The Valuation and Reporting of Organizational Capability in Carbon Emissions Management

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Abstract

Under various carbon emissions trading schemes proposed around the world (including the United States), organizations will need to implement carbon management schemes to meet carbon ration targets, earn revenue and reduce costs. Emission Trading Schemes will impact the accounting profession significantly; however, discussions on how to report these transactions are in the very formative stages. So far the accounting literature has focused on the reporting of *current* carbon assets and liabilities in the balance sheet and the timing effects of carbon releases in the income statement. However, there has been little or no discussion as to how to value and report the underlying *non-current* assets (and liabilities) that produce or use carbon allowances on the *balance sheet.* This paper proposes a model for valuing an organization's non-current carbon sequestration and emission capabilities. A new metric, *Environmental Capability Enhancing Asset (ECEA),* is introduced as the underpinning for the conversion of non-monetary CO_2 emission and sequestration measures to monetary values. The process of bringing these monetized values within the boundaries of conventional (double-entry) GAAP is also demonstrated.

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Introduction and Prior Literature

Governments internationally are grappling with the economic and political realities of global warming, particularly mounting public pressures to foster an economically and socially sustainable carbon constrained economy. The first major international regulatory response has been the *Kyoto Protocol*, which outlined various strategies for reducing global carbon emissions. This included a proposal to establish an *International Emission Trading* scheme whereby countries can trade in the international carbon credit market. In such a scheme, countries with surplus credits can sell them to countries with quantified emission limitation and reduction commitments under the Kyoto Protocol. Those countries with emissions reduction targets, will in turn set up a cap-and-trade scheme to pass on these pollution limits to business entities who are told how much CO_2 they can emit (the cap). If companies emit more than their cap they can buy carbon 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.[1]

While alternative methods have been mooted for the reduction of carbon emissions, such as those agreed to at the APEC conference in Sydney (Mackey, 2007), the *Kyoto Protocol* remains the international standard until 2012.[2] The 'cap-and-trade' approach underpinning a carbon trading market is receiving serious political consideration in Australia and the United States, notwithstanding some initial setbacks to these proposals.[3] In an effort to respond to the *Kyoto*

[1]Although a truly international Emissions Trading Scheme (ETS) is still to become a reality, there are many regional and country-specific ETSs that have been established or being considered, both within and outside the Kyoto protocol.

[2] More recently, the Copenhagen Climate Summit (December, 2009) attempted to establish a new legally binding global climate framework for the period from 2012 when the first commitment period under Kyoto expires. However, the high expectations for the conference were followed by more diminutive outcomes. The conference was only salvaged by a last minute US brokered political accord which was agreed to by several countries (and involved $US30B in new and additional resources, including forestry and investments through international institutions), but it failed to achieve broad consensus.

[3] Australia's cap-and-trade approach under the Carbon Pollution Reduction Scheme (CPRS) bill was defeated in the Senate in January 2010, forcing the Government to delay the planned commencement of a carbon trading market until 2013. The American Clean Energy and Security Act of 2009 passed by the US House of Representative on June 26, 2009, proposes a variant of cap-and-trade approach to reducing carbon emissions. The Bill is still under consideration in the US Senate.

Protocol, the Europe Union has established and maintained (since 2005) the world's largest carbon emission trading market (Cooke, 2008).

Notwithstanding some political head winds, the cap-and-trade approach remains the preferred political and economic approach to reducing carbon emissions in many countries. However, from an accounting perspective, carbon trading markets raise a plethora of valuation, measurement, and financial reporting considerations, many of which will need to be addressed by professional accountants, standard setters, regulators and academics as carbon trading markets begin to emerge around the world.

While there is some level of professional discussion (and possibly consensus) on how credits which are acquired (whether purchased or obtained from a government grant) should be reported in the financial statements, there has been no discussion in the literature of the valuation and reporting of assets capable of producing (and using) carbon credits, particularly when these assets are generated internally by the organization (rather than acquired). This paper proposes an analytical model for valuing an organization's assets that have carbon credit producing capabilities. We propose a new metric, *Environmental Capable Enhancing Asset* (or *ECEA*), which we define as those intangible assets of the organization capable of producing (or using) carbon credits. A key issue our proposed valuation model addresses is the values assigned to the model's coefficients reflecting the capability of *ECEAs* to emit or sequester CO_2 in the future. Also discussed in this context is the relationship between carbon emission sequestration measurements (such as measuring CO_2 itself) and the organization's overall *ECEA* value. The paper then proposes how *ECEA* values (and potentially liabilities) can be recorded for financial reporting purposes and potentially integrated into conventional financial statements.

Discussion of these issues in academic and professional circles is still very much in the formative stages, as evidenced by the diverse and rather disjointed nature of this literature. Freedman and Jaggi (2005) undertook early academic work on the Kyoto protocol by looking at the accounting disclosures of the largest global public firms in polluting industries. Their results show that firms from countries that ratified the Protocol have higher disclosure indexes as compared to firms in other countries. Furthermore larger firms tend to disclose more detailed pollution information.

A year later, Kundu (2006) examined financial aspects of carbon trading in a professional journal article. Ratnatunga (2007) integrated the academic and professional discourse by highlighting the difficulties that the accounting and assurance professions are having in measuring, reporting and verifying the monetary values of carbon credits bought and sold in Emission Trading Schemes. He called for academics to come up with solutions for implementation by the profession. Bebbington and Larrinaga (2008) undertook a closer inspection of the risks and uncertainties that arise from global climate change initiatives and discussed the benefits of remaining within a non-financial accounting and reporting framework with regards to carbon. That study put forward an integrated measurement and reporting framework that could potentially be used as more and more organizations increase their carbon emissions management capabilities. Hopwood (2008) highlighted a number of questions that have emerged in accounting for carbon emission permits and corporate environmental reporting, and Callon (2008) discussed the many controversies regarding carbon trading schemes and related measurement schemes. Lohmann (2008) addressed the problems caused by environmental accounting issues on conventional accounting reporting, and Cook (2008) suggested possible solutions that could be considered by the International Financial Reporting Interpretation Committee (IFRIC).[4] In terms of internal reporting, Ratnatunga and Balachandran (2009) considered the impact of carbon trading on the strategic cost management and strategic management accounting information systems.

As we might expect from an exploratory literature dealing with new and emerging issues, the literature is rather discursive and haphazard, providing little in the way of structured in-depth analysis of the major valuation and financial reporting issues likely to arise from the introduction of carbon trading markets. This study advances the literature by proposing a comprehensive valuation model and financial reporting framework to deal with a specific but important issue arising in this field: the valuation and reporting of environmental assets capable of sequestering CO_2 (*ECEAs*), and how these asset values can be effectively recorded and integrated into conventional balance sheets.

The remainder of the paper is organized as follows. Section one considers the implications of carbon trading activity to the accounting profession. This is followed by a discussion of

[4] One such suggestion was to maintain the status quo. Although Cook (2008) did not advocate this, nor did IFRIC consider maintaining it, by default this appears to be the current situation.

intangible asset valuation issues, which includes an analysis of our proposed valuation model for *ECEA* valuation and a discussion of accounting measurement issues relating to carbon emission and sequestration. Our *ECEA* metric underpins the conversion of non-monetary CO_2 emission and sequestration measures to monetary values. Section three discusses carbon financial accounting and recording issues. This section outlines a proposed financial recording and reporting process for bringing the monetized *ECEA* values within the boundaries of conventional (double-entry) GAAP. This section is followed by a discussion of alternative approaches to integrating *ECEA* values formally into the financial statements. Finally, some concluding comments and study limitations are presented.

The Implications of Carbon Trading Activity for the Accounting Profession

There are two types of carbon credits: (1) Those issued by governments (akin to ration cards) and (2) those created by an organization internally to be sold in an emissions trading scheme or used as an offset to reduce its carbon liability. Governments may issue credits free or sell them at a grant-date price. These credits are in fact, 'permits to pollute' (i.e., emit CO_2). Organizations can then surrender these credits in line with their pollution levels. If they do not pollute as much as the carbon credits they hold, the excess permits can either be sold (income) at the prevailing market price, or held (asset) as an offset against future pollution, which is the liability.

Consider a credit issued by the government to be like a set of concert tickets purchased (or obtained free) in advance for a season of concerts that is deemed by the government as being required to attend. Once a concert is attended (i.e., carbon emissions pollution happens) then a ticket must be surrendered. Excess concert tickets may be sold to those needing tickets at prevailing market (scalper) prices, and vice-versa. Such government issued credits are tangible assets like inventory. As such, there are many possible accounting treatments for such tangible assets, and the underlying liability, which will be overviewed later.

The second type of credit originates as governments may permit some organizations (such as electricity companies and forestry organizations) to issue their own credits (called 'abatement certificates') if they can document that they have undertaken carbon sequestration activity during a period.[5] The credits internally generated require a very different accounting treatment to those issued by governments, as the underlying assets that have the capability of creating such credits are *intangible* in essence. It is the valuation and reporting of such *organizational capability* that is the main focus of this paper.

Traditionally, the monetary basis on which the various stakeholders of business entities make their investment and other commercial decisions, and evaluate the results of those decisions has been through the framework of financial accounting. Due to the wide-ranging use of financial reports by multiple stakeholders, in order to ensure that the numbers reported can be relied upon, the profession has developed an auditing and assurance framework which aims to provide a 'true and fair' assessment of such reports and the quantification of the economic values therein. In terms of carbon auditing and assurance, there are three major issues with the latter two still remaining unanswered: (1) the valuation and reporting of carbon credit permits; (2) the valuation and reporting of the intangible assets capable of creating carbon credits; and (3) the reporting of how an organization is meeting its environmental and social responsibilities (Jones and Belkaoui, 2009). We will discuss these three issues, specifically focusing on the impact of carbon trading below.

With regards to the first issue, i.e. the valuation and reporting of carbon credit permits, there are three main accounting issues that have been addressed in prior discussions: (1) How should the permits be valued at the grant date and over time and when should they be reported in the income statement?; (2) How should the liability be valued over time and when should it be reported in the income statement?; and (3) How should the grant liability be recorded?

The state of current discourse on these issues is summarized in Appendix 1, which seems to show some consensus within the accounting profession that once carbon credit permits are issued, purchased or created, a company should recognize them as a *new asset* on the *balance sheet* (akin to inventory).As actual emissions occur a *liability* should be recognized and *changes in the market price* of permits (i.e., gains and losses on allowances) should be recognized in the *income statement.* Cook (2008) argues that the allowance (permit), the emissions liability and the grant liability should be recorded separately at fair value and changes in the fair values should be reported in income.

[5] Under some carbon related legislation, such as that proposed in Australia, all organizations that are brought under a carbon rationing scheme, have a potential capability of using internally generated carbon credits as an offset against their carbon liability.

With regards to the latter two issues in terms of carbon auditing and assurance, there has been (1) no specific discourse to date regarding the valuation of the assets (and liabilities) capable of producing (and using) the credits that underpin a carbon trading market; and (2) once valued, how these values should be reported to show how an organization is meeting its environmental and social responsibilities. Some might argue that such discourse falls within the rich literature on the valuation and reporting of intangible assets generally, and that credits creating intangible assets are essentially no different. We hope to demonstrate in this paper that, in fact, a special case should be made for the valuation and recording of carbon sequestration assets (i.e., the *ECEA*s).

Intangible Asset Valuation Issues

It is true that valuation problems affect most intangible assets, let alone the value of the underlying asset that generates a carbon credit. For example, how should a customer list be valued? Should it be at replacement cost in terms of the marketing and advertising for re-building it? Or should it use income projections? Or should it be the incremental income due to the customer list? Or be a market price, determined by how much it would sell for if it is sold? There are several possible responses. Thus, traditional valuation approaches of replacement costs, income projections (or discounted cash flow) and fair values typically do not work well for intangible assets, partly because the value of these assets depend at least in part on the value of the firm which is frequently not verifiable (see e.g., Watts, 2003, 2006).

New valuation approaches have therefore been considered in the literature (see Leadbeater, 2000). These new valuation approaches are developing from two directions. First, there is a range of new approaches to performance measurement and internal corporate reporting using modified discounted cash flow techniques and accrual accounting adjustments. Second, there are the index-based measures (such as the Balanced Scorecard), which attempt to link financial performance to intangible drivers such as employee quality and morale and customer satisfaction. Both of these streams of development can potentially be modified to the valuation and reporting of carbon sequestration assets.

These approaches are by no means exhaustive. Different kinds of measures might be more relevant to different audiences. Some are designed primarily to give managers and employees a clearer picture of the strengths and weaknesses of their business and change the way they think and act. Others may be designed to help analysts and investors assess the contribution that intangible assets make to financial performance. The cash flow and index based valuation approaches will now be briefly summarized.

(1) *Cash Flow Measures*: Here the future cash flow stream associated with an intangible asset is projected and discounted to the present value.[6] Another related approach is 'Shareholder Value Added (SVA)'; developed by Rappaport (1986) and which gained prominence during the 1980s. The SVA approach uses 'value- drivers' to measure the present value of past and projected free cash flows from strategic and non-strategic investments. The link of cash flow generation to share market valuations is not decisively established. One professional study found a high correlation between cash flow and market valuations (Deloitte and Touche, 1996). Another study found that between 1977 and 1996, operating cash flows were not a better guide to market value than reported earnings, notwithstanding that the study relied on estimates of operating cash flow (Lev and Zarowin, 1998).

(2) *Index-Based Measures:* These measures use coefficients to translate financial and non-financial 'Key Performance Indicators' (KPIs) to financial performance values (such as ROI). The Balanced Scorecard (Kaplan and Norton, 1992) is one such popular approach to generating such measures, in which (translation) coefficients are obtained ex-post via multiple regression procedures or statistical extrapolation (if the past is a good proxy for the future) or via managerial judgment (expert opinion) in obtaining ex-ante consensus-based indexes.

One such index-based measure is the *Capability Economic Value of Intangible and Tangible Assets (CEVITA)* valuation approach, which uses some amount of expert opinion to provide valuations and performance measurements (see Ratnatunga, Gray and Balachandran, 2004). The approach is to estimate the dollar-value of both tangible and intangible assets by first

[6] These measures include using project options valuation with net present value and decision tree analysis (Tong and Reuer, 2007; De Reyck, Degraeve and Vandenborre, 2008).

identifying its *value-increasing* and *value-decreasing* constants, and how these constant values respond to expenditure incurred to support them. Once these constants are identified and provided by the experts, then the organization's income generating capabilities can be valued and reported. We will demonstrate that this approach provides a potentially useful basis for the valuation of assets having carbon emission and sequestration capabilities. Before demonstrating the valuation model, we first discuss some important measurement issues surrounding carbon emission and sequestration necessary for a full understanding of the model.

Carbon Emission and Sequestration (CES) Accounting

The mechanism for calculating the quantum of CO_2 either emitted by a source or sequestered in a biomass sink is referred to as 'carbon accounting'. This has very little to do with monetary values usually associated with the term 'accounting'. Therefore, in this paper we will refer to it as 'carbon emission and sequestration (CES) accounting'. The CES accounting mechanism must be sufficiently robust and reliable to attract confidence from carbon trading market participants.

As can be appreciated, the detailed requirements for a CES accounting system are continually being developed by organizations such as the *Intergovernmental Panel on Climate Change*[7] (IPCC, 2007). Any CES accounting standard developed by a country or Non-Government Organization 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.

The accounting profession would want one standardized system (one size fits all) to use pertaining to CES measures. Unfortunately, the current situation is that, although the interest in the carbon trading market is high, the new market is largely unregulated and lacks transparency. Government policy in countries such as the USA and Australia is in a constant state of change, and questions of measurement and pricing required for an efficient trading system are far from settled. For example, according to Tanduka (2007), business organizations and individual

[7] The IPCC along with Al Gore, the former USA Vice-President, won the 2007 Nobel Peace prize for their work on bringing climate change issues to the foreground.

customers[8] have no way of evaluating different energy experts'claims that their scheme provides a better measurement such that:

$$\text{X trees} = \text{the sequestration of Y tons of } CO_2 \text{ emissions} = \$Z \quad (1)$$

However, without agreed CES measurements, the variation possible in the middle section of the equation (which is the domain of CES accounting measures) could lead to gross distortions of whatever dollar value is offered in a carbon trading exchange, i.e. as the sequestration or emissions measured could be a range of values (rather than a deterministic 'agreed' value) so would the dollars received or paid for such.

Whatever the methodology or approach that is ultimately 'agreed' upon in terms of CES measures, the issue for the accounting profession is the monetary value ($Z) of the CO_2 that has been either removed from the atmosphere or saved from being emitted by an organization's products, projects, services, equipment and processes. The existence of an efficient carbon trading market would be able to put a price on this in terms of a credit (or allowance). In addition, the traditional accounting reports would need to recognize that certain non-current assets (or liabilities) could also give rise to *future* carbon related revenues and expenses. Currently, a tangible asset (e.g., a power plant or forest) that generates the carbon credit is given a balance sheet value, but the related intangible asset or liability, i.e., the CO_2 sequestration or emissions capability of such an asset (as a CO_2 sink or source) is not. We argue in this paper that, in a carbon emissions management environment, if an organization records the value of the tangible, it should record the value of the related intangible as well.

For such valuations, the accounting profession would need to obtain the services of outside consultants, such as environmental scientists and biologists to undertake CES accounting measurements. The use of such external experts is not uncommon, however. The accounting profession often incorporates reports from company directors, actuaries, business analysts, engineers, quantity surveyors, lawyers etc., especially in the area of balance sheet asset valuation and fair-value accounting. Using expert opinions in accounting for CO_2 flows would be no

[8] Sergey Brin, the founder of Google is reported as having bought carbon credits to offset the immense amount of CO_2 emitted by his private Boeing 767, but confesses he is not sure if it really achieves anything (Krauthammer, 2007).

different. However, accounting standard setters have been reticent in accepting expert opinions as balance sheet values of intangible assets, and one could envisage them having concerns with values generated via CES accounting. It is here that a shift from conventional accounting practice is required. The following section outlines the proposed model for valuing carbon sequestration assets.

Measuring the Value of Assets with Environmental Capabilities

The following illustrates a framework for valuing an organization's capability of producing carbon credits. The model is an extension and application of a mathematical valuation model first derived in Vidale and Wolfe (1957) and later applied in Ratnatunga, et.al (2004) for valuing the capability of military assets. The analysis by Ratnatunga, et al., (2004) is developed in the restricted setting of a government department (Department of Defense), where traditional valuation approaches, such as DCF and market values, typically have limited relevance. This paper explores the possibility of extending the CEVITA framework to the valuation of commercial capabilities, such as carbon credits generated by private sector organizations. This paper extends Ratnatunga, et al., (2004) by first showing that there could be a practical utility for such a model in a commercial private sector financial reporting context, particularly given the lack of viable or credible methodologies for valuing intangible assets in the literature. Second the paper demonstrates that a modified model developed specifically for the valuation of defense capabilities can be valid or generalizable to other commercial contexts, such as valuing the carbon credit generating capacity of commercial organizations.

A Valuation Model for Carbon Credit Producing Assets

In this paper, we have introduced the concept of an *Environmental Capability Enhancing Asset (ECEA)* which we define as the total *intangible* capacity of an entity to produce carbon credits. The starting point of calculating the *ECEA* values would be ‘agreed’ coefficients in terms of the capability of these *ECEA*s to emit or sequester CO_2 in the future. In Ratnatunga, et al., (2004), these coefficients are obtained by ‘consensus’ from military experts within the organization for the purpose of valuing defense organizational capabilities. However, in the special case of a carbon trading market, these values can be obtained by 'external experts', and will be based on CES accounting procedures (and the related assurances of those numbers) as discussed earlier in the paper.[9]

Once this information is obtained, then the relationship of the CES accounting measures to the *ECEA* value (generated, for example via planting and maintaining trees in a forest) is estimated using the following equation:[10]

$$\frac{dS}{dt} = r.E.\left(\frac{M - S}{M}\right) - \delta S \tag{2}$$

The equation indicates that the change in the *economic value (dS/dt)* of an *Environmental Capability Enhancing Asset (ECEA)* at time 't' is a function of five factors:[11]

E the costs/expenses incurred to support the *ECEA*

r the value-increasing - *carbon sequestration constant* (defined as the *ECEA* value generated per expense dollar when S = 0)

M the maximum value of the *ECEA* sequestration capability, based on CES accounting and physical constraints (under best growth conditions) related to the *ECEA* (i.e. trees do not sequester carbon in any significant proportion after they reach maturity)

S the current value of the *ECEA* sequestration capability (under current growth conditions)

δ the value-decaying - *carbon emission constant* (defined as the fraction of the *ECEA* value lost per time unit when E= 0)

The equation states that the change (increase) in the *ECEA* value will be higher when r, E, and the untapped *ECEA* value potentials (M – S) are higher, and the value-decaying (emission) constant (δ) is lower.

[9] As discussed earlier, these CES accounting measurements will be obtained from environmental scientists and biologists; similar to how the accounting profession currently obtains asset valuations from company directors, actuaries, business analysts, engineers, quantity surveyors etc.

[10] The theoretical underpinning of this model was derived from Vidale and Wolf (1957).

[11] Over time, and with experience, these coefficient values derived by environmental scientists should reflect the value-expense relationships that exist in most spending decisions, but remain largely unquantified.

As discussed earlier, many of the equation variables and constants need to be obtained via 'agreed' CES accounting measures supplied by experts. For the purpose of our illustration, we have assumed the science behind the CES accounting measures used is accurate, and that we have confidence (via assurance) in the values generated in the middle section of Equation 1 shown earlier.

The following example will illustrate the application of the model. A newly planted forest would be both a (tangible) *Operational Capability Enhancing Asset (OCEA)* - as it has the potential to generate future cashflow by logging and selling timber; and an (intangible) *ECEA* (as a carbon sink) with the potential to generate future cash flows by selling internally generated carbon credits due to its capability for carbon sequestration. The forest becomes more capable in terms of both operations and carbon sequestration, (1) the more trees it has, (2) the more time it has to grow to maturity; (3) the better its growing environment is (in terms of climate protection, labor provided for care and maintenance, fertilizer, etc.); and (4) the more money expended (E) to support, maintain and enhance the operational capability of the forest. Although the example presented focuses on the value of the forest's sequestration capability (*ECEA*), the same metrics can be used to value its OCEAs if agreed 'fair values' (such as by using discounted cash flow techniques) cannot be computed.

Any forest would have variable capability potentials in terms of the amount of carbon it can absorb based on its growing environment (size of land, soil, climate, the maturity stage of trees, etc.). For illustrative purposes let us assume that CES accounting experts can estimate the *sequestration of Y tons of* CO_2 *emissions* (see Equation 1) over a period from the point of planting to the point of maturity, under various growing conditions (within the definition of the Kyoto protocol for fungible credits). Based on the expected permit price of a carbon credit in each year of sequestration[12], and an assumed discount rate, we can use DCF techniques to convert this to a present value of *$Z worth of tradable credits* in a carbon trading market (see Equation 1).

Under steady state conditions, i.e., where future growth conditions, discount rates and carbon credit prices are stable, this DCF computation would be the 'fair value' of the *ECEA*. No further computation is necessary. However, when the growing environment of the forest can be

[12] A permit with a face value of say $10 per metric-ton of CO_2 that becomes valid at a future date will have a present value of a lesser amount today, as they are dated, single-year permits.

affected by the actions of the business entity (by expending money (E) on care and maintenance, water, fertilizer, etc) the *ECEA* values can change, and under GAAP should be reported.

Let us, therefore assume that, by monetizing the CO_2 sequestrations using agreed CES accounting computations, the present value of potential cash flows of the forest under *best growth* conditions, is a *maximum* monetary *ECEA* value of (say) $10,000,000 (M).

Let us further assume that the forest is still growing (and thus sequestering carbon), and that its *current* sequestration potential of CO_2 metric tons of emissions, under current growth conditions, is estimated at a *present value* of $5,000,000; again based on monetizing agreed CES accounting computations (Equation 1).

Also assume that the environmental scientists and engineers, based on their CO_2 sequestration and emissions measurement models and experience, estimate the value-increasing - *carbon sequestration constant* (r) to be 6.5, and the value-decaying - *carbon emission constant* (δ) to be .05 if no physical and environmental maintenance of the *ECEA* is undertaken..

Now, if the organization owning the *ECEA* in the coming year expends $100,000 (E) to support the carbon sink by growing more trees within the physical constraints of the land and the climate, and/or providing good care and maintenance of the existing trees to grow to their full potential (in terms of providing water, fertilizer and so on) then the *ECEA*'s *Environmental Capability Value (ECV)* will be enhanced as follows:

$$\left(\frac{dS}{dT}\right) = 6.5\,(100{,}000).\left(\frac{10{,}000{,}000 - 5{,}000{,}000}{10{,}000{,}000}\right) - 0.05\,(5{,}000{,}000)$$

$$\left(\frac{dS}{dT}\right) = 6.5\,(100{,}000)\,(0.5) - 250{,}000 = \$75{,}000$$

Thus, based on the expert opinions relating to the two *carbon sequestration* (r) and *carbon emission* (δ) constants, despite spending $100,000 on supporting the organization's *ECEA*, the net-environmental capability value (ECV) of the asset has been leveraged up by only $75,000 or a net- value increase of only 0.75 of the money expended.

Let us now assume that in the early years of a carbon sink (such as a forest of fresh saplings), there is no significant value-decay – i.e. the *carbon emission constant* (such as via rotting vegetation etc.) is zero. Then, expending a similar amount of $100,000 will enhance the asset's ECV as follows:

$$\left(\frac{dS}{dT}\right) = 6.5\,(100{,}000).\left(\frac{10{,}000{,}000 - 5{,}000{,}000}{10{,}000{,}000}\right) - 0.0\,(5{,}000{,}000)$$

$$\left(\frac{dS}{dT}\right) = 6.5\,(100{,}000)\,(0.5) - 0 = \$325{,}000$$

In such a case, by spending $100,000 on supporting the *ECEA* via expansion and maintenance of the carbon sink, the ECV has been leveraged up by $325,000 or a net- value increase of 3.25. This is in keeping with what is observed in all types of assets - tangible and intangible (e.g. expenditure on machinery, human resource training, brand advertising campaigns, etc.) - that asset capability values are leveraged rapidly in the early years of its use, and then increases would be at a diminishing rate in the later years.

If the objective of the organization is merely to *maintain* its *ECEA* to current ECV levels, then dS/dt will be set to zero, thus the equation becomes:

$$0 = 6.5\,(0.5)\,E - 0.05\,(5{,}000{,}000)$$

$$250{,}000 = 6.5\,(0.5)\,E$$

$$\frac{250{,}000}{3.25} = E = \text{approx.}\,\$\,77{,}000$$

Thus, a minimum of $77,000 would need to be expended merely to maintain the capability at its current value. This approach provides an important valuation tool for an organization dealing with combinations of tangible assets (e.g. trees for logging) and intangible capabilities (i.e. the carbon emission and sequestration capabilities of the trees), as it now is able to determine what expense levels must be included for the *maintenance* of that particular *ECEA*'s capability at a zero-base. This concept is no different from the expenses a company would need to spend on *repairs* and *preventive maintenance* of its machines, i.e., just to keep the machine running at its current level of economic capability, a certain level of expenses would need to be incurred.

Once an asset has reached its maximum capability potential (M = S), then it will be of no incremental value to expend any more money on it, as the value-increasing part of the equation collapses to zero. In such a case, the asset will lose its current value (S) due to the value-decay constant (δ), i.e. the second part of the equation. Other things being equal, M will again become greater than S (as S decays), and a small amount of expenditure (E) will be required to bring the capability back to saturation point. In the case of a tree, this point of balance where M and S values vary in close proximity to one another is at its maturity where its CO_2 sequestrations equal it emissions.

Based on the CES accounting values and constants provided earlier, if the organization spends only $50,000 on supporting the *ECEA*, by applying the above *model equation*, the change in ECV (dS/dt) works out to be a *negative* $87,500, or a net-value *decrease* of 1.75. Thus an organization would have a range of *net-values*, some greater than 1, some between 0 and 1, and some negative. As the negative *net-values* reduce asset values, this is conceptually very similar to the depreciation/amortization of assets under traditional GAAP, whilst the positive *net-values* are similar to the revaluation of asset values under traditional GAAP.

Under a carbon rationing scheme, *most* tangible assets of a business entity would either have a sequestration (asset) or an emissions (liability) capability. Examples of asset capabilities are certain types of land which have geo-sequestration capabilities, and buildings designed (or refitted) in certain ways to reduce CO_2 emissions (these reductions can be sold under the Kyoto protocol as carbon credits). Examples of capabilities that are liabilities are machinery and vehicles using coal or petroleum as their energy sources (which have significant potential to emit CO_2). The equation 2 provided above can be used with all such carbon credit sequestration or emission (asset or liability) capabilities.

Our paper illustrates the capability value calculations of a tangible asset (forest, land) with an intangible CO_2 sequestration (sink) capability. The same logic will hold for entities that invest in activities that provide some form of *carbon offset*, rather than directly reducing emissions or those that take actions to *reduce the carbon footprint* of an asset (e.g. making a building energy efficient). Here the M will be the maximum energy savings potential and S the current savings. The E would be the amount expended in energy saving technologies in a particular accounting period, and the two sequestration (r) and emission (δ) constants would be provided by energy experts.

In the case of a tangible asset (machinery, motor vehicles) with an intangible CO_2 emission (liability) capability, the maximum (M) and current (S) values would be the asset's maximum and current emission (source) capabilities. Here, the more expenses (E) that are incurred on the tangible asset (e.g. burning up more petroleum in running the asset) the more the intangible liability value will increase. The two constants would reverse in this case, where the emission (r) and sequestration (δ) constants are again provided by energy experts. Having outlined the proposed valuation model, we now discuss carbon financial accounting and recording issues arising from the model.

Carbon Financial Accounting and the Recording Process

The current discourse in the accounting profession largely pertains to the issue of when revenue or expenses related to carbon credits should be recognized. As the ultimate solution to this 'timing' issue can be incorporated within the conventional accounting paradigm, it is not the focus of the paper.[13] However, for the sake of completeness, the current discourse with regard to the 'timing' issue is overviewed in Appendix 1.

This paper focuses instead on the failure of conventional GAAP to recognize and measure intangible assets that are *not acquired*. As discussed previously, whilst this failure is present in the area of intangible assets generally, this paper puts forward a special case for the valuation of carbon sources and sinks that are not acquired (such as the internal development of assets with the capability to generate future carbon credits). However, a shift in conventional thinking is required for this valuation approach to be incorporated in financial reports.

The main shift in thinking is that a balance sheet should record in monetary terms "what an organization can do (capability)" and not "what an organization has". This of course hinges on the definition of an asset. An asset is defined by the IASB as "a resource controlled by the entity as a result of past events and from which future economic benefits are expected to flow to the entity." The question then arises as to whether having the capability to reduce emissions, as opposed to having actually reduced emissions, meets the definition of an asset. There would be those who argue that having the capability to reduce emissions is less likely to provide the ability

[13] It is not an objective of this paper to offer a solution to the 'timing' issue. The objective instead is to consider the valuation and reporting of an organizations capability in generating future carbon credits.

to generate tradable carbon credits in the future than having already reduced emissions. The issue becomes clearer if the discussion is framed in terms of a tangible (non-current) asset such as a machine. Such a machine would fit the IASB definition of an asset since a past event (payment of the historical purchase price) resulted in an organization controlling this resource (machine) and its ability to produce goods (inventory) in the future, which can then be sold to provide future economic benefits. Applying this analogy to an intangible environmental asset such as a tree (i.e. its ability to generate carbon credits in the future by sequestering CO_2 via growth) suggests that the asset would be a very different asset to the inventory of credits produced by already reducing emissions.

It is noted that the unique tangible/intangible nature of carbon related assets makes their accounting treatment under conventional accounting frameworks fraught with difficulty, especially in organizations such as forestry companies that have carbon sequestration assets (sinks) such as trees. These entities may find these 'assets' instantly becoming carbon emitting sources (liabilities) should their trees be destroyed in a forest fire. Whilst accepting that there are situations in business life that organizational assets contain elements of contingent liability, *such that in the instant the asset is wiped off the books a liability arises;* most of these contingent liabilities are litigious in nature. A plane (tangible asset) that crashes or dangerous side effects that are discovered in a drug patent (intangible asset) may not only wipe out the assets from the balance sheet, but also simultaneously give rise to a class action contingent liability.[14] However, carbon sinks such as trees are simultaneously carbon sources as well (for example, trees can shed leaves while growing). Thus any metric to value the *carbon sequestration* capabilities of these assets must simultaneously capture their *carbon emission* capabilities. The following section proposes a method for recording carbon sequestration assets within the conventional double entry system.

Environmental Capability Enhancing Asset (ECEA) Accounting: The Recording Process

This proposed approach to valuing carbon credit producing (and using) assets would also require a new approach in the financial accounting recording process. If an asset is only a 'cash generating operational asset' then it could be recorded under current GAAP. However, it has

[14]The IASB is, however, considering abolishing the term 'contingent liability'.

been demonstrated that many tangible assets would have also a potential carbon sequestration capability (such as a forest) or carbon emission capability (such as a motor vehicle) under a carbon rationing and trading scheme. In such cases, the intangible asset (or liability) must be recorded as an environmental capability. Here the tangible asset has the potential of obtaining revenues from its operational capability (i.e. the tree that can be sold for logging) intertwined with revenues (or expenses) from its carbon sequestration (or emission) capability.

The following is a simple example of the types of operational and carbon emissions related transactions that would need to be recorded in the books to build up an organization's *overall* Environmental Capability Value (ECV).[15]

We demonstrate that the 'value' of the asset's operational as well as environmental capabilities come from three or more transaction categories, i.e. the purchase cost of the tangible asset; the cost/revenue potential of the intangible asset/liability that comes along with it, and the support costs (expenses) of the tangible/intangible asset. For brevity, in this example we limit our discussion to only recording the transactions pertaining to a tangible operational asset with a related intangible CO_2 sequestration capability; although in the above discussion it has been shown that transactions pertaining to a tangible asset with an intangible *liability* (carbon emissions) capability can be similarly recorded.

Let us assume the organization has an opening *Capability Balance Sheet*, represented in terms of financing and investments as shown in Table 1, clearly demarcating the operational assets (property, plant and equipment, working capital) and intangible capability assets (*ECEA*, reputation, brands, IP and so on) and the related *capability capital reserves* built over time.[16] The concept of capability capital reserves are similar to the *asset revaluation reserves* found in traditional financial reports. The *Capability Balance Sheet* shows only environmental capabilities that have the potential to be monetized, which are mainly its carbon related capabilities due to the existence of a carbon rationing and trading scheme.

Table 1: Opening Capability Balance Sheet

[15] This ECV value should not be confused as the calculation of an organization's carbon footprint, i.e. its net carbon emissions. However the CES accounting measures that are used by energy experts to calculate a carbon footprint of an organization are incorporated in the valuation model, via the value-increasing and value-decaying constants in Equation 2.

[16] The concept of 'Capability Capital' is discussed in Ratnatunga, et.al, (2004).

Investment	
Operational Assets	***$000***
Operational Capability Enhancing Assets (OCEA) (e.g. Forests)	350,000
Other Capability Enhancing Assets (e.g. Working Capital)	100,000
Intangible Assets	
Environmental Capability Enhancing Assets (ECEA)	100,000
Other Capability Enhancing Assets (Brands, Reputation, IP)	50,000
Total Investment	**600,000**
Financing	
Accumulated Surplus (Equity)	250,000
Capability Capital Reserves	300,000
Debt	50,000
Total Financing	**600,000**

The double-entry recording details of the impact on the Capability Balance Sheet of six transactions are now illustrated:

*Transaction 1**:** Purchase Timber Forest.* Let us assume this forest is purchased for $40 million, made up of a logging asset of $30 million and the associated Carbon Sink capability of $10 million. The recording of this transaction is shown as a single entry, affecting operational and intangible assets; although in reality this will require the separate recording of the land, trees, access roads, and buildings etc., as per international accounting standards. The transaction will be recorded as follows:

OCEA-Tangible (for Logging)	30,000	
ECEA-Intangible (for Carbon Sequestration)	10,000	
Other Assets (Cash)		40,000

Transaction 2: Transfer Cost Value of Timber to Logging Unit. This transfer at first appears to be a transaction without motivation as the timber has not been logged or sold. However, what we are developing here is a *Capability Balance Sheet*; one that shows what an organization *can do* (capability) and not what it *has* in historical cost terms. As such, the historical value of the forest will essentially be written off the books as a tangible asset at this stage. This entry is similar to depreciating the asset 100% in year of purchase.[17] The capability-value of the timber will be

[17] Such a 100% write-off is not uncommon in conventional accounting for certain types of assets, such as computers. This is even more the case with military hardware that is issued to war zones, as the assumption is that it will be destroyed. At the end of the second world war, the US Army left behind or destroyed their own outdated equipment in the Pacific-zone, rather than bringing them home, as such equipment which neither had a historical value (as they were 100% depreciated) nor a military capability potential.

brought back on the books in the next transaction. If the historical value and the capability value is the same then there will be no impact on balance sheet monetary values. However, if they are different (for reasons explained when discussing the next transaction) then, of course, there will be a change. The transaction will be recorded as follows:

Operational Expense (P/L)	30,000		(Ultimately affects Equity)
OCEA-Tangible (Logging)		30,000	(100% Depreciation)

In the long-run, it is expected that the ‘Asset Procurement Expenditure’ in a particular year will be similar in value to the previously calculated ‘net-depreciation’ of a whole host of assets purchased over a number of years.

A related issue is the ***physical security*** of the tangible asset. It could be argued that if one does ‘write-off’ 100% of the asset value in the year of purchase, there will be no record of its value in the Asset Register, and hence it could be subject to theft and pilferage (e.g. illicit logging in the case of a forest). However, an Assets Register can be maintained independent of the financial accounting system with units rather than values, and most forestry operations have a reasonable record of ensuring the ‘physical custody’ of tangible assets (with armed patrols) to ensure not only against theft but also against the activities of pyromaniacs.

Transaction 3: Recording the Timber in the Forest at its Fair Capability Value. This will be the present value of its capability to generate cash from operations (if the asset, in fact, does have such a capability). The transaction will be recorded as follows:

OCEA-Tangible (Logging)	50,000		(PV of Expected Revenue)
Capability Capital Reserves		50,000	(Unrealized Gains)

Thus the asset is essentially brought back onto the books as a capability value. At the point of purchase the operational capability value of a tangible asset will, in most cases, be the purchase cost as competitors may also have access to such assets, and thus they do not provide an organization a competitive advantage (at that point in time). However, in the case of some environmental assets (e.g. those with access to restricted areas or requiring special permits; and also if the organization has better trained personnel already existing to run the operations efficiently, for synergistic reasons the capability value may well exceed the purchase cost. In this example, it is assumed that the business entity has a competitive advantage such that its present (fair) value capability to generate revenue, i.e. \$50 million, is greater than its purchase price of \$ 30 million.

Transaction 4: Expend Money on the Forest. This is the operational cost (say \$2 million) of maintaining, up-keeping and hopefully enhancing the capability values of the forest that is purchased (fertilizing, thinning, labor, etc.). This is the 'E' variable in the equation provided earlier. [For brevity, we ignore the operational costs of maintaining the other 'opening' Environmental Capability Enhancing Assets listed in Table 1]. The transaction will be recorded as follows:

Capability Support Expenses (P/L)	2,000		(Ultimately affects Equity)
Other Assets (Cash)		2,000	

Transaction 5: Recognize the Incremental Intangible Sequestration Capability Value of the Forest. This is the resultant *incremental ECV* due to expending resources (Transaction 4) to maintain/enhance the carbon sequestration capability of the forest. This incremental value is derived by leveraging the expenses using the *carbon sequestration* (r) and *carbon emission* (δ) constants obtained by CES accounting procedures, for which the mathematics are demonstrated earlier in the paper (Equation 2). The current capability value (S) is the original \$10 million carbon sink capability purchased (Transaction 1). The saturation point of this capability (M) has been assumed to be \$40 million. [Again, for brevity, we ignore any incremental ECVs of the other 'opening' *ECEA*s, as it is assumed that the operational costs that are expended on them is adequate to maintain their current capability values, i.e. the dS/dt in Equation 2 is set to zero].

From the above, E = \$2,000, r = 8, δ =0.50, S= 10,000 and M = 40,000. We can insert these values into equation (2) as follows:

$$\left(\frac{dS}{dT}\right) = 8\,(2{,}000).\left(\frac{40{,}000 - 10{,}000}{40{,}000}\right) - 0.5\,(10{,}000)$$

$$\left(\frac{dS}{dT}\right) = 8\,(2{,}000)\,(0.75) - 5000 = \$7{,}000$$

The transaction will be recorded as follows:

ECEA-Intangible	7,000		(Using Equation 2)
Capability Capital Reserves		7,000	

Transaction 6: Recognize the Incremental Operational Capability Value of the Forest. This is the resultant *incremental Operating Capability Value* due to expending resources (Transaction 4) to maintain/enhance the capability of the recently purchased logging operation, with a current capability value (S) of $50 million (Transaction 3). It is assumed that the saturation point of this capability (M) is $100 million. The tangible *Operating Capability Value* can be derived either by using DCF techniques (if the variables are known) or by leveraging the expenses using different *value-increasing* (r) and *value decaying* (δ) constants obtained by valuers of agricultural lands such as forests (Equation 2). In this illustration the operational cost of $2 million is inadequate for maintaining the current capability values (S) of forest in terms of timber for logging, and thus the metric used indicates that the value has reduced by $1 million.

From the above, E = $2,000, r = 4, δ =0.10, S= 50,000 and M = 100,000. We can insert these values into equation (2) as follows:

$$\left(\frac{dS}{dT}\right) = 4\,(2{,}000).\left(\frac{100{,}000 - 50{,}000}{100{,}000}\right) - 0.10\,(50{,}000)$$

$$\left(\frac{dS}{dT}\right) = 4\,(2{,}000)\,(0.5) - 5000 = (\$1{,}000)$$

The transaction will be recorded as follows:

OCEA-Tangible	(1,000)		(Using Equation 2)
Capability Capital Reserves		(1,000)	(Unrealized Gains)

Most often, in the case of tangible operational asset capabilities, the revaluation will be a negative-asset (akin to depreciation), as it is expected that capability will be diminished as the equipment ages.[18] In the case of agricultural assets such as forests, vineyards etc., initially the operational capability will increase as the tree grows to maturity and then will diminish with age,

[18]An exception would be, as in the case of the American B-52 bomber that is still in operation today, if significant expenses have been deployed to maintain/enhance a tangible asset's capability.

whilst its sequestration capability will end at maturity at which time it will be in balance as to its sequestration and emission capabilities. Most accounting standards around the world require a revaluation of such agricultural assets every year. Any depreciation component is to be built into this revaluation (for example if part of the forest is destroyed by fire). The *Operating Capability Value* and ECV metrics will enable both the tangible and intangible components of the operational and environmental capabilities to be better assessed than existing conventional methods that only consider valuation approaches such as replacement cost and market value.

Transactions 5 & 6 would ideally be recorded as a combined journal entry, which encompasses the joint-capability components of the tangible and intangible assets working in tandem. Thus if the organization loses all of its (tangible) forest due to a fire, then the capability component of its *carbon sequestration capability* will also have their (intangible) asset value reduced to zero (and if the carbon emissions caused by the fire is recorded by the CES accounting metric used, the capability reduction would need to be recorded as an notional expense, similar to stock losses). After recording the above six transactions the *Closing Capability Balance Sheet* will show the following position (Table 2):

Table 2: Closing Capability Balance Sheet

Investment	
Operational Assets	***$000***
Operational Capability Enhancing Assets (OCEA) (e.g. Forests)	399,000
Other Capability Enhancing Assets (e.g Working Capital)	58,000
Intangible Assets	
Environmental Capability Enhancing Assets (ECEA)	117,000
Other Capability Enhancing Assets (Brands, Reputation, IP)	50,000
Total Investment	**624,000**
Financing	
Accumulated Surplus (Equity)	218,000
Capability Capital Reserves	356,000
Debt	50,000
Total Financing	**624,000**

The example above ignores the transactions that deal with the income statement side of the accounting equation (revenue and expenses) and deals almost strictly with the balance sheet equation (assets, liabilities and equity). The reason is that the example deals with only the difficulties faced by the traditional accounting framework in the valuation of non-current 'asset capabilities', especially when a tangible asset capability is intertwined with an intangible. As stated earlier (and summarized in Appendix 1), the accounting profession is closer to agreement as to how to record revenue and expenses related transactions in selling and obtaining carbon credits (current assets and liabilities) via government grants or via carbon trading markets; than on the valuation and reporting of the underlying capabilities that produce such credits (non-current assets and liabilities) on the balance sheet.

Cook (2008) has considered the balance sheet impacts of carbon trading, but has limited his discussion to the recording of carbon credit values (obtained, purchased or created via emissions sequestration activities that have already taken place) in the balance sheet. These carbon credit values would usually be incorporated into the net-valuation of the emissions liability of that organization. For example, carbon emissions valuation experts might consider that an organization's internal sequestration activities have created credits (intangible assets) to offset its emission liability. If the total of an organization's (tangible and intangible) credits are greater than its emissions liability such that netting results in a zero liability, then two recording possibilities exist. If the remaining credits are tangible inventory assets that are obtained by government grant or purchased via a carbon trading market and have not expired (i.e. they can be used against future emissions liabilities) then they would remain in the balance sheet as tangible inventory. If remaining carbon credits are internally created, then they will be intangible inventory assets that will most likely remain off-balance sheet, unless they are 'certified' as credits (say by energy experts in the case of Renewable Energy Credits) and made available for trade as Abatement Certificates. In such cases the carbon credits will convert from their intangible off-balance sheet status to tangible inventory assets, with resultant impacts in the income statement.

As stated before, this paper does not deal with the above scenarios of accounting for tangible and intangible credits and their emission liability offsets that are of interest to Cook (2008). Instead, the paper concentrates on the emission management *capabilities* of its non-current assets and liabilities, i.e. those that create the carbon credits and the valuation of such capabilities. The following section discusses approaches to integrating environmentally capable asset values into conventional financial statements.

Approaches to Integrate the Capability Values into the Financial Statements

In the reporting approach discussed above, the valuation is of 'capabilities' (what one can do) rather than assets in a traditional sense (what one has). The question of the effectiveness of the capability values generated by such an incremental shift will only be answered in time. CEOs and other stakeholders may believe that (1) fair value estimates[19] of tangible assets already capture much of the value of carbon sequestration and/or (2) recognition of these intangible asset capabilities in conventional financial statements will reduce the overall reliability (hence usefulness) of these. Another possibility is that if CEOs find that the 'value-increasing' and 'value-decaying' constants are such that they cannot control the content of the organization's capability asset, liability, revenue and expense figures, they will be loathe to adopt them. Even if these 'consensus' constants are found to be reasonably reliable, the next question that arises is whether these environmental capability-values should be integrated in the organization's (conventional) financial statements. There are three approaches as suggested by Leadbeater (2000) to integrate new measurement paradigms to organizational financial statements. These approaches are the fully integrated approach, the supplementary approach and the hybrid approach.

In the *fully integrated approach* the new measures detailed above are incorporated in the financial statements, whilst in the *supplementary approach,* separate *Capability Financial Statements* are prepared, to sit alongside the traditional statements prepared as per GAAP and IFRS. Both are intended to help investors value organizational capabilities (the intangible asset issue), including environmental capabilities (the CSR reporting issue). The *hybrid approach* is a compromise approach where the incorporation of tangible and intangible capability assets as balance sheet values is a gradual process, via either *half-way-houses* (when an organization 'quarantines' its tangible and intangible capability values before allowing them to migrate to the balance sheet); or *revisable rolling accounts* where past accounts are restated as CES accounting measurements become more accepted by the mainstream stakeholders.

Regardless of the approach to implementation adopted, it will be necessary to initially estimate the current capability value of all tangible and intangible capability assets, and have an

[19] The ECEA model described in this paper will help make these estimations.

‘Opening Capability Balance Sheet as at a particular date’ (Table 1) after which the double-entry accounting approach outlined in transactions 1- 6 could be carried out.

Summary and Limitations

We show that the economic decisions of organizations operating within a carbon trading market, and the consequences of these organizations implementing carbon emissions management strategies, will impact the accounting profession significantly. Whilst there is some discourse as to how best to report the income statement (profit and loss) effects of CO_2 trading, there has been no discourse as to how to value the underlying assets that produce or use carbon credits on the *balance sheet.*

On the surface, this approach would seem not too different from Cook (2008) who also considered balance sheet values and argued that carbon credits, the emissions liabilities and the grant liabilities should be recorded separately at fair value and changes in the fair values should be reported in the income statement. The major difference between our proposal and Cook (2008) is that he is essentially looking at the accounting treatment within contextual situations where carbon credits are obtained via government grants or purchased via a carbon trading market, and how these carbon credits should be treated in the balance sheet (as current assets and liabilities) until the emission occurred and their values could then be moved to the income statement. Here the focus is more on organizations that have the capability of generating carbon credits (i.e. those that have not only an emissions liability but also an emissions intangible carbon sequestration asset capability), although it is shown that the model can be used in the more conventional scenarios proposed by Cook (2008).

There is no controversy within the field of accounting and financial reporting that issuers of financial statements should provide the readers of these reports with all material information that is both relevant and reliable. The relevance of organizational capabilities (especially via its intangibles such as *ECEA* or carbon sequestration assets) has not usually been questioned, but the reliability of the valuations of these intangibles has often been questioned.

This paper illustrates a technique that will not only make these valuations more relevant and contextual, but also shows how tangible and intangible asset combinations provide true capability values. However, the validity of arguments of the paper rests with the practical applicability of the capability valuation equation, especially the model's *carbon sequestration* and *carbon emissions constants* that need to be obtained by 'experts' in CES accounting. It has already been discussed that existing scientific knowledge on this subject is limited and the values much disputed. However, despite these measurement disputes amongst energy experts, such numbers are routinely being computed and the resulting carbon credits are being sold as *certified emission reductions*[20] and *voluntary emission reductions*[21] in active emissions trading markets. Another limitation is that future prices of tradable credits cannot be determined with any certainty. However, such inherent uncertainty is present in all trading markets including, of course, share trading markets. This uncertainty has not prevented financial analysts from using valuation models that use estimations of future movements in (say) price-earnings ratios and financial estimates such as EPS and sales growth.

Another limitation, as the conventional accountants will argue, is that the reason why the discourse has been limited to the impact on the financial statements of known current costs of an organization's carbon related transactions is because the valuation of the underlying capabilities takes the responsibility of quantifying the financial effects away from the accountants to the realm of scientists and engineers. However, accountants and other finance professional such as bankers have routinely used 'expert' valuations as the basis for commercial transactions (such as giving loans) for a long time. Further, there is a rich literature in new valuation approaches and methodologies pertaining to intangibles valuation and how to book these values to the balance sheet (see Leadbeater, 2000). This paper presents a valuation model that extends this literature to the valuation of organizational capabilities, in which tangible and intangible assets can be inextricably intertwined.

Though the paper has discussed the model in terms of using it for financial reporting, the model is equally applicable for use in internal reporting. Several companies feel the pressure to publicize their efforts to control emission and climate control responsibility through the media and company web sites. A case in point is Apple Corporation (see Burrows, 2009). Apple has done poorly in several environmental rankings such as the Newsweek's report on The Greenest Big Companies in America where Hewlett-Packard and Dell ranked first and second on the list,

[20] Carbon credits that are sold in compliance markets under the Kyoto protocol are called 'Certified Emissions Reductions (CERs)'.

[21] 'Voluntary Emissions Reductions (VERs)' are undertaken by organizations outside the Kyoto regime (e.g. Chicago Climate Exchange).

while Apple is a long way behind at 133. Apple suffered in part because it has not set long-term environmental goals publicly. Greenpeace singled Apple out for its use of toxic chemicals in 2007.

In response, Apple undertook numerous steps to reduce their carbon footprints and made the following points. Consumers' use of Apple products accounts for 53% of the company's total 10.2 million tons of carbon emissions annually; 38% occurs from the products that are manufactured in Asia; 3% that comes from Apple's own operations. In contrast, HP and Dell put their carbon emissions at 8.4 million tons and 471,000 tons respectively, though both are larger than Apple in terms of revenue. However, by their own admission, their numbers excluded product use and at least some manufacturing and including those factors would boost their carbon totals several fold. Yet, both companies stated that more valuation models are direly needed prior to making statements on carbon emissions. Estimating the carbon emissions in tons is the first part to be done by scientist and technicians. The second part is putting a monetary value to these emissions and that is where the model suggested in this paper will be a useful start.

APPENDIX 1:

Accounting Treatment of Carbon Allowances Obtained by Government Grant or Purchased from an Emission Trading Scheme.

The accounting profession has recognized at least three treatments of carbon allowances obtained by government grant (within the traditional accounting framework) as follows:

(1) If the allowance is obtained as a *government grant* for a price (when allowances are allocated by governments for less than fair value) then it is first recognized as an intangible asset at cost (debit: carbon permit assets; credit: cash). Then, the value of the allowance (permit) is increased to its fair value with the difference between cost and fair value recognized as revenue on a systematic basis over the compliance period (debit: carbon permit assets; credit: revenue).[22] As an organization emits carbon the permit is surrendered at market value (debit: expense; credit carbon permit assets). Any gains or losses that result in disposing of the allowances are recognized in the income statement.

(2) Alternatively, government grants allocated for less than fair value could be recognized as income (on the grounds that they are immediately tradable) (debit: carbon permit assets; credit: revenue). This argument would be applicable for government grants issued free.

(3) Alternatively, government grants allocated for less than fair value could be recognized as 'liabilities' (on the ground that all or part of these will have to be returned to the government in the settlement of an emissions liability that has not yet occurred) (debit: expense; credit: liability). If there is a shortfall, the organization will need to ultimately purchase RECs in an open market equal to the shortfall (debit: liability; credit: cash) at market value.[23]

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[22] Questions as to whether such revenue is taxable or exempt from tax will be based on a specific country's tax policy.

[23] Note that a 'Liability' is a present obligation arising from past events. The issue of a 'carbon permit' relating to a possible future event is more a contingent liability.

Instead of obtaining carbon credits as government grants, if a carbon credit (permit) is purchased as an inventory item or cash flow hedge, then the current view is that it is recorded at fair value pertaining to the carbon allowances held (debit: carbon permit assets; credit: equity reserves).[24] Again, as an organization emits carbon the permits are surrendered at market value (debit: expense; credit carbon permit assets).

To account for such treatments in a carbon rationing scheme, a *net model* has been proposed whereby an entity does not recognize allocated allowances (they remain off-balance sheet), and accounts for actual emissions only when it holds insufficient allowances to cover those emissions by buying credits (debit: expenses; credit: cash) at market price.

Traditionally, however, the accounting profession prefers the separate recognition of assets and the liabilities and the different treatment of such; i.e. to treat carbon assets (i.e. allowances) independent of the liabilities (i.e. obligations). Accordingly, netting off (i.e. offsetting) of the assets and liabilities in such cases will not be permitted.

Thus an *amortizing model* has been proposed whereby an entity recognizes allocated allowances as an asset (debit: asset; credit: liability for unearned revenue) at cost price, but then amortizes the allowances as it pollutes (debit: expense; credit: asset) and simultaneously release the deferred income to revenue (debit: liability for unearned revenue; credit: revenue). In this method, the entity recognizes a liability for actual emissions only when it holds insufficient allowances to cover those emissions (debit: expense; credit: liability). The liability that the entity incurs as it emits is measured at the cost of the allowances held by the entity. However, ultimately the entity has to purchase ‘carbon credits’ in an open market equal to the shortfall (debit: liability; credit: cash), and there would be an over/under provision of this liability depending on market price. Clearly, pricing and the valuation of carbon allowances (permits) is a key to this method of accounting.

[24] The fair value would be based on market values if a trading scheme exists. Similar questions of ‘fair value’ pertain to share investments, i.e. there are reporting differences if the shares are held as ‘investments’ or as ‘inventory’ in a fund management company.

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