

This item was submitted to Loughborough's Institutional Repository (<https://dspace.lboro.ac.uk/>) by the author and is made available under the following Creative Commons Licence conditions.



**CC creative commons**  
COMMONS DEED

**Attribution-NonCommercial-NoDerivs 2.5**

**You are free:**

- to copy, distribute, display, and perform the work

**Under the following conditions:**

**BY:** **Attribution.** You must attribute the work in the manner specified by the author or licensor.

**Noncommercial.** You may not use this work for commercial purposes.

**No Derivative Works.** You may not alter, transform, or build upon this work.

- For any reuse or distribution, you must make clear to others the license terms of this work.
- Any of these conditions can be waived if you get permission from the copyright holder.

**Your fair use and other rights are in no way affected by the above.**

This is a human-readable summary of the [Legal Code \(the full license\)](#).

[Disclaimer](#) 

For the full text of this licence, please go to:  
<http://creativecommons.org/licenses/by-nc-nd/2.5/>

## Climate change accounting research: Keeping it interesting and different

Markus J. Milne  
College of Business and Economics  
University of Canterbury  
Christchurch  
New Zealand  
[markus.milne@canterbury.ac.nz](mailto:markus.milne@canterbury.ac.nz)

and

Suzana Grubnic  
Nottingham University Business School  
University of Nottingham  
Jubilee Campus  
Wollaton Road  
Nottingham  
United Kingdom  
[suzana.grubnic@nottingham.ac.uk](mailto:suzana.grubnic@nottingham.ac.uk)

### **Acknowledgements**

First and foremost we would like to thank Emily Hewitt for invaluable editorial assistance in bringing this special issue together. We also acknowledge the help and involvement of Professor Amanda Ball, University of Canterbury, for early shaping of the project, and the co-organisation of the Eighth Australasian Conference on Social and Environmental Accounting Research (CSEAR) held in Christchurch, New Zealand, which encouraged submission of a broad scope of papers tied to 'GHG measurement, management and sense-making'. Some of this paper also draws from discussions with Dr. Ian Mason, Department of Environmental and Energy Engineering, University of Canterbury, New Zealand. The authors are also indebted to the large number of authors who made submissions to this AAAJ special issue as well as an even greater number of colleagues who reviewed those submissions. We also thank two anonymous referees and AAAJ's Editors James Guthrie and Lee Parker for help and assistance on this paper. Finally, and not least, we thank the long suffering authors, editors and publishers who have shown remarkable understanding and patience during a rather traumatic 12 months due to the Canterbury Earthquakes. All errors remain the responsibility of the authors.

## **Abstract**

**Purpose** - This paper aims to set out several of the key issues and areas of the inter-disciplinary field of climate change research based in accounting and accountability, and to introduce the papers that compose this AAAJ special issue.

**Design/methodology/approach** – The paper provides an overview of issues in the science of climate, as well as an eclectic collection of independent and inter-disciplinary contributions to accounting for climate change. Through additional accounting analysis, and a shadow carbon account, it also illustrates how organisations and nations account for and communicate their Greenhouse Gas (GHG) footprints and emissions behaviour.

**Findings** – The research shows that accounting for carbon and other GHG emissions is immensely challenging because of uncertainties in estimation methods. The research also shows the enormity of the challenge associated with reducing those emissions in the near future.

**Research limitations/implications** – The research raises a series of implications for individuals, organisations, sectors and nations in coming to terms with ever increasing carbon and other GHG emissions. It raises questions about the adequacy of current policy formulations to curb such emissions.

**Originality/value** – The paper surveys past work on a wide variety of perspectives associated with climate change science, politics, policy, as well as organisational and national emissions and accounting behaviour. It provides an overview of challenges in the area, and seeks to set an agenda for future research that remains interesting and different.

**Keywords** Climate Change Accounting, Greenhouse Gas Emissions, Carbon Accounting, Sustainability, National GHG Inventory

**Paper type** General review

## 1. Introduction

When we put out the call for papers for this special issue back in 2008, things were certainly heating up. Literally in the case of the atmosphere, according to decades of scientific evidence (IPCC, 2007; Anderegg *et al.*, 2010), but also in terms of public perceptions, fanned by a series of popular books (e.g., Lynas, 2004; Flannery, 2005; Monbiot, 2006; Pearce, 2006; Hamilton, 2007), and media attention.<sup>1</sup> The Intergovernmental Panel on Climate Change (IPCC), Al Gore and Nicholas Stern also ensured lively debate in the world's political arenas (Gore, 2006; Stern, 2006; IPCC, 2007). Kevin Rudd had recently been to the Bali climate talks (Dec 2007) having signed Australia up to Kyoto, and there was building optimism that the 15<sup>th</sup> Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 15) in Copenhagen in late 2009 would finally see the world's politicians take climate change seriously and hammer out a new and significant post Kyoto 2012 agreement. The optimism was further fuelled by Barak Obama's election as US president in late 2008. As we know, that is history. Copenhagen came and went, and Cancun in December 2010 (COP 16) hardly made the news. Politically at least, things have cooled, more pressing needs such as economic recessions, bank failures, and potential EU member state failures have taken precedence, and we appear to be no closer to a new binding international agreement.<sup>2</sup>

Despite the fickle attention of politicians, however, the scientific evidence continues to amass. Although not all agree (see Morgan and McCrystal, 2009), 97-98% of the scientific community appears to accept the primary conclusions of the IPCC that it is "very likely" that "most" of the "unequivocal" warming of the Earth's average temperature over the second half of the 20<sup>th</sup> century is due to anthropogenic greenhouse gas (GHG) emissions (Anderegg *et al.*, 2010; see also Oreskes, 2004). Anderegg *et al.* reached this conclusion based on a review of 1372 climate researchers and their publication and citation records. Agreement on this aspect of the debate, however, is only part of the issue. Other aspects concern the history of climate constructed from paleoclimate records (i.e., polar ice cores, ancient lake beds) and, more pertinently, future climate scenarios using climate modelling. For example, to what level should concentrations of atmospheric carbon dioxide levels be stabilised and by when? 350ppm? 450ppm? 550ppm? By 2020? 2040? 2050? Much less scientific consensus exists in regard to these matters (Morgan and McCrystal, 2009); likewise with respect to the effects of melting ice caps, ocean circulation, tundra and deep sea methane releases, radiative forcings, clouds and water vapour, albedo feedbacks, and shorter term climatic variation such as El Nino and La Nina events.<sup>3</sup>

Add to these scientific uncertainties the uncertainties of assessment and measurement methodologies, and the vested interests of oil, coal, industrial, agricultural, environmental and political lobbyists, and one is faced with a plethora of arguments about the adequacy or otherwise of domestic and international policies to promote reductions in human-induced GHG emissions. Are alternatives needed and how drastic do they need to be? (See, for example, Meyer, 2000; Bodansky and Pew, 2004; Blok *et al.*, 2005; Boston, 2007; Hamilton, 2007; Jordan and Lorenzi, 2007; Prins and Rayner, 2007; Anderson and Bows, 2008; Stern, 2010.) The problem has been described, aptly we suggest, as 'wicked' or 'super-wicked' (Lazarus, 2008; Ludwig, 2001) and consequently without solution or perhaps in need of a 'clumsy' one (Verweij *et al.*, 2006). International policy proposals to avert 'run away' or 'dangerous' climate change include suggested targets for stabilising atmospheric GHG concentration. These include possible emission cuts of 80-90% by 2050 with significant cuts required immediately or very soon (e.g., Meyer, 2000; IPCC, 2007; Anderson *et al.*, 2008; Agnolucci *et al.*, 2008; Stern, 2008; 2010). Most countries are currently committed to only very modest reductions in GHG emissions under the Kyoto protocol.

In the following sections of this paper we firstly articulate the importance within social and environmental accounting research of inter-disciplinary perspectives. The next two sections then move on to illustrate the importance of keeping a wider preview on matters associated with climate change and emissions behaviour. With data from an organisation (Air New Zealand), examining aviation in New Zealand's tourism sector, as well as New Zealand's national GHG inventories, we illustrate the uncertainties, complexities and challenges involved in accounting for carbon dioxide and other GHGs. We also raise questions about the efficacy of offsetting and the possibilities for timely emission reduction. Our aim is to make clear that emissions come from individual as well as organisational activity, and we should not necessarily seek to reduce all climate change based accounting research to analyses of corporate carbon footprints and reporting, and if we do, there are interesting and different ways in which we might tackle those. Keeping with a theme of interesting and different, the penultimate section of our paper introduces eleven contributions to this special issue – seven of which appear in this volume and four of which continue in 2012. These papers provide an eclectic collection of viewpoints on climate change accounting research, with contributions from human geographers, political and policy scientists, organisational scholars, as well as accounting and auditing scholars. Finally, in the conclusion we return to our earlier examples to question the adequacy of existing climate change policy.

## **2. Interesting and Different**

Caught up in climate change debates are the inevitable clashes of discourse (Dryzek, 1997; Hajer, 1995; Herndl and Brown, 1996) through which we express understanding, differences, values, beliefs, desires and fears about climate change, the future and the adequacy or otherwise of policy attempts and other behaviours to address them. Emphasising differences in power/legitimacy, knowledge and emotions, Herndl and Brown (1996) offer a typology of environmental discourse that includes: (1) the regulatory/institutional, (2) the scientific/technical, and (3) the poetic/emotive. Likewise, Hannigan (2006) recognises the discourses of: (1) the poetic/romantic and (2) systems/science, and to these he adds (3) justice/rights. We suggest all these elements of discourse are likely to inform our understanding of climate change based accounting research. Many of them come through a number of the papers included in this special issue. Other work, too, drawing on these discourses has sought to offer technical, accounting, and ethical critique of carbon trading (e.g., Lohmann, 2005, 2006, 2009a, 2009b; Smith, 2007; Newell, 2008; Knox-Heyes, 2009a, 2009b), carbon offsetting (Bäckstrand and Löfbrand, 2006; Bumpus and Liverman, 2008; Smith and Rodger, 2009), and emerging codes of conduct and voluntary standards (Lovell *et al.*, 2009).

The social and environmental and critical accounting research communities are known to embrace methodological pluralism and inter-disciplinary perspectives on accounting. By avoiding the trivial and the overly technical, and by drawing on a wide range of the social sciences to provide context to their work, scholars remain focused on socially relevant problems and issues to which accounting contributes or potentially could alleviate. A pertinent and early example for this issue concerns the papers on accounting for sulphur dioxide emissions. While Wambsganss and Sanford (1996) offer a narrow technical accounting solution to the reporting of sulphur dioxide emissions permits, Milne (1996), Lehman (1996) and Gibson (1996) examine the issue in a wider inter-disciplinary context. Drawing on economics, ethics, political philosophy, law, health, and environmental studies, they more critically examine the wider social and environmental problem of acid rain, its regulation, the use of tradable emission permits, equity and justice when doing so, and broader concerns of human/nature relationships. Arguably it is work in this vein that O'Dwyer (2011) had in mind in his tribute to David Owen as marking out the tradition of social and environmental accounting research as "interesting and different." It is certainly the type of approach we seek to reflect in this AAAJ special issue, and encourage in the future. For this reason, the first three papers in this issue were commissioned from

scholars in human geography, political and policy science, and organisational behaviour. Along with other colleagues in these fields, they contribute in various ways to our understanding of climate change policy, government, organisational and individual behaviour, as well as the implications of these for accounting and vice versa. We hope these papers stimulate readers to seek out further work from these relevant fields of study.

While early research located within organisational studies noted active political resistance and climate change denial (e.g., Kolk and Levy, 2001; Levy and Egan, 2003; Livesey, 2002), businesses are now engaging in various programmes, with measures, targets and market trading (e.g., Kolk and Pinkse, 2004, 2005; Begg *et al.*, 2005; Hoffman, 2006; Pinkse and Kolk, 2009), spawning business interest in strategy, opportunities and “how-to” guides (e.g., *Harvard Business Review* special issue, 2007; Hoffman, 2006, 2007; Hoffman and Woody, 2008). Similarly, there is increased interest in carbon accounting, GHG inventories (carbon footprinting), the GHG protocol, the assurance of GHG inventories, as well as carbon offsetting, with a number of organisations in recent years proclaiming gained efficiencies in their carbon management strategies, and/or their ‘carbon neutrality’ (e.g., WBCSD/WRI, 2004; Hoffman, 2007; EM/NCF, 2008; Bebbington and Larrinaga-González, 2008; Kolk *et al.*, 2008; IAASB, 2009; Simnett *et al.*, 2009). A number of the papers in this special issue continue research on these themes.

On a more sobering note, much work remains to be done that tackles the actual dynamics of organisational emissions reduction programmes (Ball *et al.*, 2009) and the key motives that drive or inhibit action (Okereke, 2007). Similarly, considerably more work is required that critically scrutinises the obvious tensions and paradoxical motives between organisational and national desires to reduce ecological impacts and desires to grow and succeed economically. Despite the growing tide of corporate activity on climate change no meaningful progress is being made on global GHG emissions reduction, and in some instances, no meaningful progress is being made on national Kyoto emission reduction targets, suggesting the continuation of relatively weak policy regimes and ‘business-as-usual’ (Jones and Levy, 2007). In the following section we examine GHG emissions in transport and more widely in New Zealand’s tourism sector. We then consider New Zealand’s national GHG emission reductions behaviours. We hope they raise questions, provoke thought and lead others to engage in further critical analysis of climate change issues.

### **3. Scale, Eco-efficiency and the Un-sustainability of Climate Change: Can We Keep Driving and Flying (more)?**

In 2008, *Time Magazine* marked 100 years of the Model T Ford.<sup>4</sup> In 1908, the Model T could do 11-18 lit/100km, and 194,400 motor vehicles were registered in the US. By 2006, US registered vehicles numbered 135.4 million – a factor increase of 696, although it might be as high 1200.<sup>5</sup> Modern vehicles can do about 4-6 lit/100km, but some do more, and the EU now obligates fuel efficiency for new vehicles to 130g/km on average by 2015 (equivalent to less than 5 lit/100km). At best, then, a factor increase in fuel efficiency of 6 has been utterly swamped 100-200 times by vehicle volumes. The effects of scale matter! While population growth accounts for some of the 600-1200 factor increase, it does not account for much. In 1908, the US population stood at 88.7 million. By 2010 it stood a little under 4 times bigger at 308.7 million. The critical factor in rising numbers is the rising expectations, income and affluence of the population (Dargay *et al.*, 2007; Hamilton and Denniss, 2005). In 1908, less than one fifth of 1% of people in the US owned a vehicle. By 2010, on average, 81% do (Dargay *et al.*, 2007).

So what of the next 100 years? Will population and increasing affluence continue to drive vehicle ownership faster than vehicle efficiencies and, thereby, increase global emissions of CO<sub>2</sub>? In some

countries almost certainly, but overall perhaps not, since vehicle ownership rates do reach saturation levels eventually. Dargay *et al.* (2007) estimate these for various countries at between 65% and 85%, and go on to project increases in vehicle ownership out to 2030. While the US is expected to add 80 million vehicle owners over 30 years (+34%) and OECD countries 290 million (+47%), the non-OECD countries increase by a factor of 6, adding another 977 million to create a projected world total of 2080 million by 2030 – a total factor increase of 2.5. Overall, factor increases in fuel efficiency over the next 20 years may be able to keep pace with some growth rates, but bringing down global CO<sub>2</sub> emissions from vehicles any time soon seems unlikely since both China and India are expected to add 500 million vehicle owners at factor rates closer to 20.<sup>6</sup>

As with cars, so for planes. Airbus, the European aircraft manufacturer, forecasts global air passenger growth rates over the next 20 years (2010-2029) at 4.8% *per annum*, with greater growth expected in emerging economies (Airbus, 2010). To meet a tripling of capacity, it anticipates an additional 25,000 aircraft between 2010 and 2029. Between 1970 and 2010 capacity grew by a factor of 9 – significant fuel shocks and economic recessions seem only to dent demand temporarily. While fuel burn efficiency and aircraft loading rates have improved (e.g., +37% gain over last 20 years in fuel burn and +50% in loading rates over the last 45 years), they have not kept up with capacity increases and nor are they anticipated to. Claims made by Airbus on their website that over the last 40 years the aviation industry has cut fuel burn and CO<sub>2</sub> emissions by 70% seem disingenuous – they have *per flight*, but increased volume (9 times greater) simply outstrips it. Fuel burn efficiency improvements will continue (40% expected by 2030 reducing fuel burn to less than 3lit/100km/passenger)<sup>7</sup>, but they will not keep pace with a tripling of capacity. The great white hope for aviation appears to be a switch to biofuels, but there are both technical difficulties, as well as (in)justice issues over land competition for food production that seem likely to prevent any quick fix.

The aviation industry is under some pressure to establish its environmental credentials. A review of Air New Zealand's website and recent annual reports (2007-2010), for example, reveal references to increases in efficiency through fleet upgrades, flight testing jatropha (biofuel), savings of carbon emissions through plane modifications, reductions in CO<sub>2</sub> emissions *per million available seat kilometres*, the establishment of the Air New Zealand Environmental Trust, and a Carbon Offsets Programme - where passengers can elect to purchase flight offsets. Reflecting the global economic recession, the 2009 and 2010 annual reports say less about environmental impacts – indeed, the 2010 report stresses a readiness to “return to growth”. In 2007 and 2008, however, during the recent height in attention about climate change, the organisation was keen to promote it was “travelling lighter” for a “greener future for New Zealand tourism”. But such proclamations appear conditional. For example, Air New Zealand (2007, p.2) states:

Carbon emissions are an inevitable consequence of air transportation and will continue to remain so, despite technological advancements, for the foreseeable future. However, as a small, geographically isolated country, air transport is vital in providing economic links to international markets.

As New Zealand's national carrier, we are absolutely committed to playing our part in ensuring that our environmental impact is minimised. We must continue to bring tourists to New Zealand, and remain committed to managing the environmental impact we have in the process.

Unpacking such claims is critically important (Milne *et al.*, 2009; Gray, 2010), yet assessing the extent to which “environmental impact is minimised” on the basis of total carbon emissions is difficult. Absent from the reports is any clear and transparent account or statement of the organisation's carbon footprint over time. The 2007 report *does* disclose a total footprint of around 3.6 million tonnes of CO<sub>2</sub>e (MtCO<sub>2</sub>e) in 2006, and that 92% of that was contributed by jet fuel. Further reference to total emissions

in other time periods is absent. Based on emissions charts (per passenger per km) and gleaning information from the reports we estimate the organisation has made *efficiency* gains of 10-15% between 1995 and 2010. But have these also been outstripped by capacity increases? Using fuel purchase disclosures over time and publicly available jet fuel emission factors (Mfe, 2008), we construct a shadow carbon footprint shown in Table 1.<sup>8</sup>

Table 1: Air New Zealand Fuel Consumption, Carbon Footprint and Financial Indicators (1995-2009)<sup>9</sup>

	1995	1996	1997	1998	1999	...	2005	2006	2007	2008	2009	% change
Fuel (M barrel)	6.5	7.5	7.7	7.7	7.6	...	8.1	8.3	8.4	9.0	8.1	24.6
CO2e (Mt)	2.85	3.27	3.37	3.37	3.35	...	3.55	3.64	3.68	3.94	3.55	24.6
Passenger Revenue (NZ\$ Billion)							2.91	3.10	3.49	3.81	3.73	
Profit b/f Tax (NZ\$ Million)							212	148	290	359	78	
Net Profit (NZ\$ Million)							180	96	221	218	21	
Carbon Cost based on NZ\$100/t (NZ\$ Million)							355	364	368	394	355	
Carbon Cost as a % of Passenger Revenue (@NZ\$100/tonne)							12.2	11.7	10.5	10.3	9.5	

The simple percentage growth (1995-2009) of 24.6% for fuel burn and CO2e exceeds the 10-15% efficiency gains, and illustrates an *increasing* impact on the atmosphere. This rate of growth is consistent with other New Zealand organisations (Milne, 2007) and overall CO2e emissions growth in New Zealand since 1990 of 20% or more (see next section). In 2008, Air New Zealand's carbon footprint approached a new high of 3.94MtCo2e – the reduction in 2009 (and most likely in 2010) we believe is temporary and reflects economic recession impacts on demand, not recent technological improvements or the start of a declining trend. On the contrary, we anticipate a return to 2008 levels and higher.

Should Air New Zealand have to face the full cost of a carbon tax on jet fuel or purchase carbon credits on its entire emissions, they could be significant.<sup>10</sup> At a carbon price of NZ\$20-100/tonne, and an annual cost of NZ\$70-NZ\$400m, the financial viability of the organisation would be in doubt. Depending on price, such costs could eliminate its entire annual profits should it have to absorb them. Of course, it is passengers that will face these costs, and that seems potentially far less impactful. At NZ\$100/tonne, Table 1 shows an impact on current passenger revenue levels at around 10%, although at current carbon prices (NZ\$20/tonne) it would be closer to 2-3%.<sup>11</sup> Whether a 10% penalty charge would dampen demand and curb growth in aviation emissions is debatable. Rising incomes and easy lines of credit, we suspect, will accommodate such costs. We are not hopeful that existing GHG emission regimes will rein in long-term demand for air travel soon.

The prospect of *physically* offsetting aviation emissions by emissions reductions elsewhere through fuel switching or investment in substitute renewable energy projects, or by increasing levels of carbon sequestration from regenerating native forest projects or tree planting, also seems remote (Milne, 2007; Smith and Rodger, 2009). A critical aspect of Smith and Rodger's (2009) analysis, so often overlooked in carbon offsetting, and especially in regard to tree planting and forest regeneration, is recognition of the importance of *timing differences in emissions and sequestration*. A long haul flight emits CO2e in hours, yet to offset those emissions in hours is both cost prohibitive and in most cases physically impossible. And while some individuals can afford to physically balance their carbon books each year, most could not and few likely do. What is more important, however, is that everybody cannot offset emissions (Milne, 2007; Smith and Rodger, 2009). Scaling up the *matching* of New Zealand's total aviation emissions with offset options within New Zealand looks infeasible.



Based on 2005 tourist visitor numbers to New Zealand (approx 2.4 million), and estimating for return flights and applying a radiative forcings factor of 1.9 (Sausen *et al.*, 2005), Smith and Rodger (2009) estimate annual gross emissions at 7.89MtCO<sub>2e</sub>. They observe with forecasts of 3.5 million visitors in 2015 these can only grow (>12MtCO<sub>2e</sub>). To offset the 2005 emissions, they investigate *inter alia* energy efficient light bulb replacement (240million@\$578/visitor), wind farms switching for thermal generation (4250 turbines @\$4840/visitor), domestic transport reduction (-63%), and setting aside regenerating native forest (@3tCo<sub>2e</sub>/hectare/yr this requires 27,000 hectares – 10% of New Zealand’s land mass – and a likely 30% increase in forestry and reduction of 50% in agricultural pasture). Their conclusion is stark: New Zealand cannot now adopt feasible mechanisms to offset these emissions in New Zealand. It seems the only solution apart from actually reducing the emissions is to export the problem elsewhere, but can we keep doing that? And can everybody keep doing that? To get some idea of the problem at yet another scale, we now turn to New Zealand’s National GHG accounts.

#### 4. National GHG Accounting<sup>12</sup>

Depending upon the country concerned, and the composition of its national GHG inventory or profile, a raft of interesting issues arise in terms of accounting, auditing and assurance. And in some cases such issues can really stretch the imagination in terms of conventional accounting and auditing technologies. New Zealand, with its unusual combination of agriculture, tourism, forestry and low but sparsely populated regions, provides an interesting case illustration. Nearly half of New Zealand’s GHG emissions come from agriculture, and substantial forests are considered available to offset emissions. As with many Kyoto signatories, New Zealand is committed and potentially liable for GHG emissions during the first commitment period (referred to as CP1) 2008-2012. In New Zealand’s case it is committed to holding its annual total net emissions during this period to 1990 levels – in other words a zero net increase. In anticipation of settlement in 2015, and for some years now, the Government has been estimating the potential liability or asset and carrying the provision in its National Accounts. To do this it needs to determine estimates of carbon prices, currency exchange rates, and the quantum of physical emissions and potential sequestration from Kyoto compliant sinks like forestry plantations. Table 2 shows the summary results of these estimates in recent periods.

Table 2: Projections of New Zealand’s Kyoto Liability (Asset) for five-year period 2008-2012

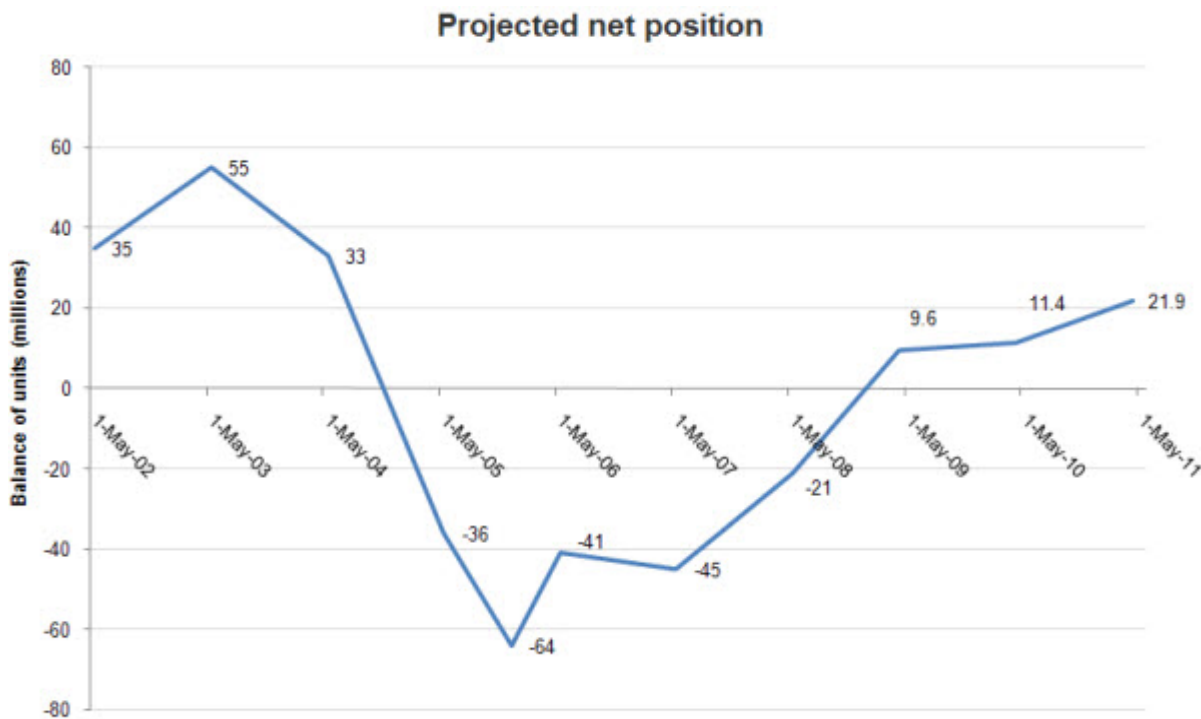
Financial Statements	Quantum Deficit/(Surplus)	Carbon Price	NZ\$ Exchange Rate	Carbon Price (\$NZ)	Net Liability/(Asset) (NZ\$ mill)
June 2005	36.2 MtCO <sub>2e</sub>	US\$ 6.00	0.7010	8.56	310
Dec 2005	64.0 MtCO <sub>2e</sub>	US\$ 6.00	0.6837	8.78	562
June 2006	41.2 MtCO <sub>2e</sub>	US\$ 9.65	0.6063	15.92	656
Dec 2006	41.2 MtCO <sub>2e</sub>	US\$ 9.65	0.7056	13.68	563
June 2007	45.5 MtCO <sub>2e</sub>	US\$ 11.90	0.7689	15.48	704
Dec 2007	45.5 MtCO <sub>2e</sub>	€ 11.13	0.5263	21.15	962
June 2008	21.7 MtCO <sub>2e</sub>	€ 12.50	0.4829	25.89	562
Dec 2008	21.7 MtCO <sub>2e</sub>	€ 10.00	0.4089	24.46	531
June 2009	(9.6) MtCO <sub>2e</sub>	€ 10.00	0.4628	21.61	(207)
Dec 2009	(9.6) MtCO <sub>2e</sub>	€ 10.75	0.5054	21.27	(194)
June 2010	(11.4) MtCO <sub>2e</sub>	€ 10.75	0.5677	18.94	(212)
Dec 2010	(11.4) MtCO <sub>2e</sub>	€ 10.75	0.5801	18.53	(207)
May 2011	(21.9) MtCO <sub>2e</sub>	€ 10.95	0.5737	19.09	(417)

Source: <http://www.mfe.govt.nz/issues/climate/greenhouse-gas-emissions/net-position/history.html>

As Table 2 shows, the potential liability estimate (or asset/surplus – since if the net emissions are lower than Kyoto determined, the Government could sell its surplus emission units) has been highly variable over the years, and this has provided much ammunition for political sniping. When the estimated deficit grew to NZ\$562m then to NZ\$962m then back to NZ\$562m and then to a *surplus* of NZ\$207m, many were understandably confused, especially since the estimates refer to the same emissions period 2008-2012. “Ropy accounting” was how Federated Farmers termed it.<sup>13</sup> The current Minister of Climate Change Issues, Nick Smith, was more sanguine noting the difficulties involved: “The big changes have been in forestry and agriculture .... These significant variations in agricultural and forest data are a cautionary message about the uncertainty and challenges of carbon accounting in respect of natural systems.”<sup>14</sup>

So what’s going on? Why are estimates of New Zealand’s Kyoto GHG emissions liability/asset so variable and what is the difficulty with forestry and agriculture? The simple answer lies in the fact that all forecasting is difficult, and the further into the future one forecasts the less accurate it is. Table 2, however, indicates that the big swings in the liability provision are not primarily the result of large swings in the price of carbon or the exchange rate, but rather to do with large fluctuations in the net physical quantum of emissions. Prices and exchange rates are current at the time of the estimates and not projections of those that will reign in 2015 when settlement day comes. The quantum of emissions over and above (or below) New Zealand’s 1990 emission levels, however, are projections of what will happen between 2008 and 2012 or, as time elapses, estimates of what did happen between 2008 and 2012.<sup>15</sup> The movement of estimates of the total physical quantum of net emissions is shown in Figure 1. These have moved from Kyoto surpluses of 35, 55, and 33 MtCO<sub>2</sub>e (2002, 2003 and 2004 projections) to overshoots of 36, 64, 41 and 21 MtCO<sub>2</sub>e (2005, 2006, 2007, 2008 projections) and most recently back to surpluses of 10, 11 and 22 MtCO<sub>2</sub>e (2009, 2010, 2011 projections).

Figure 1: Estimates of New Zealand’s surplus/deficit net emissions for Kyoto CP1 2008-2012



Source: <http://www.mfe.govt.nz/issues/climate/greenhouse-gas-emissions/net-position/history.html>

New Zealand's Ministry for the Environment (Mfe) has responsibility for estimating and projecting the balance of Kyoto Protocol units (net position) during CP1 and annually releases a net position report along with detailed appendices. To compile this report it draws on data from the Ministries for Economic Development, Environment, and Agriculture and Forestry. Table 3 provides a breakdown of the net position estimates and projections made over the recent past (since 2006) for the five-year period 2008-2012. It provides reconciliation with the quantum data shown in Table 2 and Figure 1.

Table 3: A History of New Zealand's GHG Net Position Estimates for Kyoto CP1 2008-2012 (Mt CO<sub>2</sub>e)

	May 2011	May 2010	May 2009	May 2008	May 2007	May 2006
<b>Assigned Amount Units (1990 level over 5 years)</b>	<b>309.6</b>	<b>309.6</b>	<b>309.6</b>	<b>309.6</b>	<b>309.5</b>	<b>307.6</b>
Projected Emissions						
Stationary Energy	91.1	96.6	93.0	92.4	92.8	91.3
Transport	70.5	67.8	71.9	71.3	80.1	78.8
Industrial Processes	22.0	20.6	20.7	22.0	22.2	22.9
<b>Total Energy and Industrial Processes</b>	<b>183.6</b>	<b>185.0</b>	<b>185.6</b>	<b>185.6</b>	<b>195.1</b>	<b>193.0</b>
<b>Agriculture</b>	<b>170.1</b>	<b>177.6</b>	<b>184.0</b>	<b>198.5</b>	<b>203.1</b>	<b>198.8</b>
Waste	9.9	8.2	8.3	7.2	7.0	6.5
Solvents	0.1	0.2	0.2	0.2	0.3	0.3
<b>Total Gross Emissions</b>	<b>363.7</b>	<b>370.9</b>	<b>378.2</b>	<b>391.5</b>	<b>405.4</b>	<b>398.5</b>
Projected Removals						
Removals from post 1989 planted forests	89.3	89.1	92.3	84.1	79.0	78.2
Less emissions from deforestation	-6.6	-9.2	-7.3	-16.9	-41.0	-38.5
<b>Net Forest Removals</b>	<b>82.8</b>	<b>79.9</b>	<b>85.0</b>	<b>67.2</b>	<b>38.0</b>	<b>39.7</b>
Net Emissions (Gross Emissions less removals)	280.7	291.0	293.2	324.3	367.4	358.8
Other Adjustments	-7.0	-7.2	-6.8	-7.0	+12.5	+10.0
<b>Net Position (AAUs minus net emissions +/- adj)</b>	<b>21.9</b>	<b>11.4</b>	<b>9.6</b>	<b>-21.7</b>	<b>-45.5</b>	<b>-41.2</b>

Source: <http://www.mfe.govt.nz/issues/climate/greenhouse-gas-emissions/net-position/index.html>

It is in Table 3 that we begin to get an understanding of what is going on at a national level in terms of GHG emissions and forestry sinks, remembering that each column represents estimates for the same five year period 2008-2012. The Assigned Amount Units of 309.6 MtCO<sub>2</sub>e relate to five years of the 1990 annual GHG gross emissions of 61.9 MtCO<sub>2</sub>e. From Table 3 we can see total *gross emissions* during CP1 are currently projected to be 363.7 MtCO<sub>2</sub>e, and revised down from the 2007 high projection of 405.4MtCO<sub>2</sub>e. The key variations in these projections are agriculture and transport, with most other emission source projections remaining fairly constant. The 2011 gross emission estimates equate to average annual gross emissions of 73 MtCO<sub>2</sub>e over the period 2008 through 2012 (i.e. 20% above 1990 levels of 61.9 MtCo<sub>2</sub>e), while the 2007 projection suggested average annual gross emissions of 81 MtCO<sub>2</sub>e over the period 2008-2012 (i.e. 30% above 1990 levels). This downward revision of forecasts for CP1 reflects the fact that New Zealand's annual GHG gross emissions have very recently started to trend downwards, and this can be seen in Table 4 by drawing from data in the annual GHG Inventory reports.<sup>16</sup>

Table 4: New Zealand's Annual Gross GHG Emissions (MtCO<sub>2</sub>e) 2005-2009 and 1990 benchmark

	2009	2008	2007	2006	2005	1990 <sup>17</sup>
Stationary Energy	17.7	19.6	17.9	19.7	19.5	14.8
Transport	13.8	14.3	14.9	14.4	14.2	8.8
Industrial Processes	4.3	4.3	4.6	4.2	4.3	3.4
Agriculture	32.8	34.8	36.4	37.7	37.4	32.5
Waste	2.0	1.7	1.8	1.9	1.8	2.4
<b>Total Gross Annual GHG Emissions</b>	<b>70.6</b>	<b>74.7</b>	<b>75.6</b>	<b>77.9</b>	<b>77.2</b>	<b>61.9</b>

Source: Compiled by authors

New Zealand's annual GHG emission history since 1990 has been rather poor, and in every year since 1990 it has exceeded those levels. Indeed, until only very recently have year-on-year emissions growth been curtailed. The high point in 2006 being 16 MtCO<sub>2</sub>e (26%) greater than 1990 levels. The 2009 gross emission levels currently exceed 1990 levels by 11.5 MtCO<sub>2</sub>e (20%).<sup>18</sup> In short, then, New Zealand's annual *gross* emissions were exceeding its 1990 levels by over a quarter in 2006: they now do so by a fifth. So what explains the recent decline in gross emissions? Has the upward trend really ended? Will the decline continue? To understand that one needs to unpack the changes in Table 4.

As can be seen, the biggest contributors to gross emissions are agriculture, stationary energy and transport, and declines in agriculture and transport, with stationary energy oscillating somewhat, are the primary changes. Agricultural emissions are primarily associated with methane and ruminant animals, and nitrous oxide and fertilisers. Transport is mostly CO<sub>2</sub> and road-based. And stationary energy is primarily electricity generation and other forms of static energy combustion producing CO<sub>2</sub>. Agriculture – and hence methane and nitrous oxide emissions - account for approximately 50% of New Zealand's GHG emissions. Not surprisingly, then, more of the variations in Table 4 are associated with external and natural factors than human-based policy directives or actions. The recent declines in agricultural emissions, for example, are traced to drought conditions, lower stock numbers and less fertiliser application. The decline in transport emissions is primarily traced to the global recession and recent higher fuel prices. Stationary energy emissions reduced in 2007 due to switching power generation from coal to gas, but they increased again in 2008 due to the drought and low lake levels necessitating less hydro generation and more coal-fired electricity generation.<sup>19</sup> High lake levels in 2009 reversed this. Overall, then, the recent and very modest reductions in gross emissions have more to do with the vagaries of the seasonal climate and global economic conditions than any significant changes in policy-induced behaviours. And, indeed, examining a more detailed year by year breakdown of the 2011 net position statement (see Mfe, 2011) reveals forecasts for 2010, 2011 and 2012 in which transport and stationary energy largely flat line, and agriculture rebounds and increases emissions to greater than 35 MtCO<sub>2</sub>e p.a.

Were it not for the fact that New Zealand gets to set against its gross emissions net removals from post 1989 forestry plantings under the Kyoto agreement, it would be in some strife (a liability of greater than NZ\$1 billion for CP1). Shown in Table 3 these net removals are currently (2011) projected at 82.8 MtCO<sub>2</sub>e, turning the overshoot from gross emissions into a positive surplus projection (less adjustments) of 21.9 MtCO<sub>2</sub>e. Previous projections of net forestry removals were not nearly so optimistic at approximately 40 MtCO<sub>2</sub>e, suggesting New Zealand could have faced a Kyoto overshoot of in excess of 45 MtCO<sub>2</sub>e even with forestry included. Clearly, from Table 3, the key to turning around such a liability has been (so far at least) the prevention of deforestation intentions.

So why have the agricultural and forestry (and, to a lesser extent, transport) projections been so drastically revised? And can New Zealand really rely on forestry to save its bacon as the Minister for

Climate Change Issues suggests has occurred to date? As already noted, revisions are made in part to reflect changed facts (like the 2008 drought and lower stock number estimates), but they also change in part to reflect changes in (ac)counting methodologies and their assumptions. In some cases, inventory data replaces projections of emissions. In other words, one set of estimates replaces another. In other cases, new scientific data improves estimates and recalculations are made; in yet others models are refined. Methodologies and assumptions have been revised by both the IPCC/Kyoto policy makers, as well as New Zealand's responsible Ministries, and they will likely continue to do so into the future as knowledge evolves. Detailed appendices to the net position report running to over 50 pages testify to some of the complexities involved. And all GHG Inventory reports carry sections on, and estimates of, the levels of uncertainty involved.

The forestry projections, for example, are the result of estimating: the area of post-1989 planted forests; rates of afforestation; rates of planned deforestation and related amounts of deemed emissions; forest growth rates; and soil carbon loss following afforestation. The resulting methodology and assumptions are too detailed to cover here, but the data is generated from such sources as forest owner surveys, sample plots and deforestation intention surveys. Net forest removals projections made in 2008 compared to those made in 2009, for example, have largely changed due to revised estimates of forest growth rates from sample plots – the trees are growing faster due to plantings in more fertile soils and being pruned less often (or not at all) resulting in greater CO<sub>2</sub> removals. Estimates of intended deforestation have also been revised down.

What is critical to understand, however, is that any given year's forest projections are subject to a large range of uncertainty due to "gaps in information and scientific knowledge." Indeed, the data shown in Tables 3 and 4 are point estimates, and in Table 3 are point estimates based on the 'most likely' scenario estimated at the time of the projection. So, the 2011 net forest removals estimate of 82.8 MtCO<sub>2</sub> for CP1 was considered 'most likely' at that time. At the same time, however, other scenarios could see it fall to 53.9 MtCO<sub>2</sub> (-35%) or go as high as 105.7 MtCO<sub>2</sub> (+28%). The implications of these scenarios on the 2011 projected surplus of NZ\$417m (shown in Table 2) are quite profound. Recasting the estimates using the most optimistic and pessimistic scenarios from forestry suggests New Zealand's Kyoto liability/surplus could lie in the range of NZ\$851m surplus to NZ\$137m liability – a NZ\$1 billion variation.

Future projections of forestry intentions, of course, are likely to be uncertain, but significant levels of complexity and uncertainty also exist with estimates of agricultural emissions: methane emissions for animals; nitrous oxide emissions from animal dung and urine; and from nitrogen fertiliser. To generate estimates, complex models combine small scale measurements of animal methane emissions with feed intake data in a pastoral supply response model (PSRM) and gross these up with animal age, population and productivity data. Estimates are also made of nitrous oxide emissions from urine patches, dung and fertilised pasture. Methane estimates can vary by +/- 15%, while nitrous oxide from urine estimates can vary +/- 50%. Uncertainty exists, then, both due to a lack of scientific understanding, and because activity levels (populations, productivity, feed conversion) respond to unpredictable changes in agricultural conditions (e.g., droughts). Overall levels of uncertainty in the GHG inventories are falling as methods improve (or at least agreement is reached on which ones to adopt). The reported levels of uncertainty for the 2006 GHG inventory of +/-21%, for example, has reduced to +/- 12% for the 2009 GHG inventory.

As time elapses, and New Zealand approaches the 2015 settlement date, more uncertainties will disappear. The future will become history, and projections will become firmed up as annual estimates in the GHG inventories are submitted and ultimately approved by Kyoto. Not all uncertainty will disappear, however. Even at settlement date New Zealand will not have measured its GHG emissions during the first commitment period, but rather produced acceptable estimates – estimates acceptable because

they have, or at least the methods used to derive them have, been subject to review and audit and agreed upon. GHG emission accounting, like much other accounting, is set to remain part science, part modelling, part guess work and part negotiation.

What is clear from this analysis is just how complex and uncertain the estimates are that underpin the single line liability provision for Kyoto in the National Accounts. Indeed, more staggering is the enormity and sophistication of the information systems that underpin the estimation of the physical quantum of net emissions in any given year. Just how robust the data and assumptions are that inform these systems is surely worthy of further research. Similarly, the means by which estimation models are adopted, adapted and audited needs further scrutiny. The interplay between the national inventory teams and the IPCC/Kyoto overseers also seems research worthy. Clearly national inventory teams have a vested interest in introducing new estimation techniques and revisions and recalculations that reduce GHG estimates, so how is this process managed? We have hardly touched the surface, but we note the annual New Zealand GHG inventory reports now run to over 400 pages providing a rich source of data on emissions as well as the processes involved.

The preceding analysis at macro, meso, and organizational and individual levels illustrates the enormity of the challenge we face to decarbonise (and de-methanate) modern (industrial and agricultural) human activity. It also illustrates the challenges and difficulties involved in generating reliable and meaningful estimates of GHG emissions at various levels – especially in regard to methane and nitrous oxide, but also in regard to carbon sequestration by forestry. Despite New Zealand introducing a domestic Emissions Trading Scheme, as other countries are doing, Ministry forecasts of gross emissions for 2010, 2011 and 2012 are not much reduced compared to 2008 and 2009 years. At best, one might argue such a scheme has prevented what might otherwise have been further increases in gross emissions of carbon dioxide – agriculture and methane are yet to enter the scheme – but it seems droughts and economic recession have likely done more. Whether the scheme represents the thin end of the wedge and a precursor to more serious policy initiatives remains to be seen. To date, New Zealand seems set to pin its hopes on forestry offsets with all the uncertainty that entails in both a Kyoto sense as well as in a physical (sequestration) sense. Forests, too, are susceptible to droughts and fire as well as foresters' intentions.

Substantial research opportunities exist to understand how GHG emissions are accounted for, audited, and how that comes to bear on emissions reductions policies and their effectiveness at all levels of analysis. Whether using readily available data, or that pieced together through careful analysis (i.e., shadow carbon accounting), we can see considerable opportunity to address the veracity of claims for reductions, offsetting and carbon neutrality at government, organizational and sector levels. Both within the compliance and the voluntary sectors, questions can be addressed, for example: to the scope of GHG covered; its accuracy and consistency of measurement over time; the type, calculation and timing of offsets; and the assurance of these processes. The GHG protocol emphasizes that organizations 'measure to manage' their emissions. How successful are organizations at doing this? Why? Why not? And to what extent is a lack of reductions in total emissions obfuscated through claims to gains in efficiencies and/or offsetting strategies? Given the vagaries of some aspects of GHG accounting, it seems inevitable that political and vested lobby interests are likely to enter in the design, operation, and reporting and auditing phases of emission reduction schemes, both in respect to domestic and international regimes. How do these play out? Where are the points of tension and how are they resolved, and in who's interests? In the next section, we introduce eleven papers that begin to provide some initial insights to some of these questions, but also which provide yet further stimulus for an ongoing research agenda into accounting for and assuring GHG emissions.

## 5. Further Interesting and Different Contributions to the Conversation

Starting broad and moving to finer levels of analysis, our first three contributors reflect on wider conceptual issues concerning: what *is* carbon accounting? Why is the political and policy response to climate change so weak? What concerns different constituencies in accounting for carbon? Our next four contributions move to: an analysis of the voluntary corporate reporting of GHG emissions in Australia; a questioning of who's interests are genuinely served by regulatory regimes that introduce market-based emissions trading schemes; an analysis of the performance of UK local authorities in regard to climate change performance indicators, and; insights into the private reporting relationships that exist within financial markets between institutional investors and their investments. Our last four contributions examine: the (lack of) role emissions disclosures play in financial markets; stakeholder submissions to promulgated emissions reductions policy in Australia; the prospect of an expectations gap between users, preparers and assurers of GHG emissions reports, and finally; the prospect that corporate disclosures on carbon emissions and other climate change related behaviours may serve purposes more symbolic (image) than substantive.

Francisco Ascui and Heather Lovell (2011, pp.xx-xx) begin their paper on the premise that carbon accounting means different things to different people. By acknowledging and highlighting conceptions of the meaning of carbon accounting by different communities of practice, the authors seek to illuminate tensions and contradictions as well as connections and overlaps relating to the term. Specifically, Ascui and Lovell (2011) make sense of fields occupied by scientists, politicians, economists, accountants and activists through use of the concept of framing as articulated in the social sciences. Accordingly, frames of reference considered by the authors include physical, political, market-enabling, financial and social/environmental modes of carbon accounting, respectively. Ascui and Lovell (2011) contend that only by explicitly attending to the multiple framings can we begin to understand what underlies tensions associated with climate change and, then, in their terms, "encourage constructive learning and policy change" (p.x). Vast opportunities for research exist as carbon accounting is contested, but is richly rewarding given the pertinence of addressing climate change and its appeal following on from the ongoing construction of frames by broad subsets of people.

In a thought provoking policy piece, Jonathan Boston and Frieder Lempp (2011, pp.xx-xx) attend, firstly, to four systemic reasons why liberal democracies struggle when dealing with human-induced climate change and, secondly, assess critically possible solutions. Reasons are provided in the form of asymmetries and the article includes an accounting asymmetry whereby financial statements value and account for manufactured and financial forms of capital and exclude natural capital and ecosystem services. Reporting omissions at micro-level has implications on what does or, significantly, does not happen at macro- or national governmental-level. The asymmetries provide insight into the difficulties of meeting the ambition contained in *The Brundtland Report* (1987) on meeting the needs of the present world without compromising the ability of future generations to meet their own needs (World Commission on Environment and Development, 1987). Foregrounding the four politically-salient asymmetries is the spatial dimension of the climate change problem, that is, the disincentive for each nation state to contribute to what is effectively a global cause. In response to the problems of reducing emissions, and following analysis of the literature, the authors present four categories of solutions and discuss how asymmetries may be ameliorated. While acknowledging that human-induced climate change is a "super wicked problem" (Lazarus, 2009), Boston and Lempp hold that current political inertia given the seriousness of climate change is untenable. If short-term economic interests prevail; the authors enunciate the outcome as a "tragedy of commons" (p.x).

Frances Bowen and Bettina Wittneben (2011, pp.xx-xx) take a similar stance to Ascui and Lovell (2011) and Boston and Lempp (2011) in that they seek to provide an overview of the immense task of addressing climate change and confront what impedes efforts by seeking to understand the

perspectives of key stakeholders. In a novel approach, the authors make sense of discussions from a one-day workshop designed to elicit controversies, implicit assumptions and dominant discourses from representatives of three organisational fields. Within- and across- field conversations were drawn at Oxford University from scientists; accounting professionals and academics; and, practitioners, researchers and critics of carbon governance systems. Bowen and Wittneben (2011) show how the stakeholders in each of the fields prioritise one of the IPCC's principles of accuracy, consistency and certainty outlined in the *IPCC Guidelines for National Greenhouse Gas Inventories* (2006) over the other and evaluate implications of this for developing carbon accounting systems. The authors shed light on why carbon markets are not a widespread policy choice globally and observe that until "legitimate uncertainty over measurement" is reduced, other means of regulation are perhaps more effective and efficient in tackling climate change. For nation states in which carbon markets are a reality, the authors call for negotiation between field participants in order to ensure actual reductions in greenhouse gases.

In the Australian context, given an absence of a government mandate on disclosing GHGs at the time of research, Michaela Rankin, Carolyn Windsor and Dina Wahyuni (2011, pp.xx-xx) seek to explain individual corporate choice in reporting voluntary information to external stakeholders. In a departure from previous research on social and environmental reporting, rather than use legitimacy theory as a theoretical lens, the authors utilise institutional governance systems theory (Griffiths *et al.*, 2007, Griffiths and Zammuto, 2005), an emerging theory, to develop an understanding on GHG emissions disclosure. Accordingly, the authors hypothesise that internal organisational systems and private regulation in the form of GRI guidance and the Carbon Disclosure Project (CDP) influences the decision to report and, further, affects the extent and credibility of reporting. The study employs a two-stage approach to address the two parts of the study. In order to evaluate the extent and credibility of GHG disclosure, the authors have 'tailored' an index on greenhouse gases from the guidance presented in ISO 14064-1. Encouragingly, Rankin, Windsor and Wahyuni (2011) find evidence of some companies embracing the challenge of adapting to a carbon constrained future and attribute pro-activeness to the need to address multiple risks and maintain an international as well as firm-specific advantage. While the implementation of environmental management systems within an organisation and external NGO guidance provided by CDP are likely to assist progress to a low carbon economy, public policy issued by Australian federal and state governments is also required.

Carolyn Windsor and Patty McNicholas (2011, pp.xx-xx) critically examine the idea of a market-orientated solution by considering the Australian Carbon Pollution Reduction Scheme (CPRS) and, specifically, the financial regulatory structure that will oversee and monitor commoditised carbon financial products. The authors point out that the same regulatory infrastructure failed to prevent the global financial crisis, question the efficacy of the efficient market hypothesis (Fama, 1970), and reveal that the global financial system's regulation has not been addressed (Krugman, 2010). With the support of authoritative sources, including critical commentaries and established critiques of market environmentalism, the authors argue that a carbon market supported by carbon finance (a 'financialised atmosphere') is not the solution. As strands within their argument, the authors critique an era of regulatory capitalism grounded in beliefs such as little government intervention and show that emissions trading confines accounting and accountability to the information needs of market participants rather than a broader array of stakeholders. In short, what the government perceives as a market solution to global warming, Windsor and McNicholas (2011) persuasively argue is a 'market problem' to reducing climate change. In contrast with the global financial crisis, if emissions trading fails to reduce GHGs, the authors contend that no amount of taxpayer funded bailout will avert catastrophe. The authors make a plea for leadership that engages with the wider community and initiates diverse approaches including the facilitation of known technological solutions. More research is needed on the



value of non-market solutions in reducing GHG emissions in attempts to avert human-induced climate change.

Stuart Cooper and Graham Pearce (2011, pp.xx-xx) consider action on climate change in the UK public sector in the form of a new performance framework for local authorities adopted in 2008. In a move toward providing more discretion to local authorities and concomitant less national government steering, local authorities have the choice of prioritising up to 35 national indicators for inclusion in their Local Area Agreements (LAAs) (reflecting local ambitions) from a list of 198 indicators. Following on, the authors' present results from documentary analysis on the uptake of three indicators relating to progress on climate change (two on mitigating carbon dioxide emissions and one on adapting to climate change) by all local upper-tier and single local authorities in the UK. This is supplemented with a set of in-depth interviews with officials engaged in negotiating LAA climate change indicators in local authorities located in the West Midlands. Cooper and Pearce (2011) provide empirical evidence that all but a handful of local authorities working through Local Strategic Partnerships included at least one of the three national indicators on climate change as a priority. Interview evidence gives insight into how climate change performance is measured and accounted for and reveals by-products of the performance process such as the build-up of climate change data and expertise. As a postscript, Cooper and Pearce (2011) question the appropriateness of the Coalition Government's Localism Agenda and, in particular, what this entails when the legal requirements of the Climate Change Act are considered. The call for more research on sustainability (including climate change) accounting and accountability in the public sector, as put forward by Ball and Grubnic (2007), is arguably more relevant today given misgivings on market-based solutions.

In direct contrast to research on public services, Jill Solomon, Aris Solomon, Simon Norton and Nathan Joseph (2011, pp.xx-xx) point to an absence of academic research on private climate change reporting between institutional investors and investee companies and so seek in their paper to initiate and provide momentum on research in this important area. As the authors observe (p.x):

The ways in which the institutional investment community embrace climate change issues in their investment strategy and decision-making is a crucial ingredient to the future success or failure of attempts to slow down global warming, as their impact on business through shareholder activism is substantial.

Drawing on interviews with 20 institutional investors following one-on-one meetings with investee companies, the paper provides empirical evidence on the content, nature and process of private climate change reporting. The vast majority of findings reveal that discourse is dominated by risk, risk management and crisis avoidance. On this, Solomon *et al.* draw upon Beck's (1992) thesis of a Risk Society and speculate that discourse is symptomatic of society becoming increasingly aware of, and pre-occupied with, impending events. Interestingly, the authors find that sustainability reporting discourse is not captured by corporations, as has been found in prior research on public sustainability reporting, but by the investor community. While institutional investors are aware of material opportunities relating to climate change that investee companies can exploit, there was a notable absence of any ethical discourse in the one-to-one exchanges. As a conclusion, Solomon *et al.* (2011) raise that failing to couch private climate change reporting in the language of social responsibility has implications for discharging broader accountability beyond that of financial accountability.

Continuing the investment theme of Solomon *et al.* (2011), Matthew Haigh and Matthew Shapiro (2012, *forthcoming*) recognise a potential divide between what companies report on greenhouse gas emissions and the interest taken by institutional investors in these disclosures. In order to investigate whether carbon reporting matters to investors, the authors adopt the twinned perspective of signification and decision-usefulness, drawing upon the work of Barthes (1974) and Sharpe (1992) respectively. Haigh

and Shapiro (2012) reason that just as politicians seek to convert voters through the power of the photograph, so too carbon reporters can facilitate the investment strategies of institutional investors. The paper establishes a reasonable basis for carbon reporting from the extant literature on investors' information requirements and then moves on to assess the interest of financial institutions based on interviews with finance professionals located in the main investment markets. In summary, the authors note "a level of disengagement" by institutional investors in climate policy and claim unrealised potential from the presentation of carbon reports.

The contributions by Sumit Lodhia and Nigel Martin (2012, *forthcoming*) and Wendy Green and Qixin Li (2012, *forthcoming*) both take as a starting point the introduction of government policy on reporting of GHG emissions in Australia. Lodhia and Martin (2012) analyse submissions by a range of stakeholders to government following consultation on the National Greenhouse and Energy Reporting (NGER) policy paper. Deviating from more mainstream methods for analysing data reported in social and environmental accounting and auditing research, the authors execute their study through use of the Leximancer software package. In short, this package combines the research techniques of concept mapping and analysis and content analysis. Following the two-part analytical process, results from both the coarse and fine grained analyses of the stakeholder submissions are revealing. For example, the authors find that in addition to reporting concerns by business constituents, environmental groups and associations raise issues relating to land clearing and deforestation. Given the generation of concept statistics and maps, the Leximancer software seems useful for research yielding large volumes of stakeholder-related data. More broadly, Lodhia and Martin (2012) affirm the usefulness of the agenda setting framework as a theoretical lens to understanding policy development and suggest more attention is needed on the inter-relationships between the different agendas as presented in the literature.

In contrast to the policy formation focus of Lodhia and Martin (2012), Green and Li (2012) address the important area of assurance of greenhouse gas emissions. In a paper that is thorough and comprehensive in coverage, the authors consider whether an expectation gap exists between emissions preparers, emissions assurers and shareholders with respect to the dimensions of responsibility, reliability, decision-usefulness and competency. Given prior literature on prospective financial information audits suggests that the nature of the expectation gap can differ in settings involving increased uncertainty, the authors test for this by incorporating different types of emissions provided by the Greenhouse Gas Protocol. Consequently, a different survey was developed for organisations with high levels of Scope 1 emissions (those arising directly from sources owned or controlled by the company), considered to face greater uncertainty, and for entities with high Scope 2 emissions (indirect emissions from purchased electricity). Interestingly, amongst the results, the authors find assurers of the former type of organisation perceive themselves to be more responsible for the forecasts than did preparers and users. In other words, there is evidence for a reversed expectation gap than that assumed in the literature. Now that a price for carbon has been announced by the Australian Prime Minister, research opportunities on GHG assurance abound. Green and Li (2012) suggest extending the study to consider other users of emissions data such as government policy makers and investment fund managers.

The final paper by Sue Hrasky (2012, *forthcoming*) takes note of Hopwood's (2009) observation that corporate environmental reporting may serve to protect the inner workings of an organisation from outside view and, in so doing, thicken the corporate veil (p.437). In her study, Hrasky (2012) assesses whether footprint-related disclosures by Australian companies are more reflective of symbolism (pragmatic legitimation), the concern of Hopwood (2009), or of apparent behaviour (moral legitimation). Not surprisingly, Hrasky (2012) finds evidence of both types of legitimation tactics following content analysis of reports issued by the country's largest listed companies, but the tendency of more carbon

intensive vs. less intensive organisations is perhaps counter-intuitive. While companies in the materials and industrial sectors tend toward substantive action, companies such as those in the financial sector are “shifting away” from disclosure more consistent with moral legitimation. Depressingly, Hrasky (2012) suggests that voluntary actions to reduce carbon impacts are generally not producing the desired outcome, at least in the short-term. There is urgency for research on incentives that encourage actual mitigation of the effects of climate change and on accounting-related blockages that serve to impede progress.

## 6. Conclusions

As we noted above there is clearly an enormous challenge and opportunity to undertake urgent research into a wide range of accounting and auditing issues concerning climate change, GHG emissions accounting, reporting and assurance, and emissions management and reduction which the papers in this issue serve to underline. Nonetheless, while more research *within* organizations as well as reporting and assurance by organisations is undoubtedly required, we are keen to avoid it becoming the only or even dominant focus of climate change based accounting research. In drawing some conclusions, therefore, we return to our own earlier broader analysis to raise some questions about the efficacy of Kyoto style emissions policies. The examples we provided above illustrate at various levels (e.g, individuals, products/services, organisations and nations) what has long been known by some: technological change and efficiency does not automatically deliver less impact (e.g., Ehrlich and Holdren, 1971; Commoner, 1972; Holdren and Ehrlich, 1974; Gray, 2006; Gray *et al.* 2007; Milne, 2007; Prins *et al.* 2009, Shrivastava, 2010). Consequently, policies solely focused on those ends may not deliver. Noting a ten-fold increase in his personal carbon footprint over 30 years, Paul Shrivastava wryly notes, “...the more I know about sustainability, the greater my eco-footprint grows” (Shrivastava, 2010, p. 443). Even knowledgeable individuals, then, do not escape the effects of wealth and affluence. In fact, because of ‘rebound’ behavior and Jevon’s paradox – where for income and psychological reasons consumption exceeds efficiency gains, a focus on energy and emissions efficiency may conceal or even “lock-in” (Unruh, 2000; 2002) yet greater impacts. By re-casting Ehrlich and Holdren’s (1971) IPAT identity (i.e. Environmental Impact = Population x Affluence x Technology) as follows:

$$\text{Carbon Emissions} = C = P \times \frac{\text{GDP}}{P} \times \frac{\text{TE}}{\text{GDP}} \times \frac{C}{\text{TE}}$$

Where: P = population; GDP/P = affluence; TE/GDP = energy intensity; and C/TE = emissions intensity

Prins *et al.* (2009) are also keen to ensure that if energy intensity and emissions intensity are the policy targets, they should be *direct targets* of investment and technology sharing and not indirect ones through financial incentives/penalties. They consider policy attempts that seek to deal directly with population control or curb wealth (GDP/P) as politically infeasible. Yet, as Sachs (1999) and Jackson (2009) so eloquently articulate, we need to turn our attention to both sufficiency and efficiency. The technical, innovative and investment challenge is truly enormous, but so is addressing our values and extravagant Western lifestyles. For some, Kyoto style trading solutions are simply not up to the task (e.g., Nordhaus and Shellenberger, 2007, 2008; Prins and Rayner, 2007; Prins *et al.*, 2009).

In fact, by drawing on our previous national accounting analysis, one can speculate on just how tough a Kyoto type compliance scheme needs to get before we see significant efforts in terms of gross emissions reductions. We noted above that should New Zealand face the full liability of its gross emissions without available forestry offsets, it would face a liability of approximately NZ\$1 billion. This was based on a

calculated 5-year overshoot of 54.1MtCO<sub>2</sub>e and a carbon price of NZ\$20/tonne. So the full penalty incentive is about NZ\$200m per annum. With annual GDP at NZ\$185 billion, this equates to a little over *one tenth of one per percent* of annual GDP. Yes, that's right, one tenth of one percent - about NZ\$1 a week per person. If carbon prices rose five fold to NZ\$100/tonne we are still only talking a little over half a percent of annual GDP. Even trebling the overshoot to 30MtCO<sub>2</sub>e per annum (50% above 1990 levels) and paying NZ\$100/tonne would cost less than 2% of GDP – about NZ\$15/week per person.

If this is the sort of penalty incentive necessary to bring about significant action, then we might argue, turning this around, that New Zealand requires a Kyoto target closer to 40MtCO<sub>2</sub>e p.a. (i.e. a 33% reduction below 1990 levels and a per capita gross emissions target of 10tCO<sub>2</sub>e as opposed to current levels of 18tCO<sub>2</sub>e). Anything forestry did to further offset such levels would be a bonus. The critical issue in all of this, of course, is how on Earth would New Zealand manage to reduce annual gross emissions by 30MtCO<sub>2</sub>e without devastating its economic base? From where in agriculture, transport and stationary energy would we strip out 30MtCO<sub>2</sub>e p.a., and over how long a period does this need to happen? Some believe it needs to happen within the next decade. Greenpeace New Zealand, for example, has been running a campaign that calls for a 40% cut from current emissions by 2020.<sup>20</sup> This equates to a similar reduction of about 30MtCO<sub>2</sub>e. Eliminating *all emissions* associated with transport alone would get us only half way there! And this does not include the 8MtCO<sub>2</sub>e associated with international tourism Smith and Rodger (2007) calculated, since that currently resides outside of Kyoto commitments. Decommissioning *all existing* sources of thermal generation would also help, but with what would we replace them and how soon? And what of agriculture? Without eliminating a significant portion of livestock based agriculture it is difficult to see where significant emissions reductions would come. Forests might, and we stress might given the uncertainties involved, be New Zealand's immediate saving grace, but long term and under tougher emissions regimes, that is not a feasible option. The challenge of actually reducing emissions is enormous, not just for New Zealand, for everyone.

## References

- Agnolucci, P., Anderson, K., Bows, A., Ekins, P., Lacopini, G., Mander, S. and Shackley, S. (2008), "Different scenarios for achieving radical reduction in carbon emissions: a decomposition analysis", *Ecological Economics*, Vol. 68 No. 6, pp. 1652-66.
- Anderegg, W.R.L., Prall, J.W., Harol, J. and Schneidera, S.H. (2010), "Expert credibility in climate change", *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 107 No. 27, pp. 12107-109.
- Anderson, K., and Bows, A. (2008), "Reframing the climate change challenge in light of post-2000 emission trends", *Philosophical Transactions of the Royal Society - A: Mathematical, Physical and Engineering Sciences*, Vol. 366, pp. 3863-82.
- Anderson, K., Mander S., Bows A., Shackley S., Agnolucci P. and Ekins P. (2008), "The Tyndall Decarbonisation Scenarios Part II: scenarios for a 60% CO<sub>2</sub> reduction in the UK.", *Energy Policy*, Vol. 36 No. 10, pp. 3764-73.
- Airbus (2010), "Global market forecast 2010-2029", available at: <http://www.airbus.com/company/market/gmf2010/> (accessed 29 July, 2011).
- Air New Zealand (2007), "Annual Report", available at <http://www.airnewzealand.co.nz/assets/Resources-AirNZ/Investor-Centre/2007-annual-report.pdf> (accessed 29 July, 2011).
- Ascui, F. and Lovell, H. (2011), "As frames collide: making sense of carbon accounting", *Accounting, Auditing & Accountability Journal*, Vol. 24 No. 8, pp. ???
- Bäckstrand, K. and Lövbrand, E. (2006), "Planting trees to mitigate climate change: contested discourses of ecological modernization, green governmentality and civic environmentalism", *Global Environmental Politics*, Vol. 6 No. 1, pp. 50-75.
- Ball, A. and Grubnic, S. (2007), "Sustainability accounting and accountability in the public sector", in Unerman, J., Bebbington, J. and O'Dwyer, B. (Eds.), *Sustainability Accounting and Accountability*, Routledge, Oxon pp.243-265.
- Ball, A., Mason, I., Grubnic, S. and Hughes, P. (2009), "The carbon neutral public sector: early developments and an urgent agenda for research", *Public Management Review*, Vol. 11 No.5, pp.575-600.
- Barthes, R. (1974), *S/Z*, Hill and Wang, New York.
- Bebbington, J. and Larrinaga-González, C. (2008), "Carbon trading: accounting and reporting issues", *European Accounting Review*, Vol. 17 No. 4, pp. 697 - 717.
- Beck, U. (1992), *Risk Society: Towards a New Modernity*, Sage Publications Ltd., London, UK.
- Begg, K.G., van der Woerd, F. and Levy, D. (2005), *The Business of Climate Change*. Greenleaf, Sheffield, UK.
- Block, K., Nöhne, N., Torvanger, A. and Janzic, R. (2005), *Towards a Post 2012 Climate Change Regime: Final Report*, Report to DG Environment, European Commission, Brussels.
- Bodansky, D. and Pew. (2004), *International Climate Efforts Beyond 2012: A Survey of Approaches*, Pew Centre on Global Climate Change, Arlington, VA., USA.
- Boston, J., (ed.) (2007), *Towards a New Global Climate Treaty: Looking Beyond 2012*, Institute of Policy Studies, Victoria University of Wellington, Wellington.
- Boston, J. and Lempp, F. (2011), "Climate change: explaining and solving the mismatch between scientific urgency and political inertia", *Accounting, Auditing & Accountability Journal*, Vol. 24 No. 8, pp. ???
- Bowen, F. and Wittneben, B. (2011), "Carbon accounting: negotiating accuracy, consistency and certainty across organisational fields", *Accounting, Auditing & Accountability Journal*, Vol. 24 No. 8, pp. ???
- Bows, A., and Anderson, K. (2007), "Policy clash: can projected aviation growth be reconciled with the UK Government's 60% carbon reduction policy?", *Transport Policy*, Vol. 14 No. 2, pp.103-110.

- Bumpus, A.G. and Liverman, D.M. (2008), "Accumulation by decarbonisation and governance of carbon offsets", *Economic Geography*, Vol. 84 No. 2, pp. 127-55.
- Commoner, B. (1972), *The closing circle*, Jonathan Cape, London.
- Cooper, S. and Pearce, G. (2011), "Climate change performance measurement, control and accountability in English local authority areas", *Accounting, Auditing & Accountability Journal*, Vol. 24 No. 8, pp. ???
- Dargay, J. and Gately, D. (1999), "Income's effect on car and vehicle ownership, worldwide: 1960-2015", *Transportation Research, Part A*, Vol. 33, pp.101-138.
- Dargay, J. Gately, D. and Sommer, M. (2007), "Vehicle ownership and income growth, worldwide: 1960-2030", *Energy Journal*, Vol. 28 No. 4, pp. 143-70.
- Dryzek, J., (1997), *The Politics of the Earth*, Oxford University Press, Oxford.
- EM/NCF, (2008), *Forging a Frontier: State of the Voluntary Carbon Markets 2008*, Ecosystem Markets/New Carbon Finance, <http://ecosystemmarketplace.com/> (accessed 11 June, 2008).
- Ehrlich, P.R. and Holdren, J. P. (1971), "Impact of population growth", *Science*, Vol. 171, pp. 1212-1217.
- Fama, E. (1970), "Efficient capital markets: a review of theory and empirical work", *Journal of Finance*, Vol. 25 No.2, pp.383-417.
- Flannery, T. (2005), *The Weather Makers: How Man is Changing the Climate and What it Means for Life on Earth*, Text Publishing, Melbourne.
- Gibson, K. (1996), "The problem with reporting pollution allowances: reporting is not the problem", *Critical Perspectives on Accounting*, Vol. 7, pp 655-665.
- Giddens, A. (2009), *The Politics of Climate Change*, Polity Press, Cambridge.
- Gore, A., (2006), *An Inconvenient Truth: The Planetary Emergency of Global Warming and What We Can do About It*, Rodale Press, Bloomsbury, London, UK.
- Gray, R. (2006), "Social, Environmental and Sustainability Reporting and Organisational Value Creation: Whose Value? Whose Creation?" *Accounting, Auditing and Accountability Journal* Vol. 19 No. 6, pp.793-819.
- Gray, R (2010), "Is accounting for sustainability actually accounting for sustainability...and how would we know? An exploration of narratives of organisations and the planet", *Accounting, Organizations and Society*, Vol. 35, pp. 47-62.
- Gray, R. Dillard, J., and Spence, C. (2007), Accounting as if the World Matters: Postalgia and a New Absurdism. 5<sup>th</sup> APIRA Conference, [www.bsec.canterbury.ac.nz/apira2007/proceedings.html](http://www.bsec.canterbury.ac.nz/apira2007/proceedings.html)
- Green, W. and Li, X. (2012), "Evidence of an expectation gap for greenhouse gas emissions assurance", *Accounting, Auditing & Accountability Journal*, Vol. 25 No. 1, *forthcoming*.
- Griffiths, A. and Zammuto, R.F. (2005), "Institutional governance systems and variations in national competitive advantage: an integrative framework", *The Academy of Management Review*, Vol.30 No.4, pp823-42.
- Griffiths, A., Haigh, N. and Rassias, J. (2007), "A framework for understanding institutional governance systems and climate change: the case of Australia", *European Management Journal*, Vol.25 No.6, pp.415-27.
- Haigh, M. and Shapiro, M. (2012), "Carbon Reporting: Does It Matter?", *Accounting, Auditing & Accountability Journal*, Vol. 25 No. 1, *forthcoming*.
- Hajer, M., (1995), *The Politics of Environmental Discourse*, Clarendon Press, Oxford.
- Hamilton, C. and Denniss, R. (2005), *Affluenza: When too Much is Never Enough*, Allen & Unwin, Crows Nest, NSW, Australia.
- Hamilton, C., (2007), *Scorcher: The Dirty Politics of Climate Change*, Black Inc. Agenda, Melbourne.
- Hamilton, C., (2010), *Requiem for a Species: Why We Resist the Truth About Climate Change*, Allen & Unwin, Crows Nest, NSW.
- Hannigan, J. (2006), *Environmental Sociology* (2<sup>nd</sup> Edn.), Routledge, London.

- Hansen, J. (2009), *Storms of my Grandchildren: The Truth About the Coming Climate Catastrophe and Our Last Chance to Save Humanity*, Bloomsbury, London.
- Harvard Business Review Special Issue (2007), "Climate business: business climate", *Harvard Business Review*, October.
- Herndl, C.G. and Brown, S.C. (1996), "Introduction", in C.G. Herndl and S.C. Brown (eds.) *Green Culture: Environmental Rhetoric in Contemporary America*, University of Wisconsin Press, Madison, WI.
- Hoffman, A.J. (2006), *Getting Ahead of the Curve: Corporate Strategies that Address Climate Change*. Pew Center on Global Climate Change.
- Hoffman, A.J. (2007), *Carbon Strategies: How Leading Companies are Reducing Their Climate Change Footprint*, The University of Michigan Press, Ann Arbor.
- Hoffman, A.J. and Woody, J.G. (2008), *Climate Change: What's Your Strategy?*, Harvard Business Press, Massachusetts.
- Holdren, J. P. and Ehrlich, P.R. (1974), "Human population and the global environment", *American Scientist*, Vol. 62 No. 3, pp.282-292.
- Hopwood, A. (2009), "Accounting and the environment", *Accounting, Organizations and Society*", Vol. 34 No.3/4, pp.433-39.
- Hrasky, S. (2012), "Carbon footprints and legitimation strategies: symbolism or action?", *Accounting, Auditing & Accountability Journal*, Vol. 25 No. 1, *forthcoming*.
- International Auditing and Assurance Standards Board (IAASB) (2009), Draft Assurance Standard ISAE3410 "Assurance on a Greenhouse Gas Statement", September 2009, <http://www.ifac.org/IAASB/MeetingBGPapers.php?MID=0168&ViewCat=1151>
- IPCC. (2006), *IPCC Guidelines for National Greenhouse Gas Inventories, Technical Support Unit of the IPCC Taskforce on National Greenhouse Gas Inventories*.
- IPCC. (2007), *Climate Change 2007: Synthesis Report*. Intergovernmental Panel on Climate Change, Geneva, Switzerland.
- Jackson, T. (2009), *Prosperity without Growth: Economics for a Finite Planet*, Earthscan Publications, London.
- Jones, C.A. and Levy, D. (2007), "North American business strategies towards climate change", *European Management Journal*, Vol. 25 No. 6, pp. 428-40.
- Jordan, A. and Lorenzi, I. (2007), "Is there now a political climate for policy change? Policy and politics after the Stern Review", *The Political Quarterly*, Vol. 78 No. 2, pp.310-19.
- Knox-Hayes, J. (2009a), "The developing carbon financial service industry: expertise, adaption and complementarity in London and New York", *Journal of Economic Geography*, Vol.9 No. 6, pp. 749-777.
- Knox-Hayes, J. (2009b) "Path-Dependence, Coalitions and Interlinked Networks: Legislating Carbon Markets in the Face of Financial Crisis", *Working Paper*. School of Geography and Environment (University of Oxford).
- Kolk, A. and Levy, D. (2001), "Winds of change: corporate strategy, climate change and oil multinationals", *European Management Journal*, Vol. 19 No. 5, pp. 501-9.
- Kolk, A. and Pinkse, J. (2004), "Market strategies for climate change", *European Management Journal*, Vol. 22 No. 3, pp. 304-14.
- Kolk, A. & Pinkse, J. (2005), "Business responses to climate change: identifying emergent strategies", *California Management Review*, Vol. 47 No.3, pp 6-20.
- Kolk, A., Levy, D. and Pinkse, J. (2008), "Corporate responses in an emerging climate regime: the institutionalization and commensuration of carbon disclosure", *European Accounting Review*, Vol. 17 No. 4, pp. 719 - 45.
- Krugman, P. (2010), "Bankers without a clue", *New York Times*, Opinion , 14 January, available at <http://www.nytimes.com/2010/01/15/opinion/15krugman.html>

- Lazarus, R.J. (2008), "Super wicked problems and climate change: restraining the present to liberate the future", *Cornell Law Review*, Vol. 94 No.5, pp. 1153-234.
- Lehman, G. (1996), "Environmental accounting: pollution permits or selling the environment", *Critical Perspectives on Accounting*, Vol. 7, pp 667-76.
- Levy, D. and Egan, D. (2003), "A neo-gramscian approach to corporate political strategy: conflict and accommodation in the climate change negotiations", *Journal of Management Studies*, Vol. 40 No.4, pp. 803-30.
- Livesey, S. (2002), "Global warming wars: rhetorical and discourse analytic approaches to ExxonMobil's corporate public discourse", *The Journal of Business Communication*, Vol.39 No.1, pp. 117-48.
- Lodhia, S. and Martin, N. (2012), "Stakeholder responses to the national greenhouse and energy reporting act: an agenda setting perspective", *Accounting, Auditing & Accountability Journal*, Vol. 25 No. 1, *forthcoming*.
- Lohmann, L. (2005), "Marketing and making carbon dumps: commodification, calculation and counterfactuals in climate change mitigation", *Science as Culture*, Vol.14 No.3, pp. 203-35.
- Lohmann L. (2006), *Carbon Trading: a critical conversation on climate change, privatization and power* Development Dialogue #48, Dag Hammarskjold Foundation, available at <http://www.thecornerhouse.org.uk/resource/carbon-trading-0> (last accessed 31 July, 2011)
- Lohmann, L. (2009a), "Uncertainty markets and carbon markets: variations on polanyian themes", *New Political Economy*, <http://www.thecornerhouse.org.uk/pdf/document/NPE2high.pdf> (last accessed February 2010).
- Lohmann, L. (2009b), "Toward a different debate in environmental accounting: the cases of carbon and cost-benefit", *Accounting Organizations and Society*, Vol. 34, pp. 499-534.
- Lovell H., Bulkeley H. and Liverman D. M. (2009), "Carbon offsetting: sustaining consumption?" *Environment and Planning*, Vol. 41 No. 10, pp. 2357-2379.
- Ludwig, D. (2001), "The era of management is over", *Ecosystems*, Vol. 4 No. 8, pp. 758-64.
- Lynas, M. (2004), *High Tide: The Truth About Our Climate Crisis*, Picador, New York.
- Meyer, A. (2000), *Contraction and Convergence: The Global Solution to Climate Change*, Green Books for the Schumacher Society, Devon, UK.
- McNicholas, P. and Windsor, C. (2011), "Can the financialised atmosphere be effectively regulated and accounted for?", *Accounting, Auditing & Accountability Journal*, Vol. 24 No. 8, pp. ???
- Milne, M.J. (1996), "Capitalizing and appropriating society's rights to clean air: a comment on Wambsgans & Sanford's accounting proposal", *Critical Perspectives on Accounting*, Vol. 7, pp. 681-695.
- Milne, M.J. (2007), "Downsizing Reg (me and you)! Addressing the 'real' sustainability agenda at work and home", in Gray, R.H. and Guthrie, J. (Eds.), *Social Accounting, Mega Accounting and Beyond: Festschrift in Honour of Martin (Reg) Mathews*, CSEAR: St. Andrews.
- Milne, M.J., Ball, A. and Mason, I.G. (2010) "The Kyoto seesaw: accounting for GHG emissions 2008-2012", *Chartered Accountants Journal of New Zealand*, February, pp. 25-7.
- Milne, M.J., Tregidga, H., and Walton, S. (2009), "Words not actions! The ideological role of sustainable development reporting", *Accounting, Auditing & Accountability Journal*, Vol. 22 No. 8, pp. 1211-57.
- Ministry for the Environment (Mfe) (2008), "Climate change (liquid fossil fuels) regulations 2008", available at: <http://www.mfe.govt.nz/publications/climate/emissions-trading-bulletin-9/emissions-trading-bulletin-9.html> (accessed 30 July, 2011).
- Ministry for the Environment (Mfe) (2011), "Greenhouse Gas Emissions Net Position 2011", available at: <http://www.mfe.govt.nz/issues/climate/greenhouse-gas-emissions/net-position/index.html> (last accessed 15 July 28, 2011).
- Monbiot, G., (2006), *Heat: How to Stop the Planet Burning*, Allen Lane, Penguin Books, London.
- Morgan, G. and McCrystal, J. (2009), *Poles Apart: Beyond the Shouting Who's Right About Climate Change*, Scribe, Melbourne.



- Newell, P. (2008), "Civil society, corporate accountability and the politics of climate change", *Global Environmental Politics*, Vol. 8, No. 3, pp. 122-53.
- Nordhaus, T. and Shellenberger, M. (2007), *Break Through; From the Death of Environmentalism to the Politics of Possibility*, Houghton Mifflin Company, New York.
- Nordhaus, T. and Shellenberger, M. (2008), "Scrap Kyoto", *Democracy Journal*, Summer, pp. 8-19.
- O'Dwyer, B., (2011), "The Genesis of an 'Interesting' and Important Social and Environmental Accounting Conversation: Celebrating the Contribution of Professor David Owen to Social and Environmental Accounting and Auditing (SEAA) Research and Practice", *Social and Environmental Accountability Journal*, Vol. 31, No. 1, pp.85-95,
- Okereke, C. (2007), "An exploration of motivations, drivers and barriers to carbon management: the UK FTSE 100", *European Management Journal*, Vol.25 No.6, pp. 475-86.
- Oreskes, N. (2004), "The scientific consensus on climate change", *Science* Vol. 306 No.5702, pp. 1686.
- Pearce, F., (2006), *The Last Generation: How Nature Will Take Her Revenge for Climate Change*, Eden Project Books, Random House. London.
- Pinkse, J. and Kolk, A. (2009), *International Business and Global Climate Change*, Routledge, London.
- Prins, G., Cook, M., Green, C., Hulme, M., Korhola, A., Pielke Jnr., R., Rayner, S., Sawa, A., Sarewitz, D., Stehr, N and von Storch, H. (2009), "How to Get Climate Policy Back on Course", Discussion Paper of the Institute for Science, Innovation and Society, University of Oxford and the MacKinder Centre for the Study of Long-Wave Events, London School of Economics.
- Prins. G and Rayner, S. (2007), "The Wrong Trousers: Radically Rethinking Climate Policy", Discussion Paper of the James Martin Institute for Science and Civilization, University of Oxford and the MacKinder Centre for the Study of Long-Wave Events, London School of Economics.
- Rankin, M., Windsor, C., and Wahyuni, D. (2011), "An investigation of voluntary corporate greenhouse gas emissions reporting in a market governance system: Australian evidence", *Accounting, Auditing & Accountability Journal*, Vol. 24 No. 8, pp. ???
- Sachs, W. (1999), *Planet Dialectics: Explorations in Environment and Development*, Zed Books, London.
- Sausen, R., Isaksen, I., Grewe, V., Hauglustaine, D., Lee, D.S., Myhre, G., Köhler, M.O., Pitari, G., Schumann, U., Stordal, F., Zerefos, C., (2005), "Aviation radiative forcing in 2000: An update on IPCC (1999)", *Meteorologische Zeitschrift*, Vol. 14 No. 4, pp. 555-561
- Sharpe, W.F. (1992), "Asset allocation: management style and performance evaluation", *Journal of Portfolio Management*, Vol.18 No.2, pp.7-19.
- Shrivastava, P. (2010), "Pedagogy of Passion for Sustainability", *Academy of Management Learning & Education*, Vol. 9 No. 3, pp. 443-455.
- Simnett, R., Nugent, M. and Huggins, A. L. (2009), "Developing an international assurance standard on carbon emissions disclosures", *Accounting Horizons*, Vol.23 No.4, pp. 347-63.
- Smith, I. and Rodger, C. (2009), "Carbon emission offsets for aviation-generated emissions due to international travel to and from New Zealand Carbon Emission Offsets for International Transport to and From New Zealand", Paper presented at Conference of the National Energy Research Institute, Auckland, New Zealand. *Energy Policy*, Vol. 37 No. 9, pp. 3438-47.
- Smith, K. (2007), "The carbon neutral myth: offset indulgences for your climate sins", Carbon Trade Watch. Available at: [www.carbontradewatch.org](http://www.carbontradewatch.org) (accessed: January, 2008).
- Solomon, J., Solomon, A., Norton, S.D., Joseph, N. (2011), "Private climate change reporting: An emerging discourse of risk and opportunity?", *Accounting, Auditing & Accountability Journal*, Vol. 24 No. 8, pp. ???
- Stern, N. (2006), *The Economics of Climate Change*, Cambridge University Press, Cambridge, UK.
- Stern, N. (2008), *Key elements of a global deal on climate change*, The London School of Economics and Political Science, London, UK.
- Stern, N. (2010), *A Blueprint for a Safer Planet: How We Can Save the World and Create Prosperity*, Vintage, Random House, London.

- Unruh, G. (2000), "Understanding carbon lock-in", *Energy Policy*, Vol. 28, pp. 817-30.
- Unruh, G. (2002), "Escaping carbon lock-in", *Energy Policy*, Vol. 30, pp. 317-25.
- Verweij, M., Douglas, M., Ellis, R., Engel, C., Hendriks, F., Lohmann, S., Ney, S., Rayner, S. and Thompson, M. (2006), "Clumsy solutions for a complex world: the case of climate change", *Public Administration*, Vol. 84 No. 4, pp. 817–843.
- Wambsganns, J.R. and Sanford, B. (1996), "The problem with reporting pollution allowances", *Critical Perspectives on Accounting*, Vol. 7, pp. 643-52.
- WBCSD/WRI. (2004), *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard*, Revised Edition. World Business Council for Sustainable Development, Geneva, Switzerland; World Resources Institute, Washington DC, USA.
- World Commission on Environment and Development (1987), *Our Common Future (the Brundtland Report)*, Oxford: Oxford University Press, Oxford.

## Endnotes

<sup>1</sup> Popular and useful overviews continue to emerge. See, for example, Giddens (2009), Hansen (2009), Morgan & McCrystal (2009), Hamilton (2010), and Stern (2010).

<sup>2</sup> One obvious exception to this is in Australia where the economic fallout from the global recession and bank failures has been minimal, and there has been over the past year or so a raging political debate about the Australian Carbon Pollution Reduction Scheme, and the introduction of a carbon tax. In July 2011, the Gillard Government announced the introduction of a carbon tax of AU\$23/tonne starting in July 2012 for the country's biggest 500 polluters, covering about 60% of carbon emissions – agriculture and light transport are exempted.

<sup>3</sup> For easily accessible overviews of these issues, see, for example, Lynas (2004), Flannery (2005), Monbiot (2006), Pearce (2006), Hansen (2009), Morgan & McCrystal (2009), Hamilton (2010) and Stern (2010).

<sup>4</sup> *Time Magazine*, 6 October, 2008, Vol. 172, No.14.

<sup>5</sup> *Time Magazine* may in fact have understated US vehicle ownership by up to 100%. Dargay *et al.* (2007) and Dargay and Gately (1999) report much higher levels of ownership. For example, Dargay *et al.* (2007) report US levels of ownership for 1960 as 74.4 million (41% of population), and for 2002 as 233.9 million (81% of population).

<sup>6</sup> Of course, there are other variables omitted from this analysis such as vehicle travel rates – we suspect people drive more often and further due to habits, routines and improved infrastructure; effects of congestion – which increase emissions due to more vehicle idling but also put people off driving; rates of vehicle renewal by existing owners – potentially creating lags in efficiency gains; and the price and availability of fossil fuel supplies – of which price elasticity suggests consumers are quite insensitive to all but large price increases. Such variables suggest yet greater absolute emission levels than our analysis might suggest. We also acknowledge that vehicles are safer, faster, and more comfortable than they were 100 years ago, but this is precisely why fuel efficiency gains have not been greater – vehicles are heavier than they were even 10-20 years ago.

<sup>7</sup> The aviation industry also rather disingenuously likes to compare these fuel efficiency rates with modern motor vehicles, conveniently overlooking the fact that people fly distances in order of several magnitudes greater than they drive in the same time period. One or two long haul flights in a year often produce emissions far in excess of annual driving and living emissions for some.

<sup>8</sup> Within the financial commentary of its annual reports, at least until 2009, Air New Zealand provides a breakdown of changes in profitability. It discloses, for example, that "Fuel consumption rose just under 1% to 8.4 million barrels in 2007". Using these physical quanta and observing that a barrel of liquid fuel is 42 US gallons (≈160 litres), that a litre of jet fuel emits 2.52kg of CO<sub>2</sub>e/litre (Mfe, 2008), and that as disclosed by Air New Zealand, 92% of its carbon emissions come from jet fuel, it is possible to estimate its annual total CO<sub>2</sub>e emissions. These estimates, however, ignore radiative forcings associated with combusting jet fuel at high altitudes. To account for these would significantly increase the estimates by 1.9 times (e.g., Sausen *et al.*, 2005; Bows and Anderson, 2007). We consider these estimates accurate based on two disclosures by Air New Zealand. Our 2006 estimate of 3.64MtCO<sub>2</sub>e is the same as disclosed in the 2007 annual report for 2006. Our estimate for 2009 of 3.55MtCO<sub>2</sub>e is based on 10% less fuel burn than in 2008, a fact Air New Zealand's 2009 annual report (p. 6) confirms when it notes 10% savings of 350,000tCO<sub>2</sub>e. We stress the footprint analysis is an estimate, but note the underlying growth trend in capacity is squarely based on the organisation's own fuel consumption disclosures.

---

<sup>9</sup> The middle years 2000-2004 are omitted for presentation simplicity.

<sup>10</sup> A point worth noting here is that international aviation emissions are currently excluded from the Kyoto Protocol and often, therefore, excluded from domestic emissions trading programmes or taxes. Air New Zealand currently only faces the costs of its domestic emissions under New Zealand's Emissions Trading Scheme for Liquid Fuels. Estimates of its international aviation emissions suggest these constitute greater than 50% of its total emissions at >2.2MtCO<sub>2</sub>e. The European Union is currently seeking to include all international aviation to and from the EU into its Emissions Trading Scheme, but this is being actively resisted by some countries and particularly the US.

<sup>11</sup> And this seems to square with anecdotal observations about ticket prices. For example, a return trip Auckland-London emits approx 4.8tCO<sub>2</sub>e/passenger (Ministry for the Environment NZ guidance states the carbon emission factor for international travel as 0.132 kg/km, so a return trip is the equivalent of 4839 kg CO<sub>2</sub>). This implies an additional cost (@NZ\$100/tonne) of NZ\$480/passenger, which constitutes a 12-16% increase on a typical ticket price of NZ\$3000 to NZ\$4000.

<sup>12</sup> This section draws from and extends Milne *et al.* (2010).

<sup>13</sup> Federated Farmers, media release 4 May 2009, "ETS not needed to meet Kyoto Obligations", available at: <http://www.fedfarm.org.nz/n1449,56.html>

<sup>14</sup> 22 April 2009, Hansard Vol. 653, p. 2615. Being in Government, however, does seem to have curtailed Smith's position. In opposition, he was more forthright about the estimates. "This latest figure of \$1.009 billion shows how incompetent Labour has been on climate change. This blow-out in New Zealand's Kyoto liability is a consequence of the record levels of deforestation that have occurred since 2004 and the failure of Labour's costly and ineffective policies on greenhouse gas emissions" (5 May 2008, Finance, infonews.co.nz).

<sup>15</sup> Unlike financial accounting, with its transactions basis, GHG inventory teams are far more willing to accept all they can do is *estimate* GHG emissions. Even for periods that have elapsed, they know they are providing educated guesses of carbon emissions based on a series of models and assumptions. And when these change, they re-estimate emissions levels, even for prior periods.

<sup>16</sup> In addition to projecting the net quantum of GHG for 2008 to 2012, the Ministry for the Environment is also responsible for reporting New Zealand's annual GHG Emissions Inventory. The "net position" reports for the five-year CP1 dovetail with the annual GHG inventory reports which seek to estimate and report the annual national GHG emissions. GHG Inventory reports operate two years in arrears. So, for example, the 2011 GHG Inventory Report estimates the annual emissions for 2009, the 2010 GHG Inventory Report estimates the annual GHG emissions for 2008 and so on. Come 2014, all five GHG Inventory reports (2010 to 2014) will cover the first commitment period 2008-2012.

<sup>17</sup> These 1990 levels were calculated in the GHG Inventories 2007 and earlier. A complicating factor is that subsequent GHG Inventories may periodically re-estimate prior years' levels, and especially the benchmark year of 1990. In 2008, for example, the 1990 level was re-estimated at 60.8 MtCO<sub>2</sub>e, and in 2009 it was re-estimated at 59.1 MtCO<sub>2</sub>e. Most of the revisions are associated with revised methodologies for calculating agricultural emissions, and in some instances waste. In 2008, for example, 1990 level agricultural emissions were revised down to 31.9 MtCO<sub>2</sub>e, and in 2009, they were again revised down to 30.3 MtCO<sub>2</sub>e. In 2009, 1990 waste emissions were revised down to 2.1 MtCO<sub>2</sub>e.

<sup>18</sup> Based on the 2009 re-estimated 1990 emissions level of 59.1 MtCO<sub>2</sub>e.

<sup>19</sup> Readers might tend to believe that New Zealand primarily generates electricity from hydro-electric sources. And at one time electricity generation was virtually entirely generated by hydro. 55% of electricity now comes from hydro, with a further 12% coming from other renewable like wind, biomass, geothermal. However, the increasing trend over the past few decades has been greater reliance on thermal (coal and natural gas) generation which now accounts for 33% of electricity generation.

<sup>20</sup> See <http://www.greenpeace.org/new-zealand/en/take-action/Take-action-online/Sign-On/>