

1 **The Green Bottom Line**

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THIS CHAPTER begins by addressing three questions:

- What is environment-related management accounting?
- Why should it be undertaken?
- Who should do it?

It then identifies relevant sources of financial and non-financial information and discusses the ways in which existing management accounting techniques can be modified to take account of environmental issues. A final section draws conclusions and is followed by an appendix on definitions of environmental costs and benefits.

|| What is Environment-Related Management Accounting?

The term 'environmental accounting' has been used to cover both national and firm-level accounting activities, the processing of both financial and non-financial information, and the calculation and use of monetised external damage costs as well as those that are internal to the firm (see Chapter 2). For clarity, Figure 1 distinguishes six different domains of environmental accounting that are relevant to the firm level, based on their boundaries of attention—an individual organisation, the supply chain of which it forms part and the whole of society—and the extent to which they focus on financial and/or non-financial information. The six domains that emerge can be defined in this way (the two life-cycle definitions are based on the US Environmental Protection Agency discussion in Chapter 2):

	Organisation	Supply chain	Society
Financial focus	Environment-related financial management	Life-cycle cost assessment	Environmental externalities costing
Non-financial focus	Energy and materials accounting	Life-cycle assessment	Environmental impact assessment

Figure 1: Domains of Firm-Level Environmental Accounting

- 1. Energy and materials accounting:** the tracking and analysis of all flows of energy and substances into, through and out of an organisation
- 2. Environment-related financial management:** the generation, analysis and use of monetised information in order to improve corporate environmental and economic performance
- 3. Life-cycle assessment:** a holistic approach to identifying the environmental consequences of a product or service through its entire life-cycle and identifying opportunities for achieving environmental improvements
- 4. Life-cycle cost assessment:** a systematic process for evaluating the life-cycle costs of a product or service by identifying environmental consequences and assigning measures of monetary value to those consequences
- 5. Environmental impact assessment:** a systematic process for identifying all the environmental consequences of the activities of an organisation, site or project
- 6. Environmental externalities costing:** the generation, analysis and use of monetised estimates of environmental damage (and benefits) created by the activities of an organisation, site or project

Firm-level environmental accounting can potentially encompass all of the six domains but, in practice, is centred in the first two as the areas where accountants' experience and accounting techniques (as opposed to those of, say, environmental managers and environmental management techniques) have the most to contribute.

The literature on firm-level environmental accounting initially focused—and, to a considerable extent, still does—on external accountability to stakeholders outside the company, rather than on serving the needs of management. There are two distinct aspects to this:

- A broad concept of accountability to all of a company's stakeholders
- The traditional financial accounting focus of providing accurate and reliable information on the financial position of companies to their shareholders

In both cases, the emphasis is on collecting, verifying and reporting information to audiences outside the organisation, as opposed to the internal audience of the organisation's own management.

The broad accountability approach is founded on the premise that the responsibility of companies should not be seen—as in the traditional micro-economic theory that still largely shapes company law—as limited to maximising profits or value for the benefit of their owners (shareholders) alone. On the contrary, the activities of

companies have wider impacts on society and the environment, and an enlightened company will recognise this and ensure that it maintains good relationships with all its stakeholder groups in order to preserve its implicit 'licence to operate' (RSA 1994). This was the main theme in much of the early literature on environmental accounting (Bebbington and Thompson 1996; CICA 1992; Grayson, Woolston and Tanega 1993; Müller *et al.* 1994; Gray, Bebbington and Walters 1993; Gray, Owen and Adams 1996; Owen 1992; Zadek, Pruzan and Evans 1997) and has been largely responsible for prompting many companies to publish corporate environmental reports (KPMG 1997; Lober *et al.* 1997; Owen, Gray and Adams 1997; SustainAbility/UNEP 1997). Even some authors who have seen themselves as following a management accounting approach—i.e. one that focuses on provision of information for internal decision-making—have, in practice, placed considerable emphasis on its role in generating information for external stakeholders (Birkin and Woodward 1997a–f).

There has also been a narrower concern, particularly within the accountancy profession and among financial regulators such as the US Securities and Exchange Commission (SEC), that regular financial reports by companies to their shareholders may be significantly inaccurate. It is said that these do not adequately reflect the effect on the business of environmental issues, particularly in the US where 'Superfund' liabilities can be substantial (Ethridge and Rogers 1997; Schoemaker and Schoemaker 1995). The accounting profession in Europe and internationally has also considered this and has provided guidance to its members (ASB 1997; FEE 1996; IASC 1997; ICAEW 1996), although the prevailing consensus seems to be that existing financial accounting practices, so long as they are properly applied, are adequate to deal with environmental effects on business and do not require change.

Both these bodies of work can be seen as adopting a 'financial accounting' approach, i.e. with a focus on reporting to external stakeholders. However, there is now a growing literature that adopts a genuine 'management accounting' approach that does focus on providing information to support internal decision-making (although, of course, much of this data may be of value to external stakeholders also). The starting point for this was probably the well-known '3P' (Pollution Prevention Pays) initiative introduced by 3M during the 1970s. This was expanded during the 1980s and early 1990s by further pollution prevention initiatives introduced by companies and/or government-sponsored programmes in the Netherlands, USA and other countries. These required more precise data on the costs and benefits of environmental action and therefore spawned new methodologies such as the 'total cost assessment' technique developed by the Tellus Institute for the US Environmental Protection Agency (White, Becker and Goldstein 1991; see also Chapter 14). The EPA has since sponsored a number of studies and publications on the topic—many of which are summarised in this volume—and the Tellus Institute has continued with its applied research and application. Other important US contributions have been made by Bailey and Soyka (1996), Ditz, Ranganathan and Banks (1995), Epstein (1996b, 1996c), IMA (1995) and Rubenstein (1994). In Europe, the topic has been addressed by, *inter alia*, IIIIEE and VTT (1997), Schaltegger, Müller and Hindrichsen (1996), Tuppen (1996) and Wolters and Bouman (1995).

This book is positioned within this management accounting approach and contains contributions from most of the authors and organisations cited. We see this focus as being complementary—rather than an alternative—to a financial accounting approach. It

addresses different needs and is also necessary in order to provide many of the data that are of interest to external stakeholders.

Our working definition of environment-related management accounting is therefore:

The generation, analysis and use of financial and non-financial information in order to optimise corporate environmental and economic performance and achieve sustainable business.

The term ‘environmental’ precedes ‘economic’ in order to indicate an environmental bias. As we discuss below, the main aim at present must be to overcome the barriers to environmental action that can be created by current management accounting practices. However, there will be occasions when even modified practices reveal trade-offs between environmental and economic parameters which will result in the latter being given priority over the former. For this reason, we use the term ‘environment-related management accounting’ in our following discussions to signal that the activity is focused on meeting corporate as well as societal objectives.¹

We include the term ‘sustainable business’ to indicate that, although much of the practical action generated by environment-related management accounting involves adaptation of existing activities, such as management accounting and environmental management, part of its objective is to support the goals of sustainable development (see below).

A final point is that environment-related management accounting relies heavily on non-financial information, particularly regarding inputs, outputs and flows of energy, materials and water (see below). Some would see the development of this information as a primary objective (for example, Birkin and Woodward, 1997a–f). However, we would argue that, at present, such information is a means rather than an end for environment-related management accounting. Its ultimate objective is to provide information to support environment-related decision-making by mainstream business managers. While this may sometimes require ‘raw’ physical data, we believe that the need is more often for either productivity measures (e.g. materials consumption or waste generation per unit of production) or information expressed in financial units. This is because:

- For profit-seeking firms, the ultimate objective (maximising shareholder value, or profitability) is expressible in monetary form, and information that can be expressed in the same or related (e.g. productivity) terms is always likely to attract more immediate attention.
- The financial side of management is relevant to all functions, including environmental management. Not only do environmental budgets need to be managed, but proposals for action that can be justified in terms of conventional methods of financial investment appraisal and product costing, for example, are more likely to be successful.

A supporting point is that environmental and operational managers are fully capable of developing and using such data and are often doing so in practice. Hence, there is no need to invent a new discipline or activity to accomplish this. Indeed, to do so

1. Note that these are the authors’ opinions and terminology, and would not necessarily be accepted and used by all the other contributors to the book.

could be counter-productive because it may foster resentment and defensiveness among line staff about territorial aggrandisement by accountants.

More pragmatically, there is little evidence that the accountancy and finance functions are greatly involved in energy and materials accounting activities in most companies or have the interest and expertise to do so in the near future. The Zeneca case study in Chapter 19, for example, found that the substantial savings that followed such an exercise at the company's Huddersfield site were almost entirely driven by operational staff and had only a marginal accounting involvement.

At first sight, this argument may appear to be in conflict with advocates such as Kaplan and Norton (1992, 1993, 1996a, 1996b), Simmonds (1991) and Wilson (1997), who have argued for the development of strategic management accounting and, as part of this, greater use of non-financial data and indicators. However, we would argue that their views are less relevant to an area that usually has a relative abundance of non-financial data and a shortage of financial data. Moreover, their arguments have had—at least as yet—only limited impact on management accounting practice. While there is certainly more attention being paid to the strategic use of non-financial data and indicators through 'balanced scorecards', anecdotal evidence suggests that it is more often strategic planning, business excellence and other functions that are implementing it, rather than accountancy and finance. Research in other areas of management accounting has also found that practice can be slow to adapt (Drury *et al.* 1993) and that initiatives in new or developing areas such as non-financial performance measurement are often taken by functions other than accounting.

For all of these reasons, we would suggest that the immediate priorities for environment-related management accounting are the generation, analysis and use of financial or neo-financial (e.g. indicators of resource productivity) information, and modifying and adapting the established techniques of management accounting and financial management to take account of environmental issues.

|| Why Undertake Environment-Related Management Accounting?

The primary aim of environment-related management accounting is to better inform and otherwise support decision-making processes that are influenced by environmental factors—which are primarily those of accounting and financial management, environmental management and operational management.² Some of the specific objectives that this creates can be summarised as:

- Demonstrating the impact on the income statement (profit and loss account) and/or balance sheet of environment-related activities
- Identifying cost reduction and other improvement opportunities
- Prioritising environmental actions
- Guiding product pricing, mix and development decisions
- Enhancing customer value

2. See Bartolomeo, Bennett and James (1998) for a more detailed discussion of objectives, based on research conducted for the ECOMAC project.

- Future-proofing investment and other decisions with long-term consequences
- Supporting sustainable business

Income Statement and Balance Sheet Impact. As many of the chapters in this book show, there is growing evidence that environment can have significant impacts on expenses, revenues, assets and liabilities and that these impacts are often underestimated. Making such financial impacts apparent can make it easier to take, and win support for, further environmental initiatives.

In the US, most attention has focused on the balance sheet issue of environment-related liabilities. This is a consequence of the high levels of damage claims and fines, and of specific legislation such as that requiring the clean-up of contaminated land. It has been estimated that American industry may be under-provided for 'Superfund'-related clean-up liabilities by up to a trillion dollars (Schoemaker and Schoemaker 1995). Liabilities are less in the UK and other European countries, but still significant for some companies. They may become more significant if proposed legislation on the topic comes into force.

Investment in environment-related assets can also be significant: the chemical industry has estimated that up to 20% of its new capital investment in recent years has been to deal with environmental problems. This is financially significant because these assets have to be financed but, to the extent that the need for them is driven by compliance rather than by commercial business criteria, they do not generate any direct return.

European attention has been focused more on opportunities to reduce or avoid expenses than on liabilities, and this topic is increasing in importance in the USA too. Initiatives are usually taken on a one-off basis (see below), but an aggregate measure of savings can be a useful means of demonstrating that environmental management can be a profit contributor rather than merely an additional cost burden on business, and of building bridges between environmental staff and mainstream management. 3M calculates the accumulated first year's savings from initiatives carried out under its Pollution Prevention Pays (3P) programme, while Baxter, as we discuss in Chapter 15, produces an annual environmental financial statement with details of expenses and savings. So far, less attention has been paid to the revenue opportunities arising from environmental action, but these too may be significant in future.

Cost Reduction and Improvement. A number of corporate programmes, practical demonstration projects and research studies have shown that waste minimisation and similar initiatives can create savings and cost avoidance. In the first phase of the Aire and Calder Valley study (Johnston 1994), for example, potential improvements worth £2 million per annum were identified across the eleven industrial sites studied, with more longer-term possibilities in prospect when the project had run longer. Of the proposals stimulated by the project, 72% had payback periods of either zero or less than twelve months. Similarly impressive results have been reported by other waste minimisation and energy efficiency projects—including those at Sulzer, Xerox and Zeneca, as Chapters 17–19 describe. In addition, these and other initiatives, such as product redesign, can sometimes increase product quality and therefore sales revenues.

Of course, once the 'low-hanging fruit' has been gathered, there may be a point at which further cost reductions are not available (Walley and Whitehead 1994). However, if regulatory and social demands continue to increase and to create new

potential costs for business, this point may be delayed for some time. Even after many years of waste minimisation initiatives, Dow, for example, continues to expect to find a large number of waste minimisation and similar projects that can provide annual returns on capital of at least 30%–40% over the coming decade (McLean and Shopley 1996).

Prioritise Environmental Actions. If they are fortunate, companies will need to prioritise between a number of win–win improvement opportunities. If not, they may need to prioritise between environmental improvements that do not create any net economic benefit but which may nonetheless have differing rates of (negative) return. Du Pont, for example, calculates the costs of different means of meeting given emission reduction targets as a means of achieving this.

Guide Product Pricing/Mix/Development Decisions. To maximise product profitability, it is vital that accurate product cost information is available and is taken into account when setting prices. This information also allows poorly performing products to be changed or dropped from the product range. As Chapter 9 shows, a study by the World Resources Institute found, at several of the companies that they examined, that, although environmental costs were significant, they were not being fully identified and allocated to products, so that pricing was not reflective of real costs (Ditz, Ranganathan and Banks 1995). As previously noted, environment can also influence the lifetime costs of products: for example, by requiring end-of-life disposal routes. Gaining a better understanding of these costs—as with the Philips model for considering end-of-life disposal costs (Brouwers and Stevels 1997)—allows timely action to be taken to minimise or avoid them through redesign and/or to put more cost-effective disposal routes in place.

In the long run, too, many markets are likely to be shaped by environmental factors—including the changing cost structures resulting from eco-taxes and other developments. Although this threatens some existing products and services, it also creates opportunities for others (Fussler with James 1996; Porter and van der Linde 1995b). Gaining a better understanding of medium to long-term environmental costs and benefits can help to neutralise threats and ensure that opportunities are taken.

Enhance Customer Value. Environmental actions taken within discrete portions of product chains can sometimes be economically and/or environmentally suboptimal, so co-ordinated action can provide higher returns for all of the chain members involved. One example from our research was a company providing a chemical in a small disposable container. The containers were expensive to buy and incurred waste disposal costs for the customer. Changing to re-usable containers reduced procurement costs for the supplier and eliminated the customer's waste costs. Demonstrating a detailed business case for such actions can spur improvement and also provide opportunities to develop closer relationships with customers.

Future-Proofing Decisions. Many investment and product development decisions are determined by levels of costs and benefits arising some years in the future. Unanticipated environmental factors can often affect these costs and benefits, sometimes to the point where returns become negative. Many of the chapters in this book discuss how the risks of this can be reduced through better analysis of environment-related costs and benefits (see also below).

Supporting Sustainable Business. There is increasing discussion of the implications of sustainable development for business, which are clearly considerable (DeSimone and Popoff 1997). They include:

- Radical improvements in environmental performance: a minimum ‘factor-four’ reduction in environmental impact is needed for the delivery of final goods and services to consumers, according to some estimates (von Weizsäcker, Lovins and Lovins 1997)
- ‘Eco-innovation’, i.e. development of new products and processes that are capable of meeting these objectives (Fussler with James 1996)
- A long-term perspective in decision-making, with greater emphasis on the impacts of decisions on future generations
- A greater degree of internalisation of external environmental costs to business

This implies the need for environmental and management accounting systems to collect new types of data, such as those relating to environmental effects throughout the entire product chain. It also suggests that more attention needs to be paid by accountants and others to identifying and raising internal awareness of long-term cost trends.

The section on environmental value analysis towards the end of the chapter discusses one way in which environment-related management accounting can operationalise these ideas.

|| Who are the Environment-Related Management Accountants?

Our answer to this is: anyone who is involved in generating financial and neo-financial information about the business impacts of environmental issues. Hence, many environmental and operational managers and some management accountants are already practising environment-related management accounting. In this respect, environment-related management accounting is largely a ‘virtual’ activity enhancing what already exists rather than creating something completely new. This is primarily:

1. Making better use of, or modifying, existing sources of data and generating new ones
2. Making better use of, or modifying, existing management accounting techniques

One additional task is to foster the longer-term perspective that allows the challenge of sustainable development to be addressed by the business (see above). A second is the need to create processes that bring together the accounting, environmental and other functions to achieve both specific objectives and a more general awareness of each other’s concerns and activities. An obvious example is to include environmental managers in both regular investment appraisal and other business case procedures, and also irregular accounting change activities such as activity-based costing (ABC) or business process re-engineering. Conversely, accountants and accounting data need to be included within environmental management systems (McLaughlin and Elwood 1996).

Researchers have found that the benefits from such processes can be as important as any specific outcomes. That is also the conclusion of many practical initiatives such

as the environmental financial statement developed by Baxter (see Chapter 15). AT&T also believed this to be so important that it created a 'green accounting team' to develop good relationships and a common understanding of worthwhile initiatives that might be undertaken (see Fig. 2).

This combined requirement to change the conduct of existing tasks, to establish a longer-term view of the business implications of sustainable development, and to

IN THE MID-1990s, AT&T established an ambitious design for environment (DFE) initiative, aimed at identifying whole-life environmental impacts and costs of computing and telecommunications equipment in order to make environmental considerations a priority during the design stage (examined in detail in US EPA 1995b). It created six cross-functional teams examining areas such as 'green accounting', 'life-cycle analysis', 'supply-line management' and 'product takeback'. The green accounting team combined representatives from accounting, operations, environmental management and other business functions, from both the corporate centre and business units. Members were invited to join both for their functional and specialist expertise and for their ability to use their influence to support the implementation of the team's proposals. The team was co-chaired by two executives with backgrounds in management accounting and environmental engineering respectively.

Several of the team had previous experience with activity-based costing (ABC) and activity-based management (ABM) initiatives at AT&T and saw their environmental tasks as extensions of this. Their aim was to identify those costs for which environmental factors are the main cost drivers, and track these through to products and processes. Hence, their working definition of environment-related costs was those costs where environmental professionals are the best placed to identify both the cost drivers and the means to affect them.

The team's main objective was to integrate environmental considerations into existing management accounting systems and to support long-term strategy development and decisions—in particular on product and process design.

One early example was the use of lead in soldering processes, which has adverse environmental impacts. The conventional costing system simply spread soldering costs across all products by general apportionment on the basis of the costs of materials used. However, on investigation, it was found that the true driver of both the environmental impact and the associated business costs was the number of soldering operations performed, which varied widely between different products. One product would go through the process only once, another ten times—but the existing system would apportion the same cost to both. Making this visible by changing the costing system provided the incentive to look for ways of reducing costs and environmental impacts through product redesign and the use of different types of flux. Similarly, the main driver of quantities and therefore costs of chemicals wastes in batch production systems was found to be not the volume of production but the number of set-ups required, and therefore the size of batches.

The team produced several outputs, including a glossary of environmental accounting—to reduce internal and external misunderstandings—and a checklist for sites to identify areas of costing weakness. One particularly important tool that was developed by them was the 'Green Activity Matrix'. This lists the various costs that have an environmental element, in two dimensions:

- The first dimension is categorised by the type of cost incurred: people, materials and supplies, services and consulting fees, depreciation on equipment, energy and utilities, etc. These correspond with the general ledger codes used in financial accounting systems.
- The second dimension lists some 30–40 types of environment-related activity such as obtaining permits, treating on-site waste, handling/storing/disposing of hazardous wastes, and environment-related training.

The cells in the matrix are completed with the respective amounts of cost. This provides a link between the general ledger system, which collects costs by the types of resource, and the business activities that drive the amounts of costs incurred. This can be used to identify which activities are the most significant in driving the largest proportions of costs.

Unfortunately, the break-up of AT&T in 1996 ended the team's activities (although many of its specific activities have continued in its successor companies). However, its experience shows what can be achieved through the creation of cross-functional processes and a practical model of how to do so.

Figure 2: The Green Accounting Team at AT&T

initiate and maintain new processes, suggests that there is a need for a concrete manifestation of environment-related management accounting in the form of an organisational ‘champion’. To be effective, he or she will require a combination of personal dynamism and vision and accounting, business and environmental know-how. In principle, this could be found and therefore located in any business function, but the critical need at present to change the attitudes and actions of accountants and the accounting function suggests that the champion will have maximum impact if located there.

The seeds of such a development have been sown by professional management accountancy institutes who have called for more involvement in environmental management by their members. The UK Chartered Institute of Management Accountants (1997) has commented that

the forward-thinking management accountant should be taking an active role in environmental management...as he or she has key skills to apply to the process, including the provision of advice relating to strategy formation and the effective use of resources.

Parker, commenting for the US Institute of Management Accountants’ Foundation for Applied Research on the Tellus Institute’s study of environmental cost accounting for capital budgeting (White *et al.* 1995; White and Savage 1995), has also observed that

corporate accountants and financial managers are not necessarily in the best position to recognize and understand the trend toward transforming internal costs. In many cases, recognition of what is at stake comes from non-financial professionals. But management accountants, aware of the strategic value of environmental accounting and aided by decision support tools, can wake up senior management to the necessity for analyzing environmental costs. This leadership can change senior management’s perception that management accountants are simply corporate scorekeepers (Parker 1995: 53).

There is less evidence to date of individual companies taking the initiative, but this is likely to change in future.

|| The Practice of Environment-Related Management Accounting

Figure 3 provides a graphical representation of what this involves in practice. It is divided into three vertical levels to indicate a progression from the foundation of non-financial and financial data, through the techniques that process this into information (i.e. outputs that are useful for managers and stakeholders), to the highest level—objectives (see discussion above). The next section discusses the base of the triangle, i.e. relevant data, in more detail, while the subsequent section considers the techniques that convert this into information.

|| Key Data for Environment-Related Management Accounting

This section discusses the existing data sources and systems that can provide inputs to environment-related management accounting, the extent to which they take environment into account (or conceal its importance) at present, and possible ways in which they can be modified or supplemented to reflect environmental considerations in future.

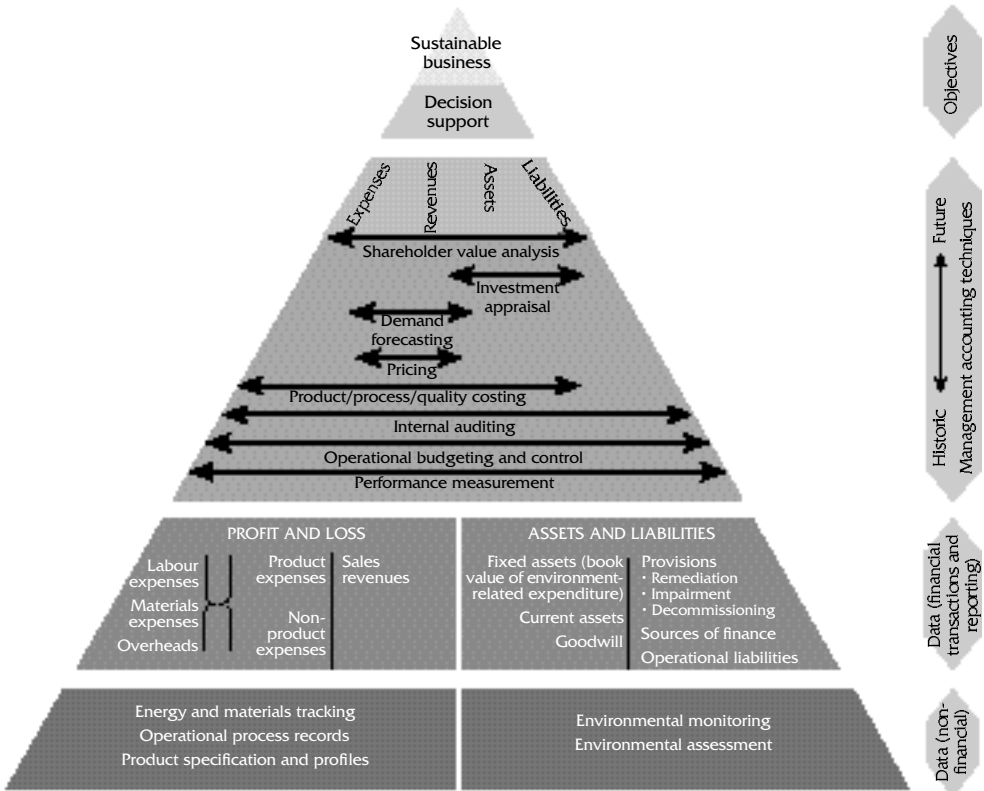


Figure 3: The Environment-Related Management Accounting Pyramid

Non-Financial Data

As Kaplan and Norton (1992, 1993, 1996a, 1996b) and others have stressed, non-financial data is an important element in all areas of management accounting. This is particularly true of environment-related management accounting, whose ultimate ‘raw material’ is data on physical and energy flows and stocks and their impacts upon the environment. This is collected in operational process records, material resource planning systems, resource planning, emissions monitoring and other systems, which are managed by production, environmental and other non-accounting functions. Moreover, Shields, Beloff and Heller’s study of five oil and chemical companies in the USA and Mexico (see Chapter 10) found that such non-financial information was more useful for day-to-day environmental decision-making than was financial data. We have argued in the Introduction that the generation of non-financial data should not be seen as a central objective of environment-related management accounting, on the grounds that it is either already being provided—or could more easily be provided in future—by functions such as environmental management or production. However, this is not to say that accounting techniques or accounting professionals cannot play a role in this area. The potential for this has been explored in detail by the previously mentioned ECOMAC project (Bartolomeo, Bennett and James 1998). One of the key opportunities that has emerged from this and other studies is to obtain a better understanding of the extent and financial implications of energy, materials and water flows

through organisations (see also Chapters 6, 11, 13 and 17 in this volume). This is important for many reasons, but especially because the full costs of wasted materials (i.e. including their purchase price and the costs of processing them to the point where they become waste) are often the single most significant environmental cost (see the appendix below and the Zeneca case in Chapter 19). Except for specific industry sectors, such as chemicals and pharmaceuticals, which have always been concerned with the yields and detailed characteristics of their processes, few organisations in the UK and USA appear to have a full picture of their energy and material flows; indeed, obtaining such a picture is usually the first step in successful waste minimisation programmes and often creates non-environmental business benefits.

As yet, there are no American or British equivalents (at least in the public domain) of the Germanic ‘eco-balancing’ approach practised by Kunert and other companies, which builds a picture of all energy and material flows on a periodic basis (Bennett and James 1998a; Birkin and Woodward 1997d; James, Prehn and Steger 1997). This is then used as the basis for day-to-day ‘eco-controlling’ in order to reduce environmental impacts (Hallay and Pfriem 1992; Hopfenbeck and Jasch 1993; Schulz and Schulz 1994). One potential task for environment-related management accounting in the US and UK is therefore to apply these ideas and associated techniques there.

Financial Data

The accounting function in business (and non-business organisations) has, potentially, three distinct objectives:

- The day-to-day **operational** needs of initiating and recording transactions, and of managing assets and liabilities such as, respectively, working capital and bank loans
- Supplying regular external **financial reports** to shareholders, to provide them with reassurance that their assets are being safeguarded and their interests are being met. This is a legal obligation for companies in all advanced economies
- Providing **management** within the organisation with **information** that is relevant to its function of making decisions and ensuring that the organisation’s activities and outputs are kept under proper control.

The first objective is essential for day-to-day operations. The second is a legal obligation. The third objective is optional, and the extent to which financial information and techniques are used in management is discretionary and will reflect the particular management style adopted. However, some internal financial processes are near-universal in organisations of any significant size, such as budget-setting and budgetary control, and tracking costs through the organisation to the responsible department and manager.

To support these three objectives in large organisations, an integrated system of accounting data capture and collection is needed—ledgers, registers, cash books, etc. Although the principal factors in the design of these systems are likely to be determined by the needs of the first two objectives, they also represent a financial database that is available for use by management.

This subsection reviews the breadth of the financial data that are usually available, based for convenience on the classification of the legally required published financial

reports. These are centred on two core financial statements. The first is the income statement, which aggregates expenses and revenues throughout a given financial period (usually a year). The second is the balance sheet, which summarises a company's assets and liabilities at a particular point in time (usually at the end of the same financial period). These four basic categories of expenses, revenues, assets and liabilities are reflected in Figure 3.

Expenses and Revenues. The basic accounting systems within organisations (the book-keeping systems and ledgers) will generally capture and collate expenses in terms of a combination of two parameters:

- The type of resource being acquired and consumed: materials, labour, services, depreciation, etc.
- The functional area of the business in which the expenses are incurred: production, selling and distribution, general and administrative, etc.

These classifications reflect the sources of the data in the various subsystems of a normal business accounting system. Labour costs will be available from payroll systems; materials costs from materials management systems which draw their data from invoices and bills of materials; the depreciation charge from a register of fixed assets; etc. The appendix discusses in detail which of the general pool of expenses and income can be classified as environment-related.

Traditionally in management accounting (including here its junior sibling, cost accounting), there has been more emphasis on dealing with costs than with revenues. This reflects the origins of cost accounting in the production function, due in large part to the financial requirement to report in published financial reports the historic cost of stocks (inventories). This requires detailed analyses of production costs.

There is no equivalent external compulsion to carry out detailed analyses of revenues. Only relatively recently in most organisations, in terms of the historic development of accounting, has the marketing function achieved the importance that it has in modern business. Hence, the traditional emphasis has been on production and costs rather than on marketing and revenues.

The accounting systems will need to capture and collect data on revenues as they arise through transactions, as evidenced by shipping documentation and invoices, and will need to analyse these in sufficient detail to support management—as a minimum, by type of product, customer, market sector and distribution channel.

Reclassifying accounting data after its initial entry is sometimes impossible and almost always time-consuming and costly. Hence, the secret of success in all areas of management accounting—including that related to environmental issues—is to capture any data necessary for analysis (such as the purpose of expenses)—when the data are entered. However, modifying existing systems can also be costly. The lowest-cost option is to build in environmental considerations when systems are being changed for other reasons: for example, because of the introduction of an activity-based costing system (see below). A key task for environment-related management accounting is therefore to ensure that the needs of environmental management are considered when changes are being made. The opportunity is to obtain better-quality data, but almost as important is to avoid a deterioration in the quality of existing data. In one company that we researched, a re-engineering exercise resulted in previously separate categories for energy

purchases—electricity, gas, etc.—being collapsed into a single energy category. As a result, it lost the ability to calculate easily its energy-related carbon dioxide emissions.

Assets. Accountants identify three broad categories of asset: fixed (or long-term) assets, current assets and goodwill (a particular type of long-term asset). Fixed assets are those with a useful life beyond a single accounting year and are (with some exceptions) stated in the balance sheet at their original historic cost, reduced by depreciation provided to date in respect of the portion of their useful life that, to date, has expired. The high cost and long life of assets such as pollution control equipment and landfill sites means that these can be significant fixed assets, and the depreciation on them can also be significant, although this is often excluded in calculations of environmental costs.

An alternative method of valuing fixed assets is at their replacement cost. This is of potential environmental significance because rising environmental standards often mean that the cost of building new environment-related facilities is much higher than those that are being replaced (see below). This is the case with landfill at Zeneca's Huddersfield site (see Chapter 19). The company has a long-standing site which is fully depreciated. Hence, only operating expenses are charged back to product and process cost centres. As the site has many years' life, this can be practically justified but, at current rates of waste generation, a replacement landfill facility will have to be built at some point. This is likely to be very expensive and will therefore result in an immediate increase in recharged costs as depreciation is included in the figures. However, the conventional method of basing these recharges on historic costs means that managers who take decisions that affect the volume of wastes generated, through process control and product design, are not encouraged by the system to take into account also the opportunity cost that is indirectly incurred as landfill capacity is consumed.

The main current assets for most companies are cash balances, debtors (accounts receivable), and stocks and work in progress. Although environment has some tangential relevance to these—changes in environmental legislation could result in stocks becoming more difficult or impossible to sell—this is not for most a major area of concern.

Goodwill is an asset with whose treatment the accounting profession has been struggling—with only limited success—for some time. Conventional accounting practice recognises and includes goodwill in company balance sheets only when money is directly outlaid to acquire it, when one company is purchased by another. The goodwill then arising is the amount by which the purchase consideration exceeds the value of the tangible net assets acquired, and represents what the acquirer is prepared to pay for the present value of the amount by which the acquirer's future profits are expected to exceed a normal rate of return. However, the true value of goodwill in any company should also include what it has built up within the business as a result of operating over time and building up a reputation among customers, even though this is not represented by any specific outlays and is therefore not captured by the accounting system. Several authors have suggested that environment is an important determinant of company reputation, although the precise extent of this is difficult to quantify (DeSimone and Popoff 1997; Charter 1992).

Liabilities. Liabilities can be distinguished by type into three broad categories: sources of finance; liabilities arising from normal operations; and provisions.

In most major corporations, the raising of finance and the balancing of debt and equity is handled within the finance function by a treasury management function which is separate from the financial controlling activities of then allocating, managing and accounting for this finance within the business. Environmental performance is increasingly significant for treasury management, since the extent of risks being borne by a company, including those that are environment-related, can affect access to and the cost of raising new capital. Several studies (for example, Butler 1997) have shown that funds that invest in companies with good environmental records have matched and sometimes out-performed the market average—thereby lowering the cost of raising equity—and, conversely, that those investing in companies that have experienced major environmental incidents have been depressed, making new equity more expensive (Blumberg, Korsvold and Blum 1997). Kvaerner, for example, has paid slightly lower interest rates on loans because of its good environmental record and consequently greater credit-worthiness. Some analysts and insurers are coming to see evidence of good environmental management by a company as indicative of the quality of its management generally.

Liabilities arising from normal operations include trade and most sundry creditors, corporation tax due, and tax collected but not yet paid over in connection with PAYE and VAT, etc. These may be affected by any events occurring within the business, including environment-related events, but are unlikely to be particularly significantly affected by environmental management.

Provisions are amounts allocated to cover any likely future liabilities or losses that have arisen but have not yet been settled (provisions included under 'liabilities' will exclude any provisions made in connection with the impairment in value of assets, such as arising from depreciation of fixed assets or from the obsolescence of inventories, which will be reflected in the balance sheet as a reduction in the value of the related assets). There is considerable concern that significant liabilities could exist, in respect of (for example) remediation or future decommissioning costs, which are frequently not fully provided for in company financial reports. Chapter 5 provides an overview of how potential remediation liabilities can be assessed as an aid to both internal decision-making and external reporting. Barth and McNicholls (1994) and Schoemaker and Schoemaker (1995) also provide good overviews.

Until now, the emphasis has been on quantifying liabilities arising from past events but, while this remains important, Brent Spar and other developments have focused attention on potential future liabilities. In order to be proactive and to ensure that environmental liabilities are not under-provided, Chevron has introduced a systematic cross-functional process to identify, evaluate, measure and disclose its environmental liabilities, and then monitor their remediation (Lawrence and Cerf 1995).

Techniques

The second tier of the pyramid in Figure 3 identifies the main management accounting techniques that are used to process the data arising from the financial and non-financial systems into information for management's benefit: performance measurement, operational budgeting and control, internal auditing, costing, pricing, demand forecasting, investment appraisal and shareholder value analysis. All of these are actually or potentially relevant to environment. One important distinction is between those that are concerned with current data and those (broadly, demand forecasting, investment appraisal

and shareholder value analysis) that make projections into the future. Subsequent sections discuss the environmental relevance of each of these techniques.

Performance Measurement. Performance measurement is a growing field in all areas of business. Traditional performance measurement in the UK and USA, particularly at higher levels of management, has focused on meeting financial targets. However, over the last decade, the quality movement and other drivers have focused attention on the importance of non-financial performance measures, and schemes such as the European Quality Award and Kaplan and Norton's 'balanced scorecard' now provide templates for this (Kaplan and Norton 1992, 1993, 1996a, 1996b). To date, environment-related performance management has largely been developed by environmental managers and has limited interaction with management or others involved in strategic performance measurement (Bennett and James 1998). However, as the Introduction and other authors (for example, Epstein 1996c) have noted, environment should be an important part of a balanced scorecard for many companies and more interaction is needed in future. Many of the practical challenges of developing and implementing environment-related performance measurement are also generic to all areas of performance measurement, and greater interaction would facilitate mutual sharing of experience and learning. Finally, the dependence of environment-related management accounting on the non-financial data that is generated by environmental, operational and other functions makes it important that its needs are considered during each of their own performance measurement processes.

Operational Budgeting and Control. The setting of budgets is an important means of implementing strategic objectives, while tracking budgetary outcomes can be a valuable means of monitoring how well objectives are being achieved. Budgeting is relevant to environmental management for three reasons. First, environmental actions will require resources that need to be specified within budgets. Second, budgetary outcomes can be a useful means of checking whether environmental goals are being achieved: for example, over-budget expenditures on energy provide an early warning that energy efficiency targets are unlikely to be achieved. Finally, as has been previously noted, identifying and allocating environmental costs to specific budgets provides a powerful incentive for action to be taken.

Internal Auditing. An external audit to verify the published financial report is required of companies by law. In addition, most companies of a significant size also operate an internal audit function. This is optional, and its responsibilities, activities and position in the organisation are at the discretion of each company, though professional guidance on internal auditing generally is available from bodies such as the Institute of Internal Auditors.

Traditionally, internal audit has been a part of the finance function, reporting to the finance director and primarily concerned with internal checks and controls on financial data and activities. One motive in many organisations was to minimise the costs of external auditors, by using internal audit as a more cost-effective means of providing assurance on the quality of internal controls and thereby to reduce the quantity of detailed checking work that the external auditors needed to do directly themselves. More recently, the role of internal audit has expanded to include the audits of

(in particular) computer systems, operations and the quality of management. Internal audit has become central to risk assessment and management in many companies, and its importance has been enhanced by recent concerns over corporate governance. One effect of this has been that internal audit now reports within the organisation, increasingly frequently, not within the finance function but at chief executive level, often with a further reporting line to an audit committee at board level.

Internal audit is potentially relevant to environmental management in several ways, especially for companies for whom environmental issues may represent potentially significant risk factors to their businesses. One area of apparent potential overlap or cooperation is the environmental audit, though this will depend on the objectives of the particular environmental audit and how far the competences that it requires may be outside the scope of the other activities of internal audit. In most organisations, most environmental audits are handled by a specialist corporate environmental management function, though some environment-related checks may be included in regular internal audit programmes.

Internal audit can also be relevant through its original purpose of checking and confirming the accuracy and integrity of information—the information that is used internally by management, as well as what is published externally. This function includes both the integrity of the data that are captured and collected through the organisation, and how these are then converted into usable information and disseminated in reports to management and/or published externally. For example, the Environmental Issues Unit of British Telecom enlists the support of their colleagues in BT's internal audit function to help to assure the integrity of the information that they plan to publish in their annual environmental report, prior to its further verification by an external party.

Costing. Costing is perhaps the area of greatest activity within environment-related management accounting (Ditz, Ranganathan and Banks 1995; Epstein 1996b, 1996c; Russell, Skalak and Miller 1995). It is also addressed to a greater or lesser degree by most of the chapters in this volume. This section discusses six main issues associated with costing:

- Activity-based costing
- Quality costing
- Product costing
- Life-cycle costing
- Cost projection
- Strategic costing

Activity-based costing (ABC). Traditional costing techniques have been based on specific categories of direct cost such as labour and materials, plus a residual overhead. The latter is then frequently either allocated to products or processes on a more or less arbitrary basis—for example, the EPA's study of the electroplating industry described in Chapter 11 found that square footage of product was the easiest way to do this for environment-related costs—or written off as a period cost and therefore not tracked through to products or processes at all. Indeed, in many companies, the main part of

environment-related costs such as energy, water, waste disposal and the salaries of environmental staff are likely to be included in overheads (White *et al.* 1995; White and Savage 1995). These practices mean that, where products or processes have high environmental costs, the figures can be hidden from decision-makers. This decreases the motivation to reduce the costs and can also create a bias against pollution prevention projects (Hamner and Stinson 1993).

One potential solution to this problem—which is common to other areas of management accounting—is cost system redesign (Drury and Tayles 1998). As Schaltegger and Müller discuss in Chapter 3, an approach that is of particular relevance to environment is activity-based costing (ABC). This tries to create more meaningful cost information by tracking costs to products and processes on the basis of the underlying ‘drivers’ that cause those costs to be created in the first place. The amount of cost lost in overheads is thereby greatly reduced. As a result, product prices can be set more accurately, and significant cost drivers can be targeted for cost reduction measures. Where environment is a significant cost driver, it will be highlighted naturally by ABC activities. However, there is usually considerable scope for more proactive environmental concern, either by building a more detailed picture of environmental cost drivers and categories where these have already emerged as important or by highlighting them when this is not the case (Kreuze and Newell 1994). Schaltegger and Müller explore this issue at a conceptual level in Chapter 3, while Bierma, Waterstraat and Ostrosky (Chapter 13) show the close relationship between ABC and environment-related management accounting at Chrysler’s Belvidere plant. However, Chapter 10 by Shields, Beloff and Heller found that ABC was not widely used by the North American companies that they studied. The previously mentioned ECOMAC survey (Bouma and Wolters 1998) reached similar conclusions for Europe. Hence, supplementary routes will be needed to introduce environment-related management accounting for the foreseeable future.

Quality costing. Several authorities have identified the links between total quality management programmes and good environmental management (Roth and Keller 1997; Davies 1997). Quality costing aims to measure in financial terms the benefits of good quality management, and is complementary to ABC. The rationale of quality costing is to highlight the costs of non-quality in order to stimulate motivation to reduce these and to prioritise possible actions. Conventional quality costing distinguishes three types of cost:

- **Failure:** the costs of putting right or otherwise dealing with defects, arising through either internal failure or external failure (i.e. those defects that occur in use by customers)
- **Monitoring:** inspection and other costs to ensure that defects are eliminated or detected
- **Prevention:** costs of avoiding defects

The finding from cost-of-quality studies is frequently that, in the long run, total costs are minimised when the emphasis is placed on prevention rather than on either monitoring or the toleration of failures. However, without these studies, this might not be apparent, since failure costs include several that are intangible and/or at some distance in the organisation from the point in the operational process at which the loss in quality occurred.

Quality costing techniques can easily be applied to the environmental area (Hughes

and Willis 1995). A Dutch study that used this model to calculate the 'costs of non-environment' found that, on a narrow definition of environment as the costs of dealing with pollution and wastes, they amounted to around 2% of total operating costs (Diependaal and de Walle 1994). To be valuable in the environmental field, 'failure costs' probably need to be defined more broadly so that they include what might be called 'indirect failure costs' or the 'costs of inefficiency', i.e. the costs of purchasing and processing materials and energy that end up as waste (see appendix).

Product costing. Producers need accurate information about the cost make-up of their products in order to determine price and identify cost reduction opportunities. Users need data about the total costs of products that they are buying in order to compare alternatives that have different proportions of acquisition and operating costs. Designers need both types of information in order to create products that have reasonable purchase and running costs. Environmental costs are important in all these cases and there can be detrimental consequences if they are not properly identified and allocated.

As several case studies demonstrate (Ditz, Ranganathan and Banks 1995), it is not uncommon for a small number of products to generate a disproportionately large share of total emissions and wastes. If these costs are not allocated to individual products but instead are treated as a general overhead, then 'clean' products will appear to have higher costs than is actually the case, while 'dirty' products will appear to be cheaper to produce than they really are.

Life-cycle costing. Environmental costs are increasing in every stage of the product life-cycle. Green taxes are being introduced on many types of raw materials, emissions, wastes and products at the end of their lives. Certain disposal routes for materials and products are being banned or are subject to stringent regulation which makes them very expensive. As the nuclear and oil industries have discovered, it can also be much more costly to decommission equipment than was originally anticipated. Producers can potentially incur liabilities as a result of environmental problems related to their products.

These changes can, to some extent, be incorporated within the emerging management accounting concept of life-cycle costing (Bailey 1991). This means extending horizons beyond the purchase costs of products to consider all the costs that will be incurred over their operating lifetime—including, in principle, the environmental costs involved in buying, using and disposing of the product. However, the dispersal of responsibility between and within suppliers and their customers can often obscure this. Bierma, Waterstraat and Ostrosky (Chapter 13), for example, demonstrate that this is a serious problem with regard to the whole-life costs of chemicals. It can therefore be sensible for the various parties to work together to identify and calculate these at the time of purchase. Two particular areas that a number of organisations have already started to examine are the costs of dealing with emissions or wastes from the operation of equipment, or of disposing of products at the end of their lives. Chapter 6 by Bartolomeo provides examples of this from Italy.

Of course, this interpretation of life-cycle costing is a narrow one which ignores all environmental costs incurred before equipment is acquired, or downstream costs for which an organisation has no responsibility. A broader definition is therefore required if environment-related management accounting is to be useful in the area of

product development, which must consider these areas.

Some authors have seen the ultimate goal of life-cycle costing as being the monetisation of all impacts identified by life-cycle assessment (LCA). However, the difficulties of achieving consensus about even the relatively simple issue of the most appropriate means of undertaking LCAs, quite apart from the contentious issue of reaching agreement on appropriate conversions from physical to monetary units, make this unrealistic for the foreseeable future.

More limited work has taken place on calculating financial costs and benefits as an input to design for environment (DFE) initiatives. These aim to reduce life-cycle impacts by taking action in the design stage, e.g. making recycling easier by making equipment easier to disassemble. Brouwers and Stevels (1997) have described an end-of-life costing model developed for this purpose at Philips. Kainz, Prokopyshen and Yester (1996) also describe an exercise at Chrysler to calculate the whole-life costs of two designs. This found that, although a design that contained mercury was cheaper to purchase, its whole-life costs were greater as the wastes generated in its production then had to be treated as special wastes.

Wood, the former leader of AT&T's green accounting team, has noted the opportunities to extend these initiatives into a more strategic approach which she terms 'environmental life-cycle costing' (Wood 1998). Monsanto provides one example of this by giving its salespeople a checklist to identify opportunities to reduce its own and/or customers' environment-related costs, to their mutual benefit (Tuppen 1996). And the Xerox case in Chapter 18 demonstrates the potential for cross-chain initiatives to change completely perceptions of key business activities and consequently to reveal major environment-related savings opportunities.

Cost projection. Projecting future costs is an important part of investment appraisal and is also valuable for other purposes. Environment can be an important determinant of these future costs. This is highly visible with new legislative or regulatory demands. However, forward-looking companies will also be considering the potential costs of possible future legislation or other environmental action. One indication that this may happen is when costs in one country are much lower than in others. Another is when there are large external damage costs created by environmental impacts that are not yet reflected in the company's internal financial calculations, but could be in future as a result of governmental or social action. There is a growing amount of research that suggests that these externalities are considerable for energy production (Cookson 1997; EC 1995; Oak Ridge and Resources for the Future 1992–96; Office of Technology Assessment 1994), transport and other economic activities. However, there is considerable controversy about the results of such research and the methodology employed so that, from a business perspective, the figures are best regarded as indicative rather than exact (Hongisto 1997).

Even so, Epstein (see Chapter 4) and other researchers (CICA 1997; Tuppen 1996) have argued that companies making capital investment and other decisions with long-term financial consequences might be wise at least to consider the implications of these. Several business leaders and companies, notably Ontario Hydro (see Chapter 16) and two senior Dow executives (Popoff and Buzzelli 1993), have also advocated the use of 'full-cost accounting' (including external costs) by companies, although little has happened in practice as a result.

Strategic costing. As Burritt notes in Chapter 8, costing is not always about creat-

ing an accurate reflection of real costs. It can also be a strategic tool to encourage or discourage certain inputs, activities and outputs by influencing relative prices: for example, by putting a high overhead on labour to encourage moves towards automated production (Bromwich and Bhimani 1994). In principle, it is easy to apply this approach to environment: for example, by introducing internal taxes on energy consumption or on waste disposal. The level of these, and their trajectory over time, could be based on long-term cost projections. In practice, it is difficult to do this because of fears about competitive disadvantage if other companies do not follow suit. Nonetheless, more use is likely to be made of this approach in future.

Pricing. Pricing requires consideration of customers and competitors as well as costs, so accounting techniques are only one aspect. However, adequate cost analysis is an essential part of pricing decisions, which may be distorted by any inaccuracies in costing systems.

Life-cycle costing provides the framework to consider costs not only within the organisation itself, but also along the product chain, by including as well as internal costs also costs incurred upstream (by suppliers) and downstream (by customers and consumers). This can help to identify opportunities where modest extra spending by the company may increase value for the customer disproportionately, which can be reflected in an increased selling price and/or increased sales volume. As Bennett and James's study (Chapter 15) demonstrates, Baxter International has generated substantial savings in materials costs for itself through packaging redesign. As well as this benefit, reducing the quantity of packaging that the final user has to dispose of is becoming an increasingly significant selling point in countries such as Germany which have strict legislative controls.

Demand Forecasting. Environmental factors are already shaping many markets and will influence more in future. This influence takes two forms: the volume of a product or a service that can be sold, and the price at which it is sold. Sales volumes of a number of products—for example, CFCs—have already been largely or completely curtailed by law as a result of environmental considerations, and the likelihood is that more will be withdrawn from the market (or 'sunsetting') in future. Customers may also discriminate against products with poor environmental performance, especially if better-performing ones offer similar value. Sunsetting and other environmental developments also create opportunities for new products. Indeed, it may be that the revenue streams from future eco-efficient products—i.e. those that offer greater customer value and better environmental performance—will have far greater impact than any of the other areas discussed in this chapter. Of course, it is not usually possible to do more than guess at the amounts of potential future revenues from hypothetical new products, and consequently less attention has been paid to this area in the environment-related management accounting literature than to methods of cost analysis. However, it is important that it should receive more attention in future.

Investment Appraisal. Environmental factors can be significant in determining the ultimate returns from new investments. It is therefore important that they are identified and considered during the early stages of investment decision-making (Kite 1995; Ruckle 1989). This not only allows major problems to be avoided, but also provides

an opportunity for remedial action at a stage when the costs of doing so can be relatively low.

Many companies are currently bringing environment into capital budgeting by requiring qualitative assessments of impacts arising from major investments. This can be done in two main ways:

- By widening the range of costs and benefits that are taken into account
- By adapting appraisal techniques

A 1995 Tellus Institute survey of US companies, for example, found that over 60% of respondents are now considering the costs of emissions and waste monitoring, treatment and disposal in project evaluations (White *et al.* 1995; White and Savage 1995). However, there are still many costs that are excluded from most evaluations, as Chapter 11 confirms for the US electroplating sector.

Research suggests that most investments in US and UK companies—including those related to environment—are appraised on the basis of relatively high discount rates (Bouma and Wolters 1998). This means that the long-term benefits that often result from environmental action frequently have a low, or even zero, net present value. Many observers also believe that conventional techniques do not properly consider the issue of risk (Busby and Pitts 1997). Hence, new or modified appraisal techniques might be required. Appraisal techniques can be adapted to take account of the long-term benefits of environmental actions and/or the potential risks of investments with serious environmental impacts. This can be done, for example, by applying lower or higher discount rates to environmentally significant investments, or for long-life projects by extending the period for which future benefits are considered beyond the usual truncation point. Chapters 4, 10, 12 and 14 discuss these issues in greater detail.

Shareholder Value Analysis. In recent years, there has been an increasing interest in measuring shareholder value (Rappaport 1986; Stewart 1991, 1994). This has in part been in recognition of the principle that, at least in the UK and USA, in law (and so far as capital markets are concerned), corporations exist primarily for the benefit of equity investors. It is also a correction for generally perceived deficiencies of conventional measures of accounting profitability as the main indicator of business performance.

The term is often used only loosely but, when used more precisely, defines shareholder value as the present value of the company's future cash flows, discounted at an appropriate rate that reflects the risks involved. As environment can affect all of the main parameters in this equation—future expenses, revenues and cost of capital—it is therefore an important element to be considered in any calculations.

The ultimate aim of shareholder value analysis is to influence equity valuations, both directly by influencing capital market perceptions and indirectly by making it a priority issue for internal managers. Several studies have suggested that financial analysts and fund managers are either ignorant of or unconcerned about the environmental performance of the companies in whom they invest (Business in the Environment 1994; UNDP 1997). However, other more recent studies have established a strong case for trying to establish a link between environment and shareholder value, and/or have provided evidence that such a link already exists (Barber, Daley and Sherwood 1997; Blumberg, Korsvold and Blum 1997; Cohen, Fenn and Naimon 1995; EAAR 1997; Müller *et al.* 1994; Müller *et al.* 1996; Schaltegger and Figge 1997; Schmidheiny and

Zorraquin 1996; Verschoor 1997). Schaltegger and Figge (1997) have also developed a detailed framework, with examples, to analyse the linkages. An important element in their analysis is the importance of environment-related financial risk, which has also been addressed by the Centre for the Study of Financial Innovation. It has developed an environmental equivalent to the well-established financial risk-rating processes of Moodys and Standard & Poor (CSFI 1995).

Establishing the existence of links between environment and shareholder value is not sufficient to influence market perceptions. Companies also need to communicate effectively, in terms relevant to the financial markets, the significance of environmental issues to their long-term business success and the adequacy of the efforts that they are taking to manage them (ACBE 1996; Kreuze, Newell and Newell 1996).

Environmental Value Analysis. This is the relationship between an organisation's economic value added and its environmental impacts. Although there have been few attempts to measure this to date, it is an important issue, which in principle can be evaluated in two ways. The first is by developing relational measures. The output measure can take a variety of forms—for example, turnover or profits—but, as value added is a more direct measure of the net economic contribution made by a company, it is widely considered to be the most appropriate. Calculations can then be made of value added per tonne of emission or per unit of environmental impact or, alternatively, tonnes emitted or units of environmental impact per £ of value added. These give a crude measure of how efficiently organisations—or, in aggregate, industries—are using environmental resources.

However, knowing that an organisation is using resources efficiently says little about whether its use is sustainable. Sustainability implies limited 'eco-capacity', i.e. a finite availability of physical resources such as fossil fuels and biological materials, and of environmental 'sinks' such as the atmosphere. The costs of exceeding this eco-capacity can, in principle, be calculated and then disaggregated to the level of an individual business via taxes—for example, a carbon tax—or other means. The relationship between these 'costs of unsustainability' and value added can therefore serve as a crude measure of an enterprise's sustainability.

Of course, in a world where all such costs are internalised through taxes and other measures, sustainable value added would be equal to economic value added, but this is far from being the case at present. Hence, approximations to sustainable value added can be produced by taking estimates of damage costs. In the case of environmental damage costs, figures are available for many impacts, although there is limited consensus about the best basis of calculation or their accuracy. In the case of social damage costs, few figures are available and this situation seems unlikely to change for the foreseeable future.

Only one organisation has so far made even a crude attempt to calculate its sustainable value added. This is the Dutch computer services company BSO Origin, who, in its 1992 environmental report, calculated its main environmental impacts and then converted these into financial amounts to represent the imputed costs of those impacts. The data for this were based on calculations of long-term costs of control in the Dutch National Environmental Protection Plan. This gives a net cost of each environmental impact individually, and of all its environmental impacts in aggregate, which can be compared with the value added as calculated through its conventional business

accounting processes.

The methodology of this can easily be criticised, both for the bases on which costs per unit of impact are calculated, and on how far upstream and downstream costs should legitimately be included. At the present level of understanding of business (and other) impacts on the environment, it is difficult to assess what meaning if any can be attributed to the values generated; BSO recognises this, and claims only that its system indicates orders of magnitude rather than precise values. However, the BSO exercise is best seen as a first experiment in devising a comprehensive system that recognises and quantifies all of the environmental impacts of a business, irrespective of the quality of current legislation and regulation in the country of operation.

|| Conclusions and Future Trends

As the previous discussion—and the following chapters—demonstrate, there is now a growing and rich theoretical and practical body of work on the topic of environment-related management accounting. There is also a trend towards integration of the work and practices being carried out within individual countries. US practice and research is becoming well known in Europe, and practitioners and researchers in individual European countries are also interacting to a greater degree.

This interaction has demonstrated that the relevance and form of environment-related management accounting is influenced by many contingent variables, such as organisational structure and strategic objectives. These are often related to national circumstances, which also have a direct influence: for example, by requiring collection of detailed environmental expenditure statistics.

One broad difference is between the two sides of the Atlantic Ocean. In general, the US has a tougher environmental liabilities regime and higher regulatory penalties, but somewhat lower resource costs, than Europe. Hence, much of the focus of environment-related management accounting in the former has been on recognising and avoiding liabilities and penalties. In Europe, there has been relatively greater attention paid to the systematic analysis of energy, materials and waste flows to identify opportunities for reduction, and also to consideration of further internalisation of the externalities created by resource consumption and transport use.

Within Europe, there is also a divide between, on the one hand, the UK and, on the other, Germany and several other countries in continental Europe. British companies—like those of the USA—are generally strongly influenced by capital markets, tend to have shorter decision-making horizons and are more likely to consider the creation of shareholder value as their principal corporate objective. By contrast, German and many other European companies are less dependent for finance on capital markets, usually have longer decision-making horizons and place greater relative weight on the interests of other stakeholders such as employees and communities. All of these have a considerable influence on environment-related management accounting in practice: for example, with regard to the introduction of systematic eco-balancing approaches (see above and James, Prehn and Steger 1997). However, there is currently a great deal of convergence both within Europe and between Europe and America, and it may be that some of these differences will become less important in future.

Despite these variations, the clear finding of most of the chapters in this book—

and other work in the field—is that there can be considerable business benefits from the application of environment-related management accounting and the development of ‘green-bottom-line’ frameworks. In most cases at present, these applications will be relatively simple ones, such as adjustments to investment appraisal procedures or ad hoc ‘costs of waste’ initiatives. However, as the Baxter, Xerox and other case studies in this volume indicate, there is also the opportunity for more advanced initiatives in organisations with substantial environmental costs and/or potential environment-related financial benefits. Although the numbers of these may be relatively low at present, they are likely to increase in future.

Environment-related management accounting can also reach beyond these utilitarian financial goals by helping to implement the goals of sustainable development within the business community. Of course, sustainability is about far more than economics, just as business encompasses many elements other than income statements and balance sheets. Nonetheless, environment-related management accounting can be a significant driver of action through demonstrating the long-term financial implications of sustainability, and creating a vision of the most appropriate responses. In this respect, it has what McAuley, Russell and Sims (1997) have termed a ‘narrative’ role of making sense of a complex world as well as a ‘logico-scientific’ one of developing an accurate representation of reality. One practical implication of this is the introduction of internal taxes, as advocated by Burritt (Chapter 8). Even when this is impractical, such a role can at least reduce any danger that environment-related management accounting could introduce a systematic bias towards environmental inaction. This could occur if immediate financial drivers are limited and net financial benefit is seen as the only justification for action.

However, it is important to avoid exaggerating the speed at which environment-related management accounting is likely to be adopted by business. There remain many internal barriers, of which the most significant is the difficulty of considering issues of risk and long-term benefit within high-discount-rate investment appraisal models. The strength and durability of these barriers will be determined primarily by the extent to which regulation and other political and social drivers increase the costs to business of poor environmental performance and enhance the financial incentives for environmental improvement. To date, these are much slower in developing than we and most environmentally concerned observers would like. As a result, the development of environment-related management accounting is likely to be discontinuous in nature. Most organisations will probably experience occasional bursts of activity as, on the one hand, external events such as the introduction of new taxes raise actual costs and/or business’s awareness of them, or, on the other hand, internal changes, such as the introduction of ABC, provide opportunities.

This is consistent with the findings of a recent study to which the present authors made a contribution (Tuppen 1996). This concluded that most actions being taken at present are mainly relatively simple ones such as the identification and allocation of energy and waste disposal costs that either did arise, or could well have arisen, for non-environmental reasons.³ However, it noted eight practical environment-related management accounting options that could be introduced by the report’s sponsors, BT, and—by extension—other European companies.

One interpretation of these conclusions could be that environment-related man-

agement accounting is merely an instance of empire-building by academics, and that the simple tasks identified can easily be handled by existing accounting and environmental management accounting activities and staff. A similar criticism might be that the concept is merely a form of aggrandisement by the accounting profession, and that the tasks identified are already—and can in future be—accomplished successfully by environmental and operational managers. In either case, environment-related management accounting would be merely creating a new bottle for old wine which is already maturing nicely.

We have some sympathy for these points, and generally believe that the long-term aim of those interested in the field should be to make environment a part of everyday management accounting. However, we also note the evidence from many of the following chapters that a number of environment-related costs are often not identified by normal procedures, and that it therefore requires a systematic environment-related management accounting exercise to identify them and to drive action to reduce them. Equally, while we would certainly argue that the role of environment-related management accounting is, like management accounting generally, to support decision-makers in other functions, our experience also suggests that environmental and other operational managers often lack sufficient understanding of accounting concepts and techniques to utilise fully the information that these can provide. A final point is that some of the longer-term issues—such as the progressive internalisation of externalities or the broader requirements of sustainable development—can be difficult to integrate into management activities that normally focus on day-to-day operational issues. Hence, for the foreseeable future, the adoption of environment-related management accounting is likely to be an extraordinary rather than an ordinary activity, and one that will require unusual champions—such as financially astute environmental managers or environmentally aware accountants—to drive it. We hope that this volume will encourage the development of more such individuals within business.

|| Appendix: Defining Costs and Benefits

There are no standardised definitions of environmental costs and benefits, despite their centrality to almost every discussion of environment-related management accounting (Department of the Environment 1996). In some countries, organisations are required to submit data on costs for tax and/or statistical purposes, but the definitions used vary between countries. They also tend to be biased towards defensive expenditures such as expenditure on pollution control equipment rather than more proactive expenditures such as, for example, expenditures to prevent pollution at source.

The management accounting maxim of ‘different costs for different purposes’—which is based on a recognition that cost and benefit data are context-dependent and that universal consistency of definition is therefore impractical—is valid for the field of environment-related management accounting also (see Chapter 2). However, it is clear that the scale of imprecision in the field creates a need for some clarification of the alternative definitions that are available.

In broad terms, environmental costs and benefits from a management accounting

3. The report, entitled ‘Environmental Accounting in Industry: A Practical Review’, can be obtained, free of charge, from BT Environment Unit, PP1A57, Angel Centre, 403 St Johns St, London EC1V 4PL; tel: +44 (0)171 843 5266, or freephone: 0800 731 2403; fax: +44 (0)171 843 7881.

perspective are those for which environment-related factors such as current or likely future environmental legislation are a significant (though not necessarily the only) driver. A pragmatic definition (and one adopted by the AT&T 'green accounting team' described in Fig. 2) is that they are types of costs and benefits where the expertise of environmental professionals is important to their identification and management.

In the case of costs, this results in three generic categories:

- Internal environmental costs, i.e. expenses that are wholly or partially driven by environmental considerations
- External environmental costs, i.e. financial outgoings or other quantifiable disbenefits that are incurred outside the organisation but are not internalised within its accounts (see below and Chapter 20)
- Environmental opportunity costs, i.e. foregone benefits such as higher-than-necessary energy or waste costs

Clearly, the first of these categories is the easiest to quantify, although, as we discuss below, not necessarily the most important.

The potential financial benefits of environmental initiatives can be summarised as:

- Revenues arising from environmental action, e.g. the sale of materials recovered as a result of recycling, or additional or maintained sales of products and services whose markets are strongly influenced by environmental considerations
- Savings and avoided costs as a result of environmental action, e.g. through better use of energy and materials, or by introducing waste minimisation schemes that avoid the need to incur pollution control expenditures
- Intangible benefits arising from environmental actions, such as enhancing the value of a brand or reducing environment-related risks

Internal Environment-Related Costs

From an environmental management perspective, the internal environment-related costs of a business or other organisation consist of two primary elements:

- Direct environmental expenses, i.e. those that are primarily related to environmental purposes
- Business-integrated environmental expenses, i.e. those that are partially related to environmental purposes but are also influenced by other business objectives

There is also a third, more ambiguous, category of resource expense, i.e. the costs of purchasing, handling and processing energy, materials, water and other resources to the point at which they become either products or wastes.

Direct Environmental Expenses. Following the quality costing model, these can be classified into three categories:

- **The costs of failure:** the costs of putting right, but only *after* they have arisen, environmental impacts or their potential causes. Examples include the capital and operating expenses of remediating past environmental impacts such as

cleaning up contaminated land, and the use of end-of-pipe technologies to capture environmentally hazardous wastes, effluents and emissions.

- **Monitoring:** inspection and other costs to ensure that impacts are eliminated or detected, e.g. costs of air- and water-sampling equipment
- **Prevention:** costs of preventing environmental impacts, e.g. additional expenses of using water-based rather than solvent-based cleaners

Many environmental expenses are also incurred in the expectation that they will prove to be an investment that will justify itself through future benefits, through either cost savings or enhanced revenues. Baxter's Environmental Financial Statement (see Chapter 15) reports two separate categories of environmental expense: 'Remediation and waste disposal costs' and 'Costs of proactive programme'. The costs of the proactive programme, in contrast to those of remediation and waste disposal, are incurred in the expectation that they will generate future benefits: for example, the time spent by staff in redesign of products and their packaging. The total of these expenses can then be compared with the resulting benefits to provide an approximate cost-benefit evaluation.

There is no clear boundary between these proactive environmental expenses and business-integrated expenses: in both cases, there are usually both environmental and business benefits. One distinction that can be made is on the basis of the primary purpose of the expenditure. Proactive environmental expenses are likely to be driven primarily by environmental management staff, and are strongly influenced by environmental considerations. Business-integrated expenses, on the other hand, are those that are driven by non-environmental staff, for commercial reasons, and would probably be undertaken even if there were no benefit to the environment. However, this is a difficult demarcation to attempt to apply, and some would argue it can be distracting as it may encourage a competitive focus on the sources of initiative, which may discourage the cross-functional co-operation between environmental and operational managers which is necessary to achieve improvements.

Business-Integrated Environmental Expenses. Improvements in environmental performance are increasingly achieved by incorporating environmental concerns into normal operations, investment decisions, etc.: for example, into a decision to invest in new technology that reduces wastes and therefore has both environmental and business benefits. Often this can be done without incurring any additional expense. When this is not the case, it can be extremely difficult—and frequently somewhat arbitrary—to determine the precise proportion of the expenses that has been incurred for environmental rather than for business purposes. Essentially, this requires that the actual cost of the investment, etc., is compared against the amount that *would* have been spent, hypothetically, if environment had not been a consideration in the decision. The environmental portion of the cost is then the incremental amount in excess of this comparator, which—since by definition it will not actually be incurred—is a hypothetical figure that must be estimated. However, some companies have felt that this is worth doing when environmental considerations have driven a significant proportion of any expenditures.

A special case of business-integrated expenses is the time that mainstream business

staff spend on environmental management. A significant proportion of these costs may be hidden in cost codes that do not make this apparent. For example, a large chemicals manufacturer found through an activity analysis of its staff that nearly 3% of the time of operational staff was being spent on the non-value adding task of capturing and collecting environment-related production data (e.g. reading meters and taking samples) in order to meet its legal reporting requirements. This identified the potential to invest in new computerised environmental information systems, to reduce this burden.

Resource Expenses. Resource expenses differ from direct and business-integrated environmental expenses in being an integral part of doing business rather than an unwanted overhead. On the other hand, the winning, processing, distribution and use of resources such as energy and materials is a major source of environmental impact. The possibility that resources are not being used in a sustainable manner is also considered by many to be an environmental issue.

Even more importantly, resource expenses are a major example of opportunity costs. Research suggests that the 'costs of resource inefficiency', i.e. the costs of purchasing and processing materials and energy that end up as waste, can be very significant in many companies and usually outweigh direct and business-integrated environmental expenses combined. This is especially true in Europe where the liability costs associated with accidents or contamination are less onerous than in the USA. The German textile producer Kunert, for example, has calculated that its costs of resource inefficiency amount to around 10% of turnover (Kunert 1995).

In practice, of course, the laws of thermodynamics mean that no organisation can completely eliminate waste. Hence, the practical use of the concept of the costs of resource inefficiency requires the identification of some feasible level of wastage with which the current situation can be compared. Nonetheless, the case of Zeneca in Chapter 19 is just one that demonstrates how wide this gap can sometimes be.

One further point to note with regard to the costs of resource inefficiency is that conventional thinking sees the identification and elimination of these as the objective and practice of day-to-day operational management. Hence, by the criterion identified above—areas of cost and benefit where the expertise of environmental professionals is important—this is not, or should not be, environment-related in any sense. In practice, however, there is much evidence that many organisations do not routinely identify their total costs of inefficiency and that waste minimisation and similar environment-related initiatives can often provide the first effective stimulus to do so. This is true of several of our case studies, notably Xerox (Chapter 18) and Zeneca (Chapter 19).

|| Internal Environment-Related Benefits

Revenues. The most obvious source of environment-related revenues is those arising from recycling and similar schemes, which can sometimes be significant: for example, Baxter identifies over \$5 million in recycling income in 1996. However, for most companies, greater benefits are available by making improvements that have effects upstream in the '3 Rs' sequence (reduce–re-use–recycle), e.g. by changing processes in order to avoid wastes arising in the first place rather than merely by maximising the income

from recycling them. It may also be risky, particularly for an environmental management function that is still establishing its position in the organisation, to encourage a perception in the rest of the company that good environmental management is represented by managing bottle banks and waste paper collection systems. This could have the effect of positioning environmental management as peripheral to the main business and make it more difficult to achieve a positive involvement in mainstream business processes such as capital investment decisions.

In the longer term, a much more significant revenue stream is likely to be from products or services that are sold at least partially on the basis of environmental considerations. This is difficult to quantify, for reasons that are similar to those that make calculation of business-integrated environmental expenses difficult: for example, the difficulty of apportioning when environment is only one of several drivers. This is even more true when environmental attributes have the role of maintaining existing markets that might otherwise have been lost. Nonetheless, both are likely to be of considerable importance in future; indeed, some would see them as the most significant 'green bottom line' element in coming decades (Fussler with James 1996).

Savings and Cost Avoidance. 'Savings' are any direct cost savings resulting from environment-related actions, as indicated by reductions in the absolute amounts of spending on a cost item—for example, hazardous waste disposal costs—from one year to the next. However, this measure alone may be misleading. Even if real improvements in environmental performance have been achieved, the absolute amount spent could still increase rather than decrease if either the volume of output has increased more than proportionately, or the prices charged for the product or service that is being purchased have increased.

The latter is particularly likely with environment-related costs, and is one of the main stimuli for companies to take action. For example, the landfill tax recently introduced in the UK means that waste disposal costs have increased by more than would otherwise have been justified by either general inflation or market-generated price changes. Similarly, the costs per kilo of ozone-depleting substances such as CFCs have increased several-fold over recent years since the Montreal Protocol. The real value of the improvements in performance is therefore indicated best by a comparison of actual current spending, not against previous years' spending in absolute terms, but against an estimate of what the cost *would* have been if that improvement had not taken place but market prices and business volumes had continued to increase. This is a hypothetical figure and therefore less easy to calculate and justify than an actual figure taken from an accounting ledger, but a more realistic measure of real benefit. It is the basis adopted by Baxter International in its calculations of 'cost avoidance' in preparing its Environmental Financial Statement (see Chapter 15).

Intangible Benefits. Benefits such as those arising from enhanced customer perceptions of the company, or improved staff morale, are also real but even more difficult to attempt to measure. In practice, it is usually unlikely to be worthwhile to attempt to quantify the benefits, at least not in monetary form, though this should not mean that their existence is then overlooked. To avoid this, Baxter note at the foot of their Environmental Financial Statement, without quantification, 'Examples of Undetermined Savings' (and also, for transparency, 'Examples of Undetermined Costs').

Reduction of Risks. One important kind of intangible (and sometimes tangible) ben-

efit is a reduction of environment-related financial risks. Well-publicised business failures such as Barings Bank have helped to encourage an increasing awareness of the financial benefits of risk management in business generally. The environment can pose several risks for many businesses, and proactive environmental management aims positively to anticipate and reduce possible risks as well as to deal with the consequences of those risks that unfortunately have actually been realised. A company's competence in managing its risks, including environmental risks, is also relevant to its financial stakeholders, such as investors, bankers and insurers, and can affect the costs of insurance and of raising new capital (*Business and the Environment* 1998; Lascelles 1993; Leggett 1995; Mansley 1995).

There are several types of possible environment-related risk for a business:

- The risk of a major incident or catastrophe such as Bhopal or the Exxon Valdez
- Adverse environmental impacts over a period of time, such as leakage of toxic wastes into land and underground water-courses. These may be more difficult for a business to cope with than a major incident, since these gradual risks are becoming more difficult, if not impossible, to insure against.
- Damage to reputation and public image, which can have an effect on the business not only through the marketplace but also through the ease with which it can obtain new permits or changes to existing permits, which may depend on the perceptions of local communities
- Where a business's operational process and cost structure is based on environmentally unsustainable assumptions—for example, that private road transport will continue indefinitely to be readily available at (relatively) low cost—there is a risk that changes through (for example) environmental taxes could mean that a previously profitable business becomes no longer viable.

|| References

- Accounting Standards Board (ASB) (1997) *Provisions and Contingencies* (Financial Reporting Exposure Draft, 14; Milton Keynes: ASB Publications).
- Advisory Council on Business and the Environment (ACBE) (1996) *Environmental Reporting and the Financial Sector: An Approach to Good Practice* (London: Department of the Environment).
- Bailey, P. (1991) 'Full Cost Accounting for Life-Cycle Costs: A Guide for Engineers and Financial Analysts', *Environmental Finance* Spring 1991: 13-29.
- Bailey, P., and P. Soyka (1996) 'Environmental Accounting: Making it Work for Your Company', *Total Quality Environmental Management* Summer 1996: 13-30.
- Barber, J., F. Daley and M. Sherwood (1997) 'Rating Environmental Risk', *Certified Accountant* March 1997: 42-43.
- Barth, M., and M. McNichols (1994) 'Estimation and Market Valuation of Environmental Liabilities Relating to Superfund Sites', *Journal of Accounting Research* 32 (Supplement): 177-209.
- Bartolomeo, M., M. Bennett and P. James (1998) *Eco-Management Accounting: A Framework for Analysis and Action* (Wolverhampton, UK: Wolverhampton Business School Environmental Management Accounting Group).
- Bebbington, J., and I. Thompson (1996) *Business Concepts of Sustainability and the Implications for Accountancy* (London: Association of Chartered Certified Accountants).

- Bennett, M., and P. James (1998a) *Environment-Related Performance Measurement* (London: Association of Chartered Certified Accountants).
- Bennett, M., and P. James (1998b) *ECOMAC Case Study: Baxter Healthcare, Irish Manufacturing Operations* (Working paper WP 004/98; Wolverhampton, UK: Wolverhampton Business School, Environmental Management Accounting Group).
- Birkin, F., and D. Woodward (1997a) 'Introduction', *Management Accounting* (UK) (Management Accounting for Sustainable Development Series): June 1997: 24-26.
- Birkin, F., and D. Woodward (1997b) 'From Economic to Ecological Efficiency', *Management Accounting* (UK) (Management Accounting for Sustainable Development Series): July/August 1997: 42-45.
- Birkin, F., and D. Woodward (1997c) 'Stakeholder Analysis', *Management Accounting* (UK) (Management Accounting for Sustainable Development Series): September 1997: 58-60.
- Birkin, F., and D. Woodward (1997d) 'The Eco-Balance Account', *Management Accounting* (UK) (Management Accounting for Sustainable Development Series): October 1997: 50-52.
- Birkin, F., and D. Woodward (1997e) 'Accounting for Sustainable Development', *Management Accounting* (UK) (Management Accounting for Sustainable Development Series): November 1997: 52-54.
- Birkin, F., and D. Woodward (1997f) 'A Zero-Base Approach to Accounting for Sustainable Development', *Management Accounting* (UK) (Management Accounting for Sustainable Development Series): December 1997: 40-42.
- Blumberg, J., A. Korsvold and G. Blum (1997) *Environmental Performance and Shareholder Value* (Geneva: World Business Council for Sustainable Development).
- Bouma, J., and T. Wolters (1998) *Management Accounting and Environmental Management: A Survey Among 84 European Companies* (Zoetermeer, Netherlands: EIM).
- Bromwich, M., and A. Bhimani (1994) *Management Accounting: Pathways to Progress* (London: Chartered Institute of Management Accountants).
- Brouwers, W., and A. Stevels, (1997) 'A Cost Model for the End-of-Life Stage of Electronic Consumer Goods', *Greener Management International* 17 (Spring 1997): 129-39.
- Busby, J., and C. Pitts (1997) 'Real Options and Capital Investment Decisions', *Management Accounting* (US) November 1997: 38-39.
- Business and the Environment* (1998) 'New Tools for Getting the Green Message across to the Financial Sector', *Business and the Environment* 9.2: 1-3.
- Business in the Environment and Extel Financial (1994) *City Analysts and the Environment* (London: Business in the Environment).
- Butler, D. (1997) 'I'm Green, Buy Me', *Accountancy* March 1997: 36-38.
- Canadian Institute of Chartered Accountants (CICA) (1992) *Environmental Accounting and the Role of the Accounting Profession* (Toronto: CICA).
- Canadian Institute of Chartered Accountants (CICA) (1997) *Full Cost Accounting from an Environmental Perspective* (Toronto: CICA).
- Centre for the Study of Financial Innovation (CSFI) (1995) *An Environmental Risk Rating for Scottish Nuclear* (London: CSFI).
- Charter, M. (ed.) (1992) *Greener Marketing: A Responsible Approach to Business* (Sheffield, UK: Greenleaf Publishing)
- Chartered Institute of Management Accountants (CIMA) (UK) (1997) *Environmental Management: The Role of the Management Accountant* (London: CIMA).
- Cohen, M., S. Fenn and J. Naimon (1995) *Environmental and Financial Performance: Are They Related?* (Washington, DC: Investor Responsibility Research Center).
- Cookson, C. (1997) 'World Must Look to Nature's Free Services', *Financial Times* 17 February 1997.
- Davies, A.J. (1997) 'The Environment and Business Today', *Certified Accountant* June: 20-23.

- Department of the Environment (1996) *Environmental Protection Expenditure by Industry* (London: HMSO).
- DeSimone, L., and F. Popoff (1997) *Eco-Efficiency: The Business Path to Sustainable Development* (Cambridge, MA: MIT Press).
- Diependaal, M., and F. de Walle (1994) 'A Model for Environmental Costs for Corporations', *Waste Management and Research* 12: 429-39.
- Ditz, D., J. Ranganathan and R.D. Banks (eds.) (1995) *Green Ledgers: Case Studies in Corporate Environmental Accounting* (Washington, DC: World Resources Institute).
- Drury, C., S. Braund, P. Osborne and M. Tayles (1993) *A Survey of Management Accounting Practice in UK Manufacturing Companies* (London: Chartered Association of Certified Accountants).
- Drury, C., and M. Tayles (1998) 'Cost System Design for Enhancing Profitability', *Management Accounting* (UK): January: 40-42.
- Environmental Accounting and Auditing Reporter* (EAAR) (1997) 'Are Financial and Environmental Performance Interlinked?', EAAR May 1997: 4-8
- Epstein, M.J. (1996b) 'Improving Environmental Management with Full Environmental Cost Accounting', *Environmental Quality Management* Autumn 1996: 11-22.
- Epstein, M.J. (1996c) *Measuring Corporate Environmental Performance: Best Practices for Costing and Managing an Effective Environmental Strategy* (Chicago: Irwin/Institute of Management Accountants).
- Ethridge, J., and V. Rogers (1997) 'Transactions that may Prompt Environmental Reporting Problems', *Management Accounting* (US) July 1997: 57-58.
- European Commission (EC) (1995) *JOULE ExternE: Externalities of Energy* (6 vols.; DG XII; Luxembourg: European Commission).
- Fédération des experts comptables européens (FEE) (1996) *Expert Statements on Environmental Reports* (Research paper; Brussels: FEE).
- Fussler, C., with P. James (1996) *Driving Eco-Innovation: A Breakthrough Discipline for Innovation and Sustainability* (London: Pitman Publishing).
- Gray, R.H., J. Bebbington and D. Walters (1993) *Accounting for the Environment* (London: Paul Chapman and Association of Chartered Certified Accountants).
- Gray, R.H., D. Owen and C. Adams (1996) *Accounting and Accountability: Changes and Challenges in Corporate Social and Environmental Reporting* (Hemel Hempstead, UK: Prentice-Hall).
- Grayson, L., H. Woolston and I. Tanega (1993) *Business and Environmental Accountability: An Overview and Guide to the Literature* (London: Technical Communications).
- Hallay, H., and R. Pfiem (1992) *Öko-Controlling. Umweltschutz in mittelständischen Unternehmen* (Frankfurt: Campus).
- Hamner, B., and C. Stinson (1993) *Managerial Accounting and Compliance Costs* (University of Washington discussion paper; Washington, DC: University of Washington; reprinted in *Journal of Cost Management* Summer 1995: 4-10).
- Hongisto, M. (1997) 'Assessment of External Costs of Power Production', paper presented to *IIIEE and VTT Seminar on Total Cost Assessment*, Nagu, June 1997 (Helsinki: IVO).
- Hopfenbeck, W., and C. Jasch (1993) *Öko-Controlling: Umdenken zahlt sich aus! Audits, Umweltberichte und Ökobilanzen als betriebliche Führungsinstrumente (Eco-Controlling: New Philosophy Pays! Audits, Environmental Reports and LCA as Management Tools)* (Landsberg: Verlag Moderne Industrie).
- Hughes, S., and D. Willis (1995) 'How Quality Control Concepts can Reduce Environmental Expenditures', *Journal of Cost Management* Summer 1995: 15-19.
- Institute of Chartered Accountants in England and Wales (ICAEW) (1996) *Environmental Issues in Financial Reporting* (London: ICAEW).
- Institute of Management Accountants (IMA) (US) (1995) *Practices and Techniques: Implementing Corporate Environmental Strategies* (Montvale, NJ: IMA).

- International Accounting Standards Committee (IASC) (1997) *Provisions, Contingent Liabilities and Contingent Assets* (Exposure Draft, 59; London: International Accounting Standards Committee).
- International Institute for Industrial Environmental Economics (IIIEP) and VTT Non-Waste Technology (1997) *Challenges and Approaches to Incorporating the Environment into Business Decisions: International Expert Seminar* (Lund, Sweden: IIIEP; Helsinki: VTT).
- James, P., M. Prehn and U. Steger (1997) *Corporate Environmental Management in Britain and Germany* (London: Anglo-German Foundation).
- Johnston, N. (1994) *Waste Minimisation: A Route to Profit and Cleaner Production* (London: Centre for Exploitation of Science and Technology).
- Kainz, R., M. Prokopyshen and S. Yester (1996) 'Life Cycle Management at Chrysler', *Pollution Prevention Review* Spring 1996: 71-83.
- Kaplan, R., and D. Norton (1992) 'The Balanced Scorecard: Measures that Drive Performance', *Harvard Business Review* January/February 1992: 71-79 (reprint 92105).
- Kaplan, R., and D. Norton (1993) 'Putting the Balanced Scorecard to Work', *Harvard Business Review* September/October 1993: 134-42 (reprint 93505).
- Kaplan, R., and D. Norton (1996a) 'Using the Balanced Scorecard as a Strategic Management System', *Harvard Business Review* January/February 1996: 75-85 (reprint 96107).
- Kaplan, R., and D. Norton (1996b) *The Balanced Scorecard* (Cambridge, MA: Harvard Business School Press).
- Kite, D. (1995) 'Capital Budgeting: Integrating Environmental Impact', *Journal of Cost Management* Summer 1995: 11-19.
- KPMG, *Survey of Environmental Reporting 1997* (London: KPMG).
- Kreuze, J.G., and G.E. Newell (1994) 'ABC and Life-Cycle Costing for Environmental Expenditures', *Management Accounting* (US) February 1994: 38-42.
- Kreuze, J.G., G.E. Newell and S.J. Newell (1996) 'Environmental Disclosures: What Companies are Reporting', *Management Accounting* (US) July 1996: 37-43
- Kunert AG (1995) *Environmental Report* (Immenstadt, Germany: Kunert AG).
- Lascelles, D. (1993) *Rating Environmental Risk* (London: Centre for the Study of Financial Innovation).
- Lawrence, J.E., and D. Cerf (1995) 'Management and Reporting of Environmental Liabilities', *Management Accounting* (US) August 1995: 48-54.
- Leggett, J. (1995) *Die Klimaveränderung und der Finanzsektor (Climate Change and the Financial Sector)* (Hamburg: Greenpeace).
- Lober, D., D. Bynum, E. Campbell and M. Jacques (1997) 'The 100 Plus Corporate Environmental Report Study', *Business Strategy and the Environment* May 1997: 1-12.
- Mansley, M. (1995) *Long Term Financial Risks to the Carbon Fuel from the Climate Change* (London: The Delphi Industry Group).
- McAuley, L., G. Russell and J. Sims (1997) 'How Do Financial Directors Make Decisions?', *Management Accounting* November 1997: 32-34.
- McLaughlin, S., and H. Elwood (1996) 'Environmental Accounting and EMSs', *Pollution Prevention Review* Spring 1996: 13-21.
- McLean, R., and J. Shopley (1996) 'Green Light Shows for Corporate Gains', *Financial Times*, 3 July 1996.
- Müller, K., J. de Frutos, K. Schüssler and H. Haarbosch (1994) *Environmental Reporting and Disclosures: The Financial Analyst's View* (London: Working Group on Environmental Issues of the Accounting Commission of the European Federation of Financial Analysts' Societies).
- Müller, K., J. de Frutos, K. Schüssler, H. Haarbosch and M. Randel (1996) *Eco-Efficiency and Financial Analysis* (Basel: European Federation of Financial Analysts' Societies).

- Oak Ridge National Laboratory and Resources for the Future (1992–96) *External Costs and Benefits of Fuel Cycles* (8 vols.; Washington, DC: US Department of Energy).
- Office of Technology Assessment (1994) *Studies of the Environmental Costs of Electricity* (Washington, DC: US Government Printing Office).
- Owen, D. (ed.) (1992) *Green Reporting: Accountancy and the Challenge of the Nineties* (London: Chapman & Hall).
- Owen, D., R. Gray and R. Adams (1997) *Corporate Environmental Disclosure: Encouraging Trends* (London: Association of Chartered Certified Accountants).
- Parker, J.N. (1995) 'Profits and Ethics in Environmental Investments', *Management Accounting* (US) October 1995: 52-53.
- Popoff, F., and D. Buzzelli (1993) Full Cost Accounting, *Chemical Engineering News* 11 January 1993: 8-10.
- Porter, M.E., and C. van der Linde (1995b) 'Green and Competitive: Ending the Stalemate', *Harvard Business Review* September/October 1995: 120-34.
- Rappaport, A. (1986) *Creating Shareholder Value: The New Standards for Business Performance* (New York: Free Press).
- Roth, H.P., and C.E. Keller (1997) 'Quality, Profits and the Environment: Diverse Goals or Common Objectives?', *Management Accounting* (US) July 1997: 50-55.
- Royal Society of Arts (RSA) (1994) *Tomorrow's Company* (London: RSA).
- Rubenstein, D.B. (1994) *Environmental Accounting for the Sustainable Corporation* (Westport, CT: Quorum Books).
- Rückle, D. (1989) 'Investitionskalküle für Umweltschutzinvestitionen' ('Investment Appraisal for Environmental Investments'), *Betriebswirtschaftliche Forschung und Praxis (BFuP)* 41.1/89: 51-65.
- Russell, W., S. Skalak and G. Miller (1995) 'Environmental Cost Accounting: The Bottom Line for Environmental Quality Management', in J. Willig (ed.), *Auditing for Environmental Quality Leadership* (Chichester, UK: John Wiley).
- Schaltegger, S., and F. Figge (1997) *Environmental Shareholder Value* (Basel: Centre of Economics and Business Administration, University of Basel).
- Schaltegger, S., with K. Müller and H. Hindrichsen (1996) *Corporate Environmental Accounting* (Chichester, UK: John Wiley).
- Schmidheiny, S., and F. Zorraquin (1996) *Financing Change: The Financial Community, Eco-Efficiency and Sustainable Development* (Cambridge, MA: MIT Press with the World Business Council for Sustainable Development).
- Schoemaker, P.J.H., and J.A. Schoemaker (1995) 'Estimating Environmental Liability: Quantifying the Unknown', *California Management Review* 37.3 (Spring 1995): 29-61.
- Schulz, E., and W. Schulz (1994) *Umweltcontrolling in der Praxis (Environmental Controlling in Practice)* (Munich: Vahlen).
- Simmonds, K. (1991) 'Strategic Management Accounting', *Management Accounting* (UK): April 1991: 26-29.
- Stewart, G.B. (1991) *The Quest for Value* (New York: Harper Business).
- Stewart, G.B. (1994) 'EVA: Fact and Fantasy', *Journal of Applied Corporate Finance* Summer: 71-84.
- SustainAbility/United Nations Environment Programme (UNEP) (1997) *Engaging Stakeholders: The Third International Progress Report on Company Environmental Reporting* (London: SustainAbility; Paris: UNEP).
- Tuppen, C. (ed.) (1996) *Environmental Accounting in Industry: A Practical Review* (London: British Telecom).
- United Nations Development Programme (UNDP) (1997) *Valuing the Environment: How Fortune 500 CFOs and Analysts Measure Corporate Performance* (ODS Working Paper; New York: United Nations Office of Development Studies).

- US Environmental Protection Agency (EPA) (1995b) *Environmental Accounting Case Studies: Green Accounting at AT&T* (EPA 742-R-95-003; Washington DC: EPA).
- Verschoor, C.C. (1997) 'Principles Build Profits', *Management Accounting* (US) October 1997: 42-46.
- Von Weizsäcker, E.U., A. Lovins and L.H. Lovins (1997) *Factor Four: Doubling Wealth, Halving Resource Use* (London: Earthscan).
- Walley, N., and B. Whitehead (1994) 'It's Not Easy Being Green', *Harvard Business Review* May/June 1994: 46-52. (See also follow-up letters: 'The Challenge of Going Green', *Harvard Business Review*, July/August 1994: 37-50.)
- White, A., and D. Savage (1995) 'Budgeting for Environmental Projects: A Survey', *Management Accounting* (US) October 1995: 48-54.
- White, A., M. Becker and J. Goldstein (1991) *Total Cost Assessment: Accelerating Industrial Pollution Prevention through Innovative Project Financial Analysis* (Sponsored by the US Environmental Protection Agency; Boston, MA: Tellus Institute).
- White, A., D. Savage, J. Brody, D. Cavanader and L. Lach (1995) *Environmental Cost Accounting for Capital Budgeting: A Benchmark Survey of Management Accountants* (Sponsored by the US Environmental Protection Agency; Boston, MA: Tellus Institute).
- Wilson, R. (ed.) (1997) *Strategic Cost Management* (Aldershot, UK: Ashgate).
- Wolters, T., and M. Bouman (eds.) (1995) *Milieu-investeringen in Bedrijfseconomisch Perspectief* (Alphen aan den Rijn/Zaventem, Netherlands: Sansom Bedrijfsinformatie).
- Wood, J. (1998) 'Environmental Life Cycle Costing' (Mimeo available from Life Cycle Dimensions, 30 Cambridge Road, Bedminster, NJ 07921, USA).
- Zadek, S., P. Pruzan and R. Evans (eds.) (1997) *Building Corporate Accountability: The Emerging Practices in Social and Ethical Accounting, Auditing and Reporting* (London: Earthscan).