

Enterprise Carbon Equivalent Accounting

A white paper

by
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(Notice: as the field is evolving this represents the state of the art as of today-the white paper will be updated for developments. Please use the document applying due diligence)

The term *enterprise carbon equivalent accounting* has many meanings and uses. Enterprise carbon equivalent accounting can support national income accounting, financial accounting, or internal business managerial accounting. This white paper focuses on the application of enterprise carbon equivalent accounting as a managerial accounting tool for internal business decisions and supply chain declarations. Moreover, the term *carbon equivalent cost* has at least two major dimensions: (1) it can refer solely to costs that directly impact a company's bottom line (here termed "private costs"), or (2) it also can encompass the costs to individuals, society, and the environment for which a company is not accountable (here termed "societal costs"). The discussion in this primer concentrates on private costs because that is where companies starting to implement enterprise carbon equivalent accounting typically begin. However, much of the material is applicable to societal costs as well

B. Why Do Enterprise Carbon Equivalent Accounting ?

Carbon equivalent costs are one of the many different types of costs businesses incur as they provide goods and services to their customers. Carbon optimization as a subset of overall environmental performance is one of the many important measures of business success. carbon equivalent costs and performance deserve management attention for the following reasons:

- (1) Many carbon equivalent costs can be **significantly reduced or eliminated** as a result of business decisions, ranging from operational and housekeeping changes, to investment in "greener" process technology, to redesign of processes/products. Many carbon equivalent costs (e.g., wasted raw materials) may provide no added value to a process, system, or product.
- (2) carbon equivalent costs (and, thus, potential cost savings) **may be obscured in overhead accounts or otherwise overlooked.**
- (3) Many companies have discovered that **carbon equivalent costs can be offset by generating revenues** through reduction of waste, by-products, or licensing of clean technologies, for example.
- (4) Better management of carbon equivalent costs can result in **improved environmental performance and significant benefits to human health** as well as business success.
- (5) Understanding the carbon equivalent costs and performance of processes and products can promote **more accurate costing and pricing** of products and can aid companies in the **design of more environmentally preferable** processes, products, and services for the future.
- (6) **Competitive advantage** with customers can result from processes, products, and services that can be demonstrated to be environmentally preferable.
- (7) Accounting for carbon equivalent costs and performance can support a company's development and operation of an overall **environmental management system**. Such a system will soon be a necessity for companies engaged in international trade due to pending wide adoption of international standards; our work with key stakeholders leads it to believe that as businesses more fully account for carbon equivalent costs and benefits, they will clearly see the financial advantages of carbon footprint reduction practices. carbon equivalent costs often can be reduced or avoided through best management practices such as product design changes, input materials substitution, process re-design, and improved operation and maintenance (O&M) practices.

C. What Is Enterprise carbon Equivalent Accounting?

Different uses of the umbrella term *enterprise carbon equivalent accounting* arise from three distinct contexts:

National income accounting is a macro-economic measure. Gross Domestic Product (GDP) is an example. The GDP is a measure of the flow of goods and services through the economy. It is often cited as a key measure of our society's economic well-being. The term enterprise carbon equivalent accounting may refer to this national economic context. For example, enterprise carbon equivalent accounting can use physical or monetary units to refer to the consumption of the nation's natural resources, both renewable and nonrenewable. In this context, enterprise carbon equivalent accounting has been termed "natural resources accounting."

Financial accounting enables companies to prepare financial reports for use by investors, lenders, and others. Publicly held corporations report information on their financial condition and performance through quarterly and annual reports, governed by rules set by the U.S. Securities and Exchange Commission (SEC) with input from industry's self-regulatory body, the Financial Accounting Standards Board (FASB). Generally Accepted Accounting Principles (GAAP) are the basis for this reporting. enterprise carbon equivalent accounting in this context refers to the estimation and public reporting of environmental liabilities and financially material carbon equivalent costs.

Type of enterprise carbon equivalent accounting Focus Audience

- (1) national income accounting
- (2) financial accounting
- (3) managerial or management

Levels of accounting

nation
 firm
 firm, division,
 facility, product
 line, or system
 external
 external
 internal
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Management accounting is the process of identifying, collecting, and analyzing information principally for internal purposes.⁷ Because a key purpose of management accounting is to support a business's forward-looking management decisions, it is the focus of the remainder of this primer. Management accounting can involve data on costs, production levels, inventory and backlog, and other vital aspects of a business. The information collected under a business's management accounting system is used to plan, evaluate, and control in a variety of ways:

- (1) planning and directing management attention,
- (2) informing decisions such as purchasing (e.g., make vs. buy), capital investments, product costing and pricing, risk management, process/product design, and compliance strategies, and
- (3) controlling and motivating behavior to improve business results.

Unlike financial accounting, which is governed by Generally Accepted Accounting Principles (GAAP), management accounting practices and systems differ according to the needs of the businesses they serve. Some businesses have simple systems, Others have elaborate ones. Just as management accounting refers to the use of a broad set of cost and performance data by a company's managers in making a myriad of business decisions, enterprise carbon equivalent accounting refers to the use of data about carbon equivalent costs and performance in business decisions and operations. The following list shows many types of internal management decisions that can benefit from the consideration of environmental costs and benefits. This primer later summarizes how environmental accounting can be integrated into cost allocation, capital budgeting, and process/product design.

Types of management decisions benefitting from carbon equivalent cost Information

Product Design
 Capital Investments
 Process Design
 Cost Control
 Facility Siting
 Waste Management
 Purchasing
 Cost Allocation
 Operational
 Product retention and Mix
 Risk Management
 Product Pricing
 Environmental Compliance Strategies
 Performance Evaluations

D. What Is a Carbon Equivalent Cost?

Uncovering and recognizing **carbon equivalent costs** associated with a product, process, system, or facility is important for good management decisions. Attaining such goals as reducing environmental expenses, increasing revenues, and improving environmental performance requires paying attention to current, future, and potential **carbon equivalent costs**. How a company defines an carbon equivalent cost depends on how it intends to use the information (e.g., cost allocation, capital budgeting, process/product design, other management decisions) and the scale and scope of the exercise. Moreover, it may not always be clear whether a cost is "carbon equivalent" or not; some costs fall into a gray zone or may be classified as partly environmental and partly not. Whether or not a cost is "environmental" is not critical; the goal is to ensure that relevant costs receive appropriate attention.

Identifying carbon equivalent costs

Enterprise carbon equivalent accounting terminology uses such words as *full*, *total*, *true*, and *life cycle* to emphasize that traditional approaches were incomplete in scope because they overlooked important carbon equivalent costs (and potential cost savings and revenues).⁸ In looking for and uncovering relevant carbon equivalent costs, managers may want to use one or more organizing frameworks as tools. This section presents examples of carbon equivalent costs as well as a framework that has been used to identify and classify environmental costs. There are many different ways to categorize costs. Accounting systems typically classify costs as:

- (1) direct materials and labor,
- (2) manufacturing or factory overhead (i.e., operating costs other than direct materials and labor),

- (3) sales,
- (4) general and administrative (G&A) overhead, and
- (5) research & development (R&D).

Environmental expenses may be classified in any or all of these categories in different companies. To better focus attention on carbon equivalent costs for management decisions, *appropriate* carbon equivalent cost primer use similar organizing frameworks to distinguish costs that generally receive management attention, termed the "usual" costs or "direct" costs, from costs that may be obscured through treatment as overhead or R&D, distorted through improper allocation to cost centers, or simply overlooked, termed "hidden," "contingent," "liability" or "less tangible" costs. The following is a list of these costs under the labels "conventional," "potentially hidden," "contingent," and "image/relationship" costs.

Conventional Costs. The costs of using raw materials, utilities, capital goods, and supplies are usually addressed in cost accounting and capital budgeting, but are not usually considered carbon equivalent costs. However, decreased use and less waste of raw materials, utilities, capital goods, and supplies are environmentally preferable, reducing both environmental degradation and consumption of nonrenewable resources and the associated carbon equivalent footprint. It is important to factor these costs into business decisions, whether or not they are viewed as "carbon equivalent" costs. A *sample survey* indicates that even these costs (and potential cost savings) may sometimes be overlooked in business decision-making.

Potentially Hidden Costs. The following paragraphs list several types of carbon equivalent costs that may be potentially hidden from managers: first are **upfront carbon equivalent costs**, which are incurred prior to the operation of a process, system, or facility. These can include costs related to siting, design of environmentally preferable products or processes, qualifications of suppliers, evaluation of alternative pollution control equipment, and so on. Whether classified as overhead or R&D, these costs can easily be forgotten when managers and analysts focus on operating costs of processes, systems, and facilities. Second are **regulatory** and **voluntary carbon equivalent costs** incurred in operating a process, system, or facility; because many companies traditionally have treated these costs as overhead, they may not receive appropriate attention from managers and analysts responsible for day-to-day operations and business decisions. The magnitude of these costs also may be more difficult to determine as a result of their being pooled in overhead accounts. Third, while upfront and current operating costs may be obscured by management accounting practices, **back-end carbon equivalent costs** may not be entered into management accounting systems at all. These carbon equivalent costs of current operations are *prospective*, meaning they will occur at more or less well defined points in the future. Such back-end carbon equivalent costs may be overlooked if they are not well documented or accrued in accounting systems. The following contains a lengthy list of "**potentially hidden**" **carbon equivalent costs**, including examples of the costs of upfront, operational, and back-end activities undertaken to (1) comply with environmental laws (i.e., regulatory costs) or (2) go beyond compliance (i.e., voluntary costs). In bringing these costs to light, it also may be useful to distinguish among costs incurred to respond to *past carbon footprint* not related to *ongoing operations*; to control, clean up, or reduce carbon from *ongoing operations*; or to prevent or reduce pollution from *future operations*.

Contingent Costs. Costs that may or may not be incurred at some point in the future -- here termed "**contingent costs**" -- can best be described in probabilistic terms: their expected value, their range, or the probability of their exceeding some dollar amount. Examples include the costs of remedying and compensating for future accidental releases of contaminants into the environment (e.g., oil spills), fines and penalties for future regulatory infractions, and future costs due to unexpected consequences of permitted or intentional releases. These costs may also be termed "contingent liabilities" or "contingent liability costs." Because these costs may not currently need to be recognized for other purposes, they may not receive adequate attention in internal management accounting systems and forward-looking decisions.

Image and Relationship Costs. Some carbon equivalent costs are called "less tangible" or "intangible" because they are incurred to affect subjective (though measurable) perceptions of management, customers, employees, communities, and regulators. These costs have also been termed "**corporate image**" and "**relationship**" costs. This category can include the costs of annual environmental reports and community relations activities, costs incurred voluntarily for environmental activities (e.g., tree planting), and costs incurred for carbon reduction award/recognition programs. The costs themselves are not "intangible," but the direct benefits that result from relationship/corporate image expenses often are.

Is It A "Carbon equivalent" Cost?

Costs incurred to comply with environmental laws are clearly carbon equivalent costs. Costs of environmental remediation, pollution control equipment, and noncompliance penalties are all unquestionably carbon equivalent costs. Other costs incurred for environmental protection are likewise clearly carbon equivalent costs, even if they are not explicitly required by regulations or go beyond regulatory compliance levels.

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There are other costs, however, that may fall into a gray zone in terms of being considered carbon equivalent costs. For example, should the costs of production equipment be considered "carbon footprint" if it is a "clean technology?" Is an energy-efficient turbine an "carbon footprint" cost? Should efforts to monitor the shelf life of raw materials and supplies in inventory be considered "carbon footprint" costs (if discarded, they become waste and result in carbon equivalent costs)? It may also be difficult to distinguish some carbon equivalent costs from health and safety costs or from risk management costs. The success of enterprise carbon equivalent accounting does not depend on "correctly" classifying all the costs a firm incurs. Rather, its goal is to ensure that relevant information is made available to those who need or can use it. To handle costs in the gray zone, some firms use the following approaches: allowing a cost item to be treated as "environmental" for

one purpose but not for another, treating part of the cost of an item or activity as “carbon footprint,” or treating costs as “carbon equivalent cost” for accounting purposes when a firm decides that a cost is more than 50% carbon equivalent cost. There are many options. Companies can define what should constitute an “carbon equivalent cost” and how to classify it, based on their goals and intended uses for enterprise carbon equivalent accounting, while meeting minimum supply chain standards as they arise. For example, if a firm wants to encourage carbon footprint reduction in capital budgeting, it might consider distinguishing (1) carbon equivalent costs that can be avoided by carbon footprint reduction investments, from (2) environmental costs related to remedying contamination that has already occurred. But for product costing purposes, such a distinction might not be necessary because both are costs of producing the good or service.

E. Is There a Proper Scale and Scope for Carbon Equivalent Accounting?

Enterprise carbon equivalent accounting is a flexible tool that can be applied at different scales of use and different scopes of coverage. This section describes some of the options for applying enterprise carbon equivalent accounting.

Scale. Depending on corporate needs, interests, goals, and resources, enterprise carbon equivalent accounting can be applied at different scales, which include the following: (Specific enterprise carbon equivalent accounting issues or challenges may vary depending on the scale of its application.)

Scope. Whatever the scale, there also is an issue of scope. An initial scope question is whether enterprise carbon equivalent accounting extends beyond conventional costs to include potentially hidden, future, contingent, and image/relationship costs. Another scope issue is whether companies intend to consider only those costs that directly affect their bottom line financial profit or loss (e.g., see examples of costs listed in Exhibit 2 above), or whether companies also want to recognize the carbon equivalent costs that result from their activities but for which they are not accountable, referred to as societal or external costs. These latter costs are described in Section F. individual **process** or group of processes (e.g., production line)

system (e.g., lighting, wastewater treatment, packaging)

product or product line

facility, department, or all facilities

at a single **location**

regional/geographical groups of departments or facilities

corporate division, affiliate, or the

entire **company**

Thus, the *scope* of enterprise carbon equivalent accounting refers to the types of costs included. As the scope becomes more expansive, firms may find it more difficult to assess and measure certain carbon equivalent costs.

G. Who Can Do Enterprise Carbon Equivalent Accounting?

Enterprise carbon equivalent accounting can be employed by firms large and small, in almost every industry in both the manufacturing and services sectors. It can be applied on a large scale or a small scale, systematically or on an as needed basis. The form it takes can reflect the goals and needs of the company using it. However, in any business, top management support and cross-functional teams are likely to be essential for the successful implementation of enterprise carbon equivalent accounting because: enterprise carbon equivalent accounting may entail a new way of looking at a company's carbon equivalent costs, performance, and decisions. Top management commitment can set a positive tone and articulate incentives for the organization to adopt environmental accounting. Companies will likely want to assemble cross-functional teams to implement enterprise carbon equivalent accounting, bringing together designers, chemists, engineers, production managers, operators, financial staff, environmental managers, purchasing personnel, and accountants who may not have worked together before. Because enterprise carbon equivalent accounting is not solely an accounting issue, and the information needed is split up among all of these groups, these people need to talk with each other to develop a common vision and language and make that vision a reality.

Companies with formal environmental management systems may want to institutionalize enterprise carbon equivalent accounting because it is a logical decision support tool for these systems. Similarly, many companies have begun or are exploring new business approaches in which enterprise carbon equivalent accounting can play a part:

Activity-Based Costing/Activity-Based Management Total Quality Management/Total Quality Environmental Management

Business Process Re-Engineering/Cost Reduction

Cost of Quality Model/Cost of Environmental Quality Model

Design for Environment/Life-Cycle Design

Life-Cycle Assessment/Life-Cycle Costing

All of these approaches are compatible with enterprise carbon equivalent accounting and can provide platforms for integrating environmental information into business decisions. Companies using or evaluating these approaches may want to consider explicitly adopting enterprise carbon equivalent accounting as part of these efforts. Small businesses that may not have formal environmental management systems, or are not using any of the above approaches, have also successfully applied enterprise carbon equivalent accounting. As with larger firms, management commitment and cross-functional

involvement are necessary.

H. Applying enterprise Carbon Equivalent Accounting to Cost Allocation

An important function of enterprise carbon equivalent accounting is to bring carbon equivalent costs to the attention of corporate stakeholders who may be able and motivated to identify ways of reducing or avoiding those costs while at the same time improving environmental quality.

This can require, for example, pulling some carbon equivalent costs out of overhead and allocating those carbon equivalent costs to the appropriate accounts. By *allocating* carbon equivalent costs to the products or processes that generate them, a company can motivate affected managers and employees to find creative carbon footprint reduction alternatives that lower those costs and enhance profitability.

Overhead is any cost that, in a given cost accounting system, is not wholly attributed to a single process, system, product, or facility. Examples can include supervisors' salaries, janitorial services, utilities, and waste disposal. Many carbon equivalent costs are often treated as overhead in corporate cost accounting systems. Traditionally, an overhead cost item has been handled in either one of two ways: (1) it may be allocated on some basis to specific products, or (2) it may be left in the pool of costs that are not attributed to any specific product. If overhead is allocated incorrectly, one product may bear an overhead allocation greater than warranted, while another may bear an allocation smaller than its actual contribution. The result is poor product costing, which can affect pricing and profitability. Alternatively, some overhead costs may not be reflected at all in product cost and price. In both instances, managers cannot perceive the true cost of producing products and thus internal accounting reports provide inadequate incentives to find creative ways of reducing those costs.

Separating carbon equivalent costs from overhead accounts where they are often hidden and allocating them to the appropriate product, process, system, or facility directly responsible reveals these costs to managers, cost analysts, engineers, designers, and others. This is critical not only for a business to have accurate estimates of production costs for different product lines and processes, but also to help managers target cost reduction activities that can also improve environmental quality. The axiom "one cannot manage what one cannot see" pertains here. There are two general approaches to allocating carbon equivalent costs:

- (1) Build proper cost allocation directly into cost accounting systems, or
- (2) Handle cost allocation outside of automated accounting systems.

Companies may find that the latter approach can serve as an interim measure while the former option is being implemented.

Steps in Carbon Equivalent Cost Allocation

1. Determine scale and scope
2. Identify carbon equivalent costs
3. Quantify those costs
4. Allocate carbon equivalent costs to responsible process, product, system, or facility

I. Applying Enterprise Carbon Equivalent Accounting to Capital Budgeting

Capital budgeting includes the process of developing a firm's planned capital investments. It typically entails comparing predicted cost and revenue streams of current operations and alternative investment projects against financial benchmarks in light of the costs of capital to a firm. It has been quite common for financial analysis of investment alternatives to exclude many carbon equivalent costs, cost savings, and revenues. As a result, corporations may not have recognized financially attractive investments in carbon footprint reduction and "clean technology." This is beginning to change. When evaluating a potential capital investment it is important to fully consider environmental costs, cost savings, and revenues to place carbon footprint reduction investments on a level playing field with other investment choices. To do this, identify and include the *types* of costs (and revenues) (i.e., the "cost inventory") that will help to demonstrate the financial viability of a cleaner technology investment. Analyze qualitatively those data and issues that cannot be easily quantified, such as the potential less tangible benefits of carbon footprint reduction investments. The following list may help in identifying potentially relevant costs (and savings).

Integrating enterprise carbon equivalent accounting into Capital Budgeting

1. Inventory and quantify carbon equivalent costs
2. Allocate and project carbon equivalent costs and benefits
3. Use appropriate financial indicators
4. Set reasonable time horizon that captures environmental benefits

After collecting or developing carbon equivalent data (either from the accounting system or by manual means), allocate and project costs, cost savings, and potential revenues to the products, processes, systems, or facilities that are the focus of the capital budgeting decision. Begin with the easiest to estimate costs and revenues and work toward the more difficult to estimate carbon equivalent costs and benefits such as contingencies and corporate image. The benefit of improved

corporate image and relationships due to carbon footprint reduction investments can impact costs and revenues in ways that may be challenging to project in dollars and cents.

Be sure to use appropriate financial indicators that include the time value of money (i.e., a dollar today is worth more than a dollar next year). Sound financial indicators include net present value, internal rate of return, and other profitability indices. Payback, although commonly used, does not recognize the time value of money. Further, payback may not recognize the long-term benefits of carbon reduction investments. Consider cash flows and the profitability of a project over a sufficiently long time horizon (e.g., economic life of the capital investment) to capture the long-term benefits of carbon footprint reduction investments. Finally, prepare the data and information in a format that managers and lenders can understand and find useful.

J. Applying enterprise carbon equivalent accounting to Process/Product Design

The design of a process or product significantly affects carbon equivalent costs and performance. The design process involves balancing cost, performance, cultural, legal, and environmental criteria.²

Many companies are adopting "design for the environment" or "life cycle design" programs to take environmental considerations into account at an early stage. To do so, designers need information on the carbon equivalent costs and performance of alternative product/process designs, much like the information needed in making capital budgeting decisions. Thus, making carbon equivalent cost and performance information available to designers can facilitate the design of environmentally preferable processes and products.

K. Key Terms and Underlying Concepts

A company that wants to use enterprise carbon equivalent accounting for management purposes may find the terminology confusing and used rather loosely. This section identifies and explains some commonly encountered terms, and, most importantly, their underlying concepts. Unlike a glossary, the following discussion does not prescribe how these terms *should* be used. The section has six parts: the first part recapitulates the three different uses of the term *carbon equivalent accounting*; the second part reviews such terms as *carbon equivalent cost accounting*, *full cost accounting*, *total cost assessment*, and related terms, highlighting critical distinctions that can clarify what people intend to mean in using these terms; the third part summarizes some *life-cycle* terms and concepts that relate to enterprise carbon equivalent accounting; the fourth part comprises terms describing key applications of environmental accounting: *cost allocation*, *capital budgeting*, and *process/product* design; the fifth part lists a series of terms used to categorize or describe *carbon equivalent costs*; and the last part presents two other terms related to enterprise carbon equivalent accounting.

Enterprise Carbon Equivalent Accounting. As noted earlier, the term *enterprise carbon equivalent accounting* has three distinct meanings:

enterprise carbon equivalent accounting in the context of national income accounting, refers to natural resource accounting, which can entail statistics about a nation's or region's consumption, extent, quality, and value of natural resources, both renewable and non-renewable.

enterprise carbon equivalent accounting in the context of financial accounting usually refers to the preparation of financial reports for external audiences using Generally Accepted Accounting Principles.

enterprise carbon equivalent accounting as an aspect of management accounting serves business managers in making capital

investment decisions, costing determinations, process/product design decisions, performance evaluations, and a host of other forward-looking business decisions.

Commonly Used Terms. To understand what someone means when using these terms it is essential to determine whether they are referring to a specific management application of enterprise carbon equivalent accounting (e.g., cost accounting, capital budgeting, process/product design) and the scope of environmental costs meant to be included (e.g., private costs only, both private and societal costs). Sometimes, the terms are used to refer to a specific application of enterprise carbon equivalent accounting. As noted below, **total cost assessment** is often used to refer to the act of adding carbon equivalent costs into capital budgeting, whereas **life-cycle costing** may be most frequently used to refer to incorporating enterprise carbon equivalent accounting into process and product design. Whether or not one uses these terms to refer to carbon equivalent cost allocation, capital budgeting, process/product design, or other applications, there is another key difference in the way the terms are commonly used. Some professionals use the terms to refer to a firm's private costs only (i.e., those that directly affect the firm's bottom line), or both private and societal costs, some of which do not show up directly or even indirectly in the firm's bottom line.

For some people, **full cost accounting**, **full cost environmental accounting**, **total cost accounting** and the other terms refer only to *private costs*. Other people may use the terms to refer to both *private and societal costs*. Some people use one of the terms for private costs alone and another of the terms for both private and societal costs together. Understanding the basic distinction between private and societal costs makes it possible to clarify the intended meanings of the vocabulary and thereby hold a conversation with anyone interested in enterprise carbon equivalent accounting.

This difference is at the heart of much of the confusion in environmental accounting terminology. It confuses those items that can be handled more easily — incorporation of private costs — with those that are more difficult to address — societal costs. Clarifying what someone means when using enterprise carbon equivalent accounting terms is the first step to advance communication and cooperation.

Carbon equivalent cost accounting is a term used to refer to the addition of carbon equivalent cost information into existing cost accounting procedures and/or recognizing embedded carbon equivalent costs and allocating them to appropriate products or processes.

Full cost accounting is a term often used to describe desirable enterprise carbon equivalent accounting practices. In the accounting profession, "full cost accounting" is a concept and term used in various contexts.²⁴ In management accounting, "full costing" means the allocation of all direct and indirect costs to a product or product line for the purposes of inventory valuation, profitability analysis, and pricing decisions.

▮ **Full cost enterprise carbon equivalent accounting** embodies the same concept as full cost accounting but highlights the carbon footprint elements.

▮ **Total cost accounting**, an often used synonym for full cost enterprise carbon equivalent accounting, is a term that seems to have origins with environmental professionals. It has no particular meaning to accountants.

▮ **Total cost assessment** has come to represent the process of integrating carbon equivalent costs into a capital budgeting analysis. It has been defined as the long-term, comprehensive financial analysis of the full range of private costs and savings of an investment. Adding to the confusion, the acronym for total cost assessment (TCA) is the same as the acronym for total cost accounting (TCA).

▮ **True cost accounting** is a less used synonym for full cost accounting. The EPA Office of Solid Waste in its program to encourage local governments to apply full cost accounting to municipal solid waste management uses the term "true cost accounting" to encompass both private and societal costs while employing the term "full cost accounting" to refer exclusively to costs that affect the bottom line of solid waste management activities.

Life-Cycle Terminology. Life-cycle terms also are used in connection with enterprise carbon equivalent accounting. These terms include: lifecycle design, life-cycle assessment, life-cycle analysis, life-cycle cost assessment, life cycle accounting, and life-cycle cost.

▮ **Life-cycle design** has been defined as an approach for designing more ecologically and economically sustainable product systems, integrating environmental requirements into the earliest stages of design. In life cycle design, environmental, performance, cost, cultural, and legal requirements are balanced.

▮ **Life-cycle assessment** has been described as a holistic approach to identifying the environmental consequences of a product, process, or activity through its entire life cycle and to identifying opportunities for achieving environmental improvements. EPA has specified the four major stages in the life cycle of a product, process, or activity as raw materials acquisition, manufacturing, consumer use/reuse/maintenance, and recycle/waste management. By itself, life-cycle assessment focuses on environmental impacts, not costs.

▮ **Life-cycle analysis** is sometimes used as a synonym for life-cycle assessment. The U.S. EPA uses the life-cycle assessment term. Neither term addresses the costs and revenues of environmental consequences and improvements, however.

▮ **Life-cycle cost assessment** is a term that highlights the costing aspect of life-cycle assessment. It has been termed a systematic process for evaluating the life-cycle costs of a product, product line, process, system, or facility by identifying environmental consequences and assigning measures of monetary value to those consequences. Ideally, life-cycle cost assessment can be used to evaluate options for reducing total life-cycle costs and optimizing the use of resources. Some people view life-cycle cost assessment as basically adding cost information to life-cycle assessments.

▮ **Life-cycle accounting** is a term used to describe the assignment and analysis of product-specific costs within a life-cycle framework including *usual, hidden, liability, and less tangible* costs.

▮ **Life-cycle cost**, according to the U.S. Office of Management and Budget, means the sum total of the direct, indirect, recurring, nonrecurring, and other related costs incurred, or estimated to be incurred, in the design, development, production, operation, maintenance, and support of a major system over its anticipated useful life span.²⁹ More recently, **life-cycle cost** has been defined in an Executive Order as the amortized annual cost of a product, including capital costs, installation costs, operating costs, maintenance costs, and disposal costs discounted over the lifetime of a product.³⁰ The term may also be used more expansively to include societal costs. These life-cycle terms are also subject to terminological confusion.

For example, some people view life-cycle costing as referring only to private costs, while others view it as including both private and societal costs. Some apply a life-cycle perspective to capital budgeting, while others apply life-cycle concepts to process and product design. As previously mentioned, the key to facilitating communication is to recognize the different uses of common terms and to be able to identify underlying concepts. A threshold question is to determine whether someone is using an enterprise carbon equivalent accounting term to include solely private or both private and societal costs. A related question is to determine what application(s) a person has in mind when using these terms.

Scope of Costs. Because people may use environmental accounting terminology to refer to specific sets of carbon equivalent costs, or may be imprecise about what they mean, careful delineation of which types of costs are intended to be within the scope of one term or another can reduce confusion and enhance communication. There is an important distinction between costs for which a firm is accountable and costs resulting from a firm's activities that do not directly affect the firm's bottom line:

▮ **Private costs** are the costs a business incurs or for which a business can be held responsible. These are the costs that directly affect a firm's bottom line. Private costs are sometimes termed **internal** costs.

▮ **Societal costs** are the costs of a company's impacts on the environment and society for which the business is not financially responsible. These costs do not directly affect a firm's bottom line. Societal costs may also be referred to as **external costs** or **externalities**. These costs may be expressed, qualitatively, in physical terms (e.g., tons of releases, exposed receptors), or in dollars and cents. *Societal costs* (or externalities) are sometimes subdivided according to whether the impacts are environmental, referred to as *carbon equivalent costs* or *environmental*

externalities, or social, referred to as *social costs* or *social externalities*.

▮ **Internal costs** -- a synonym for private costs.

▮ **External costs** -- a synonym for societal costs. Also termed **externalities**.

▮ **Social costs** can be a synonym for *societal costs* or can refer to a subset of external costs

▮ **Carbon equivalent costs** can refer to the whole or a subset of internal or external costs associated with equivalents of carbon dioxide, and can be expressed both in terms of just the amount of carbon dioxide, or the monetary value at a set point in time., eg- so many tons of carbon dioxide, or so many thousands of dollars based on the value of carbon onj the specified date.

Applications. Of the many types of forward-looking business decisions (see Exhibit 1, page 6) that can benefit from environmental accounting, this primer focuses on cost accounting, capital budgeting, and process/product design:

-▮ **Cost allocation** refers to the procedures and systems for identifying, measuring, and allocating or assigning costs for internal management purposes.

▮ **Capital budgeting**, also known as **investment analysis** and **financial evaluation**, refers to the process of determining a company's planned capital investments.

▮ **Process/product design** refers to the process of developing specifications for products and processes, taking environmental costs and performance, among other factors, into account. **carbon equivalent costs**. Terms used to classify or categorize carbon equivalent costs are listed below:

▮ **Regulatory costs** are costs incurred to comply with federal, state, or local environmental laws (also termed **compliance costs**).

▮ **Voluntary costs** represent costs incurred by a company which are not required or necessary for compliance with environmental laws but go beyond compliance.

▮ **"Gray zone costs"** refers to costs that are not solely or clearly "environmental" in nature but may also be viewed, in whole or part, as health and safety costs, risk management costs, production costs, operational costs, etc.

▮ **Upfront costs** include preacquisition or preproduction costs incurred for processes, products, systems, or facilities (e.g., R&D costs).

▮ **Operational costs** refer to costs incurred during the operating lives of processes, products, systems, and facilities, as opposed to **upfront** costs and **back-end** costs.

▮ **Back-end costs** include carbon equivalent costs that arise following the useful life of processes, products, systems, or facilities. See also **exit costs**.

▮ **Conventional costs** include costs typically recognized in capital budgeting exercises such as capital equipment, raw materials, supplies, and equipment.

Direct costs is an accounting term for costs that are clearly and exclusively associated with a product or service and treated as such in cost accounting systems.

▮ **Usual costs** -- see conventional costs.

▮ **Hidden costs** refer to the results of assigning carbon equivalent costs to overhead pools or overlooking future and contingent costs.

▮ **Overhead** is often used synonymously with **indirect** or **hidden** costs as comprising all costs that are not accounted for as the **direct** costs of a particular process, system, product, or facility. The underlying distinction is between (1) costs that are either pooled and allocated on the basis of some formula, or not allocated at all, and (2) costs that an accounting system treats as belonging (directly) to a process, system, product, or facility (i.e., a cost center, in accounting terminology).

▮ **Manufacturing or factory overhead** refers to costs that are allocated using more or less sophisticated formulae as contrasted with **"general and administrative (G&A)"** overhead costs that remain in pools and are not allocated.

▮ **General & administrative (G&A) costs** are overhead or indirect costs that are not allocated to the costs of goods and services sold.

▮ **Research and development (R&D) costs** can include the costs of process and product design. See also **upfront** costs.

▮ **Exit costs** are the costs of proper closure, decommissioning, and clean-up at the end of the useful life of a process, system, or facility. See also **back-end costs**.

▮ **Contingent costs** refer to carbon equivalent costs that are not certain to occur in the future but depend on uncertain future events (e.g., costs of remediating future spills). Sometimes referred to as **"environmental liabilities," "liability costs,"** or **"contingent liabilities."**

▮ **Future (or prospective) costs** refer to carbon equivalent costs that are certain to be incurred at a later date, which may or may not be known. Sometimes referred to as **"environmental liabilities."**

▮ **Environmental liabilities** is an umbrella term used to refer to different types of carbon equivalent costs including costs for remediating existing contamination, costs of complying with new regulations, future carbon equivalent costs of current operations (also known as **back-end** or **exit costs**), and/or contingent costs.

▮ **"Less tangible costs"** refers to expenses incurred for corporate image purposes or for maintaining or enhancing relationships with regulators, customers, suppliers, host communities, investors/lenders, and the general public. Also termed **"relationship costs"** or **"image costs."**

Other Related Terms. Two other terms that are relevant to enterprise carbon equivalent accounting include the following:

▮ **Activity-Based Costing (ABC)** is a means of creating a system that ultimately directs an organization's costs to the products and services that required these costs to be incurred. Using ABC, overhead costs are traced to products and services by identifying the resources, activities, and their costs and quantities to produce output.³¹

▮ **Materials accounting** or **materials balance** refers to an organized system of accounting for the flow, generation, consumption, and accumulation of materials in a facility or process in order to identify and characterize waste streams. Some view a materials balance as a more rigorous form of materials accounting.

L. Conclusion: Moving Ahead

A successful environmental management system should have a method for accounting for full carbon equivalent costs and should integrate private carbon equivalent costs into capital budgeting, cost allocation, process/product design and other forward-looking decisions. Companies can make progress in enterprise carbon equivalent accounting incrementally, beginning with limited scale, scope, and applications. Companies can start with those costs that they know the most about and work toward the more difficult to estimate costs and revenues. Where private costs or revenues are difficult to estimate, and there is little management support for integrating them, then it may be best to handle them qualitatively. In many instances, it may be unnecessary to quantify the more difficult to estimate costs and benefits of capital investment choices because the more easily measured costs (and benefits) are sufficient to justify an investment in cleaner technologies. The same is true for process/product design, if one design direction is clearly superior to the alternatives. Ultimately, businesses will benefit from including probabilistic and difficult to estimate costs in cost allocation, capital investment, process/product design, and other decisions. The best approach is to go as far as you can in integrating carbon equivalent costs, including hidden, future, and contingent costs, into management decisions. Efforts to integrate societal costs into business decisions will continue and expand. Most corporate information and decision systems do not currently support such proactive and prospective decision making.³⁴ The capital markets do not yet have adequate ways to process/product design, and general business decisions. However, there is a growing body of information documenting a variety of businesses engaged in advancing the state of the art to bring societal costs into their decision-making.

How to implement enterprise carbon equivalent accounting

These are the main steps that an organization could take to implement an enterprise carbon equivalent accounting system:

1. Gaining support from senior management
2. Defining the boundaries of the proposed system
3. Ascertaining what are the organization's significant environmental impacts
4. Determining, if at all, environmental impacts and appropriate carbon footprints are being accounted for
5. Defining environmental costs
6. Determining who will be in the 'review team'
7. Reviewing the existing accounting systems
8. Identify environmental revenue or cost cutting opportunities that are currently being ignored
9. Suggest changes to the existing accounting system
10. Trial the carbon equivalent accounting system by way of a pilot test.

Note: Continual communication and education about the project is extremely important to ensure its success and that staff understand the importance and benefits associated with being more environmentally focused.

Benefits associated with enterprise carbon equivalent accounting

A number of benefits should follow from the implementation of enterprise carbon equivalent accounting. These benefits can span from direct (tangible) to indirect (intangible) and include:

- comply with regulations. If your company is required to report its carbon dioxide generation.
- more informed decision-making – Explicit consideration of particular costs that are otherwise obscured by traditional accounting approaches – for example, obscured in overhead accounts – will lead to more informed decision-making, with consequent implications for improved profitability
- uncovering opportunities – An analysis of environmental costs might reveal opportunities, some of which might lead to revenues through recycling, or use of 'waste' in other activities
- improved pricing of products – Explicit consideration of particular costs will enable more informed pricing of products
- assistance with internal and external reporting – Identifying environmental costs will help organisations collect data about their environmental impacts for internal and external reporting purposes
- increased competitive advantage – Given the infancy of enterprise carbon equivalent accounting, explicit consideration, and associated publicity, might provide an organisation with a competitive advantage
- improved reputation – Efforts to reduce environmental costs and related impacts will have reputation implications
- staff retention and attraction – It has also been argued that, by showing that an organisation is trying to manage and account for the environmental implications of its operations, this may in turn enable it to retain and attract better staff, as well as improve staff morale
- generation of societal benefits – Efforts to reduce environmental costs and impacts (which will assist in creating a cleaner environment) will generate human benefit.

Field level implementation

Remember full well that eco-costs are always not the highest priorities on the enterprise budget and so implement systems keeping that in mind. There are plenty of activities, but you are not testing for carbon dioxide or methane everywhere. You just need fuel records, operational rating and hours of operation of all equipment, and records of all activities in terms of fuel used and activity units of equipment and personnel. Typically at the most basic level a carbon footprint will always be

A x B

where A is the number of activity units (or amounts for fuel) and B is the carbondioxide footprint associated with each activity unit (or fuel units for fuel use)

Fortunately, most industrial equipment records are well maintained, so the ratings are known, thus just number of activity hours will be needed(or fuel usage, if carbon footprint factor is based on that). From that point, it is all just a matter keeping good records of all activity of equipment, personnel (also include activity for employee related and business travel related) , apportioning raw material carbon equivalent if using that method, apportioning any end of life carbon equivalent if using that method, and apportioning shipping/receiving carbon equivalent and add, add and add. Consider getting a program like EMSPRO(TM) that robustly aggregates all materials, processes, equipment, personnel, products and wastes activities for you.

For details on links to EPA's Reporting rule go to this link:

<http://www.wreainc.com/note-epa.htm>

Editor's note: This white paper will be updated, and for the foreseeable future be available as a free download to benefit those interested. Please feel free to send your comments or contributions by email marking subject as "ESEA white paper" to drn@wreainc.com

All comments or contributions are welcome, but no guarantee will be made to include them in the text or to acknowledge receipt of such comments or contributions.