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A MAGAZINE ABOUT CONTEMPORARY ECONOMIC ISSUES FOR EVERYONE

UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND

EcoNZ@Otago

23

OCTOBER 2009

The economic value of a Norwegian marine paradise

FROM THE editor

Welcome to Issue 23 of *EcoNZ@Otago*!

As most readers know already, *EcoNZ@Otago* is a magazine about contemporary economic issues, published by the University of Otago's Department of Economics.

The contents of the previous 22 issues of *EcoNZ@Otago* are listed at the back of this issue, and single issues are available on request (our addresses are below).

If there are any economic issues that you would like examined in a future issue of *EcoNZ@Otago*, please email your suggestions to econz@otago.ac.nz. Alternatively you can write to EcoNZ@Otago, Department of Economics, University of Otago, PO Box 56, Dunedin.

This is the first issue since inheriting the editor position from Niven Winchester. Under Niven's guidance, both the reputation and the quality of the magazine continued to advance. Authors and readers greatly benefited from his incisive editorship. The Department of Economics would like to thank Niven for his efforts.

Dan Farhat

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Because most natural resources have multiple uses (tourism, mineral extraction, logging, etc.), the *value* of a natural resource is broadly defined and difficult to measure. Without knowing its true value, policy-makers often find it difficult to determine effective policies and evaluate the impact of existing policies for a natural resource (especially when they have many goals in mind). This paper presents a Total Economic Value (TEV) analysis for waters outside Lofoten-Vesterålen on the Norwegian coast. We find that the value of tourism surpasses that of fisheries in this traditionally fishery-intensive area. We also take a first step in connecting these TEV results to policy decision-making by presenting what we coin an 'impact matrix'. This matrix identifies the activities where policy decisions will have the greatest economic effect.

Lofoten Islands, Norway by Reinhard Pantke (www.images-photography-pictures.net)

The valuation of nature in terms of the goods and services environmental resources provide has become one of the fastest-growing areas in environmental economics over the last 30 years (Turner et al., 2003). One method economists use to estimate the value of a natural resource is known as Total Economic Value (TEV). TEV evaluates the goods and services of the terrestrial natural resources in small bounded geographical areas.

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The TEV method is supposed to provide policy-makers (who must decide how natural resources are to be shared amongst many users) with a gauge for choosing and evaluating policies. There is little evidence, however, that policy-makers actually rely on TEV results when determining policy, suggesting that it may be difficult to clearly connect TEV results with the policy outcomes. In this study, we conduct a TEV analysis for a coastal marine environment.[3] Further, we explicitly show how the results can be used when evaluating policy.

A Norwegian paradise

Our study is based on the findings of a report that we were asked to prepare for the Norwegian Ministry of Environment in 2008 (Armstrong, Kahui & Aanesen, 2008). The report focused on estimating the current value of the coastal waters off Lofoten-Vesterålen, which is one of Norway's most pristine marine ecosystems. The ecosystem contains key areas of spawning for commercial fish stocks and has valuable cold-water coral and sponge communities. It is also an important breeding, moulting and wintering area for seabirds. The Lofoten Islands are a tourist destination famous for their exceptional natural beauty and culturally rich fishing traditions.[4] Historically, this area has been used for fishing and maritime transport industries, but there is now growing pressure for oil and gas extraction, transport of oil, cruise traffic and marine bio-prospectors.

Use and non-use – what's it all worth?

The Total Economic Valuation (TEV) concept, as presented in Table 1, is a well-accepted framework for identifying values connected to natural environments (Pearce & Turner, 1990).[5]

Table 1: Total Economic Valuation Framework

Total Economic Value	
Use Value	
Direct use value	Market value of extracted resources (e.g. fisheries, aquaculture, tourism, etc.)
Indirect use value	Value of the environment to direct uses (e.g. habitats, food for commercial species, etc.)
Option value	Potential future value of the environment.
Quasi-option value	What society is willing to pay to preserve the environment, expecting knowledge of its future value
Non-use Value	
Existence value	Value of existence, not connected to use
Bequest value	What society is willing to pay to preserve the environment for future generations

Table 2: Direct use values in billion Norwegian Kroner (NOK)

Good/Service	Monetary value per year	Present value	Assessment
Tourism	3.71	92.8	Uncertain
Fishery/aquaculture	1.66	41.6	Underestimate
Processing of marine products	0.96	24.1	Underestimate
TOTAL	6.34	158.5	
Annual and present value (discounted at 4%), measured as gross product based on data from 2004, adjusted for inflation to January 2008 (1 USD = 5.04 NOK as of January 2008).			

Table 3: Indirect use values and existence values in billion NOK

Good/Service	Monetary value per year	Present value	Method and measure	Assessment
Recreation	3.2	80	Implicit value (CS[8])	Uncertain
Nutrient cycling	25.3 - 158	632.5-3950	Opportunity cost	Underestimate
Waste treatment	0.19	4.9	Opportunity cost	Acceptable
Gas and climate regulation	0.88	22.1	Calculated CO_2 value of sequestration (CS and PS[9])	Underestimate
Existence values	0.35	8.8	Willingness to pay (CS)	Underestimate
TOTAL	29.9 – 162.6	748.3 – 4065.8		
Annual and present value (discounted at 4%), constant January 2008 prices.				

3 Coastal environments receive less attention in the literature compared to land-based environments. The only TEV study for a marine environment that we are aware of is Beaumont et al. (2008) for waters surrounding Great Britain.
4 Six communities in the Lofoten islands have applied for admission to UNESCO's world heritage list.
5 There are also other less well-known approaches to the valuation of ecosystem goods and services (see for instance Kumar & Kumar (2008) and Chee (2004)).

Table 4: Impact matrix

Potentially affects:	**Increased activity in:**					
	Oil/gas	Transport	Tourism	Fishery	Aquaculture	Waste Disposal
Nutrient cycling						
Tourism						
Recreation						
Fishery/Aquaculture						
Gas/climate Regulation						
Existence values						
Waste treatment						

White is no or negligible potential effect, light grey is some potential effect and dark grey is large potential effect.

Total economic value is divided between use and non-use values. Use values are comprised of the market values associated with using the natural resources in the area (direct use values), the value of the supporting structures underlying the natural resources in the area (indirect use values), the potential value of the environment in the future (option values) and the amount society is willing to pay to preserve the environment expecting to gain future knowledge of its value (quasi-option values). Non-use values are comprised of the value of sheer existence of the environment (existence value) and the value of preserving the environment for future generations (bequest value).

In our study, we focus on direct use values, indirect use values and existence values in estimating total economic value. Direct use values are measured by observing market activity. Indirect use values and existence values are estimated by transferring values from a range of comparable studies to our study area (a technique called 'benefit transfer'). These studies use a variety of methods (such as replacement cost methods[6] and contingent valuation methods[7]) to estimate a per-unit indirect value for a natural resource good or service. We then apply these estimates to the Lofoten-Vesterålen area using existing market data. Our results are reported in Tables 2 and 3. We choose not to aggregate estimated direct and indirect use values into a single number as doing so detracts from the uncertainty and complexities associated with valuing ecosystems.

The tables indicate that indirect uses (such as recreation, nutrient cycling, waste treatment and gas and climate regulation) of the pristine waters off Lofoten-Vesterålen are as important if not more important than direct uses (such as tourism, fishery/aquaculture and the processing of marine products). That is, the per-year monetary value from direct uses (6.34 billion NOK) is less than the per-year monetary value from indirect uses (29.9 – 162.6 billion NOK).

The matrix

We now explore how the results from the TEV study above can be used to assess the impact of new or increased activities in the Lofoten-Vesterålen coastal area. The coastal waters off Lofoten-Vesterålen, once an area known for its fishery practices, are under increasing pressure from oil companies for oil and gas extraction. In Table 4, we construct an 'impact matrix' to show how the results from our study may be used by decision-makers to evaluate whether or not a policy supporting oil extraction should be adopted. It is important to note that the content of the matrix represents a hypothetical extrapolation of our results and is used only as an illustration.

In Table 4, we have ranked the different goods and services identified in Tables 2 and 3 in descending order according to their present values. Nutrient cycling, which carries the greatest value, is first, while waste treatment, which carries the lowest value, is last. The first row in Table 4 indicates potential policy actions that lead to increased or new activity in selected economic sectors, such as transport, tourism, fisheries, aquaculture, waste disposal (increased activity) and oil/gas extraction (new activity).

There are two key aspects to take into account when considering the scale of impact of increased and/or new activities. First, how compatible the new or increased activity is with existing activities. Second, how the original values of the existing goods and services are being affected by the new or increased activity. The shade of the cell represents the first aspect: the darker the cell, the less compatible the new or increased activity is with the existing activities. For example, a policy allowing for oil extraction would greatly impact recreation (the cell is a medium grey) but not significantly affect waste treatment (the cell is white).

The vertical position of a grey cell represents the second aspect. A dark grey cell near the top of the table indicates a stronger impact than a dark grey cell near the bottom of the table. For example, the dark grey cell for tourism caused by any new activity in oil/gas extraction represents a larger total economic impact than the equally dark grey cell for fishery/aquaculture, since it is higher up in the first column of Table 4.

As an example, any new activity in oil and gas extraction will imply increased marine traffic activities in the form of

6 The replacement cost method assumes that the value of an existing good or service is the cost of replacing it.
7 The contingent valuation method is used to estimate the economic value of a natural resource by directly asking people how much they would be willing to pay for a specific environmental service.
8 Measures consumer surplus (CS).
9 Measures producer surplus (PS).

seismic exploration and the shipping of industrial goods. At some point, this will have the potential to crowd out tourism and fishery activities[10] and have a negative effect on recreation (as indicated by a light grey cell). Emissions into the sea from the ships due to regular sea traffic may also have negative effects on the quality of the natural environment, affecting the existence values of seabirds and killer whales should these animals be accidentally killed or displaced due to deteriorating habitat quality. Gas and climate regulations along with waste treatment services, on the other hand, may experience a very small impact in the short term.

Beyond the matrix

The results from our TEV analysis and the construction of our 'impact matrix' provide a roadmap for decision-makers. Dark grey cells in the upper part of the impact matrix indicate that a good or service with a relatively high value may be severely affected by the introduction of new or increased commercial and non-commercial activity. The impact matrix serves as an important first step in applying TEV analyses to practical decision-making, but more detailed information is necessary once a particular activity is being considered by policy-makers (such as impact studies, which take into account the 'before and after' states as environmental change occurs).

Questions to consider

1. What is the TEV concept?
2. What information does TEV results provide to policy makers and other interested readers?
3. How can the impact matrix facilitate the application of the TEV values to potential decision making?

Further reading

See Wilson and Hoehn (2006) for further discussion of the valuation of environmental goods. Olsgaard & Gray (1995) analyse the effects of offshore resource exploration on the Norwegian coast.

Useful websites

For general information on the Lofoten district in Norway, see http://en.wikipedia.org/wiki/Lofoten

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10 After seismic exploration carried out in the Lofoten and Vesterålen area in the summer of 2008, economic compensation was paid to fishermen whose fishing season was cut short by the activities.

Emission caps: competing for the climate change cup in 2009?

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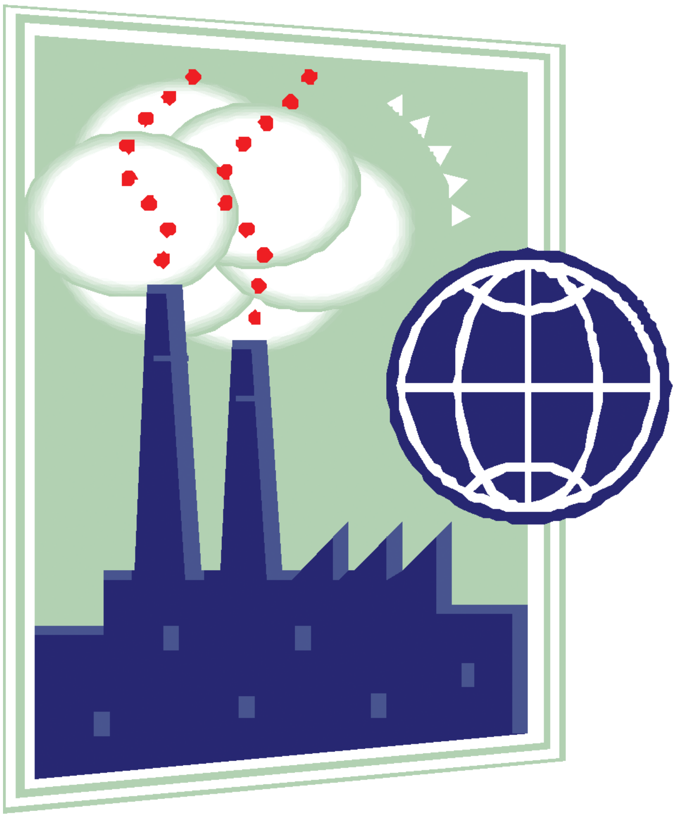
In 2008, New Zealand became the first country to introduce a comprehensive emissions trading scheme (ETS) that includes all sectors and all gases. The scheme is likely to impose substantial economic costs and its success will hinge on the emergence of an open, viable, and liquid international carbon market. The game is on as leaders negotiate a second round of emissions targets later this year.



The problem

The role that greenhouse gases (GHGs) play in trapping energy and making the atmosphere warmer is not in dispute. Scientific evidence suggests that the atmospheric concentration of many GHGs has increased markedly as a result of human activity. Global GHG emissions increased by 70% between 1970 and 2004. Carbon dioxide (CO_2), the most important GHG, accounted for around 77% of global GHG emissions in 2004 (IPCC 2007). Methane emissions, which have a warming potential 21 times that of CO_2,[2] is of particular significance to New Zealand. Although scientists agree that the level of GHG emissions has increased, uncertainty arises over the impact of GHG emissions on climate change. Battle lines have been drawn between climate change sceptics and those who firmly believe there is a direct linkage. No doubt the debate will continue.

In the meantime however, many countries are taking this issue seriously and proposing policies aimed at limiting GHG emissions. Australia is currently working through its climate change legislation. In the US, a climate change bill has passed through the House and is destined for the Senate. The EU has long had a policy aimed at constraining GHGs and has introduced a market in which emission rights are traded. The UK is proposing measures to cover emissions from sectors not already covered by the EU scheme. The newly elected Prime Minister of Japan has stated that he would like to see his country's GHGs cut by 25%. All of these countries are important trading partners for New Zealand. The potential for trade barriers and/or consumer reluctance to buy carbon-intensive products is a threat to New Zealand's comparative advantage that should be taken very seriously. It's no small wonder that sectors like

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2 To account for differences in warming potential, GHGs are converted into a common metric: carbon dioxide equivalent (CO_2-e).

kiwifruit, dairy, wine, lamb and beef are studying their emission footprints.

Closing the global commons

Textbook economics defines *public goods* as having two characteristics: non-rivalry and non-excludability. Let's assume that GHGs do have an adverse impact on the climate. If a country unilaterally reduces emissions, those who do not contribute to emission reductions cannot be excluded from enjoying the benefits (non-excludability). Furthermore, everyone simultaneously enjoys the same level of benefit derived from reducing emissions (non-rivalry). This gives rise to the presence of free-riders: those who want to enjoy the benefits of a more stable climate without having to pay the costs associated with cutting their emissions. When free-riding is present, emissions are not optimally reduced. Collective action limiting GHG emission at the international level becomes necessary.

Depletion of the atmosphere is not a new problem. Several years ago excessive use of chlorofluorocarbons (CFCs) was considered responsible for depleting the ozone layer that protects us from harmful radiation. The Montreal Protocol in 1987 formed the basis for international cooperation aimed at reducing the use of CFCs. If the agreement is adhered to, the ozone layer is expected to recover by 2050. New Zealand was an early adopter of the Protocol, introducing legislation aimed at phasing out the use of CFCs and in some instances enabling the transfer of rights to use ozone-depleting substances. Kofi Annan, the Director General of the United Nations, hailed the agreement as an exemplar of international co-operation.

The Kyoto Protocol adopted in 1997 laid the foundations for a collective approach to limiting GHG emissions. It set binding targets for 37 industrialised countries and the EU for reducing GHGs. We can refer to these targets as a cap on emissions. The Protocol enables the use of tradable emission units which, in principle, can achieve a cap at least cost ('cap-and-trade'). Economic efficiency is beyond the reach of a cap-and-trade regime because it is most unlikely that the cap is set at a level which balances costs and benefits at the margin.

New Zealand ratified the Kyoto Protocol in 2002, committing it to reducing average net emissions of GHGs over the first commitment period, 2008-2012, to 1990 levels or take responsibility for the difference. Approximately 309.5 million assigned-amount units were received by New Zealand plus an expected net increase in forestry sinks of 67.2 million. If our entitlement falls short we must either purchase units on the international market or reduce emissions. In 2009, New Zealand was found to be in surplus, but this can change.

Lessons from an operating carbon market

What evidence is there from a working cap-and-trade system? Insights can be gained from the European carbon market, the world's largest GHG emissions trading scheme. The European market was launched in 2005 with Phase I operating through 2007. European Union Allowance (EUA) units are equal to one metric tonne of CO_2–e. Project based units are also included in the European market. Two lessons emerge from Phase I.

First, in May 2006 the EU announced an overall surplus of units which caused both the spot and futures market to plunge. In simple terms, the cap was not a binding constraint on emissions.

Second, prices were further affected by a limit on carrying over unused units into Phase II. The right to bank unused EUAs and use them in the future adversely affected prices. Clearly the shape of emission rights has implications for their market value. Allowance banking was permitted in Phase II, improving market continuity and, of course, the value of a right.

New Zealand's approach

New Zealand's Emissions Trading Scheme (ETS) is a standard cap-and-trade approach to externalities that has its origins in the early work of Coase (1960) and Dales (1968). The structure of the ETS is designed around four core pillars.

First, participants that want to emit GHG have an obligation to hold and surrender emission units that match their annual emission levels. Second, the ETS includes all major sectors and all gases. Third, a New Zealand Unit (NZU), fully comparable with Kyoto Units, is the primary domestic unit of trade. Both sales to and purchases from international markets are allowed. Fourth, forest landowners derive credits for forestry activities that lead to carbon absorption, but are liable for subsequent releases of carbon into the atmosphere.

When introducing a cap-and-trade regime, policy-makers must grapple with the problem of setting initial entitlements. Grand-parenting based on existing emissions is one option; auctions are another. The allocation method has implications for both economic welfare and the technology strategy adopted by firms operating in a carbon-constrained economy. Free allocations can create perverse incentives by not encouraging firms to invest in clean technology.

A unique feature of New Zealand's ETS is that it was designed to include all sectors. Thus, the time at which each sector is included in the scheme is of economic significance, particularly if the objective is to achieve reductions at least cost. Current legislation has forestry entering the ETS first, followed by energy-related sectors, with agriculture being the last sector to be included.

Economic impacts

New Zealand is an open economy and economic growth and prosperity depends heavily on success in our export markets. Economic leakage is a term used to describe the part of the cost increase caused by the ETS that regulated producers can't pass on to consumers without losing market share. Given New Zealand's price-taking position in most export markets the prospect of leakage is real.

Government estimates of the economic costs vary. A study by the Treasury shows that a price of $13 per tonne and $51 per tonne would see GDP fall by 0.04% and 0.24% by 2010, respectively (Whitehead 2008). The New Zealand Institute for Economic Research (2009) examined the macroeconomic effects of policy options for climate change mitigation using a computable general equilibrium model. Their results are informative.

First, the welfare impacts of New Zealand taking unilateral action are conditional on what the rest of the world does. If the world prices carbon, the economic impact is reduced. Second, the economy may still grow under a carbon pricing regime but the higher the world price of carbon the greater the negative impacts. Third, free allocation of NZUs can reduce welfare losses especially in industries which have few available technologies to reduce emissions.

Concluding comments

The New Zealand ETS, as legislated, stands out on the international stage as the first comprehensive market-based mechanism applied to GHGs. Later this year leaders will meet in Copenhagen to settle on targets for post-2013. The game is on!

Questions to consider

1. What are the possible economic impacts of New Zealand not implementing the ETS and the world moving ahead with carbon pricing?
2. Why is it that we can't be sure that a cap-and-trade system is economically efficient? What is the best we can hope for?
3. What are the advantages and disadvantages of free allocations to firms producing GHGs?
4. What economic reasons would you use to decide when sectors should enter the ETS?
5. Assume that you represent New Zealanders interested in negotiating post-2013 targets. What would your strategy be?

Useful websites

Current New Zealand climate change information is available at www.climatechange.govt.nz. Information on the United Nations Framework Convention on Climate Change is available at http://unfccc.int/ghg_data/items/3800.php.

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Leave only (carbon) footprints? The climate change impact of New Zealand tourism

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Accelerating global climate change poses major economic and societal challenges for all countries. New Zealand's economy is heavily dependent on international tourism, and the majority of visitors come by air, emitting greenhouse gases in the process. These emissions pose a growing risk to the reputation of New Zealand as a 'clean-and-green' tourism destination. This article looks at possible carbon offsetting schemes to lessen the climate impact of this international air travel.

Mike Moreu, *The Christchurch Press,* January 5th, 2007

International tourism to New Zealand is an important source of income for our country, accounting for 19.2% of export earnings (Statistics New Zealand, 2007). The international tourism industry is a larger export earner than the dairy industry (which accounted for 13.2% of export receipts in 2006). When we include contributions from industries that support tourism, the tourism industry produces 9% of the country's total gross domestic product (GDP). The scale size of tourist visits to New Zealand is huge, and has grown significantly over the last few decades. For example, in 1983 about 500,000 international visitors travelled to New Zealand. In 2005, this rose to 2.4 million people (an increase of 480%). Prior to the current economic downturn, the New Zealand tourism industry had been planning for 4% annual growth out to 2015. Although the visitor numbers are currently down due to the global recession, the expected 4% growth in the tourism industry could very well eventuate should the world economy recover.

The friendly skies

All economic activity has an environmental impact. Tourism is no exception, even so-called 'eco-tourism'. For New Zealand, a geographically isolated island nation deep in the South Pacific, the transport of tourists to and from the country is the primary environmental impact (Becken & Hay 2007). This is irrespective of how 'green' the visitors' activities inside the country are. An increase in demand for international air travel has led to an increase in emissions attributable to the aviation industry.

At high altitudes, aircraft that fly international routes burn fuel known as 'Jet A-1', a form of kerosene. This produces carbon dioxide and other greenhouse gases (the combined impact of which is described through carbon dioxide equivalent, or CO_2-e, emission units). Particles are emitted and high-altitude cirrus clouds are formed. Taken together, these lead to an overall warming of the Earth.

Evidence of accelerating global climate change has increased the urgency with which the world considers the need to reduce carbon emissions. In many European countries, there is increasing media attention on the role that long-haul travel plays in global climate change. Emissions from international air travel, however, are not currently liable under the Kyoto Protocol. This may change in future international agreements, such as the one to be negotiated in Copenhagen this December.

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Departures and arrivals

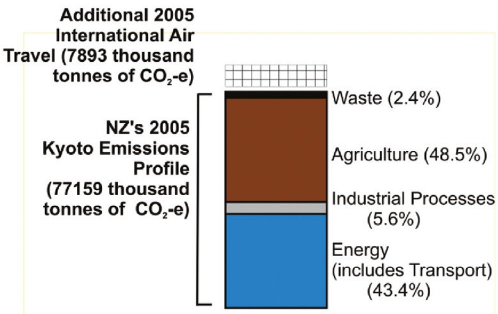
Since there is no international collective action on the reduction of air travel emissions, a number of so-called 'carbon offsetting schemes' have emerged. These schemes allow individual travellers and companies to compensate for their international air travel emissions. Recent research at the University of Otago has performed a case study assessment of the physical feasibility of five offsetting schemes to compensate for the greenhouse gas emissions of visitors travelling to and from New Zealand (Smith & Rodger, 2009). These offsetting methods include:

- the installation of energy-efficient light bulbs
- replacing thermal electricity generation with wind farms
- reducing road transport
- regenerating native forests
- improving the efficiency of thermal electricity generation

No easy fixes

It turns out that all of these offsetting approaches are very challenging (at best) due to the sheer scale size of the greenhouse gas emissions produced by visitors' travel to and from New Zealand. To estimate the size of the greenhouse gas emissions, we combine Statistics New Zealand visitor information with a greenhouse calculation method for passenger air transport based on work by the United Kingdom Department of Environment, Food and Rural Affairs. Our calculations show that in 2005, the CO_2-e emissions from the return air flights of the 2.4 million international visitors was nearly 7.9 million tonnes – roughly the same as the emissions from all the country's coal, gas and oil-fired power generation (8.2 million tonnes). The significance of these emissions, which are not currently included in our Kyoto liabilities, is clear when compared to New Zealand's known emission profile, which is outlined in Figure 1. In 2005, the CO_2-e emissions from visitors to New Zealand were approximately 10% of the country's Kyoto liable emissions.

Figure 1. New Zealand's 2005 CO_2-e emissions liability under the Kyoto Protocol (solid colours), and the additional CO_2-e emissions that are generated by international visitors to New Zealand (square-hatched section).



Case studies

Light Bulbs. In 2005, 14.29 terawatt hours (TWh) of electricity were generated by thermal (gas, coal) power plants in New Zealand. The installation of a 20 watt energy-efficient light bulb in a New Zealand household (assuming 5 hours of operation each day) would reduce the amount of electricity used and annually offset 31.9 kg of CO_2-e generated by thermal power plants. Thus the installation of 248 million light bulbs (or 105 light bulbs per international visitor) would have to be replaced by energy-efficient light bulbs to offset the 2005 visitor emissions. This is unrealistic in the New Zealand context, as the country had only 1.48 million dwellings in 2006.

Wind Farms. A 1000 megawatt (MW) wind farm can produce 3.24 TWh of electricity per year in New Zealand, partially offsetting thermal generation. In 2005, thermal generation emitted 0.57g CO_2-e per watt hour (Wh) in New Zealand. The installation of 4250 MW of wind generation would offset the 2005 visitor emissions. This is 4250 1 MW wind turbines, equivalent to 96% of New Zealand's 2005 total thermal generation (or 13.715 TWh). New Zealand's total wind resource available to contribute to consumer energy by 2015 has been forecast as being only 6.74 TWh per year (at best), which is less than half of the amount needed. It would, therefore, be highly challenging to meet this offsetting goal through the use of wind.

Road Transport. In 2005, the CO_2-e emissions from all road transport in New Zealand was 12.6 million tonnes. The carbon emissions attributable to international visitors flying to and from New Zealand in 2005 are, therefore, 63% of the total amount produced by road transport. Reducing car use and freight haulage in New Zealand by 63% is clearly unrealistic to offset the visitor emissions in the short to medium term.

Native Forests. Regenerating New Zealand forests absorb 3 tonnes of CO_2 each year per hectare of forest. By setting aside land for forest to regenerate, some of the emissions produced by visitors to New Zealand could be offset. In order to offset the 2005 visitor emissions, 26 300 km2 of regenerating forest would be required. This is 15 times the size of Stewart Island, or 10% of the country's total land area. It would require increasing New Zealand's total forested area by one third, probably by decreasing the 50% of New Zealand land area currently used for pasture. This approach appears somewhat unrealistic, and would be likely to have significant additional economic impacts, making it politically difficult to implement.

Improved Efficiency. According to Genesis Energy Ltd, the installation of the E3P-combined cycle gas turbine at Huntly replaced 385 MW of thermal generation, reducing CO_2 emissions by 1000 thousand tonnes per year. In order to offset the 2005 visitor emissions, 8.2 E3P units would need to be installed. Since this is approximately all of New Zealand's 2005 total thermal generation (97%), this approach would be technically challenging.

Prepare for take-off

Our research focussed on the offsetting schemes for carbon emissions attributable to international air transport that are currently available. As of yet, we have been unable to identify an offsetting option that is physically realistic, or politically realistic, within New Zealand. It appears that offsetting solutions require international cooperation. Any attempt to offset the entire carbon emissions load attributable to flights by international visitors would need to be at least partially based in other countries. It would seem logical to explore offsetting in the visitor's country of origin.

Some combination of the offsetting approaches described in our research may work in the future, but this will require significant further research efforts combined with societal changes. Future research will need to identify what level of changes, such as land use change from pastoral to forests, are acceptable in a policy context, as well as quantifying the impact of such changes. While it is frustrating not to be able to deliver a clear solution to the offsetting problem, the sheer size of the aviation emissions and the scale of the international tourism industry in New Zealand indicates it is vital to work towards a practical (in an economic and political sense) resolution.

Questions to consider

1. Why might tourism damage the environment even when tourists are engaged in eco-friendly tourism activities while they are inside the country?

2. What is a 'carbon offsetting scheme'? Who should be responsible for implementing these sorts of schemes: the tourists, the airlines, or the residents of New Zealand?

3. Why is switching to energy-efficient light bulbs an infeasible carbon offsetting scheme? What about wind farms or native forest regeneration? What does this say about the size of the pollution problem?

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How much is your child's health worth?[1]

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Using a Willingness To Pay (WTP) approach, we examine the economic impact of childhood illness in three Otago primary schools. We find the mean WTP varies considerably by type of illness, by income and household employment circumstances.

Gesundheit

When a child gets ill – a frequent occurrence with the average school-aged child contracting at least four colds each year (Dyer et al., 2000) – the entire family is affected. Not only is the family at risk of contracting the illness, arrangements to care for the sick child may result in a disruption to daily life. The costs that arise when a child becomes ill are a concern for both families and society.

When a child becomes sick, parents may have to take time off from work resulting in lost wages and a reduction in productivity. Measuring the costs associated with child illness by calculating the loss in the parents' productivity is what economists refer to as a 'human capital' approach. Lost productivity, however, is undoubtedly an under-estimate of the true costs of a child becoming ill. First, it only values parents' time while engaged in paid labour. Even in cases where there is no lost productivity (for instance if one parent does not work), costs are still incurred as a child's illness may prevent a parent from undertaking usual daily activities. Second, and perhaps of greater importance, is that children's illnesses are unpleasant, both for the child and their parents. These two factors (and indeed there may be others) suggest that simply valuing children's illness based on the lost productivity of parents does not fully capture its true cost.

To tackle this shortcoming, economic evaluators often rely on what is known as a 'willingness to pay' (WTP) approach to assessing the impact of something for which there is no obvious market mechanism to observe direct preferences. The aim of this article is to arrive at an estimate of parents' WTP to avoid illness by directly asking parents how much they would pay to avoid a bout of childhood illness. As there are no ways in which the parent could pay in advance to avoid getting most communicable diseases, this is a hypothetical problem. Then we seek to decompose these cost estimates by a number of family attributes.

1 This research is part of a pilot study funded by the HRC in which we examine the impact of installing hand sanitisers in New Zealand primary schools.
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The doctor is 'in'

Three Otago schools, one rural, one affluent urban school and one less affluent urban school, were involved in the study over a 14-week period in Terms 1 and 2 of 2009. Parents were provided with an introductory letter explaining the nature of the study in the weekly school newsletter. In the next week, a background survey was sent followed by a follow-up survey two or three weeks later. The data consists of 108 preliminary household surveys collected between 19 February and 31 March 2009. The data provides baseline information about household composition, family and whānau living in the area, income, and normal arrangements for dealing with children's illness. 83 households (77%) participated in the on-going study.

Weekly absence information from the 14-week period was collected. Telephone interviews followed-up on student absences to determine the length of the absence from school, the nature of the sickness, and whether other family members had also become sick. Of greatest interest was the WTP question in which parents were directly asked:

> *"When your child gets ill your family incurs losses such as medical costs, lost productivity and missed leisure time. I am now going to ask you a hypothetical question. Suppose you were told in the next month your child was going to contract another illness, like the one they have just had. Assume you can purchase a special preventative medicine to completely avoid getting this illness again. Think about the total amount you would be willing to pay for this medicine. Take into account that the money you spend on this will then not be able to be used on other things such as leisure activities."*

Tell me where it hurts

About 80% of respondent families are dual parent households and 70% have extended family members living in the same town, indicating a high degree of parental support either within the household or within the town. 22% of families have a stay-at-home parent. The average income in the sample was in the $60,000 to $80,000 bracket, with the mode income bracket being $40,000 to $60,000. 19.2% reported an income of $40,000 or less. The household survey shows that 36% of families have two or more types of arrangements which they commonly use to manage their children's school absences.

Table 1: Usual sick care arrangements

	Percentage of Families
Rearrange or take time off work	64.8%
Parent at home	36.1%
Ask someone to look after the children	31.5%
Employ someone	2.8%
Take child to work	1.9%

Table 1 shows that most of the caring for sick children falls on parents, although a significant minority of families indicated that could call upon someone else to provide care. Very few had to hire someone or have their child accompany them to work.

Table 2: Absence by illness type

Reason for absence	Count	Percentage
Respiratory Illness (RI)	50	48.1%
Gastrointestinal Illness (GI)	22	21.2%
Another Illness or Unsure of Type of Illness	18	17.3%
Other reasons	14	13.5%

Respiratory illness (e.g. head colds and coughs) comprises just under half the cases, with gastrointestinal illnesses (e.g. stomach problems) being the next most common reported reason for sickness absence. Children who were absent for reasons other than illness were excluded from the remaining analysis.

Table 3: WTP by illness type

Sickness	WTP per episode	WTP per day of school absence
Respiratory	$78.88	$24.63
Gastro-Intestinal	$157.00	$96.87
Other or unsure	$71.92	$42.90

Table 3 reveals that WTP varies considerably by the nature of the sickness, with WTP per episode of gastro-intestinal illness being double that of respiratory illness and four times greater when comparing on the basis of a cost per day of school absence.

Table 4: WTP by income and household employment structure

Income Group	Average WTP by income and number of income earners in the household (Count)			Average WTP per day of illness
	No Earners	One Earner	Two Earners	
$0- $40,000	$17.88 (3)	$17.90 (10)	$6.99 (5)	$15.65
$40,001- $80,000	(0)	$28.44 (9)	$88.97 (31)	$75.70
$80,001+	(0)	$15.42 (3)	$16.98 (19)	$16.77

Table 5: WTP by household structure

Family Type	Average WTP per day of illness
Single parent, not working	$17.86
Single parent, working	$42.14
Dual parent household, one parent working	$15.39
Dual parent, both working	$56.80

Table 4 reveals a pattern of WTP increasing steadily through the income categories until the categories above $80,000 are reached, at which point it falls off sharply. Interestingly, the fall in the WTP figure for our highest income group is especially dramatic for two-earner households. Table 5 reveals that children's illness is valued most highly in households where there is no stay-at-home parent. It is slightly higher in households with two parents working relative to single parents who are working.

A spoonful of sugar

This study reveals that there are considerable differences in WTP for the prevention of communicable diseases among children. In moderate income households, WTP is the greatest, tapering off at the highest income categories. This may reflect an occupational composition effect, with workers at the top end of the income distribution being more able to alter their work schedule so that there is no loss in pay and a minimal loss in productivity. We also observe that the household structure has an association with WTP. WTP is greatest in households where there are no stay-at-home parents. Interestingly, WTP is higher in two-income families as compared to single working parents.

As dual-income households increasingly become the norm, we would expect the mean WTP for children's illnesses to rise. Furthermore, as successive governments have encouraged increased labour force participation, a factor that may potentially inhibit the decision to join the labour market is the availability of flexible arrangements to support families when children become ill.

Questions to consider

1. What other family dimensions might you expect to affect WTP to avoid children's illness?
2. Are there any concerns with the WTP approach that you can identify?
3. Are there other contexts where WTP could be utilised to assess economic impact?
4. Given the findings presented, are there policy alternatives that governments might wish to consider?

Useful websites

For more information about children's health initiatives, visit the New Zealand Ministry of Health's Child Health website at http://www.moh.govt.nz/childhealth.

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Commentary on the New Zealand Economy

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	Mar 2009	Dec 2008	Sep 2008	Jun 2008	Mar 2008
GDP (real, annual growth rate, %)	–1.0	0.2	1.6	2.5	3.1
Consumption (real, annual growth rate, %)	0.2	0.9	1.7	2.7	3.4
Investment (real, annual growth rate, %)	–7.7	–1.4	1.6	4.4	6.7
Employment: full-time (000s)	1686	1701	1699	1690	1676
Employment: part-time (000s)	495	508	494	496	488
Unemployment (% of labour force)	5.0	4.7	4.3	4.0	3.8
Consumer Price Inflation (annual rate, %)	3.0	3.4	5.1	4.0	3.4
Food Price Inflation (annual rate, %)	8.8	9.4	9.5	6.9	5.1
Producer Price Inflation (outputs, annual rate, %)	6.5	9.9	9.8	8.5	6.1
Producer Price Inflation (inputs, annual rate, %)	4.7	9.7	13.6	12.3	7.3
Salary and Wage Rates (annual growth rate, %)	3.4	3.6	3.9	3.6	3.4
Narrow Money Supply (M1, annual growth rate, %)	2.5	3.0	0.7	4.3	2.4
Broad Money Supply (M3, annual growth rate, %)	6.7	6.4	6.9	7.4	6.4
Interest rates (90-day bank bills, %)	3.24	5.23	7.95	8.68	8.91
Exchange rate (TWI, June 1979 = 100)	53.8	55.1	63.8	68.1	71.6
Exports (fob, $m, year to date)	43,346	42,900	41,973	40,028	38,128
Imports (cif, $m, year to date)	48,141	48,514	47,022	44,507	42,653
Exports (volume, June 2002 [not seas. adj.] = 1000)	1058	1038	1044	1068	1102
Imports (volume, June 2002 [not seas. adj.] = 1000)	1407	1559	1667	1733	1659
Terms of Trade (June 2002 = 1000)	1182	1218	1230	1242	1247
Current Account Balance (% of GDP, year to date)	–8.5	–9.0	–8.7	–8.4	–8.0

Sources: Statistics New Zealand (www.stats.govt.nz), Reserve Bank of New Zealand (www.rbnz.govt.nz)

It has been an eventful six months, and the fallout from the global financial crisis can be seen in most parts of the table. The economy has shrunk in each of the last five quarters and its rate of shrinkage has increased almost every quarter, as consumption spending has stalled and investment spending has slumped. Employment is down and unemployment is up.

To date, however, New Zealand has got off relatively lightly. For example, although the unemployment rate has reached a seven-year high in June, at 6% it is still well below its post-Asian Financial Crisis peak (7.7%) and half the level seen during the recession of the early 1990s (10–11%). In contrast, both the US and the European Union currently have an unemployment rate of around 9%.

There are two main reasons for this. First, New Zealand's banking and financial sectors were not exposed to the types of financial securities that were the source of the debilitating losses suffered by US and European financial institutions. Consequently, we have not seen the massive job losses in the financial sector that have taken place abroad.

Second, as access to credit for households and businesses has tightened globally, this has primarily pared backed demand for consumer durables (cars and whiteware) and investment goods (buildings, plant and machinery). Countries with a comparative advantage in such goods have therefore suffered the double whammy of falling domestic and export demand in their key industries. In New Zealand's case, with the exception of construction, the same change in spending patterns has impacted on imports more so than domestic production. This has transformed the $1,585 million trade deficit for the first seven months of 2008 into a matching surplus for the same period this year.

New Zealand's 'easy run' will not last, as the flow-on effects of the crisis are still working their way through. The tourism sector, in particular, has yet to feel the full force of the global recession, due to what is often a long lag between tourists booking flights and actually stepping off the plane.

In summary, the situation can be likened to an earthquake. New Zealand may have been lucky enough to escape the direct effects of the tremor, but the tsunami is still coming our way. We may be relatively well off at present, but we will catch up with the rest of the world.

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