OFFSETTING CARBON DIOXIDE EMISSIONS FROM TOURISM

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ABSTRACT

Despite energy-efficiency and renewable-energy initiatives, tourism remains an energy-intensive industry and a significant emitter of greenhouse gases, especially CO_2. Air travel in particular is a major contributor to CO_2 emissions, and travel to a destination can contribute as much as 80% of an international tourists' total CO_2 emissions. Carbon-neutral transport technology is not expected to be mainstream in the near future. Other initiatives are needed to offset tourism's emissions, at least in the short and medium term, to move tourism towards being ecologically sustainable. A few schemes for reducing energy use and/or carbon offsetting now exist. We describe a New Zealand carbon-offsetting scheme and its application to tourism. The EBEX21® (Emissions Biodiversity Exchange) scheme sequesters carbon and at the same time enhances biodiversity by regenerating native forests on marginal land in New Zealand. Using EBEX21 we calculated the cost of CO_2 emissions, as well as the native forest area needed to offset CO_2 emissions from international tourism to and within New Zealand. Two models are suggested: firstly, a voluntary mechanism for tourists to offset their emissions. Secondly, regulatory models that charge a 'carbon tax' on every tourist, based on average emissions resulting from travel within New Zealand, and an 'ecotax' that compensates for other environmental costs, including CO_2 emissions from international travel to New Zealand. For both models sufficient marginal land (one million hectares) is available for offsetting every international tourist's CO_2 emissions on an annual basis.

KEYWORDS: *Carbon dioxide emissions, Offsetting, Sinks, Biodiversity, Emission tax*

INTRODUCTION

Tourism is attracting increasing attention as an emitter of greenhouse gases and a consequent contributor to climate change. Gössling (1) suggested that CO_2 emissions (adjusted for nitrous oxides and water emitted by aircraft) from tourism may be in the order of 5.3% of the global total. Ninety per cent of these emissions come from transport. Within transport there is now a growing debate on aviation's role in climate change. Penner et al. (2) estimate that international aviation contributes about 3.5% to climate change. Most attention has focused on the emission of CO_2 and neglected other effects, including emission of ozone and nitrous oxides, condensation trails and increased cirrus cloudiness, which in total contribute to climate change significantly more than do CO_2 emissions (3). So far the international aviation industry has not had to face up to fuel taxes or other emission reduction schemes, as bunker fuels lie outside the Kyoto Protocol. The European Union is now actively considering steps towards curbing greenhouse gas emissions from transport, and recently the International Civil Aviation Organisation's Committee on Aviation Environmental Protection agreed on a model for voluntary measures to reduce emissions from aeroplanes (3). In New Zealand, planning is underway to introduce a carbon tax in 2007 capped at NZ$25 a tonne of CO_2 (4) subject to the Kyoto Protocol coming into force.

Mitigation options for the tourism industry include improving energy efficiency, replacing fossil fuel with renewable energy sources, and carbon offsetting. Continuing improvements in transport fuel efficiency are expected and hydrogen-powered cars are being developed. In the medium term there are no practical alternatives to kerosene-based fuels for aircraft. The offsetting or sequestration of CO_2 as biomass (usually trees) is termed 'mitigation' because the growth of new forests will reduce the amount of atmospheric CO_2 (Kyoto Protocol, Article 3). Little is known about tourist awareness of the impacts of travel on climate change, or tourist willingness to mitigate their impact by, for example, sequestering carbon. Tourists may not see the link between tourism and climate change, although they may still be favourably disposed to planting trees for their benefits in relation to biodiversity, hydrology, and soil retention (5). This paper describes existing carbon offsetting schemes for tourists, and in particular a case study approach in New Zealand. Two models to fund such an approach are discussed: a voluntary mechanism for tourists to offset their emissions, and regulatory models that charge eco/emission taxes. It is beyond the scope of this paper to consider the role of tourist operators or emissions trading schemes.

CARBON OFFSETTING SCHEMES IN TOURISM

A small number of web-based carbon offsetting schemes tailored to various markets are now available (e.g. Climate Care, Climate Protection Partnership, Business Enterprises for Sustainable Travel, Future Forests, 500 ppm, Trees for Travellers, Emissions Biodiversity Exchange (EBEX21®)[1]). Most offer individual travellers the opportunity to work out their travel greenhouse gas emissions with an online calculator. Tourists can then invest either in energy-efficiency measures (e.g. low-energy light bulbs), energy renewal (e.g. hydro-turbines), or carbon

[1] Climate Care (www.climatecare.org.uk); Climate Protection Partnership (www.clipp.org); Business Enterprises for Sustainable Travel (www.sustainabletravel.org); Future Forests (www.futureforests.com); 500 ppm, http://travel.500ppm.com); Trees for Travellers (www.treesfortravellers.co.nz); Emissions Biodiversity Exchange (EBEX21) (www.ebex21.co.nz)

sequestration (e.g. by projects for restoring forests). Often these projects are in developing countries, in order to empower communities through commerce and tackle climate change at the same time. Climate Care also works with tour operators who include offsetting in their package. An approach in New Zealand being led by the Kaikoura District Council is providing tourists with the opportunity to plant a tree during their visit to Kaikoura. The tree is numbered, its exact location recorded, and it can be revisited by the tourist.

Concerns are sometimes raised about the effectiveness of tree planting in mitigating CO_2. Some of the difficulties are forest pests, diseases and fire, the difficulty of measuring carbon uptake (6), sinks being a short-term solution, insecurity of projects, and costs of administration. Moreover, in tree-planting schemes the initial rates of sequestration are low and, therefore, it can be some years before travel emissions are actually offset. EBEX21 takes a different approach and promotes the retirement of marginal (not suited for farming) hill farmland to promote natural regeneration of shrublands and native forests, a process that can deliver high initial sequestration rates. Hence, EBEX21 invests in carbon sequestration and the permanent restoration of native biodiversity (7). Tourists or organisations that want to offset their CO_2 emissions provide funding via EBEX21 to landowners for regeneration work. Natural regeneration will sequester carbon for 150–300 years depending on site selection, species range, fertility, rainfall, and nearby seed sources (8). Because New Zealand is also seeking to enhance its landscapes and biodiversity (which underpin its 100% Pure NZ brand), these new native forest sinks provide multiple environmental benefits, as well as potentially providing new economic opportunities for the more remote parts of New Zealand.

A NEW ZEALAND CASE-STUDY

METHOD

By using arrival figures for international tourists (9), and estimated energy use, CO_2 emissions from international air travel can be calculated. Average travel distances for one-way travel to New Zealand are available (10), as well as energy intensities for air travel (1.75 MJ per passenger-kilometre (11)) and CO_2 conversion factors (69 g CO_2 per MJ (12)). Energy use and emissions were calculated for tourists from the 36 countries that made up 94% of all international arrivals in 2002 (9). Results were linearly extrapolated to estimate CO_2 emissions for all arrivals. In addition, the energy use and CO_2 emissions associated with tourist activity *within* New Zealand were estimated. Only transport and accommodation behaviour were taken into account, as those two sectors contribute over 90% of the total (internal) energy use of an international tourist (13). We considered energy and emission rates for different tourist types, and weighted them according to their representation among all international tourists to New Zealand (14).

Having derived CO_2 emissions for international air travel, internal transport and accommodation, it was possible to estimate the emission costs and the native forest area required to offset these emissions. To this end, we used a cost of NZ$25 per tonne of CO_2 (4). The required area of land was derived by assuming a minimum carbon sequestration rate of 3 t CO_2 per hectare of land per annum. Calculations in this paper focused on CO_2 and did not include other greenhouse gases. The overall radiative forcing, however, is estimated to be 2.7 times higher than the mere effect of CO_2 as a result of other effects specific to aviation, such as the formation of ozone and contrails (2).

RESULTS

The analysis of 2002 arrival figures showed an energy use of 36.4 PJ and emissions of 2513 kt of CO_2 (Table 1). On average, an international tourist consumed 17 800 MJ of energy for their one-way flight, which resulted in 1.2 t of CO_2 and a CO_2 emission cost of NZ$30. The average area required to offset the one-way air travel emissions would be 0.4 ha per tourist.

Table 1: Arrival numbers (9), travel distances and energy use for one-way air travel to New Zealand (10 largest markets)

Country of origin	*Arrival number in 2002*	*Average travel distance **	*Energy use per tourist (MJ **)*	*Energy use per country (PJ)*	*CO_2 emissions per country (t)****
Australia	632 470	3 372	5 900	3.73	257 497
United Kingdom	236 986	19 955	34 922	8.28	571 042
USA	205 289	11 146	19 506	4.00	276 295
Japan	173 567	9 931	17 379	3.02	208 132
Korea, Republic of	109 936	10 684	18 697	2.06	141 830
China, PR	76 534	13 874	24 279	1.86	128 216
Germany	48 951	20 701	36 228	1.77	122 363
Canada	39 669	15 172	26 550	1.05	72 673
Taiwan	38 358	9 579	16 764	0.64	44 368
Singapore	34 019	8 514	14 899	0.51	34 974
Total (including other countries)	2 044 962	-	-	36.41	2 513 120

* Based on 1999 calculations (10); ** One-way energy use at an energy intensity of 1.75 MJ / passenger-km (11);
*** Carbon dioxide emissions with an emission factor of 69 g / MJ (12).

This analysis of energy use and CO_2 emissions resulting from international tourist transport and accommodation within New Zealand showed that tourism uses about 8 PJ of energy annually within New Zealand, resulting in 532 kt of CO_2 emissions (Table 2). Tourist types differed markedly, with camping tourists, for example, emitting about 0.44 t of CO_2 per person, compared with coach tourists emitting only 0.24 t of CO_2. An average international tourist (emitting 0.26 t of CO_2 within New Zealand) would have to pay NZ$7 for their CO_2 emissions and would require a native forest area of 0.09 ha to offset these emissions. In total, an average international tourist would pay NZ$37 to offset CO_2 emissions from their New Zealand holiday under the assumption of an equal share of international emissions between country of origin and destination.

Table 2: Energy use within New Zealand for transport and accommodation for different tourist types (data from 2001 International Visitor Survey (IVS) (14))

International tourists 2001	*Number of touring tourists*	*Energy use per tourist within NZ (MJ)*	*Total energy use (PJ)*	*CO_2 per tourist within NZ (t)*	*Total CO_2 (t)*
Coach tourist	429 159	3538	1.52	0.244	104 767
VFR	343 577	3649	1.25	0.252	86 506
Auto tourist	247 972	3440	0.85	0.237	58 859
Backpacker	131 419	3657	0.48	0.252	33 161
Camper	84 195	6306	0.53	0.435	36 634
Soft comfort	42 966	5035	0.22	0.347	14 927
TOTAL*	1 279 288	na	4.85	na	334 855
Extrapolated to 2002 arrivals	2 044 962		7.70		531 516

*Note: The IVS does not include all tourists and the above tourist types do not include 'gateway-only' tourists (21% of all international tourists). Energy use for attractions is also not included. Results from the IVS analysis were extrapolated to 2002 arrivals provided by Statistics New Zealand. These are minimum estimates for energy use and emissions only.

The total area required to offset all emissions from international tourism (including the one-way flight) to and within New Zealand would be 1 014 800 ha. With about one million hectares of marginal land potentially available for native forest regeneration in New Zealand (7), it is just possible to offset tourism's emissions and restore biodiversity at the same time. However, the radiative forcing of CO_2 is only about one-third of the total radiative effect of all climate-impacting aviation emissions, and if the total aviation effect was taken into account the land available for regenerating native forest sinks would not be enough.

FUNDING MODELS FOR OFFSETTING TOURIST EMISSIONS IN NEW ZEALAND

Voluntary schemes: Tourists can calculate their emissions according to country of origin and travel style (Tables 1 and 2), and then use EBEX21 or one of the other schemes to offset their emissions. Although there has been some interest by international tourists in EBEX21, few have offset their emissions. Educational campaigns about the benefits of carbon sequestration may persuade more tourists to offset their emissions. In-flight videos showing this kind of information en route to New Zealand could increase the awareness of the issue. However, a study carried out in the tourism information centre of Christchurch, New Zealand (A Reiser, Lincoln University pers. comm.)

showed no preference by tourists for eco-labelled operators' products compared with those of other operators. This suggests voluntary schemes might struggle without ongoing educational campaigns, marketing and government support. It is possible that tourists are more amenable to offsetting their emissions early in their decision making, for example when booking their flights. This would require the cooperation of travel agents, tour wholesalers and airlines. Further research is needed to answer these questions, and to learn how they might complement operator-led and regulatory approaches.

Regulatory schemes: There are two approaches whereby tourists could be levied or taxed for their emissions. A general 'ecotax' (15) imposed on entry to New Zealand would directly target international tourists but would probably attract negative reaction from the tourism industry, even though the ecotax would meet the aim of sustainability of the New Zealand Tourism Strategy 2010. A NZ$100 ecotax is already being mentioned by some politicians in New Zealand. About a third of this (totalling an estimated NZ$60 million) would be needed to carbon-offset the trip with co-benefits for restoring biodiversity. The remaining amount could go towards national park management and infrastructure improvements. Since the New Zealand Government aims to internalise carbon costs by introducing a carbon tax in 2007, tourists would automatically pay for their internal emissions (e.g. calculated to be a six cent increase in the price of petrol). The calculations in this paper indicate that the Government could raise at least NZ$13 million for climate change mitigation from international tourists' emissions within New Zealand. The Government could use these funds to purchase credits in schemes like EBEX21, thereby creating new tourist attractions in the form of native 'tourist forests'.

CONCLUSION

Non-harvested native forest sinks are an important part of the New Zealand carbon cycle and could be increased in area to buy time for tourism to come up with more effective energy use, allowing the New Zealand tourism industry to become carbon neutral. We suggest that New Zealand (and maybe some other countries) can capture benefits from offsetting CO_2 emissions by restoring biodiversity, and potentially creating additional tourist attractions around restored native forest areas, thus effectively underpinning its 100% Pure NZ brand.

However, as has happened with ecolabels in tourism (16), the proliferation of a diversity of worldwide voluntary schemes may confuse tourists such that they prefer to ignore them. Voluntary schemes that stress multiple benefits (i.e. carbon sequestration and restoring forest ecosystems) may find favour and acceptance from tourists. For New Zealand, a regulatory model is likely to be more effective, especially given that a carbon tax is already planned. Another option is to impose a general ecotax on entry to New Zealand, or some combination of both an entry ecotax and an internal carbon tax. The ecotax may cause some negative reaction and strong resistance amongst tourists and tourism stakeholders since their awareness of climate change issues remains poor (17). A strong education campaign will be needed in any case.

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