

Editorial**Carbon Cost Accounting:
The Impact of Global
Warming on the Cost
Accounting Profession***Janek Ratnatunga****Abstract**

With the advent of the ratification of the Kyoto Protocol by most of the world, including recently, Australia, business entities need to consider issues such as trading in carbon allowances (or permits), investment in low- CO₂ emission technologies, counting the costs of carbon regularity compliance and passing on the increased cost of carbon regulation to consumers through higher prices. Such considerations require information for informed decision making, thus the need for cost accounting and cost management techniques and measures is evident.

It is demonstrated in this paper that the information from the strategic cost accounting systems will be particularly useful in this new carbon-economy, especially in evaluating the ‘whole-of-life’ costs in terms of carbon emissions relating to products and services.

This paper reports on a research study that was conducted to study the impact of the Kyoto protocol on cost accounting and cost management.

Keywords

**Kyoto Protocol
Global Warming
Carbon Cost Accounting
Life Cycle Costing
Whole-of-Life Costs
Product-Distance**

Introduction

In recent times there has been significant concern that human economic and consumption activity is the principle cause of global warming. The possibility of costly disruption from rapid climate change as a result of this warming calls for greater attention and precautionary measures to be put in place. A key initiative in this area is the Kyoto protocol, which dictates how governments, business entities and consumers would need to change behaviour and bring about a new economic environment.

In terms of business entities, the extent to which the protocol measures are incorporated in decision making will result in winners and losers, both economically and environmentally. Some of the key measures in the protocol that business entities are considering are: investment in low- CO₂ emission technologies, counting the costs of carbon regularity compliance and passing on the increased cost of carbon regulation to consumers through higher prices.

This paper reports the findings of a research study that was conducted in the second half of 2003, to determine the impact of the Kyoto protocol on cost accounting.¹ At that time the accounting profession was just starting to consider the implications of accounting for emission allowances.² However, most of the work was being undertaken in the area of financial accounting (Ratnatunga, 2007). In this study the researchers concentrated on how cost accounting considerations will impact on carbon emission reduction activities.

¹ The research project was financed by the Institute of Certified Management Accountants (ICMA) (Australia) under its competitive grants scheme.

² The International Accounting Standards Board (IASB)'s International Financial Reporting Interpretations Committee (IFRIC) decided to accelerate work on replacing IAS 20 by considering the impact of emissions trading on this standard.

* Monash University

As there is no literature available in the academic journals that deals specifically with the impact of carbon trading on cost accounting theory and practice, the researchers felt that the undertaking of an empirical-descriptive study of practices in the field was of little value as the area was so new and there were little (if any) practices to report. What was required, therefore, was 'theory building' research of a normative or prescriptive nature. Such theory building research was just starting in financial accounting (see Ratnatunga, 2007). This study looked instead at the cost accounting area by canvassing the views of practitioners in the area.

Carbon Emissions Trading

One of the recommendations of the Kyoto protocol is that a *cap-and-trade* scheme should be established in each country that ratifies the protocol, especially those placed under agreed carbon emission limits. It would work like this: companies are told how much CO₂ they can emit (the cap). If they produce less than the cap, they have surplus credits for sale.³ If they emit more than their cap they can buy credits from other businesses that come in under their cap (the trade). Trade takes place in an over the counter market, or via a Carbon Credit Exchange trading market.

One of the earliest such trading schemes is the *European Union Emission Trading Scheme (EU ETS)* which is the world's largest multi-country cap and trade system. The EU has established a cap that limits emissions for its member states, each of which has been given a specific number of credits. The total amount of credits cannot exceed the cap, limiting total emissions to that level.

In order for a *cap-and-trade* scheme to work, there must be an agreed mechanism, referred to as 'carbon emission and sequestration (CES) accounting', for calculating the quantum of CO₂ either emitted by a source or sequestered in a biomass sink. The CES accounting mechanism must be sufficiently robust that

3 Called 'Renewable Energy Credits (RECs).

the carbon trading market has confidence that the amount of carbon sequestered can be both measured and considered to be equivalent in its impact on global warming potential to the CO₂ released to the atmosphere from activities producing greenhouse gases. Confidence in the CES accounting system is fundamental to building confidence in use of CO₂ sequestration in a carbon trading market, thereby underpinning growth and investment in new carbon sequestration activity.⁴

As can be appreciated, the detailed requirements for a CES accounting system are continually being developed by organisations such as the Intergovernmental Panel on Climate Change (IPCC, 2007) under the United Nations Framework Convention on Climate Change (UNFCCC). Any CES accounting standard developed by a country or NGO will need to be consistent with the IPCC principles before carbon credits generated from carbon sinks can be used in an emissions trading regime under the Kyoto Protocol.

Carbon Cost Accounting

From the above discussion it can be seen that business entities will need to consider new business practices in order to take advantage of (or at least not be disadvantaged by) mandatory carbon rationing and trading schemes under the Kyoto protocol. In this paper, cost accounting and cost management issues relating to implementing such business practices are discussed.

As discussed before, to date, the focus (if any) has been mainly on financial statement accounting and taxation. Little, if any, work has been done in the accounting profession on cost accounting and project evaluation has been undertaken in the area.

4 Forestry projects are the largest source of carbon offsets in Australia because Kyoto compliant land – cleared before 1990 – is plentiful, the science is available and photographs of trees are good for publicity (Amita Tandukar, "From Neutral into Drive", BRW, Innovation, March 15-21, 2007, pp. 74-75).

Traditional cost accounting relates direct and indirect costs⁵ to cost objects such as products, services, customers and organisational processors. A cost can be assigned 'directly' to a cost object if it is traceable solely to that cost object; and if not, it is allocated (see Sharma and Ratnatunga, 1997, for a comprehensive discussion of costing systems). Recent discussions in the literature are mainly to do with allocation related cause-effect relationships such as using a direct labour only (single cost driver) or using Activity Based Costing Systems (multiple cost drivers) (see, Johnson and Kaplan, 1987 and Cooper and Kaplan, 1988). In product costing, the 'cost' is computed up to the stage that goods are available for sale. Costs incurred subsequent to the product being sold are usually not calculated, except in cases where a product carries a warranty, or some other after-sales service component. Then, the probability cost of that service is incorporated into the cost (or price). Some costings may also include the cost of money blocked in accounts receivable, i.e. the credit period being treated as an 'after-sales service'.

Carbon cost accounting is a subset of the push towards 'environmental cost accounting' (see Mathews, 1997 and Adams, 2004) that highlights the cost impacts 'beyond' those related to a specific cost object such as a product. Let us take a product such as a computer printer as an example. Typical environmental costs (both prior and subsequent to the sale) are:

Raw Material: Raw material environmental costs are simply the cost of the raw materials such as plastics, cartridges and steel in the waste. Every time a raw material is used and does not become a product, it becomes a waste. Even when such material become saleable products, on the obsolescence of the product, it goes into landfills as waste.

Labour: Prior to sale, the typical labour environmental costs would be the labour component of an off-specification product that becomes waste. Post sale, the labour costs that are required for re-cycling of parts is an environmental related cost.

Overhead: Utility costs, such as water and energy, are also often overlooked in determining the true cost of waste generation, both before and after a sale. These costs are a significant item in CO₂ emissions management.

Waste Management: The most obvious environmental expenses are the treatment and disposal costs of waste generated in the production process. Other waste management costs may include the expenses to collect samples, paper work, permit fees, consulting fees, and potentially fines for violations. The flip side of the hidden costs and impacts of waste generation is the hidden benefits resulting from actions taken to improve the environmental performance of a particular facility.

Recycling: This is a form of waste management at the obsolescence end of the product life cycle. This requires a three pronged approach: (1) the opportunity cost calculation (including the environmental impacts) of recycling components of existing hardware vis-à-vis using new components (2) locking in recycling cost efficiencies at the design stage of new hardware (3) using the cost-benefit analyses of the first two stages to influence Government policy on tax credits etc. for undertaking such environmentally sustainable programs. The U.S. Environmental Protection Agency (EPA) has an Environmental Accounting Project which encourages business to understand the full spectrum of their environmental costs and integrate these costs into decision-making.⁶

⁵ These cost categories are based on the nature of the expenditure items, such as the cost of raw materials, human input (labour) and overhead (rent, depreciation etc.)

⁶ See <http://www.epa.gov/oppt/library/pubs/archive/acc-t-archive/index.htm>

There are often conflicts between the different cost categories. A study by CNW Marketing Research⁷ says that the total energy cost used in manufacturing, driving and recycling a Hybrid Toyota Prius is higher than that of most conventionally powered vehicles. The two-year study (claimed to have been independently funded) included factors such as:

- How many years it took to develop the vehicles.
- How the material used was processed and how far these had to travel to get to manufacturing stage.
- How far auto workers travelled, and whether or not they used public transportation.
- The energy used in manufacturing
- The percentage of materials that can be effectively recycled.
- The percentage of labour produced by robots versus humans.
- Variable estimated lifetime of components.
- Cost of fuel used over an estimated lifetime of 100,000 miles.
- Expected parts that would need to be repaired.

This study showed that hybrid cars, whilst clearly using less fossil fuel to run, are environmentally more expensive to manufacture and to re-cycle than conventional cars (CNW Marketing, 2007). For example, the 'whole-of-life costs' for a Hummer H3 (placed number 30 overall) was A\$1.8126 per Km, whilst the Toyota Prius Hybrid (placed number 24 overall) was A\$3.0675 per Km. The least cost car in the study was the Jeep Wrangler (A\$0.5743 per Km) and the highest was the Mercedes Benz Maybach (at number 96) with a cost of A\$10.9416 per Km (de Fraga, 2007).

How is this so? Let us consider the Hybrid car as a case study example. The raw material costs of the special electric battery required by the hybrid. The nickel for the battery for the Toyota Prius hybrid is mined

in Sudbury, Ontario, and smelted at nearby Nickel Centre, just north of the province's massive Georgian Bay. The smelter has a 1,250 foot-tall smokestack that is claimed to emit large quantities of sulphur dioxide to the surrounding area. This is included in the 'whole-of-life' calculation. Toyota buys about 1,000 tons of nickel from the facility each year, ships the nickel to Wales for refining, then to China, where it is manufactured into nickel foam, and then onto Toyota's battery plant in Japan. That alone creates a globe-trotting trail of carbon emissions that from start-to finish is estimated to travel more than 10,000 miles - mostly by container ship, but also by diesel locomotive (Martin, 2007). At the end of its life, the battery has to go back to Japan for recycling, again often travelling large distances and burning more CO₂. In fact, due to the costs involved, to date none of Prius batteries in Australia have been sent back to Japan for recycling. They will most likely fill landfills (de Fraga, 2007). As expected, Toyota has challenged the CNW study, stating the energy ratios used in the study pertaining to the manufacture-driving-recycle lifecycle of a car is very different to other studies done by the Argonne National Laboratory and the Massachusetts Institute of Technology. The latter studies found that whilst hybrids require more energy to manufacture and recycle, 80-85% of life-time energy is used in driving, where the hybrids have a clear advantage. The CNW study shows these percentages to be reversed (de Farga, 2007), hence disadvantaging the hybrids.

Another example of lifecycle carbon cost accounting was in Australia, where the power company, Origin Energy, began changing its environmental practices when it audited the lifecycle of its products, from production to consumption, to discover it contributed about 30 million tonnes of carbon dioxide to the environment - about 8 per cent of Australia's total emissions. Since undertaking the audit, Origin has invested \$20 million in solar energy, spent an extra \$500,000 converting to sustainable power for its own use, and signed up 12 per cent of its customers to a "green-power" alternative. The company's work is audited by accounting firm Ernst & Young which

⁷ See <http://www.cnwmr.com/nss-folder/automotiveenergy/> (accessed May 6 2007)

uses the International Auditing and Assurance Standards Board framework, ISAE 3000 (Walters, 2006).

The problem with studies of this nature is that the complicated set of assumptions can greatly influence the outcome. In the case of hybrid cars, the assumptions regarding the carbon emitted in the manufacture-driving-recycle lifecycle of a car (as will individual driving patterns) is crucial to the calculated results. In the case of the Origin Energy company, different results most likely would have been computed if Ernst & Young's used the AccountAbility (2007) AA1000 or any other standard, rather than ISAE 3000.

There are many approaches to obtaining 'assurance' of emissions calculations (see Ratnatunga, 2007) all having different methodologies. Whilst no study, approach or methodology can be considered definitive, there is clearly a need for reasonably accurate calculations of carbon costs, using life-cycle accounting and costing techniques (see Table One)

In undertaking a life-cycle costing exercise using carbon allowance costs, the issue of transaction costing vs. opportunity costing needs to be recognised. Some studies may take an opportunity cost approach and determine that the freely allocated allowances are worth the same as purchased allowances. Others take a more transactional 'environmental compliance approach' and treat as a 'hard cost' only the cost of purchased allowances over the year.

Companies that start managing for environmental efficiency will also automatically cut costs and boost revenue. There is a view developing in some businesses that there is a direct measurable correlation between environmental efficiency and economic results. For example, Westpac, one of Australia's large banks, sees carbon costing no longer as an "add on" but central to its operations. They claim that the reduction of emissions at the Bank had significantly boosted its bottom line (Weekes, 2007).

The Focus Group Research Study

The issues relating to carbon cost accounting discussed before, and the possible business impacts were discussed at length in 31 research symposiums in 11 countries with a total of 638 respondents, in the period mid 2003 to early 2007. The objective of the research was to get 'focus groups' opinions of issues confronting business as a result of the Kyoto Protocol.

The research symposiums (one-day each) were undertaken in Australia (8), Canada (4), India (1), China (1), Lebanon (2), The Philippines (1), Papua New Guinea (2), Indonesia (4), Sri Lanka (4), Malaysia (2), Singapore (1), United Arab Emirates (1). The countries chosen were where there were established branches of the ICMA (Australia). The participants were self-selecting as although the symposiums were advertised only to members of the ICMA⁸, they had to pay a fee for attending. The participants were all holding senior positions in their organisations, such as cost accountant, management accountant, business analyst, CFO and CEO (or similar). The issues of global warming and carbon trading and the impact of these on the accounting profession was the focus of discussion at the symposiums. Although the discussion of issues was free flowing, the researchers guided the discussion in the focus groups to the carbon emissions area. All discussions were recorded, and the key points extracted from the focus groups are presented in Tables One and Two.

Table One overviews all the product / service costing areas that can produce bottom-line improvements via efficient carbon management throughout the lifecycle, and Table Two considers potential issues that could arise in Strategic Carbon Cost Management. These tables are the summarised views emanating from the research symposiums.

⁸ Members of the ICMA (Australia) must have a degree in accounting, specialist training in management accounting and at least 5-years relevant experience. A majority of members also have a Masters in Accounting or MBA degree.

Table One: The Whole-of-Life Impact of Carbon Emission Efficiencies on Costs and Revenues

Areas of Cost Reduction or Revenue Generation via Efficient Carbon Cost Management :	Pre- Sale Environmental Impact	Post - Sale Environmental Impact*
<i>Raw Materials</i>	Production Waste	Landfill Waste
<i>Human Input</i>	Wasted Time on Rejects and Recovery	Time to separate recyclable components
Traditional Overhead Expenses		
<i>Electricity</i>	All of these overhead items have carbon emissions that will affect if the organisation is a <i>net- sequester</i> or <i>net-emitter</i> . Techniques utilised to reduce CO ₂ emissions via using alternative energy sources etc., will impact on the carbon credit cost item shown under the Environmental overhead category.	
<i>Rental</i>		
<i>Marketing</i>		
<i>Transportation</i>		
<i>Administration</i>		
<i>Depreciation of Machinery</i>		
<i>After Sales Service Costs</i>		
Environmental Overhead		
<i>Regulatory Costs</i>	Meeting Emissions Standards	Litigation Costs of Environmental Pollution
<i>Waste Management</i>	Production Waste	Landfill Waste
<i>Recycling</i>	These costs can be reduced via the proper design of components at pre-production stage. Such design costs should be amortised over life of product, via Life-Cycle costing.	
<i>Amortisation of Design Costs</i>		
<i>Carbon Credit</i>	This can be a cost or revenue item depending on if the organisation is a <i>net- sequester</i> or <i>net-emitter</i> .	Purchase/sale of carbon credits depending on if the organisation is a <i>net- sequester</i> or <i>net-emitter</i> .
Financing Costs		
<i>Stock Holding Costs</i>	These costs include cost of capital, excess handling, obsolescence, deterioration, stock administration and insurance	These costs include cost relating to warranty returns such as excess handling, deterioration, stock administration and insurance
<i>Debtors Costs</i>	None	These costs include cost of capital and the risk of bad debts
<i>Carbon Tax</i>	This tax could be an additional cost or revenue item (Tax Credit) depending on if the organisation is a <i>net- sequester</i> or <i>net-emitter</i>	
* These Post Environmental Costs can be incorporated into product costs using probability estimates		

Table Two: Issues in Strategic Carbon Cost Management

SCM Issue	Carbon Management Impact
<i>Management Control Systems</i>	Employee behaviour modification to achieve carbon efficiency targets
<i>Production Management</i>	Lean production techniques. More attention to the use of energy in machinery, less materials and time wastage. JIT philosophy.
<i>Employee Safety</i>	Ensuring low energy work environment do not cause hazardous working conditions
<i>Wages & Trade Union Demands</i>	May demand more if comfort levels fall. More demands for the sharing of high carbon windfall profits
<i>Total Quality Management</i>	Carbon efficiency seen as part of quality equation
<i>Purchasing Management</i>	Production resources (components, labour, and overhead) sourced locally.
<i>Cost Control</i>	Lean Accounting. Significant attention paid to reduce carbon emission costs. More use on Backflush Costing methods
<i>Make or Buy Decisions</i>	Consideration given to carbon emissions when considering alternatives
<i>Cost Classification</i>	Carbon costs classified into direct, indirect, fixed and variable costs.
<i>Allocating Indirect Costs</i>	Variation of ABC by having consideration of 'carbon cost drivers' to link emission indirect overhead to products and services
<i>Life Cycle Costing</i>	Amortisation of design costs to make products more carbon friendly and worker training costs to reduce carbon emissions
<i>Target Costing</i>	Redesigning products and services to meet carbon emission targets
<i>Benchmarking</i>	Comparing the KPIs of World Class performers in carbon efficiency
<i>Customer Profitability Analysis</i>	Segmenting customers by profitability per carbon usage
<i>Process Control and Activity Based Management</i>	Evaluating the performance of organisational processes, including white-collar departments in terms of achieving carbon efficiency KPIs.
<i>Efficiency or Productivity</i>	Consideration given not only to economic efficiency, but also carbon usage efficiency.
<i>Price Relationship or Recovery</i>	Reductions in purchase prices considered via the sale of carbon efficiency credits
<i>Overall Effectiveness</i>	This profitability of the bottom-line figure given in terms of both economic and environmental effectiveness.
<i>Value-Adding/Non-Value Adding Work</i>	All reworks, recoveries, errors etc. considered to be avoidable carbon emitting activities
<i>Executive Information Systems (EIS)</i>	The drill-down facilities to be extended to financial and non-financial carbon emitting measures.
<i>Corporate Governance</i>	Accountability and transparency issues extended reporting on carbon management initiatives
<i>Enforcement and Compliance</i>	Voluntary and mandatory enforcement of carbon emission targets
<i>The Strategic Audit</i>	Extended to cover the expected future carbon footprint of the organisation due to its production, marketing, logistics, capital investment and HRM practises
<i>Corporate Reputation Audit</i>	The evaluation of the organisation's image and brand with regards to being a responsible carbon citizen of the world.

Summary

The concentrations of greenhouse gases in the atmosphere have risen dramatically leading to an out-of-balance greenhouse effect that most scientists believe will continue to cause a very rapid warming of the world's climate.

The possibility of costly disruption from rapid climate change either globally or locally, calls for greater attention and precautionary measures to be put in place. Governments, business entities and consumers would be impacted by the extent to which such precautionary measures are incorporated in their decision making process.

Business entities especially need to consider issues such as trading in carbon allowances (or permits), investment in low-CO₂ emission technologies, counting the costs of carbon regularity compliance and passing on the increased cost of carbon regulation to consumers through higher prices. Consumers need to consider if, given a choice, they are willing to pay a higher price for CO₂ neutral products and services so as to play their part in reducing CO₂ emissions.

These decisions and their consequences will impact the cost and management accounting profession significantly. Information from the strategic cost and management accounting systems will be particularly useful in this new economy that global warming has forced upon us. New costing techniques need to be considered to evaluate the 'whole-of-life' costs in terms of carbon emissions relating to products and services.

References

- AccountAbility, (2007), "Application of the Principles of Materiality, Completeness and Responsiveness as they Relate to the AA1000 Assurance Standard", available at <http://www.accountability21.net/aa1000/default.asp?pageid=286>, accessed 30 March 2007.
- Adams, C. A. (2004), "The ethical, social and environmental reporting-performance portrayal gap", *Accounting, Auditing and Accountability Journal*, 17(5), pp.731.
- CNW Marketing Research, Inc. (2007), "Dust to Dust: The Energy Cost of New Vehicles: From Concept to Disposal", <http://www.cnwmr.com/nss-folder/automotiveenergy/DUST%20PDF%20VERSION.pdf>
- Cooper, R. and Kaplan, R.S., (1988) "Measure Costs Right: Make the Right Decisions", *Harvard Business Review*, September-October, pp. 96-103.
- De Fraga, C. (2007). "How Green is Your Hybrid?", *Royal Auto*, May, pp. 64- 66.
- Intergovernmental Panel on Climate Change (IPCC), (2007), "Climate Change 2007: The Physical Science Basis", available at www.ipcc.ch/SPM2feb07.pdf, accessed 30 March 2007.
- Janissen, B. (2007), "Emissions Trading: New Markets for the 21st Century", INFINACE, March, pp. 38-40.
- Johnson, H.T. and Kaplan, R.S., (1987) *Relevance Lost: The Rise and Fall of Management Accounting*, Harvard Business School Press, Boston.
- Martin, J.L. (2007) "The Hidden Cost of Driving a Prius" <http://www.cnwmr.com/nss-folder/automotiveenergy/Hidden%20Cost%20of%20Driving%20a%20Prius%20Commentary.pdf>, accessed May 6 2007.
- Mathews, M. R. (1997). "Twenty-five Years of Social and Environmental Accounting Research: Is there a silver Jubilee to Celebrate?" *Accounting, Auditing and Accountability Journal*, 10(4), pp. 481-531.
- Ratnatunga, J., (2007), "The Inconvenient Truth about Accounting", *Journal of Applied Management Accounting Research*, 5(1), pp. 1-20.
- Sharma, R., and Ratnatunga, J., (1997), "Traditional and Activity Based Costing Systems", *Accounting Education: An International Journal*, 6(4), pp. 337-345.
- Tandukar, A. (2007), "From Neutral into Drive", *BRW - Innovation*, March 15-21, pp. 74-75.
- Walters, K. (2006), "Certified Green", *Business Review Weekly*, 16-22 November, pp. 39-40
- Weekes, P. (2007), "Firms Go It Alone on Carbon Trading", *The Sunday Age*, April 8, Business, p. 17