to draw down the resource at a rate and in a manner that will not exceed the rate at which the resource renews or replenishes. In practice, communities may choose to manage renewable resources so as to protect additional values, like recreational and cultural uses, which means that we can use even less of these resources.

In some cases, New Zealand may be called upon to do its part to manage within global biophysical limits for natural resources, as we are under the United Nations Framework Convention on Climate Change and the Montreal Protocol on Substances that Deplete the Ozone Layer.

Tools and mechanisms for natural resource and environmental management include:<sup>10</sup>

- *Environmental regulations*, including bans, non-tradable quotas or licenses, standards, and regulations that concern the temporal or spatial extent of an activity. Regulations are best suited to pollutants or behaviours with localised impacts in cases where firms face similar costs of mitigation. Because standards are most often defined in terms of a rate, rather than a level, prescriptive regulations do not guarantee a certain environmental outcome. Grandfathering, or exempting existing firms from regulation, can prevent existing assets from being stranded but may create a bias against new market entrants.
- *Creating markets*, including tradable quotas or rights. These approaches minimise firms' abatement costs and provide incentives for technological advances. Trading schemes impose a relative or absolute restriction on the quantity of emissions or consumption allowed and allow the price of emissions or consumption to adjust to the marginal cost of abatement or substitution.

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<sup>10</sup> Paraphrased from Coria, J. & Sterner, T. (2011.) "Natural resource management: Challenges and policy options." Annual Review of Resource Economics 3: 203-230.

- *Direct price interventions (or using markets)*, including subsidies, subsidy reduction or removal, environmental charges on inputs or products, user charges (taxes or fees), performance bonds, deposit-refund systems, and targeted subsidies. Environmental taxes set a price for emissions or the use or consumption of a resource and allow the quantity emitted, used, or consumed to adjust to the level at which marginal abatement or substitution cost is equal to the level of the tax.
- *Engaging the public*, including information disclosure, labelling, environmental auditing and certification, and community participation in environmental or natural resources management. Providing consumers with more and better information about their consumption and its impacts may influence behaviour. Involving the public in resource management planning may ensure higher compliance and lower transaction costs.
- *International treaties or agreements*, including agreements to collective global action to address localised or global environmental or natural resource management issues. For New Zealand, the challenge in this area is weighing up global benefits against domestic costs.
- *Macroeconomic policies*, including sovereign wealth funds. Where a country has significant deposits of non-renewable natural resources, fiscal and regulatory regimes which maximise the revenue take from their sale must be accompanied by sensible policies for managing the wealth created and distributing it within and between generations.

The goal of natural resource management and environmental policy is to put in place incentives for efficient resource use by communicating the true value of those resources. Advanced natural resource management and environmental policies facilitate better long-term investment decisions, prevent stranded capital, and avoid disputes over ownership and governance. Early non-regulatory policies that build capability for measurement and monitoring can ease the transition to later regulatory policies or market-based mechanisms.

## 1.4 Case studies

In general, long-term challenges and opportunities in the natural resource sector can be grouped into three categories: resource and asset realisation, where there may be an opportunity to realise value from natural capital we already have; mitigation issues, where our economic activities give rise to negative externalities that we want to avoid; and international obligations, where, as a global citizen, New Zealand is called upon to work with other countries in solving cross-border environmental problems.

The following sections present three case studies, intended to illustrate the diversity of New Zealand's natural resource base and therefore the challenges we face in designing effective management regimes for its sustenance:

- Oil and gas are examples of nationalised non-renewable resources with a long-running management regime;
- Fresh water is the model renewable resource, for which existing management structures are at present loosely regulated and highly decentralised; and,
- Climate change offers an example of New Zealand's participation in a global resource management effort.

In considering each of these case studies, we have explored:

- Fiscal sustainability, or the actual fiscal impacts associated with relevant resource management and policies and potential mid- to long-term expectations and drivers,
- Economic growth and efficiency, or the productivity and growth implications associated with relevant resource management and policies and potential mid- to long-term scenarios and drivers, and
- Equity and distribution, or the equity, in particular intergenerational equity, issues raised by resource management and policies and possible methods to address these issues.

## 2 Oil and gas

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### 2.1 Key message

Petroleum already represents a significant revenue stream to the Crown, with significant upside potential. To maximise the benefits of petroleum production, the Crown needs to carefully consider fiscal terms and ensure robust regulatory settings to manage potential environment and health and safety risks.

### 2.2 Introduction

New Zealand already benefits substantially from the revenue gathered from the development and sale of petroleum resources: in 2011/12, the Crown collected \$335 million in royalties and levies on petroleum, excluding associated corporate tax revenue or indirect taxation revenue, or 0.2 percent of GDP. However, most of New Zealand's territory is yet to be explored, and the potential for further development of petroleum resources is significant.

Today, all petroleum mining and production in New Zealand occurs in the Taranaki basin: in total 16 fields produced 19.3 million barrels of crude oil and 0.157 trillion cubic feet of gas in 2010.<sup>11</sup> Gas generated over 20 percent of New Zealand's electricity in 2010.<sup>12</sup> The Ministry for Business, Innovation, and Employment (MBIE) estimates that in 2009, the oil and gas industry, including exploration, production, and supply chain, directly contributed \$1.9 billion (1.5 percent) to national GDP.<sup>13</sup>

New Zealand's crude oil receives a premium on international markets for its high quality, and therefore the majority of domestic production is exported: in 2009, New Zealand exported nearly 90 percent of the crude oil produced domestically.<sup>14</sup> In 2011, crude oil was New Zealand's fourth largest merchandise export at \$2.0 billion, or over 4 percent of total exports.<sup>15</sup>

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<sup>11</sup> Ministry for Business, Innovation, and Employment. (2012.) "The Economic Contribution and Potential of New Zealand's Oil and Gas Industry."

<sup>12</sup> Ministry for Business, Innovation, and Employment. (2012.) "New Zealand's Energy Outlook 2011: Summary of 2011 Modelling Results – Electricity Generation and Build." Retrieved from <http://www.med.govt.nz/sectors-industries/energy/energy-modelling/modelling/new-zealands-energy-outlook>

<sup>13</sup> Ministry of Economic Development. (2012.) "Fact file – Economic contribution Oil and gas Industry."

<sup>14</sup> International Energy Agency. (2012.) "Oil in New Zealand in 2009." Retrieved from [http://www.iea.org/stats/oildata.asp?COUNTRY\\_CODE=NZ](http://www.iea.org/stats/oildata.asp?COUNTRY_CODE=NZ)

<sup>15</sup> Statistics New Zealand. (2012.) "New Zealand in Profile: 2012: Exports." Retrieved from [http://www.stats.govt.nz/browse\\_for\\_stats/snapshots-of-nz/nz-in-profile-2012/exports.aspx](http://www.stats.govt.nz/browse_for_stats/snapshots-of-nz/nz-in-profile-2012/exports.aspx)

## 2.3 Fiscal sustainability

From the Crown perspective, the economics of petroleum exploration and production depend on three interrelated factors:

- Price, or the royalties, taxes, and charges levied on the resources produced,
- Quantity, or the total resources that can practically and cost-effectively be extracted from current fields and potential future discoveries, and
- Risk, or the environmental, health, and safety risks associated with exploration and extraction, which may effectively limit the extent of extractable resources by precluding exploration in certain areas.

### 2.3.1 Price

Taxation schemes for petroleum are designed to ensure the procurement of a reasonable share of revenues for government without introducing distortions that prevent an efficient collection of taxes or that make new oil and gas field development uneconomic. An optimal fiscal system is: targeted on economic rents, related to profits so as to allow for cost recovery plus an adequate return, and flexible to variations in prices and production and operational costs.<sup>16</sup>

In New Zealand, the Crown owns the subsurface petroleum resources; any company wanting to prospect, explore, or mine petroleum in New Zealand must obtain a permit from New Zealand Petroleum and Minerals (NZPAM). The Crown receives approximately 42 percent of the accounting profit from petroleum field developments as royalty and company tax.<sup>17</sup>

Royalty rates should enable the Crown to gain a maximum share of profits consistent with maintaining international competitiveness.

Countries use a variety of approaches to collect revenue from petroleum operations, including auctioning the rights to resources, unit/value production-based royalties, sector specific royalties, accounting profits royalties, resource rent income sharing arrangements, and/or direct dividends from state-owned companies. In New Zealand, the Crown collects the higher of either a five percent royalty on gross revenues or a 20 percent accounting profits royalty.

A study by AUPEC completed in 2009 showed that the New Zealand petroleum fiscal regime is highly competitive against comparator countries, based on data from currently producing fields.<sup>18</sup> AUPEC's assessment is consistent with the Journal of World Energy and Business ranking New Zealand fourth-most fiscally attractive jurisdiction between 1998 and 2007, as shown in Figure 4.

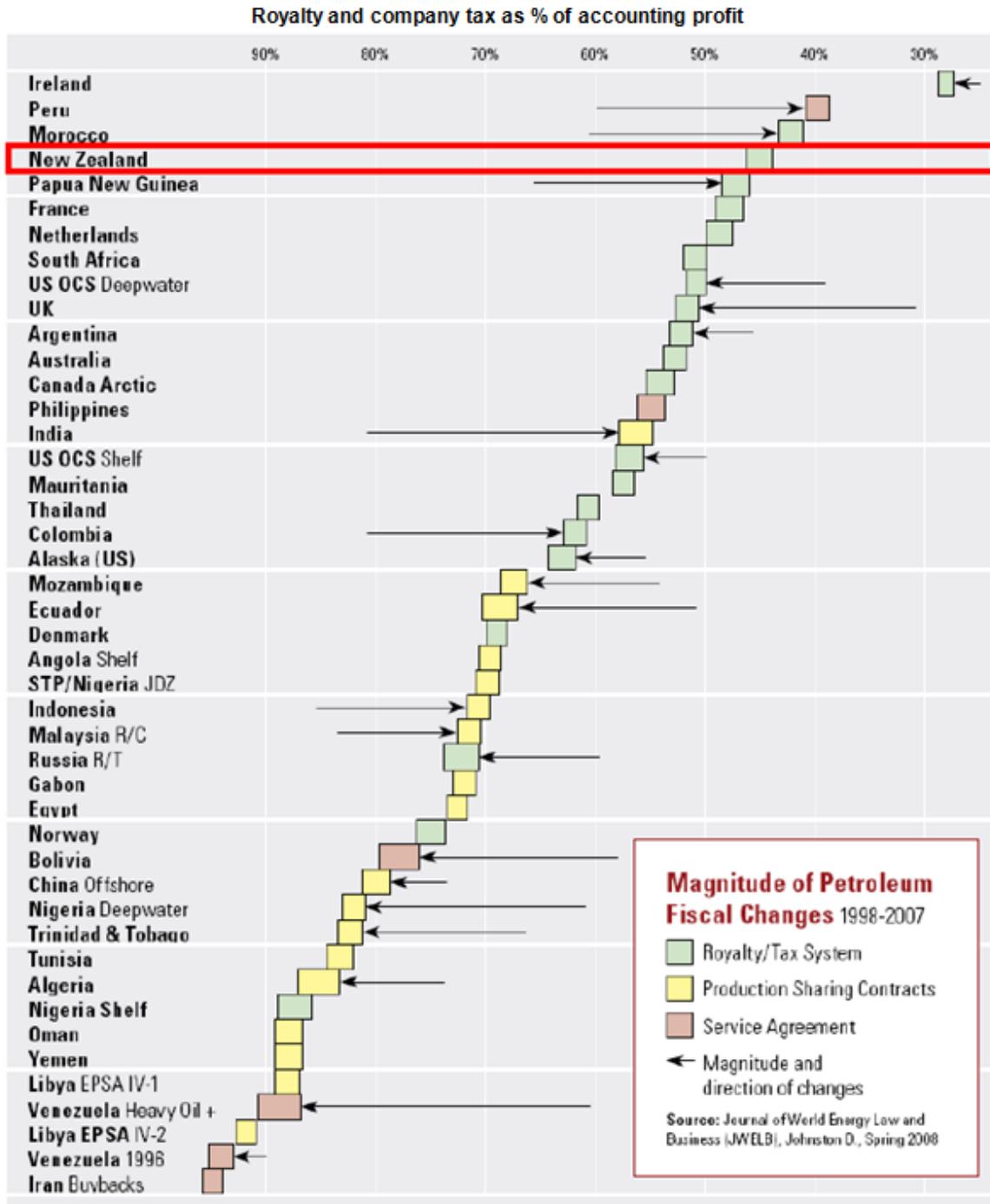
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<sup>16</sup> AUPEC. (2009.) "Evaluation of the Petroleum Tax and Licensing Regime of New Zealand." Retrieved from <http://www.med.govt.nz/sectors-industries/natural-resources/oil-and-gas/petroleum-expert-reports/AUPEC-report-pdf/view>

<sup>17</sup> Ministry for Business, Innovation, and Employment. (2012.) "Review of the royalty regime for petroleum: Background to the regime and options for changes." Retrieved from <http://www.med.govt.nz/sectors-industries/natural-resources/pdf-docs-library/oil-and-gas/crown-minerals-act-review/review-of-the-royalty-regime-for-petroleum.pdf/view>

<sup>18</sup> AUPEC. (2009.) "Evaluation of the Petroleum Tax and Licensing Regime of New Zealand." Comparator countries include Australia, China, Thailand, Papua New Guinea, and India.

Figure 4 – Comparison of international petroleum fiscal regimes



Source: MBIE.<sup>19</sup>

AUPEC noted that the ad valorem royalty imposes a relatively greater burden on marginal fields than on highly profitable fields, which has the effect of making some marginal fields uneconomic to develop. A change from the status quo could offer some benefits in terms of averting the mildly regressive effects of the current system. However, MBIE’s analysis

<sup>19</sup> Ministry for Business, Innovation, and Employment. (2012.) “Review of the royalty regime for petroleum: Background to the regime and options for changes.”

of alternative approaches indicates that the value to the Crown of changes to the fiscal regime will be fiscally marginal.<sup>20</sup>

A resource rent royalty, under which the Crown would collect a percentage of revenue once a project has surpassed a predetermined rate of return, would not disadvantage marginal projects. However, resource rent royalties shift part of the downside project development risk from the private sector to the Crown, as projects that do not become profitable will not pay any royalties; resource rentals are also difficult to forecast, as project developers may 'goldplate' projects, or intentionally inflate costs to keep profitability below the threshold rate.

Australia has adopted a Minerals Resource Rent Tax, which targets true economic rents from mineral extraction, but not at such a rate that marginal extractions do not occur, as might be the case with a fixed rate royalty. Total economic rents, or the profit that exceeds a marginal return, are subject to surtax. The surtax applies in addition to the normal company income tax, which is levied on the entire profit of the extraction company.

Changes to the fiscal regime for petroleum could be reviewed, particularly in the event that future discoveries increase demand for petroleum exploration in New Zealand. Any changes to the New Zealand fiscal regime should aim to:

- Allocate resource rights to the highest value use,
- Provide a fair return to the Crown as owner of the resource,
- Provide appropriate risk-sharing between the Crown and industry, ie, maintain returns to companies on marginal operations and improve returns to the Crown in a high-price, high-exploration environment, and
- Be neutral and non-distortionary, ie, avoid incentives for operators to over-invest for the purpose of reducing royalty payments.

Given oil and gas is a non-renewable resource, any increased royalty take should not offset structural Government expenditure increases. This would leave the Government at risk of ongoing structural deficits when royalty revenues inevitably decrease. Any consequent future service cuts would effectively represent inter-generational inequity, with earlier generations spending at the expense of later generations.

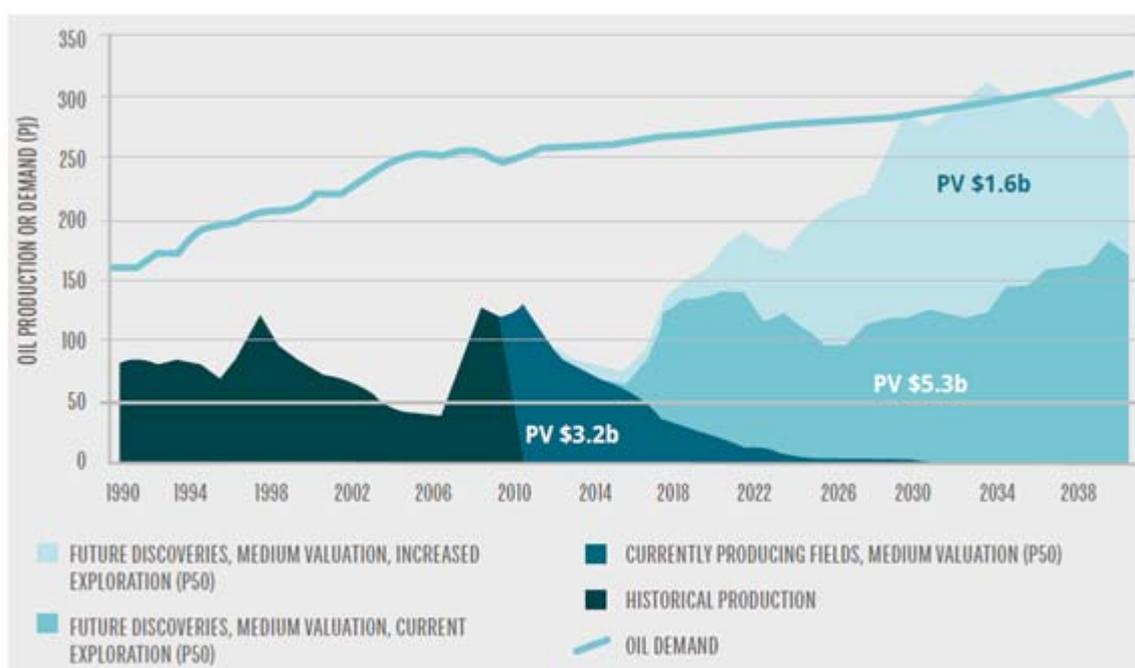
### 2.3.2 Quantity

Using geological information prepared by GNS in 2009, Woodward Partners estimated production frontiers for both currently producing oil fields and further discoveries in the Taranaki and other basins. Figure 5 shows the mid valuation production scenario for currently producing fields and frontier basins against projected domestic oil demand to 2040.

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<sup>20</sup> Ministry for Business, Innovation, and Employment. (2012.) "Review of the royalty regime for petroleum: Background to the regime and options for changes."

**Figure 5 – Oil production scenarios and the present value (PV) of future royalty income**



Source: MBIE.

Woodward Partners also valued the royalties arising from currently producing fields and further discoveries based on estimates of in-place oil and gas reserves and a scenario analysis of commercially viable discoveries.<sup>21</sup> Between 2011 and 2050, the discounted total value of the Crown’s royalty stream from currently producing fields in the oil and gas estate may be estimated at \$3.2 billion and from potential future discoveries at \$5.3 billion. The valuation of royalties from future discoveries could be as low as \$1.6 billion and as high as \$10.3 billion, depending on the assumed rate of future industry activity, projected petroleum prices, and projected exchange rates.<sup>22</sup>

These discounted valuation figures veil the potentially significant future production and associated real tax revenue in the lower probability scenarios and should be treated with caution, given uncertainty in the commercial viability of any resources.

### 2.3.3 Risk

A high degree of aversion to health, safety, and environmental risks may effectively limit the extent to which resources can be discovered and extracted by prescribing certain methods that must be used or areas where exploration and production cannot be undertaken.

<sup>21</sup> Woodward Partners. (2011.) “Valuation of the Crown’s Royalty Streams from the Petroleum Estate.” The valuation of forecast royalties from future discoveries draws on a complex model of forecast future discoveries and production developed by MBIE. The model performs a Monte Carlo analysis, using a number of probability-weighted inputs to generate several hundred scenarios, where each scenario sets out a unique forecast of the total producing fields in each of the eight frontier basins, their revenues, profits, and royalties.

<sup>22</sup> Woodward Partners. (2011.) “Valuation of the Crown’s Royalty Streams from the Petroleum Estate.” Valuations are derived using a discounted cash flow approach with a weighted average cost of capital (WACC) of 8.89 percent for current basins and 11.85 percent for future discoveries. Estimates exclude any corporate tax revenue. Estimate for future discoveries based on the mid scenario with probabilities of 10 percent, 50 percent, and 90 percent are combined according to Swanson’s Rule, which assumes constant or slightly reducing industry exploratory activity and slowly increasing petroleum prices. Six oil price paths and three gas price paths were applied; oil prices in 2030 across the scenarios range from US\$50 to US\$200 per barrel by 2030. Gas is assumed to be sold domestically in NZ dollars; oil is assumed to be sold internationally in US dollars at a long-run average exchange rate of 0.600.

In New Zealand, the regulatory regimes for permitting and for environmental assessment and risk management are separate. Permits for exploration and production are granted under the Crown Minerals Act 1991 (CMA). The regulatory framework for managing environmental risks associated with petroleum exploration and production includes provisions under Resource Management Act 1991 (RMA) and the Exclusive Economic Zone and Continental Shelf Act (Environmental Effects) 2012 (EEZ) and associated regulations. Both exploration and production on land or in the territorial sea are regulated, under the RMA by local authorities; for activities further than 12 nautical miles offshore, the EEZ applies.

## **Environmental risks**

Oil and gas exploration and production operations have the potential for a variety of impacts on the environment including noise; spills, emissions, and other discharges; site access and footprint; socioeconomic and cultural issues; and interference with other resource users. Aerial surveying and seismic operations usually entail transient, short-term impacts. Onshore, exploration requiring vegetation clearance can drive erosion issues, changes in surface hydrology, loss of habitat, and biodiversity impacts. Offshore, where the majority of New Zealand's potential oil fields lie, exploratory operations may impact benthic and pelagic organisms and marine birds and reduce sediment, water, and air quality. Development and production processes carry increased risks of soil and water contamination from spills and leaks and ongoing disruption to the local economy.<sup>23</sup>

The frequency and severity of significant disturbances in New Zealand, including oil spills, has been low historically. According to Maritime New Zealand, less than ten more significant marine oil spills have occurred in New Zealand since 1990 and none of these incidents were the result of petroleum exploration or production activities.<sup>24</sup>

## **Health and safety risks**

Workplace health and safety legislation plays a key role in ensuring that operators prevent the uncontrolled release of oil and gas at their operations. While an uncontrolled release of oil and gas can result in substantial environmental damage it can also lead to a major accident, resulting in multiple injuries and fatalities. Risks associated with major accident hazards are evaluated and controlled through the safety cases and well notifications that are prepared by operators under the Health and Safety in Employment (Petroleum Exploration and Extraction) Regulations 1999.

An external review of New Zealand's health, safety, and environmental legislation for offshore petroleum operations conducted in 2010 revealed a number of gaps in the regulatory framework, the majority of which will be addressed by the EEZ and proposed changes to the health and safety provisions under the CMA.<sup>25</sup>

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<sup>23</sup> Joint E&P Forum/United Nations Environment Programme. (1997.) "Environmental management in oil and gas exploration and production."

<sup>24</sup> Maritime New Zealand. (2013.)

<sup>25</sup> Atkins Holm Joseph Majurey Ltd. (2010.) "Comparative Review of Health, Safety and Environmental Legislation for Offshore Petroleum Operations." Retrieved from <http://www.med.govt.nz/sectors-industries/natural-resources/oil-and-gas/hse-review>

## 2.4 Economic growth and efficiency

The economic benefits of enhanced petroleum exploration and production can be observed in terms of GDP, direct royalty and taxation returns, more and higher-paying jobs, investment, regional development, and exports.

The International Energy Agency (IEA) forecasts that primary oil demand will continue to rise to 2030, driven by demand for transport fuels in the developing and emerging economies, and that oil supply will simultaneously continue to fall, as oil companies resort to more expensive, less conventional sources. However, there is some uncertainty surrounding these projections, given rapid developments in relatively low-cost unconventional sources: the U.S. Energy Information Administration projects that the average crude oil import price could fall to US\$70 or rise as high as US\$230 per barrel in 2011 dollars by 2040 compared with US\$103 per barrel in 2011.<sup>26</sup>

New Zealand's dependence on imported oil is highly variable: imported oil as a percent of the total annual volume of oil consumed dropped as low as 35 percent in 1997 and reached as high as 85 percent in 2006.<sup>27</sup> Oil production in 2011 was equivalent to 50 percent of the total annual volume consumed.<sup>28</sup> Domestically produced crude oils are generally too light and waxy to make good aviation and diesel fuel, which account for nearly 50 percent of New Zealand's oil consumption.<sup>29</sup> A 2005 study by the Reserve Bank suggested that the indirect effects of higher oil prices on inflation and the economy, through an increase in the cost of providing transport services and other goods and services, could be relatively large.<sup>30</sup>

General equilibrium modelling by NZIER has shown that a South Island basin development scenario including the discovery of ten new oil and gas fields over 2010-2040 could drive an increase in Gross National Disposable Income of 0.77 percent and in GDP of 1.2 percent on average per annum. The increase in export values results in higher income and improved living standards for New Zealanders, an improvement in the balance of trade, and indirect tax revenues. The upside is restricted by a number of counterbalancing effects, including an appreciation in the exchange rate, which could disadvantage competing exporters, and an increase in net foreign liabilities.<sup>31, 32</sup>

### 2.4.1 "Dutch Disease" and macroeconomic policy

A significant increase in oil and gas production as a result of new discoveries can have significant impacts on the economy. Positive effects result from the increase in the country's wealth. However, these benefits can be offset by an exchange rate appreciation that reduces the competitiveness of other sectors, such as import-competing or non-petroleum export industries (eg, manufacturing, agriculture, tourism). These effects are

<sup>26</sup> U.S Energy Information Administration. (2013.) "Annual Energy Outlook 2013: With projections to 2040."

<sup>27</sup> Ministry for Business, Innovation, and Employment. (2012.) "The Economic Contribution and Potential of New Zealand's Oil and Gas Industry."

<sup>28</sup> Ministry of Economic Development. (2012.) "Fact file – Economic contribution Oil and gas Industry."

<sup>29</sup> Parliamentary Commissioner for the Environment. (2010.) "Some biofuels are better than others: Thinking strategically about biofuels." Retrieved from <http://pce.parliament.nz/publications/all-publications/some-biofuels-are-better-than-others-thinking-strategically-about-biofuels/>

<sup>30</sup> Delbruck, F. (2005.) "Oil prices and the New Zealand economy." Reserve Bank of New Zealand: Bulletin 68 4.

<sup>31</sup> Ministry for Business, Innovation, and Employment. (2012.) "The Economic Contribution and Potential of New Zealand's Oil and Gas Industry."

<sup>32</sup> Zuccollo, J. & Ballingall, J. (2012.) "Value of oil and gas exploration: Hypothetical scenarios." New Zealand Institute of Economic Research.

sometimes collectively referred to as “Dutch Disease,” a term originally used to describe the decline of the manufacturing sector in the Netherlands after the discovery of a large natural gas field in the late 1950s.

The literature suggests that the optimal policy response to “Dutch Disease” effects may consist of:<sup>33, 34, 35, 36, 37</sup>

- Avoiding fiscal policy pro-cyclicality by preventing the increased tax and royalty revenues from flowing through into tax reductions or increased government spending. Revenues could be saved into sovereign wealth or stabilisation fund, thereby making those resources unavailable to meet other funding pressures.
- Promoting ongoing structural reform to facilitate adjustment, improve the business environment for the non-commodity sector, and drive productivity improvements.
- Improving financial regulation and supervision to contain any credit booms and asset bubbles.

A number of other countries have experienced large resource booms, such as Norway, Chile, and Australia. These countries have managed their resource booms in different ways, and we can learn from their experiences about how to minimise the undesired macroeconomic consequences. Even the lowest probability scenario modelled by Woodward Partners is unlikely to be as large as these other countries’ resource booms. However, in the event of a significant petroleum resource discovery New Zealand should be prepared to consider such measures.

## 2.5 Equity and distribution

Because they are finite, exhaustible resources, the extraction of oil and gas entails obvious intergenerational equity issues: oil and gas should be produced so as to realise the highest returns and those maximised returns should benefit current and future generations. Because the value of these natural resources is determined by a highly volatile, global market, it will be challenging to buy and sell optimally or to distribute resulting returns equitably.

As explained, these characteristics of natural resource rents have encouraged many oil-producing nations to establish sovereign wealth or oil funds, which are designed to manage and invest a nation’s wealth accumulated through the sale of natural resources, both to manage macroeconomic effects and the effects of exchange rate appreciation and to distribute both benefit of oil wealth accumulated and the risk of price volatility and extraction uncertainty across generations.

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<sup>33</sup> Cordon, M. (2012.) “The Dutch Disease in Australia: Policy options for a three-speed economy.” Melbourne Institute Working Paper No. 5/12.

<sup>34</sup> Garton, P. (2012.) “Sovereign wealth funds and the exchange rate: comparing resource booms in Australia, Chile and Norway.” Australian Treasury Economic Roundup 2:19-38.

[http://econpapers.repec.org/article/tsyjournl/journl\\_5ftsy\\_5fer\\_5f2012\\_5f2\\_5f2.htm](http://econpapers.repec.org/article/tsyjournl/journl_5ftsy_5fer_5f2012_5f2_5f2.htm)

<sup>35</sup> Magud, N., & Sosa, S. (2010.) “When and why worry about real exchange rate appreciation?” IMF Working Paper 10/271.

<sup>36</sup> International Monetary Fund. (2012.) “Macroeconomic policy frameworks for resource-rich developing countries.”

<sup>37</sup> OECD. (2012.) “2012 Economic Review – Australia.”

## 3 Fresh water

### 3.1 Key message

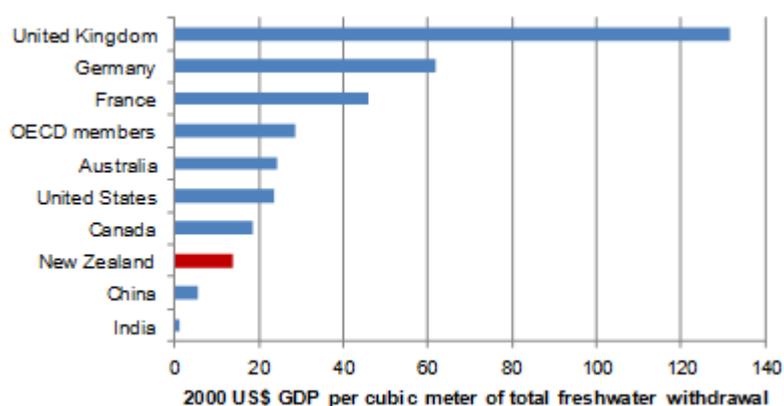
While New Zealand has a very large freshwater resource, quality and availability of water are deteriorating at the regional- and catchment-level. Once regions set objectives and limits for the quantity and quality of the water in their catchments, it will be important that regions have the regulatory and legislative tools that they need to manage within those limits and maximise the social, cultural, environmental, and economic value they obtain from the water available for use. Market-based mechanisms, like tradable water permits and water charges, may be needed in some regions.

### 3.2 Introduction

Fresh water provides an essential, life-supporting service to our communities and the wider economy. The resource is pervasive, as nearly every product or service we consume or activity we undertake is reliant on fresh water, including agricultural and energy production, cultural identity, leisure activities, and tourism. Water also adds significant value to our economy: in 2004, charges for water supply by local authorities, value-added from irrigation, and value-added from water in hydroelectric power generation amounted to nearly 1.4 percent of GDP.<sup>38</sup>

By international standards, fresh water in New Zealand is both clean and plentiful in supply. The OECD ranks New Zealand fourth among OECD countries for volume of fresh water per capita and third for water withdrawal as a percentage of gross annual availability. However, Figure 6 shows that New Zealand's water productivity, or GDP per cubic metre of water withdrawal, is lower than the OECD average. This is largely a reflection of our significantly agricultural economy, which relies more heavily on fresh water as an input than other manufacturing-based economies.

**Figure 6 – GDP per cubic metre of total freshwater withdrawal, 2009**



Source: Food and Agriculture Organization, World Bank, and OECD.

Our freshwater resource is spread across 425,000 kilometres of rivers and streams, almost 4,000 lakes larger than one hectare, and about 200 aquifers.<sup>39</sup> We currently abstract less than 5 percent of the freshwater resource, primarily drawn from surface waters.<sup>40</sup>

<sup>38</sup> Statistics New Zealand. (2004). "The Water Monetary Stock Report." Retrieved from <http://www.stats.govt.nz/~media/Statistics/browse-categories/environment/natural-resources/water-monetary-stock-report/wms-report.pdf>

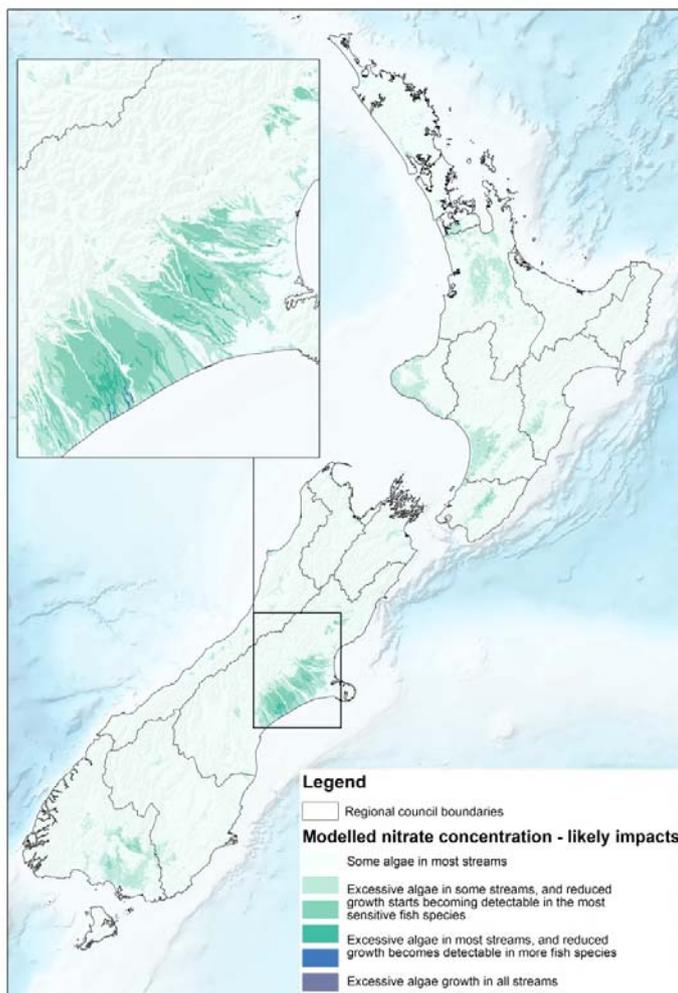
<sup>39</sup> Ministry for the Environment. (2007.) "Environment New Zealand 2007."

In 2010, the total weekly consented allocation of fresh water was 3,946 million cubic metres, with approximately 19 percent for consumptive use, ie, once taken, the water is not available to other uses at that point in time.<sup>41</sup> Forty-six percent of weekly consumptive allocation is for irrigation, 41 percent is for consumptive hydrogeneration, and the remainder is split between industrial, drinking, and stock uses.<sup>42</sup> Apart from cultural and leisure activities, most uses of water are consumptive. An exception is hydroelectricity generation, where most takes will generally be returned to the source after use, thereby making it available to other users.

### 3.2.1 Quality

Figure 7 presents modelled impacts of nitrate concentrations for all river reaches in New Zealand and indicates that the state of water quality in New Zealand’s rivers is highly variable but declining in some places.

**Figure 7 – Modelled nitrate concentrations in rivers**



Source: Ministry for the Environment (MfE).<sup>43</sup>

<sup>40</sup> Ministry for the Environment. (2012.)

<sup>41</sup> Aqualinc Research Ltd. (2010.) "Update of Water Allocation Data and Estimate of Actual Water Use of Consented Takes 2009-10."

<sup>42</sup> Aqualinc Research Ltd. (2010.) "Update of Water Allocation Data and Estimate of Actual Water Use of Consented Takes 2009-10." The consumptive hydrogeneration take which accounts for 41 percent of national weekly allocation is the Manapouri Power Station, which takes water from the Waiau River and discharges it out to sea. Excluding this take, nearly 80 percent of national weekly allocation is for irrigation.

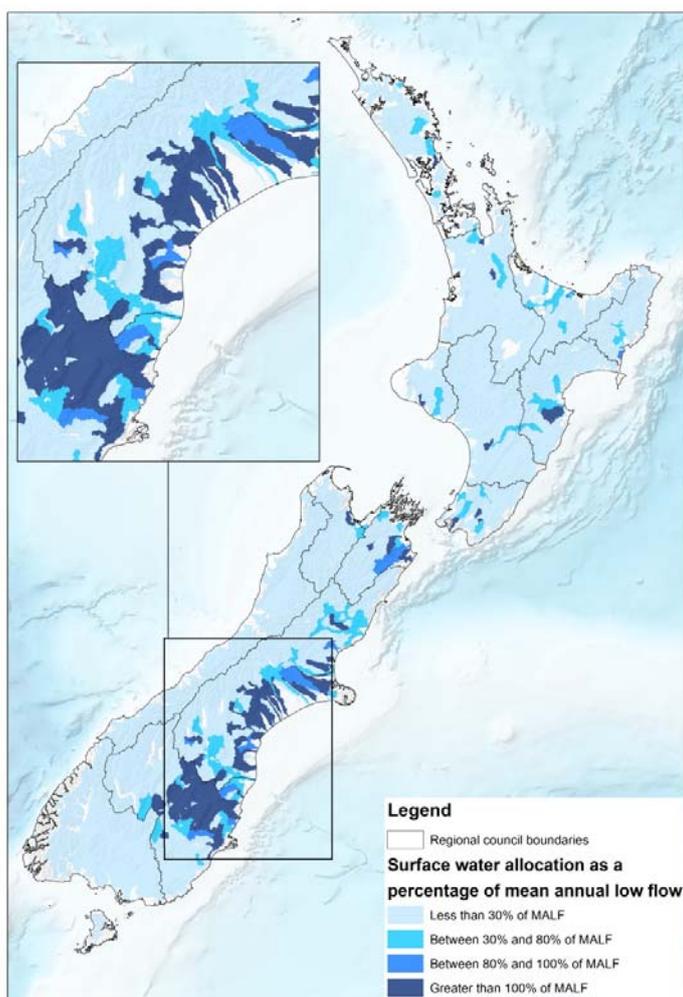
<sup>43</sup> NIWA. (2010.) "Modelling water quality in New Zealand rivers from catchment-scale physical, hydrological and land-cover descriptors using random forest models." The models incorporate river water quality data from up to 601 sites between 2003 and 2007 and explain around 70 percent of the variation in nitrate and bacterial levels.

Rivers in urban and rural areas generally have poorer water quality compared to rivers in native forest. Catchment features, such as land-cover, climate, and geology have a large influence on water quality, which highlights the significant contribution of non-point sources, such as run-off from agriculture, to poor water quality.

Water quality is degraded in some lowland areas of Northland, Auckland, Waikato, the east coast of the North Island, Taranaki, Manawatu-Wanganui, Canterbury, and Southland, where nutrients could stimulate plants and algae to grow to excessive levels in some rivers and streams.

### 3.2.2 Quantity

**Figure 8 – Estimated surface water allocation pressure**



Source: MfE.<sup>44</sup>

Figure 8 shows a ‘worst case scenario’ assessment of the volume of consented water allocations as a percentage of the volume of available surface water. Figure 8 illustrates that quantity pressures are generally a catchment or regional rather than a national issue.

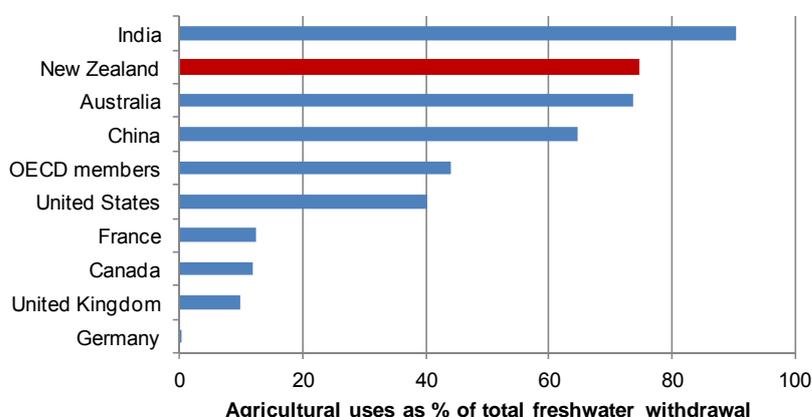
<sup>44</sup> Water availability is based on Mean Annual Low Flow (MALF), which assesses the surface water level conditions during the driest part of the year and assumes that all allocated water is taken. The MALF is modelled for stream segments by NIWA, and the most downstream value in each catchment is assigned to the catchment. The consented water allocation includes consumptive surface water sources (ie, it excludes storage, groundwater and non-consumptive takes), which captures 60 percent of all consented consumptive allocation in New Zealand in 2010.

Based on the map, 85 percent of large catchments fall in the light blue area where there is low allocation pressure on the available water relative to mean annual low flow, 6 percent fall in the 30 to 80 percent allocation bands, 1 percent in the 80 to 100 band, and 8 percent have allocations greater than the modelled minimum flow (dark blue areas).

The allocation bands are modelled on consented water use. This is an important distinction as the average national actual water use for consumptive takes is estimated to be 65 percent of consented volume, meaning that consent holders are entitled to use more water under their permit than they are actually using.<sup>45</sup>

Figure 9 shows that New Zealand uses nearly 75 percent of total water withdrawal for the agriculture sector, putting us on par with Australia, but significantly higher than the OECD mean.

**Figure 9 – Agricultural uses as a percent of total freshwater withdrawal, 2009**



Source: Food and Agriculture Organisation.

The Crown has devolved responsibility for managing New Zealand’s freshwater resource to regional councils. Beyond an individual’s reasonable domestic needs, drinking water for livestock, and water for fire fighting, water use requires a permit unless expressly provided for through a National Environmental Standard or a rule in a regional plan.

The Resource Management Act 1991 (RMA) provides regional councils with the authority to issue resource consents for water take and use and discharge of contaminants to water bodies or land. Water permits tend to be granted in the order they are received and vary in length; they are typically granted for periods of five to 15 years but can go up to a maximum of 35 years where greater upfront capital investment is required and/or projects entail significant regional or national benefits. The length of consents has an important bearing on the commercial viability, including investment incentives, of some uses, particularly where large capital assets are involved.

In 2009, the Government commissioned advice from the Land and Water Forum (the Forum), which ran a stakeholder-led collaborative process to build a consensus view on shared outcomes, goals, and long-term strategies for fresh water in New Zealand. The Forum produced three reports over 2009-2012 which included specific recommendations on objective- and limit-setting, governance, and managing within limits for water quality and quantity.

<sup>45</sup> Aqualinc. (2010.) "Update of Water Allocation Data and Estimate of Actual Water Use of consented Takes 2009-10."

In 2011, the Government introduced a National Policy Statement on Freshwater Management (NPS-FM), which sets out objectives and policies that direct local government to manage water in an integrated and sustainable way, while providing for economic growth within set water quantity and quality limits. Under the NPS-FM, regional councils are responsible for putting in place limits for discharges of contaminants and water takes by 2030.

The Government is now in the process of responding to the recommendations of the Forum and has proposed a number of potential reforms to the freshwater management system, including an alternative collaborative process for freshwater planning; a National Objectives Framework, to assist regions in selecting their management values and setting objectives for water bodies; and regulations requiring complete accounting for both water takes and sources of contamination.<sup>46</sup> Later reforms could include further central government direction and guidance on management approaches, including tools to promote efficient use and alternative allocation models.

### 3.3 Fiscal sustainability and economic growth and efficiency

Coming decades will be characterised by increasing water scarcity and reduced reliability of water supply and quality in key catchments and regions at the times of year and in the places where water is in highest demand. Failure to plan for these challenges may entail significant fiscal costs, both in the form of decreased tax revenue from the agriculture sector and increased expenses for *ex post* clean-up resulting from over-use and under-management. Since 2008, approximately \$340 million in Crown funding has been committed to the clean-up of just eight lakes and rivers.

In order to avoid the environmental and economic costs of poor management, there are a number of policies and tools that can be used by regions in managing increasing pressure on freshwater resources. These tools include regulatory approaches, like requiring the use of best management practices or restricting the discharge of contaminants. Command and control approaches like these can be effective for managing water where resource users have similar demand for water and similar cost curves for pollution abatement, but, in the event that resource users face differing marginal costs of abatement or reduced availability, regulatory approaches may be more expensive than market-based policies.

The OECD has suggested that New Zealand continue to encourage the development of market-based mechanisms where possible to manage the supply and quality of fresh water.<sup>47</sup> Market-based policies assign, either implicitly or explicitly, a price for water or discharge of contaminants that reflects supply, economic, or full costs associated with that use or discharge. These policies include quantity-based controls, like trading of water permits, rights, or quotas, or direct price interventions, like water charges, rent taxes, or royalties. These market-based instruments may be guided by one or a mix of the following objectives:

- **Economic efficiency**: Establishing or increasing the price of water can drive greater technical and productive efficiency by ensuring business or household decisions take into account the value of water inputs.

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<sup>46</sup> Ministry for the Environment. (2013.) "Freshwater reform 2013 and beyond." Retrieved from <http://www.mfe.govt.nz/publications/water/freshwater-reform-2013/>

<sup>47</sup> OECD. (2013.) "2013 Economic Review – New Zealand."

- **Distributive efficiency and equity:** Price-based tools can assist local authorities in recovering costs from direct beneficiaries to fund capital infrastructure, environmental clean-up, or water planning, research, or monitoring activities.
- **Fiscal benefits:** These policies could generate revenues to the extent that freshwater use is charged or taxed and rents gathered accrue to regional or central government.

The application of market-based tools to freshwater will be informed by the particular scarcity or quality challenges relevant to the locality. A number of market-based tools are already being employed in New Zealand to manage demand and reduce pollution.

### 3.3.1 Market-based mechanisms for managing water quality

Regulatory, or command-and-control, approaches for managing freshwater quality have been highly successful in addressing point source pollution in New Zealand. However, the proliferation of dairy and other pastoral farming has resulted in an increase in non-point source discharges to surface waters. The water quality state impacts of these non-point source discharges depend upon the hydrology of individual catchments, soil types, and proximity to waterways. These impacts may take years or even decades to become apparent.

There is some experience with market-based mechanisms for managing water quality in New Zealand. Lake Taupo is the largest freshwater lake in Australasia and one of New Zealand's most iconic physical landmarks. The lake attracts a large proportion of Taupo district's half-million visitors annually<sup>48</sup> and supports a world-renowned recreational trout fishery. The water in Lake Taupo is characterised by high quality and clarity and low nutrients loads. However, pastoral farming in the lake's catchment has driven a decline in water quality over the past 40 years.<sup>49</sup> Despite occupying only 18 percent of the surrounding land, farming activities contribute more than 90 percent of the manageable nitrogen input to the lake.<sup>50</sup>

To address local and national concerns over the potential for decreased water quality in Lake Taupo, the Waikato Regional Council has implemented a cap-and-trade scheme for nitrogen discharges in the catchment. Under this scheme, fully tradable nitrogen discharge allowances are allocated for free to landowners based on the highest leaching year between 2001 and 2005. The scheme aims to reduce total annual anthropogenic nitrogen discharges to the lake by 20 percent by 2020; this target will largely be accomplished the buy-back of nitrogen discharge allowances by the Lake Taupo Protection Trust at a rate of \$0.4 million per tonne. The Trust will receive nearly \$82 million in total local and central government funding over 2004 to 2019. They expect to achieve their 20 percent reduction target in 2015, or five years ahead of plan.

<sup>48</sup> Enterprise Great Lake Taupo. (2013.) "Taupo District Monitor – Trends to September Quarter 2012." Retrieved from <http://www.greatlaketaupo.biz/index.php/research>

<sup>49</sup> Waikato Regional Council. (2013.) "How land use affects Lake Taupo." Retrieved from <http://www.waikatoregion.govt.nz/Environment/Natural-resources/Water/Lakes/Lake-Taupo/How-land-use-affects-Lake-Taupo/>. This decline in water quality is the result of an increase in chlorophyll a, an associated increase in the particulate forms of the nutrients phosphorus and nitrogen in the lake's surface waters, and an increase of 200 percent in nitrate nitrogen in the bottom waters of the lake. This nitrate nitrogen can lead to algal blooms, which decrease water clarity.

<sup>50</sup> Proffitt, F. (2011.) "How clean are our rivers?" NIWA.

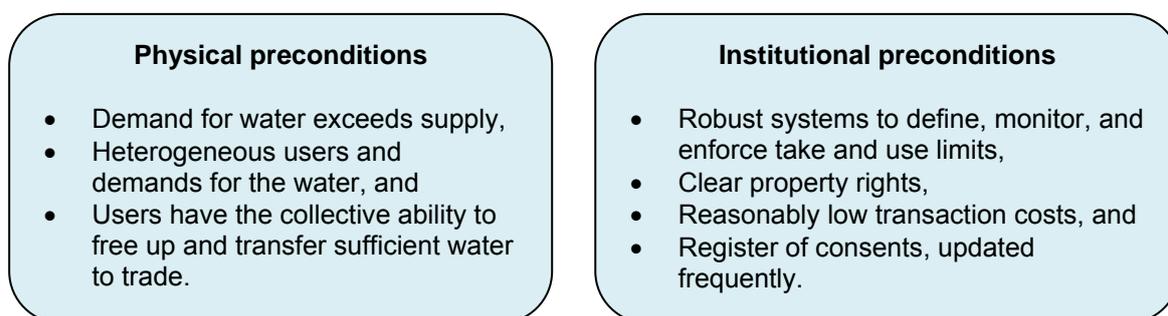
### 3.3.2 Market-based mechanisms for managing water quantity

#### Trading

There is substantial international evidence that demonstrates that water markets can reveal the value of water to existing and potential users, generating short-term incentives to use water more efficiently and longer-term incentives to shift water to higher value uses. Trading may also generate incentives for water users to develop or reconfigure infrastructure, such as water storage and irrigation.

Water trading has been progressively introduced in Australia's Murray–Darling Basin (MDB) since the late 1980s. The Australian Government's National Water Commission has undertaken modelling which estimated that water trading in the southern MDB (sMDB) contributed over 2 percent to Australia's GDP in 2009. The total benefits were even greater within the sMDB, where water trading increased gross regional product by over A\$370 million in that year, indicating that water trading maintained productive capacity within the sMDB, rather than shifting it to other areas of Australia. Trading, along with more efficient management practices, also drove absolute decreases in water use in irrigation: between 2001 and 2006, the value of agricultural production in the sMDB (including dryland and irrigated agriculture) increased by nearly 2 percent despite a 14 percent reduction in water use.<sup>51</sup>

In the New Zealand context, there may only be a few regions that will surpass limits for water takes and therefore possess the prerequisites for trading:



The RMA provides for the transfer of water permits to another site within the same catchment or zone under some circumstances; the majority of regional plans do not expressly allow off-site transfer of water permits and transfers have occurred very infrequently. Trading has taken place in a number of regions experiencing water shortages, including Canterbury, Hawkes Bay, and Otago, often as shares within irrigation schemes that have a single consent or bilaterally between farmers or brokers.<sup>52</sup> HydroTrader, a Canterbury-based water broker, assisted in completing nearly 50 sales and leases of water permits over 2007 to 2012 amounting to over 8 million cubic metres per annum.<sup>53</sup>

Horizons Regional Council's Proposed One Plan indicates that transfers of water permits within water management zones will generally be approved where water is needed and being used efficiently and there are no more than minor adverse effects on other water users. Transfers have been allowed through plans in the region during periods of low-flow since the late 1990s.

<sup>51</sup> National Water Commission, Australian Government. (2010.) "The impacts of water trading in the southern Murray–Darling Basin: An economic, social and environmental assessment."

<sup>52</sup> Brokers include HydroTrader and real estate agents.

<sup>53</sup> HydroTrader. (2013.) "Sales history." Retrieved from <https://www.hydrotrader.co.nz/auction/salesAll.do>

## Charging

Pricing or charging can take various forms, including volumetric use charges; resource rentals or royalties; fees or charges levied at the point of issue or allocation; and/or surcharges levied at the point of transfer or trade. Charges can be seasonal and, where they are flat fees, can be banded or adjusted depending on the scale of the take. Revenues generated will depend on the pricing or charging model used and the outcome desired.

Water taxes have been successfully implemented in other jurisdictions with significant success. A study undertaken by the European Commission in 2011 found that volumetric charges on drinking and industrial water in the Netherlands and Cyprus have reduced consumption by between 8 and 40 percent, depending on user group.<sup>54</sup>

Strictly speaking, charging to reduce demand and increase efficiency should only be undertaken in circumstances where the resource is scarce or approaching scarcity or the use of the resource causes environmental damage. While there are a number of regions in New Zealand that face these kind of challenges, there are a larger number of regions where water is available when and where it is needed. In these circumstances, introducing charges may be inefficient, introduce unnecessary price distortions between regions, or cost more to implement and administer than any resulting economic benefit.

There is some institutional experience with water charging in New Zealand, although largely for the purpose of recuperating costs associated with urban and municipal water services and delivery infrastructure. Charges have not been explicitly used as a pricing tool to encourage efficiency in use and there is very little, if any, volumetric charging for other abstractive uses such as agriculture and industry. In the majority of cases, councils in New Zealand fund water delivery to residential ratepayers through rates and development levies, not through any charges relating to actual use.

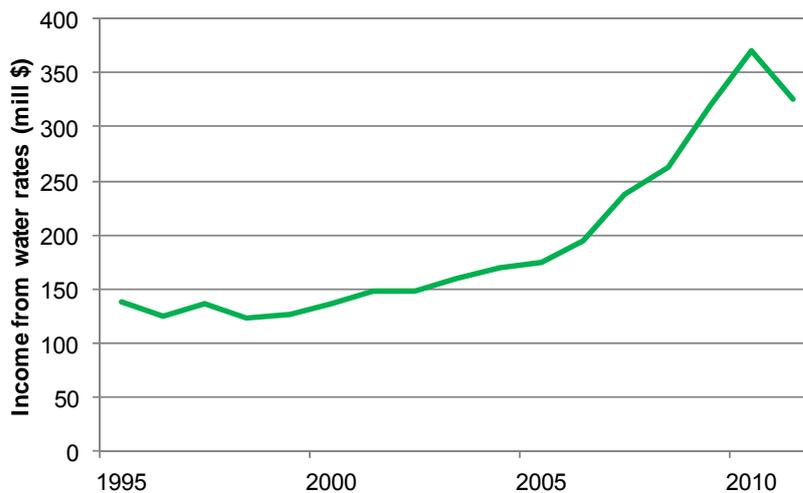
Six of 66 local authorities meter and volumetrically charge across the whole of their jurisdictions and an additional eight meter and volumetrically charge across parts of their jurisdictions.<sup>55</sup> The remainder of authorities include water charges in their general rates. Figure 10 shows annual actual income from targeted water rates for all local authorities over 1995 to 2011. Revenues from targeted water charges have more than doubled over the past 15 years, despite patchy application and demand reduction responses.

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<sup>54</sup> European Commission. (2011). "The role of market-based instruments in achieving a resource efficient economy." Retrieved from [http://ec.europa.eu/environment/enveco/taxation/pdf/role\\_marketbased.pdf](http://ec.europa.eu/environment/enveco/taxation/pdf/role_marketbased.pdf)

<sup>55</sup> These are Whangarei District, Auckland Council, Tauranga City, Carterton District, Nelson City, and Tasman District.

**Figure 10 – Annual revenue from targeted water rates**



Source: Statistics NZ.<sup>56</sup>

### *Auckland Council*

Charging for reticulated water supply and wastewater disposal is currently undertaken in Auckland by Watercare, a water and wastewater treatment supplier wholly owned and operated by the Auckland Council. The company supplies around 370 million litres of water per day. Watercare levies volumetric charges on water delivery: in the year to July 2013, the charge amounts to \$1.343 per 1000 litres.

Although the fees are aimed at cost recovery, they are realising co-benefits in demand management and aim to reduce gross consumption by 15 percent by 2025.<sup>57</sup> Auckland City consistently demonstrates the lowest per capita water consumption in New Zealand.<sup>58</sup>

### *Tauranga City Council*

Tauranga City Council uses targeted water rates to recover costs associated with water collection, treatment, distribution, and water conservation measures.<sup>59</sup> The Council's processing facilities have capacity to process 67 million litres of water per day. Tauranga City Council levies volumetric charges on water delivery: in the year to July 2013, the charge amounts to \$1.70 per 1000 litres, plus a base charge of \$26 for all standard domestic customers.

<sup>56</sup> Includes only targeted water rates and therefore excludes charges associated with water service, delivery, and management that are included in general rates.

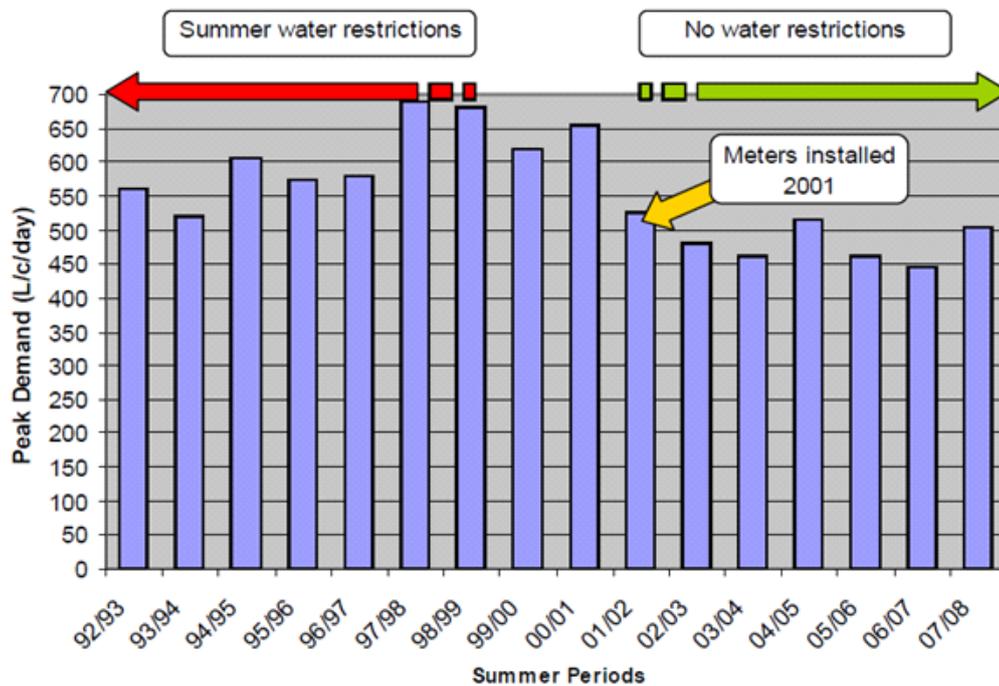
<sup>57</sup> Watercare Services Ltd. "Annual Report 2012." Retrieved from [http://www.watercare.co.nz/SiteCollectionDocuments/AllPDFs/Publications/Watercare\\_Annual\\_Report\\_excl\\_Supplementary\\_Materials\\_2012.pdf](http://www.watercare.co.nz/SiteCollectionDocuments/AllPDFs/Publications/Watercare_Annual_Report_excl_Supplementary_Materials_2012.pdf)

<sup>58</sup> Water New Zealand. "Water Metering." (2011.) Retrieved from [http://www.waternz.org.nz/Folder?Action=View%20File&Folder\\_id=99&File=111118%20metering%20overview.pdf](http://www.waternz.org.nz/Folder?Action=View%20File&Folder_id=99&File=111118%20metering%20overview.pdf)

<sup>59</sup> Conservation initiatives include active leakage control, pressure management, the renewal of pipes in poor condition, continuous monitoring of the distribution system, and customer education programmes.

As shown in Figure 11, average per capita water consumption in Tauranga City has fallen 25 percent and per capita peak use has fallen by 30 percent since the introduction of metering and volumetric charging in 2001. Decreased demand has allowed the Council to delay estimated capital expenditure of \$70 million on water supply investments for more than 10 years. Taking into account the delayed capital expenditure and depreciation costs and reduced treatment needs as a result of reduced demand, the Council estimates that metering and charging will yield an average saving of \$4.7 million per annum over 2002 to 2032 or \$83 million in present value terms over the 30-year period.<sup>60</sup>

**Figure 11 – Peak summer water demand in Tauranga City**



Source: Local Government Infrastructure Efficiency Expert Advisory Group.

Given the capital intensity of our agriculture sector, it is critical that policy methods and tools are well-signalled and effective in constraining long-term discharge levels within environmental limits. Fluctuating water policies can lead to substantial economic and environmental costs, eg, lost return on investment or *ex post* clean-up. The need for investor certainty will have to be balanced against a need for flexibility in the policy mix.

Fresh water also generates other forms of value, particularly stemming from non-consumptive uses where the activities do not preclude water from being allocated to another user. Broadly speaking, the quality of the water may be relatively more important for such uses. Apart from hydro generation, there are several non-commercial activities that fall in that category. For example, in-stream activities like tourism, recreational fishing and swimming; near-stream activities that yield amenity value; and Māori cultural and spiritual value as *taonga*. The value derived from such activities is not easily expressed on a per volume basis.

<sup>60</sup> Sternberg, J., & Bahrs, P. "Water metering: The Tauranga Journey." (2011.) Retrieved from [http://econtent.tauranga.govt.nz/data/water/files/water\\_metering\\_the\\_tauranga\\_journey\\_paper\\_2011.pdf](http://econtent.tauranga.govt.nz/data/water/files/water_metering_the_tauranga_journey_paper_2011.pdf)

### 3.4 Equity and distribution

Generally speaking, the most significant market benefits of water extraction and contamination accrue privately to businesses, like manufacturers and farms, which require water as an input to production or rely on the ability of water bodies to absorb contaminants that are by-products of production processes. These firms have a significant incentive to secure consents to take and discharge to water. As a result, more passive recreational and cultural users, whose water use isn't monetised or easily valued have relatively less influence over the availability and quality of freshwater resources.

Policies that aim to control discharges, reduce demand, or drive water toward higher-valued uses may entail costs on productive users to the extent that they have to change practices or invest capital in new or improved technologies. The benefits of those policies will accrue more widely. Regional councils will have to consider the trade-offs between public and private costs and benefits and the best approach to redistribution of costs and benefits where appropriate; there may be a role for central government in supporting regional councils in developing these capabilities.

Decisions about policy for managing freshwater quality have implications for inter-generational equity, as some discharges take years or even decades to reach water bodies and affect the water's quality and costs incurred by current taxpayers may not realise water quality state benefits for many years. Good planning now, which imposes lower-level costs over longer transition timelines, can avoid damage to water bodies which may be either too costly or impossible to correct in the future.

## 4 Climate change

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### 4.1 Key message

New Zealand faces challenges and information barriers in reducing its greenhouse emissions and adapting to climate change. While the shape of international policy remains unclear, it will be economically important that New Zealand contributes our 'fair share' of global mitigation in-step with other countries and maintains our competitive advantage in those areas where our production is less emissions-intensive.

### 4.2 Introduction

As an island nation with a long coastline and an economy reliant on primary production, New Zealand is vulnerable to changes in the climate. Rainfall patterns may shift and temperatures may be 1°C higher by 2040 and 2°C higher by 2090, on average relative to 1990.<sup>61</sup> While New Zealand may not be as severely affected by climate change as some countries, impacts may include an increased frequency and intensity of natural hazards and extreme events, such as floods, landslides, droughts, hot days, storms, and coastal erosion.<sup>62,63</sup> While we can predict some of these changes in weather patterns and even the economic impacts of more gradual warming,<sup>64</sup> it is nearly impossible to predict the precise impacts that may be associated with individual extreme, or catastrophic, events that could be brought about by climate change.

The potential risks we face from a changing climate will require adaptive response and our reputation for progressive environmental policymaking position us to play a role in global efforts to reduce greenhouse gas emissions.

New Zealand emits only 0.2 percent of global greenhouse gas emissions. For this reason, our mitigation policies will be most effective in contributing to a global solution to the extent that they encourage larger-emitting nations to take action.

New Zealand faces significant challenges in reducing our greenhouse gas emissions. Compared to the rapidly developing Asian economies and large developed countries, New Zealand has fewer low-cost opportunities to reduce emissions from business-as-usual activity. In these countries, the great majority of emissions come from fossil fuel use and industrial processes. Nearly 50 percent of our emissions come from the agriculture sector, where fewer abatement options are available. The forestry sector has large potential for carbon sequestration in the short-term, but regardless of its eventual use, carbon stored in wood products is emitted at or over time after harvest.

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<sup>61</sup> "Projections of Future New Zealand Climate Change, Climate Change Effects and Impacts Assessment: A Guidance Manual for Local Government in New Zealand." (2008.) Ministry for the Environment. Retrieved from <http://www.mfe.govt.nz/publications/climate/climate-change-effect-impacts-assessments-may08/page4.html>

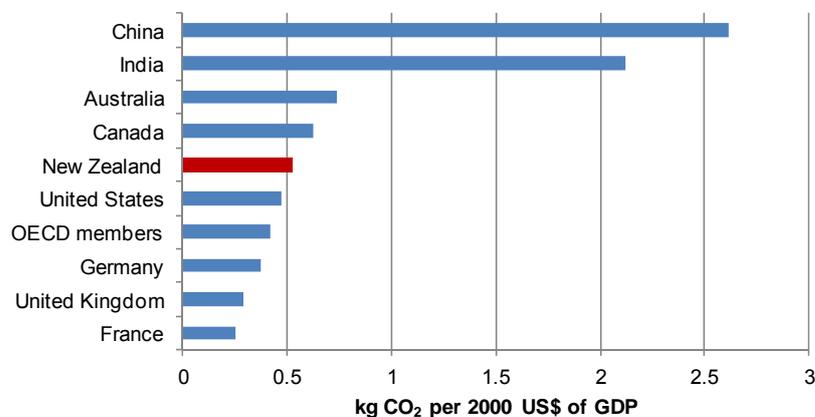
<sup>62</sup> Joshi, M. et al. (2011.) "Projections of when temperature change will exceed 2°C above pre-industrial levels." *Nature Clim. Change* 1 (8): 407-412.

<sup>63</sup> Ministry for the Environment. (2008.) "Climate Change Effects and Impacts Assessment: A Guidance Manual for Local Government in New Zealand." Retrieved from <http://www.mfe.govt.nz/publications/climate/climate-change-effect-impacts-assessments-may08/>

<sup>64</sup> For example, a change of one standard deviation in the number of days of soil moisture deficit (DSMD) may reduce GDP by 0.1 percent and a change of three standard deviations in DSMD may reduce national GDP by around 1 percent. (EcoClimate. (2008.) "Costs and benefits of climate change and adaptation to climate change in New Zealand agriculture: What do we know so far?")

Our non-agricultural sectors are relatively carbon-efficient. Figure 12 shows that New Zealand’s emissions intensity, emissions of fossil carbon dioxide (CO<sub>2</sub>) per unit economic output, is close to the OECD mean and far below the rapidly developing Asian economies.

**Figure 12 – Carbon dioxide emissions intensity, 2008**



Source: Carbon Dioxide Information Analysis Centre.<sup>65</sup>

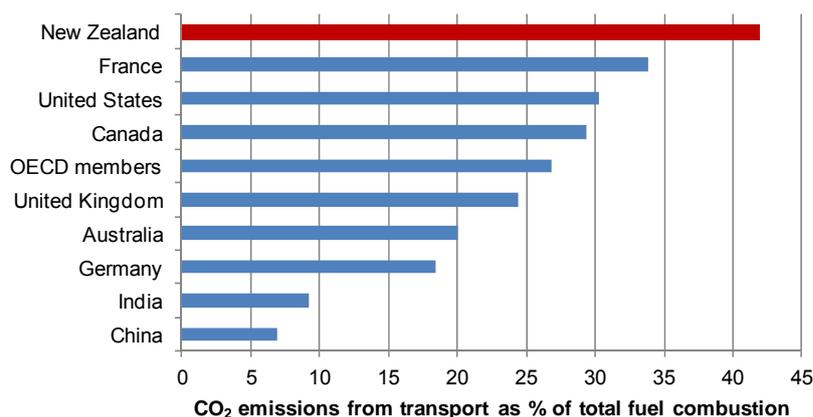
New Zealand’s electricity is over 70 percent renewable, including hydroelectric, geothermal, and wind power, and may reach nearly 90 percent renewable by 2040. Even in high GDP growth scenarios, the share of renewable electricity generation is expected to rise and the share of non-renewable electricity generation is expected to fall to 2040.<sup>66</sup> Of total energy supply, non-fossil fuel sources currently account for approximately 40 percent; this figure could grow to 60 percent by 2040.<sup>67</sup> For this reason and New Zealand’s topography, transport-related emissions comprise a high proportion of our total emissions from fuel combustion relative to other countries and the OECD mean, as shown by Figure 13. There are few lost-cost emissions reduction options in the transport sector and consumer demand tends to be more price-inelastic.

<sup>65</sup> Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring.

<sup>66</sup> Ministry for Business, Innovation, and Employment. “Summary of 2011 Modelling Results – Electricity Generation and Build, New Zealand’s Energy Outlook 2011.” (2012.) Retrieved from <http://www.med.govt.nz/sectors-industries/energy/energy-modelling/modelling/new-zealands-energy-outlook>. Assumes \$100 per tonne CO<sub>2</sub>e.

<sup>67</sup> Ministry for Business, Innovation, and Employment. “Summary of 2011 Modelling Results – Energy Supply and Demand, New Zealand’s Energy Outlook 2011.” (2012.) Retrieved from <http://www.med.govt.nz/sectors-industries/energy/energy-modelling/modelling/new-zealands-energy-outlook>.

**Figure 13 – Carbon dioxide emissions from transport, 2008**



Source: International Energy Agency.<sup>68</sup>

Moreover, unlike many other developed nations, New Zealand's population is growing: between 1990 and 2009, population rose by 30 percent, making New Zealand the second fastest growing developed country. Population is expected to grow more than 60 percent on 1990 by 2050.<sup>69</sup> A larger population drives increases in total emissions.

The nature of future international climate change commitments, and their relation to domestic action, is unclear. Negotiations under the United Nations Framework Convention on Climate Change have recently agreed that a global deal should be negotiated by 2015 to enter into force from 2020. The characteristics of that deal, including the mechanism, accounting rules, and ambition of commitments, will remain uncertain in the near-term. The long-term aim is a global agreement covering all countries.

Opportunities do exist for New Zealand firms to realise lower-carbon growth while staying globally competitive. Government and the private sector can tailor investments in energy and transportation infrastructure in coming decades toward lower-emitting outcomes. It may be possible to realise growth while avoiding emissions increases by making smarter, longer-view investment and research and development decisions in the short- to medium-term.

The global marketplace for New Zealand's goods and services is likely to continue changing, as both companies and countries take action independently. How New Zealand's climate policies are perceived will impact on the 'New Zealand brand' and on the ability of our firms to access overseas markets. While it is difficult to estimate the value of this intangible asset, the value of maintaining a 1 percent premium paid for New Zealand's tourism, food, and agricultural products thanks to a 'clean green image' corresponds to approximately \$200 million per annum.<sup>70</sup>

<sup>68</sup> CO<sub>2</sub> emissions from transport contains emissions from the combustion of fuel for all transport activity, regardless of the sector, except for international marine bunkers and international aviation. This includes domestic aviation, domestic navigation, road, rail and pipeline transport.

<sup>69</sup> Statistics New Zealand. "National population projections: 2009-base to 2061." Retrieved from: [http://www.stats.govt.nz/tools\\_and\\_services/tools/TableBuilder/population-projections-tables.aspx](http://www.stats.govt.nz/tools_and_services/tools/TableBuilder/population-projections-tables.aspx).

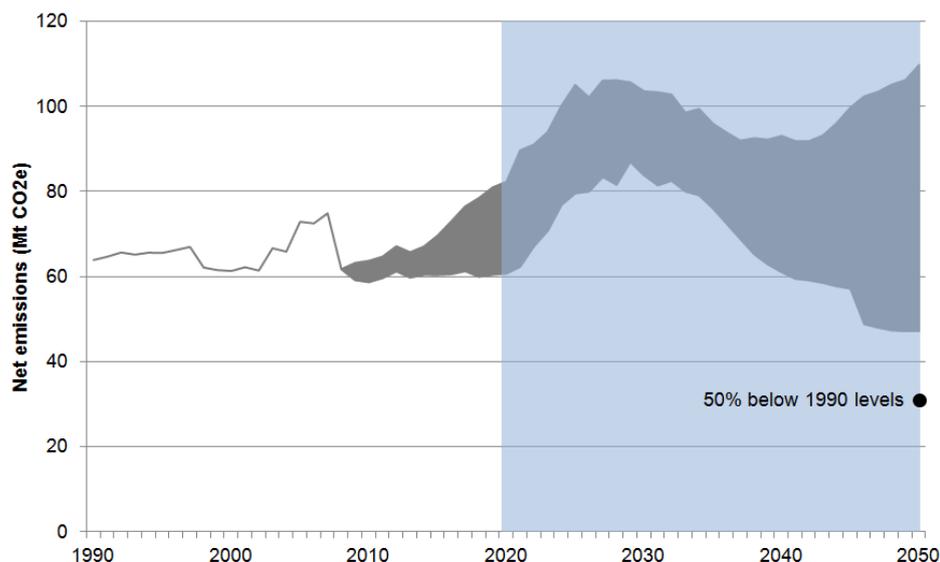
<sup>70</sup> Based on 2009 contribution to gross domestic product by industry data, table 1.5: [http://www.stats.govt.nz/browse\\_for\\_stats/economic\\_indicators/NationalAccounts/NationalAccounts\\_HOTPYeMar11.aspx](http://www.stats.govt.nz/browse_for_stats/economic_indicators/NationalAccounts/NationalAccounts_HOTPYeMar11.aspx)

### 4.3 Fiscal sustainability

Domestic greenhouse gas mitigation policies and international commitments to reduce emissions have financial implications, both of which are driven by and in turn impact upon New Zealand's emission profile.

Figure 14 shows the range of New Zealand's projected net emissions and prospective international commitments consistent with a reduction to 50 percent below 1990 levels by 2050.

**Figure 14 – New Zealand's historical and projected net greenhouse gas emissions**



Source: MBIE, Ministry for Primary Industries (MPI), and MfE.<sup>71</sup>

The high emissions scenario shows net emissions reaching 70 percent above 1990 levels by 2040<sup>72</sup>; in the low case, net emissions may fall to nearly 30 percent below 1990 levels by 2050. In either case, reducing emissions to 50 percent below 1990 levels by 2050 will require significant mitigation or the purchase of a large number of international emissions reductions. New Zealand's emissions profile is cyclical as a result of our large plantation forestry industry; as forests grow, they absorb or sequester carbon and as they are harvested, the carbon stored in the trees over their lifetime is considered to be released.

#### 4.3.1 Domestic mitigation policies

New Zealand has already taken action in passing and implementing the Emissions Trading Scheme (ETS). The ETS was designed to assist New Zealand in meeting international climate change commitments at least cost and to reduce New Zealand's net emissions below business-as-usual levels, by placing obligations on emitters to surrender units in relation to their emissions. The ETS is currently an open scheme, meaning that emitters can purchase eligible international units from Clean Development Mechanism and Joint Implementation projects and surrender them to satisfy their ETS obligations.

<sup>71</sup> Emissions projections for forestry are based on the existing Article 3.3 of the Kyoto Protocol and the Durban decision text (2/CMP.7) and take the following assumptions: post-1989 sequestration removals and harvest emissions; deforestation emissions of post-1989, pre-1990 and natural forests; decay of post-1989 harvested wood products consumed domestically from 2013; the flexible land use provision; no post-1989 harvesting afforestation/reforestation debit credit rule.

<sup>72</sup> Forestry emissions in the high emissions scenario are driven by low afforestation rates, high deforestation rates, and shorter rotations; energy and industrial processes and agricultural emissions are driven by high annual GDP growth and a zero carbon price.

Over the longer term, New Zealand will require access to purchase emissions reductions from abroad in order to manage the cyclical nature of New Zealand's emissions profile.

While the ETS is a useful tool for delivering international emissions reduction units, New Zealand's limited low-cost mitigation potential effectively restricts the scheme's ability to drive significant domestic emissions reductions. Economic modelling has shown that an increase in the price of carbon from \$0 to \$25 may reduce gross emissions by only 6 million tonnes carbon dioxide equivalent (CO<sub>2</sub>e) in 2040, or 5 percent below business as usual; an increase in the price of carbon from \$25 to \$100 may further reduce gross emissions by only 5 million tonnes CO<sub>2</sub>e in 2040, or an additional 5 percent.<sup>73</sup>

The ETS can be calibrated to be fiscally neutral to the Crown over the long term. On this basis, emitters would surrender in aggregate no more than the number of units and/or cash necessary to satisfy New Zealand's international commitments. The objective of fiscal neutrality needs to be balanced against broader economic considerations, including the impact of ETS obligations on businesses and potential benefits to the economy of innovation and increased efficiency in natural resource use.

#### **4.3.2 International commitments**

When New Zealand took its commitment under the Kyoto Protocol, the commitment was treated as a financial liability equivalent to the difference between the total projected emissions over 2008 to 2012 and the target level. Were New Zealand to take another international commitment, this commitment would likely entail fiscal costs to the extent that our net emissions exceed a binding target.

An international commitment to reduce emissions to 50 percent below 1990 levels by 2050 would present a significant fiscal burden to the Crown based on current ETS settings, as the ETS has been scaled back to reduce short-term economic costs to participants during this period of international policy uncertainty. In order to achieve fiscal neutrality, this cost would need to be distributed through changes to ETS settings to deliver more emissions reductions or alternatively the target would need to be revised.

If ETS settings are attuned to deliver international commitments, climate change policy will be fiscally sustainable over the long term as business and consumers pay the emissions tab. However, this tax burden will have growth implications and associated longer-term fiscal implications, particularly in the event that New Zealand takes earlier, more aggressive action than its competitors.

#### **4.3.3 Adaptation policy**

As New Zealand's emissions are such a low percentage of the global whole, it will not be possible for our actions to meaningfully decrease the probability of catastrophic events. In the long term, large-scale events entailing high global damages may impact on New Zealand economically and fiscally, suggesting the increasing importance of maintaining prudent debt levels and investing in resilient infrastructure. Weitzman argues that the presence of fat tails in the probability distribution for catastrophic events, like hurricanes and tsunamis, suggests that aggressive early policies and investments should

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<sup>73</sup> Emissions projections sourced from the Ministry for the Environment. Assumptions include AR4 Global Warming Potential values, and central GDP, Oil Price and Exchange rate forecasts.

be implemented in order to reduce catastrophic risks, even those with very small probabilities.<sup>74,75</sup>

Given the importance of the primary industries to our economic prosperity, historical experience has shown the New Zealand economy to be susceptible to shifting weather patterns and changing climatic conditions, suggesting a need for better and more information on the likely impacts of climate change and early investment where viable infrastructural and preparedness options exist.<sup>76</sup>

Adaptation will continue to be carried out in response to and in anticipation of changes in climatic conditions. Early and effective adaptation is often less costly than retrospective or emergency action; however, this will only hold true where we are able to accurately predict where and how climate changes will effect New Zealand. Efficient adaptation can complement a long-term fiscally prudent approach that reduces surprises that government may face in the future.

## 4.4 Economic growth and efficiency

Decisions about whether and how to reduce greenhouse gas emissions have real implications for New Zealand's economic growth, both in the short-term and the longer-term.

Computable general equilibrium analysis conducted in 2011 by NZIER and Infometrics suggested that the cost of delivering an international commitment to reduce emissions to 15 percent below 1990 levels by 2020 ranges from 0.1 to 1.1 percent of GDP in 2020, depending on the carbon price faced by firms in New Zealand and that faced by export competitors, the provision of free allocation of carbon units to ETS participants, and the inclusion of the agriculture sector in the ETS.<sup>77</sup>

### 4.4.1 Growth impacts of action in-step with competitors

Studies have suggested that, at a global level, the benefits of strong, early action far outweigh the potential long-term combined costs of climate change damages and mitigation required to avoid dangerous climate change.<sup>78,79</sup>

In the context of concerted global action, under which developed and large-emitting developing economies alike provide comparable, clear incentives to their domestic industries to reduce the greenhouse gas intensity of production, ambitious climate change policy in New Zealand will encourage innovation, fuel economic growth, and ensure that our goods and services remain competitive in the global marketplace. In such a world, countries demonstrating effort to reduce emissions will prefer to trade with other countries who do so. Countries without limits on greenhouse gas emissions will find fewer markets and yield lower prices for their goods.

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<sup>74</sup> Weitzman, M. (2009.) "On modeling and interpreting the economics of catastrophic climate change." *Review of Economics and Statistics* 91(1):1-19.

<sup>75</sup> Weitzman, M. (2011.) "Fat-tailed uncertainty in the economics of catastrophic climate change." *Review of Environmental Economics and Policy* 5(2): 275-92.

<sup>76</sup> New Zealand Treasury. (2002.) "Working Paper 02/26 A structural VAR model of the New Zealand business cycle."

<sup>77</sup> Ballingall, J., Schilling, C., & Stroombergen, A. (2011.) "Macroeconomic impacts of the New Zealand Emissions Trading Scheme: A computable general equilibrium analysis." New Zealand Institute of Economic Research and Infometrics.

<sup>78</sup> Clarke, L., Edmonds, J., Krey, V., Richels, R., Rose, S., & Tavoni, M. (2009.) "International climate policy architectures: Overview of the EMF 22 International Scenarios." *Energy Economics* 31.

<sup>79</sup> Stern, N. (2006.) "Stern Review Report on the Economics of Climate Change." UK Treasury.

#### 4.4.2 Growth impacts of action ahead of competitors

At present, concerted international action is still under negotiation. While countries such as the United States, Japan, and Canada are increasing their mitigation actions, they have not made any definitive or binding moves to put economy-wide price or quantity controls on their domestic emissions. In this context and given the ongoing emissions growth of developing countries like China, aggressive, unilateral policies will entail negative effects on productivity growth and income in the short-term for developed countries, primarily as a result of shifting human and capital resources to work on mitigation, reducing the resources available for producing other goods and services.<sup>80, 81, 82</sup>

In the developing world, where fossil fuel-based infrastructure has not necessarily been locked in, aggressive climate change policies and regulations and the provision of funding for these efforts by developed countries may actually promote economic growth.<sup>83</sup> This has the potential to magnify the negative impact on New Zealand's trade position.

The closer in-step we are with competitors, the lesser the relative impact on our growth. Modelling has suggested that consistent action across the rest of the world reduces GDP impact relative to business as usual by between 30 and 50 percent, compared to a scenario under which New Zealand takes strong action to reduce emissions ahead of the rest of the world.<sup>84</sup>

#### 4.5 Equity and distribution

The distribution of the ETS tax burden will remain, in the near-term, highly differential by sector, as the ETS assigns varying degrees of responsibility for emissions to various industries, taking into account the availability and cost of mitigation options and exposure to international markets. This distribution is relevant within generations.

When designing and implementing climate change policies, we must also consider the distribution of costs between generations: early, ambitious action ahead of international competitors will be highly costly to current generations and may yield only marginal cost savings for future generations. Conversely, action that is behind international competitors could save costs now, but to the detriment of future generations.

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<sup>80</sup> Garnaut, R. (2011.) "Garnaut Climate Change Review—Update 2011." Australian Government.

<sup>81</sup> Mendelsohn, M. (2009.) "Climate Change and Economic Growth." The World Bank, Commission on Growth and Development, Working Paper No. 60

<sup>82</sup> OECD. (2008.) "Climate Change Mitigation: What Do We Do?"

<sup>83</sup> Hof, A. F., den Elzen, M. G. J., van Vuuren, D. P., Beltran, A. M., & Slingerland, S. (2011.) "Climate Policy after Kyoto. Analytical insights into key issues in the climate negotiations." PBL Netherlands Environmental Assessment Agency.

<sup>84</sup> Ballingall, J., Schilling, C., & Stroombergen, A. (2011.) "Macroeconomic impacts of the New Zealand Emissions Trading Scheme: A computable general equilibrium analysis." New Zealand Institute of Economic Research and Infometrics.

## 5 Conclusion

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New Zealand is wealthy in natural resources and these resources will be a determinant of our social, cultural, and economic development. Our resource endowment is very diverse and resources should be managed in ways that reflect this diversity.

In order to use and protect this natural resource advantage, we need to:

- Know more about what resources we have: The more and better detailed information we have about the resources we have, their current use, and future demand, the better able we will be to assess and value our natural capital stocks and flows, conduct an informed public debate on the use of our resources, and design effective management frameworks to protect and utilise them sustainably.
- Think carefully and creatively about how and when we use them: New Zealand firms are renowned for progressive environmental planning. As non-renewable resources are consumed and demand for renewable resources increases, we need to improve environmental management tools and financial mechanisms. These improvements will ensure resources flow to their highest-value uses, and promote sustainable long-term growth.

We have the opportunity to use many of our natural resources more productively and to plan ahead for challenges to come.