Creating Economic Incentives for Sustainable Development

A report to the
New Zealand Business Council for Sustainable Development

Jim Sinner and Guy Salmon

New Zealand Business Council
for Sustainable Development

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PATHWAYS TO SUSTAINABILITY

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by

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Creating Economic Incentives for Sustainable Development

Executive Summary

Sustainable development is about economic growth that takes proper account of environmental effects and that is socially responsible. Sustainable growth provides more and better employment opportunities and it provides additional revenue for government to address environmental and social problems that cannot be addressed through the marketplace.

Economic incentives are a promising tool for advancing sustainable development. These incentives can take a variety of forms, and they are not just tools for government. Businesses can adjust their own pricing policies to ensure that their customers have incentives to conserve scarce resources. Metrowater and Orion, through pricing of water services and electricity network services, have done precisely that.

Governments in Australia, Europe, and the United States are also using economic incentives to promote more sustainable development. Examples include tradable water entitlements in Australia, waste levies in Denmark, a levy on plastic bags in Ireland, and energy or emissions charges in various European countries. In New Zealand, the fisheries Quota Management System introduced in 1984 uses individual tradable fishing quota, in what is widely recognised as world best practice, and a tax differential was used to accelerate the phase out of leaded petrol.

Economic incentives are not a cure-all for all situations. They are most effective where the need to conserve a resource is well-understood, where users have a variety of needs and cost structures and hence value the resource differently, and where well-designed incentives can be provided without high transaction costs.

A compelling case for economic incentives

From international experience with economic incentives, we can draw several conclusions:

- *Properly implemented, economic incentives work – they achieve environmental objectives effectively and at lower cost than other approaches.*

  In cases such as the Hunter River Salinity Trading Scheme in Australia, economic incentives make solutions possible at reasonable cost when no other practical solution was available without substantial cost to business.

- *While economic incentives have mostly been targeted at achieving environmental objectives in an economically efficient manner, they can also be designed to enhance social objectives.*

  Levies on waste are an example of a measure with social as well as environmental benefits, because they reduce the need for new landfills to be built in the face of community opposition. Measures to manage air pollution

can be designed to assist low-income households, and road pricing can also take social objectives into account.

- *Economic incentives are business friendly – they enable flexible low-cost solutions, spur innovation, encourage more employment and enable major investments in infrastructure to be postponed.*

  Through its pricing policies, Orion has spread demand for electricity over a wider time period, reducing peak pressure on its network. This allowed Orion to postpone $200 million of investment to upgrade the network, the cost of which will have to be passed on to users.

- *Economic incentives help businesses to protect and grow shareholder value.*

  New Zealand's Quota Management System for fisheries has reduced the excess capacity that was eroding the profitability of fishing. Quota has become a valuable asset that can be used to secure investment finance, enabling the New Zealand fishing industry to become one of the most efficient in the world based on a sustainably managed resource.

- *As users respond to incentives, more resources become available for new users, enabling economic growth within a framework that protects sustainability.*

  For example, water trading in Australia is one of the factors that has made possible the growth of the wine industry in that country.

- *When revenues from economic incentives are recycled through lower taxes, many businesses and individuals will pay less tax in total.*

  Tax reductions can be designed to assist low-income households, all households, businesses or some combination of all of these, depending on government priorities. This provides a mechanism to address social objectives as well as economic and environmental objectives.

  In some cases, an economic incentive will have positive effects for some businesses and negative effects for others. Heavy users of resources could end up paying more overall, thus encouraging innovation to find ways to use less.

- *Economic incentives provide businesses with maximum flexibility as to how they will meet environmental requirements, thus spurring innovation that can provide an impetus for economic growth.*

  The Hunter River scheme cited above enabled each business to determine how it would manage its salt discharges, based on the price of buying and selling additional allowances.

Opportunities for New Zealand

There are numerous opportunities in New Zealand to create economic incentives for sustainable development. These include:

- Increased use of tradable water entitlements to resolve increasing tensions over water allocation, e.g. in the Waitaki catchment, and to get the most economic benefit from a limited resource;
- A charge on greenhouse gas emissions to encourage energy efficiency and renewable energy, with revenue used to reduce income taxes or GST;
- Road network pricing to alleviate congestion and fund new transport capacity enhancements;
- A transferable certificate system designed to encourage waste reduction and resource recovery;
- Tradable air emission allowances combined with emission charges to address urban air pollution, e.g. in Nelson and Christchurch.

Ecologic Foundation is initiating a programme of research to identify obstacles to the use of economic incentives and to develop a better understanding of their potential effects. Such an understanding will help in the design of measures to ensure that they will have the desired outcomes for sustainable development in New Zealand. The research programme is likely to examine as case studies one or more of the potential incentive measures mentioned above.

Where to from here

Businesses can start by ensuring that their own pricing structures are not undervaluing natural resources. This can add value to business profitability in the short term and help to protect the resources upon which the long-term future of the business depends.

For many other measures, to overcome the inertia of the status quo requires active support from central and local government. Central government should assist with the design, analysis of effects and implementation of instruments where these break new ground. For some incentives, legislation is necessary to remove legal impediments and uncertainties. Pilot programmes are also needed, to work out technical issues and test public response. The support of all community interests needs to be won.

The status quo has huge inertia. The established way of doing things often leads to conflict which can become a national habit, fortified by those who are passionate about only one of the three components of sustainable development – economic, environmental or social.

Moving beyond the status quo requires a willingness to do three things:

- to acknowledge New Zealand's larger interests;
- to be creative and innovative; and
- to adopt a can-do attitude.

First and foremost, however, adopting economic incentives requires local champions from leading members of the community. There will always be plenty of reasons not to innovate, to avoid controversy, to stick with what's been done before. The status quo has no shortage of defenders.

In the history of New Zealand, there are some who had a different attitude to change. Kate Sheppard, Richard Pearse, Sir James Fletcher, Clarence Beeby, and Sir William Hamilton, among others, all challenged conventional thinking. These New Zealanders dared to be different, and they persisted in their pursuit of a better way of doing things.

One of the challenges for New Zealand's business and community leaders today is to dare to be different, and support the use of economic incentives to advance sustainable development.

1 Introduction

1.1 "New" approaches to sustainable development

There have been calls from various commentators, in New Zealand, Australia, and overseas, for the integration of the cost of natural resources into the economy[1]. Transferable permits, environmental user charges and other types of economic incentives – also sometimes referred to as "economic instruments" or "market-based instruments" – are increasingly being used overseas for management of natural and physical resources. Already in 1991, the Organisation for Economic Co-operation and Development was reporting "the use of economic instruments has increased significantly over the last fifteen years" (OECD, 1991). Twelve years later in New Zealand, while there are some instances of these tools being used, there is much more unrealized potential.

The failure to integrate economic signals into resource management contributes to a lack of technological innovation, including a failure to adopt a wide range of existing technologies that are both economically and environmentally sound (von Weizsacker et al, 1997). While New Zealand's lack of innovation can be put down to this country's relatively low levels of research and development expenditure, it is exacerbated by the failure to put an appropriate price on resources. As a result, technological innovation has focussed on reducing use of labour, which is taxed, instead of natural resource use, which is effectively subsidized (ibid.). Hardly a week goes by without a New Zealand company announcing it is shedding staff to cut costs.

Policy measures using economic incentives provide an opportunity to address this fundamental drag on economic growth in New Zealand while at the same time improving management of the environment and enhancing social conditions.

Some countries, and some local jurisdictions overseas, are reviewing their entire tax structures to determine whether to shift significant portions of the tax burden away from labour and income, which society wants to encourage, towards pollution and resource use, which society wants to discourage. Often referred to as "environmental tax reform" or "environmental fiscal reform", this process is being most actively pursued in northern Europe, although governments there still rely heavily on traditional revenue sources (OECD, 2001a). As discussed further in section 3.4, there can be significant social gains from such tax reform as well.

1.2 Economic incentives in New Zealand

Some of these tools *are* being adopted in New Zealand, albeit slowly and sporadically. Probably the most successful example is New Zealand's fisheries quota management system (QMS). Although the QMS is still being improved and extended, it is frequently hailed as the most advanced fisheries management regime in the world (see, e.g., Batstone and Sharp, 1999). The Ministry of Economic Development oversees a tradeable permit regime for managing the phase-out of ozone-depleting substances (MED, 2001). Cost recovery for solid waste management

[1] For an excellent exposition of both theory and practice, see Schelling, 1983. Recent work of relevance to New Zealand and Australia includes James, 1997; Panayotou, 1998; Hamilton et al, 2000; OECD, 2001a; Kerr, 2001; McLeod et al, 2001; Sharp, 2002; and Scrimgeour and Piddington, 2002.

and public water supply is increasing. But other examples are sparse -- there are vested interests and significant inertia on the side of the status quo.

New Zealand's recent review of the tax system (McLeod et al, 2001) supported the concept of environmental fiscal reform but, apart from an emissions charge for greenhouse gases, concluded that the main scope for environmental taxes was at local government level. This was because New Zealand's resource management system places primary responsibility for environmental matters with regional, district and city councils rather than central government. The review provided a set of criteria for the application of environmental taxes. However, the criteria suggested by the McLeod review were too strict – if the same criteria were applied to regulatory measures we would have little in the way of environmental protection in New Zealand.

Furthermore, New Zealand is too small a country, and local authorities are correspondingly too small, for each of them to function as policy laboratories or innovation centres. Although some local authorities have overcome this and done innovative things, and councils can and do collaborate on some projects, more is required. Councils are in some cases impeded by legislation that makes the use of economic incentives difficult if not impossible. Many councils also have limited resources to design and assess innovative management approaches. Without national leadership on such a significant issue, progress will continue to be slow.

Kerr (2001) also noted that economic incentives are "probably underutilised" in New Zealand and that central government might need to do more to help local authorities realise the full potential of these instruments. Scrimgeour and Piddington (2002) critiqued the conclusions of the McLeod Tax Review and provided a useful overview of numerous issues that have been discussed and considered regarding environmental taxes and other types of economic incentives. They concluded that it is time for in-depth analysis and consideration of specific applications of these tools in New Zealand.

Sharp (2002) identified a number of possible obstacles to the use of economic incentives for environmental management, including vested interests in the status quo. Whether to use these instruments in a given situation, and the appropriate roles of central and local government, is an empirical question requiring careful investigation. Sharp added a caution: "Ill-conceived proposals for the use of market-based instruments will not gain the acceptance needed for implementation."

In Australia, the Commonwealth and State governments established in April 2003 the National Market-Based Instruments Pilot Program. Under the National Action Plan for Salinity and Water Quality, this programme will provide $5 million for projects to investigate ways to use innovative financial arrangements to encourage better land and water management[2]. This programme aims to develop a sound conceptual and community basis for these incentive mechanisms, prior to considering them for full implementation.

[2] For more information, see www.affa.gov.au/actionsalinityandwater.

1.3 Objectives of this study

The New Zealand Business Council on Sustainable Development (NZBCSD) has funded this study to invigorate the New Zealand policy debate on economic incentives, seeking to move from a theoretical discussion into practical investigation and application. Before this can occur, leaders in business, government and society need to be convinced that economic incentives are practical, can be good for the economy and good for the environment, and can be applied in socially responsible ways.

With greater use of economic incentives, the economic benefits of resource use can be increased. Environmental standards will be met at lower cost, and innovation to reduce adverse effects on the environment will be encouraged. Use of economic incentives will enhance shareholder value and spur wider economic growth, while helping to restore public confidence that growth is a goal well worth pursuing.

Economic incentives are not 'just another tax'. In some cases, they involve no tax at all, and in other cases any tax can be completely offset by reductions in other taxes. The purpose of economic incentives is to change the relative prices of goods and services and, by doing so, to change behaviour – not to raise revenue.

These management approaches can be good for business – they help businesses to grow shareholder value, and they encourage sustainable economic growth and stimulate innovation and resource efficiency. If more businesses implemented these principles in their own pricing policies, and more actively supported the implementation of economic incentives by central and local government, the pace of reform would in all likelihood quicken substantially.

This report documents the compelling case for the use of economic incentives for sustainable development, identifies opportunities for their application in New Zealand, and suggests next steps for advancing their implementation.

Chapter 2 briefly explains the most common types of economic incentives for environmental management. Chapter 3 makes the case for their use, and supports this with several case studies from New Zealand and overseas. Chapter 4 identifies the potential for further use of economic incentives in New Zealand, as well as some of the obstacles to their wider use, and Chapter 5 suggests steps that can be taken to promote their use.

2 Key features of Economic Incentives

2.1 Types of economic incentives

Numerous papers and reports list the different types of economic incentives for sustainable development and their key characteristics.[3] These approaches are also known as "economic instruments" or "market-based instruments" for environmental or resource management. Common types of these instruments are listed in the box below.

Economic incentives are not just tools for government. Businesses can adjust their own pricing policies to ensure that their customers have incentives to conserve scarce resources. This can, for instance, allow infrastructure companies to postpone costly new investments. Case studies included in this report describe businesses in New Zealand that have done this with considerable success.

Types of Economic Incentives for Environmental Management

Market creation techniques:
- Tradable emission permits
- Tradable development rights
- Tradable water entitlements
- Individual transferable fishing quota

Prices, taxes and charges:
- Differential pricing
- Emission charges
- Differential tax treatment
- User fees
- Investment tax incentives

Liability mechanisms
- Deposit-refund schemes
- Performance bonds
- Mandatory insurance
- Legal liability for damage

Positive incentives
- Subsidies
- Competitive grant schemes
- Tax exemptions or rebates

[3] See, for example, Panayotou (1998), who provides a comprehensive list of different types of instruments and an overview of their application and potential in both developed and developing countries.

In this report, the term "economic incentives" does not include any measures to collect resource rent. Economic incentive measures are explicitly designed to change behaviour to correct distortions. Any measure designed to collect resource rent should aim to leave behaviour unchanged, so as not to introduce distortions. Issues regarding resource rent are beyond the scope of this report.

2.2 Different uses of economic incentives

All types of market-based instruments generate economic incentives and, if different instruments resulted in the same price signal, in theory the results would be identical and there would be no preference for one type of economic instrument vs. another. In practice, there are numerous factors to consider. These include administration and enforcement costs, whether one wants to generate revenue, whether to give preference to existing users, and whether it is more important to achieve certainty on the price or the quantity of the resource being managed.

Tradable permits or entitlements are typically used when there is a desire to give preference to existing users (in which case existing users get tradable entitlements free of charge, often called "grandparenting") or when there is a fixed quantity of a resource available. New businesses, or those who seek to expand their operations, can enter the market to obtain permits or entitlements from existing participants, or some or all permits can be sold by auction.

The best-known example of tradable entitlements in New Zealand is individual transferable quota for fish, which entitle fishers to catch a share of the maximum sustainable yield of a stock. Overseas examples include tradable water permits, tradable air discharge allowances, and tradable salinity credits.

Prices, taxes and charges are more appropriate when there are revenue objectives or when there is a high value on price certainty for resource users. Whereas a fixed supply of tradable permits might sell for a very high price (and this is often difficult to anticipate prior to introduction of transferable permits), a tax or charge can provide greater certainty to businesses and consumers that the price of a resource will not exceed a maximum specified rate. Revenue objectives may be associated with equity concerns, e.g. to avoid heavy users from being subsidised by those who use the resource less or not at all, especially where user charges seek to cover the cost of supplying a service or resource. A business can also set its prices to ensure that it is not selling some goods or services at less than marginal cost.

Liability mechanisms are sometimes used when there is a low probability of accidents or other events with high adverse consequences. Requiring a company or consumer to post a deposit or a bond can significantly increase the chances that, for instance, an item will be recycled or that the appropriate degree of care will be taken. If a bond for potential damages would be so high as to inhibit worthwhile activity, some programmes use a levy to fund clean-up programmes or require firms to purchase insurance.

Subsidies and tax rebates are sometimes frowned upon because they violate the polluter-pays principle. However, they can be appropriate when there is a significant change in the environmental standard to be met, and where there is scope for a

demonstration effect from leading companies "learning by doing". Government use of environmental subsidies is subject to provisions of the World Trade Organisation's Agreement on Subsidies and Countervailing Duties.

All market-based instruments for resource management have one fundamental feature in common: they create an economic incentive, i.e. a "price signal", to conserve a resource that was previously undervalued or treated as free. Even where users are not directly charged for the resource, market-based instruments create an "opportunity cost" of resource use. For example, with tradable permits, if the resource is not used it can be sold to another user. Thus, the resource has a price or value even if it was originally obtained at no cost. It is this value or price that motivates efficient use of resources and stimulates innovation to do more with less, and why market-based instruments are widely seen as among the most efficient and effective ways to manage a range of resources.

That economic incentives can motivate significant and rapid change in behaviour was shown by the reaction to a levy on plastic shopping bags in Ireland (see box).

The Irish Plastic Bag Levy

In March 2002, the Irish government introduced a levy on plastic shopping bags in response to a negative public perception of plastic bags.

Visual pollution

The roadsides of Ireland are adorned with hedgerows, shrubs, trees, and ditches. But Ireland is a country of frequent and often high winds, and bags released on the street can quickly travel a substantial distance.

This combination of wind, hedgerows and public carelessness regarding the disposal of plastic bags means that the hedges and trees of the countryside are randomly littered with bags in various states of disintegration.

The rural landscape in Ireland is valued by the locals, and is also an important dimension of the tourist industry. The Irish Environment Minister responded to this situation by introducing a levy on plastic bags, with the dual aims of reducing plastic bag use and raising public awareness of the environment.

Consultation addresses concerns

The levy was set at €0.15 (NZ$0.30), at point of retail sale, on the basis that this would be sufficiently high to give most consumers pause for thought and motivate them to bring their own 'permanent' reusable shopping bags with them. No attempt was made to calculate the 'marginal external cost' of plastic bag use.

Retailers were initially concerned that they would be seen as profiteering. The solution, resulting from an extensive consultation process with the Irish Business and Employers Confederation, was a strong publicity campaign from the government conveying the reasons for introducing the levy.

The consultation process also resulted in some exemptions for particular uses of plastic bags – in particular meat purchases, which need to be wrapped separately for hygiene reasons.

A dramatic drop in plastic bags

As a result of the levy, plastic bag usage in Ireland has dropped some 90%. Overall, consumers are very much in favour of the levy. Surveys have shown that a majority feel that the levy has enhanced the convenience at checkouts, while improving the quality of the environment by noticeably reducing plastic bags. The levy has also raised the public's awareness of the environment – many people report feeling 'guilty' when purchasing plastic bags.

For retail firms, the revenue collection and reporting was easily integrated with their collection systems for Value Added Tax (akin to New Zealand's GST) so net additional costs were modest, and more than offset by the reduced cost of plastic bags. Overall, retailers found the effects of the levy to be neutral to positive.

The fiscal cost of introducing the levy was a one-off set up cost of €1.2 million with €350,000/yr ongoing for administration and enforcement. Projections of revenue from the levy are in the order of €10-11 million, which goes into an Environmental Trust Fund to support other waste reduction and resource efficiency programs.

Source: Convery and McDonnell, 2003.

3 The Compelling Case for Economic Incentives

3.1 Environmental effectiveness at lower cost

One of the most compelling arguments for using market-based instruments for environmental management is that, in many cases, they achieve the environmental objective at less cost to businesses and consumers. Compared to alternative approaches, market-based instruments are therefore more conducive to sustainable economic growth.

Comparison with voluntary and regulatory approaches

An OECD report (2001b) surveyed the environmental effectiveness and economic efficiency of three broad approaches to environmental management:

- traditional regulatory approaches that specify standards to be met and/or technology to be employed (sometimes referred to as "command and control");
- voluntary agreements between business and government, e.g. in which targets are set; and
- market-based instruments such as tradable permits and environmental taxes and charges (which also involve regulatory structures).

The survey concluded that voluntary programmes were not very effective, because voluntary targets often do not achieve much more than "business as usual." According to the OECD, a study of toxic releases in the USA concluded that the so-called 33/50 voluntary targets programme was actually responsible for only about one fourth of reductions achieved. The other three fourths would have been achieved without the programme.

Voluntary programmes can be more efficient than traditional regulatory approaches, but are less efficient than environmental charges or tradable permits. And both traditional regulation and voluntary programmes fail to stimulate innovation in new abatement technology because they do not create an opportunity cost in the resource, i.e. there is no price or value to generate an on-going economic incentive to use less.

Examples of success

In the United States, the use of tradeable emissions permits for sulphur dioxide (SO_2) enabled emission reductions to be achieved at a much lower cost than the traditional regulatory approach being considered (Saile, 1998). Spurred by emissions trading, US utilities reduced their SO_2 emissions by 30% more than required, at half the compliance cost that was originally anticipated.

In the Hunter River catchment of New South Wales, Australia, the Environment Protection Authority solved a seemingly intractable salinity problem with tradeable discharge allowances (see box below). Discharges from over thirty coal mines and power plants were essential to those operations, but were making the river almost unusable for irrigation in dry summers when it was needed most. The scheme has the support of both irrigators, who now have access to irrigation-quality water during droughts, and industrial sources of saline discharges, who no longer face the threat of major restrictions on their commercial activities to solve the salinity problem.

Tradable salt discharge credits in the Hunter River

An insoluble problem?

The Hunter River drains the largest coastal catchment in New South Wales, Australia, covering some 22,000 square kilometres. The region includes wineries, vegetable production, dairying and other livestock enterprises, many of which rely on irrigation water from the Hunter River.

Also in the catchment are 20 of the world's largest coal mines and three electricity generation plants. During mining operations, salty water collects in mine pits and shafts and must be pumped out. Power generation uses water for cooling. As this water evaporates, natural salt is concentrated in the water that remains, and this saline water is discharged to the river.

Prior to 1994, the state regulated these facilities using "trickle" discharge permits, i.e. continuous discharge was allowed at low volumes. While in theory this spread the salt load over time, there was no link between discharges and the state of the river. In dry times, the river became very saline, making it unusable for irrigation when it was needed most. In wet weather, the opportunity to discharge without an impact was often missed because the permits did not allow it.

An innovative solution using tradable credits

In January 1994, after extensive consultation with industry and community stakeholders, the former Environment Protection Authority (EPA) of New South Wales* started a pilot programme with a new approach. Each EPA-licensed coal mine and power plant in the Hunter catchment was given an allocation of tradable salinity credits entitling them to a proportion of a total allowable discharge (TAD) of salt.

To achieve the salinity targets, the river flow is divided into numbered blocks, each one representing the water that will flow past the city of Singleton, in the lower catchment, on a given day. Before a given block reaches the first discharge point, the Department of Infrastructure and Natural Resources determines the TAD for that block, using a river model with real-time flow and salinity monitoring data.

* The EPA is now part of the Department of Environment and Conservation.

Each facility is then entitled to discharge into that block a volume of salt equal to the discharger's proportion of tradable salinity credits for that block.

For example, if the TAD for a block is 112 tonnes, a coal mine holding 45 out of the 1000 total credits would be entitled to discharge 5.04 tonnes of salt (112t x 45/1000) as the block of water passes the facility. As that block moves down the river, other facilities can discharge based on their holdings of credits for the block.

Tradability gives license holders the flexibility to increase or decrease their allowable discharge from time to time, while capping the total amount of salt that is discharged into the river. The trading system is online, and shows the current holdings of each facility as well as all trades completed.

The TAD varies depending on flow and other parameters, to ensure that salinity does not exceed 600 EC** in the upper catchment or 900 EC when the river flows past Singleton. When the flow drops below a minimum threshold, the TAD is zero and no discharge is allowed.

Conversely, when the river is in flood, unlimited discharges are allowed provided scheme members coordinate their discharges to ensure that the salinity targets are still met.

The Hunter River scheme has had dramatic success at reducing river salinity. Prior to the scheme's inception in 1994, average monthly salinity regularly exceeded 900 EC, and reached 1800 EC in 1991.

Since 1994, the monthly means have been below 900 EC for all but a few months, when they were briefly around 1000 EC due to natural sources, and have typically ranged between 600 EC and 800 EC. See Figure 1 on the next page.

(continued on next page)

** Salinity is estimated by measuring electrical conductivity (EC), which is reported in micro-siemens per centimetre. Drinking quality water in Australia usually measures between 600 EC and 1200 EC.

Tradable salt discharge credits in the Hunter River (continued)

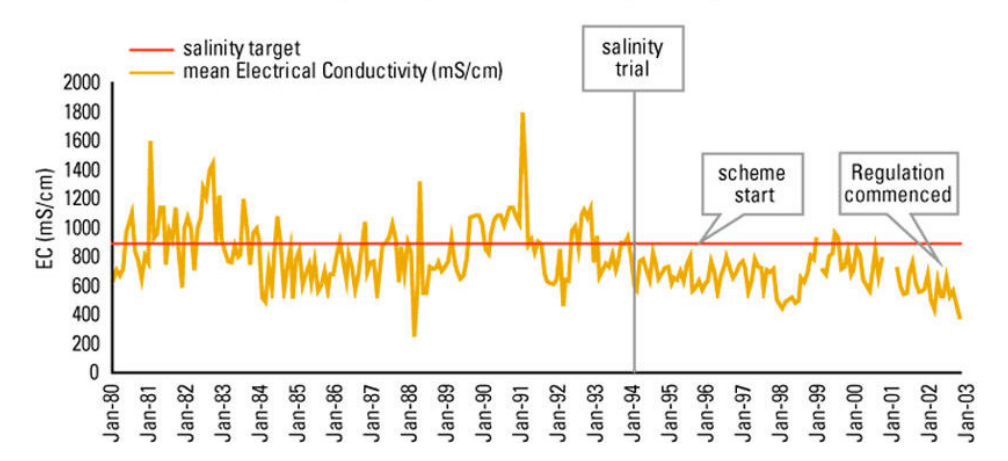

Figure 1. Electrical conductivity in the Hunter River at Singleton 1980-2002, monthly means (EPA, 2003).

Pilot to permanent, with industry support

The pilot scheme operated from 1995 until 2002, during which time it was refined based on experience gained. In 2002, the scheme was formalized through regulations. These contain rules and safety measures, such as discounting the value of credits if too many are traded into one sector of the river.

For the pilot, credits were allocated free of charge to all facilities, based on a formula that took into account a facility's environmental performance and other factors. Credits were re-issued when the regulations were introduced based on the credit holdings at the end of the pilot, but with varying durations: 20% of credits will expire every two years.

New credits will be sold by auction to replace these, to maintain the total number in the system. The auction will reveal the value of the credits and will provide another avenue for new industry to enter the scheme.

The scheme operates on a full cost-recovery basis. Annual contributions from participants pay for costs including monitoring, modelling and operating the credit register. Proceeds from credits sold at auction will be deducted from the total annual contributions payable by participants.

For more information: See EPA (2003), http://hrs1.epa.nsw.gov.au, and Simon Smith (2003).

Economic incentives are not free of compliance costs, however – users still generally need to obtain permission of some sort to utilise the resource, and typically face monitoring and reporting costs as well.

As is clear from the Hunter River example and from New Zealand's fisheries quota system (see case study on p. 12), market-based instruments require a regulatory framework to operate. These regulations often impose obligations to monitor and report emissions or other activity, to pay a charge or to have sufficient permits for that activity, and to pay fines or incur other penalties if the primary obligations are not met. These regulations differ from a "traditional" regulatory approach, which typically specifies a standard to be met at the point of discharge or, less frequently, a certain technology to be used.

The crucial difference between these approaches to environmental management is that market-based instruments create economic incentives for continuous improvement. Traditional approaches in effect discourage a firm from doing more than is required to

meet the minimum standard, because any cost of doing so is difficult to justify to shareholders.

Adaptive Management

Economic incentives can also play a key role in "adaptive management" programmes, that is, programmes that are designed to generate information about resource use so that management measures can then be refined. The Ministry of Fisheries has an Adaptive Management Programme for fisheries whose sustainability is not immediately threatened but about which more needs to be known. The Ministry uses information obtained from monitoring fishing activity to adjust or confirm catch limits in these fisheries.

The Kyoto Protocol is, in effect, a type of adaptive management programme. Under the Protocol, every five years the member nations assess experience, including the expected costs of achieving the current targets, and then set targets for the next five years based on this experience. This allows the rate of emission reduction to be reviewed and adjusted over time, taking account of new scientific information and the availability of new technology to reduce emissions.

Economic incentives, such as tradable allowances or pollution charges, are well-suited to adaptive management. They establish a flexible regulatory framework within which businesses can operate, and they allow targets and/or taxes and charges to be adjusted as more is learned about the resource and about the cost of management measures.

3.2 Providing investment certainty for growing shareholder value

"Business requires investment, and investment requires certainty." That statement comes from Owen Symmans, chief executive of the New Zealand Seafood Industry Council (Symmans, 2003). New Zealand's seafood industry has benefited from the certainty of access to New Zealand's major fisheries provided by the Quota Management System (see box), although it is seeking more certainty for investment in marine farming.

Economic incentives can increase certainty for business in a variety of ways, and thereby facilitate investment that increases shareholder value.

First and foremost, economic approaches help to clarify businesses rights and responsibilities with respect to the environment. In a system of tradeable quota, permits or allowances, whether these are permanent or for a fixed period, investors know what their access rights to a resource are, and can plan on that basis. This does not mean that catch limits (e.g. for fish) or other regulatory requirements will not change, but if the regulatory decision criteria are clearly spelled out this will increase certainty for business. Managing a resource using quota or another form of tradeable access rights ensures that government will not continue granting access to new users, which would undermine the investment of existing users.

Other forms of economic incentive can also provide certainty for business. In an over-utilised resource, proper pricing will provide greater certainty that the resource will be available to those that need it most. As explained in Chapter 5, this might

apply to transport networks in places such as Auckland. By providing a clear framework in which policy objectives can be achieved, economic incentives reduce the likelihood of ad hoc policy interventions that undermine business certainty.

Growing shareholder value with fisheries quota

New Zealand implemented its Quota Management System (QMS) for fisheries in 1986 with 26 species comprising about 83% of total commercial catch of finfish. The key element of the QMS is individual transferable quota (ITQ), which is a permanent right to fish for a share of a total allowable commercial catch (TACC). The Minister of Fisheries sets a TACC for each fish stock in the QMS based on the stock's maximum sustainable yield.

Fishing under the QMS: more rational investment…

Under the open-access policy prior to introduction of ITQ, fishers competed to catch as much fish as possible. Vessels were under-utilised once total catch limits were reached. If a fishery was profitable, more fishers would enter the fishery and race to catch the available fish, leading to overfishing and low profitability.

Estimates made by the Fishing Industry Board in 1983 suggested the inshore fleet was over-capitalised by about 20% at that time, leading to over-exploitation of a few valuable and vulnerable species. Through the setting of TACCs under the QMS, these catches were brought down, while the permitted-catch levels for other species were increased. This allowed the fleet to adjust without an urgent need to shed capacity (Connor 2001).

A substantial number of smaller vessels exited at the implementation of the QMS, and the decline in numbers of small boats continued through the 1990s. This may have been a product of both efficiency considerations and the age of many of these vessels. In general, it seems that replacement of vessels in most classes has become more regular than it has been in the past, with a similar number of new vessels brought in each year, rather than all at once in response to a policy change as was previously the case (*ibid.*).

The increased security offered to businesses by quota ownership, as part of a credible commitment from government regarding access to resources, has promoted the massive investments required in vessels and shore processing-operations required to capture for New Zealand the catching and processing of fish taken from the NZ EEZ. Local companies used cash flows from fishing to back investment to expand their own capacity, turning the fishing industry into a major contributor to GDP and export earnings for New Zealand (*ibid.*).

… and growth of shareholder value

A study by Newell et al (2002) showed that the value of fishing quota has increased since the beginning of the QMS, particularly for those fisheries that were initially over-capitalised and over-fished. For these stocks, the price of quota increased, on average, by 10% *per year* after the QMS was introduced, even after allowing for factors such as the price of fish, operating costs, and the general growth in the economy.

Sanford Ltd has built its business around sustainable seafood. The company's market capitalisation has grown from $95 million in 1986, when the QMS was first introduced, to $516 million today. Since 1997, Sanford's share price has outperformed the NZSE gross index by roughly 300% (Sanford, 2002).

3.3 Lower taxes for eco-efficient businesses

In addition to being an effective and efficient way to achieve environmental objectives, economic incentives can raise revenue in some cases. This revenue can be used to fund measures to avoid, remedy or mitigate adverse effects, but it can also be "recycled" through the tax system to reduce other taxes.

In particular, revenue from charges on things we want to discourage, i.e. negative environmental consequences of economic activity, enables governments to reduce taxes on economic goods, such as property, income taxes or GST.

This means that environmental taxes with revenue recycling can benefit businesses and consumers that are resource-efficient and use only limited quantities of the taxed resource. Of course, if the tax shift is revenue neutral, other businesses and/or consumers must be paying more, but this provides them with the incentive to conserve and make more resources available to other businesses or the environment.

Several European countries have implemented environmentally related taxation with explicit cuts in other taxes. Most have been targeted at increasing employment. In the UK, the 1996 landfill tax was accompanied by a 0.2% reduction in employer's social security (i.e. superannuation) contributions. The German ecological tax reform of 1999 included a reduction in social security contributions of 0.8%, with a further 1% reduction to take effect by 2003 (OECD, 2000).

In some cases, price measures can be used to fund a major project rather than relying on general tax revenues. Such charges are typically aimed at cost recovery rather than changing people's behaviour. For example, the State of Victoria decided to implement tolls on its CityLink motorway project in the 1990s because this was seen as the only way to fund the project. In addition to raising revenue, however, such charges encourage more efficient use of resources and avoid significant tax increases to fund infrastructure that is necessary for community development.

The potential for significant benefits from revenue recycling can be seen from the revenue expected from the greenhouse gas emissions charge that the New Zealand government plans to implement in 2007 or 2008. See section 4.2 of this report.

Some environmental taxes can be so effective that they destroy their own tax base, resulting in minimal revenue. One such example comes from Denmark, which imposed a tax on nickel-cadmium (NiCad) rechargeable batteries, which are toxic to the environment if not disposed of properly. Alternatives were not taxed, and usage of NiCad batteries dropped significantly soon after the introduction of the tax, nearly eliminating the source of revenue (OECD, 2001a).

3.4 Lifting employment

Following Pearce (1991) and Repetto et al (1992), there have been suggestions that environmental tax reform (ETR) would yield a "double dividend." These authors argued that, in addition to the environmental gains, ETR would spur the economy by removing distortions on labour and income.

Two common versions of the double dividend hypotheses are as follows: that ETR will increase economic welfare, as measured by traditional measures such as Gross Domestic Product (GDP), and a more narrow claim that ETR will increase employment.

It is important to emphasize that, as long as pollution taxes and other measures do not over-correct, ETR will generally leave society better off in terms of total net welfare[4]. This occurs because the environmental benefits of reduced resource use will exceed any reduction in economic benefits. Thus, this is the "first dividend" from environmental improvements in the tax structure.

This first effect will not necessarily increase GDP and other economic measures, however, because these measures typically fail to capture the value of environmental quality to society. For example, a tax on air pollution might cause a factory to reduce production by, say, 10%, and hence reduce measured economic output, i.e. GDP. However, the improvement in the quality of life for community residents does not show up in the GDP statistics, but it may well exceed the value of the lost production. So GDP could decline even while total welfare of society improved, because society valued the clean air more than the lost production.

There are, however, reasons to believe that ETR will have roughly neutral and possibly even positive effects on GDP, quite apart from welfare effects. If revenues from taxes on pollution and other uses of resources are used to reduce other taxes, it has been suggested that this will lead to an overall increase in GDP, i.e. a second dividend from ETR.[5]

Some European governments have begun this process of tax reform, initiating or increasing taxes on environmentally harmful products and reducing taxes on employment and income. To date the percentage of tax revenue involved has been relatively small. As shown below, however, in Ireland, Korea, the Netherlands, Turkey, and the UK, the revenue from all “green taxes” accounted for around 10% of revenue in 2000[6].

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[4] In fact, a small over-correction would still leave society better off, i.e. if it is smaller than the distortion being removed by the reduction in other taxes.

[5] The suggested double dividend stems from the well-known fact that taxes cause economic distortions – when people’s incomes are taxed, they work less, and employers have to pay more to obtain the workers they need. So if these distortions can be reduced, by lowering taxes on incomes and other things that society values, then GDP ought to rise. ETR enables just such a shift to take place. There is on-going debate amongst researchers about the conditions under which the double dividend will be realised in practice. Studies during the 1990s argued that, due to "tax interaction effects", ETR is likely to increase GDP only if a country's pre-reform tax system contained substantial distortions (Bovenberg and de Mooij, 1994; Parry, Williams and Goulder, 1998; McLeod et al, 2001). Kerr (2001) summarised this debate and concluded that, because New Zealand has a relatively neutral tax structure, ETR would be unlikely to stimulate significant economic growth. On the other hand, more recently Wolfe (2003) showed that if the use of "natural capital" such as water and air were initially untaxed, a GDP increase from ETR is likely. Wolfe’s findings have yet to be published in a peer-reviewed journal, and the extent to which they apply to New Zealand has not been investigated. Given that air and water are not taxed in New Zealand, there may be some grounds for cautious optimism about the effects of ETR on GDP.

[6] The OECD recommends that this graph be interpreted with caution. Few -- if any -- inferences concerning the "environmental friendliness" of the tax system in the countries can be drawn from the graph alone. For instance, low revenue from the taxes in question could either be due to little use of environmentally related taxes, or due to broad use of such taxes, where high tax rates have caused significant changes in behavioural patterns among producers and consumers (e.g. reduced emissions). Similarly, high revenues per capita can in some cases be caused by foreign persons purchasing significant amounts of a taxed product in the country in question because the tax rates there are lower than in neighbouring countries. Revenues from fees and charges, e.g. cost recovery for goods

Hoerner and Bosquet (2001) reviewed the European experience with ETR and compiled the results of numerous modelling studies of the likely macroeconomic impacts of reforms that have been implemented in Europe. European reforms have tended to raise energy taxes, due to climate change considerations and the large potential for revenue, and to reduce the tax burden on labour by reducing non-wage costs such as social security contributions from employers.

The modelling results were varied depending upon the nature of the reform, in particular which taxes were reduced. Overall, most studies suggested that ETR would create employment, while the predicted impacts on GDP were small and mixed, and tended to be negative when income taxes, rather than social security contributions, were reduced. Cutting value added taxes (such as New Zealand's goods and services tax, GST) showed mixed results in the modelling.

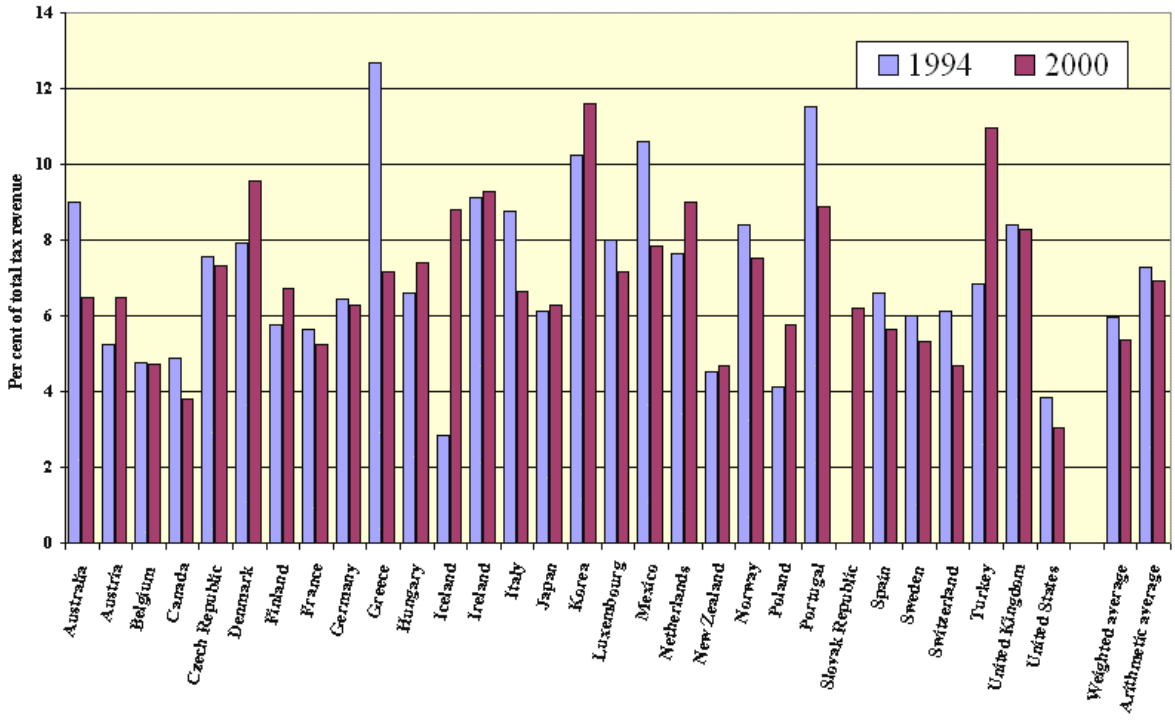

Figure 2. Environmental Tax Revenues as a Percentage of Total Tax Revenues in OECD countries, 1994 and 2000. Excludes revenue from fees and charges (source: OECD, 2003).

Given that New Zealand does not finance its superannuation system with a tax on wages, reductions in income taxes and GST are more likely options for revenue recycling. In this case, one might expect ETR to have a positive impact on employment but little effect on GDP. Regardless of whether this "second dividend" eventuates, appropriate implementation of economic incentives will increase the overall welfare of society and the sustainability of New Zealand's economy.

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or services provided to the payee, are not included. Further details concerning the actual design of each of the taxes can be found through the queries in the OECD's online database, at www.oecd.org/env/tax-database.

3.5 EIs motivate change and spur innovation

Using economic incentives for sustainable development provides a financial incentive for resource users to conserve those resources, to find ways to do more with less.

In a traditional regulatory approach, once a company has met its regulatory requirements, there is no particular incentive to improve its pollution-control technology or to use less of "free" resources such as air or water. But once there is an opportunity cost for these resources, a business can increase its profits by using less – there is a financial benefit from continuous improvement in environmental performance. That is what Tip Top Manufacturing and Sanford Ltd discovered as they reduced their water use in response to increased water charges in Auckland (see box on next page).

3.6 More resources for growth

By encouraging businesses and consumers to conserve scarce resources, economic incentives also free up resources for other users, thus enabling economic growth. Examples can be found in Denmark, Australia and New Zealand.

The renowned economist Hotelling described how the price of a fixed resource tends to rise as the resource is depleted, encouraging conservation and substitution. In theory, this leads to the result that a resource would be exhausted only at the point where demand goes to zero, e.g. because substitutes have priced it out of the market[7]. For resources managed by government-owned or regulated utilities, however, prices are typically not determined by these market forces. Prices are usually set based on the cost of current supply, rather than the marginal cost of additional supply. The result is that these resources do not comply with Hotelling's conditions. They tend to be under-priced and consumed in greater quantities than would be efficient. This leads to a more rapid depletion of exhaustible resources or, in the case of a network utility, increasing pressure on network capacity and demand for early expansion of the network.

Proper economic pricing of resources protects against such depletion by both stimulating development of alternatives and by reducing the rate of resource use, thereby leaving more for future users and future growth.

In Denmark, the introduction of a levy on solid waste disposal has extended the life of landfills, and has made recycling competitive. In Australia, trading of water entitlements has enabled water to shift to higher value uses, in particular to vineyards, allowing the wine industry to continue to expand. And in Christchurch, a demand management programme implemented by the electricity lines company Orion has postponed the need for costly investment in the distribution network.

Case studies of each of these follow (see boxes on pages 18, 19 and 20).

[7] In practical terms, of course, society is concerned about depletion and scarcity causing prices to rise significantly, as well as about exhaustion of certain resources. See Solow (1974) for a discussion of Hotelling's analysis and the assumptions upon which it rests. Solow noted that, if society has a lower discount rate than the marketplace (i.e. places a higher value on the welfare of future generations than indicated by market interest rates), this will lead to more rapid depletion and higher future prices of resources than would be optimal.

Water consumption in Auckland

Analysis of historical water consumption records for all water supply Local Network Operators (LNOs) in the Auckland Region demonstrates that consumption responds to variable water charges.

Since the drought of 1994-95, both Metrowater (serving Auckland City) and United Water (serving the Papakura District Council area) have implemented user-pays wastewater charges in addition to the user-pays tariffs already charged for water supply. All other LNOs charge for water supply only – their wastewater charges are included in general property rates.

Water charges lead to declining per capita demand

From 1996 to 2002, Metrowater and United Water had decreasing per capita demand for water, while the other LNOs had steady or increasing per capita demands. Prior to the drought, Metrowater's per capita demand was dropping by approximately 7 litres per person per day (L/pers/day) every year.

This could be due to a number of factors. City-wide metering at household connections began in the early 1990's. In addition to enabling introduction of variable water charges, installation of meters probably had an effect on public awareness of water consumption and therefore contributed to reductions in per capita consumption levels.

During the drought, per capita consumption levels for Metrowater dropped considerably – by up to 50 L/pers/day – encouraged by large-scale advertising and water-saving campaigns. Following the drought, demand gradually rebounded as many consumers returned to pre-drought levels of consumption. Nearly all the LNOs had slightly increasing per capita demand from 1995 to 1997.

However, at Metrowater, from mid-1997 onwards, per capita consumption declined again, by approximately 10 L/pers/day. This was prompted by a series of price changes, progressively moving from fixed charges to a variable charging regime. After each price change, there was a corresponding decrease in per-capita consumption.

At Metrowater, average annual per capita consumption by residential users dropped from 239 L/pers/day in 1996, when only some water supply was subject to variable charges, to 188 L/pers/day in July 2001, when variable charges for wastewater were fully implemented. Subsequent research by independent consultants has confirmed that these price changes were a significant factor in explaining the decreasing water consumption in Auckland City.

United Water, which also introduced variable charges for wastewater, was the only other LNO in the Auckland region to show a steady trend of declining per capita consumption after 1997.

See Appendix 2 for a more detailed analysis of residential water consumption in Auckland.

Business innovation

More dramatic in some ways than changes in residential demand are the water savings that some large users have made in response to unit charges for water and wastewater services.

In the past year, Tip Top Ice Cream has cut its consumption from 230,906m^3 to 155,523m^3, a reduction of over 20%, saving the company around $100,000 annually. Also in the past year, Sanford Ltd has saved $70,000 from reduced water consumption.

And at the Civic Building, Auckland City Council has achieved an 85% reduction in water consumption by focussing on the drainage valves in the air conditioning cooling tower, saving not only water but ratepayers funds.

As Eric Barratt, Managing Director of Sanford's says, "When you start measuring, you start managing."

Solid Waste Management: Denmark's Success

Denmark shares numerous commonalities with New Zealand. It has a similar population (5.5 million), and major industries like high-tech agriculture, meat, dairy, fish and chemicals. Danes also share with New Zealanders an appetite for consumption and the ensuing waste. Both Denmark and New Zealand produce around 2 tonnes of waste per person per year.

However, Denmark does not have the space that New Zealanders enjoy, being only 2.5 times the size of greater Auckland. This lack of space is perhaps the reason that Denmark has taken serious action on waste minimisation before New Zealand, and in doing so has provided some important examples of resource efficiency through economic incentives.

The linchpin of the Danish waste minimisation strategy has been a tax on the landfilling and incineration of waste, along with various supporting instruments and initiatives. The tax was introduced in 1987 with the aim of dramatically increasing recycling activities by rendering them economically competitive with disposal options.

The tax was initially €5/tonne (NZ$9.80/tonne) and has been steadily increased to around €50/tonne (NZ$98/tonne) at present. As a result of the tax, a remarkable increase in recycling has been observed in two areas – household waste, and construction and demolition (C&D) waste.

Weight-related collection for household waste

Like New Zealand, Danish municipalities are responsible for disposing of household waste, with most households charged for this service on a 'pay-per-house' basis. During the 1990's, 18 Danish municipalities reduced the fixed charge per household and introduced a per-kg fee on 'mixed' household waste. Separated organic waste may carry a lower fee per kg, while recyclables are free. The bins are weighed by suitably equipped collection trucks, which also identify the waste-bins electronically for bill generation.

This system more efficiently passes on the cost of disposal (amplified by the landfill tax) to the generation source – the household. Because people pay more for throwing away low value mixed-waste, this provides an incentive to separate materials, thus providing better quality waste streams for recycling.

In response, households under the pay-per-kg system have not only increased their recycling rate, but also reduced their total waste output.

Table 1 illustrates how the waste outputs differ between the two systems. Mixed waste to landfill/incineration was more than halved in the pay-per-kg households. There have been no indications of large-scale illegal waste disposal that could account for this difference.

In fact most citizens believe that a weight-related fee is an advantage to them, and that it is the fairest way of calculating the refuse collection fee. The average household expense for waste collection in municipalities with weighing systems tends to be at the lower end of Denmark's average of €150-€230/year. This Danish experiment shows that pricing waste collection correctly reduces waste, encourages recycling and saves people money – a true win-win.

See Appendix 3 for a description of the effects of Denmark's landfill tax on construction and demolition (C&D) waste.

Source: Jacobsen and Kristoffersen, 2002.

Table 1. Average household waste in Denmark

Waste Stream	Fixed annual fee	Pay per kg
Mixed household waste	739 kg/year	325 kg/year
Paper and cardboard	67 kg/year	105 kg/year
Glass	36 kg/year	38 kg/year
Green waste	44 kg/year	124 kg/year
Total	876 kg/year	592 kg/year

Water markets on the River Murray

Water trading was introduced in Australia in the early 1980s to address a number of concerns, including the need for more efficient use of water available for abstraction. However, trading was limited to within states, and the majority of the water trading has been temporary and along individual river valleys.

In 1998, the Murray-Darling Basin Commission (MDBC) initiated a trial of inter-state water trading along the lower Murray. During the first two years of the trial, 9.5 gigalitres* of water entitlements were traded for an estimated total of A$9.9 million. This represented only 1% of the total water entitlements in the three states.

The economic benefits of water trading

Although water was both bought and sold in all three states involved, most of the entitlements were purchased from Victoria and New South Wales for use in South Australia, primarily driven by investment in vineyards. Expansion of area in olives and other horticultural crops is also driving water demand.

Winegrapes are a high value enterprise with relatively low demand for water. From 1995-2000, South Australian grape growers with access to River Murray water increased planted area by 67%, an increase of 14,217 ha. Grape production has also expanded noticeably in New South Wales and Victoria. The real value of both winegrape and wine production grew by more than 10% *per annum* over the 12 years to 2000.

A review (Young et al, 2000) of two years of inter-state trading on the lower Murray found:

- There is much more water traded intra-state than across state boundaries. In Victoria, during 1995-2000, about 30 GL of entitlements were traded into Sunraysia from rest of Victoria.
- Average prices for inter-state trades were about A$1050/megalitre**; some transactions were for amounts in excess of A$1 million. There are some reports of water trading for as much as A$10,000/ML within certain areas, e.g. the McLaren Vale.
- Water trading was enabling water to move to more profitable uses. Three-quarters of all purchases led to the buyer increasing irrigated area, with 55% going to viticulture, 18% to horticulture and 16% to greenfields dairy development.
- Buyers were more efficient irrigators than sellers. Of buyers, 59% used drip irrigation and only 12% used flood or furrow irrigation. Amongst sellers, 54% used flood or furrow irrigation and only 7% used drip irrigation. A larger proportion of buyers than sellers manage their properties using a whole-farm plan (96% vs 36%) and use aids in the monitoring and scheduling of irrigation (96% vs 57%).
- Of the water traded across state boundaries, less than 1% was being used at its origin.

Gyles (2003) has shown that the potential for increased returns from water transfers should not be overstated. In Australia, taking into account the investment required in enterprises with higher gross margins, the returns to irrigation water for new horticulture and dairy operations are about the same as for existing irrigated grazing, roughly A$500/megalitre.

So, while water trading has clearly enabled significant expansion of some very high value industries (as evidenced by their willingness to pay A$1000/megalitre), existing land uses with lower gross margins will continue to be competitive. Water trading will not radically alter the pattern of land use overnight. Social and environmental impacts of inter-state water trading are described in more detail in Appendix 1.

Lessons from the Murray-Darling

The experience on the River Murray highlights some important pre-requisites for trading of water entitlements. First, local effects of irrigation must be managed properly or trading may have adverse environmental effects. In addition to salinity issues, this applies to changes in nutrient and sediment loading, chemical usage and other issues that may accompany intensification or changes in land use.

(continued)

* 1 gigalitre (GL) equals 10^9 litres or 1 million cubic metres (m^3), as an annual entitlement.
** A megalitre equals 1 million litres or 1000 m3. An irrigator would use this amount in 24 hours if irrigating at a rate of 11.6 l/sec.

Water markets on the River Murray (continued)

Potential social impacts of land use change should also be considered. The analysis of inter-state trading on the Murray found that, despite concerns about social impacts, most water traded was from unused entitlements and the only clear social impacts were benefits from increased investment (Young et al, 2000).

Environmental and social issues need to be managed properly regardless of water trading, of course, because otherwise adverse effects can arise as land use changes over time. Water trading allows land use change to occur more quickly – this enables greater economic growth but this can lead to greater environmental degradation unless appropriate constraints are first put in place.

Only where a management regime specifies minimum environmental flows and enforces these through restrictions on abstraction permits, e.g. reductions in allowed takes in times of low flow, can water trading safely be allowed without threatening environmental values.

This highlights the most difficult issue of all for the Murray-Darling Basin – the system is so seriously over-allocated that the river mouth has silted up. There are insufficient flows to flush the sediment through the river. Dryland salinity is reducing productivity across the basin.

There is a growing realisation in Australia that the volume of water taken from the Murray-Darling must be substantially reduced. How this will be done, and whether irrigators will be compensated for reductions, is now the focus of much debate. As the Australian Conservation Foundation and the National Farmers Federation recently agreed (ACF and NFF, 2003), once the amount of water available for abstraction has been reduced, it will be even more important that entitlements be transferable so that maximum value can be obtained from the limited water available.

See Appendix 1 for more details of water trading on the River Murray.

Orion – Electricity Demand Management

Orion owns and operates the infrastructure, or 'network', that supplies electricity to Christchurch City and its surrounding regions. Orion's network connects to around 170,000 customers and delivers 3,050 GWh each year. This is approximately 7% of New Zealand's total electricity usage. Orion's objective is to manage its network efficiently and cost-effectively, with a focus on maintaining a low price for its customers.

Up until 1989 the maximum electricity load on the Orion network, known as the winter peak-load, had increased by 2.5% each year. This rate of increase was a reflection of the general trend in electricity demand by New Zealand as a whole.

With the increasing winter-peak load, the need to reinforce Orion's network and construct a new Transpower transmission line between Twizel and Christchurch was rapidly approaching. The cost of further investment to handle the ever-increasing demand was estimated at $200m. To avoid the need for this investment, the increase in the winter peak had to be slowed.

So in 1990, Orion (then Southpower) began a major 'Demand-Side Management' project. The aim of the project was to reduce the growth in peak demand of the electricity network from 2.5% to 1%. Because Orion does not directly control electricity use, the solution needed to motivate customers to voluntarily use less power, or use it in a different way. For this reason an economic instrument was applied.

Orion's pricing structure now varies depending on the network load, so that a higher price is charged during peak-time. This encourages off-peak use of the system and voluntary load reduction during periods of peak demand. The switch in pricing schedules is signalled to the end user by means of an electric pulse, or 'ripple', that is sent through the power lines.

(continued)

Orion – Electricity Demand Management (continued)

End users can choose to install devices on their electrical equipment (mainly hot water systems) that detect this ripple and subsequently turn the equipment on or off to take advantage of off-peak pricing. Combined with a customer education program, this system effectively 'penalises' those users who consume electricity at peak times while 'rewarding' those who are energy efficient and aware.

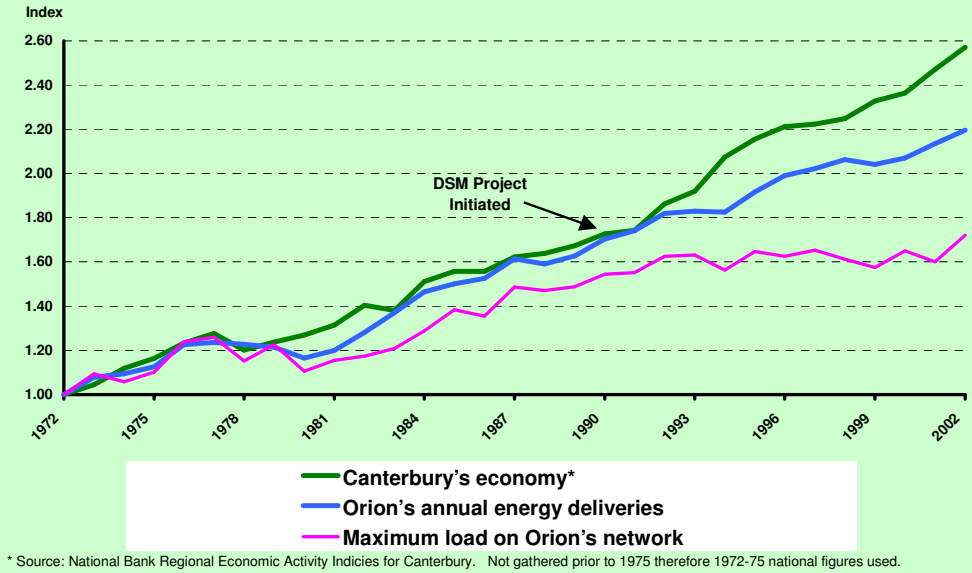
Electricity industry reforms of the 1990's have meant that Orion no longer operates an electricity retail service. However, Orion has continued with its variable pricing schedule, which clearly signals to electricity retailers the marginal investment cost in the network, and encourages retailers to pursue 'Demand-Side Management' measures with their customers.

Orion believes that one of the best ways of encouraging energy efficiency is through correctly signalling investment cost implications to electricity retailers via its pricing structure. Orion further progressed its pricing structure in 2001 by removing fixed charges for residential and small business customers. All revenue is now generated through per unit charges on electricity. Passing on all costs to end-users in this manner also increases users' incentives for savings, and hence encourages greater energy efficiency.

As a result of Orion's 'Demand-Side Management' project, the peak-load growth throughout the 1990's was reduced to 0.95% per annum. The entire project cost $20m, most of which was spent on the technology for producing and receiving the 'ripples'.

The reduced load negated the need for $200m of additional infrastructure, resulting in estimated net savings of $180m. These savings have been passed on to consumers, with electricity prices around 7% lower than what they would have been without the economic instrument. Avoided additions to network capacity also had environmental benefits in terms of materials saved and adverse effects of construction activities avoided.

Orion's Demand-Side Management programme has spread the load on its network and reduced peak daytime demand. Although total demand has increased by 20% during the 1990s, Orion has managed to postpone significant investments and has thereby saved its customers money. See Figure 1.



* Source: National Bank Regional Economic Activity Indicies for Canterbury. Not gathered prior to 1975 therefore 1972-75 national figures used.

Figure 3. Growth of Orion's maximum load versus growth of the Canterbury economy

3.7 Competitiveness and other issues

Competitiveness of sustainable business

The international competitiveness of firms has been defined as "the ability of specific firms or industries to compete for market share with businesses located in other countries" (Sinner 2002).

Research on the effects of environmental regulation on competitiveness has generally found that estimated effects "are either small, statistically insignificant, or not robust to tests of model specification" (Jaffe et al 1995). Among several reasons given for this is the fact that costs of environmental regulation tend to be a relatively minor component of a firm's overall costs, and tend to be overwhelmed by differences in costs of labour, energy and raw materials, and other factors.[8]

This is not to deny that the use of economic incentives for sustainable development is likely to result in some shifts between sectors, i.e. from resource-intensive and polluting businesses to more resource-efficient businesses. When revenues from environmental taxes and charges are recycled and used to lower other taxes, resource-efficient businesses come out ahead. By making this country's resource-efficient businesses relatively more competitive, economic incentives encourage growth in those sectors rather than others.

That, indeed, is the objective, to move New Zealand onto a path of more sustainable development. This is likely to be a gradual process, however, rather than one that rapidly alters the competitiveness of different industries and firms within the economy.

Social and cultural dimensions of sustainability

This report deals primarily with the economic and environmental dimensions of sustainability, but social and cultural dimensions are equally important.

Instruments based on economic incentives leave the ultimate decisions about resource use up to the user, whereas government-imposed solutions fail to harness the variety of possibilities and preferences known only to individual users.

Economic incentives can be designed to address social and cultural goals. In section 4.4, we show how a tradable certificate scheme for solid waste could improve social as well as environmental outcomes. Market-based instruments can also offer some protection for efficient small and medium enterprises. Of the big fishing companies and the quota management system, one New Zealand crayfisher said, "In my opinion, they [the big companies] are trying to force the little man out, but so long as the little man owns quota, they can't" (Somerville, 2003).

Where incentive mechanisms target environmental outcomes, social and cultural factors need to be taken into account. For instance, a key principle of the New Zealand Government's climate change policy is that lower socio-economic groups should not bear the burden of change (DPMC, 2002). This principle might be reflected in how the Government recycles revenue from the greenhouse gas emissions charge, for example.

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[8] For some industries, however, the cost of greenhouse gas emission charges and related policies are likely to be non-negligible, and the New Zealand Government has therefore offered exemptions to qualifying companies (see section 4.2 below).

Some people are not comfortable with the concept that access to resources might be determined by ability to pay. Some see access to water, for instance, as a basic right and believe water should be free to all. Such views can be accommodated in several ways. In creating water markets in rivers, a minimum flow regime to protect recreational and fishery values should be established prior to allowing any flows to be traded. In the case of household water supplies, every household could be granted a basic allocation for a low or nil charge, for instance. But households should also decide whether they need more than this, and should have an incentive to conserve resources when doing so.

Certain types of economic incentive measures can also highlight issues of ownership of resources. If a measure generates government revenues beyond the cost of providing a service, for instance, then the 'owners' of the resource can reasonably expect to share in those returns. In some cases, it may be appropriate to put revenues into trust funds until ownership issues can be resolved, rather than continue to provide access to resources for free and letting users reap all of the benefits.

4 Opportunities for New Zealand

4.1 Water markets and water pricing

Benefits of water markets

Enabling the creation of water markets to increase the transferability, or tradability, of water permits has been talked about in New Zealand for over a decade. Under its Programme of Action for Sustainable Development, the Government is again examining the scope for economic incentives to improve the sustainability of outcomes from water management.

New Zealand does not have catchments of the size of the Murray-Darling basin, so there is less scope for water markets on the scale seen in Australia. Nonetheless, there is considerable potential for increased transferability of water permits as a means to increase efficiency of water use in New Zealand and to increase total production from the water available.

Under the traditional approach used in New Zealand, councils face difficult decisions about how much water to allocate from finite resources. Logic might suggest this should be no more than 100% of the available flow in excess of that needed to maintain in-stream values in a river, or up to 100% of the rate of replenishment of a groundwater resource. But because different users need water at different times, 100% allocation usually means that some available flow goes unused. For this reason, among others, some resources are "over-allocated", e.g. to 130%, but if councils enforce minimum flow regimes, over-allocation reduces the security of supply of those who have water permits, especially if users expand production or otherwise make more complete use of their allocated amounts.

This dilemma can be avoided with a water market. Councils can allocate 100% of the available flow, and any water not being used during a particular time period can be traded, temporarily or permanently, to those who need it at that time. There is no need to over-allocate a resource in order to take full advantage of the available water.

Another benefit of water markets is that, by putting a clear economic value on water, they encourage and enable water storage. Without tradability, the value of water is not clear and hence it is more difficult to calculate the return to a prospective investment in water storage. Furthermore, without tradability, storing water on one property and transferring it to another via the river or stream would face a number of obstacles. A water market solves both of these problems – a resource consent would still be required for the storage and release of water, but the ability to transfer the water downstream to another user would be assured.

Markets for groundwater have been contemplated in both the Auckland region and in Marlborough but have not proceeded. In 1997, the Tasman District Council consulted with water users on the Waimea Plains regarding tradable permits, but opted to maintain the status quo, including so-called 'use it or lose it' provisions. It appears that vocal opposition from a few might be over-shadowing the wider community interest in transferability.

Meanwhile, the potential benefits from more efficient use of water are often not visible and have no champions, and as a result councils tend to avoid change. One encouraging sign is that Environment Waikato's proposed regional water plan includes water transfers as a permitted activity in certain situations, although one aspect of this has been appealed.

Attitudes regarding water transfer

Robb et al (2001) examined attitudes and barriers to water transfer in New Zealand. They found that resistance to change in land use within a catchment is a major barrier to water transfer, especially if there was a perception that water would move away from land to industrial or other urban uses. An earlier study (Kearney and Sinner, 1997) found similar attitudes amongst water users on the Waimea Plains. In 1995, such concerns in the small Oroua catchment in Manawatu led the regional council to allow only transfers between irrigators, in what remains New Zealand's only confirmed regional plan that allows site-to-site transfers as a permitted activity.[9] At the time, irrigators resisted more flexible water allocation policies (e.g. transferability of permits) out of concerns about land use change and its associated social implications for a community. Some water-users are concerned that economically powerful organizations would buy and hoard water permits.

These are legitimate concerns, but they need to be rigorously examined. In reviewing inter-state trading along the River Murray in Australia, Young et al found only positive social impacts, from more efficient water use and new investment. On the Waimea Plains in New Zealand, all of the forecast increase in urban and industrial water demand could be met, without changing irrigated area, if irrigators improved their efficiency of water use by just 5% over 25 years, i.e. by just 0.2% per year (Kearney and Sinner, 1997). Economically powerful organizations do not take over and hoard land, because there is a significant cost involved in purchasing and holding an asset that is not being fully utilised.

Robb et al (2001) did not find land use change to be a major concern of regional council staff they interviewed. Council staff were concerned about technical issues such as real-time compliance and the difficulty of defining zones within which to allow transfers, but were, according to Robb et al, generally supportive of water transfer. However, given opposition from some stakeholders, and in the absence of strong public support for transferable water permits, councils have maintained the status quo.

A survey of 46 existing users in New Zealand found that there is potential for water trading, albeit on a limited scale at least initially (Robb et al, 2001). And despite the fact that irrigators especially have been vocal in their opposition to transferability in some regions, the survey found that roughly three-quarters thought that water should be able to be moved between properties, and over one-half supported the concept of permanent transfer (as opposed to temporary leases). About one-third of these users wanted to obtain more water. Analysis of willingness to pay and willingness to sell

[9] See Manawatu Wanganui Regional Council, *Oroua Catchment Water Allocation and River Flows Regional Plan (Change 1)*, June 1997. Due to the small size of the catchment, the limitations on transfer, and the fact that irrigators have faced few actual restrictions, only a few transfers have taken place. During March and April 2003, even though flows twice fell below the trigger level specified in the regional plan, the council did not notify irrigators of restrictions (because rain was forecast), so irrigators have had little need to engage in transfers.

suggested that anywhere from 2% to 15% of water entitlements might be traded in certain areas in New Zealand, depending on the conditions of transfer.

If transfers were permitted under regional plans, transfers might increase over time as users become more aware of the value of water and water transfer becomes more acceptable.

Whither the Waitaki?

In Canterbury and the Waimea Plains, there is still a good deal of water being used for flood irrigation and for stock-water races, even though higher value uses are sometimes available within the same catchment. There is also potential for more private investment in small-scale facilities to store excess flows, e.g. in winter.

In Otago, a debate has emerged over the best use of the water in the Waitaki River: a series of hydro-electric power plants with some irrigation, or other irrigation schemes that are not consistent with the power scheme. A local Member of Parliament has argued that the power company, Meridian Energy, should pay $120 million to the local community as compensation if the project proceeds.[10] An editorial in the Otago Daily Times has suggested that all commercial water users should be charged fair market value for the use of the water and the revenue returned to the local community[11].

Under the RMA, resource consents are typically considered on a first-in, first-served basis. Councils do not, and probably cannot, consider the merits of one application relative to another. Furthermore, the lack of permitted transfers means that, once granted, water entitlements do not easily move to other uses.

Faced with the competing interests in the Waitaki, the Government in September 2003 "called in" all Waitaki water permit applications, in effect to putting them on hold while it develops an allocation framework for the river. The Government has commissioned a cost-benefit study of irrigation potential along the Waitaki, suggesting it might be looking at a political/administrative allocation rather than a market-based one. Special legislation is planned to provide a framework for water allocation decisions.

The Government has already acknowledged that first-in, first-served is not an efficient or equitable way to allocate water permits. It is not evident, however, that a political/administrative allocation framework will be either more efficient or more equitable. Rather, the Government should auction water permits for the Waitaki so that the water goes to the most highly-valued use. While some might consider that it is not equitable to require irrigators to compete with Meridian Energy in an auction, in fact Meridian is no more likely to pay more than the water is worth to the company than an individual irrigator is. Meridian operates in a competitive electricity market, and if it paid too much for water rights on the Waitaki, Project Aqua would lose money.

Regardless of which parties get the initial allocation in the Waitaki, the economics of both irrigation and electricity will vary over time. Contrary to the "either/or"

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[10] Vernon Small, "Why Big Projects Present Big Problems", *The Dominion Post*, 18 September 2003.
[11] See Otago Daily Times, "River of no return?" 30 August 2003. www.stuff.co.nz/otago.

publicity, it is likely that a mix of irrigation and power generation would be the optimal outcome on the Waitaki. This mix will vary seasonally as well as over time, and it is essential that mechanisms be in place to allow the highest value use at any point in time. The most straightforward and sensible option would be to allow permit holders to trade their entitlements on both a temporary and permanent basis, within constraints that ensure that ecological and amenity values are protected. Indeed, Cabinet has noted that "the ability under the RMA to provide for transferability of water permits through a regional plan will be retained" (New Zealand Cabinet, 2003).

This will make it even more obvious, however, that those who secure water permits often get a windfall from the environment. If permit holders are allowed to sell their access to water, as we believe they should be, without having purchased them, then the community is also entitled to some return for allowing the use of the water in the first place.[12]

Overcoming the obstacles to transferable water permits

In key catchments, there is a limited amount of water available for productive uses at times of peak demand. Councils are not well placed to determine what abstractive uses of water will best advance sustainable development – they do not take water allocations away from one user to give to another. Their role should be to set guidelines to protect community interests and the environment, and then let the market direct water to the highest value use. Councils will need to do more research and analysis to determine appropriate standards and limitations, e.g. to ensure that increased irrigation in an area does not cause excessive nutrient loss to groundwater, rivers, lakes and vulnerable coastal areas, or microbial contamination from livestock faeces.

This research will require resources. In some catchments, there may be insufficient potential for additional water use to justify the planning required. But where this potential exists, the work needs to be done. If New Zealand is to unlock the economic potential of its water resources, and to do so in a sustainable way, then environmental and social issues must be addressed.

The possibility of water trading also raises Treaty of Waitangi issues. Some iwi have lodged claims for ownership of certain rivers; other iwi have made claims for a greater say in water management. These claims have not yet been resolved, and any system to increase the ease of transferring water permits must not pre-empt or jeopardise their resolution. It is therefore important to emphasise that, in New Zealand law, a resource consent to abstract water is a temporary authorisation with no guaranteed right of renewal. Any transfer of the consent, such as is already allowed by application, is simply a transfer of the temporary authority to use the water. It does not transfer ownership. As long as this is clear, transfers need not compromise the resolution of claims over water resources.

Increasing the transferability of water permits would allow greater economic return from the water currently available in New Zealand. It is not a panacea to water allocation issues, as many catchments are small and hence the potential for transfers between users is limited. Yet the potential for transfers exists, and the number of

[12] Where required, revenues could be put in trust pending resolution with tangata whenua of any outstanding claims to water resources.

transfers could grow over time. Enabling councils to charge for water, beyond just recovering the cost of delivery, could also increase the efficiency of water use and potentially make more water available for new and higher value uses.

Sustainable development requires consideration of environmental, social and tangata whenua concerns as well as economic development. There is scope for these issues to be resolved within systems allowing greater transferability of water, but it requires a focussed effort by councils and their communities. Those who are interested in making water available for new and higher value uses will need to speak up and engage in the debate with those who are seeking to preserve the status quo.

Although the amount of water transferred in New Zealand might be small if more permits were made transferable, the experience from Australia suggests that only a small percentage of entitlements need to be traded to generate significant investment and to make the true value of water apparent to all potential users and investors.

4.2 Economic incentives to manage greenhouse gas emissions

As part of its response to its obligations under the Kyoto Protocol, the New Zealand government has announced that it will use incentive-based measures to manage greenhouse gas emissions. These include a charge on greenhouse gas emissions starting in 2007 or 2008 and a 'projects mechanism' to reward emission-reducing projects.

An emissions charge is intended to ensure that energy users face the full cost of their emissions and have an economic incentive to identify and adopt more energy-efficient alternatives. Electricity users will pay an additional cent or two per kilowatt-hour, while vehicle users will pay an extra few cents per litre (DPMC, 2002).

In practice, the responsiveness of energy demand to price incentives depends on a number of factors, including the availability of information and feasible alternatives. Landlords of commercial and residential property determine the choice of lighting, heating and air conditioning systems, leaving tenants with limited options. The government is considering establishing minimum energy performance standards for these appliances to address this problem, and has mandatory labelling requirements for other appliances to ensure that purchasers have adequate information on energy consumption of competing products.

A recent study suggests that New Zealanders' demand for petrol is even less responsive to price changes than drivers in other countries (Barns, 2002). It appears that petrol consumption might not respond to price increases until the availability of public transport and other alternatives gives people more viable options. In the meantime, the emissions charge ensures that road users pay for the cost of their emissions, rather than this cost being passed on to the general taxpayer.

Indeed, due to reductions in other taxes, many taxpayers will see a net benefit from the emission charge (see box).

Emission charges and tax cuts

The New Zealand government has announced that it will implement a charge on greenhouse gas emissions starting in 2007 or 2008, and that most of the revenue will be 'recycled' to the economy via reductions in taxes.

The level of the emissions charge will be determined based on the price at which emission credits are trading internationally, but will be capped at no more than NZ$25/tonne until 2012. Most carbon dioxide emissions will be subject to the charge, in particular emissions from the transport and energy sectors.

Revenue from the emissions charge…

The revenue to be derived from the emissions charge is not yet known, because the government is still negotiating some exemptions with industry. Furthermore, the charge itself will probably not be set until 2006 or 2007, and then might be adjusted occasionally to reflect the international price of emissions. However, an estimate of likely revenue can be made based on emissions data and trends.

In 2002, New Zealand emitted 31 million tonnes of CO_2 from energy sources. The emissions trend suggests continued growth at 2.1% annually, or 36.3 million tonnes of CO_2 emissions from energy use by 2010 (MED, 2003).

If 25% of these emissions were covered by negotiated greenhouse agreements and therefore exempt from the emissions charge, as the Government has suggested (DPMC, 2002), annual revenue from the charge would be approximately $272 million at $10/tonne or $681 million at $25/tonne.

In addition to revenues from the charge itself, New Zealand will have surplus credits for carbon dioxide absorbed by forests planted since 1990. The number of credits available to be sold will depend on various factors. These include the effectiveness of the emissions charge, NGAs and other policies at reducing emissions, the extent to which methane emissions from agriculture continue to increase above 1990 levels, and the international price for emission credits.

Allowing for exemptions from the emissions charge and the use of some forestry credits to finance the government's project mechanism, the government could recycle the revenue from approximately 10.5 million tonnes per year, i.e. roughly half of the forestry credits it expects to receive for the period 2008-2012.

At $10/tonne, this would generate $105 million, while at $25/tonne these credits would be worth $262 million per year.

Thus, combining revenue from the emissions charge and from sale of forestry credits, there would be an estimated $377 million or $943 million, at $10/tonne or $25/tonne respectively, available annually for revenue recycling.

…can be used to cut taxes

This revenue could be used to cut taxes in various ways. At $25/tonne, options include a 2% reduction in GST, a 6% reduction in company tax, or a 3% cut in the bottom tax rate of 19.5% on income up to $38,000, which would benefit all taxpayers*. Alternatively, all personal income tax rates and the company tax rate could *each* be cut by about 1.5%.

As a result of such a tax reduction, many businesses and households that are efficient users of electricity and transport would expect to see net increases in their after-tax profit and disposable household income.

At the margin, tax reform of this nature would encourage a shift towards more labour-intensive business strategies while, at the same time, lower personal income taxes would increase take-home pay and hence could attract more people into the work force. The result should be an increase in employment and, possibly, an increase in Gross Domestic Product, although the effect on economic output is hard to predict with any confidence.

* Estimates based on information from the NZ Treasury. Various conditions and qualifications apply, so these estimates are indicative only. See www.treasury.govt.nz/readyreckoner/reckoner.asp.

Furthermore, firms whose international competitiveness would be jeopardised by the charge are eligible for exemption from the charge if they have a Negotiated Greenhouse Agreement (NGA).[13] An NGA is a binding contract with the Government to take specific measures to manage greenhouse gas emissions, including adoption of world best practice.

It is also worth noting that the system for administering the emissions charge can be converted to an emissions trading regime relatively easily. This would avoid the need for the government to set and periodically adjust the emissions charge, which itself could cause some strategic behaviour by emitters as they attempt to anticipate the likely direction of changes in the charge. Emissions trading would also enable New Zealand companies to manage their own obligations and to meet their obligations by, for instance, trading with companies in the European Union, where trading is due to begin in 2005, or by investing in emission-reduction projects in developing countries.

Through its projects mechanism, the New Zealand Government is offering emission credits, tradable on the global emissions trading market, to projects that offer reductions in emissions from an agreed baseline. This creates incentives in sectors not subject to the emissions charge, although energy projects are also eligible. There is thus a risk of some projects getting a 'double-incentive' through both the emissions charge and the project mechanism, and that the resulting reductions will cost more than the value of emissions saved. This can be avoided by careful drafting and application of the assessment criteria.

4.3 Beating congestion: new approaches to road pricing

The cost of congestion

Traffic congestion is a significant and growing problem in several New Zealand cities, especially Auckland. The hidden costs associated with congestion include travel time delays (including increased wages for businesses), increased fuel usage and associated greenhouse gas emissions, increased vehicle running costs, additional buses and delivery vehicles needed to achieve equivalent on-time performance, increased crash risk and health effects from pollution resulting from interference between vehicles in the traffic stream, and driver stress.

An Ernst and Young report (1997) blended two cost estimates together to produce an estimated externality cost of Auckland congestion of $755 million. This estimate can be roughly updated to 2003 using data from the Auckland Regional Council's Auckland Regional Transport Model, which indicates that average travel times in the morning peak have increased by 10 percent, average trip speeds have decreased by 10

[13] In addition to exemption from the emission charge that a company would otherwise have had to pay, NGAs might compensate companies for the increase in electricity costs due to the emission charges on electricity generation. Because electricity is traded in a competitive market, the price of all electricity is expected to increase, not just the electricity from generation plants using fossil fuels. However, about half of New Zealand's electricity is from hydroelectric power plants operated by state-owned enterprises. These companies will benefit from the higher price of electricity without having to pay an emission charge on renewable electricity, and hence will have higher profits to return to the government via annual dividends. Thus, rebates to companies with NGAs can be made from these dividends and, because most electricity users will not have NGAs, there should still be some additional dividends left over. In this respect, the estimate of revenue from the emission charge (see box) might be under-stated.

percent, while traffic has increased by an average of 14 percent. Accordingly, the costs of congestion to Auckland almost certainly now exceed $1 billion.

Road congestion is not just a toll on the lifestyle of Aucklanders – it is a huge burden on the city's manufacturing, distribution and service businesses. There is also a competitiveness risk to Auckland's and indeed to New Zealand's future: if transport congestion continues to worsen, the exodus of businesses and skilled workers to competing cities in Australia may accelerate.

Growth in traffic is, in some respects, evidence of social and economic vitality, but ever-increasing congestion indicates poor urban design and a failure to manage growth. The metropolitan condition that spawns congestion – namely, high levels of access to a wide variety of economic and social attractions and opportunities – is a highly desired condition. A degree of traffic congestion at peak times is an alternative to costly additions to infrastructure capacity. It follows that, in principle, there is such a thing as an optimal level of congestion (Hau 1998). The difficulty with managing congestion is that, once traffic exceeds optimal usage, small increases in traffic volume can cause big increases in traffic congestion and delay.

Approaches to reducing congestion

The question of how to deal with marginal increases in road traffic is the key to the problem. There are three broad approaches:

- Divert the marginal increase to public transport;
- Build more roading capacity to cope with the increase;
- Introduce congestion pricing, to deter use of roads at times they are congested, and encourage travelling at other times or by other modes.

The first two of these approaches have been widely tried in cities around the world. The results have been disappointing. A global study by the World Business Council for Sustainable Development (2001) summarises the overall picture:

> *Congestion seems to be getting worse in the urbanized areas of most developed countries. Efforts to construct new transportation infrastructure have been overwhelmed by demand generated in response to construction of more road capacity, and by community resistance to the location of many urban infrastructure projects… Efforts to roll back the tide of private automobiles in a major way by luring drivers to conventional public transport have largely failed. Public transport ridership has been increasing in many cities, but public transport's share of total urban personal transportation has not.*[14]

These failures have heightened interest in congestion pricing as a means to address these issues. However, congestion pricing is not a silver bullet, either. To be workable in Auckland, it would need to be accompanied by increases in both roading and public transport capacity. In order to consider the role of congestion pricing, it is first necessary to understand the factors motivating the behaviour of marginal drivers entering a crowded roadway, and to consider how this behaviour might be influenced.

[14] WBCSD 2001 page 1.16

Triple convergence

A single additional vehicle entering a congested motorway can, in some instances, add as much as an hour's delay to the travel times of other commuters using that motorway.[15] When roads are paid for through petrol taxes, or through other mechanisms such as road user charges that do not reflect the capacity and level of usage of the road, the marginal cost of that time loss is not borne by the driver of the vehicle entering the road. The driver of the additional vehicle faces only a fraction of the marginal costs that his or her presence imposes on others. The costs faced are mainly in the form of time, which may not be highly valued by some, but are often highly valued by others using the road.

If road capacity is expanded to deal with this problem, then worldwide experience shows it is quickly filled with increased numbers of peak-time commuter vehicles, through what Downs (1992) describes as a 'triple convergence.' At peak times, vehicles converge on the new road capacity from:

- alternative routes;
- adjoining time periods; and
- alternative modes (people moving from public transport, walking or cycling).

Each of these 'groups' moves to the new road capacity because they are improving their individual amenity. Given the low marginal price of using the facility, the number of commuter vehicles willing to use peak-time capacity is substantially greater than those who are actually able to do so without causing congestion, and the triple convergence phenomenon is driven by those frustrated commuters. Under existing pricing systems, there is an almost insatiable character to the demand for new road capacity investments. Downs also notes that those cities that have built new public transit systems have not experienced much – if any – reduction in peak-hour vehicle congestion.

Road pricing – adjusted by time of day or level of congestion – is the only congestion remedy that has been able to avert the triple convergence phenomenon. It is a rationing mechanism for road use which ensures the costs and charges of using the roading system become more transparent to both users and providers, and hence enable demand and supply of transport network capacity to become more balanced.

Singapore offers the most long-standing and successful example of congestion pricing (see box). Paris successfully uses congestion pricing on several autoroutes approaching the city, while Rome has congestion charges for an area of the city centre. Oslo and several smaller Norwegian cities have cordon tolling systems involving charges for entry to city centres during the day. These charges are set fairly low and their objective is revenue generation to finance new transport facilities rather than changing the behaviour of commuters. However, the system operating at Trondheim (population: 140,000) has achieved both objectives to some degree (Transportation Research Board 2003).

[15] Measured for San Francisco – see Downs (1992) p194. Kockelman (quoted in Institute of Transportation Studies 2003) notes that the last 100 people to enter a facility nearing capacity can cause traffic flow to deteriorate from 60 mph to 20 mph.

Singapore: congestion pricing pioneer

In 1975 Singapore, which had a population of a little over 2 million at the time, introduced a congestion pricing charge for traffic entering a restricted zone of 620 ha of the central business district during the morning traffic peak from 7.30 am to 10.15 am. Vehicles in the zone during this period had to display a window sticker for which a daily or monthly fee was payable.

Within three months, motorised vehicles entering the restricted zone had dropped by 44%. The largest behaviour changes were among inbound commuters whose place of work was inside the zone. In response to the congestion charge, these commuters increased their car-pooling trips from 8% to 19% and their bus trips from 33% to 46%.

The need for an integrated solution

However, Singapore's average door-to-door commuting time for all travellers did not improve significantly. This disappointing result was attributed to insufficient public transport options, and to increased congestion on roads bypassing the restricted zone. Both issues were subsequently addressed.

An expressway opened in 1981 to provide increased capacity to bypass the restricted area; the bus fleet was almost doubled between 1974 and 1990; and a Mass Rapid Transit railway system was introduced in stages. The experience illustrates the importance of an integrated approach to urban transport issues.

A relatively high congestion charge was established from the outset in 1975, in the context of a fast-growing economy and a relatively authoritarian political system. Revenues were fully recycled through a 33% reduction in Singapore's sizeable vehicle registration fees and a reduction in existing road taxes.

Over a 15-year period from its introduction, in conjunction with public transport improvements, the congestion pricing system achieved a reduction in the use of private vehicles for commuting trips into the restricted zone from 56% to 23%.

However, with the greater efficiency in use of the road system, the total number of vehicles entering the zone grew by 24% over the period. (This was still well below the 72% growth in the total vehicle population.) Employment within the zone expanded by 30% during the period.

Going electronic

In 1998 Singapore's congestion pricing system was upgraded by the introduction of electronic road pricing (ERP). This allowed a more flexible charging system, wider coverage and reduced costs to motorists. Charges are now set on a schedule for every half hour, and they apply not only to an enlarged central zone but also to a range of expressways and arterial roads.

The charges are reviewed every three months and prior to school holidays, to achieve optimal traffic speeds. 95% of vehicles now travel at over 45 kph on motorways, and 90% of vehicles travel at over 20 kph on major roads.

The pricing system also differentiates by type of vehicle fuel, with electric vehicles paying a fee 20% lower, while hybrid and CNG vehicles pay 10% less. These incentives are designed to encourage changes in the vehicle fleet to reduce greenhouse gas emissions.

The system uses in-vehicle transponder units that accept stored-value CashCards for payment. The CashCards can also be used to pay for goods and services in shops, government agencies and internet sites. They can be recharged at ATMs, petrol stations and special kiosks.

The ERP system cost S$197 million (NZ$184 million) to install, including more than a million in-vehicle units that were provided free to motorists. The total cost was substantially less than the avoided cost of new motorway capacity. The annual running costs were S$10 million (NZ$9.3 million) in 2002.

Sources: Transportation Research Board 2003; Zen 1999; and Singapore Land Transport Authority websites www.lta.gov.sg and http://trffic.smart.lta.gov.sg.

Early in 2003, a congestion pricing system was introduced in central London. In two months this led to a 20% traffic reduction in the target zone and a doubling of average speeds, to 17 km/hour. In the words of London's Mayor, Ken Livingstone, "These results confirm that traffic congestion and journey times for motorists, bus passengers, and business journeys are significantly reduced both inside and outside the congestion charging zone."[16] London's experience has given momentum to congestion pricing in many other cities around the world. A recent study by Deloitte Research indicates that 26 cities are now planning to introduce congestion pricing systems within the next decade (Eggers, Samuel & Munk, 2003).

The road pricing approach used in overseas cities cannot necessarily be transferred to Auckland, or other New Zealand cities, without modification. Simply putting a price on entry into Auckland's central business district would not properly target the problem. Indeed, it could be counterproductive if it undermined the viability of job creation in the CBD in favour of a more sprawling pattern of urban development.

The best solution would be a comprehensive road pricing system for the Auckland region's whole transport network, or at least its motorways and arterial routes, with the prices for using different sections depending on the level of congestion on that section at the time. There are two barriers to achieving such a system: one technical, the other political.

Addressing the barriers

The technical problem is on the verge of being solved. Electronic road user charging (ERUC) has progressed to the point where congestion charging can be applied not just for crossing a cordon into a central restricted zone, but for a wide-ranging transport network. Ground-based ERUC systems have been operating in recent years in a number of cities including Melbourne (see box) as well as Singapore. A similar system covers the entire national motorway network of Austria.

A more advanced form of ERUC, using satellite tracking systems linked to GPS[17] units in each vehicle, is currently under development. This has been incorporated into a charging system for trucks in Switzerland, and is being introduced in a more sophisticated form next year in Germany, where the charges will vary depending on the route being taken and the time of day. Peak times on heavily used routes will cost more. The European Commission (2003) has proposed requiring satellite-based systems to be used for all new road pricing systems after 2008, and for a single Europe-wide, satellite-based road charging system to be operative by 2012.

New Zealand's own Ministry of Transport is investigating a nationwide, satellite-based ERUC system as a better way of charging trucks for their road use. The business case for investing in such a system for the New Zealand truck fleet would be strengthened if it were later extended to cover all vehicles. The costs of satellite tracking systems are coming down rapidly and the European Commission (2003)

[16] Ken Livingstone "Mayor hails latest results on the impacts of congestion charging" press release 6 June 2003, http://www.london.gov.uk/view_press_release.jsp?releaseid=1770. A more recent analysis confirms the success of the scheme in achieving congestion reduction objectives: see Transport for London 2003, "Congestion Charging: Six Months On" available at www.tfl.gov.uk/tfl/cc_intro.shtml

[17] Global positioning system – units with GPS software can receive transmissions from GPS satellites and determine the precise coordinates of the unit's location.

Melbourne's CityLink – using tolls to finance roads and reduce congestion

City Link is a privately operated, electronic toll road in the heart of Melbourne. Fully opened in late 2000, the project joined together three of the city's freeways, creating a 22-km expressway linking the major routes between Melbourne Airport, the port and industrial centres in the southeast.

Like Singapore's system, City Link incorporates a fully electronic, cashless tolling system without toll stations or boom gates. The system allows motorists to travel the entire route without stopping or slowing to pay tolls.

Growing pains

In the 1960s and 1970s, the State of Victoria built a series of motorways to service the growing city of Melbourne. However, these projects were done piecemeal rather than as part of an overall plan. The result was a number of unconnected freeways that were depositing unprecedented volumes of traffic into the central business district (CBD). The freeways were linked by residential and city streets that, by the early 1990s, were overloaded. Trucks and other traffic that wanted to go across Melbourne had to go through the CBD to get from one freeway to another. Half of the traffic in the inner city was just passing through.

To need to link the freeways was recognised, but the only realistic option required extensive tunnelling. The overland route faced too many obstacles: the world-renowned Botanic Gardens, the city's major entertainment and sporting complex, and a historic suburb lay in the path. While advances in tunnelling technology had made the project possible by the 1990s, the price tag was still very high.

A public-private partnership

At an estimated cost of $2 billion, the State of Victoria could not afford the project. In 1992, the state called for tenders to build and operate the link as a toll road, the ownership of which would be transferred to the state after the investors had realised a fair return. The operator was required meet a set of specific noise, air and water quality standards. Subsequent reviews and negotiations took three years, but in 1995 the contract was awarded to a consortium called Transurban. Construction began in 1996, the first segments opened in 1999, and by December 2000 the project was fully open.

Travel time savings

The average toll per trip is approximately A$2.60, comparable to a public transit fare in inner Melbourne of A$2.30. Travel time savings, during peak periods, average 13 to 19 minutes, and time savings exceed one hour for trips using the full length of the new link.

While most Victorians accepted the tolls as the only way to get the road built, some objected to paying tolls on parts of existing freeways that were going to be significantly upgraded. Ultimately, these tolls proceeded on the basis that alternative routes were available, and that commuters using the upgraded freeway were getting significant benefits in terms of travel time reduction.

There are also complaints that drivers avoiding tolls are clogging secondary roads. But the evidence shows that volumes on CityLink have increased, including on pre-existing segments now subject to tolls. Thus, it seems that congestion on secondary roads is due to an overall increase in traffic, and would probably be worse if it were not for CityLink.

Sources: Lay and Daley (2002), Tagaza (2002) and discussions with CityLink officials.

expects the in-vehicle transponders to cost between 20 and 50 euros each (NZ$37 to $93) by 2010.

The political problem facing any proposal to introduce congestion charging is more challenging. However, public acceptance of a new road pricing system on existing roads might be facilitated if people were given the opportunity to try it out on a small scale first, in situations where they had a choice about paying. An opportunity for doing this could be provided by establishing "HOT" lanes on a trial basis on some of Auckland's motorways, and possibly also in Wellington. In Auckland, the HOT lane concept could make better use of existing bus lanes.

A HOT lane is a motorway lane that is reserved for two classes of vehicle:

- high occupancy vehicles that can use the lane for free (i.e., buses and private vehicles with a driver and at least two passengers); and
- other vehicles that pay a toll to use the lane.

HOT lanes are a form of congestion pricing that is becoming popular in California and Texas (Institute of Transportation Studies 2003; Transportation Research Board 2003). They can be established on a relatively low cost, trial basis. They provide people with the choice of avoiding congestion delays, either by taking a bus, car-pooling, or paying a toll, but nobody is forced to use them. People can decide for themselves what represents value for money at the time they want to travel. If they wish, they can continue to use free-of-charge lanes on the same motorway. Revenue from HOT lanes has been used to finance added roading capacity and, in the case of San Diego's I-15 FasTrak lanes, a new express bus service.

Experience with trial HOT lanes in Auckland and Wellington could give people a better idea of whether they wanted to take the next step, of replacing petrol tax funding for roads with a new, comprehensive ERUC system of charging for actual use of particular roads at particular times.

In the long run, putting the land transport system on a fully sustainable basis would require other externalities besides congestion to be factored into prices faced by road users. The 1996 Land Transport Pricing Study estimated, for example, that $290 million of property value reductions suffered by property owners could be attributed to traffic noise. The costs of properly mitigating contaminated stormwater runoff from existing streets are significant, and in principle are attributable to road users. Neither of these externalities is normally accounted into the costs faced by road users at present. As discussed below, there are also significant air pollution and public health costs that are not yet factored into road user charges.

In addition, the capital value of the roading network should in principle be reflected in road pricing, net of any reductions in transfers from motorists (e.g. via petrol taxes) to the Crown Account. A previous effort to address this issue departed from normal practice for treatment of state-owned assets by proposing to lower the assessed asset value of the public roading system from $23 billion to $10-13 billion, evidently in order to largely eliminate any flow-on effects into road pricing (Roading Advisory Group 1997).

Congestion pricing: the triple bottom line

The advantages of congestion pricing for sustainable development can be summed up under three headings: economic, environmental and social.

Congestion pricing improves the economic sustainability of a city because it allows those road users who value their time most highly to avoid congestion delays. For example, a delivery van could accomplish several more deliveries during business hours than it could without road pricing, enabling transport companies to operate with smaller fleets. Such benefits flow on to lower the cost of doing business throughout the urban area, and to improve the city's competitiveness.

Congestion pricing is often first introduced in a near-crisis congestion situation, in which it is supported in part as a means of funding transport capacity enhancements. In the longer term, however, by ensuring that more efficient use is made of existing transport infrastructure, congestion pricing serves to avoid or defer costly road-building projects. It thus lowers the community's total transport infrastructure costs.

Congestion pricing also contributes directly to a city's environmental sustainability. On the one hand, it improves the quality of life for city residents, who experience improved access to urban facilities and amenities, and reduced hassle and stress. On the other hand, it stimulates the use of public transport and reduces harmful air emissions by eliminating the wasteful fuel burn from congested vehicles that are stationary with their engines running, or are crawling forward in low gear. The health implications are significant.

An estimate of the number of people above 30 years of age who die prematurely in New Zealand due to exposure to emissions of PM_{10} particulates from vehicles is about 400 per year (with a 95% confidence range of 241 to 566 people). Of the increased mortality attributable to PM_{10} emissions from vehicles, 64% occurs in greater Auckland, 14% in greater Wellington, 10% in Christchurch, and 12% in the rest of New Zealand (Fisher et al 2002). Vehicle emission standards and emission testing are the main strategies to address this problem, but congestion reduction measures can assist. As well as directly reducing PM_{10} emissions in transport corridors where they tend to build up to harmful levels, congestion pricing of roads is likely to stimulate the growth of walking, cycling and public transport, bringing additional benefits for the environment and public health.

Congestion is a major source of unnecessary CO_2 emissions.[18] A preliminary estimate generated from computer modelling work by the Auckland Regional Council in 2000 suggested that elimination of congestion in the Auckland region could generate savings of 364,000 tonnes of CO_2 per year during the first Kyoto commitment period 2008-12. This is just under 4 percent of the estimated total national amount of excess emissions for which New Zealand must take responsibility, after existing policies but before applying forest credits, in the first commitment period.

[18] A study by Cambridge Systematics (1999) of the 167 worst highway congestion bottlenecks in the United States suggested that greenhouse gas emissions on these road sections could be reduced by 71% by eliminating congestion, compared with business as usual over a twenty-year period. This represented total national savings on an annual averaged basis of about 11 million tonnes/year.

A review of the environmental effects of congestion pricing by the Swedish National Road Administration suggested that "the big environmental gain is that new roads can be avoided" (Eliasson and Lundberg 2003).

The effect of congestion pricing on social sustainability also needs to be properly researched and considered, not least because public perceptions as to whether a road pricing proposal is equitable tends to dominate public acceptance of such proposals (Transportation Research Board 2003).

The question of who wins and who loses from a road pricing proposal depends on comparisons with the pre-existing status quo, and on how any revenues from the road pricing project are spent. HOT lane proposals in the US have won public support on the basis that the road users who benefit from motorway enhancements are made to pay for them, in contrast to the pre-existing situation in which all road users pay for additions to the roading system whether they use them or not. Additional support has been forthcoming where a portion of the revenues (as in San Diego) have been used to subsidise public transport.

There is limited data available on the equity aspects of congestion pricing. Analysis of data from the United States by Elliott (2000) suggests four points:

- Low income people are much less likely than other groups to be on the road at the peak commuting times, when the introduction of a congestion charge would affect them;
- Those low and middle income drivers who are on the road at peak times, and who pay congestion charges and keep driving, end up better off than they would have been without the charge, once the value of their time is taken into account (unless they are commuting for long distances);
- Low income commuters who carpool or use buses also benefit from the introduction of congestion charges or HOT lanes, as these improve bus service and reduce travel time;
- If congestion charging is compared with using petrol taxes for building more roads, lower income people are better off under congestion charging. This is because petrol taxes are regressive, and when used to pay for increasing motorway capacity, they represent a subsidy from motorists in general, to those motorists who use big city roads at peak times (which tend to be higher income people).

A review of studies on the social equity impacts of congestion pricing carried out for the Swedish National Road Administration (Eliasson and Lundberg 2003) made three points:

- Equity findings tend to be context-specific;
- The differences in impacts between groups appear to be small;
- How the revenues are used is the more important issue.

The importance of local context means there is a need to undertake social impact assessment of a range of congestion pricing options in New Zealand cities. There is also a need to consider whether any identified equity effects of introducing road pricing in particular places could be mitigated as part of the design of the project. For example, San Diego and London have used a portion of congestion pricing revenues to support public transport (although this is not usually a particularly well-targeted way to benefit disadvantaged groups, because a large portion of the benefits accrue to middle-income commuters). Other possibilities include the provision of discounts for certain target categories of drivers. Relevant categories might include the disabled, people under certain income levels, or (in the case of cordon pricing of small areas) those living within the cordon.

Making progress on congestion pricing

While Auckland has New Zealand's most acute congestion problems, other cities are starting to face the same problem. Wellington has a number of peak-time choke points that are worse than Auckland's (Ruscoe 2003). For example, the road connecting Wellington and the Kapiti coast, which parallels an under-used railway line, is a place where congestion pricing could provide real benefits. Overall, vehicle use is growing faster than population. It is only a matter of time before several of New Zealand's growing cities experience similar problems to Auckland. The need for an effective new approach to road pricing is therefore a national issue.

A striking feature of congestion pricing internationally is the number of technically feasible and carefully planned pricing initiatives that have failed for political reasons (Eliasson and Lundberg 2003). Accordingly, nine of the ten "strategies for success" recommended for establishing congestion pricing schemes by Deloitte Research (2003) explicitly address the need to manage the political environment and win public acceptance.

Several of these strategies are of particular relevance in the New Zealand context, for example, having an influential champion for the project; securing co-operation from influential third parties; keeping the public and stakeholders informed and on side; and making the use of funds acceptable to the public.

4.4 An incentive approach to reducing waste

There are a range of opportunities for using economic incentives to reduce waste, and the preferred choice of instrument depends on the weighting given to various criteria (Menell 1990, BDA Group and McLennan Magasanik Associates 2003). There are, however, some preliminary issues that have to be addressed in the New Zealand context. The first is the need to eliminate various forms of subsidy to landfilling that still exist, and which appear difficult to justify from any perspective. The second is to clarify the objectives of an incentive policy.

Subsidies to landfilling

There are two main kinds of subsidy to landfilling (Ministry for the Environment 2002). One is where councils have a policy of wholly or partly subsidising waste disposal to landfill from rates. While there is a widespread move away from this practice, it is still reasonably common. Where it occurs, the waste generator (whether

household or business) does not face the full cost of waste disposal, and the economic incentive to reduce waste and recycle at source is reduced or completely lacking. The practice is also unfair to those who generate little waste, or who take the trouble to reuse and recycle, since they are subsidising other waste generators through their rates.

Second, many landfills are of low standard and fail to use best practices to protect the environment from contamination risk. In these cases, the environment itself may be said to be subsidising waste disposal. In 2002, 53% of New Zealand's landfills lacked leachate collection systems, and 90% lacked landfill gas extraction systems. Controls over dumping of hazardous waste are variable, with many small rural landfills having no controls over site access (MFE, 2003c).

Where either or both of these subsidies apply, the cost of waste disposal can be so low that waste reduction and recycling is heavily discouraged. Such subsidies need to be eliminated prior to, or in conjunction with, the introduction of any waste reduction incentive policies.

Objectives of waste policy

Various forms of unwanted waste – household waste, industrial and trade wastes, construction and demolition waste, sewage and agricultural discharges, contaminated storm-water, airborne emissions and greenhouse gases – have all traditionally been regarded as inevitable by-products of economic growth.

But that approach to growth is no longer acceptable, as society realizes it cannot go on fouling its nest. One of the biggest challenges of adopting a sustainable pattern of development is to de-couple waste production from economic growth. In the long run, humans must follow nature's model, in which organisms do not poison their environment but instead re-use or compost and recycle their wastes as food and nourishment for the next generation.

Amongst society's various waste streams, municipal solid waste is unusual in that it bundles together a variety of resources, many of which could be recovered and put to beneficial use. In 1996 the Local Government Act was amended, in effect to require local authorities to develop plans to un-bundle the waste stream, so that its various components can be reduced, reused, recycled and (for the residual) safely disposed of.

More recently, the Government's New Zealand Waste Strategy (2002) commits to zero waste as a long-term vision, and sets out a range of steps that need to be taken to reduce waste. In the meantime, the Ministry for the Environment and regional councils are co-operating to raise public awareness through campaigns like www.reducerubbish.govt.nz.

There is widespread community, professional and private sector support for this approach. Communities faced with proposed new landfills, even those that meet the highest environmental requirements, oppose them vigorously. Community groups promoting zero waste have proliferated, often working in a practical way with local councils. The aim is to find ways of reducing waste, waste truck movements, and the need for landfills itself.

Responding to this community sentiment, a leading private sector company, Waste Management NZ Ltd, is no longer a truck-it-and-bury-it business. It is working with business clients to keep their waste streams separated and uncontaminated, to facilitate reuse and recovery, and it has invested in resource recovery through companies like Living Earth Ltd. The professional organization WasteMINZ (Waste Management Institute of New Zealand) has added momentum and strategic thinking with its recent publication Life After Waste.

Overall, then, there is broad support today for a public policy that identifies waste reduction, and not just safe waste disposal, as the waste management objective. Incentives need to be aligned to this objective.

Studies show that most of the benefit of recovering and reusing waste is 'upstream' of the landfill. The environmental impact of a bauxite mine, for example, and of all the energy and emissions needed to process the ore into aluminium, could be largely avoided if everything taken from the mine and manufactured into products was recycled at the end of its useful life. Australian studies, summarised by BDA Group and McLennan Magasanik Associates (2003), show that while the overall benefits of kerbside recycling programmes are significant, as little as 2 percent of that value is attributable to avoiding landfilling itself. The main benefits lay in reductions in air and water pollution arising from avoided product manufacturing using virgin materials. There were also avoided natural resource costs, greenhouse gas emissions and traffic impacts.

In principle, instruments are more likely to achieve policy goals effectively and efficiently if they are applied directly at the point in supply chains where impacts are generated. Economists generally prefer to use multiple policy instruments to address multiple sources of impact. However, the technical and political difficulties in pursuing that approach are many, and it will be a long time before all supply chain externalities are fully charged to those who generate them. Meanwhile, strong political and community support is evident for focusing on waste reduction directly, an approach which the available studies indicate has net benefits for most commonly recycled materials, at least in the Australian context. It therefore seems appropriate to take a pragmatic approach and get started on the use of economic incentives targeted at reducing the municipal waste stream, while work on other instruments to address upstream externalities is progressed over a longer time frame.

Businesses can use incentives internally, to reduce their own waste and improve their bottom line (see www.nzbcsd.org.nz/zerowaste). Closing the loop, by composting and making beneficial use of biosolids from sewage, is a business activity that also creates a commercial incentive to get contaminants out of the waste stream.

Barriers to better performance

Actual waste management practice around the country remains variable (Gatt et al 2003; Ministry for the Environment 2003). There are many barriers to waste reduction and resource recovery besides lack of awareness, and these barriers remain to be tackled. They include:

- In many parts of New Zealand, the cost of waste disposal is so low that waste reduction and recycling is discouraged. As noted above, this occurs where

local authorities rely on cheap rubbish dumps, which are unable to protect the environment from contamination; and where landfills are still subsidised from council rates.

- Elsewhere, local authorities have been pro-active in establishing both user-pays waste disposal policies and kerbside recycling facilities. But in some cases, their efforts are being undercut by waste companies offering a cheap, bulk wheelie bin service, which effectively removes the incentive on households to segregate their wastes for recycling. Again, this is possible because consumers and wheelie bin operators are not paying for the externalities of mining, processing, and waste disposal.

- Organic matter, which makes up about half of the waste stream, could be converted to compost. Compost is already widely produced and there is huge physical potential for expanding its production from the waste stream. But present agricultural cropping practices make only limited use of compost. Instead, soil organic matter is often run down to low levels, to a state in which the soil has little capacity to retain nutrients and moisture. Growers then rely on frequent applications of artificial fertilizers and irrigation water. In intensive cropping areas, these practices are unsustainable because they are leading to a serious build-up in groundwater contamination. Such practices must change, and compost must be marketed more competitively if its use is to be greatly expanded.

- However, current landfill prices are not favourable for the competitive production and marketing of compost. Compost company Living Earth Ltd has traditionally priced its organic waste drop off fee at around 60% of the landfill gate charge for municipal solid waste, to provide sufficient incentive for waste generators to separate organic material (Giblin 2003). Accordingly, Living Earth's capacity to increase production and invest in capital expansion is directly governed by prevailing landfill pricing. This is currently too low and uncertain to enable major expansion of compost production.

- Overall, there are many ambitious targets for waste reduction and resource recovery, but progress toward these targets cannot be sustained unless there is substantially increased investment in reprocessing facilities, collection systems and market development for compost and recyclables. There is a gap between the incentives facing stakeholders, and the actions that are desired of them.

The concept in The New Zealand Waste Strategy of a levy on waste going to landfill could help to close this gap. Christchurch City Council has pioneered this concept. It imposes a small levy on household waste and uses it to fund the Recovered Materials Foundation, a non-profit council-owned entity that operates recycling activities and has pioneered market-making activities for materials in the city's waste stream.

Scaling up the incentive-based approach

If this approach is to be scaled up nationwide and made really effective, a way needs to be found for the business of resource recovery to be driven forward by the private sector. In this way, the power of the marketplace could be harnessed to get the results

that society desires, while the risks of increasingly large investments in new business activities are removed from ratepayers.

Australia has developed a useful model for getting large-scale sustainability results through a scheme that requires electricity companies to generate a certain amount of electricity from certified, renewable sources. M-Co, the marketplace company that operates wholesale electricity markets in New Zealand and Singapore, has adapted this model of an independently-certified, tradable scheme to the objective of stimulating waste recovery.[19]

Based on this model, an incentive-based approach to efficiently achieve waste reduction in New Zealand would involve the following steps:

- Create a tradable credit for sustainable resource recovery, called a transferable resource recovery certificate (TRRC), to be used as an offset against waste generation. This would involve a process for independently certifying that sustainable resource recovery had occurred.

- Create a regulatory obligation on waste generators to either create or purchase a certain number of these recovery certificates for every hundred tonnes of waste they send to landfill.

- Gradually increase the obligation on waste generators as experience is gained with the resulting business opportunities and their cost, and as society determines how much it wishes to pay to achieve waste reduction results.

The TRRC approach would have distinct advantages over a landfill levy. It would level the playing field between different market players, achieve certainty around waste volumes reduced, reduce or avoid incentives for illegal dumping, and be easier to explain to the public. It would have the further advantages that funds would flow directly from waste generators to resource recovery industries and there would be a commercial incentive to minimise administration costs.

On the other hand, the administrative costs might be greater than those for a simple landfill levy scheme. There are costs associated with accreditation (of certifying agencies); of validation (of TRRCs created by certifiers); and of verification/audit (that certificates surrendered were created by an accredited agency). These costs and competencies are similar to those associated with existing certification schemes used on a commercial basis by various industries, but a more detailed study would be needed to make a firm case for the policy proposal.

The United Kingdom has recently adopted a similar, tradable quota scheme for diversion of wastes from landfill under its Waste and Emissions Trading Act 2003. Experience gained in the operation of this scheme could provide a useful input into the design of a New Zealand scheme.

To work effectively, a TRRC system would need to be complemented by continued progress in phasing out sub-standard landfills and subsidies for landfilling. A number of benefits would then follow:

[19] For a presentation, see www.au.m-co.com/grids

- A transparent market price would emerge, to reflect the value society places on avoiding waste and landfilling.
- This would stimulate the development, commercialization and large-scale application of new technologies for resource recovery.
- There would be an incentive to purchase products which lend themselves to re-use, recycling or resource recovery, rather than those that do not (see www.nzbcsd.org.nz/supplychain); this incentive would feed back into the design of products, with long term benefits to society.
- A level playing field would be created between different waste management organizations, so that those who undertake efficient recycling activities could no longer be undermined by those who do not.
- The price of compost would fall, strengthening the business case for using compost in market gardens, intensive cropping for export, and the growing of maize as stock feed for the dairy industry, and improving the overall sustainability of these activities.
- More employment could be expected, based on the relatively employment-intensive nature of resource recovery industries compared with waste disposal (R W Beck Inc, 2001).
- Identified waste reduction targets would be met, rather than just talked about and strived for.

4.5 Clearing the air

New Zealand's winter air pollution problem

Air pollution in Auckland is worse than in London in some respects, and Christchurch has been trying to solve its problems for several years, but air pollution is not just a "big-city" problem. Nelson, Kaiapoi, Timaru, Tokoroa, Taihape, and Taumaranui all have serious winter air pollution problems, and the monitoring data available suggests that Hamilton, Te Kuiti, Tauranga, Upper Hutt, Rangiora, Ashburton and Invercargill also have problems[20] – typically the result of cold winter nights and still days, local topography, and a high reliance on solid fuel burners for residential heating.

Monitoring has shown that, in many areas, the main issue of concern is fine particles known as PM_{10} (particulate matter with a diameter less than 10 microns – i.e. 10 millionths of a metre). Emissions from household woodburners and open fires are a major source of pollution, as are vehicles.

There is no known safe level of PM_{10}. Ministry for the Environment (MFE) guidelines state that 33 microgrammes/cubic metre ($\mu g/m^3$) is the maximum "acceptable" level. Levels between 33 and 50 $\mu g/m^3$ constitute an "alert" status, whereas levels over 50 $\mu g/m^3$ are in the "action" category.

[20] See NCC (2003a); Environment Canterbury (2002); Horizons.mw (2001); Environet Ltd (2003).

MFE has proposed to implement mandatory national standards for ambient air quality that would, among other things, set maximum ambient concentrations for PM_{10} and other air pollutants, ban outdoor burning of refuse at landfills and certain noxious substances, and establish emission standards for wood and coal burning appliances (MFE, 2003a). Local authorities would be required to meet the ambient air quality standards "within 3 to 4 years" and, where concentrations exceed the standards, their ability to issue resource consents for new discharges would be restricted (MFE, 2003b).

Clearing the air faster, with more certainty, using economic incentives

For some cities and towns, meeting the targets within 3 or 4 years is going to prove difficult. In Nelson, despite using economic incentives such as financial assistance to low-income households and offsetting the projected emissions from new roads or other new sources, the city council's target for achieving the proposed national standard is 17 years away (see box). If local authorities embraced economic incentives more fully, through emission charges, tradeable allowances, or a combination of both, they could clear the air faster and at lower cost to ratepayers.

PM_{10} emissions come from industrial and commercial premises, households and vehicles, though the proportions vary depending on location. One approach would be to put a charge on all such emissions whatever their source. Industrial and commercial emissions would be monitored or estimated, households would pay an annual fee based on the type of solid fuel burner they use, and local councils and Transit would pay for the vehicles using their roads. The funds raised could be used to assist not only low-income households but also others wanting to switch to less-polluting forms of home heating, without calling on ratepayer funds. The emission charges could vary by airshed and by season, and would be adjusted as necessary to achieve interim targets for reduction in air pollution.

Such an approach would require careful consideration of social issues. Many lower income households rely on solid fuel for home heating and might be unable to afford conversion to other heating methods or the on-going cost of electricity or gas. In this situation, councils need to provide adequate financial assistance to these households. This should involve improving insulation, provision for installing clean heating and, possibly, assistance with energy bills for five years or some other defined period. To avoid putting excessive burdens on households least able to afford it, some funding from general rates might still be required.

Emission charges on stationary sources could probably be implemented using s.108 and possibly other provisions of the Resource Management Act, but motor vehicles are exempt from that Act. There appears to be no legal mechanism to require road authorities to take on-going responsibility for transport emissions once roads are built. Nonetheless, there is a growing acceptance by the Government that the transport sector needs to accept this responsibility (Ministry of Transport, 2002). Transit NZ could agree to such an arrangement to improve community acceptance of new road projects. With emerging technology for electronic road user charges (see section 4.3), it will not be too long before emission charges for vehicles could be passed on to vehicle owners.

Another option would be to assign each sector (industrial, commercial, households and transport) a share of total emissions based on recent practice, and to reduce the total allowable emissions over time to achieve the target standard of air quality. Each sector would have to reduce its emissions accordingly, or acquire additional shares from another sector that is able to achieve more than its required reduction. The basic principles are the same as in the Hunter River scheme described in section 3.1.

Air pollution and Nelson's proposed Southern Link road

The air pollution situation in Nelson demonstrates the seriousness of the problem and the issues that arise for local authorities in attempting to address it*.

During 2001, PM_{10} readings in Nelson exceeded the national 'Action' guideline of 50 $\mu g/m^3$ on 81 occasions, roughly two out of every three winter days, with a peak recording of 165 $\mu g/m^3$. In 2002, a considerably milder winter, pollution exceeded the action guideline on almost 50 occasions, including several over 100 $\mu g/m^3$.

Premature deaths from PM_{10} pollution

Research has estimated that up to 40 premature deaths and 20 hospitalisations *per year* could be occurring in Nelson alone due to the effects of PM_{10}. Premature infants and the elderly are most at risk. Restricted activity days** in Nelson have been estimated at 58,000 per year.

The Nelson City Council (NCC) has responded with a proposed air quality plan that bans backyard fires and imposes restrictions on the use of fireplaces and solid fuel burners for home heating, the source of an estimated 78% of Nelson's PM_{10} emissions. The plan also offers financial assistance for some low-income households to install alternative heating.

The Council's target is to achieve compliance with the air quality 'Alert' guideline (i.e. not to exceed 50 $\mu g/m^3$) by "no later than 2020, or sooner if practicable, towards ultimate compliance with the 'Acceptable' air quality category" (NCC, 2003). The plan provides no indication as to when 'Acceptable' air quality will be achieved.

Problems for the Southern Link road

Meanwhile, Transit NZ is seeking approval for a new road project in Nelson known as the Southern Link. The project has received strong support from the NCC, commuters and the local business community, which sees it as vital to provide better access to the port and the central business district.

The road would travel through neighbourhoods that are already experiencing Nelson's worst PM_{10} pollution, and has encountered strong opposition from a community group and from schools along the route.

In early 2002, commissioners hearing Transit's application for the road recommended against the project mainly due to the added air pollution it would cause. The issue was referred to the Environment Court. Hearings are being held in November 2003 with a decision due in 2004.

Since the initial decision in 2002, the NCC (in support of Transit NZ's proposal) has signed contracts to pay numerous residents along the route to convert from open fires and woodburners to other forms of home heating, in an attempt to "remove" from the airshed enough emissions to offset what the road would add.

However, there is some doubt regarding the extent to which these reductions are "additional" to what the air plan would achieve. There are other problems as well, not least the fact that there is still no assurance that air quality parameters would be met, or that vehicular emissions would not exceed projections. If the road were built, the NCC would have no control over the resulting emissions.

* Data for this case study is from Nelson City Council (2003a and 2003b).

** A restricted activity day occurs when the normal activities a person carries out are altered due to air pollution. The number of such days in a year for all persons in an area can be summed to determine total restricted activity days, e.g. if 1000 people each had their activities restricted for 58 days/year, the total would be 58,000.

Industrial and large commercial premises could manage their own shares, but it would probably be more practical to have the local councils and Transit NZ manage emission shares for households and vehicles. District and city councils could pass on costs to households through emissions charges as described above, and could reduce pollution from this sector through financial assistance to households that convert their appliances. Requiring Transit NZ to participate in such a scheme would probably require legislation, although the agency could be approached to implement it on a voluntary basis.

This approach would have the following benefits:

- Emission charges would provide revenue to help low-income households convert to clean appliances.
- Businesses could fund cleaner alternatives by selling shares to others who find emission reduction options too costly.
- Air quality targets could be met by defined dates, although these could be adjusted depending on experience, including the costs to businesses and households of reducing emissions.

The proposed ambient air quality standards are likely to set a clear benchmark that councils will be expected to achieve, and would provide the regulatory context in which economic incentives could work efficiently and effectively. Either of the approaches described above would offer increased certainty that air quality would be cleaned up in a reasonable timeframe, with significant health benefits to the residents currently living in polluted areas. This could all be achieved with funding from those responsible for the pollution rather than from business and residential ratepayers at large. Through assistance to low-income households and reduced health impacts on the most vulnerable members of the community, this approach would improve social components of sustainable development as well as environmental and economic dimensions.

The above suggestions entail an element of legal uncertainty. Environment Canterbury considered similar approaches during preparation of its proposed air quality plan, but did not pursue them due to legal uncertainty, as well as concerns the measures might be administratively difficult and cause delay in getting actions approved and implemented (ECan, 2002).

Innovative approaches such as these might well require some assistance from central government to remove legal uncertainty, through legislation if necessary, and to assist councils with overcoming design and administrative issues. Councils that are left to be pioneers on their own will more often than not opt for the more traditional policies and methods, as both Environment Canterbury and Nelson have shown to date, even if they are less effective than economic incentives would be.

5 Where to from here

5.1 Emerging technology

We are on the cusp of technologies that can make incentive-based approaches much more feasible. One of the potential disadvantages of incentive-based approaches is the cost of countless transactions for individual households and small businesses, and the difficulty of disseminating information when and where it is needed. These problems are rapidly fading as information and communication technology advances.

The city of Melbourne pioneered electronic road tolls, and the CityLink system now deducts road tolls from cars travelling at speed. Emerging technology will soon make it possible to track vehicle movements, and assess tolls where appropriate, anywhere in the country.

Meanwhile, the internet has made trading systems much more efficient by making information readily available and trades easy to execute, as demonstrated by the Hunter River Salinity Trading Scheme.

Such developments mean that information and transaction costs are falling substantially, making feasible an ever-increasing range of management approaches.

5.2 There is no 'one-size-fits-all'

As should be apparent from the examples given in this report, there are numerous types of economic incentives and, for each, various ways in which they can be applied. For any given issue, the appropriate type of incentive measure, or combination of measures, will depend on the nature of the problem and the policy or business objective.

Where a clear quantitative target is being sought, i.e. a maximum amount of discharge to air or maximum extraction from a water resource, tradeable permits can help to achieve the target at least cost or maximum benefit. Where it is more important to achieve certainty of costs than a quantitative target, measures such as environmental taxes, charges or grants can help to motivate more efficient use of resources, and revenue can be used to reduce other taxes. Performance bonds and other types of liability instruments can be appropriate where there is a low probability of a high impact event.

For businesses, the main focus is accurate pricing of goods and services that reflects the true marginal cost of the resources used to produce them. Many businesses charge a uniform price for products that are ostensibly the same, e.g. a kilowatt of electricity at 6 p.m. and a kilowatt at 3 a.m., when in fact the marginal cost of producing and delivering those products can be very different. The result of uniform pricing is that consumers of the lower cost product have to subsidise consumers of the higher cost product, and hence too much of the higher cost product is consumed relative to the lower cost product. As the case study from Orion has shown, there is a value proposition for business in accurate pricing policies to remove these cross-subsidies.

5.3 Economic incentives should normally be revenue-neutral

Economic instruments are designed to change behaviour, to move New Zealand towards more sustainable development. Their primary purpose should not be to raise revenue. However, some measures will raise revenue in the process of motivating behaviour. To make these measures acceptable to politicians and the public, any environmental taxes should be offset by reductions in other taxes to avoid increasing the burden on the economy. Indeed, as argued in sections 3.3 and 3.4 above, environmental taxes can improve the efficiency of the tax system and the wider economy by reducing the distortions caused by traditional taxes.

Thus, rather than an increase in taxes, these measures allow a shift in taxes, from things that society values, like income and labour, towards things that society wants to discourage, like pollution or other adverse effects on society or the environment. The carbon emissions charge planned for 2007-2008 provides an opportunity to do just that, as shown in section 4.2.

There are some exceptions to the general proposition that economic instruments should be revenue-neutral. In some cases, revenue can be used to advance an environmental objective that would otherwise have required government expenditure or the imposition of additional compliance costs on businesses and households. For example, as suggested in section 4.5, Nelson city could impose charges on domestic fireplaces and woodburners in order to provide financial assistance to households willing to convert to less polluting forms of domestic heating.

5.4 The basis for political acceptance

There is a discernable pattern internationally in which incentive-based approaches are much-discussed, and often proceed through design stages, but are not finally implemented by political decision-makers. Urban congestion pricing schemes, for example, have been introduced in remarkably few cities.

This pattern appears to be rooted in the sectional nature of politics. Characteristically, either business interests do not want action taken on an environmental problem, or environmental interests do not want a market-based solution used, or both.

Economic incentives for sustainable development are most likely to be introduced where, first, the environmental problem being addressed and the need for action is well understood by the public and, second, where the leadership of both business and environmental organisations is willing to focus on the country's larger interests.

5.5 The need for research, design and trials

A staged approach is needed for addressing both technical and political issues. For a given issue or policy problem, analysis requires, firstly, selection of options, including what types of economic instruments if any will be considered. Each option must be developed in sufficient detail to enable its effectiveness, efficiency and social and cultural effects to be analysed. This is true for "traditional" methods as well as for economic incentives.

Economic incentive measures are often dismissed early in the analysis, before there is sufficient detail to assess their potential performance. Reasons given include legal uncertainty and assumed political or public resistance to economic measures that appear to create "a right to pollute," a proprietary interest in public resources, or a charging regime where none existed before.

One way to overcome these difficulties is through trials to test public support, identify issues, and refine workability. In Australia, the Commonwealth and state governments have created a fund and recently approved ten pilot projects on market-based instruments for land and water management. New Zealand needs to invest more in operational research of this nature, e.g. by testing the response to optional toll lanes on Auckland motorways (see section 4.3).

Ecologic Foundation has commenced a programme of research to identify obstacles to the use of economic incentives and to develop a better understanding of their potential effects. Such an understanding will help in the design of measures to ensure that they will achieve the desired outcomes for sustainable development in New Zealand.

The research programme is likely to examine as case studies one or more of the incentive measures proposed in Chapter 4 of this report. Several government, business and civil society organisations have agreed to participate in the research as end-user partners, with the primary funding coming from the Foundation for Research, Science and Technology. For more information, see www.ecologic.org.nz.

5.6 In some cases, legislative amendment will be needed

The Resource Management Act (RMA) contains provisions that signal the desirability of using economic incentives to solve environmental problems. In particular, s.32 has a procedure to check whether a proposed regulation is the most efficient way of achieving an objective, while s.24 gives the Minister the function of "the consideration and investigation of the use of economic instruments (including charges, levies other fiscal measures, and incentives) to achieve the purpose of this Act." However, the Minister has not performed this function, and the remainder of the Act does not explicitly empower the use of most economic incentive mechanisms. Exceptions are the coastal tendering provisions in Part VII, which have never been used, and the provision at s.136 for tradable water permits, which have been used only twice. The Act contains no associated mechanism for efficient initial allocation of permits to be traded.

The new Local Government Act (LGA) does not fill the gaps left by the RMA. The LGA has provision for development contributions, and wide-ranging powers to establish by-laws that may prescribe fees, but s.150 provides that such fees must not recover more than the reasonable costs actually incurred by the local authority. Charging under the general powers in s.12 is limited to goods, services or amenities provided by the local authority.

Neither the RMA nor LGA powers appear to extend to charging for use of natural resources not owned by the authority, nor to charging for permits to discharge into the environment. Constitutional convention indicates that taxes may not be raised except as explicitly empowered by Parliament. In the absence of explicit powers, the raising

of a charge may be open to challenge on the basis that it is really a tax. Against this background, Environment Canterbury and Nelson City Council were reluctant to consider seriously the use of charging or trading mechanisms to improve air quality because of uncertainty over the legality of such measures, despite legal advice that there were no prohibitions on their use.

The new Land Transport Management Act establishes a generic framework for road tolling. This is directed at facilitating the construction of new roads, rather than reducing congestion and improving sustainability on existing roads. The Minister of Transport has indicated that further legislation to consider these matters will be introduced next year. It would be desirable for the next round of transport legislation to provide a full set of tools for tackling congestion on existing roads, and to give scope for local councils to charge road authorities for the adverse effects generated by road users, as envisaged by the approach suggested for Nelson in section 4.5.

When central government decides to implement an economic incentive, e.g. a charge on greenhouse gas emissions, it can enact legislation to do so. But when local authorities want to do something not catered for in existing law, they have to ask the current government to enact legislation. Often, because the prospects of prompt legislative action are not good, they simply dismiss the option and revert to more traditional methods.

5.7 Recommendations

Recommendations for business

For businesses, there are two simple messages:

- **Apply economic incentives in your own company.** Ensure that pricing of your company's products reflects the true marginal cost of the resources used in their production. Avoid requiring your lower-cost customers to subsidize consumers of your higher cost products and protect, for the longer term, the resource base upon which your business depends.

- **Support initiatives by central and local government to use economic incentives.** Many economic incentives will need to be implemented by government to ensure that resources are properly priced and to establish a level playing field for sustainable business. If properly designed, these initiatives will reward sustainable businesses and further sustainable development – they need your support.

Recommendations for local government

- **Be bold – and reach out to those who will support innovative approaches to sustainable development.** There are barriers to economic incentives, but these will only be overcome if they are clearly identified and shown to be preventing implementation of effective approaches to resource management. Where an economic incentive should be used, make a case for it and try to overcome the barriers, rather than settling for second best.

- **Conduct trials of economic incentives** to show how they can work. Trials are not always appropriate, but in many cases they can demonstrate the effectiveness of new approaches to those with concerns. Even before conducting trials, however, councils need to conduct research to design new measures properly and to understand potential economic, environmental, cultural and social impacts.

Recommendations for central government

- **Actively assist local government to explore innovative approaches.** Accord priority for funding, through the Sustainable Farming Fund and the Sustainable Management Fund, of pilot applications of economic incentive programmes and supporting research. Encourage councillors and council staff to explore new ideas, and help bridge the gap with businesses and community groups by explaining the sound basis for economic incentives.

- **Amend legislation to remove obstacles to economic incentives.** The Government should amend the Resource Management Act, the Local Government Act and the Land Transport Management Act to:
    - Enable local authorities and road controlling authorities to charge for access to resources, and for adverse effects on resources, for fixed time periods (being clear that permanent ownership is not being sold) – this would include charging for access to road networks;
    - Enable local authorities to create tradable permits or allowances for access to resources and to distribute these by auction or other specified means.

5.8 Progress requires active support from business and community leaders

The status quo has huge inertia. The established way of doing things often leads to conflict which can become a national habit, fortified by those who are passionate about only one of the three components of sustainable development – economic, environmental or social.

Moving beyond the status quo requires a willingness to do three things:

- to acknowledge New Zealand's larger interests;
- to be creative and innovative; and
- to adopt a can-do attitude.

Central and local government need to design and facilitate incentive-based approaches. As noted above, in most cases this will require improving legislation. But first and foremost, adopting incentive-based policies will require champions from leading members of the community. There will always be plenty of reasons not to innovate, to avoid controversy, to stick with what has been done before. The status quo has no shortage of defenders.

In the history of New Zealand, there are some who had a different attitude to change.

Kate Sheppard led New Zealand women to be the first in the world to gain the right to vote in 1893. She was also one of the first female cyclists in Christchurch, defying the conventional wisdom that cycling was unhealthy for women and girls.

In 1903 or 1904, Richard Pearse designed and flew an airplane at about the same time as the Wright brothers were making history in America.

In 1908, a young James Fletcher arrived in New Zealand with a bag of tools. Within ten years Fletcher Construction was firmly established. Fletcher later played a leading role in the construction of state housing, persevering despite heavy financial losses early in the project. He also helped to found Tasman Pulp and Paper.

In 1910, Ernest Rutherford discovered the structure of the atom and, in 1919, succeeded at splitting the nucleus of a nitrogen atom.

In the 1930s, Clarence Beeby promoted the then-novel idea that every person, regardless of background or ability, has a right to an education for which they are best suited, and New Zealand became the first country in the world to re-design its education system based on equal opportunity.

In the 1950s, Sir William Hamilton pioneered a new design for boat propulsion. The company he founded, Hamilton Jet, is still a world leader in jet boats.

And in the 1980s, government officials teamed up with leaders of the fishing industry to design New Zealand's world-leading fisheries management system.

These New Zealanders dared to be different, and they persisted in their pursuit of a better way of doing things.

One of the challenges for New Zealand's business and community leaders today is to dare to be different, and support the use of economic incentives to advance sustainable development.

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Appendix 1: Water transfers on the River Murray

As in New Zealand, irrigation for agriculture is the major user of freshwater in Australia, where it accounts for between 70 and 80 per cent of all water used. Much of this irrigation takes place in the Murray-Darling River Basin that covers parts of four states: New South Wales, Queensland, Victoria and South Australia. Because of recognised environmental impacts of withdrawals for irrigation, a cap has been placed on water diversions from the Murray-Darling system.

Water trading was introduced in Australia in the early 1980s to address a number of concerns, including the need for more efficient use of water available for abstraction. However, trading was limited to within states, and the majority of the water trading has been temporary, and along individual river valleys. In 1998, the Murray-Darling Basin Commission (MDBC) initiated a trial of inter-state water trading along the lower Murray.

During the first two years of the trial, 9.5 gigalitres[21] of water entitlements were traded for an estimated total of A$9.9 million. This represented only 1% of the total water entitlements in the three states.

The economic benefits of water trading

Although there were trades in both directions between the three states, most of the entitlements traded were purchased for use in South Australia, driven primarily by investment in grapes for wine. Expansion of area in olives and other horticultural crops is also driving water demand.

Winegrapes are a high value enterprise with relatively low demand for water. From 1995-2000, South Australian grape growers with access to River Murray water increased planted area by 67%, an increase of 14,217 ha. Grape production has also expanded noticeably in New South Wales and Victoria. The real value of both winegrape and wine production grew by more than 10% *per annum* over the 12 years to 2000.

The volume of wine exports as a share of total Australian production is expected to soon be 50%, whereas only twenty years ago Australia was a wine importer. With total water diversions from the Murray-Darling capped, this growth has been made possible by trading of water entitlements.

A review (Young et al, 2000) of the first two years of inter-state trading on the lower Murray found:

- There is much more water traded intra-state than across state boundaries. In Victoria, during 1995-2000, about 30 GL of entitlements were traded into Sunraysia from rest of Victoria.
- Average prices for inter-state trades were about A$1050/megalitre[22]; some transactions were for amounts in excess of A$1 million. There are some

[21] A gigalitre (GL) = 10^9 litres = 1 million cubic metres. 1 gigalitre per year = 32 l/sec on a constant flow basis.
[22] At 11.6 l/sec, an irrigator would use 1 megalitre (i.e. 1 million litres, or 1000 m^3) in 24 hours.

reports of water trading for as much as A$10,000/ML within certain areas, e.g. the McLaren Vale.

- Water trading was enabling water to move to more profitable uses. Three-quarters of all purchases led to the buyer increasing irrigated area, with 55% going to viticulture, 18% to horticulture and 16% to greenfields dairy development.
- Buyers were more efficient irrigators than sellers. Of buyers, 59% used drip irrigation and only 12% used flood or furrow irrigation. Amongst sellers, 54% used flood or furrow irrigation and only 7% used drip irrigation. A larger proportion of buyers than sellers manage their properties using a whole-farm plan (96% vs 36%) and use aids in the monitoring and scheduling of irrigation (96% vs 57%).
- Of the water traded across state boundaries, less than 1% was being used at its origin.

Social and environmental impacts of water trading

There have been a range of concerns about potential social impacts of water trading – erosion of the local tax base, decline of economic activity and therefore rural communities, fewer people left to support irrigation infrastructure, etc. One district capped the proportion of total entitlements that could be sold out of a district in any given year and there have been suggestions of exit fees to protect remaining users of infrastructure.

While Young et al saw these concerns as valid, the experience during the trial was that only unused water entitlements were traded inter-state and therefore negative social impacts from the trial were minimal. Young et al concluded:

- "As far as we can detect, inter-state trading during the two-year trial period has had no direct adverse social implications for the districts that have sold water inter-state and in some districts it has had significant positive benefits".
- Trading has had very positive social impacts for districts that have acquired water. "Virtually all of the water traded has been associated with new state-of-the-art investments. Typically, these generate more employment, involve high value product generation and considerable multiplier effects for the processing, tourism, transport and service sectors".
- Detailed arrangements were made to deal with salinity effect of water trades, but these obligations were not always enforced and hence trading in the first two years had some negative impacts on river salinity. If salinity obligations were enforced, then the long-term salinity effects could be neutral.

Gyles (2003) has shown that the potential for increased returns from water transfers should not be overstated. In Australia, when one takes into account the investment required in enterprises with higher gross margins, the returns to irrigation water for new horticulture and dairy operations are about the same as for existing irrigated grazing, roughly A$500/megalitre. So, while water trading has clearly enabled significant expansion of some very high value industries (as evidenced by their willingness to pay A$1000/megalitre), existing land uses with lower gross margins

will continue to be competitive. Water trading will not radically alter the pattern of land use overnight.

Lessons from the Murray-Darling

The experience on the River Murray highlights some important pre-requisites for trading of water entitlements. First, local adverse effects of irrigation must be managed properly if trading is not to have adverse environmental effects. This applies not just to salinity issues, but also to changes in nutrient and sediment loading, chemical usage and other issues that may accompany intensification or changes in land use. Potential social impacts of land use change should also be considered. These issues need to be managed properly regardless of water trading, of course, because otherwise adverse effects will arise as land use changes over time. Water trading allows land use change to occur more quickly – this enables greater economic growth but this can lead to greater environmental degradation unless appropriate constraints are first put in place.

In the Murray trial of inter-state trading, most water traded was from unused entitlements. Hence, there was apparently little if any gain to in-stream flows, especially since the statewide caps on total diversions tend to be the constraining factor. Only where a management regime specifies minimum environmental flows and enforces these through restrictions on abstraction permits, e.g. reductions in allowed takes in times of low flow, can water trading safely be allowed without threatening environmental values.

This highlights the most difficult issue of all for the Murray-Darling Basin – the system is so seriously over-allocated that the river mouth has silted up. There are insufficient flows to flush the sediment through the river. Dryland salinity is reducing productivity across the basin. There is a growing realisation in Australia that the volume of water taken from the Murray-Darling must be substantially reduced. How this will be done, and whether irrigators will be compensated for reductions, is now the focus of much debate. Once the amount of water available for abstraction has been reduced, it will be even more important that entitlements be transferable so that maximum value can be obtained from the limited water available.

Although various technical schemes to increase water use efficiency have been proposed, Gyles (2003) has shown that many of the purported savings are illusory or much more costly than the market value of water. Reducing abstractions will come at a cost to production, and the best way to value this correctly, so as to strike the right balance, is to allow trading of water permits. This step will also allow abstractors to get the most value from water that remains available.

Despite the sometimes polarised debate, the Australian Conservation Foundation and the National Farmers Federation agreed in July 2003 that Australia must address the inadequacies of past water management. The ACF and NFF agreed that moving forward should include, among other things:

- securing flows for the environment,
- clarifying water entitlements and clearly defining the associated security and responsibilities, and

- removing impediments and encouraging water trading within environmental limits.

On 29 August 2003, the Council of Australian Governments announced it would develop a National Water Initiative with the key elements proposed by the ACF and NFF, and committed A$500 million over five years to the project. Centrepieces of the initiative will be to "ensure ecosystem health by implementing regimes to protect environmental assets" and "by returning over-allocated systems to sustainable allocation levels" and to "ensure water is put to best use by encouraging the expansion of water markets and trading across districts and States."

Appendix 2: Metrowater

Introduction

This brief report analyses historical water consumption records for all Water Supply Local Network Operators (LNOs) in the Auckland Region. This report is based on an analysis prepared by Maunsell for use in the Metrowater Water Demand Forecasting Study.

Water consumption volumes (purchases from Watercare) were obtained for each LNO from January 1996 to July 2002. Population data for each LNO were obtained from Statistics NZ ("usually-resident population" estimates to 30 June). This data period is 'post-drought' (i.e. post-1994), although the report includes some comparison with consumption trends before and during the drought period.

The purpose of this analysis is to examine the pre- and post-drought consumption records and compare per capita demand patterns between LNOs over the period.

Since the drought, both Metrowater (serving Auckland City) and United Water (serving the Papakura District Council area) have implemented user-pays wastewater charges in addition to the user-pays tariffs already charged for water supply. All other LNOs charge for water supply only; wastewater charges are included in general property rates.

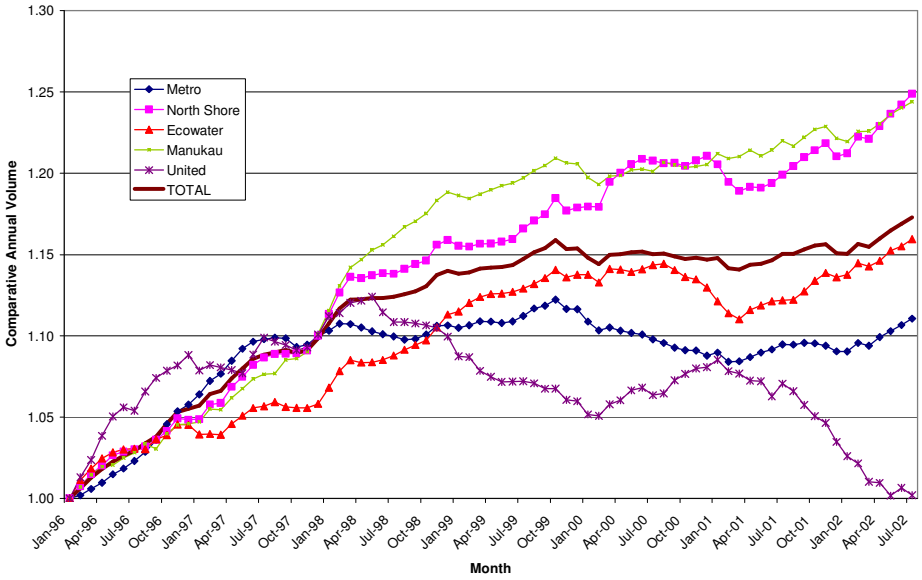
Comparison of Total Demands

An initial review of total monthly volumes consumed for each LNO from Jan 1996 to July 2002 indicated that for North Shore City Council (NSCC), Manukau Water, and Ecowater water consumption has steadily increased, with total consumption up by 15-25% over the period. In contrast, Metrowater shows a 10% increase to 1997 and then constant demand levels for the remainder of the period. United Water shows a 12% increase to mid 1998 and then a rapid reduction over the next 4 years back to 1996 levels.

This is illustrated by the graph below, which shows the relative annual average increase in total consumption since January 1996.

To better understand these demand patterns, the population growth for each area needs to be taken into account, as this is a major driver for total water consumption.

Figure 1.0 Relative Growth in Water Consumption for LNOs since Jan 1996



Source: Metrowater.

Population Analysis

Table 1.0 shows that the major Auckland LNOs have had similar growth in population, whereas United Water has only had 4% growth since 1996.

Table 1.0 LNO Population Change

LNO	Population 1996	Population 2002	% Increase
Metrowater	354,398	392,667	11%
NSCC	179,500	199,000	11%
Ecowater	161,600	180,800	12%
Manukau	266,500	307,100	15%
United Water	41,100	42,700	4%

Source: Statistics NZ, "Usually Resident Population Estimates" to 30 June.

Per Capita Demand

When the consumption records are normalised for population, a more accurate comparison of individual consumption patterns emerges. Per capita demand is derived by dividing the recorded total (gross) monthly consumption values by the estimated population at that time. Gross monthly consumption values include residential consumption, non-residential consumption *and* unaccounted for water (losses) - and therefore are only *indicative* of individual residential patterns. Figure 2.0 shows the trend in average per capita demands for each LNO for the period 1996 to 2002. The graph also shows per capita total *and* residential consumption for Metrowater back to 1990.

A comparison of Metrowater's gross and residential consumption shows that they are strongly correlated. If anything the Metrowater data indicate that residential demand is more responsive to price changes than non-residential demand. Therefore it is assumed that, for the other LNOs, residential consumption patterns would be correspondingly similar to the gross consumption patterns graphed.

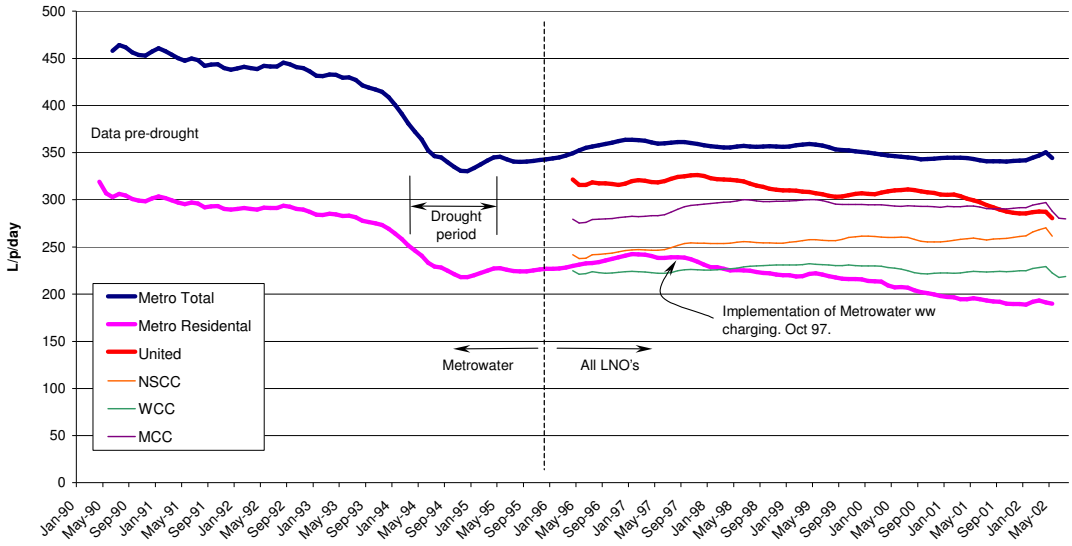


Figure 2.0 Average per capita demands (Weighted Moving Averages - WMA)
Note: All data except Metrowater Residential includes non-residential demand and losses. Metrowater Residential demand excludes losses and non-residential demand.

Figure 2.0 shows that from 1996 to 2002 all LNOs experienced steady or increasing per capita demand for water *except* Metrowater and United Water.

Prior to the drought, Metrowater's per capita demand was dropping by approximately 7 litres per person per day (L/pers/day) every year. This decline could be due to a number of factors, including the beginning of metering at household connections in the early 1990's. In addition to enabling introduction of variable water charges, it is likely that installation of meters had an effect on public awareness of water consumption and therefore led to reductions in per capita consumption levels.

During the drought, per capita consumption levels for Metrowater dropped considerably - by up to 50 L/pers/day. Large-scale advertising and water-saving campaigns were undertaken during the drought, which would have helped generate these savings. Following the drought, demand rebounded slightly as many consumers returned to pre-drought consumption and water use habits. This was a gradual process and nearly all the LNOs show slightly increasing per capita demand to 1997.

From mid-1997 onwards, the Metrowater WMA of per capita consumption started declining again, by approximately 10 L/pers/day per year. This increase in the rate of decline when compared to the pre drought rate of decline (by 3 L/pers/day per year) is discussed below.

Table 2.0 Record of Metrowater Price Changes

Year	Water *	Wastewater*
1995 - 1997	Unmetered - $230 fixed charge Metered - $63 fixed plus 88c variable	Included in Property Rates
From 1/10/97	Unmetered - $230 fixed charge Metered - $63 fixed plus 88c variable	Unmetered - $330 fixed charge Metered - $165 fixed plus 95c variable (on 75% of water use)
From 1/07/98	Unmetered - $230 fixed charge Metered - $63 fixed plus 88c variable	Unmetered - $370 fixed charge Metered - $184 fixed plus 1.06c variable (on 75% of water use)
From 1/10/99	Metered - $30 fixed plus $1.10 variable	Metered - $30 fixed plus $2.55 variable
From 1/08/00	Metered - $30 fixed plus $1.16 variable	Metered - $30 fixed plus $2.77 variable
From 1/07/01	Metered - $30 fixed plus $1.18 variable	Metered - $30 fixed plus $2.81 variable

* Variable charges are per 1000 litres.

Effects of Price Changes on Metrowater Residential Water Consumption

Since January 1996, Metrowater has implemented a number of price changes as summarised in Table 2.0. These events were analysed using a structural regression model for the Metrowater Water Demand Forecasting Study, which is currently being carried out by Maunsell.[23]

Apart from pricing changes, no major demand management initiatives have been undertaken by Metrowater since the drought. Maunsell has concluded that per capita demand has dropped for both Metrowater and United Water due to implementation of new tariff regimes – in particular those relating to wastewater charging.

The results of the regression analysis indicated that each of the pricing changes had a significant effect on consumption and passed all diagnostic testing with high R^2 (correlation coefficient), high DCA (Directional Change Accuracy) and low MAPE (Mean Absolute Percentage Error). Overall, the model provides a very strong representation of the underlying data.

The results indicated that at each price change event there was a corresponding decrease in per-capita consumption, as shown in Table 3.0.

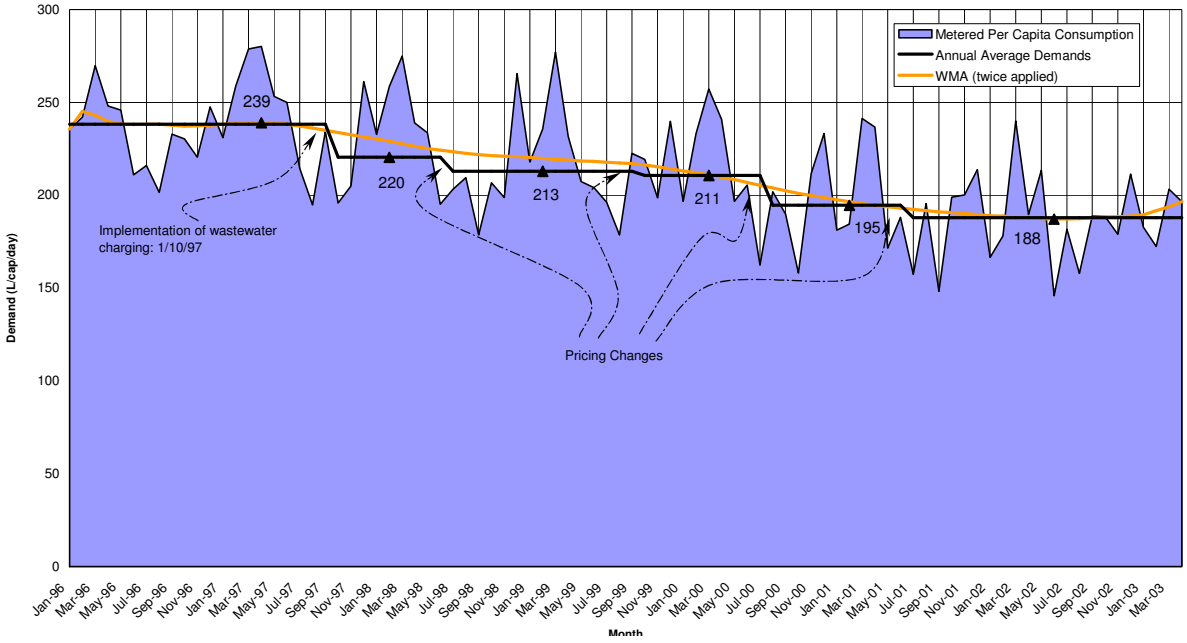
Figure 3.0 presents the residential demand over the period January 1996 to present and shows the pricing changes, along with the 13-month centred weighted moving average demands.

[23] Metrowater Water Demand Forecasting Study – Stage 1a. Prepared by Maunsell (Meritec)

Table 3.0 Summary of effects of pricing changes

Event	Description	Annual Average Per Capita Consumption following price change
1996	Only Water Supply (WS) user pays charging	239 L/pers/day
From 1/10/97	User Pays Wastewater (WW) charging introduced	220 L/pers/day
From 1/07/98	Increase in WW charges	213 L/pers/day
From 1/10/99	Change in tariff structure and charges for WS and WW	211 L/pers/day
From 1/08/00	Increase in WS and WW charges	195 L/pers/day
From 1/07/01	Increase in WS and WW charges	188 L/pers/day

Figure 3.0 Metrowater City Wide Residential Water Consumption Showing Price Changes



The reduction in consumption at each price change was not constant. The size of these reductions depended on a wide variety of factors associated with the price reduction such as:

- The level of awareness about the pricing change (advertising, publicity etc)
- Frequency of billing at the time
- The magnitude of the price change
- General public perception and awareness of water conservation issues.

Conclusions

From this brief analysis of consumption records for Auckland LNOs and the results of the analysis carried out for the Metrowater Demand Forecasting Model, one can draw the following conclusions:

1. That since Jan 1996, in general, per capita demands have been steady or have increased slightly for all LNOs *except* Metrowater and United Water.
2. Metrowater has shown a decrease of approx 50L/pers/day in residential demand and United Water approx 40L/pers/day in total demand over this period.
3. Metrowater consumption patterns were decreasing prior to the drought, however in the period post-drought are shown to decrease at a faster rate (rate of decline increased by 3L/pers/day per year).
4. It is the opinion of Maunsell that the drought itself would not cause the ongoing decreases in per capita consumption as none of the other LNOs exhibits decreases.
5. The likely cause of the reduction is attributed to the implementation of a user-pays wastewater charging regime and the associated public awareness of water consumption generated as a result of this (and also the publicity undertaken in association with the implementation).
6. Regression analyses gave significant, robust results for the pricing changes implemented by Metrowater – and the reductions in water consumption were explained well by the implementation of pricing changes at various times between 1996 and 2002.

Appendix 3: Denmark's landfill tax on construction and demolition waste

(See the box on page 18 for additional background to this case study.)

Construction and demolition waste accounts for around a quarter of Denmark's total waste generation. This figure is similar to that of New Zealand – C&D waste accounted for 20% of Auckland's landfill material in 1995. Because of the density and sheer volume of C&D waste, it is particularly responsive to a weight-based tax. In Denmark, the €50/tonne (NZ$98/tonne) tax rendered it very expensive to landfill concrete, bricks and asphalt, making recycling of these materials a competitive option.

However, a range of other initiatives were also introduced to ensure that the technological solutions, and physical and organisational infrastructure required to provide the recycling service, were in place. These initiatives include: funding for recycling projects, standards for recycled building materials, dedicated sorting/processing facilities, taxes on virgin raw materials, and a government-industry agreement on 'selective demolition'.

Selective demolition refers to a method of deconstruction that carefully separates materials during the process, and is in contrast to traditional demolition techniques such as the bulldozer and wrecking ball. Traditional demolition is quicker and therefore cheaper in terms of labour, but results in a large amount of low value mixed waste. However, the high disposal cost instituted by the waste tax has left selective demolition more competitive, and facilitated an industry agreement to separate materials into clean fractions at source.

The cost of reprocessing clean waste streams at dedicated crushing facilities by the end of 2000 was very competitive. At these facilities, C&D material carries a gate fee of between €5-€18/tonne depending on the type of material and whether it contains steel reinforcing, which is harder to process. This provides a huge saving to contractors who would otherwise pay between €50-€80/tonne at a landfill. The processed material is sold for between €4-€8/tonne depending on its grade. As a direct result of the landfill tax and supporting infrastructure, the rate of C&D recycling increased from 25% in 1990 to 90% in 1996. Thus recycling of C&D waste contributes significantly to stretching the Danish landfill capacity, while creating jobs within the secondary materials industry.

Source: Jacobsen and Kristoffersen, 2002.